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Association between Far East pink salmon catches and variations of heat content in the upper 100-m layer of the North Pacific during winter seasons, 1978-2021

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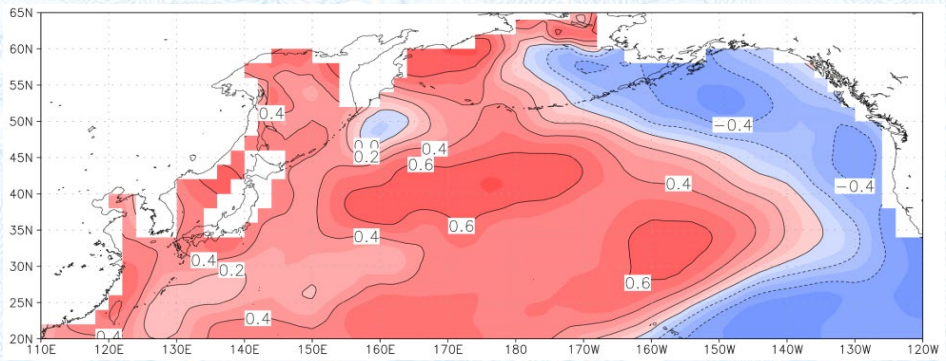
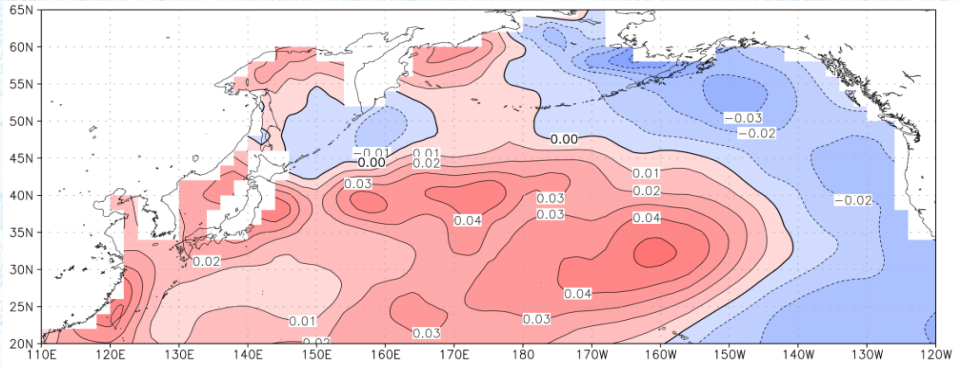
Long periods of increased/decreased abundance and biomass of Pacific salmons are clearly associated with the corresponding climatic “epochs” and may be predicted with some degree of certainty (Krovnin and Klovach, 2019)

Association of total salmon catches with climatic characteristics of the NH in 1982-2013

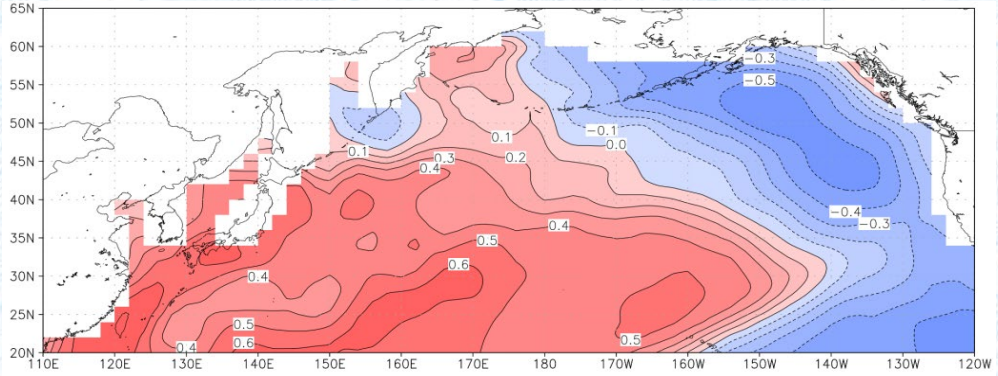
Correlation pattern between total salmon catches and mean winter SSTA in the North Pacific in 1982-2013



Values of linear trends (ºC/yr) of mean winter SSTA in the North Pacific in 1982-2013



Correlation pattern between sum of anomalies of longitudes of the NAO centers in winter seasons of 1977-2005 and SSTA in the NP with lag of 6 years



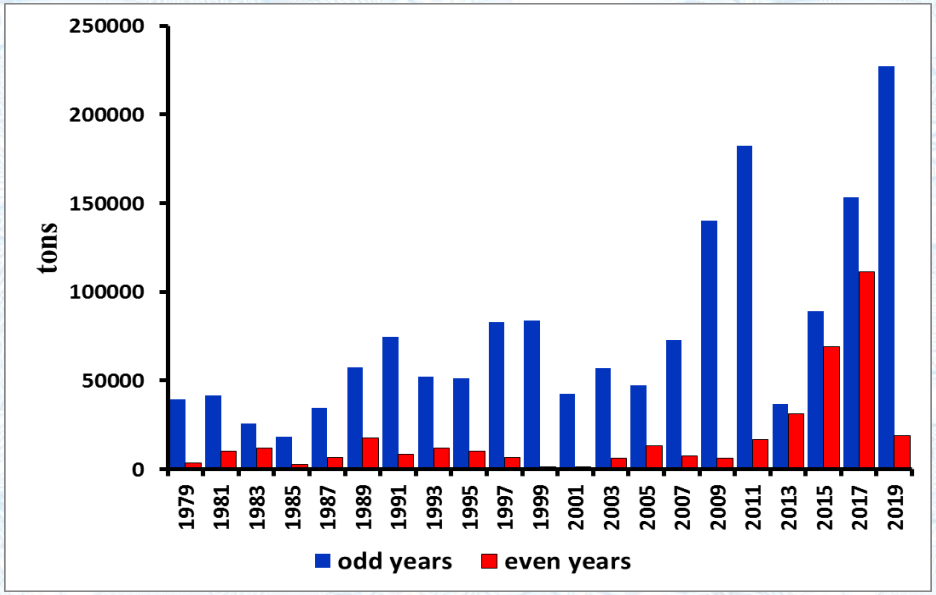
However, the reasons of very sharp increases/decreases in catch during the specific period of high/low abundance are uncertain and require special consideration and research. So, the main purpose of this study is to find correlationships between catches of 5 main Far East pink salmon stocks and thermal conditions in the NP during the wintering period.

