



Impact of the water circulation changes in the Okhotsk Sea on the stock of greenland halibut at Sakhalin Island

Nadezhda ASEEEVA

Pacific Fisheries Research Center Vladivostok Russia

e-mail: aseeva_n@hotmail.com

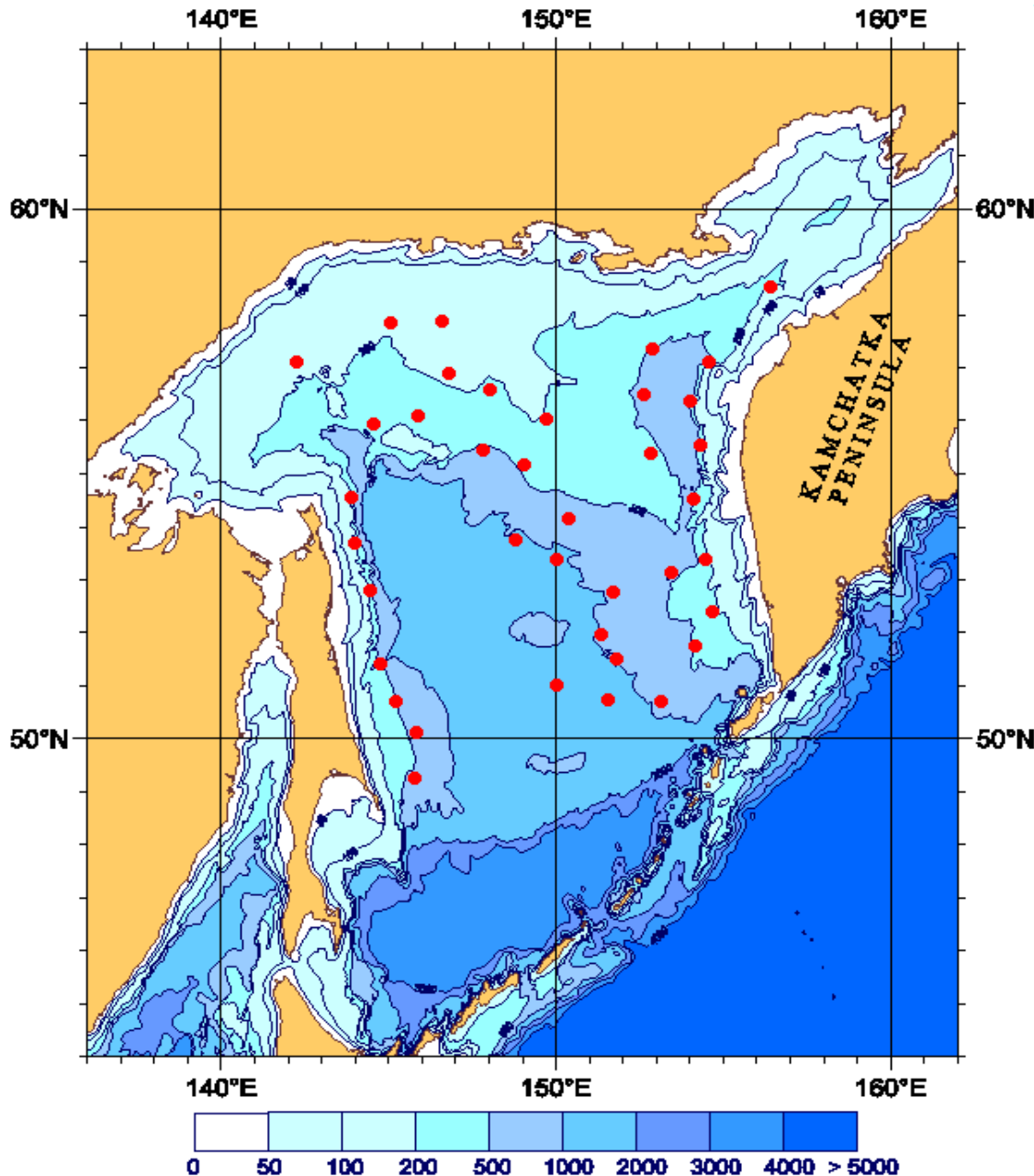


Goals:

In this study I tried to understand: what environmental factors are responsible for fluctuations of the greenland halibut stock at the eastern coast of Sakhalin



