Long-term variability of sublittoral macrobenthos of the Sakhalin's shelf of Tatar Strait (Sea of Japan)

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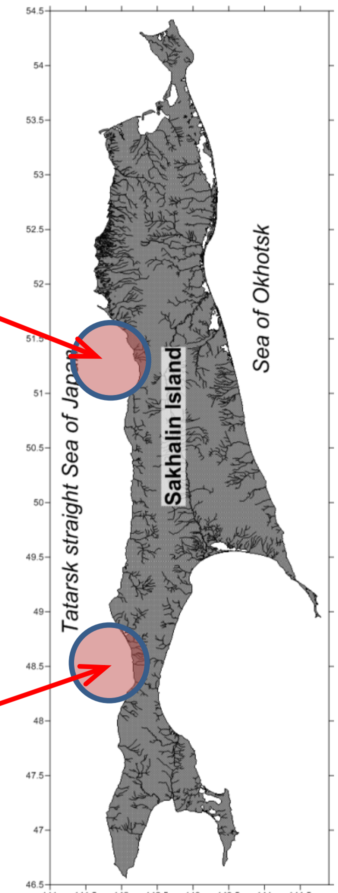
The research reasons

- Last decades fishing industry has faced falloff of fish capacity in a northwest part of sea of Japan. Almost all stocks of mass benthic fishes and crabs are now on a low level abundances.

Two basic areas of a fishery:

Northern area

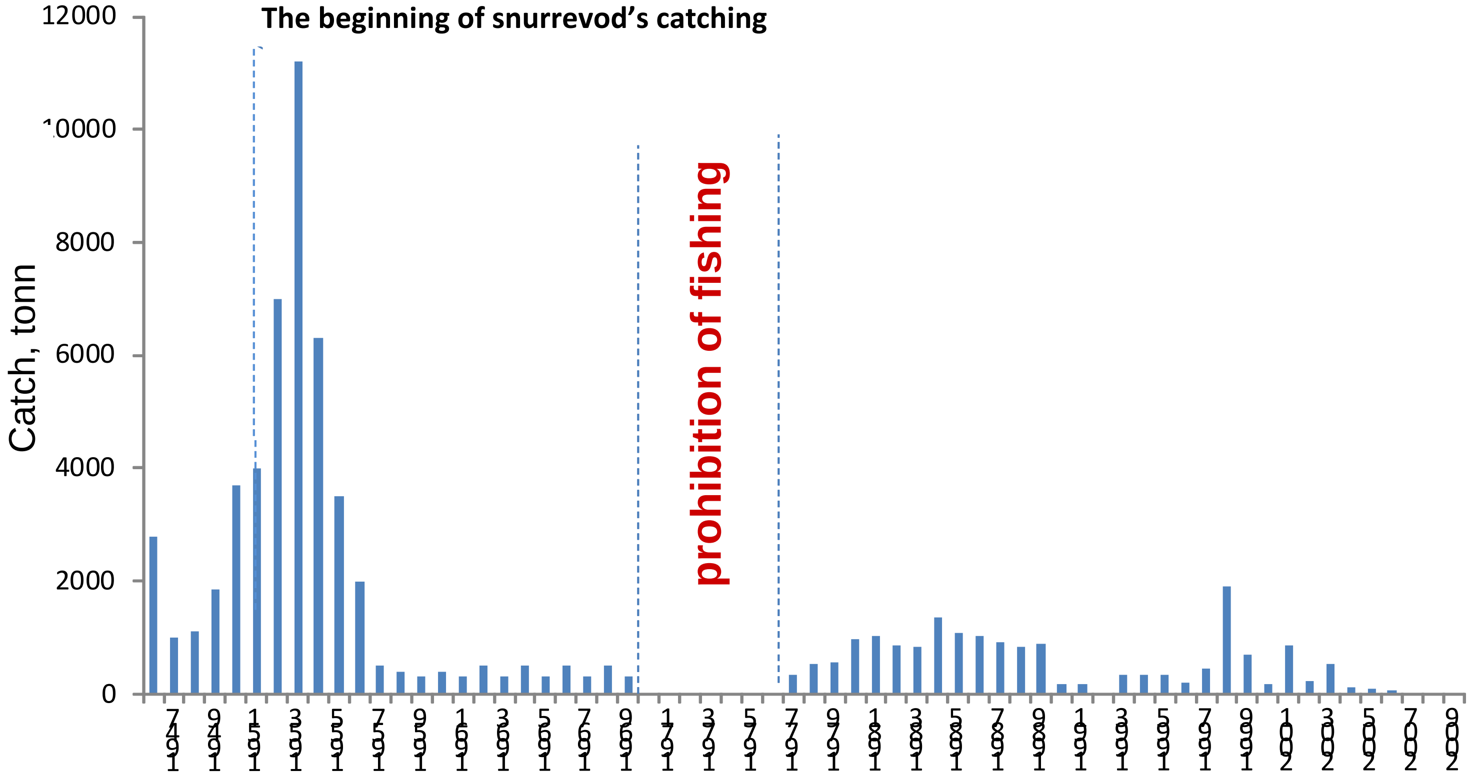
Sothern area

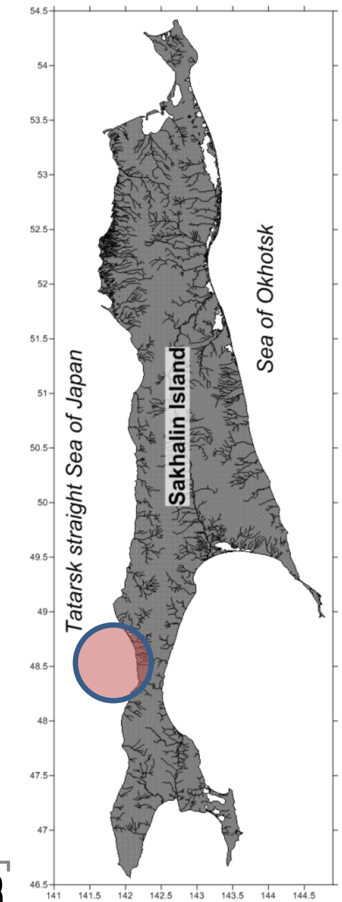


The research reasons

- Last decades fishing industry has faced falloff of fish capacity in a northwest part of sea of Japan. Almost all stocks of mass benthic fishes and crabs are now on a low level abundances.

Catch of flounders in Chehovo-Ilinskoe shoal (southern district):



