Bioindicators of marine pollution in impact areas of the Sea of Okhotsk

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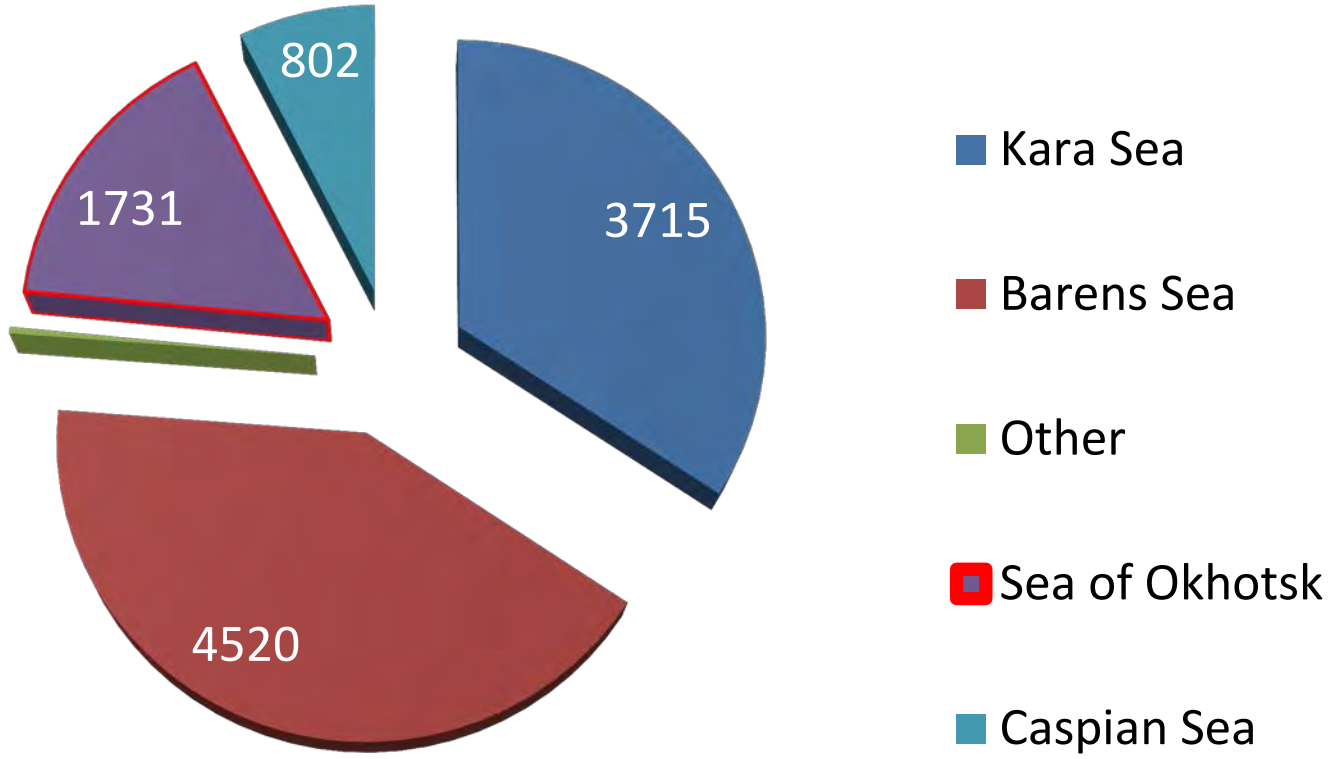
Oil & gas deposits on the continental shelf of RF



The main areas of oil & gas deposits in the Sea of Okhotsk

1 – North-Eastern Sakhalin shelf 2 – Western Kamchatka shelf 3 – Magadan shelf

Spatial distribution of trawl stations of TINRO-centre in the Sea of Okhotsk in 1977- 2014

The main fish products:
Walley Pollock,
flounders,
herring,
capelin,
halibut,
crab.