Data and methods

Catch statistic for Far East pink salmon stocks for 1978-2020 is available online from NPAFC web site (www.npafc.org)

- Heat content was calculated at VNIRO using EN4 dataset v. 4.2.1 (Good, Martin and Rayner, 2013) available at Met Office Hadley Centre web site (www.metoffice.gov.uk/hadobs/en4/)
- Ice cover data for 1978-2020 were taken from Climate Data record (CDR) NOAA/NSIDC (Meier et al, 2017) (www.nsidc.org)

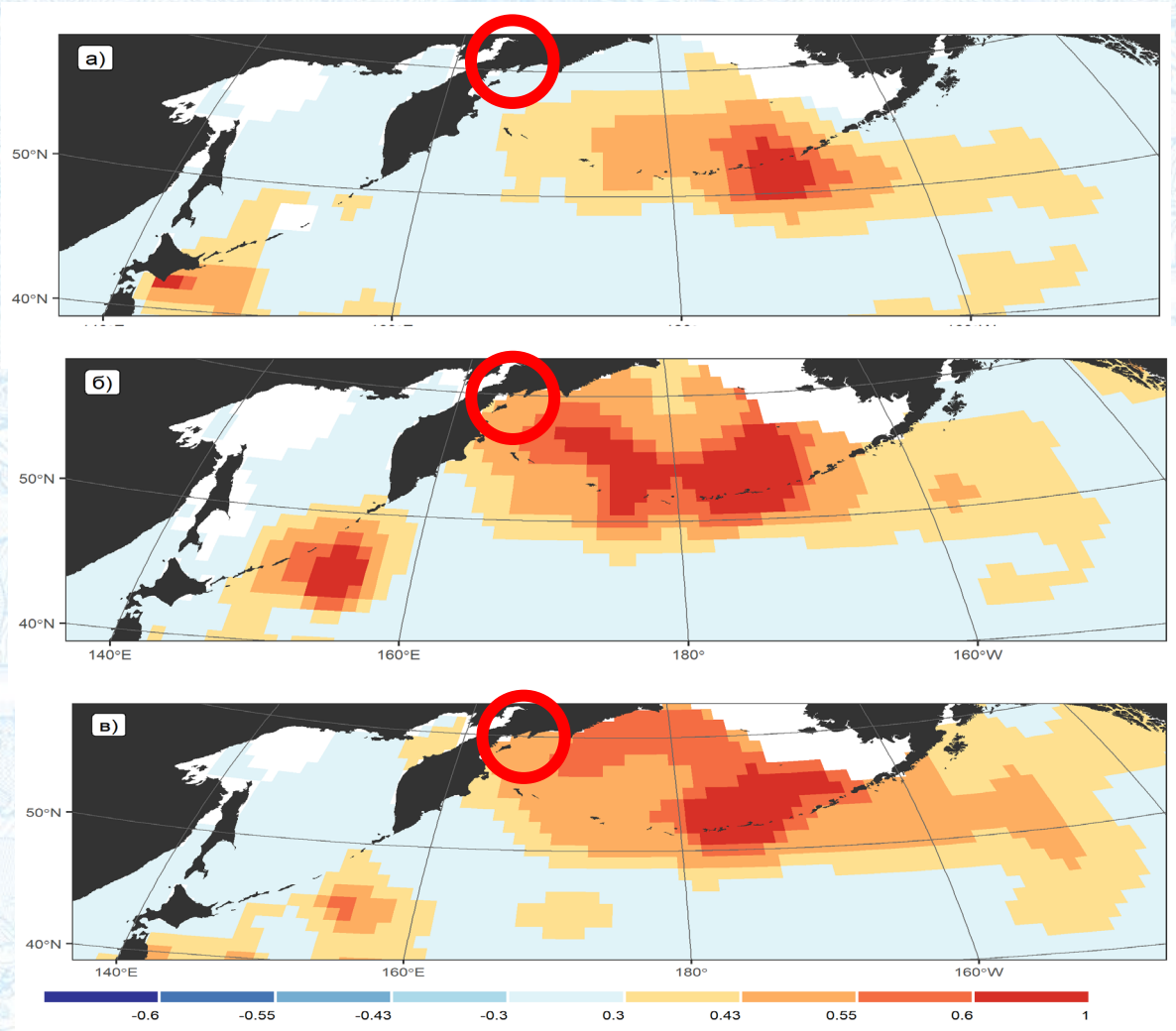
East Kamchatka pink salmon



From 2012 to 2018 the catch of EK pink salmon of even generations increased more han 6 times, from 16,370 t to 111,250 t, respectively. In 2018 the share of EK pink salmon in total catch of Russian pink salmon reached almost 22 %.

In 2020, the situation has changed. The total pink salmon catch was 179,400 t under the expected volume of 222,800 t, i.e. it was 1.25 times lower than expected. The maximal underfishing relative to the projected one was noted near east Kamchatka, 20,700 t and 82,700 t, that is the catch constituted only ¼ of the expected volume.

Correlation patterns between catches of EK pink salmon of even-year generations and heat content in the 0-100 m layer during 1978-2020



