Bioindicators of multiple stressors interaction in the North-Eastern shelf of Sakhalin Island (Okhotsk Sea)

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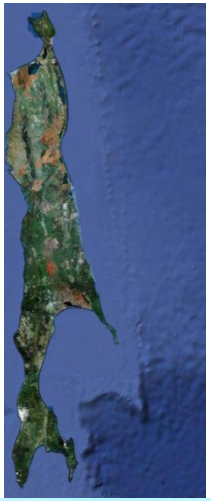
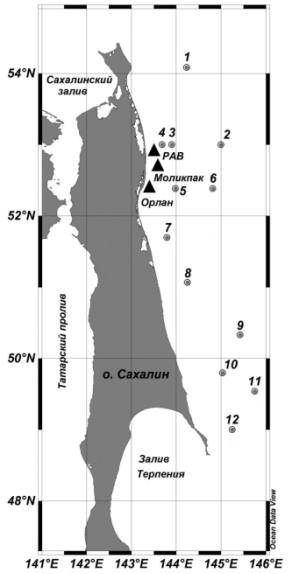



300
0
(km)
600


54°N
52°N
50°N
48°N
141°E
142°E
143°E
144°E
145°E
146°E
Сахалинский залив
Татарский пролив
о. Сахалин
Залив Терпения
РАВ
Моликпак
Орлан
1
2
3
4
5
6
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8
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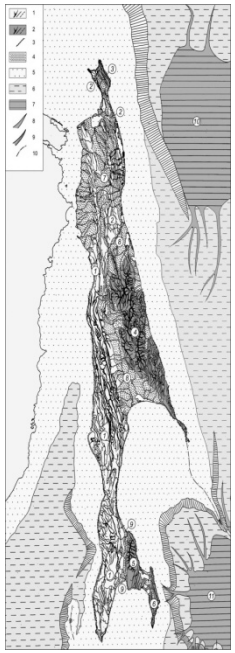
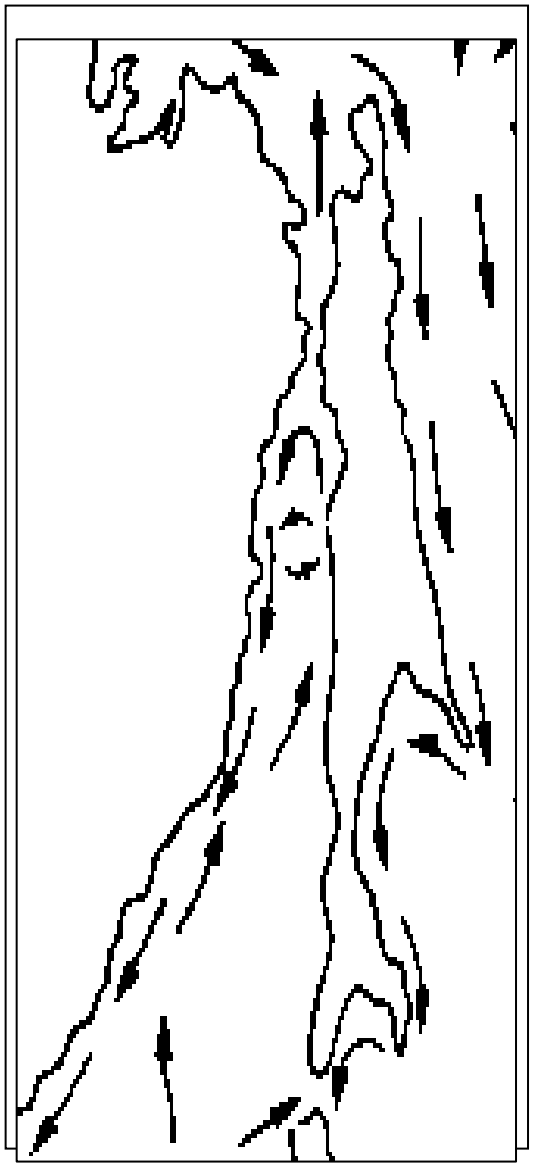
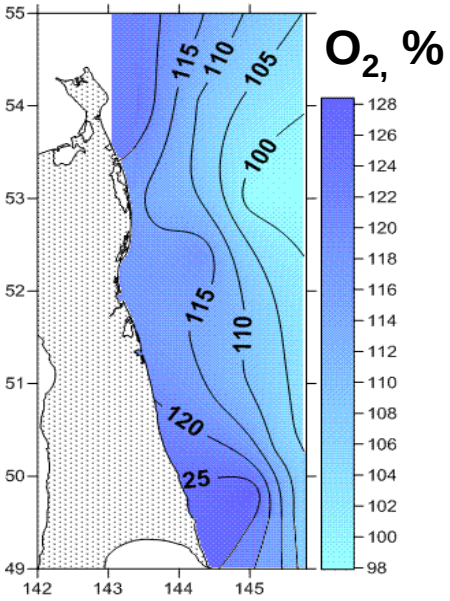
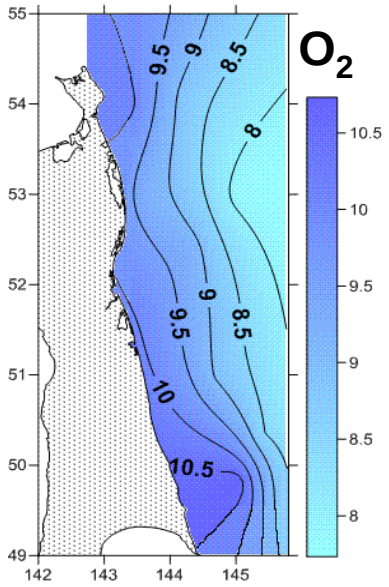
10
11
12