Biological resources of the Sea of Okhotsk

The Okhotsk Sea is regarded as the richest fishery region in the World Ocean

54,6 million t - total biomass of bottom and pelagic macrofauna

38,4 million t – total biomass of pelagic and bottom fish and cephalopods

11 million t - total volume of biological resources

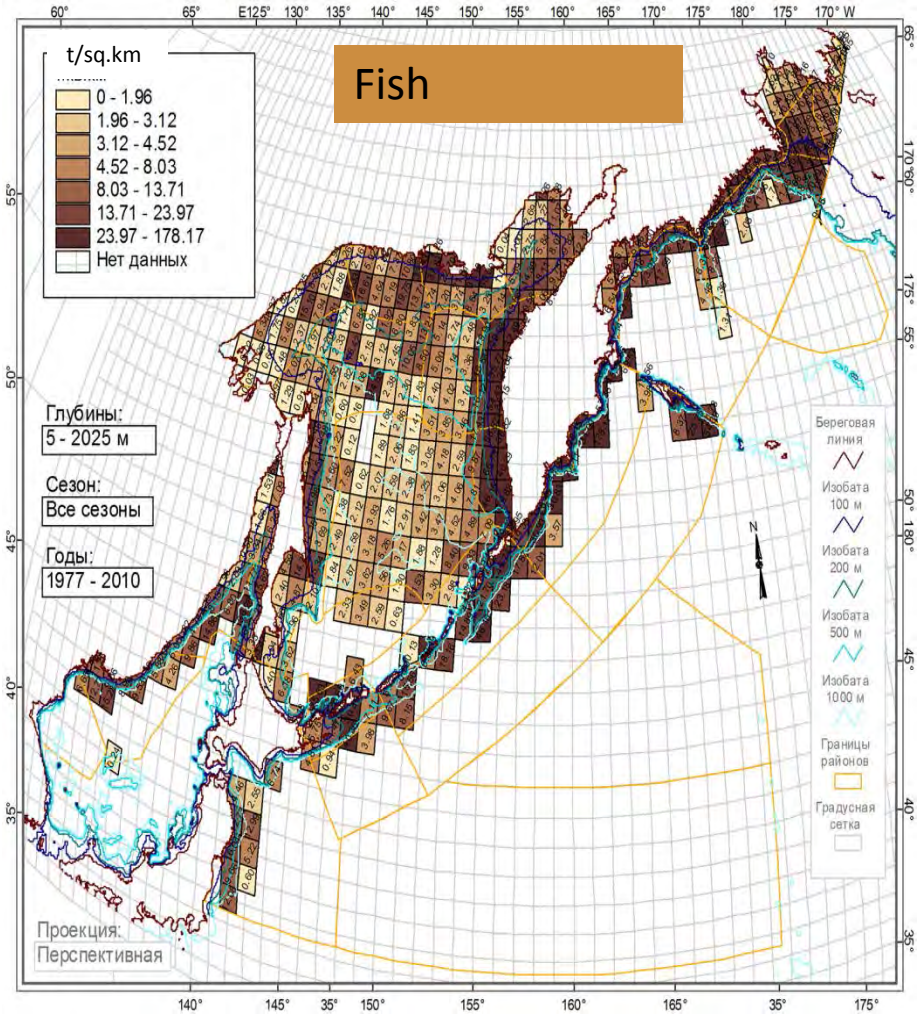
7 million t of cod

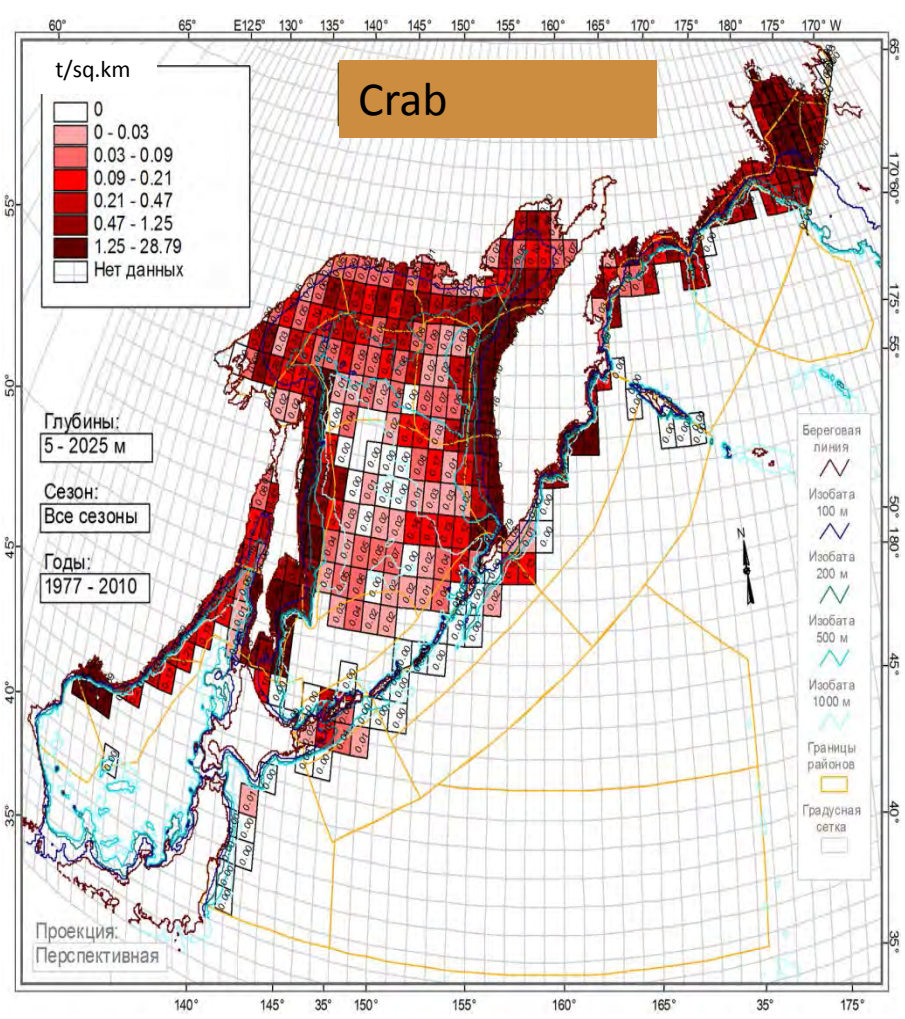
2.5 million t of herring

1.5 million t of other seafood (e.g. molluscs and algae)

(Shuntov, 2001;
Shuntov, Volvenko, 2015)

Spatial distribution of fish and crabs in the Sea of Okhotsk





(Shuntov, Volvenko, 2015)

Goals

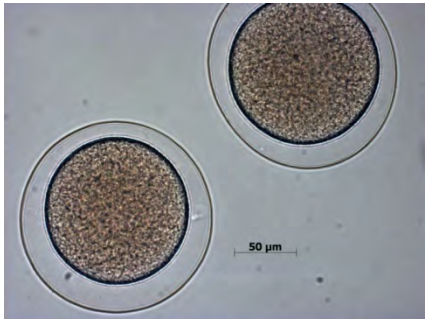
- To evaluate the marine environmental quality in impact areas of the Sea of Okhotsk using bioindicators
- To use the early embriogenesis of sea urchin *Scaphechinus mirabilis* as bioindicator of oil pollution on the nothern-eastern shelf of Sakhalin Island and western Kamchatka shelf

Embryos and larvae of sea urchins as Bioindicators

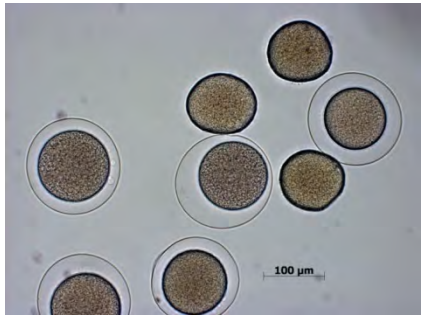
Embryos and larvae of sea urchins (Strongylocentrotus nudus, S.intermedius, Scaphechinus mirabilis) are used as bioindicators of sea water quality

Sea urchin eggs fertilization membrane formation

Normal



Exposure



The advantages of sea urchin embryos as bioindicator:

