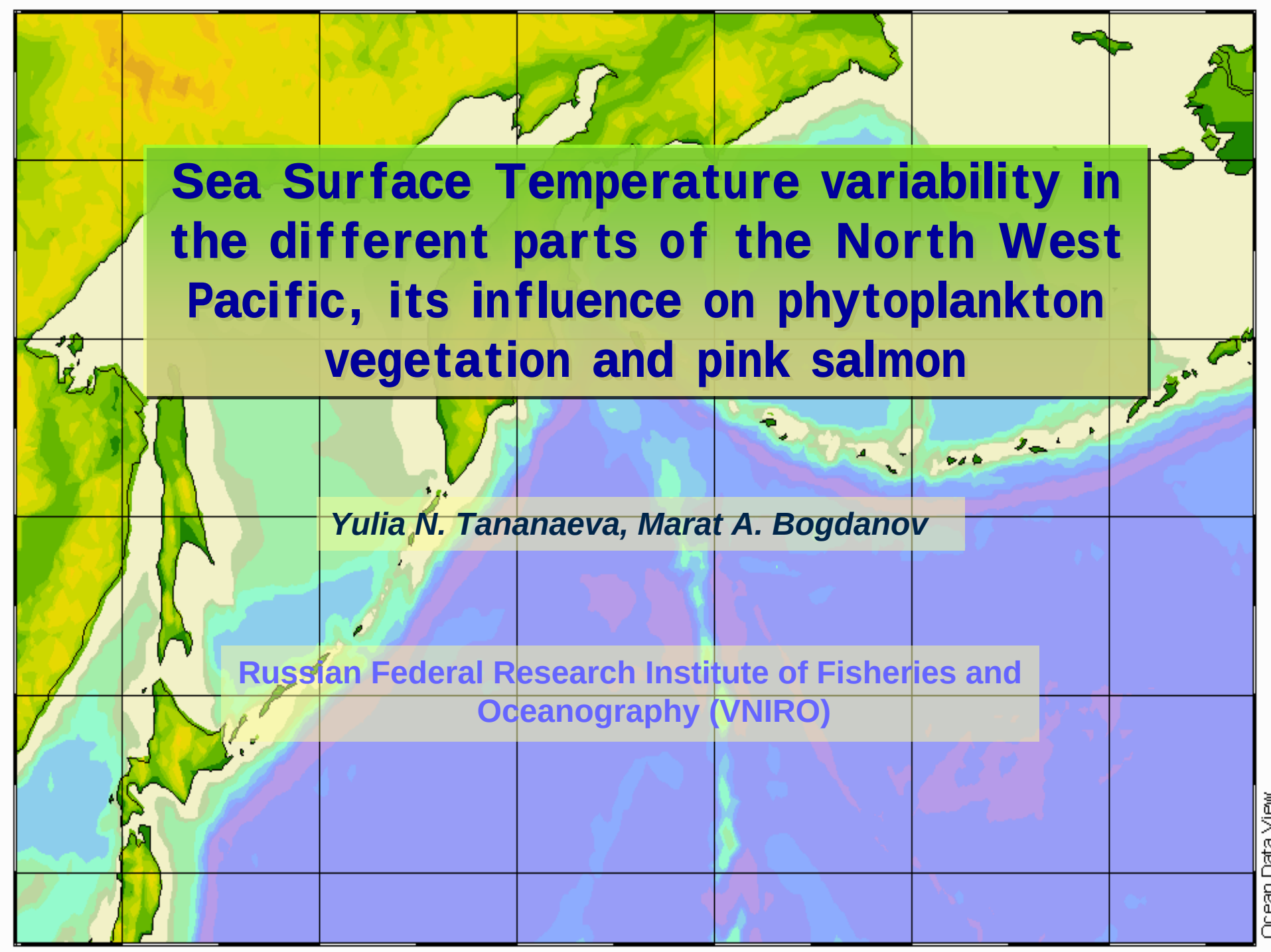

Sea Surface Temperature variability in the different parts of the North West Pacific, its influence on phytoplankton vegetation and pink salmon

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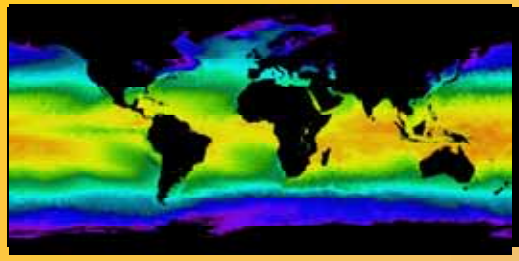
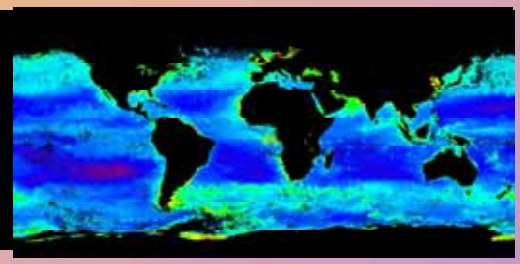