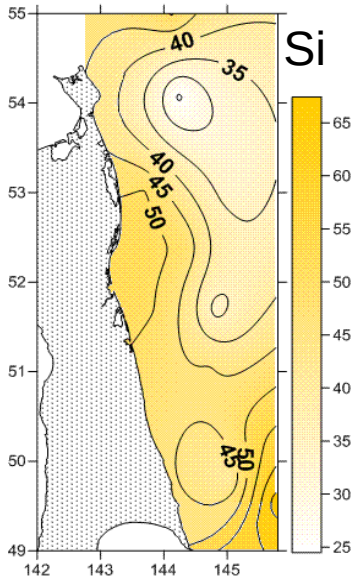


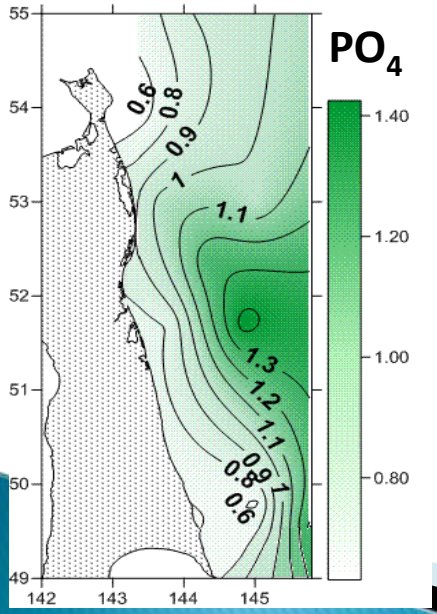


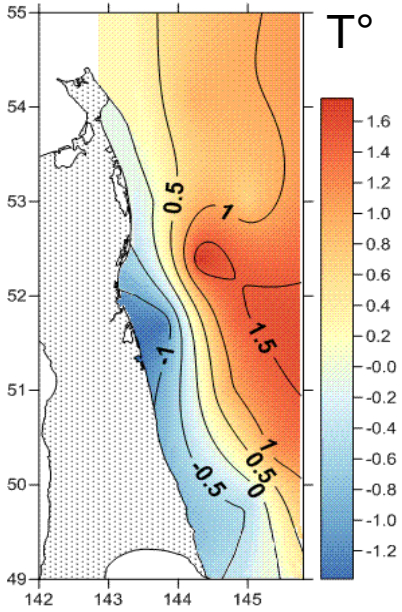
Hydrochemical parameters at the north-eastern shelf of Sakhalin Island in May, 2011

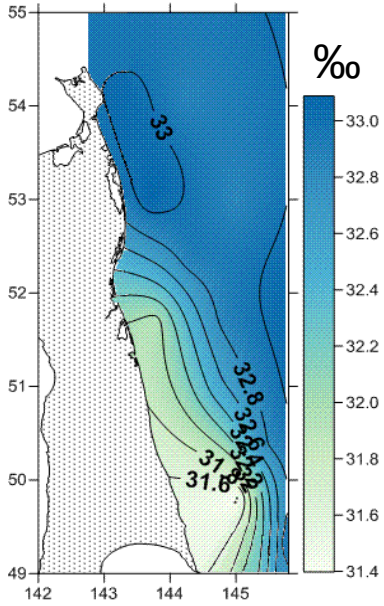




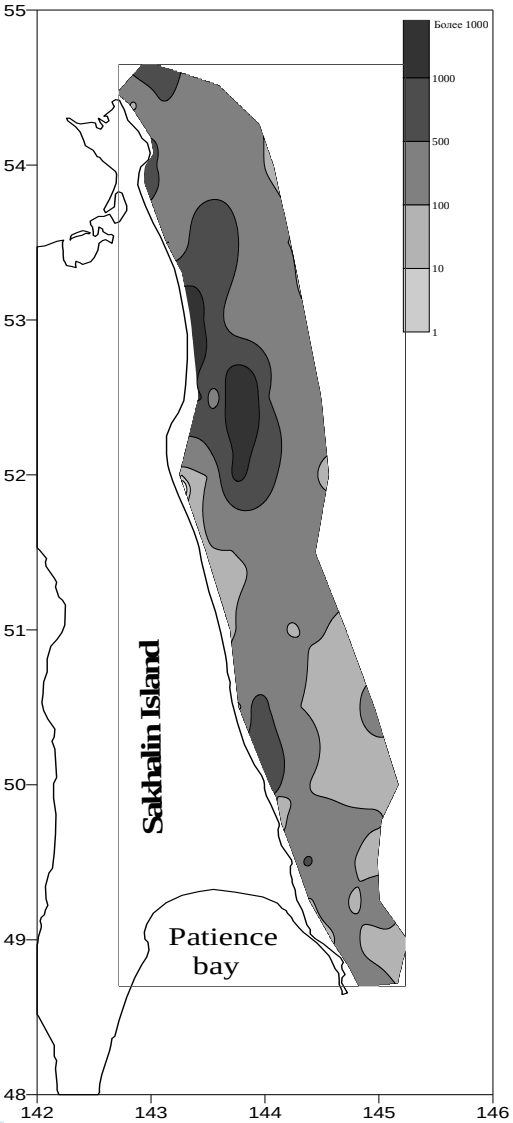




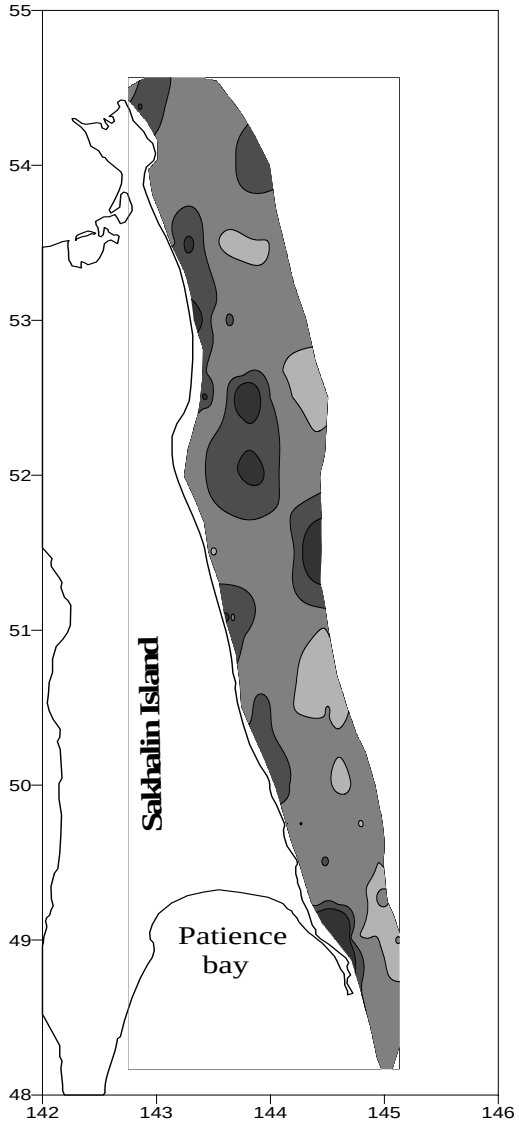




Total benthos biomass (g/m²)