Materials and methods



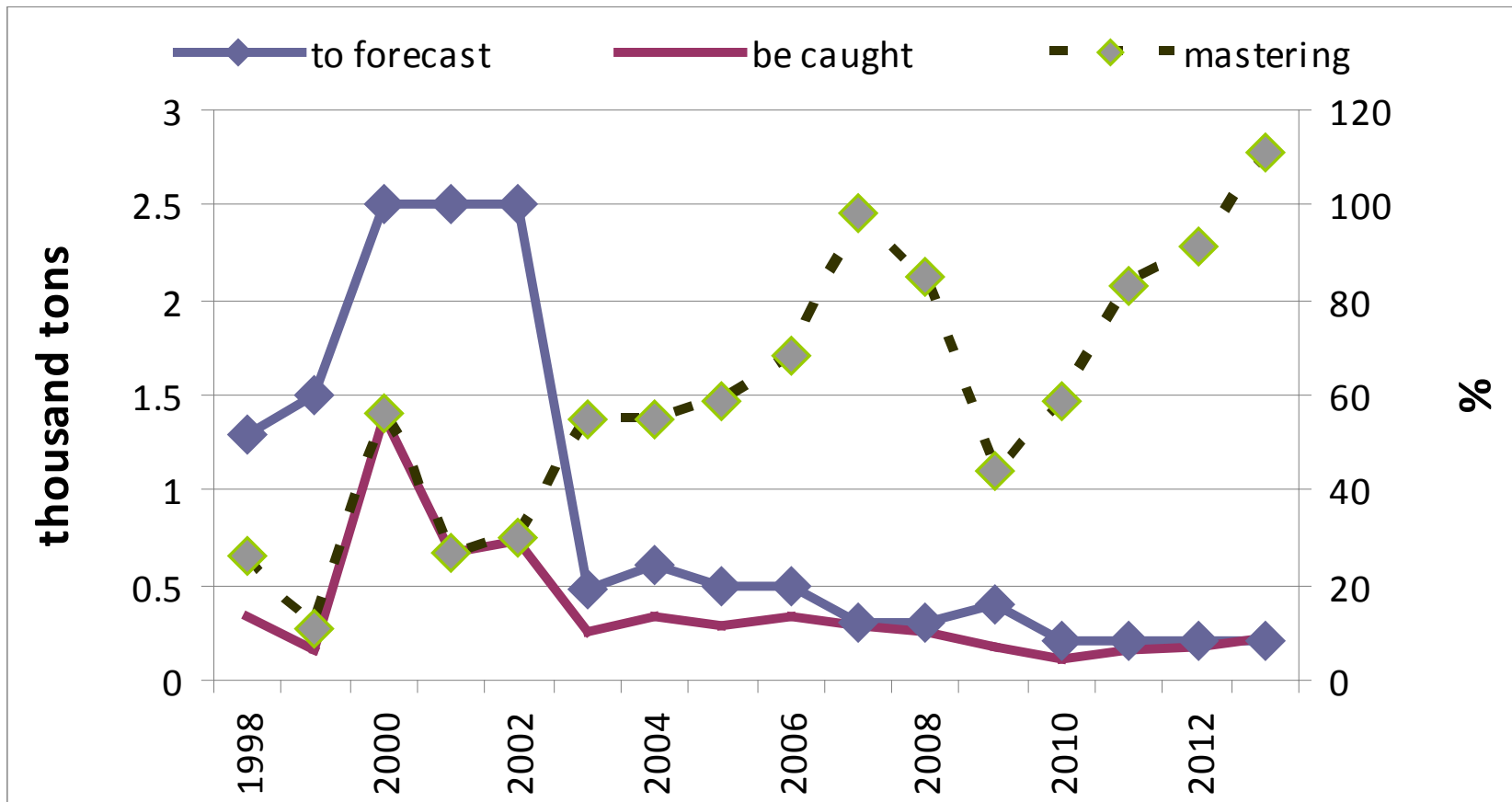
More than 30 bottom trawl surveys and the reports of our observers aboard fishery vessels for the period from 1974 to 2013 are analyzed separately for 3 biostatistical areas:

- West-Kamchatka zone,
- North-Okhotsk zone,
- and East-Sakhalin zone.

Abundance of 8-years-old fish is used as the index of year-class strength (this age group is usually modal in catches of greenland halibut).