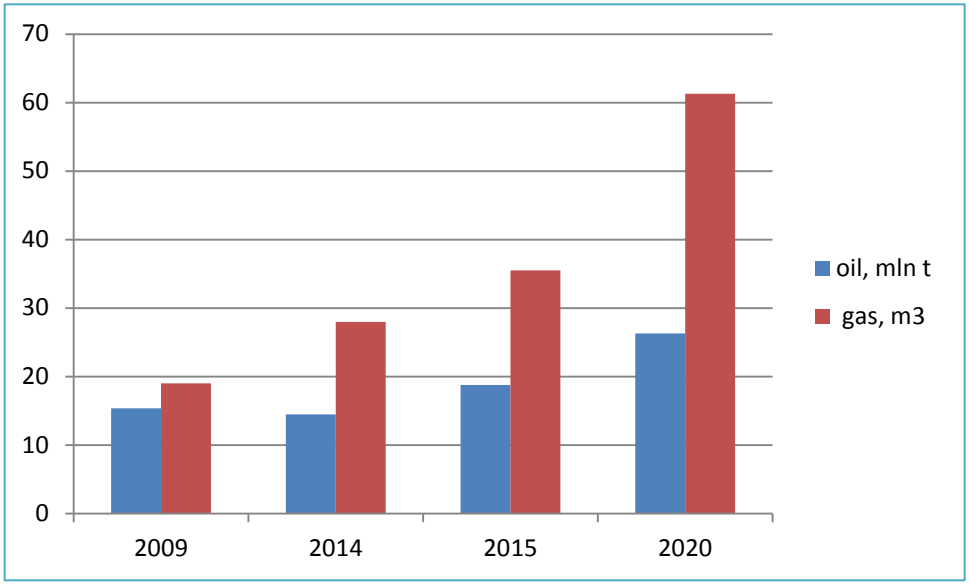
- the possibility of getting of a large number of gametes
- synchronous embryogenesis
- simple methods of exposure
- simple methods of observation and recording
- the possibility of using of any sea urchin species due to their similar sensitivity to the toxic agents

Procedure (Kobayashi, 1977, 1994)

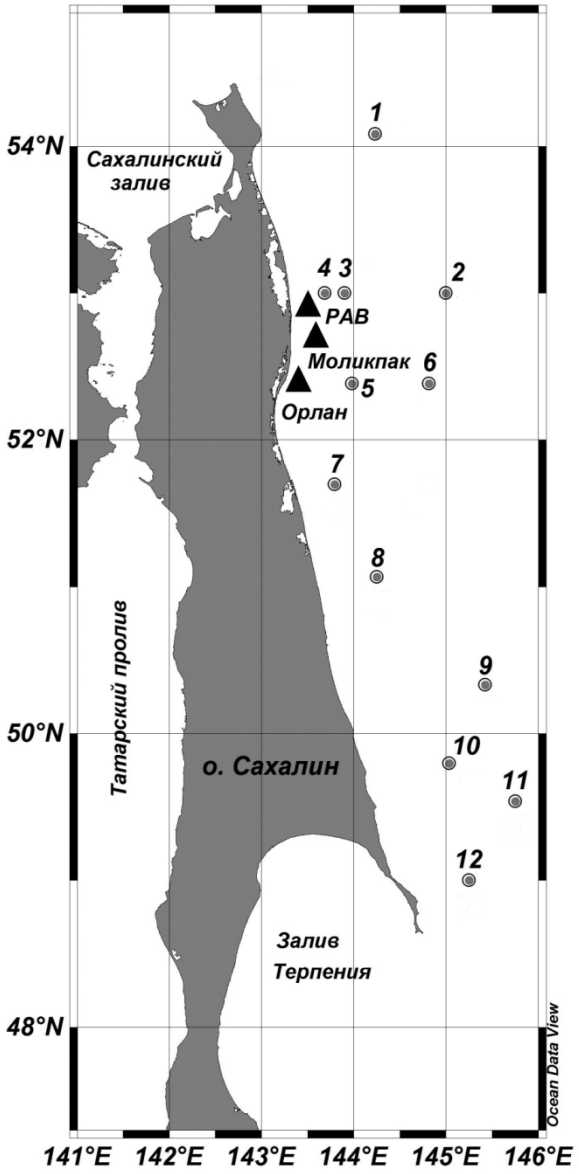
- Get the mature eggs and sperms
- Fertilization in testing sea water
- Survey the early development during 48-96 hours