purposes



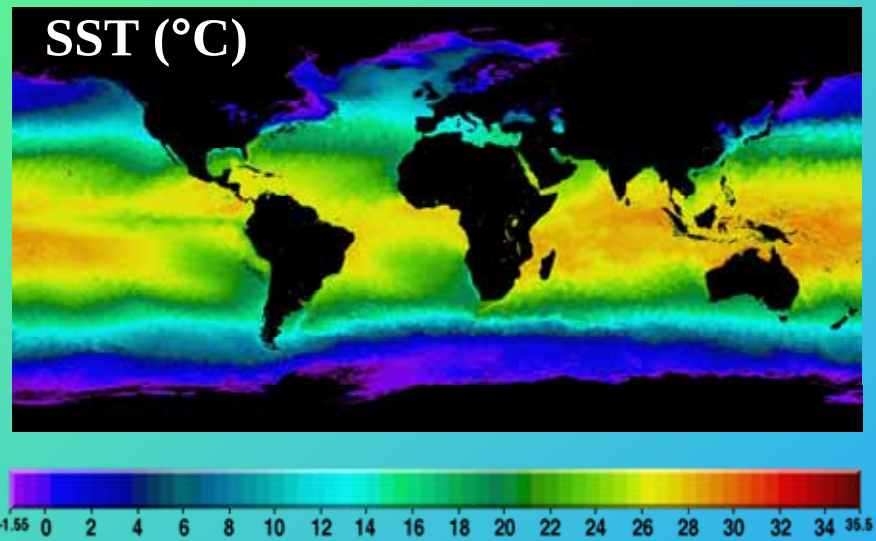
- to research SST variability;
- to reveal the influence of thermal conditions on the phytoplankton vegetation;
- to correlate the winter SST to the pink salmon winter catches;
- to divide the North West Pacific into different parts, based on the similar physical and biological processes.

Weekly, monthly and seasonal

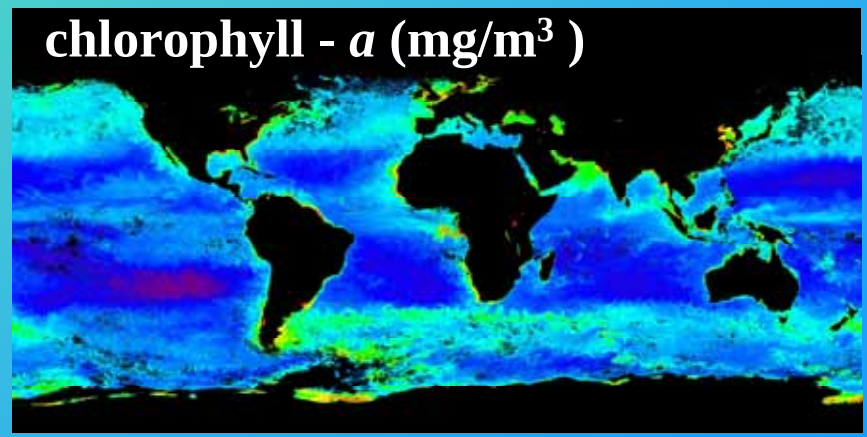
SST

chlorophyll - a

charts developed by NASA (http://oceancolor.gsfc.nasa.gov/cgi/) and VNIRO for 1998 – 2007.



South-East Sakhalin pink salmon *(Oncorhynchus gorbuscha)* catches.



The research consisted in the following:

- seasonal and interannual thermal trends in different parts of the North West Pacific;
- beginning, duration and completion of the seasons with the same temperature;
- velocities of warming up and cooling of the sea surface;
- minimal winter SST in the pink salmon's wintering area, its duration for various years;
- variability of chlorophyll-a (mg/m^3) concentration, its correlation to thermal variability;

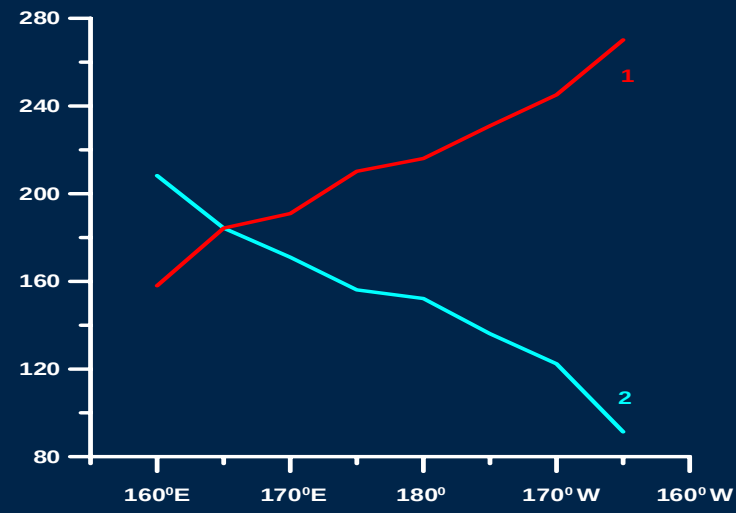
- the main area of pink salmon's winter inhabitance is a part of the sub arctic frontal zone located to the south of the Aleutian Islands. The 5°C isotherm may be considered as the north-west boundary of pink salmon wintering area;

- pink salmon feeds on zooplankton, but there isn't sufficient data of its winter distribution. In its turn, it depends on the phytoplankton distribution, so we can draw some conclusions about winter zooplankton on the basis of the chlorophyll-*a* information.

Results

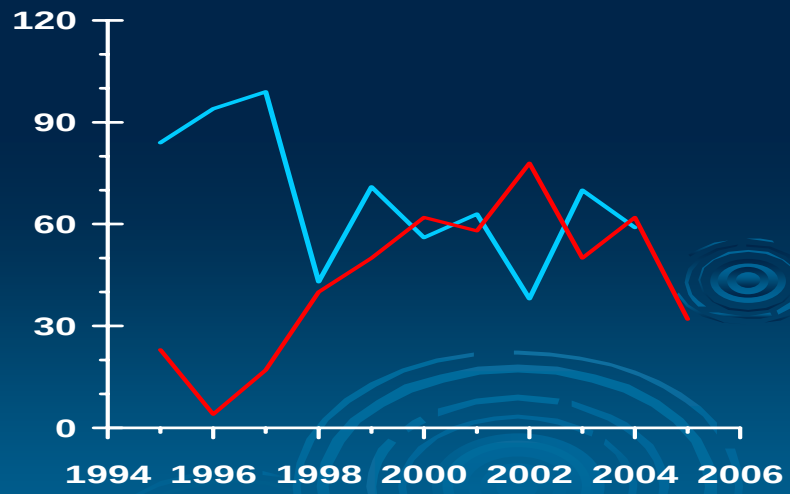
Thermal regime

- Autumn cooling of the surface layer in the North West Pacific begins from the northwest and moves towards to the southeast. Warming up moves from the southeast, and also from the Asian coast (due to warming up of the continent).