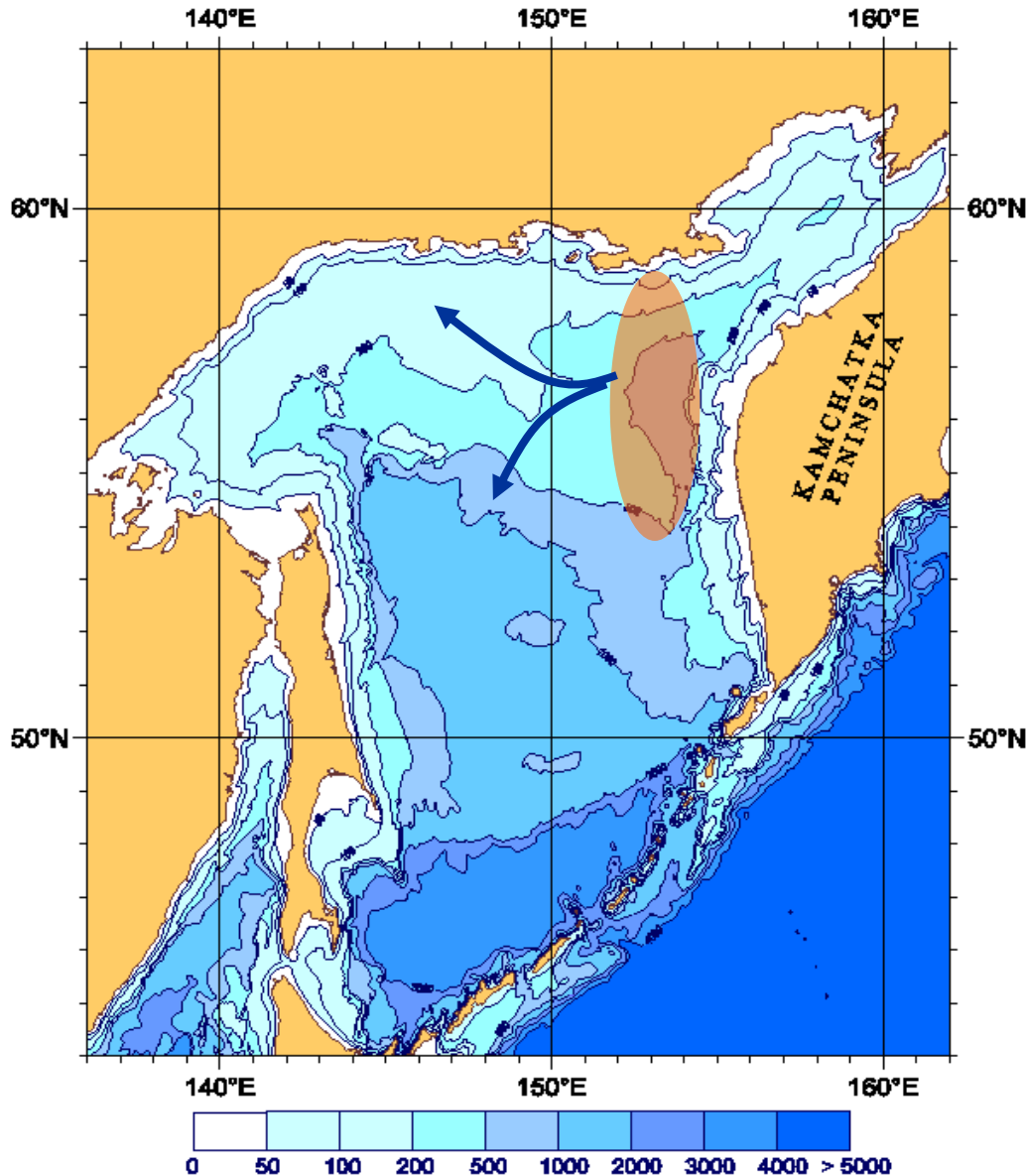
Water circulation was determined for density-induced currents using geostrophic approximation. The direction and velocity of geostrophic currents are calculated relatively to 500 m depth by **Alex Figurkin**, from TINRO.

Fluctuations of greenland halibut stock in the East-Sakhalin zone



Stock of greenland halibut in the East-Sakhalin zone has huge fluctuations. Note a considerable lowering of the stock in the last decades. As the result, the specialized fishery of greenland halibut is now banned there and it can be caught in bycatch only.