Northern-Eastern Sakhalin Island shelf

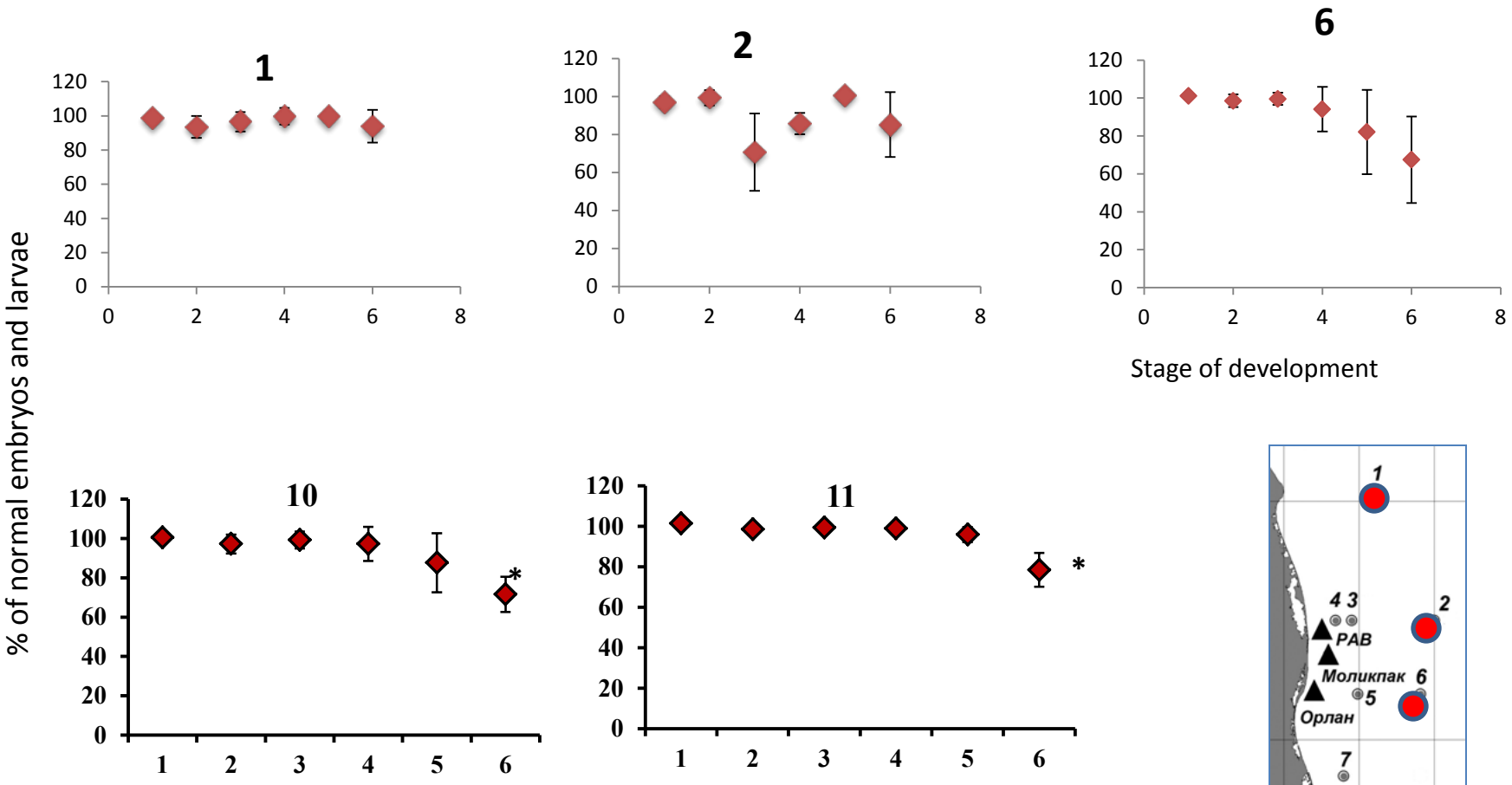
Oil & gas drilling on Sakhalin shelf



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

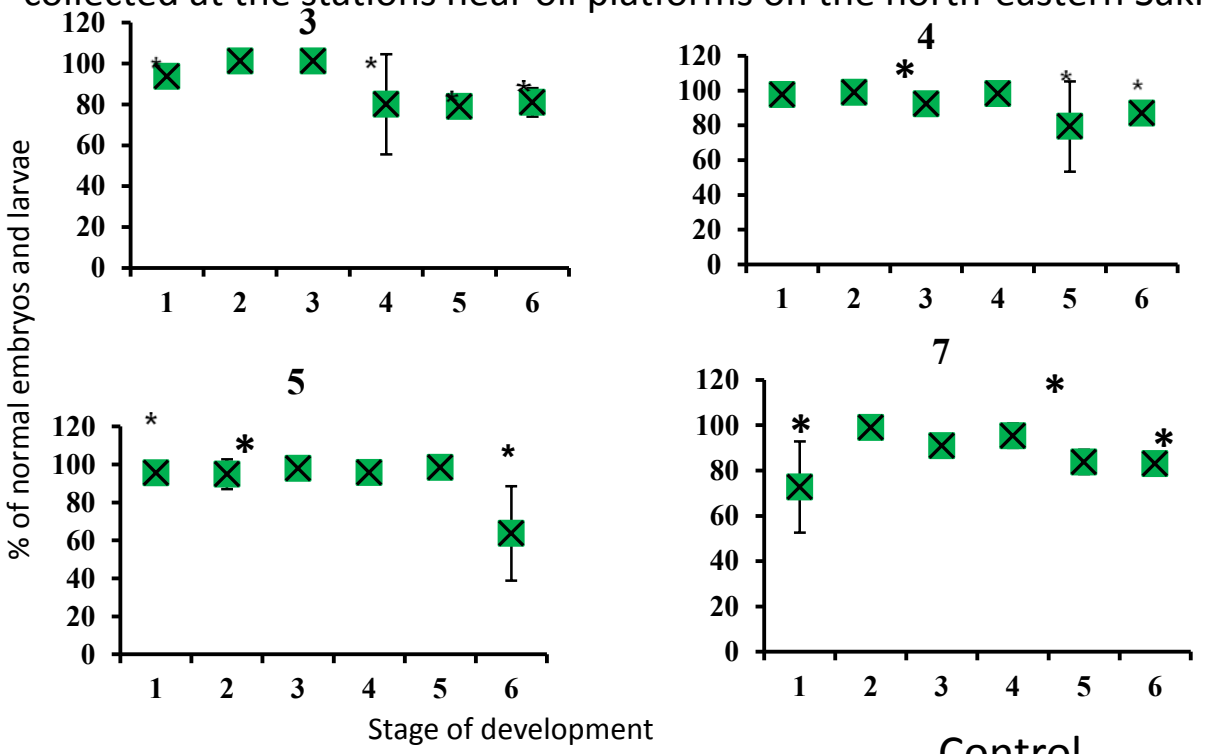


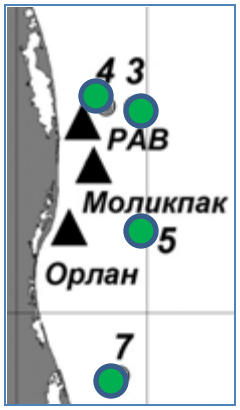
Amount of normal embryo and larvae (%) of sea urchin S. mirabilis developing in sea water from the off shore stations at the north-eastern Sakhalin shelf