5 ℃ isotherm's transition of 50 ℃N
1 – warming-up duration at various longitudes (days)
2 – cooling duration

- Terms and velocity of cooling and warming up are being changed greatly from year to year. These differences are very important, as the pink salmon spawning migrations depend on terms and velocities of warming up. Onset and velocity of cooling greatly affects its wintering migrations.

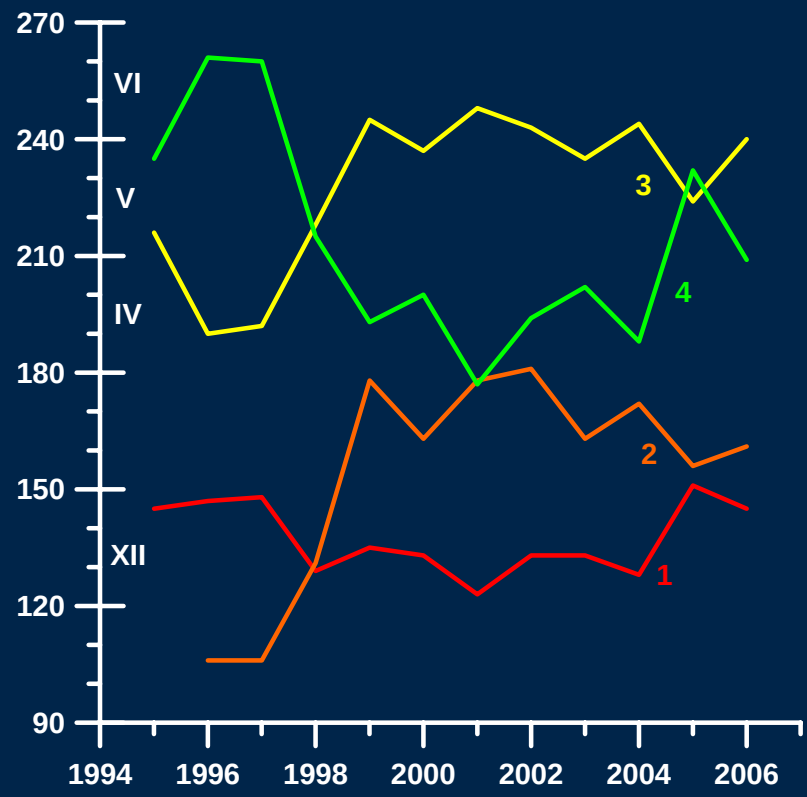


4°C isotherm,
Velocities of warming-up 1 and cooling 2 in the area
50 - 60°N., 170°E – 175°W

- **Velocity of warming up depends on time of its beginning - the earlier warming begun, the longer it will be continued.**

- **interannual changes of the time of onset of a season (warm and cold) are inversely related to interannual changes of its duration.**

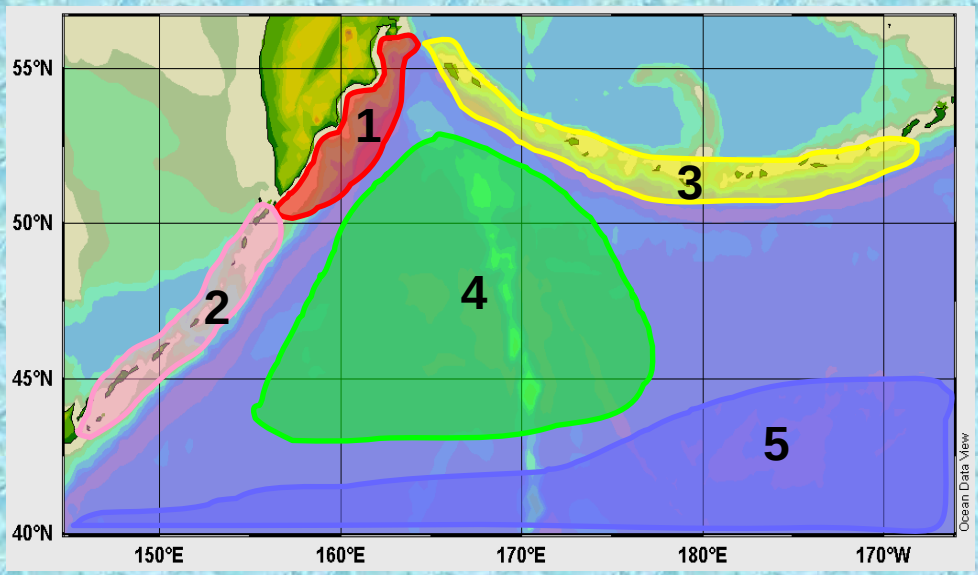
- **For the most part of the period under study, years with long-duration cold season are followed by years with it's short duration.**