Greenland halibut reproduction in the Okhotsk Sea



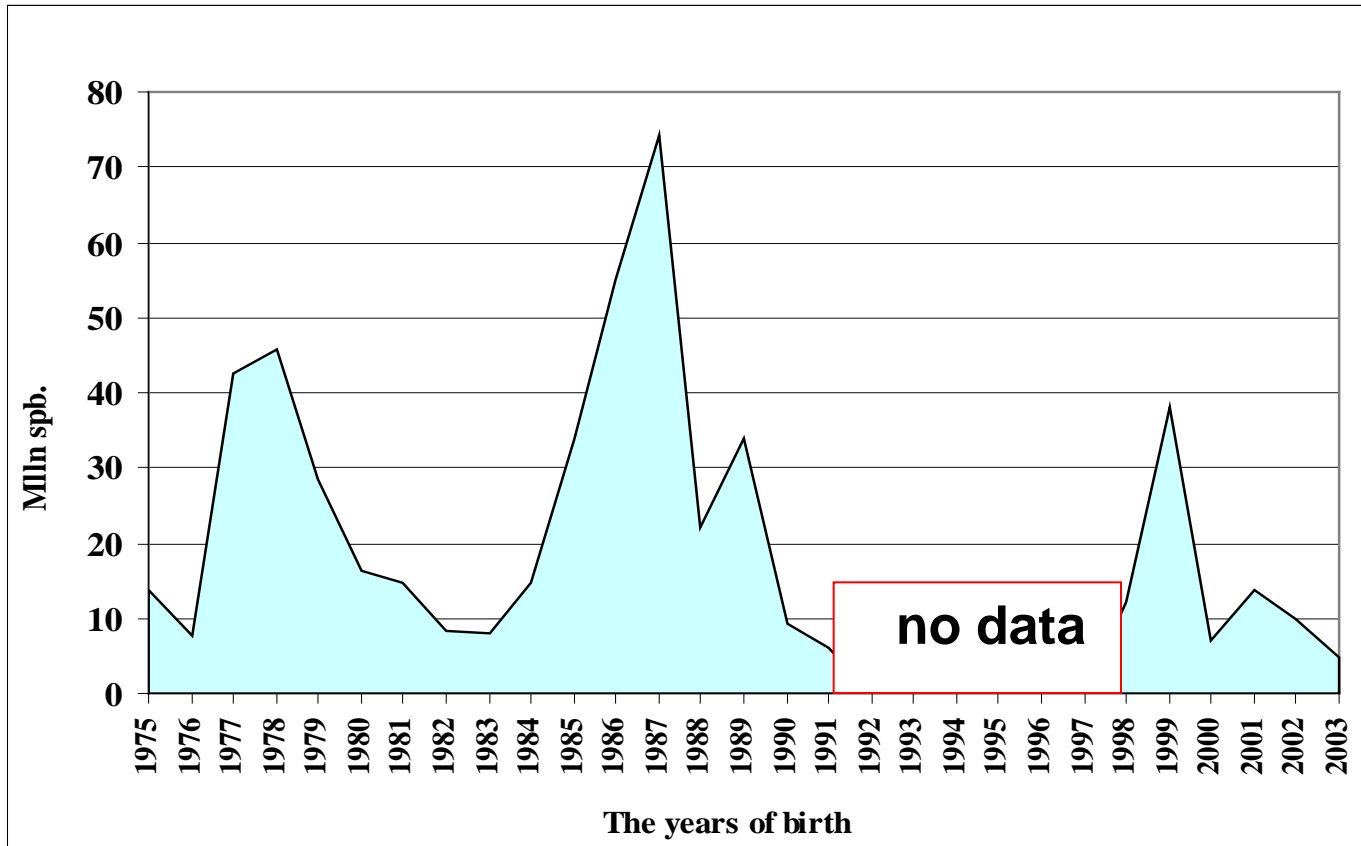
The halibut stocks in all three zones of the Okhotsk Sea have the same source, because all of them are reproduced in one spawning ground that is located on the continental slope of West Kamchatka. From this spawning ground, the eggs and larvae of greenland halibut are distributed over the whole Sea, including the North-Okhotsk zone and East-Sakhalin zone, by surface currents.

Problem:

In early 1990s the biomass of the greenland halibut at east Sakhalin exceeded 27 thousand tons, but it dropped sharply to 5 thousand tons in the first decade of this century. The fishery could not be a reason for this drop, so far as the halibut fishery was banned more than 10 years ago, before the time of the lowest stock.