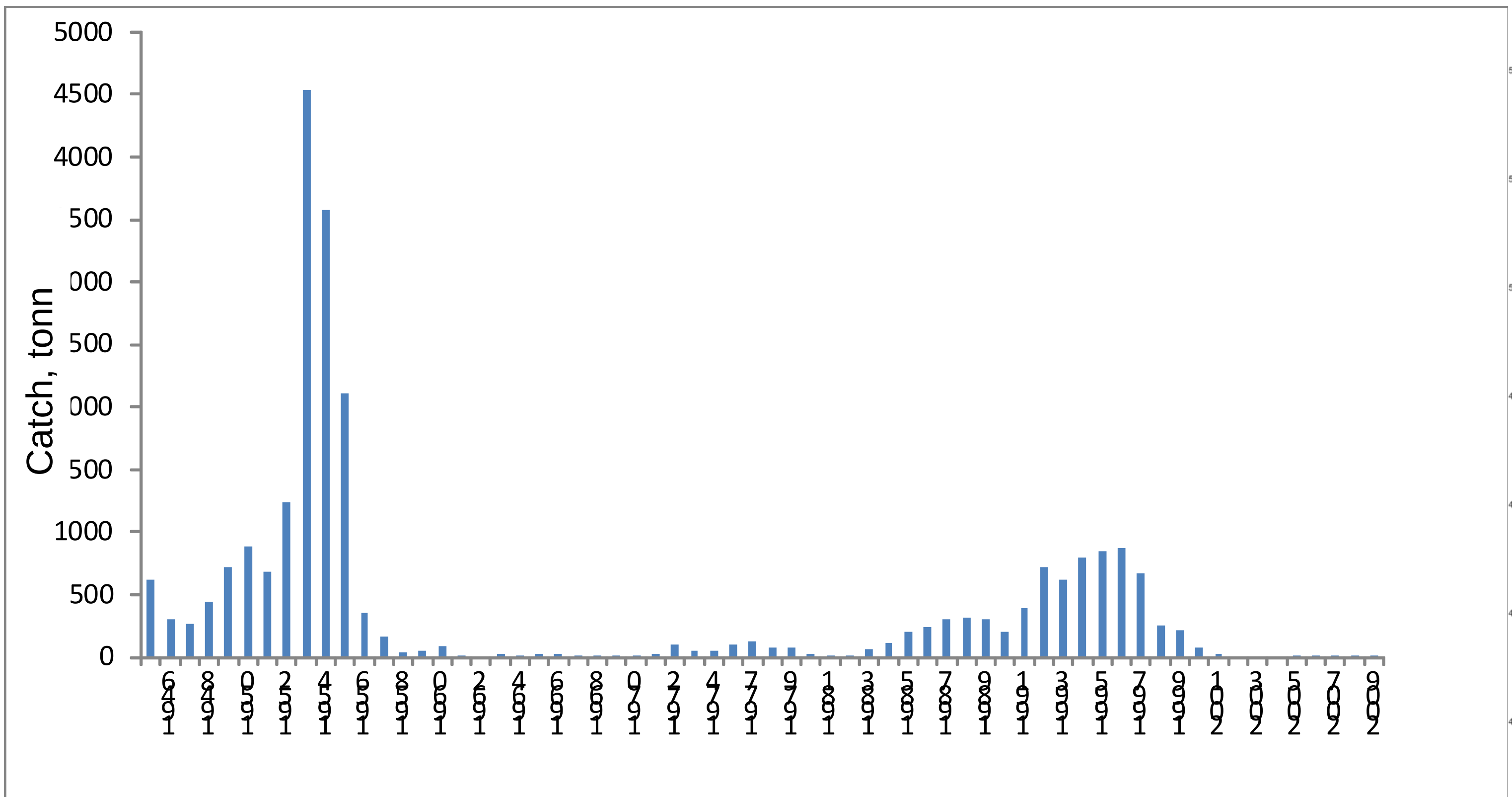


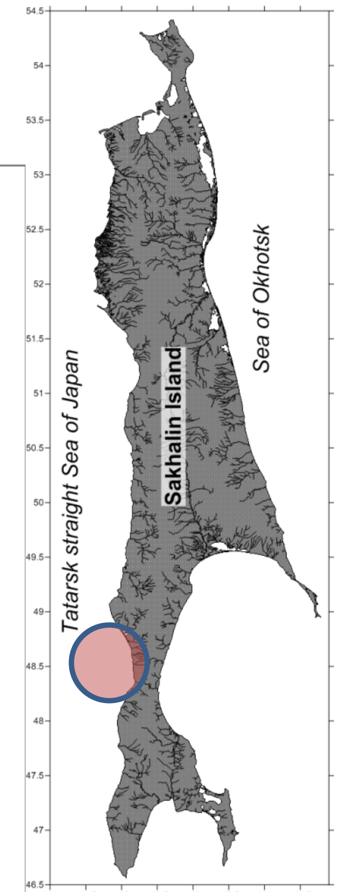
Data source: Fadeev, 1971; Estimation of a condition of a stock of the basic food fishes and not fish objects in Sahalino-Kuril area …, 1968–1970; The forecast of possible withdrawal of biological objects of Sahalino-Kuril area …, 1986–2009.

The research reasons

- Last decades fishing industry has faced falloff of fish capacity in a northwest part of sea of Japan. Almost all stocks of mass benthic fishes and crabs are now on a low level abundances.

Catch of king crabs in Chehovo-Ilinskoe shoal (southern district):



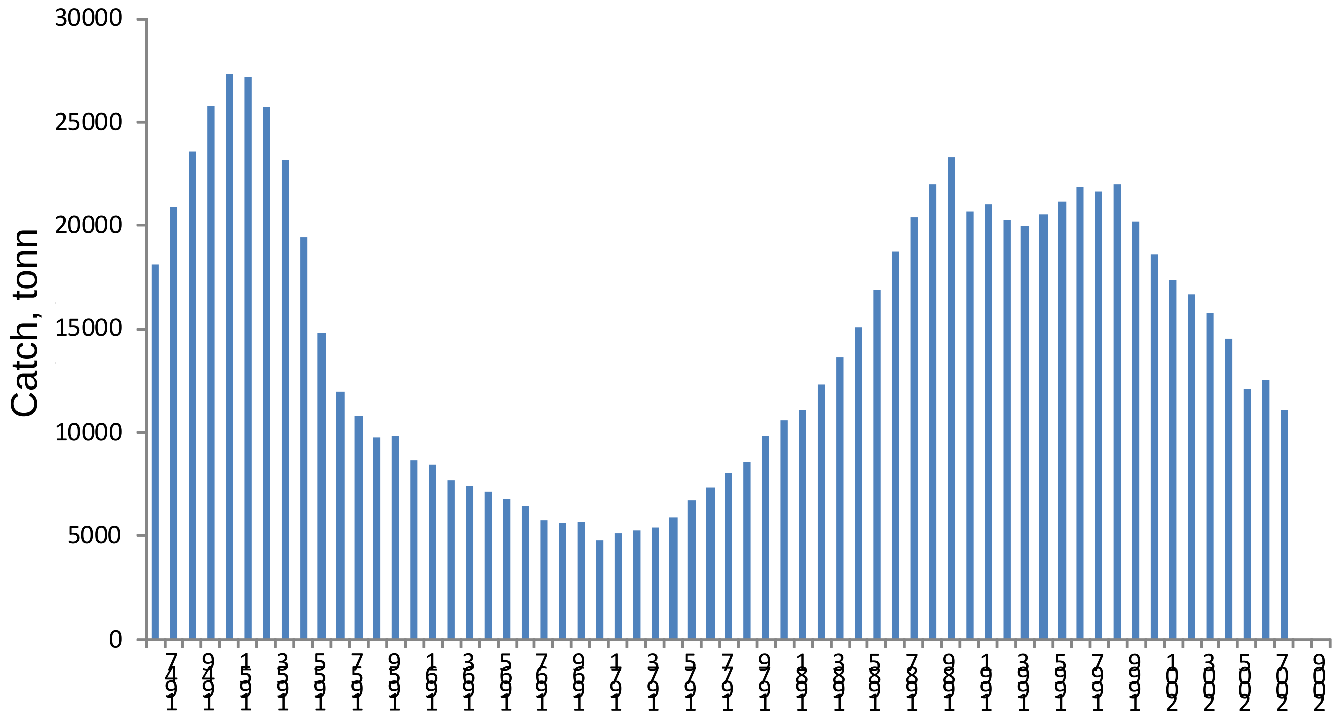


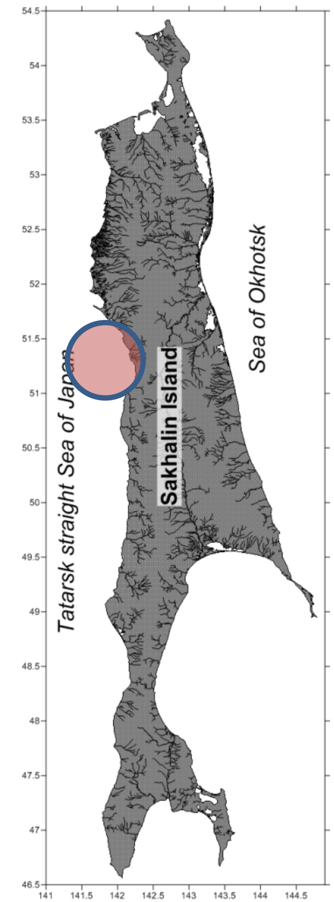
Data source: Data is given by A. K. Klitin

The research reasons

- Last decades fishing industry has faced falloff of fish capacity in a northwest part of sea of Japan. Almost all stocks of mass benthic fishes and crabs are now on a low level abundances.

Yellow-finned sole in Aleksandrovsk-Sakhalinskiy shoal (southern district):





Data source: Model of calculation of a stock by S. N. Tarasjuk (retrospective)

The research reasons

What reasons of decrease in a stock?

- Official fishing science: Injurious overfishing.
- There are questions:

1. Why the discord between northern and southern fishing areas is observed?
2. Why the released trophic niches have not been occupied by other species?

The work purpose

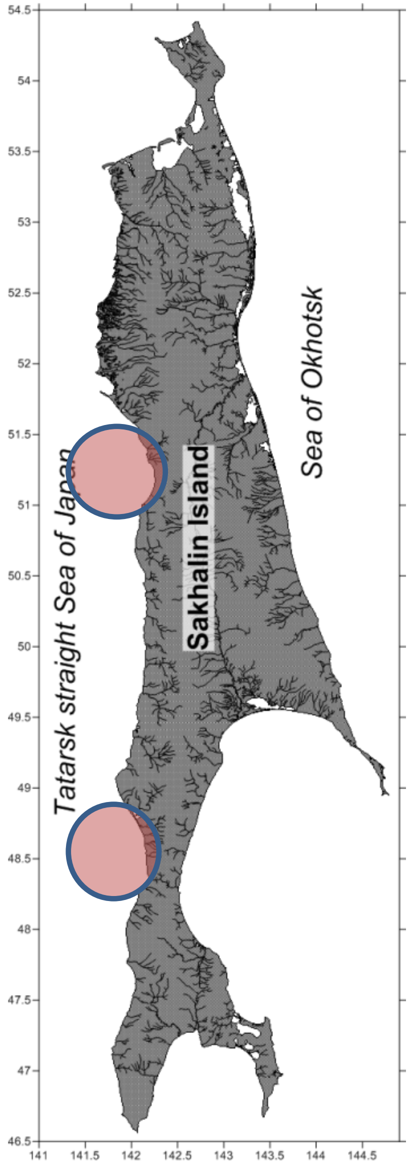
To describe a current state of food supply of bottom-dwelling fishes and invertebrates and to establish the decrease causes of fish capacity in Tatar strait of Sea of Japan.

METHODS: Data source

Interval of depths: 20 – 75 m

- **1948–1949**: The atlas of oceanographic bases ..., 1955; Kobjakova, 1959; Levenshtein, Pasternak, 1976.
- **1977–1979**: Fadeev, 1988
- **2010**: Own researches:

Sample drawing was made from a research vessel "Dmitry Peskov" in May-June, 2010.
Two polygons: northern and southern.
Samples have been collected in 20 points on each polygon.
From each point it has been collected three samples by the Van-Veen bottom sampler (0,2 m²).