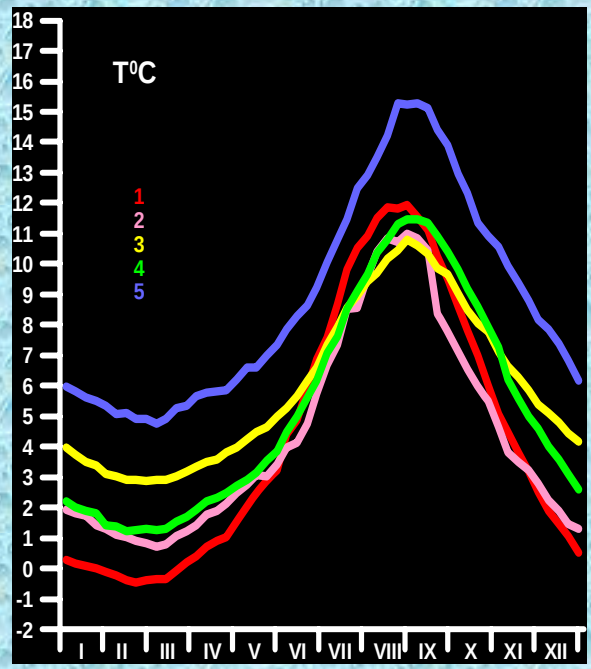


5 ℃ isotherm's transition of 50 ℃N

1 – crossing to the South (beginning of cooling)
2 – duration to the South,
3 – crossing to the North (beginning of warming-up),
4 – duration to the North.

According to some thermal and biological regularities, we can divide the North West Pacific into different parts with similar features:





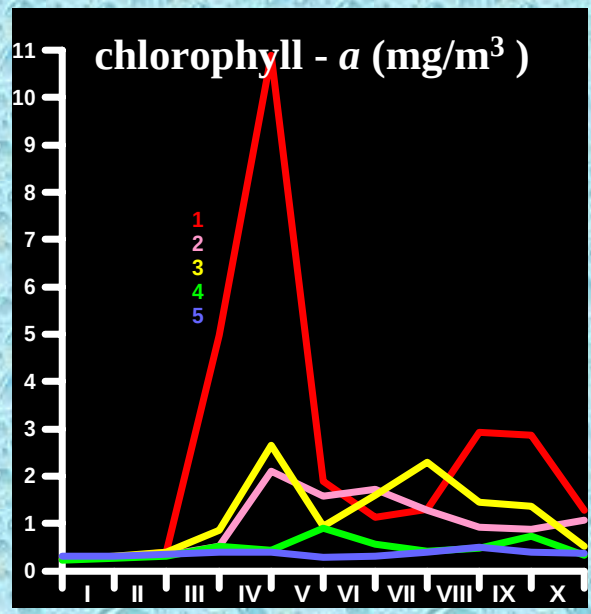
1) East Kamchatka Shelf

2) The Kurils

3) The Komandorskie Islands, the Aleutians

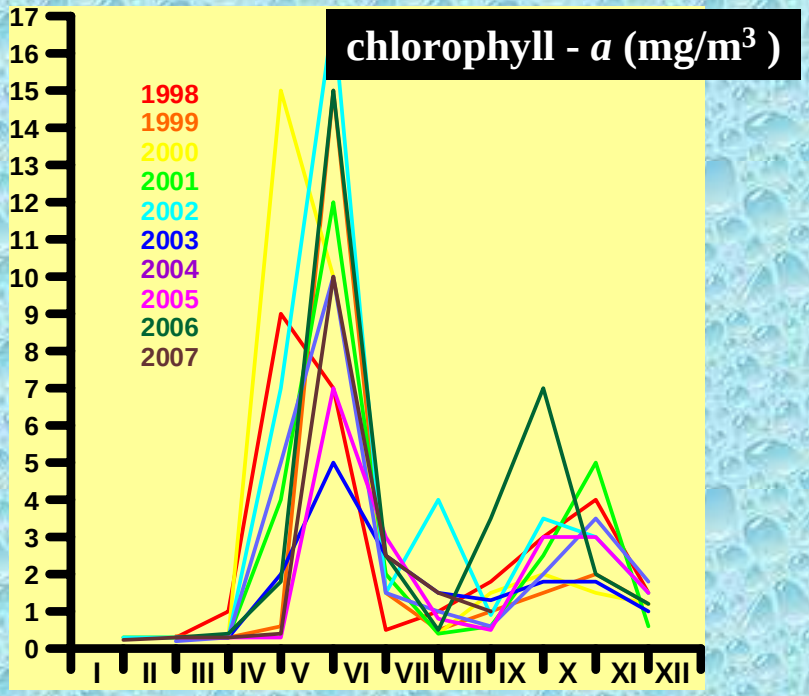
4) Western Subarctic Gyre

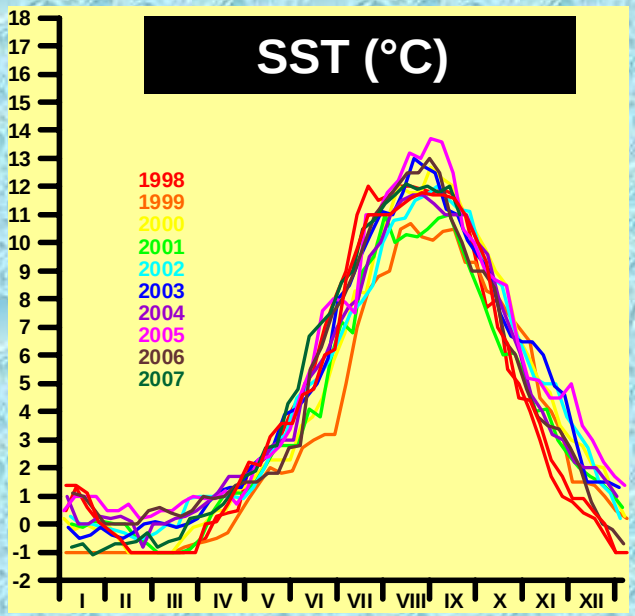
5) Subarctic frontal zone



East Kamchatka Shelf

Spring concentration of a chlorophyll-a is maximal in comparison to the other regions. The phytoplankton's vegetation depends on the terms of sea ice melting and warming of the surface water layer. The earlier warming-up begins, the earlier and longer blooming will last (April-May). If warming up blooming will begin later, then its duration will be less (only in May).