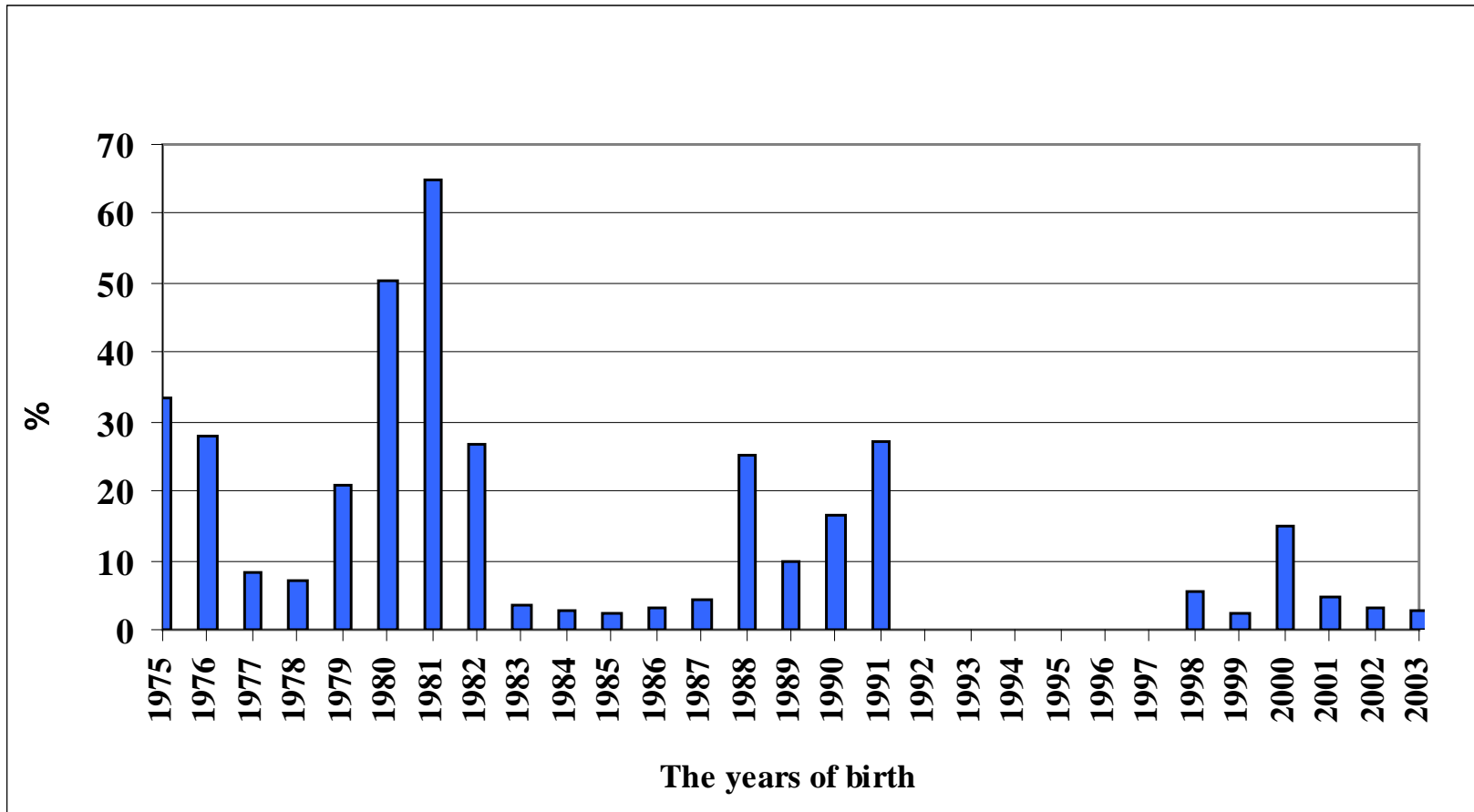
To understand the reason of this phenomenon at Sakhalin Island, there is necessary to consider the stocks fluctuations in all three biostatistical areas of the Okhotsk Sea.

Total abundance of 8-years-old greenland halibut in the Okhotsk Sea



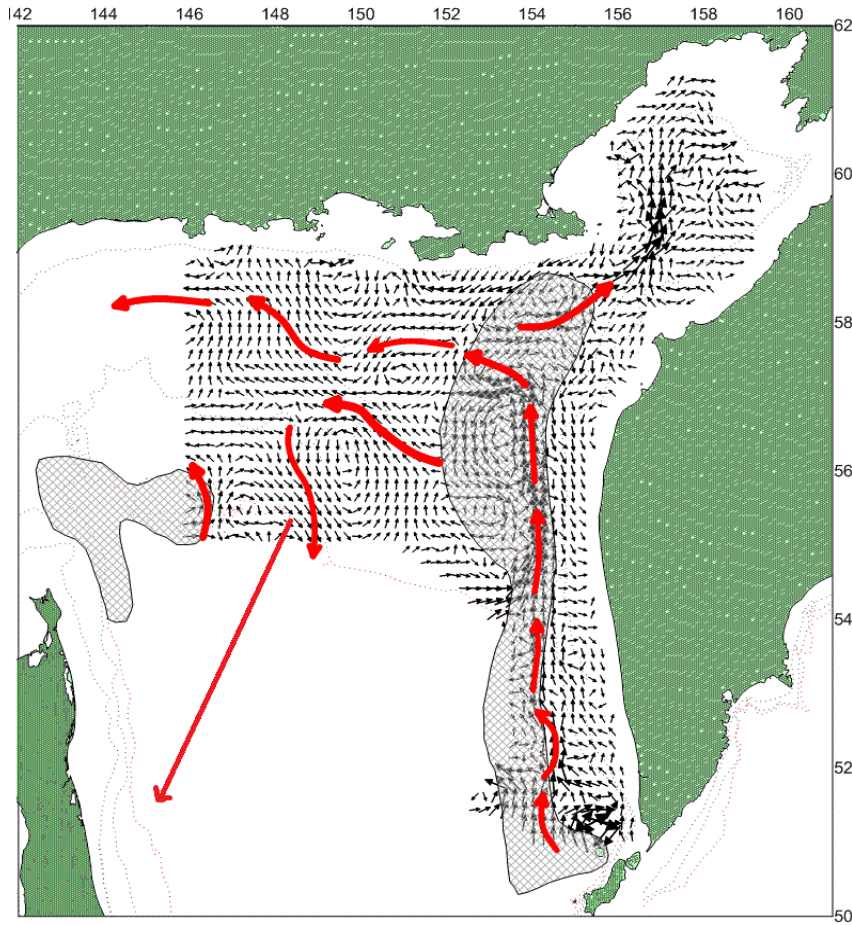
Dynamics of year-classes strength for the classes of greenland halibut born after 1975 calculated for the entire Okhotsk Sea population (summarized number of 8-years-old fish in all 3 biostatistical areas)