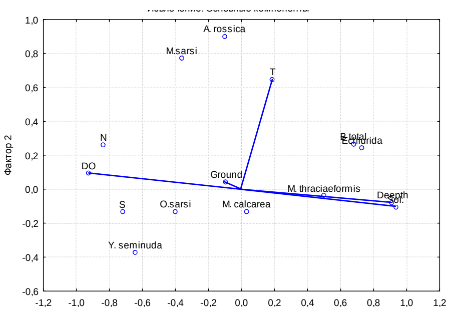
RESULTS: 2010

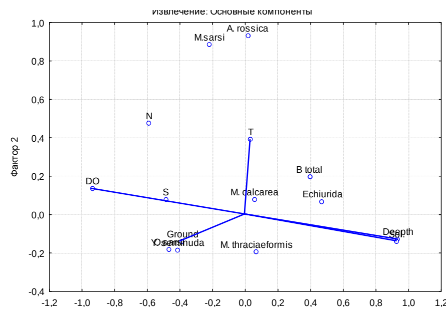
- Northern polygon: 159 species, 417±41 ind./m^2, 81,63±11,57 g/m^2
- Southern polygon: 273 species, 514±62 ind./m^2, 89,82±14,53 g/m^2

Parameter	Northern polygon	Southern polygon
19–20 m		
Number of species	86	89
N, ind./m^2	558±59	566±101
B, g/m^2	36,12±5,49	42,44±7,97
29–33 m		
Number of species	96	110
N, ind./m^2	727±68	502±59
B, g/m^2	24,24±2,73	22,17±2,48
45–55 m		
Number of species	59	150
N, ind./m^2	231±26	547±54
B, g/m^2	134,43±17,28	178,42±26,15
66–75 m		
Number of species	59	168
N, ind./m^2	152±20	375±37
B, g/m^2	131,72±16,92	99,4±11,89

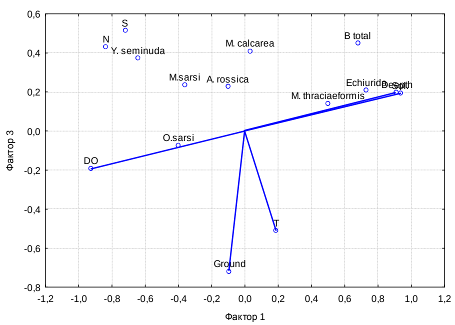
RESULTS: 2010
Ordination analysis: CCA

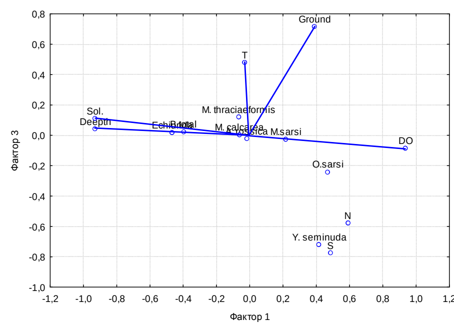
Nonrotating	Rotating



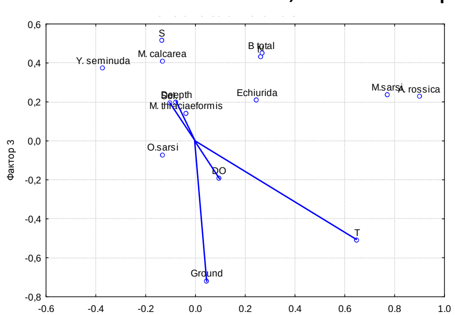


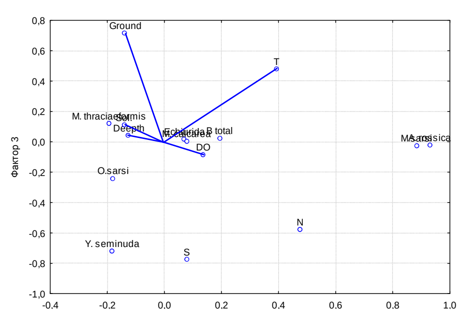
Factor 1 : Factor 2; 53% of dispersion





Factor 1 : Factor 3; 52% of dispersion

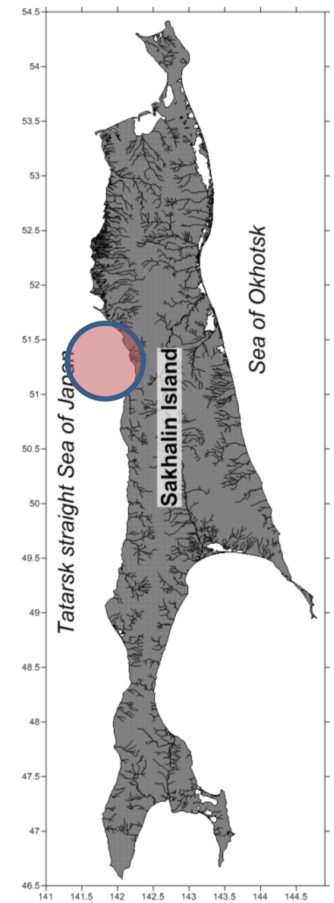




Factor 2 : Factor 3; 28% of dispersion

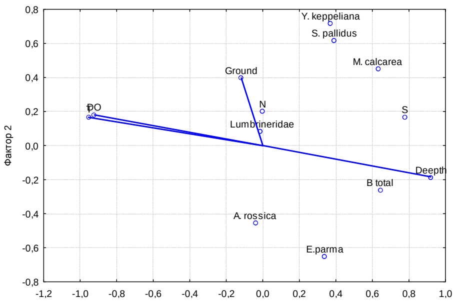
Northern polygon

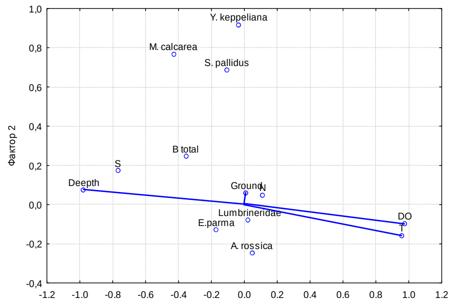
	Associated factors
S	Depth, D O_2
N	?
B	Depth, T
Echiurida	Depth, T
Megayoldia thraciaeformis	Depth, ground
Maldane sarsi	?
Yoldia seminuda	Ground
Ophiura sarsi	Ground, D O_2
Amphiodia rossica	?
Macoma calcarea	?