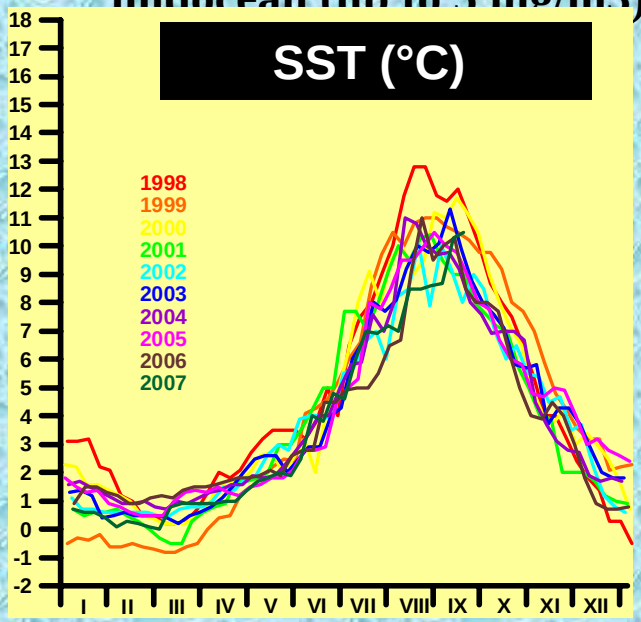


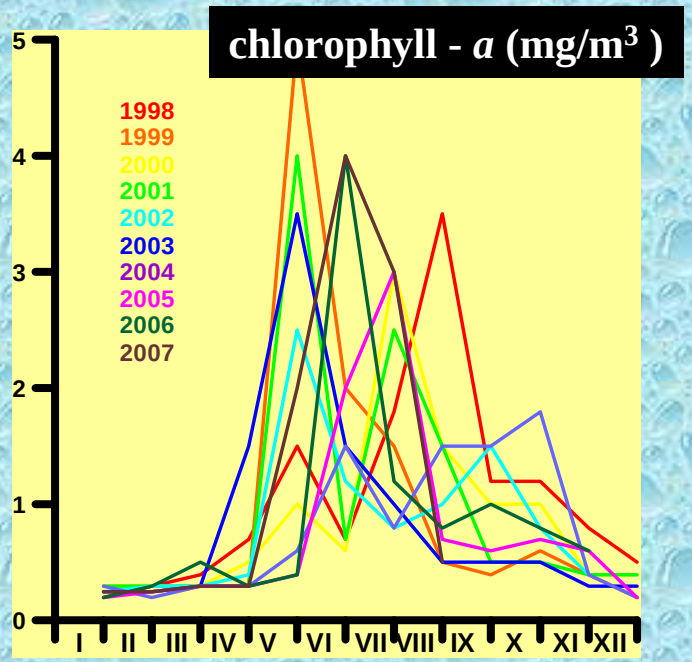
The winter temperature is too low for Pink salmon wintering. Some of them cross this water area during their spawning migrations.

Zones of island arcs (the Kurils, Komandorskie Islands, the Aleutians)

These are regions of intensive tidal mixing, especially the Kuril zone. Both thermal and biological processes first of all depend on water dynamics.

The amount of phytoplankton is less than East Kamchatka Shelf but more than in the midocean (up to 5 mg/m3).