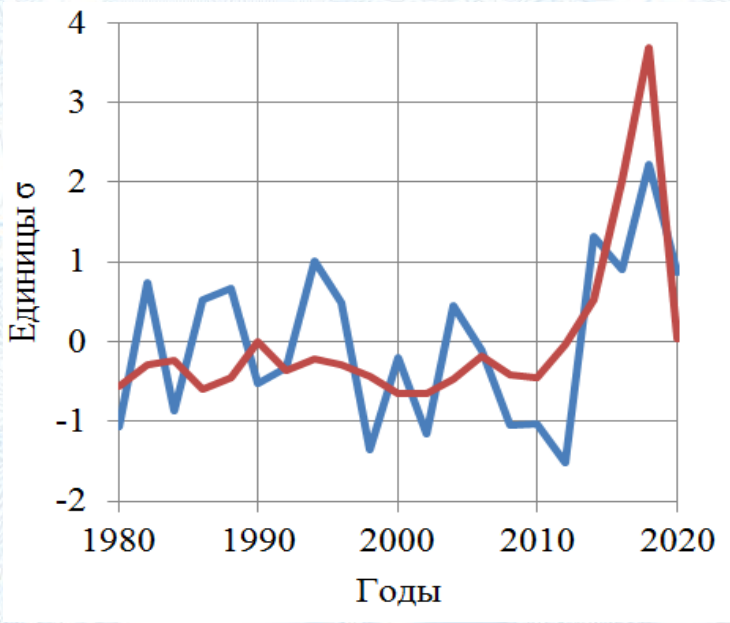
December

February

April

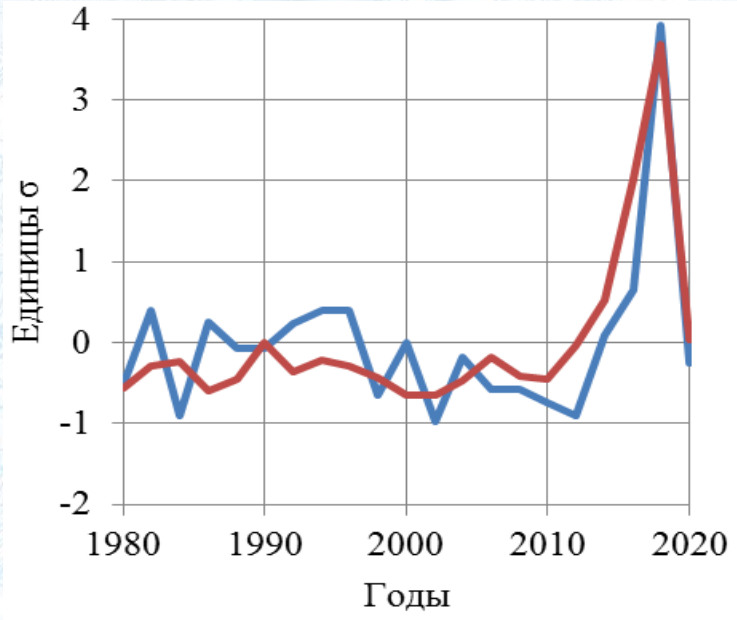
Catch of EK pink salmon in even years and long-term variability of ice conditions in the Bering Sea (1978-2020)

R =0,60 (p < 0,05)



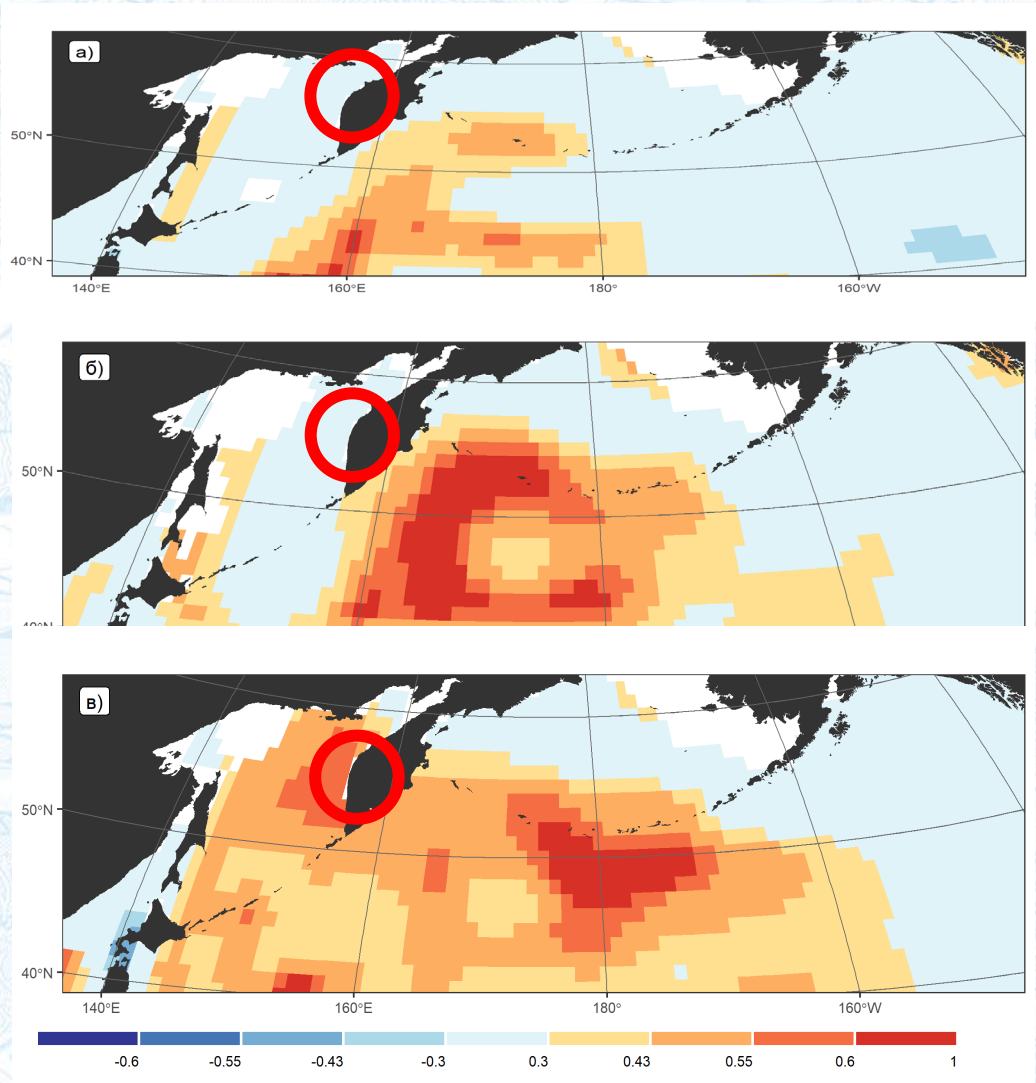
This Figure shows changes in latitude of ice centroid in the Bering Sea (blue line)

R =0,84 (p < 0,01)



The Figure shows changes in position of ice margin at 175 W (blue line)

Correlation patterns between catches of EK pink salmon of dominant odd-year generations and heat content in the 0-100 m layer during 1979-2021