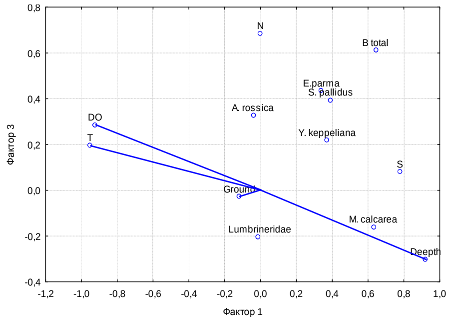
RESULTS: 2010
Ordination analysis: CCA

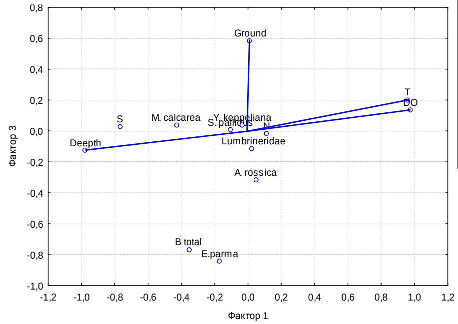
Nonrotating | Rotating



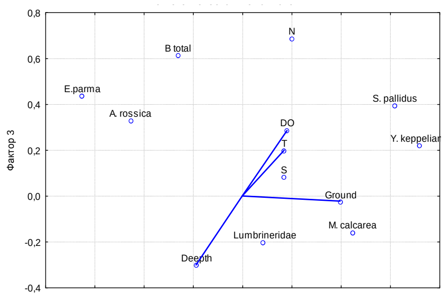


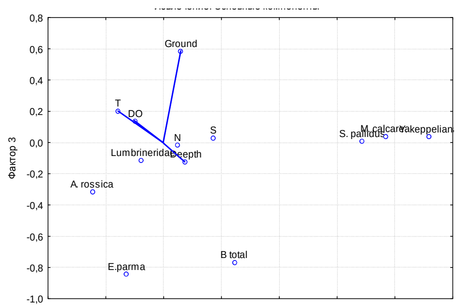
Factor 1 : Factor 2; 50% of dispersion





Factor 1 : Factor 3; 47% of dispersion

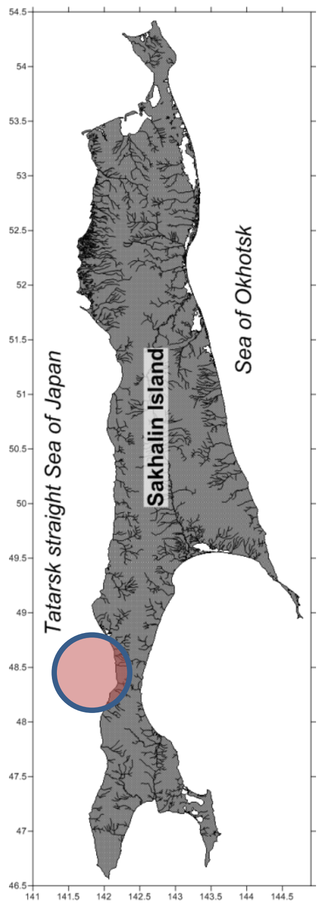




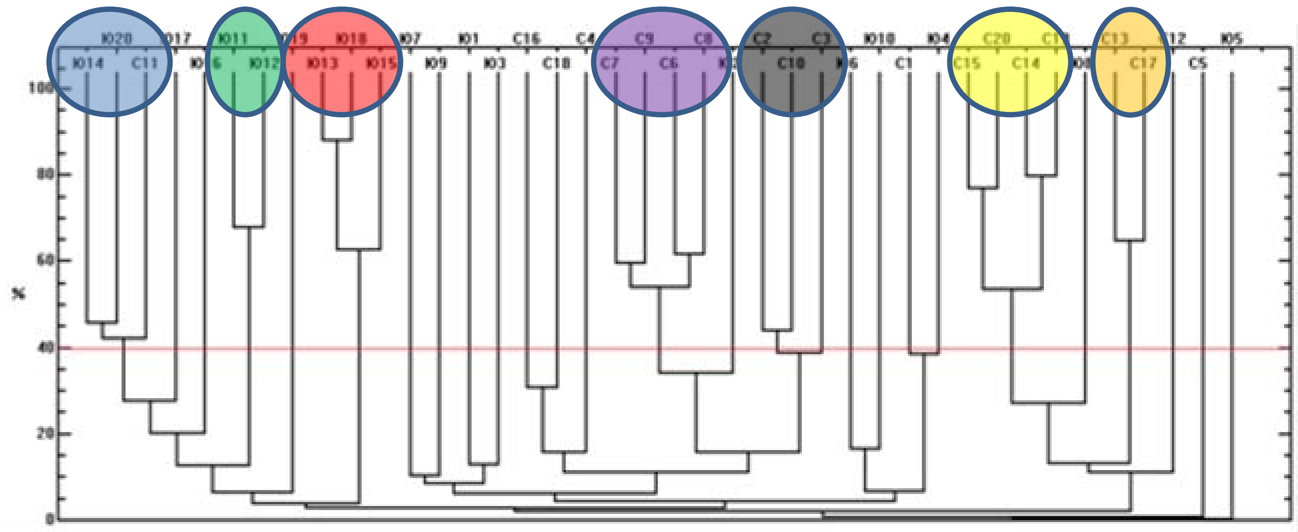
Factor 2 : Factor 3; 29% of dispersion

Southern polygon

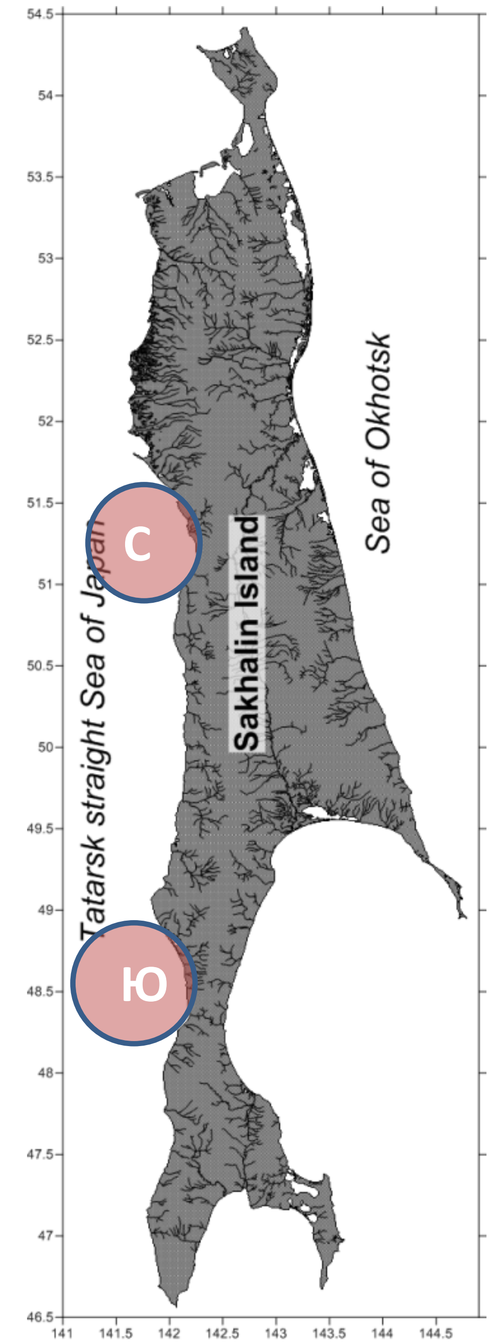
	Associated factors
S	Depth, T, Ground
N	Ground, Depth
B	Depth (?)
Echinarachnius parma	?
Strongylocentrotus pallidus	Depth (?)
Yoldia keppeliana	Depth (?)
Lumbrineridae	Ground, Depth
Amphiodia rossica	?
Macoma calcarea	Depth