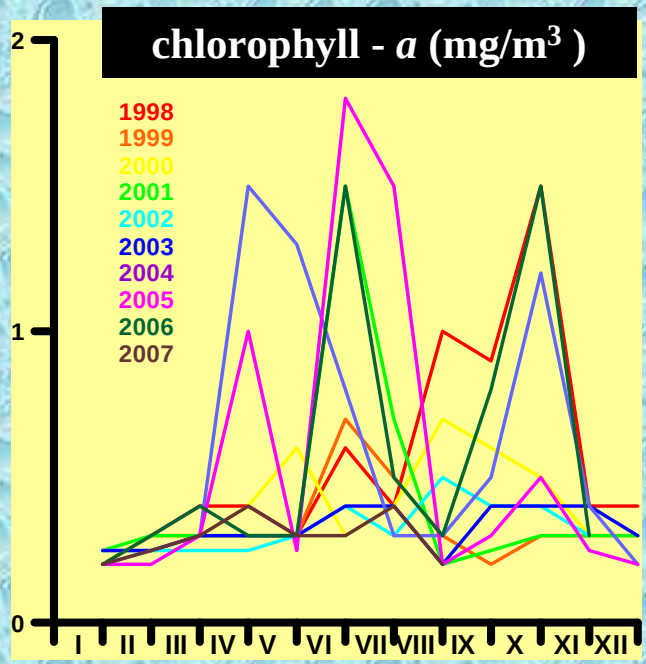


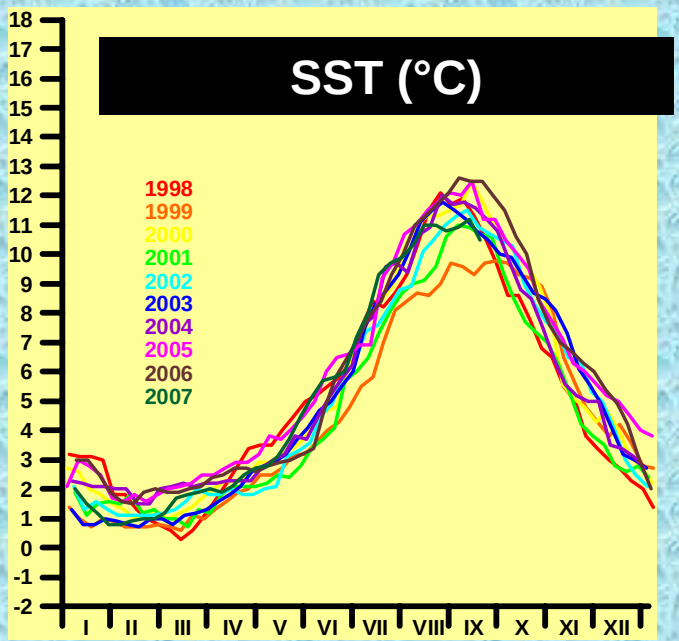
Pink salmon crosses these water areas during its growing period on the way to spawning grounds. Terms of sea ice melting and surface water warming greatly affects the terms of their spawning migrations.

Western Subarctic Gyre

- The main factor for phytoplankton distribution pattern is water circulation, as it is quasi-stationary cyclonic gyre.

- Chlorophyll-a concentration is rather low (up to 2 mg/m3), as it is a High Nutrients Low Chlorophyll Area. The phytoplankton blooming begins much later than the East Kamchatka Shelf zone (maximal in August - September).



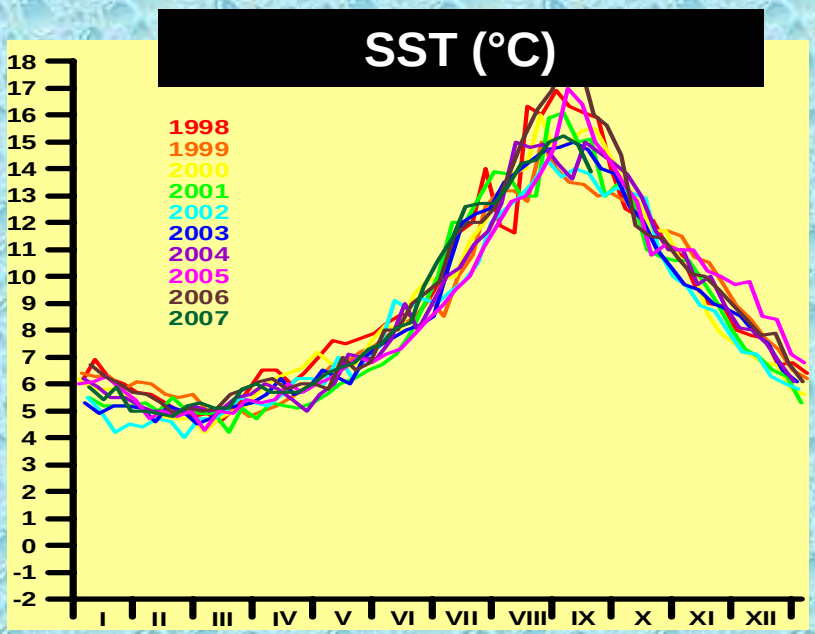


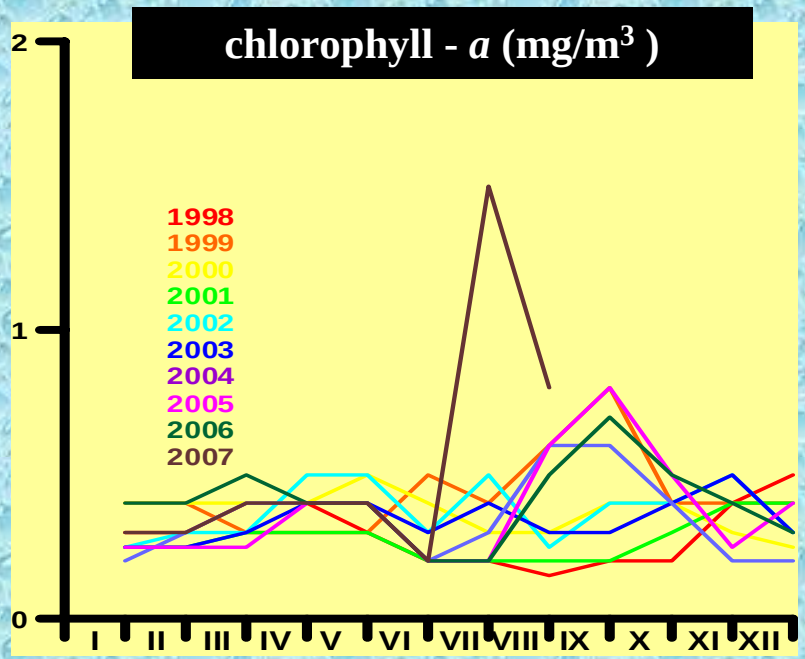
- In warm winters the south-eastern part of WSG is likely to be used by pink salmon for wintering.

Sub arctic frontal zone

- It is a divergent zone, so it has permanent influx of deep water, which enriches the surface water layer with nutrients.

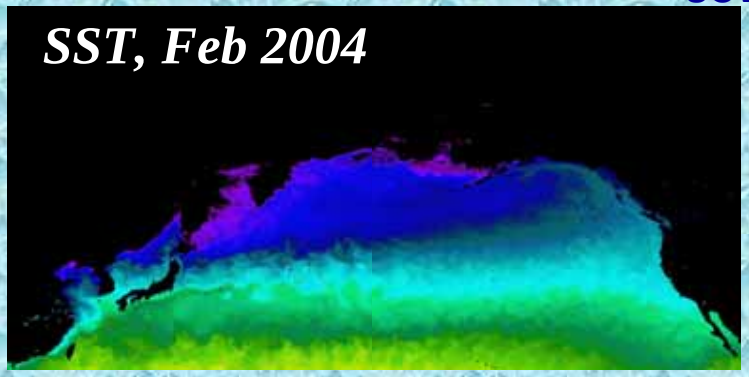
- But the pycnocline is unstable, that's why the chlorophyll concentrations are not high all round the year. But this region is characterized by the highest winter chlorophyll concentrations compared with other NWP regions.