Percentage of the 8-years-old greenland halibut in the East-Sakhalin zone relatively to its total abundance

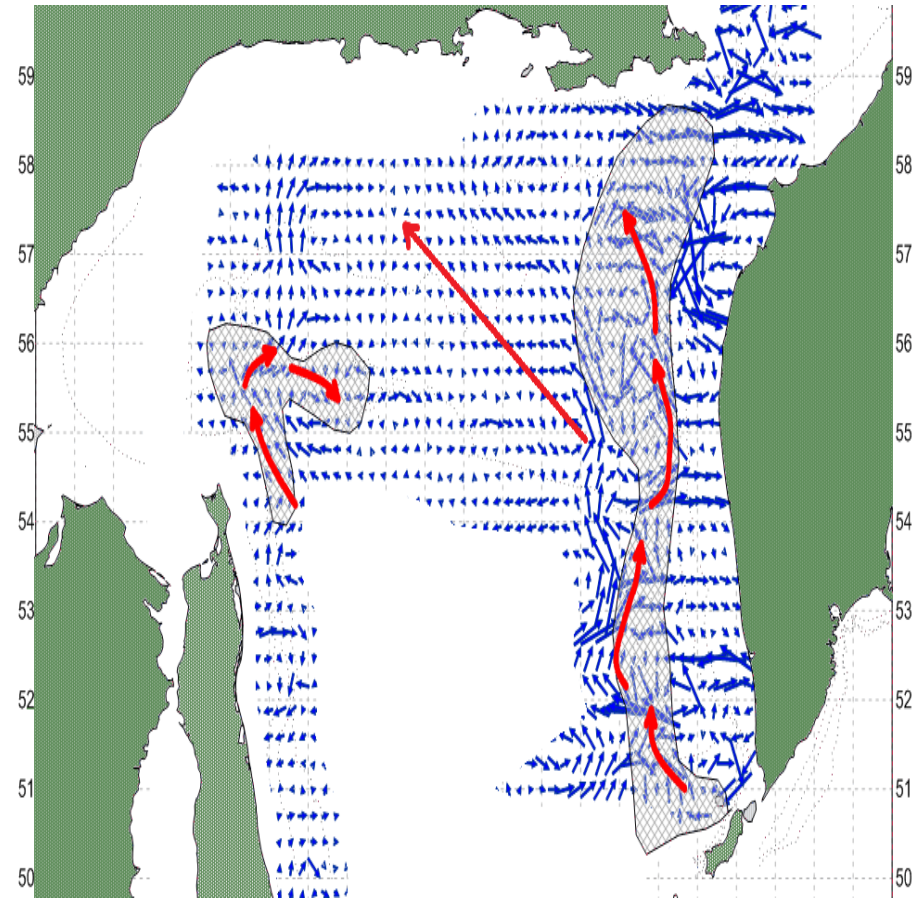


The portion of recruits in the East-Sakhalin zone is the lowest in recent times. The stock of halibut at East Sakhalin changes independently on its total recruitment but depends mostly on sharing of the recruits between the parts of the Okhotsk Sea, and recently the sharing is not in favor of this area.