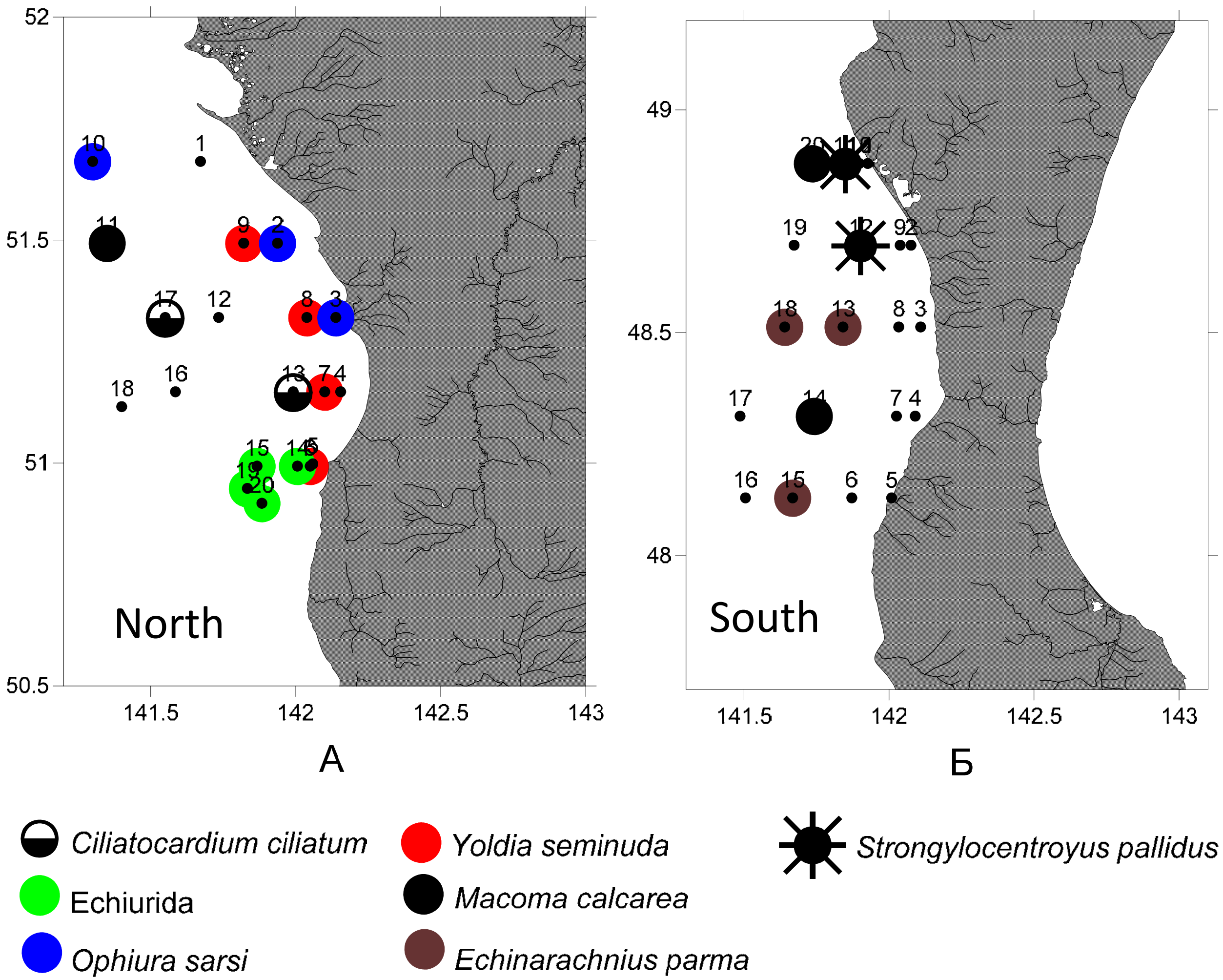
RESULTS: 2010
Basic communities

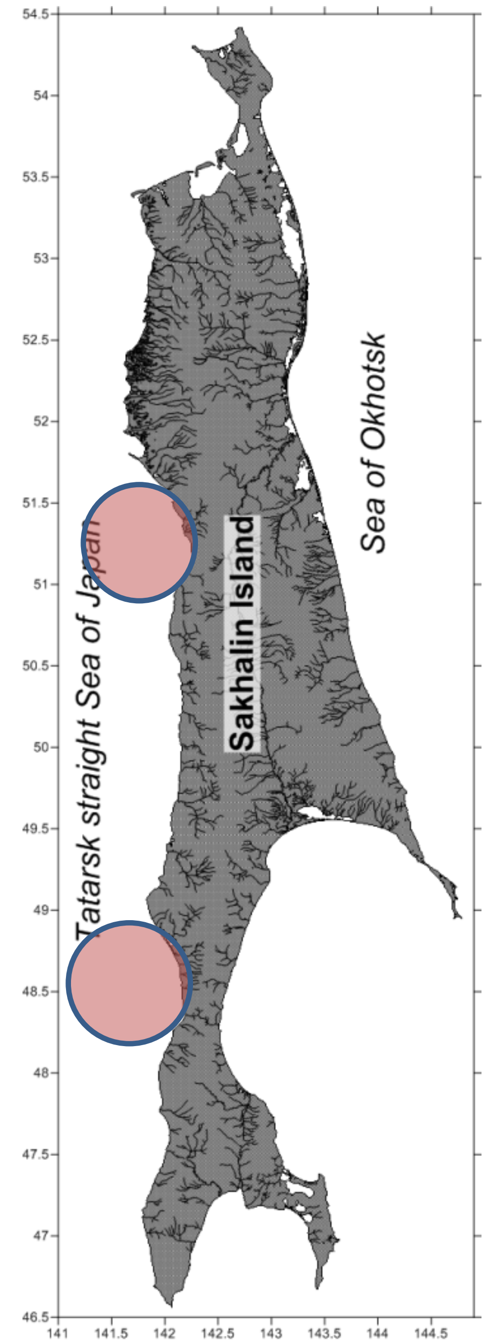


- *Macoma calcarea*
- *Strongylocentrotus pallidus*
- *Echinarachnius parma*
- *Yoldia seminuda + Maldane sarsi*
- *Ophiura sarsi vadicola*
- Echiurida
- *Ciliatocardium ciliatum tchuktchense*



RESULTS: 2010
Basic communities

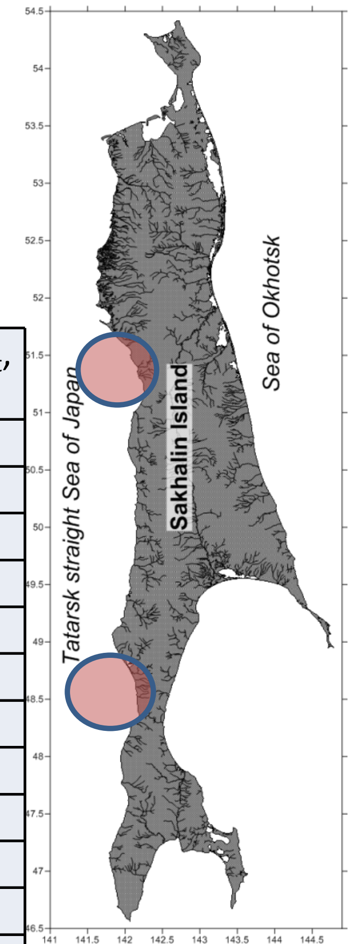




RESULTS: 2010
Basic communities

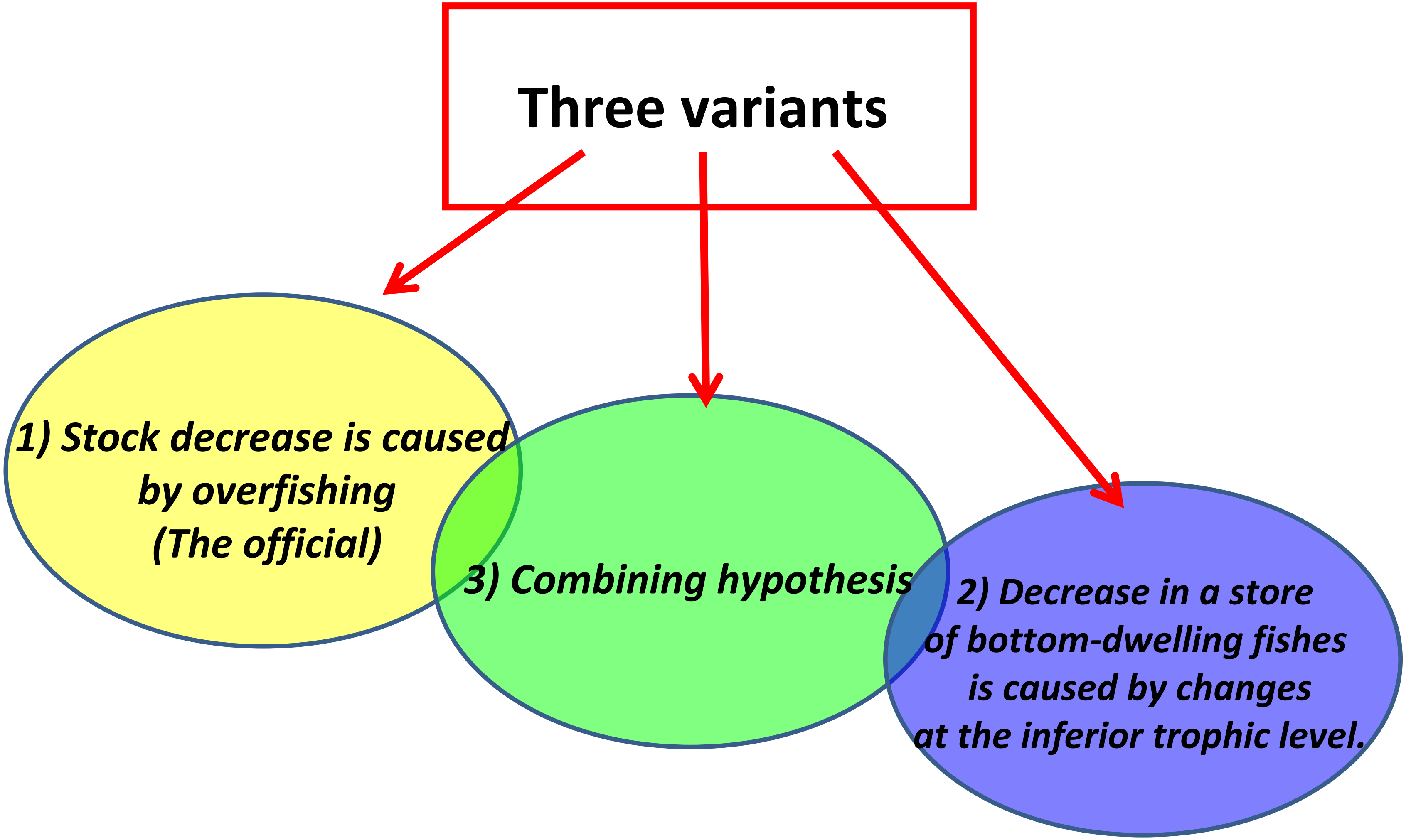
Community		Depth, m	S, species	N, ind./m^2	B, g/m^2	B dominant, %
Macoma calcarea	2010	45–70	87	424±42	130,5±15,4	42,1
	1977–1979	≈ 60	184	524	142	33,9
Strongylocentrotus pallidus	2010	48–50	99	678±71	136,3±15,8	57,0
	1977–1979	**No**				
Echinarachnius parma	2010	48–70	109	420±41	223,5±32,9	82,1
	1977–1979	10–100	245	828	295	77,6
Yoldia seminuda + Maldane sarsi	2010	29–33	89	735±71	16,3±1,6	41,6
	1977–1979	**No**				
Ophiura sarsi	2010	19–29	66	587±58	35,4±3,8	39,9
	1977–1979	15–40	60	2130	67	29,9
Echiurida	2010	50–75	58	175±22	223,0±22,9	64,8
	1977–1979	**No**				
Ciliatocardium ciliatum	2010	50–55	32	104±11	101,3±14,0	69,9
	1977–1979	**No**				

Data source: Fadeev, 1988



The basic changes in communities for 30 years: Disappearance of some communities marked earlier; Occurrence of several new communities; Change of dominating species; The general decrease in an abundance of a macrobenthos