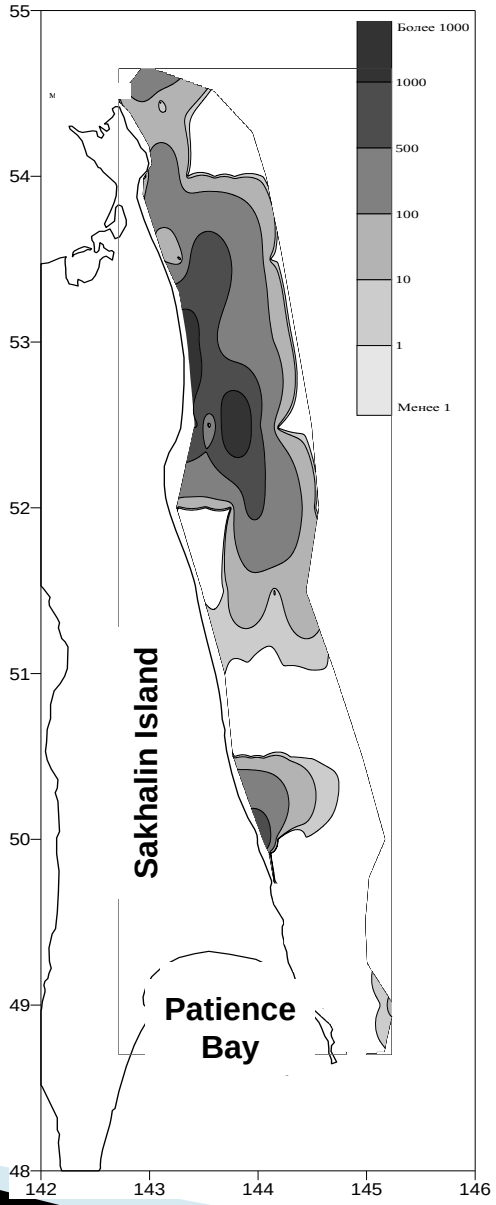


August, 1977

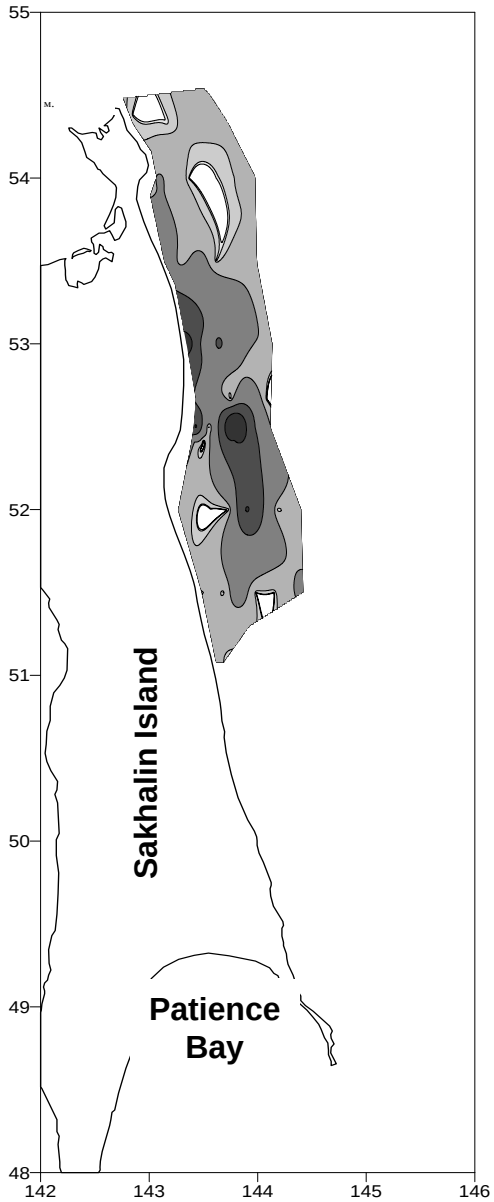


July, 2002

Total biomass of Echinoidea (g/m²)