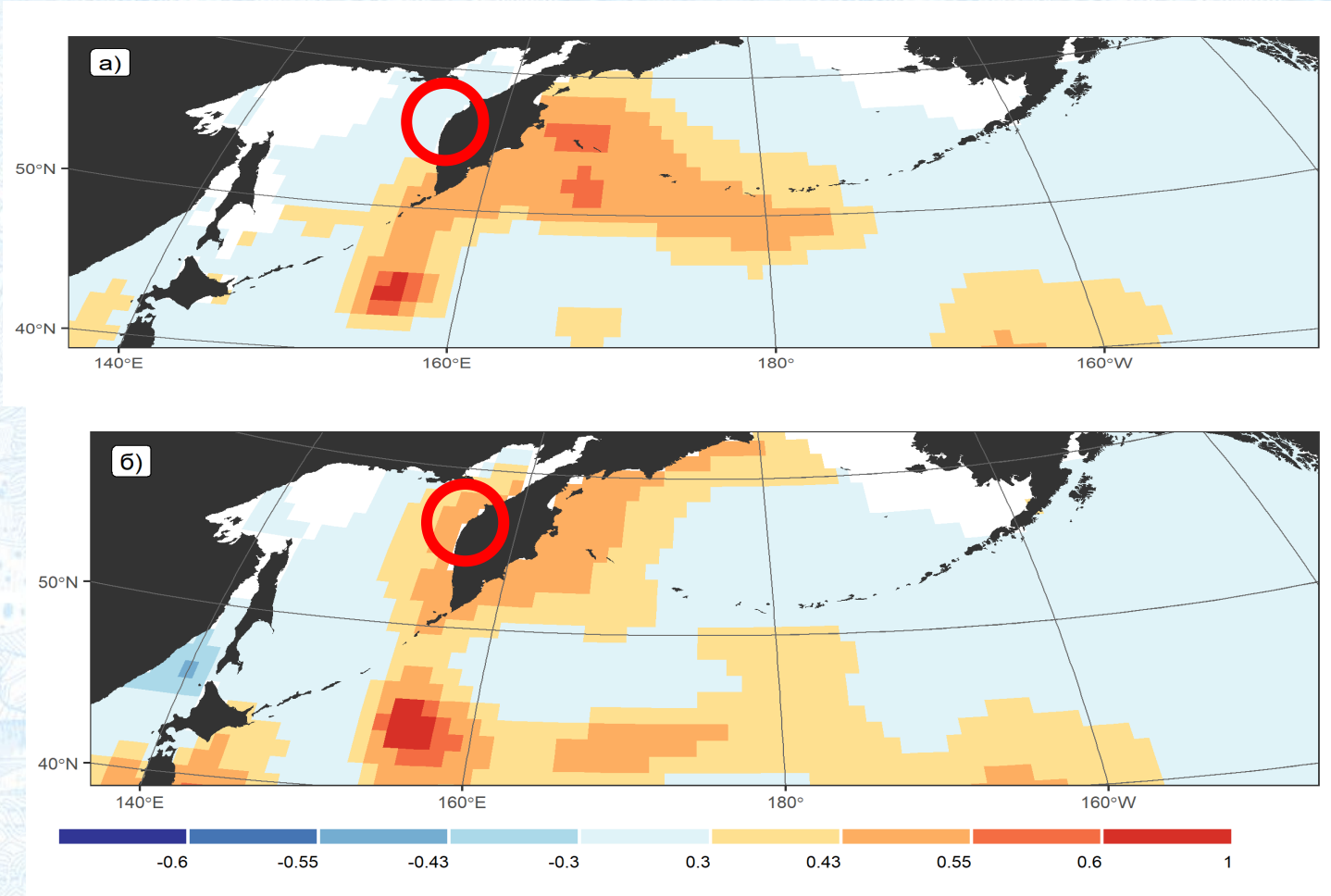


December

February

April

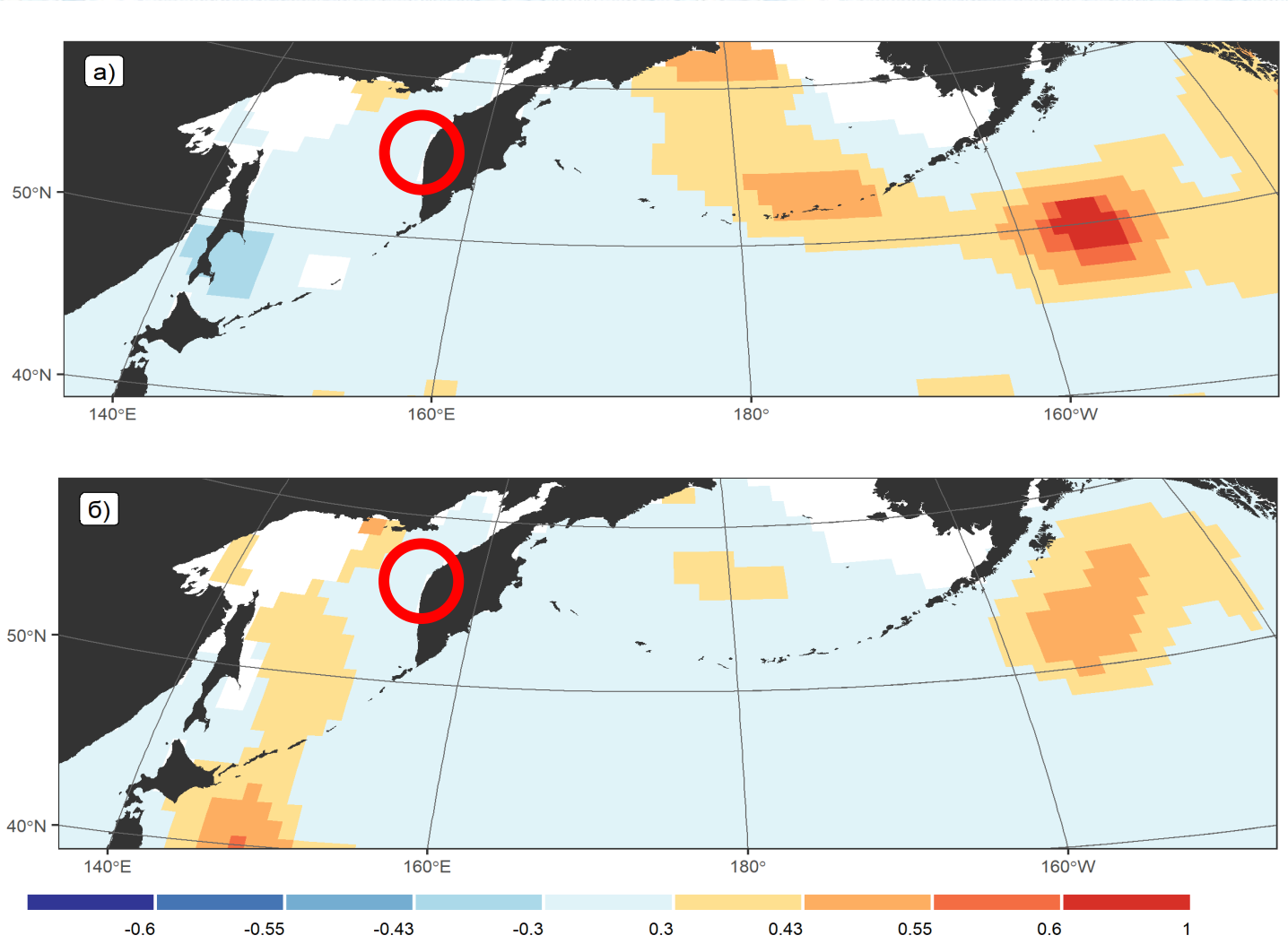
Correlation patterns between catches of WK pink salmon of dominant even-year generations and heat content in the 0-100 m layer during 1978-2020