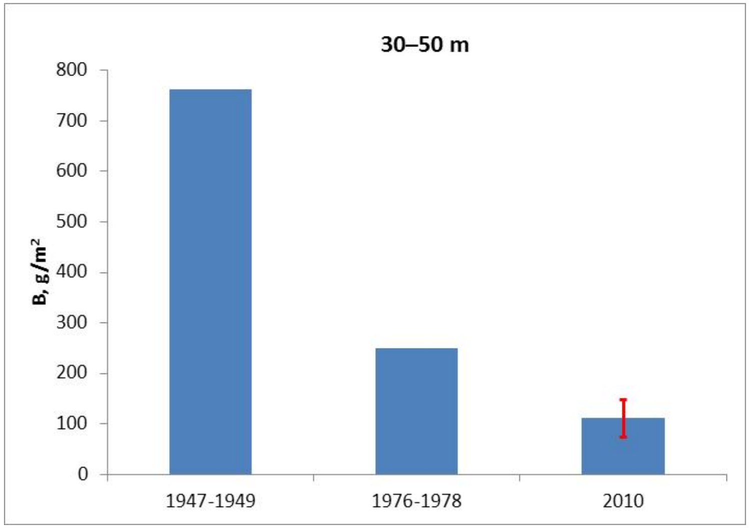
DISCUSSION:
Probable scenarios of event

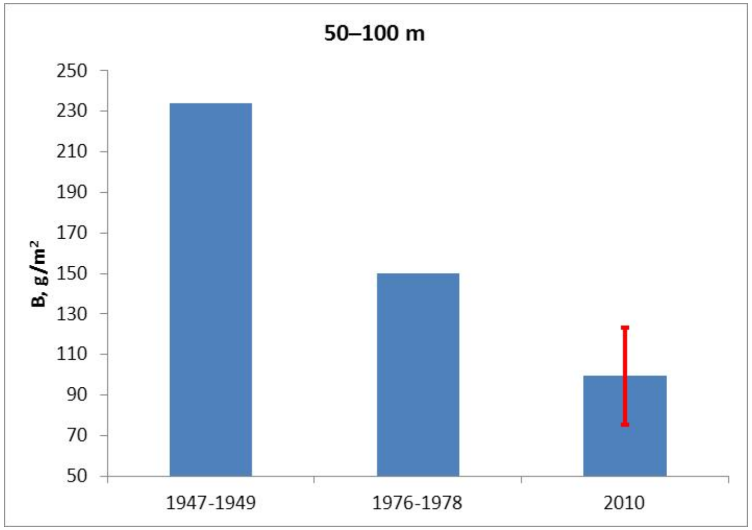


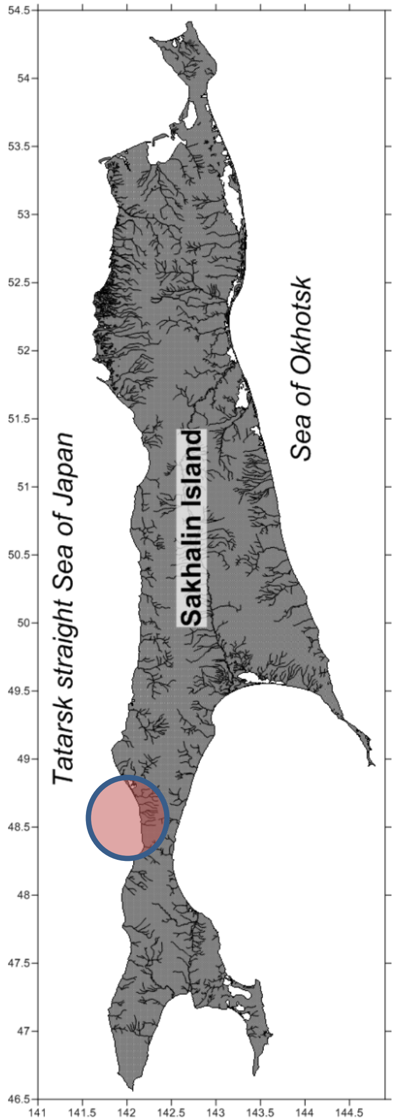
DISCUSSION: Interannual changes of a biomass

Southern polygon

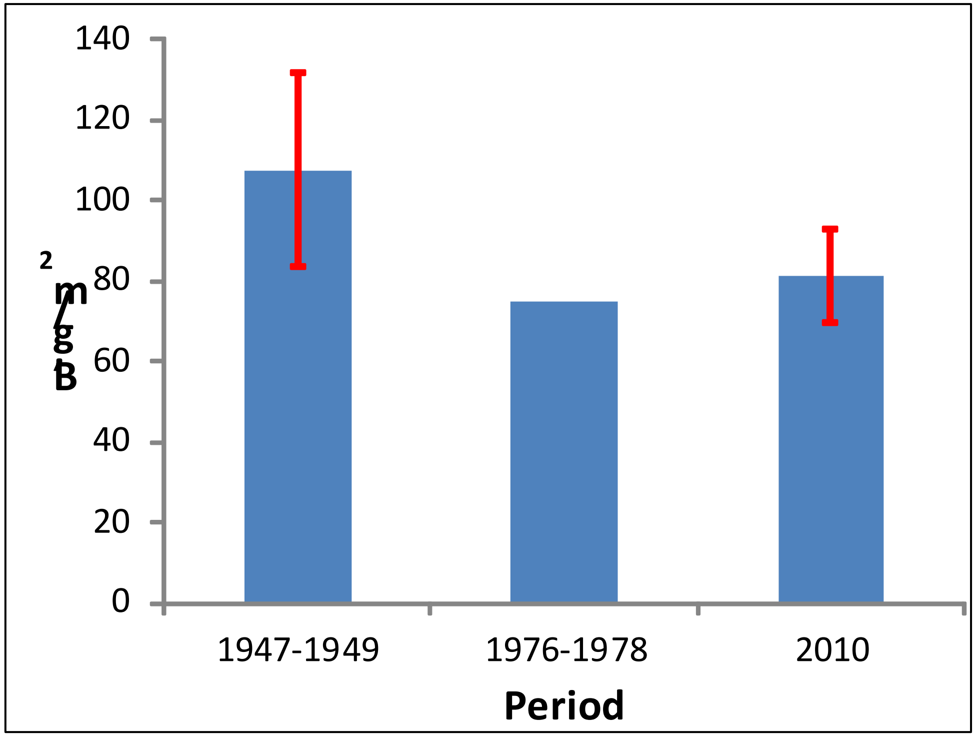
Biomass decreasing in the upper sublittoral (30-50) and in the inferior sublittoral (70) is observed. Average values of a biomass on the compared periods are not overlaped by a centre error that allows to speak about objectivity of observed process. The greatest falling of a biomass is noted for the top sublittoral where the index has decreased almost 7 times last 60 years . In the lower sublittoral the biomass has dropped in 2,4 times. **Biomass changes are accompanied by change of communities and change of its structure** (see above).

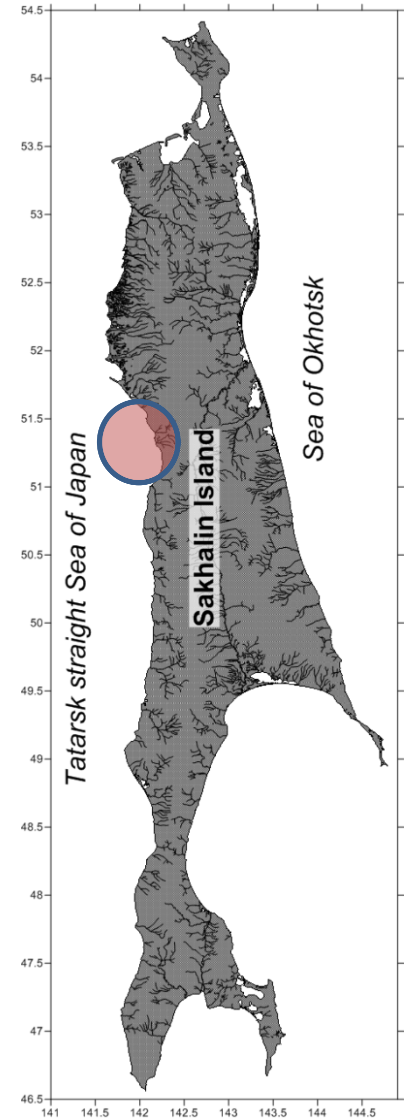






DISCUSSION:
Interannual changes of a biomass





Northern polygon

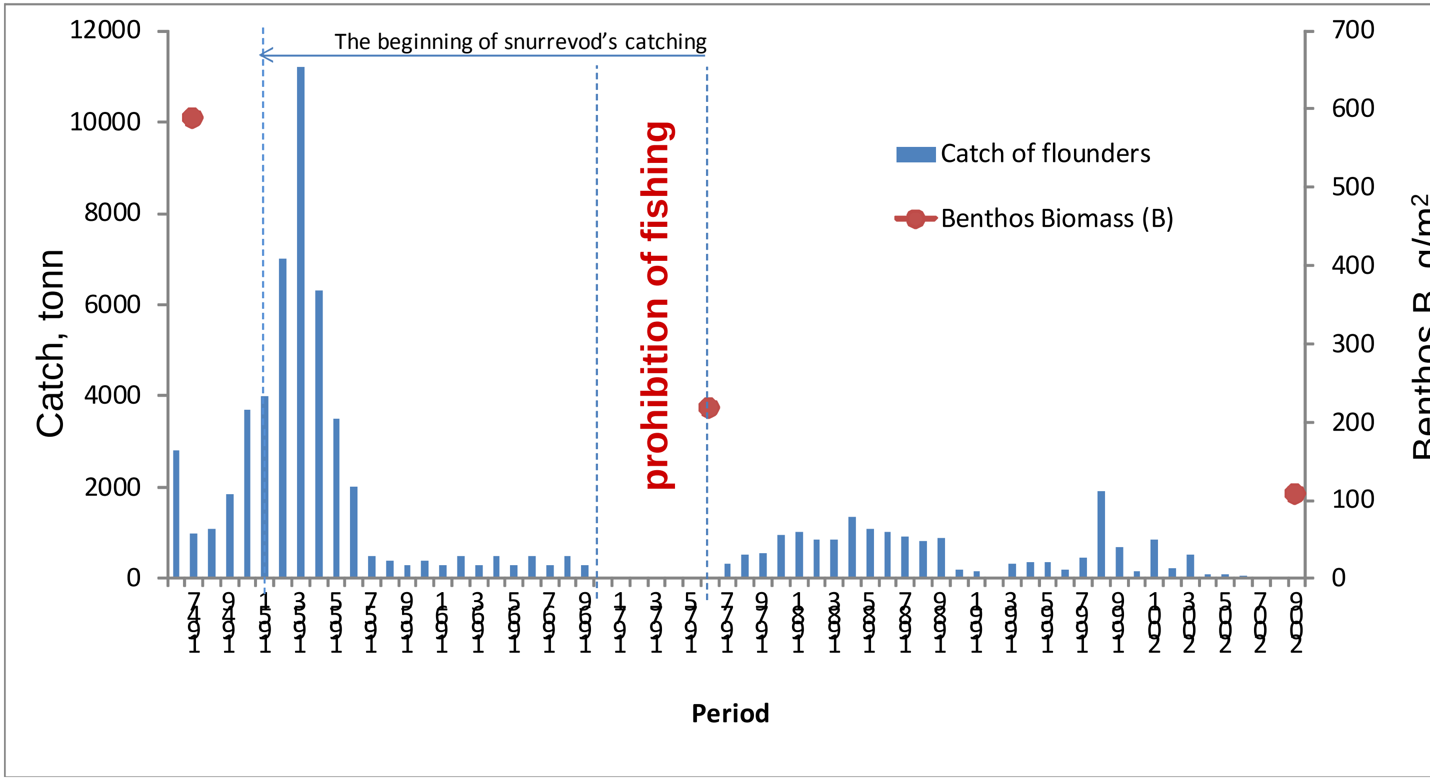
Biomass decrease to the middle of the seventieth years of past century is observed. Average values of a biomass on the compared periods are overlaped by a centre error.