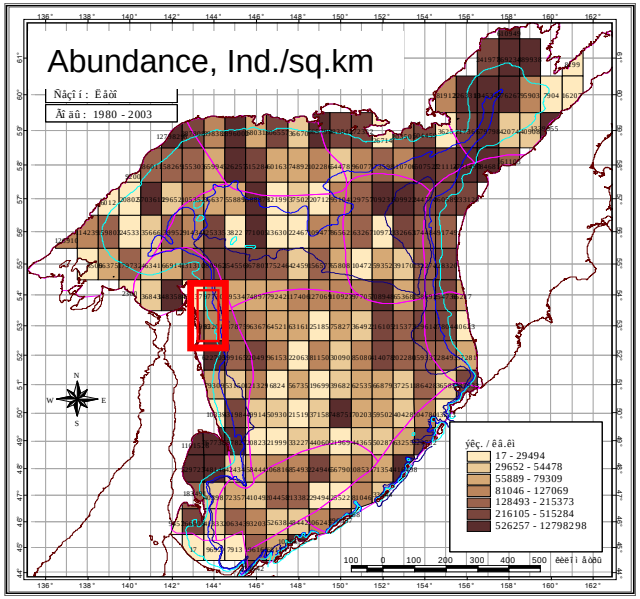


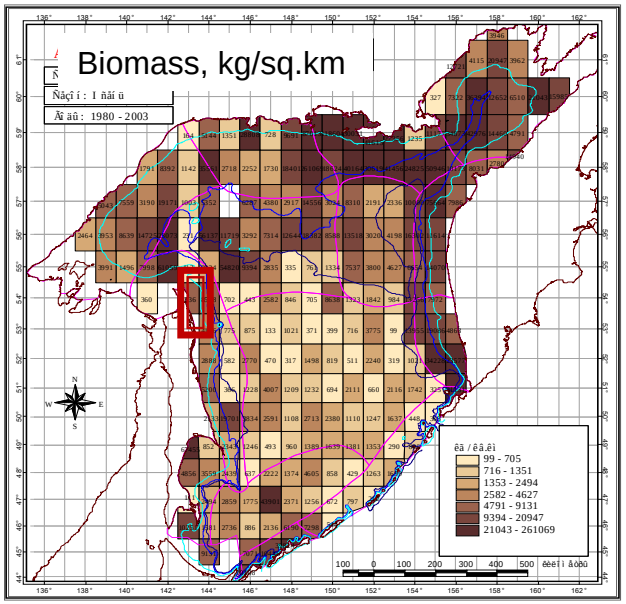
1977

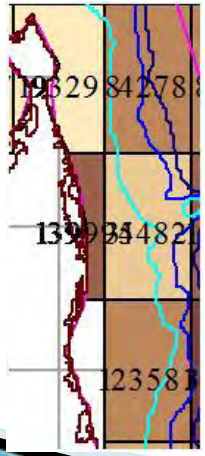


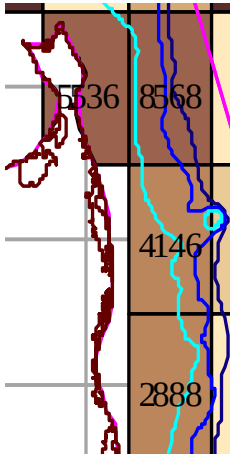
2002

Necton in Okhotsk Sea , 1980-2003

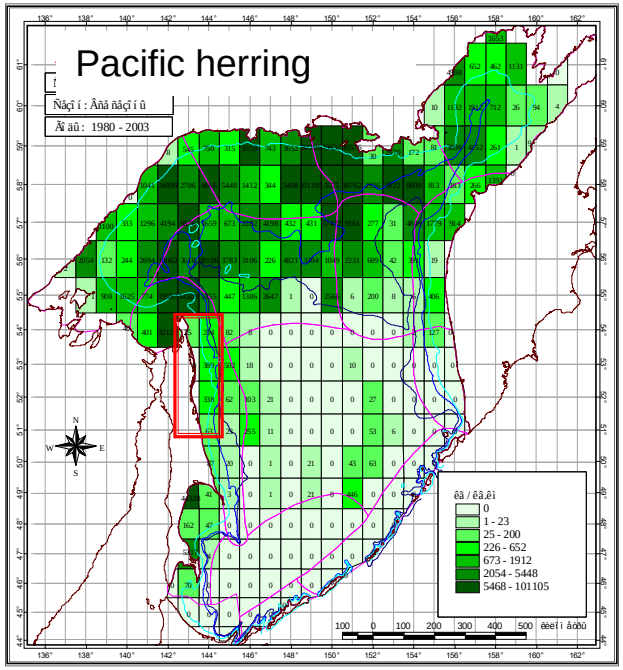


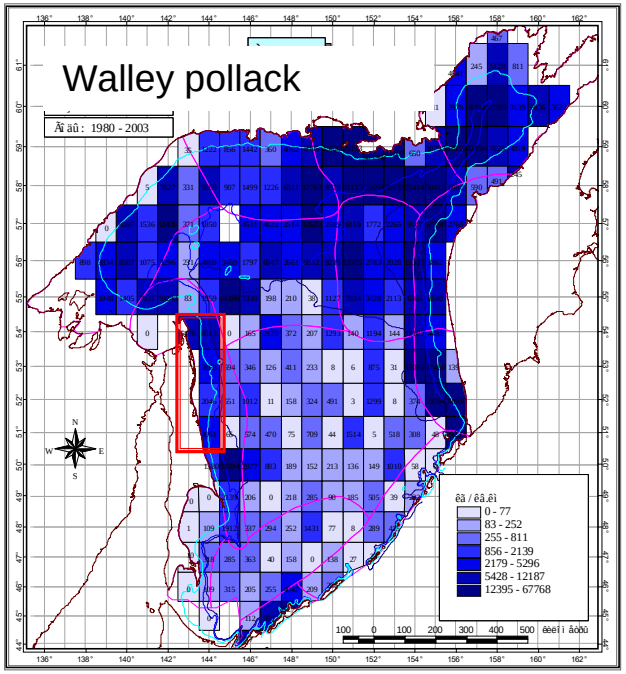


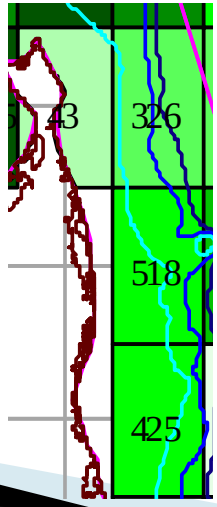


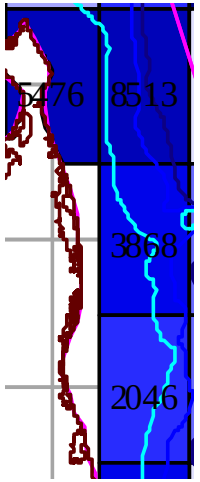


Biomass of commercial fish in Okhotsk Sea (kg/sq.km)







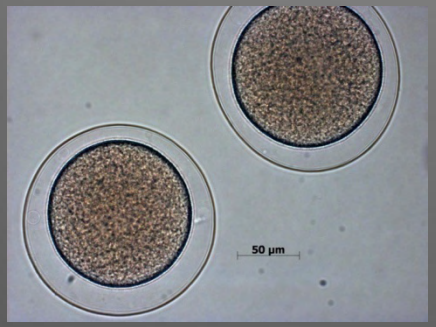


Bioassay

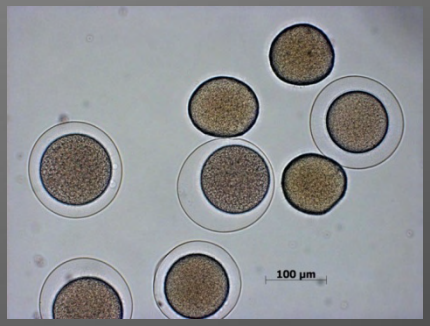
Embryos and larvae of sea urchins (Strongylocentrotus nudus, S.intermedius, Scaphechinus mirabilis) are used for bioassay of sea water quality