February

April

Correlation patterns between catches of WK pink salmon of odd-year generations and heat content in the 0-100 m layer during 1979-2021

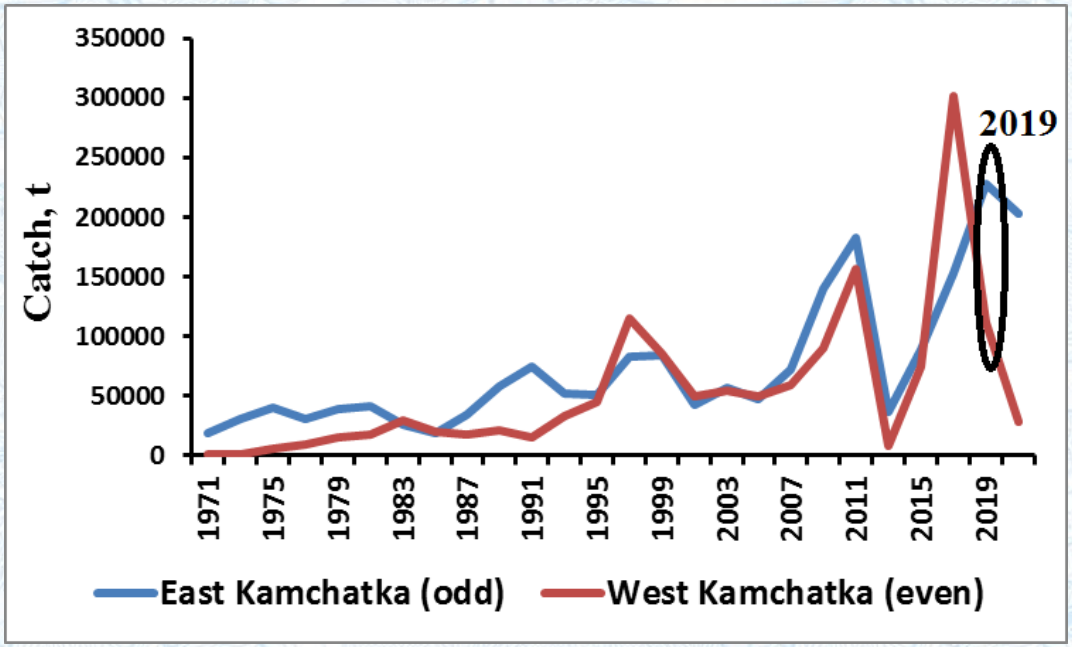


December

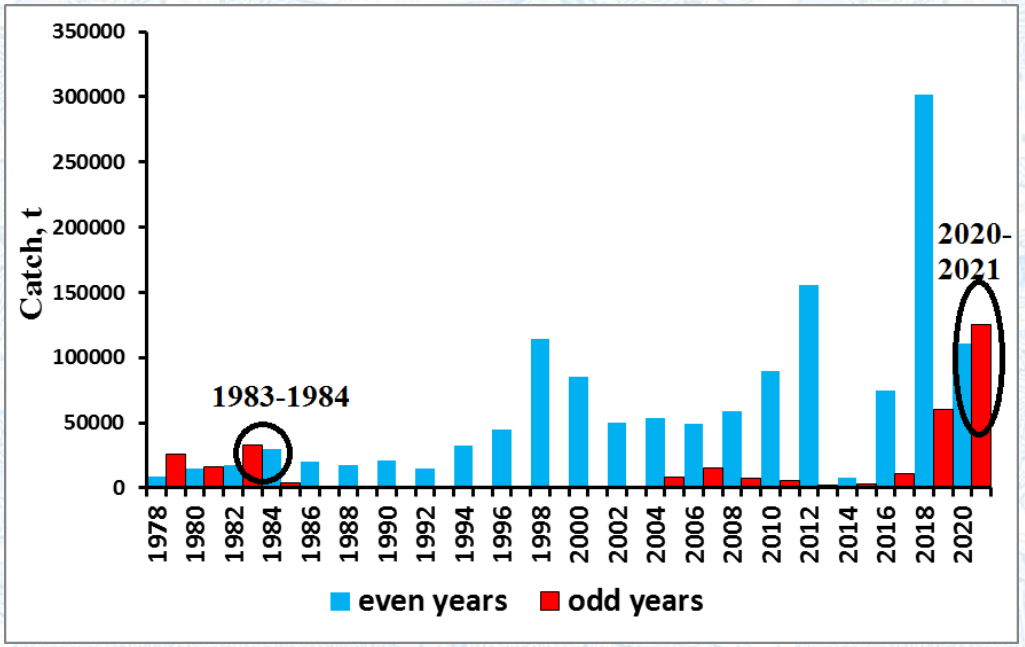
February

West Kamchatka pink salmon stocks

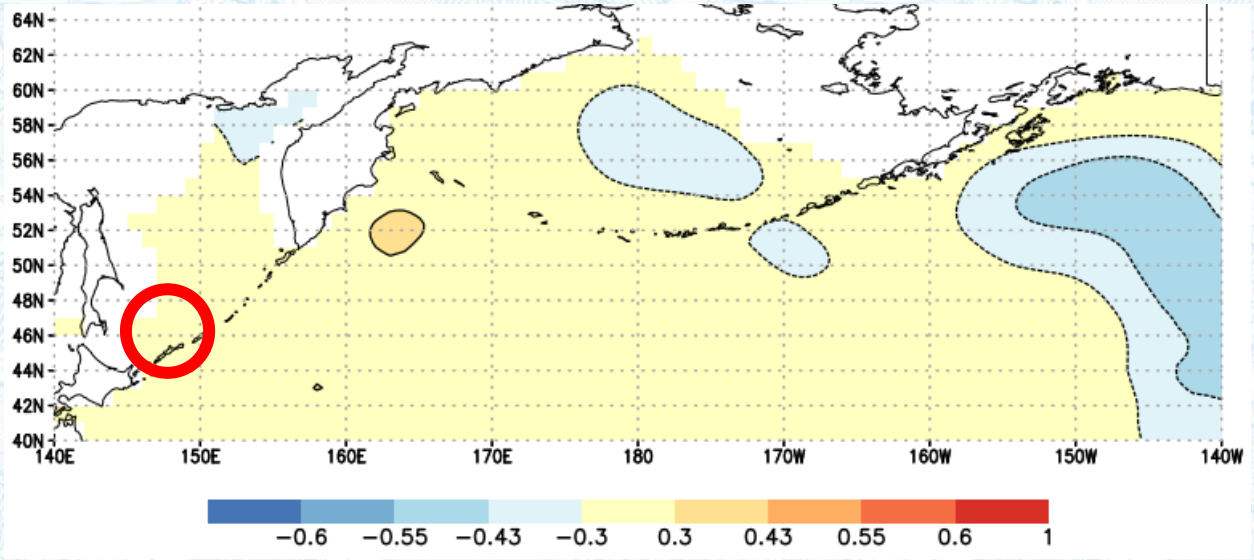