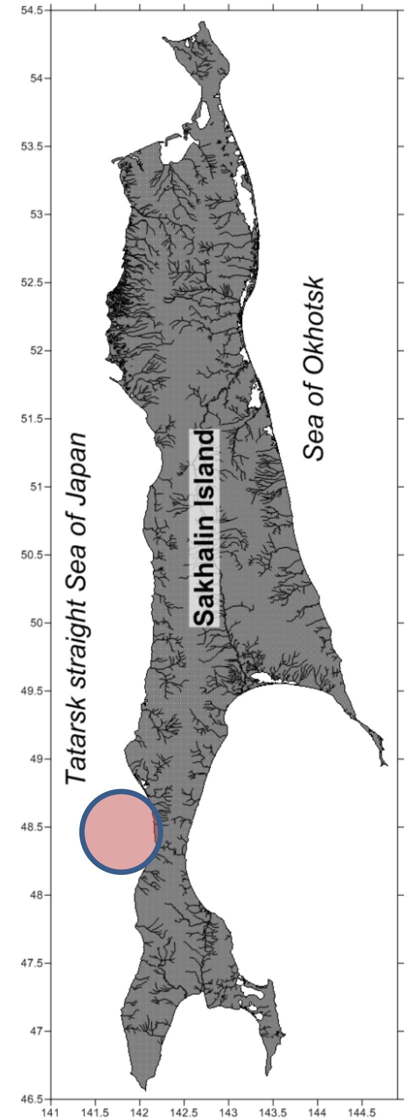
H_0: Comparison of the data of the end of the fortieth years of past century and the data of the beginning of the present century has shown weak variability of a macrobenthos biomass for the last period.

T-test: **P = 0,96**

Thus distinctions in long-term variability of a macrobenthos biomass in southern and northern parts of Tatar strait are observed.

DISCUSSION:
Influence on the top trophic levels



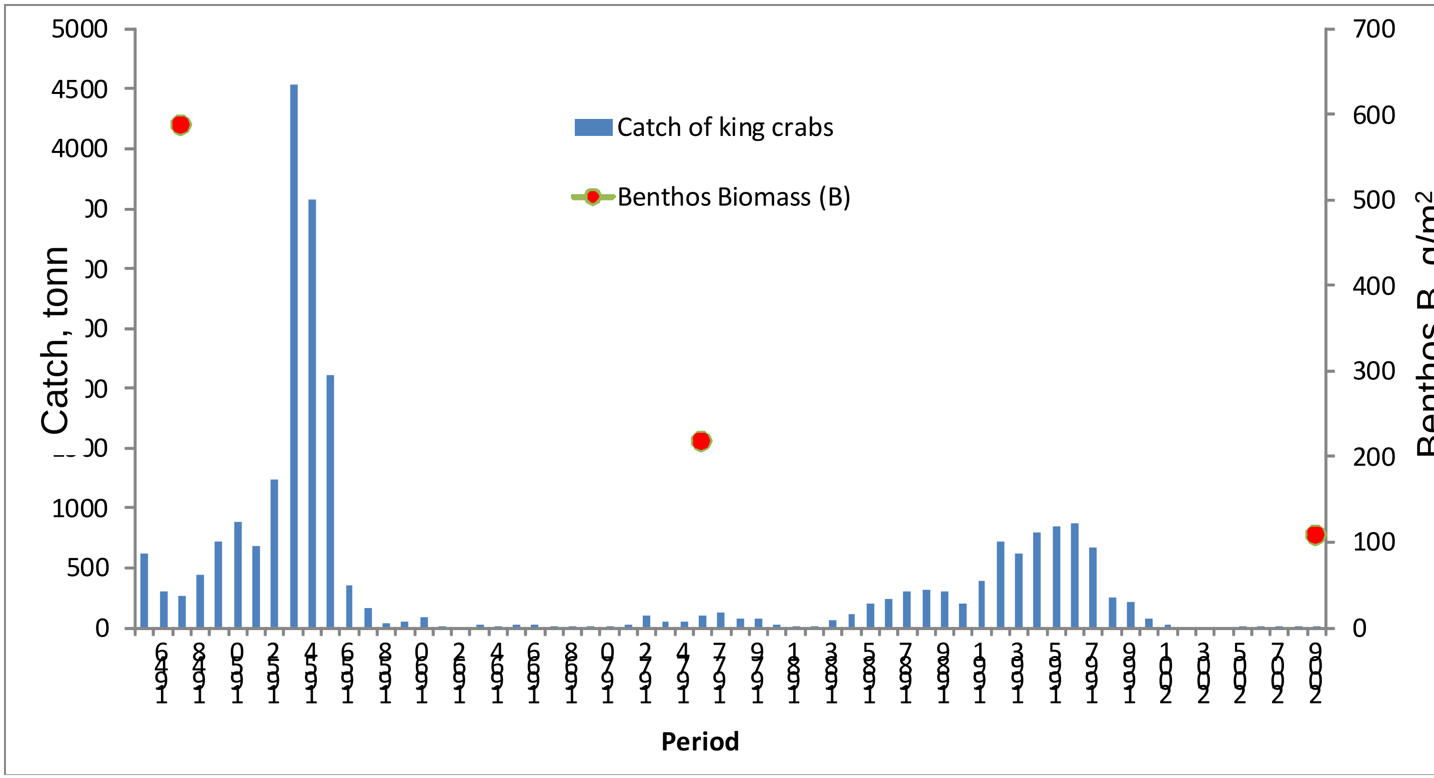


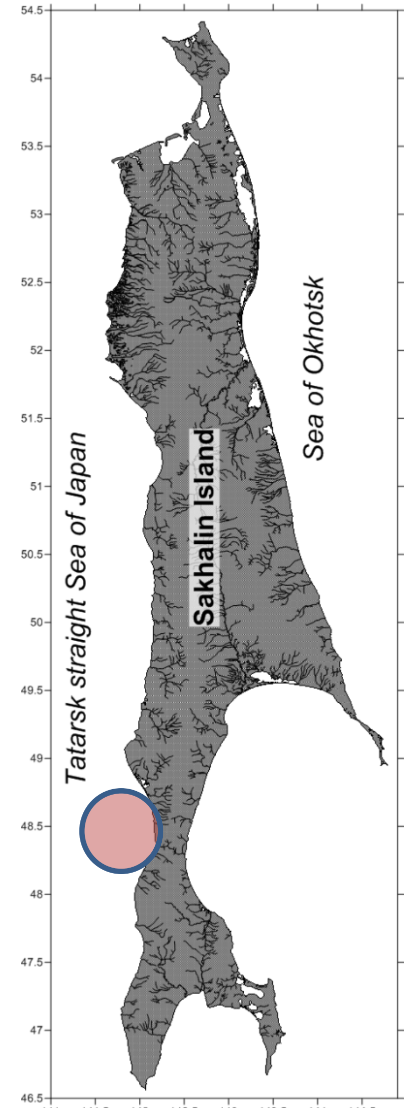
Southern polygon

Catching change precisely enough corresponds to dynamics of a macrobenthos biomass.