Sea urchin eggs fertilization membrane formation

Normal



Exposure



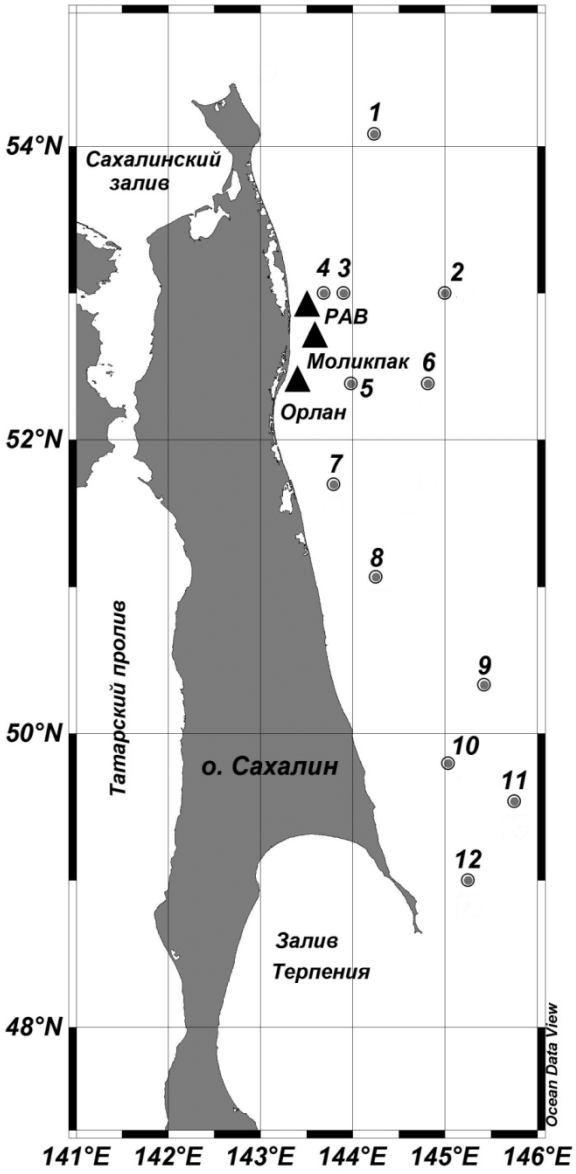
The advantages of sea urchin embryos for bioassay :

- the possibility of getting of a large number of gametes
- synchronous embryogenesis
- simple methods of exposure
- simple methods of observation and recording
- the possibility of using of any sea urchin species due to their similar sensitivity to the toxic agents

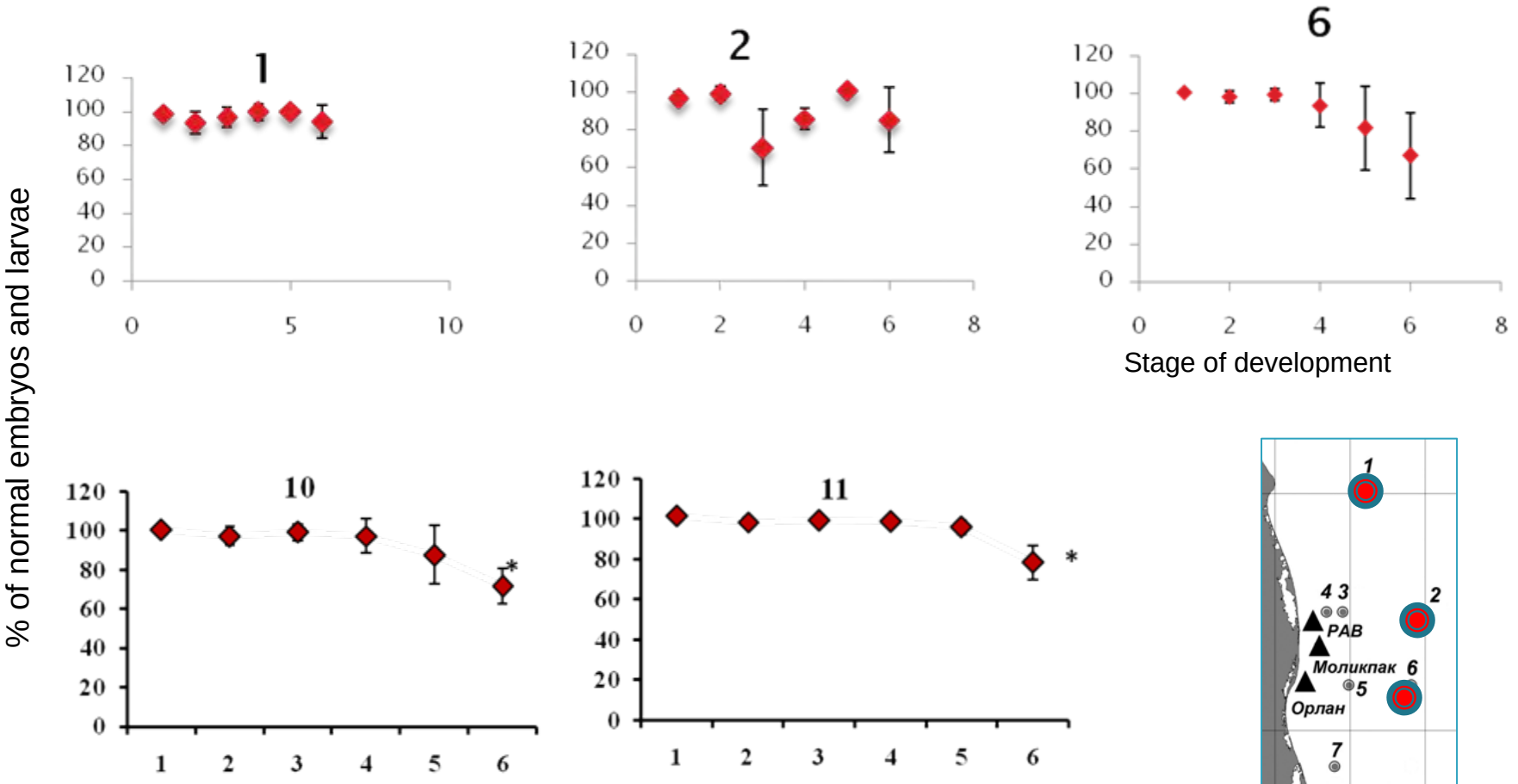
Procedure (Kobayashi, 1977, 1994)