Catches of EK pink salmon in odd years (1971-2021) and WK salmon in even years (1972-2022) shifted 1 year back



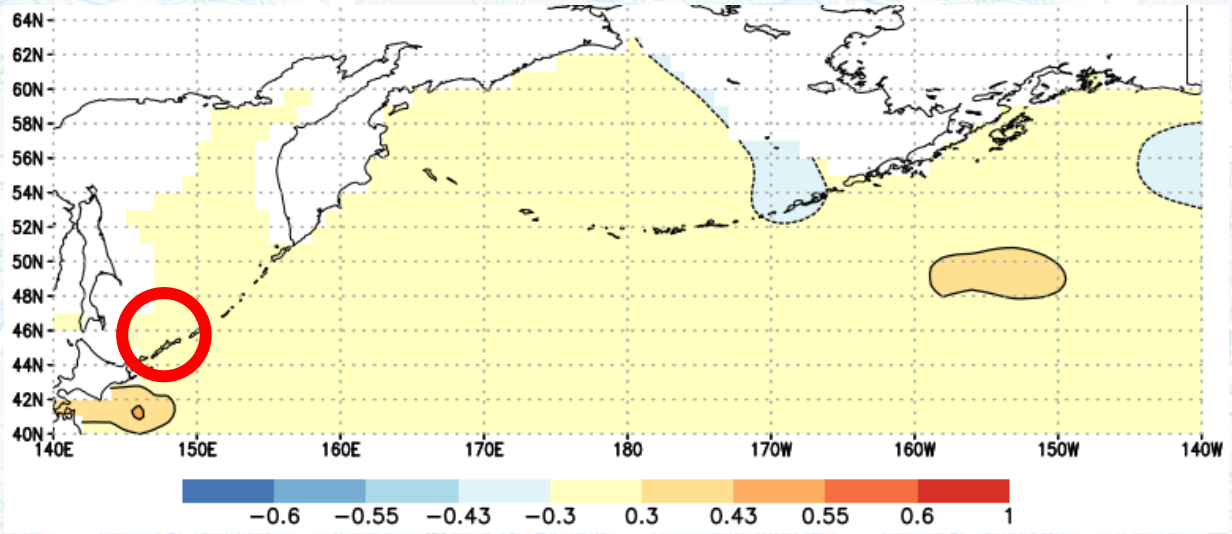
Catches of West Kamchatka pink salmon, 1978-2021



Correlation patterns between catches of South Kurils pink salmon and February heat content in the 0-100 m layer during 1978-2021