Spearman's rho: **ρ = 1,0**

DISCUSSION:
Influence on the top trophic levels: step 1



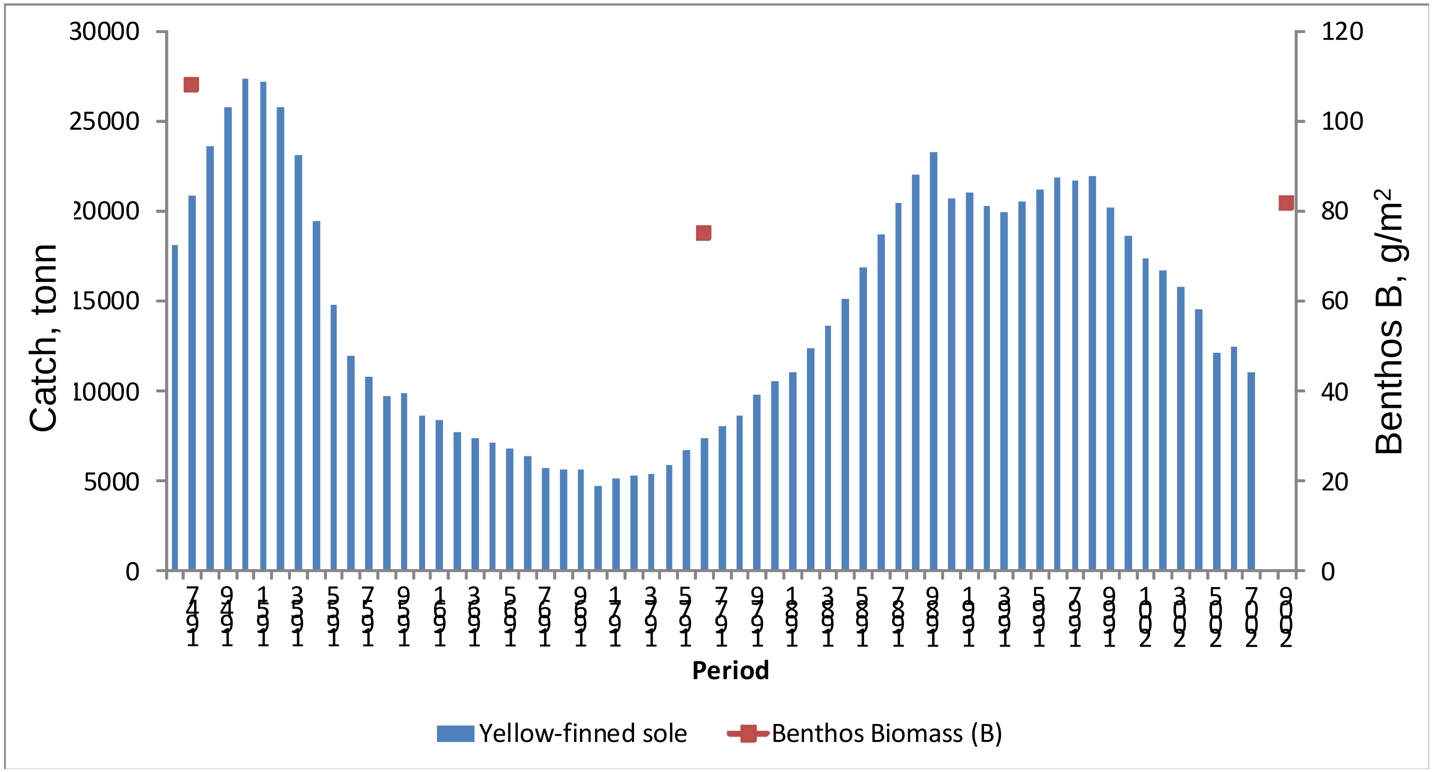


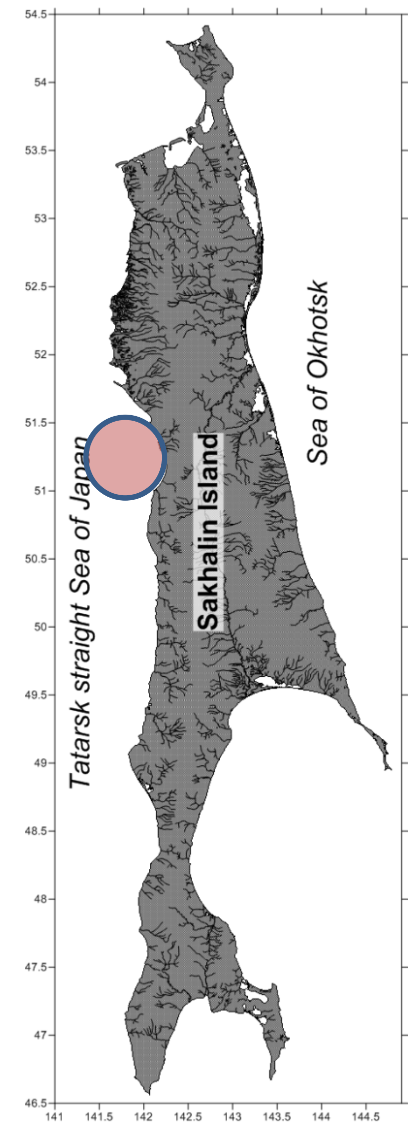
Southern polygon

Crab's catching change precisely enough corresponds to dynamics of a macrobenthos biomass.

Spearman's rho: **ρ = 1,0**

DISCUSSION:
Influence on the top trophic levels: step 1





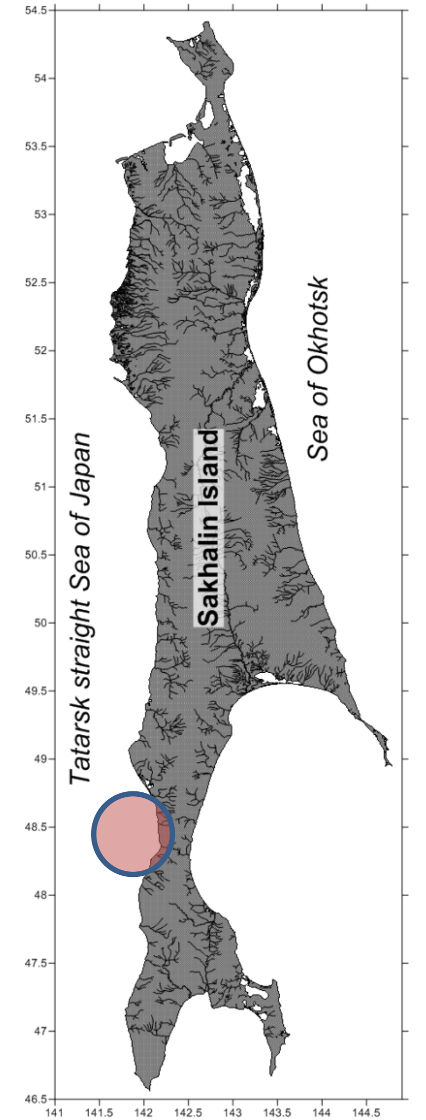
Northern polygon

Yellow-finned sole stock change precisely enough corresponds to dynamics of a macrobenthos biomass.

Spearman's rho: **ρ = 1,0**

DISCUSSION: Influence on the top trophic levels

step 2 – Whether fish capacity falloff only is caused by decrease in a biomass of a fodder macrobenthos?



Southern polygon

The macrobenthos biomass decreased in **6 times** for 60 years.
Fish stock decreased in **140 times (!)** for the same period.
The equation connecting a macrobenthos biomass and production of a bottom fishes:

$P_f = B*P/B*K_E*K_3$

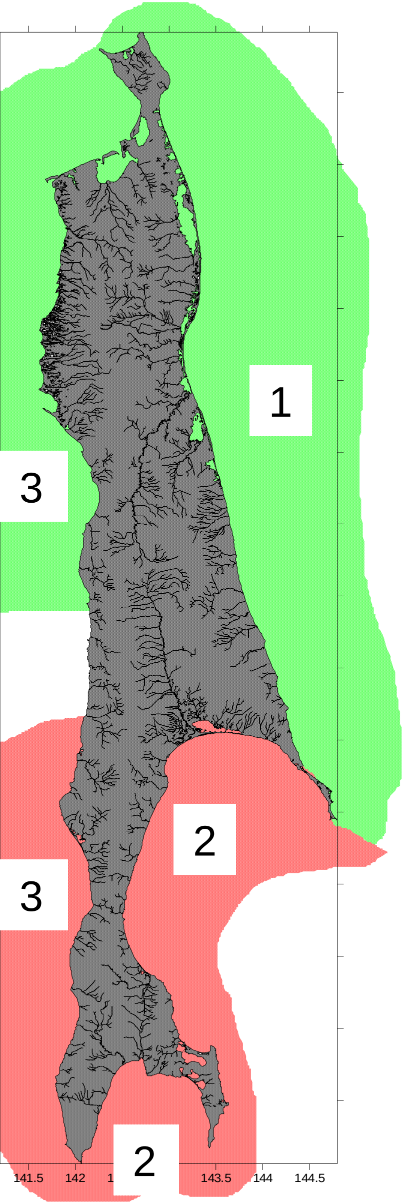
were: P_f – a production of a bottom fishes, B – a macrobenthos biomass , P/B – coefficient of transfer of a benthos biomass in a benthos production, K_E – effectiveness ratio of use of food on growth of fishes, K_3 – average for the given ecosystem coeficient (share) of use of a forage reserve by bottom fishes.

Predicted decreasing of fishes production (multiplicity):

$$\frac{\overset{1947}{P_F}}{\underset{2010}{P_F}} = \frac{B*P/B*K_E*K_3}{B/6*P/B*K_E*K_3} = 6$$

Hence the combining hypothesis proves to be true.
The reasons of lowering of fish capacity: ***overfishing + global changes of the ecosystem (inferior trophic level).***

Instead of the conclusion: water areas of global changes last 60 years



Weak changes

Considerable changes

Source:

1) Nadtochy & Budnikova, 2004; own data

2) Samatov & Labay, 2009; Labay & Kochnev, 2009

3) The present data

Thank you for attention!