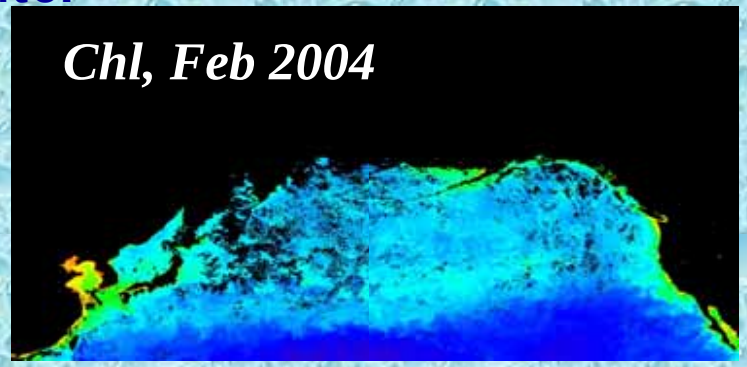




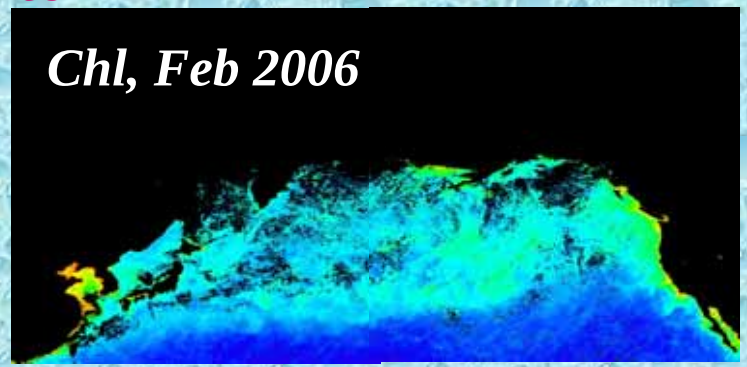
- Part of the sub arctic frontal zone located to the south of the Aleutian Islands is most favorable for pink salmon wintering because of favorable thermal and feeding conditions.