Scheme of the surface water circulation in the Okhotsk Sea



1st type



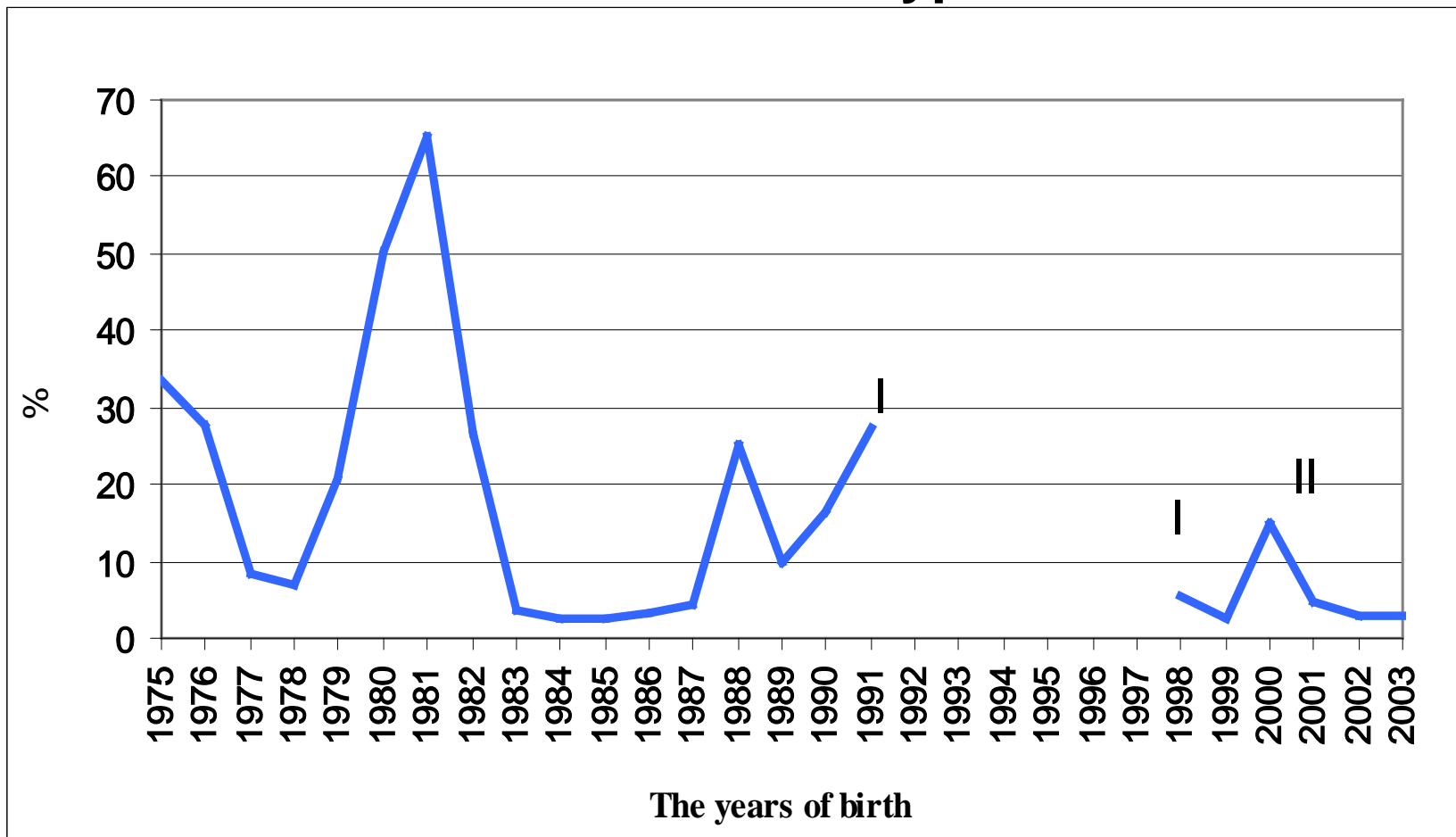
2nd type

Two types of the circulation in the northern Okhotsk Sea:

1st type – water transfer in two directions: from the halibut spawning grounds at Kamchatka toward the northern Okhotsk Sea and toward East Sakhalin. This type was observed in 1980s and 1990s (last time in 2000)