- Get the mature eggs and sperms
- Fertilization in testing sea water
- Survey the early development during 48-96 hours

Map of sampling sites of sea water collected at the north-eastern shelf of Sakhalin Island in May , 2011

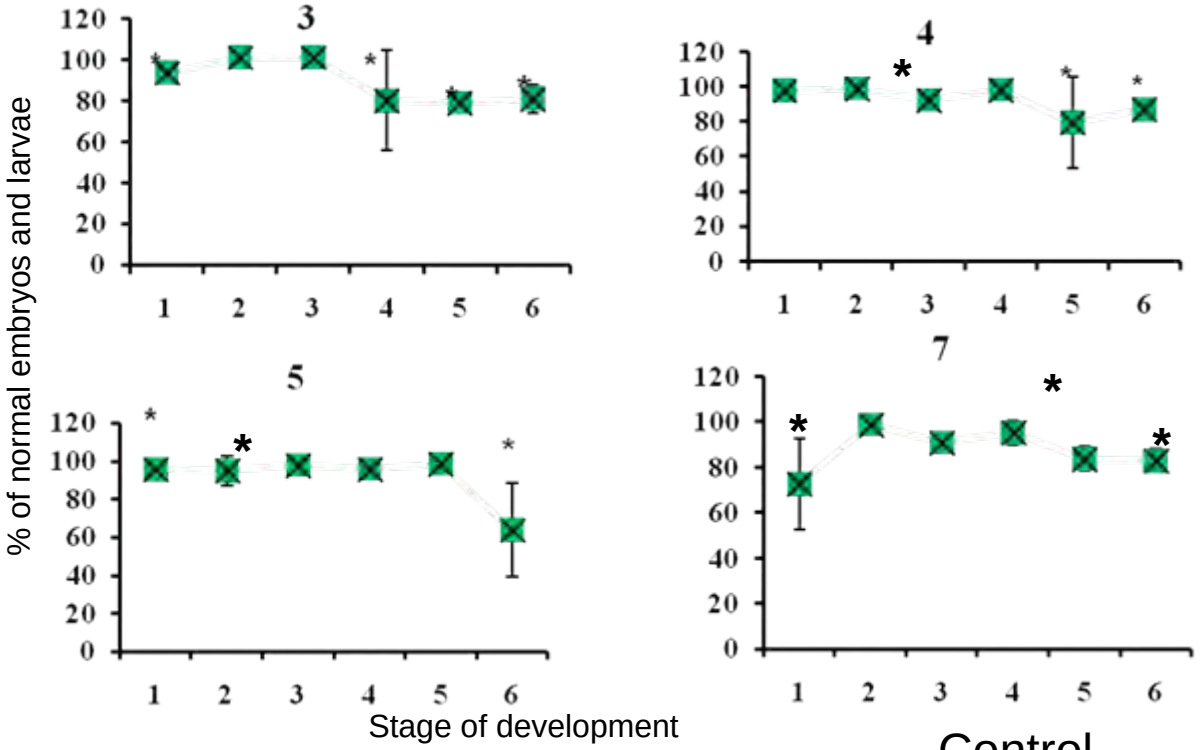


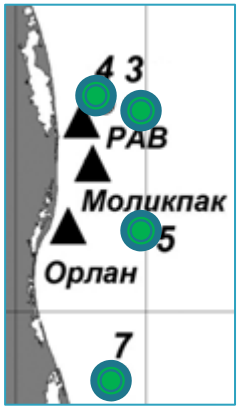
Amount of normal embryo and larvae (%) of sea urchin S. mirabilis developing in sea water from the off shore stations at the north-eastern Sakhalin shelf



1 – Fertilization membrane formation
2 – First cleavage
3 – Blastula formation
4 – Gastrulation
5 – 2-armed pluteus
6 – 4-armed pluteus

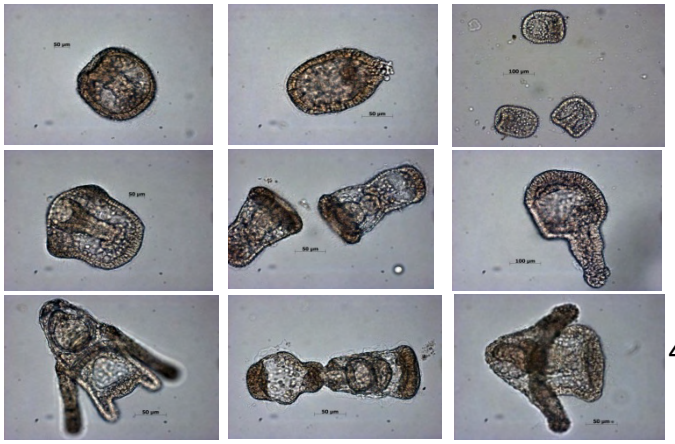
Amount of normal embryo and larvae (%) of sea urchin S. mirabilis developing in sea water collected at the stations near oil platforms on the north-eastern Sakhalin shelf





Types of abnormalities:
- Asynchronous development
- Retardation of development
- Different malformations