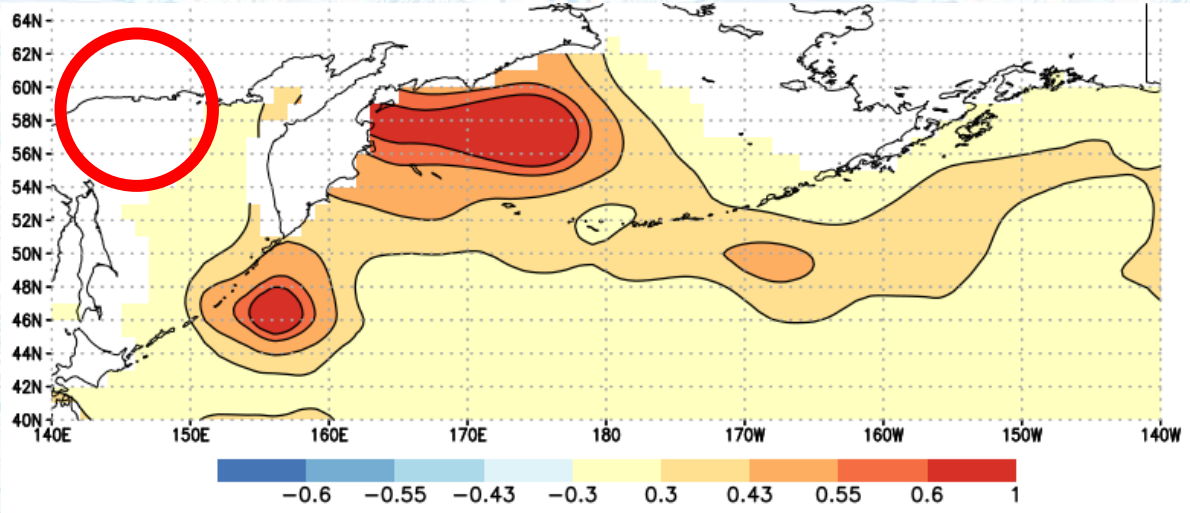


Even years

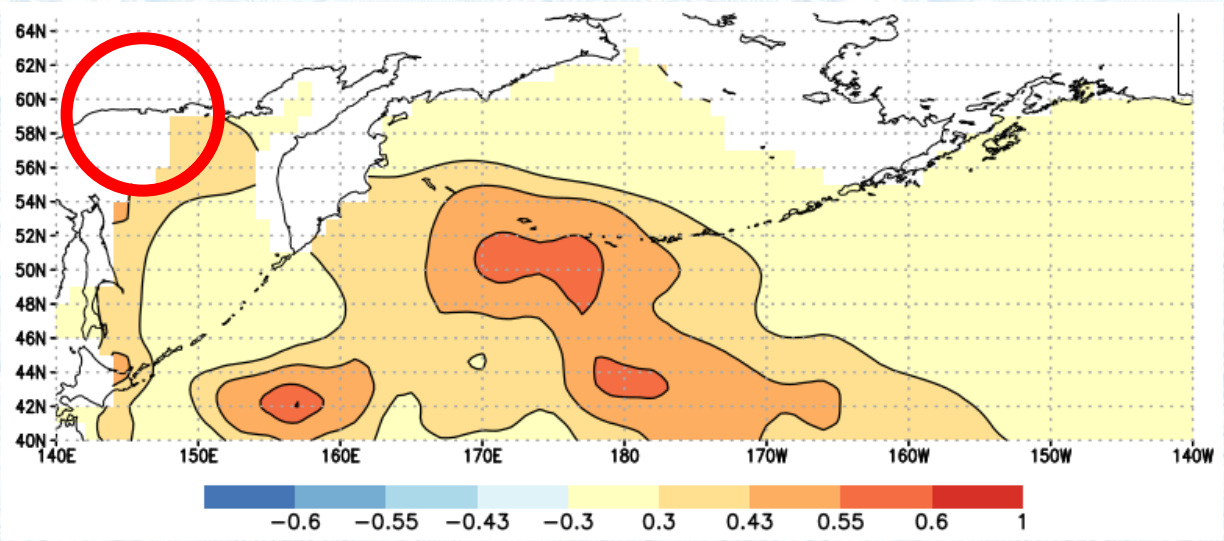


Odd years

Correlation patterns between catches of Okhotsk continental coast pink salmon and heat content in the 0-100 m layer during 1978-2021

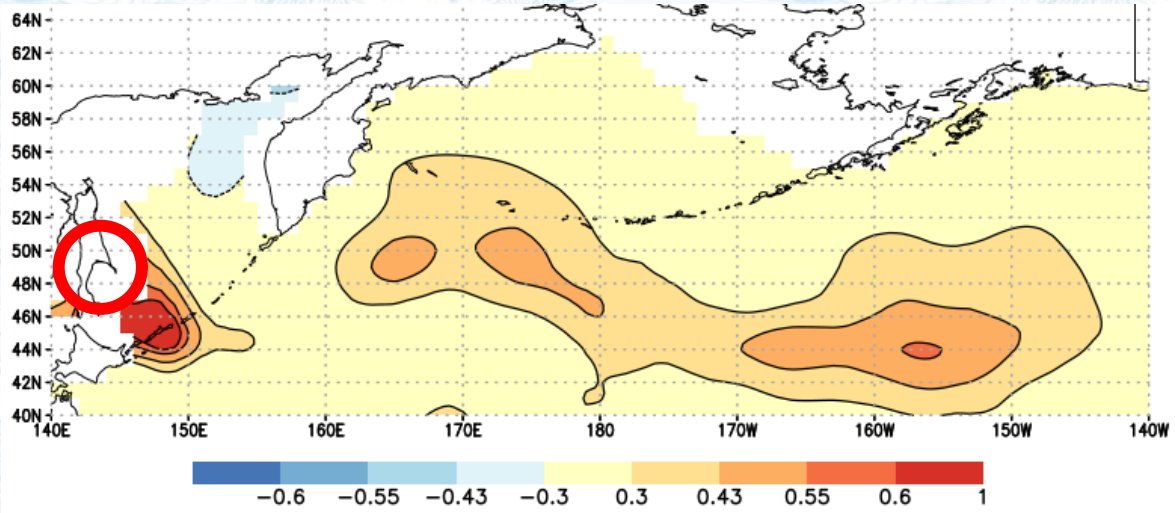


Even years

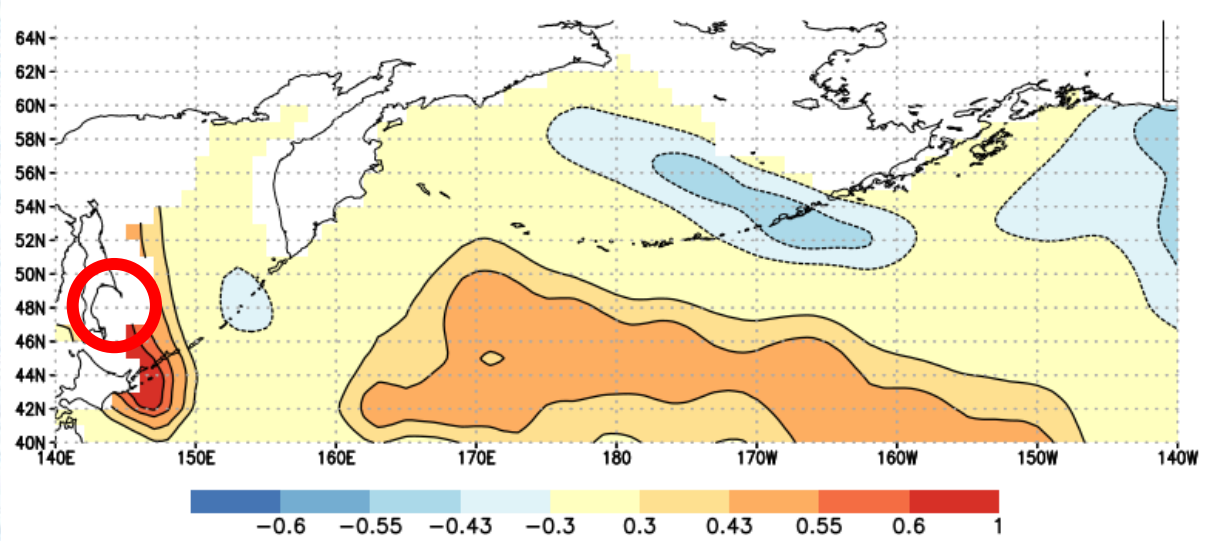


Odd years

Correlation patterns between catches of East Sakhalin pink salmon and February heat content in the 0-100 m layer during 1978-2021