“severe” winter



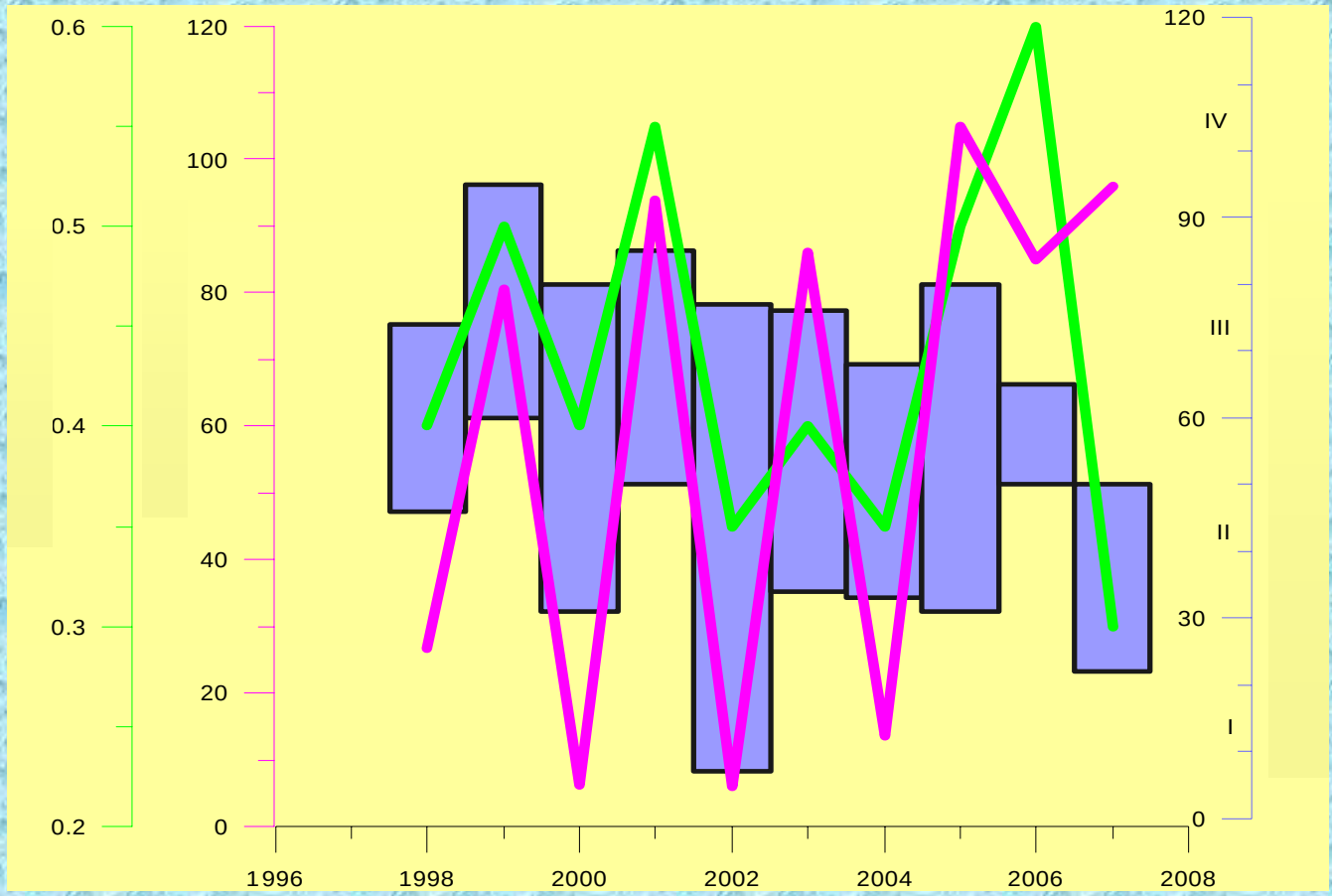


"moderate" winter

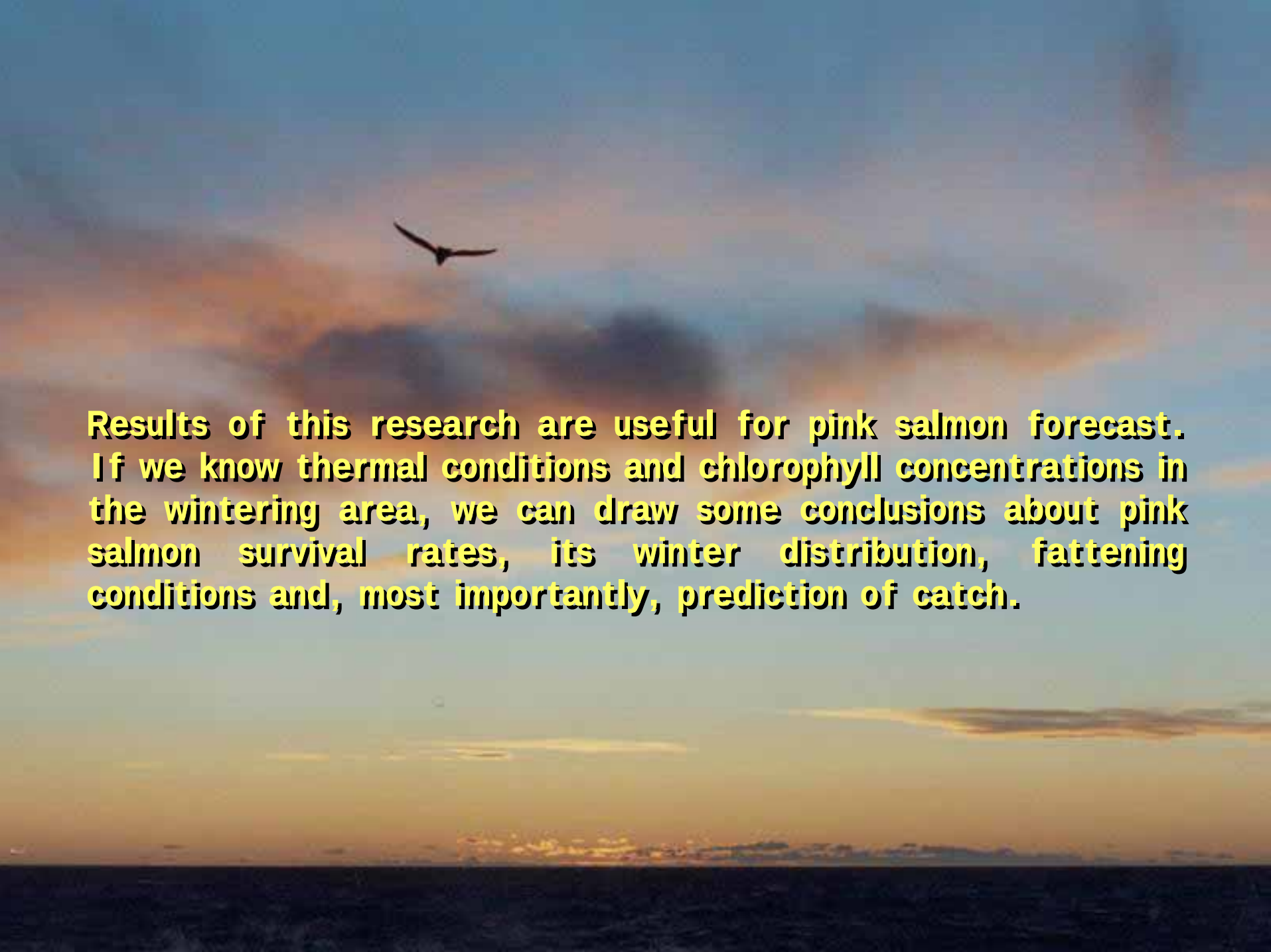


Interannual SST variability is rather low in this region, in relation to severity of winter time the width of the frontal zone may be significantly changed. In so-called "moderate" winters it is much wider than in more "severe" ones. In “severe” winters the concentrations of chlorophyll are very low (about 0.3 mg/m3). Areas with higher concentrations are comparatively restricted. In "moderate" winters such areas are broader and concentration of chlorophyll-*a* is greater (up to 0.5 mg/m3).

According to these changes the pink salmon wintering area varies too. In "moderate" winters the area of wintering extends northwestwards. In "severe" ones it is rather narrow, fish-fattening grounds decrease, they become more accessible for predators and their survival rates decrease sharply.



The most cold period's chlorophyll concentration
East-Sakhalin's pink salmon catch
Beginning, duration and completion of period > 5°C



Results of this research are useful for pink salmon forecast. If we know thermal conditions and chlorophyll concentrations in the wintering area, we can draw some conclusions about pink salmon survival rates, its winter distribution, fattening conditions and, most importantly, prediction of catch.

Thank you for attention!

Ocean Data View