Control Abnormalities

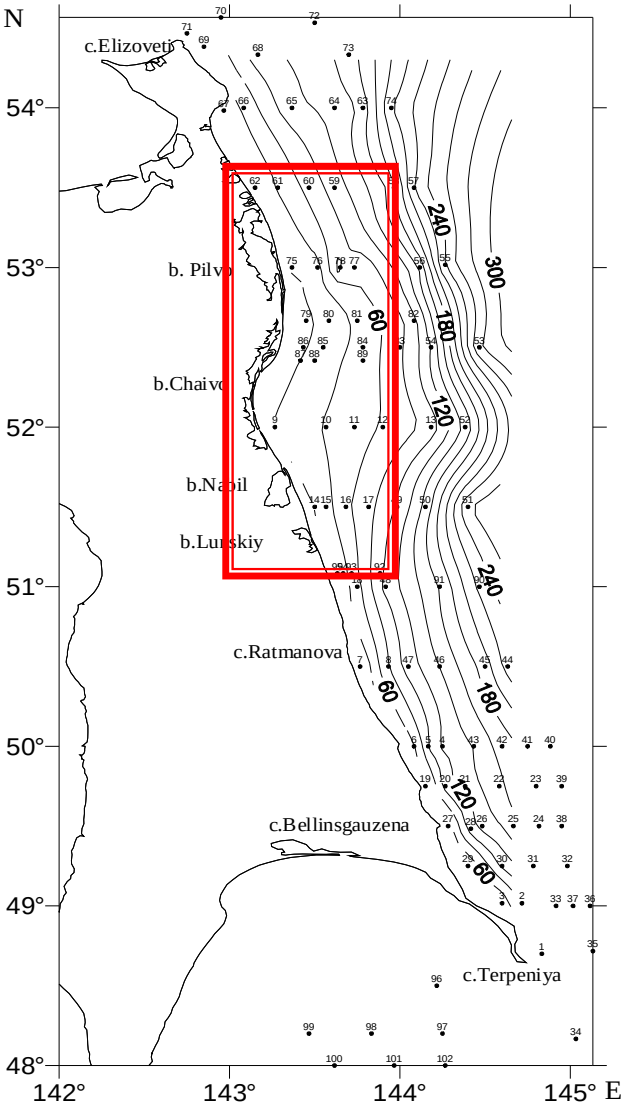


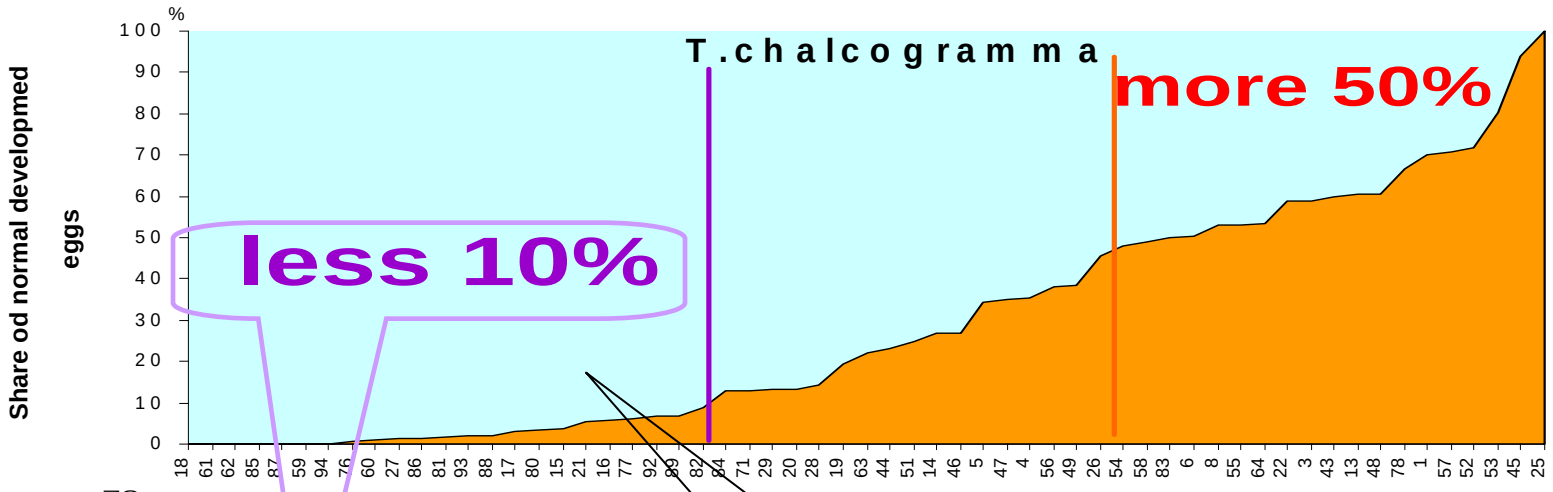
Gastrula

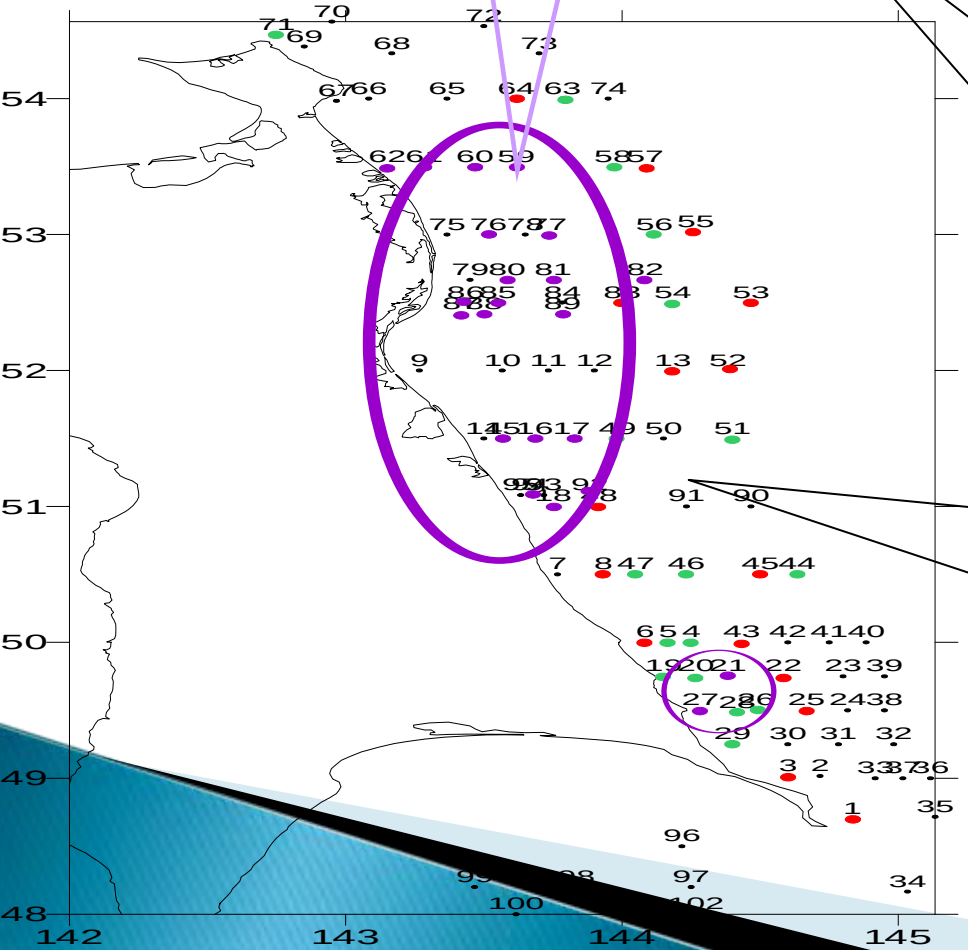
2-armed pluteus

4-armed pluteus

Sampling of fish eggs along the northern-eastern shelf of Sakhalin Island, June, 2002

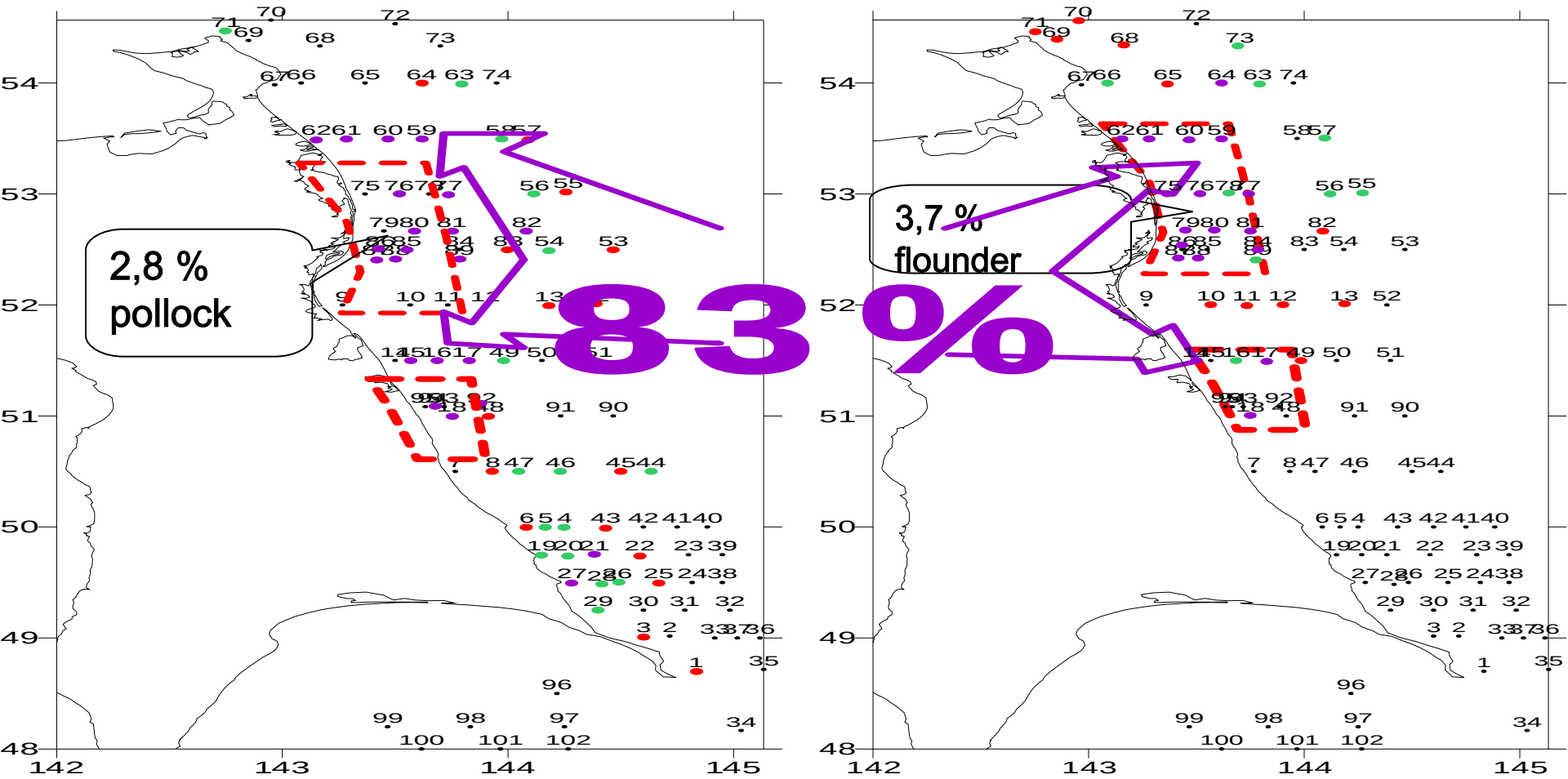






Every catch of **indicator species** was sorted to increase of share of normally developing eggs (without division on the different stages). Then we separated stations where this parameter was less than 10 % and called them -**unfavorable stations**

All data were put on the scheme of stations. Comparison of proportion eggs both species on the different stages along of shelf indicated that samples contained only 50 % (and less) live individuals were presented by eggs on first stages basically.



Then unfavorable stations were marked by outline. This “anomalous zones” were compared for number identical stations. As a result, 83% number of anomaly stations with share of dead eggs more 90% was similar for both species. Such high similarity of areas with high share of dead eggs yellow-fin sole and pollock can testify about common factors causing egg’s mortality. The share of normally developing eggs in “anomalous zones” was 2,8 % (for pollock) and 3,7 % (for flounder), although for all water area this parameter was higher in 10 times. We marked that samples with maximum number of "dead" eggs of both species were coincided with oil and gas deposits on the north and northeast shelf









Photo: Tiunov, Blokhin, 2011

Conclusion

- Various natural and anthropogenic stress factors interact at the off-shore of north-eastern Sakhalin Island.
- Oil and other stress factors affect the different species of marine organisms, as well off-shore as shore line .
- Eggs, embryos and larvae of marine fish and echinoderms may be used as bioindicators of early disturbances due to multiple stressors interaction in vulnerable ecosystems.