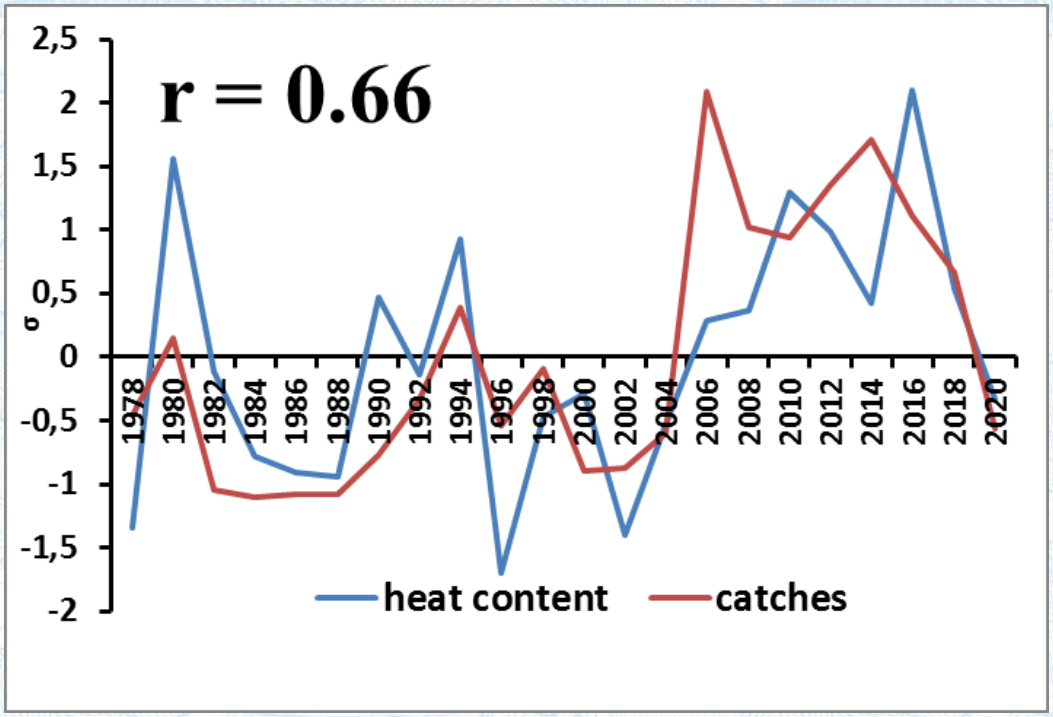
Even years



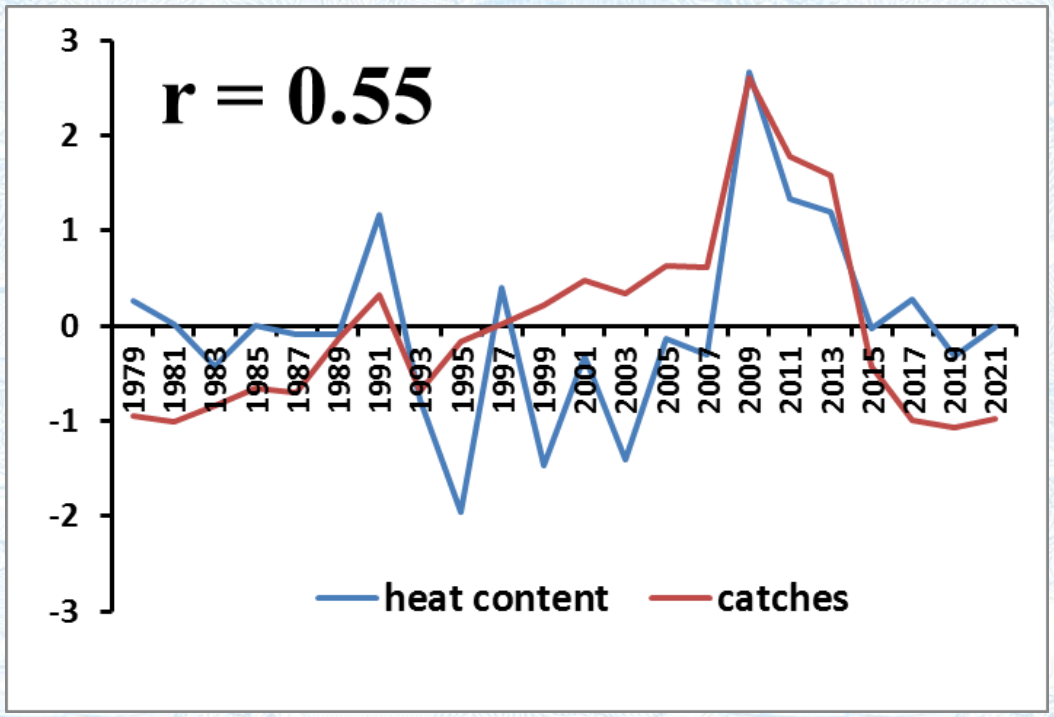
Odd years

Association between normalized time series of East Sakhalin pink salmon catches and winter heat content (0-100 m) in the southern Sea of Okhotsk

EVEN YEARS



ODD YEARS



Conclusion

1. Based on the analysis of the correlation between catches and heat content in the upper 100 m layer of the North Pacific region in the winter months, it can be assumed that wintering areas of most Far East pink salmon stocks are located within the Western Subarctic Gyre. The exception are even-year generations of EK pink salmon, for which they lie mainly in the southern Bering Sea, and East Sakhalin stocks, which wintering area are located mainly in the southern Sea of Okhotsk.

2. The growth of even-year catches of EK pink salmon in 2014-2018 was associated with high heat content of surface waters in the northern North Pacific, anomalous decrease in ice cover area in the Bering Sea and displacement of its southern margin far to the north. These factors led to widening of the area with favorable conditions for wintering in the southern Bering Sea. The return of climatic conditions in the Bering Sea to the “normal” state in winter 2019-2020 resulted in recovery of ”saw-tooth” changes in abundance characteristic of this stock during last decades, with high catches in odd years and low catches in even years.

3. The rise of odd-year catches of WK pink salmon from 2017 may be indicative of shift of dominant generations from even years to odd years.