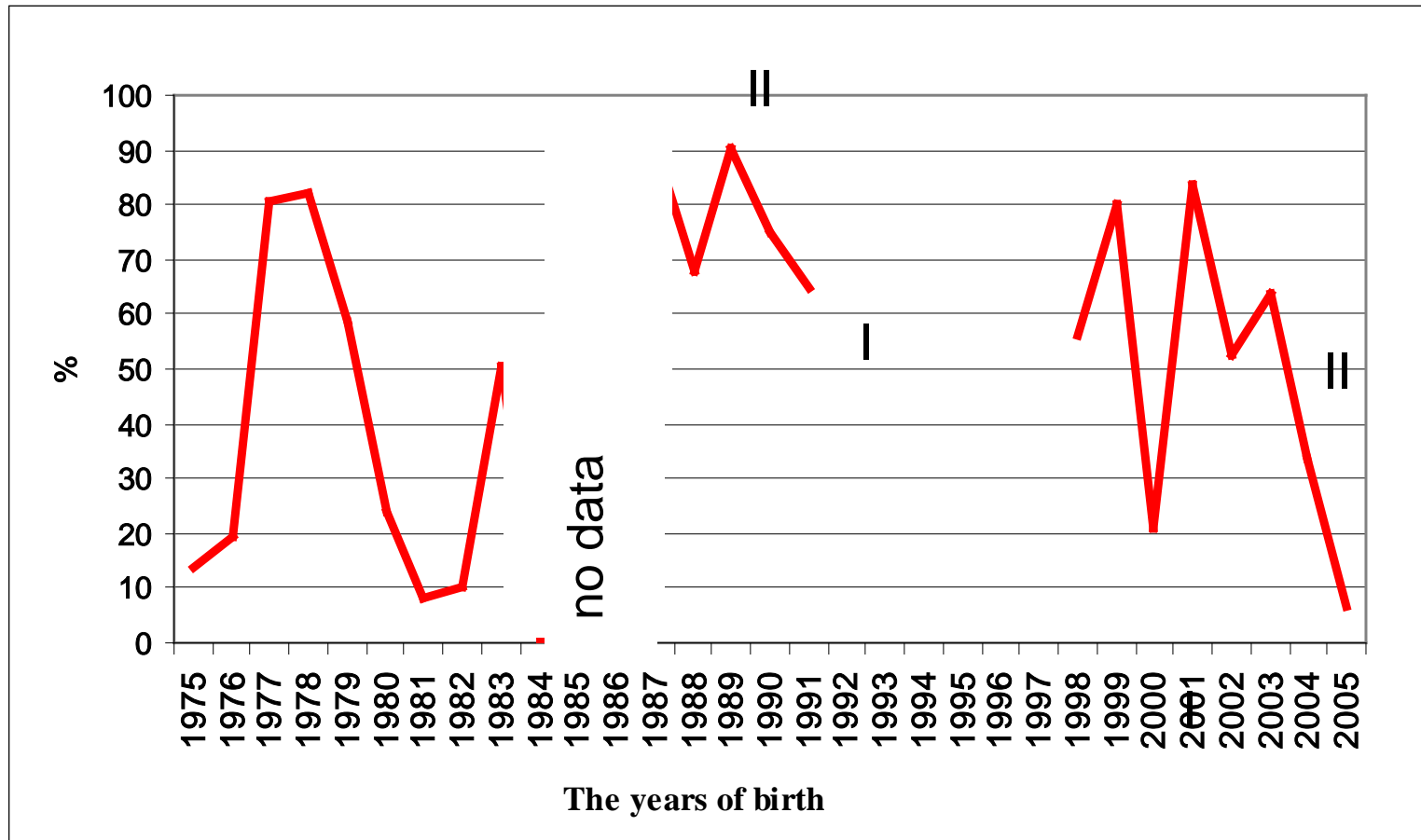
2nd type – water transfer from Kamchatka toward the northern coast only. This type was observed after 2000, including the last survey in 2010.

Portion of the greenland halibut recruits replenished the stock at eastern Sakhalin vs types of circulation



Reorganization of the water circulation in 2000 corresponds with sharp lowering of the portion of recruits come into the East-Sakhalin zone. Before the reorganization, more than 10% of the recruits came toward East Sakhalin annually, and both North-Okhotsk and East-Sakhalin stocks of halibut were replenished successfully. After the reorganization, the North-Okhotsk and West-Kamchatka stocks only are replenished enough

Portion of the greenland halibut recruits replenished the stock in the North-Okhotsk zone vs types of circulation



Dynamics of the recruits in the North-Okhotsk zone is opposite to the East-Sakhalin zone: the portion of recruitment occurs to the North-Okhotsk zone is lower in the years with the 1st type of circulation and higher in the years with the 2nd type. Recently the circulation patterns are favorable for recovery of the greenland halibut stock in the North-Okhotsk zone

Conclusions

- **Water circulation in the northern Okhotsk Sea changes from year to year that induces 2 different types of eggs and larvae transport out of the greenland halibut spawning grounds at West Kamchatka;**
- **The type of water circulation that provides the transport of the halibut eggs and larvae both toward the northern coast and toward East Sakhalin is favorable for maintenance of its stock in the East-Sakhalin zone, but in case of their transport toward the northern coast only the stock at East Sakhalin is not replenished by recruits enough.**
- **State of the greenland halibut stock at East Sakhalin depends on both reproduction on spawning grounds at West Kamchatka and distribution of the recruitment that is determined by the type of water circulation.**
- **Recently the 2nd type of circulation occurs in the northern Okhotsk Sea that makes impossible a recovery of the greenland halibut stock at East Sakhalin, though its stocks at West Kamchatka and at the northern coast of the Sea are able to recover.**