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

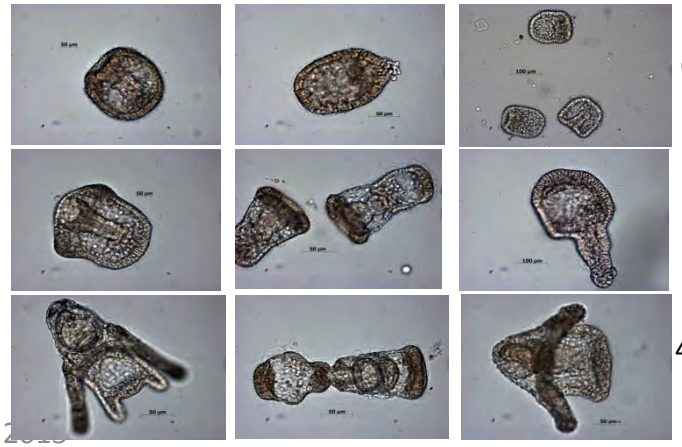




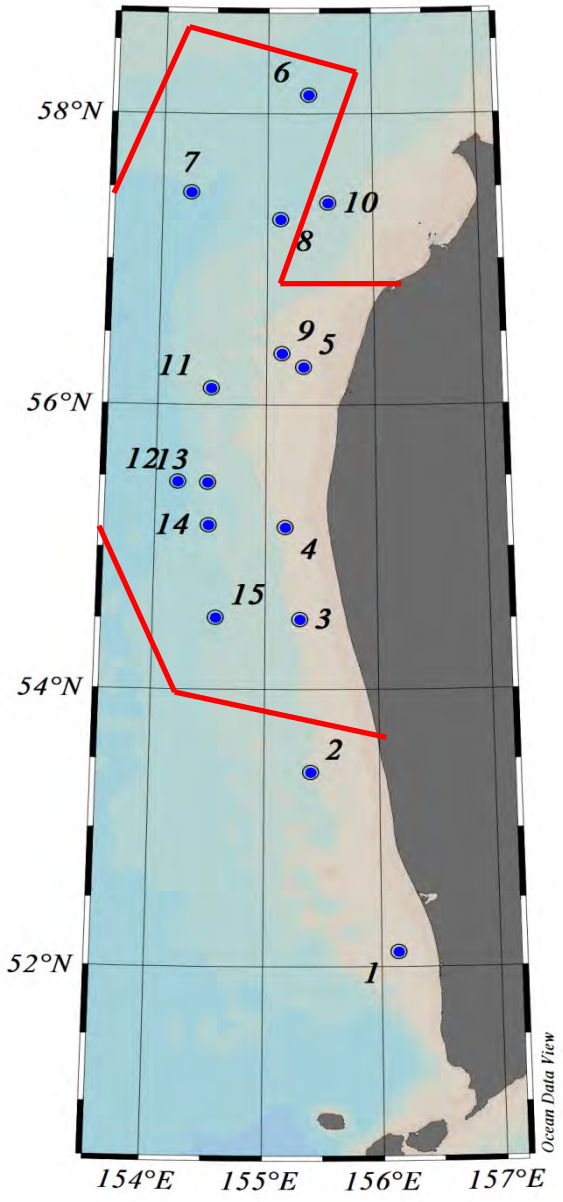
Types of abnormalities:
- Asynchronous development
- Retardation of development
- Different malformations

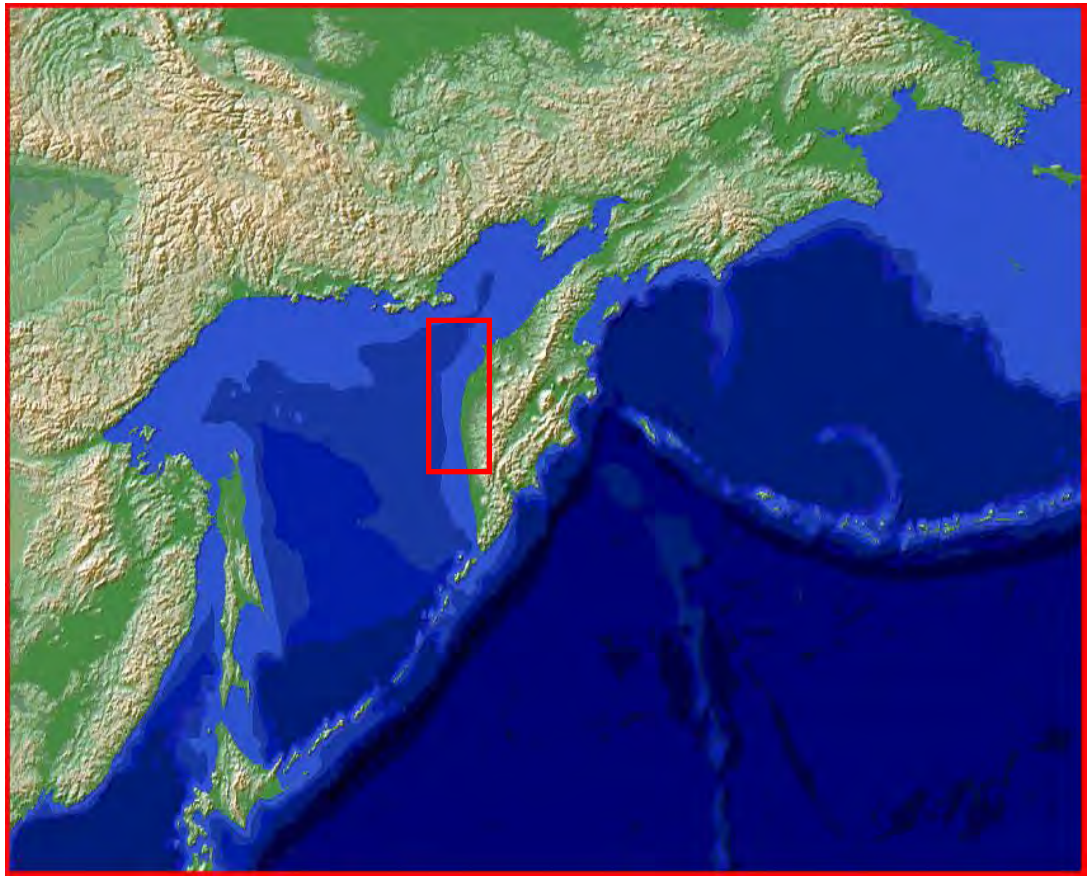
Number of abnormalities to 36 %.

Control Abnormalities

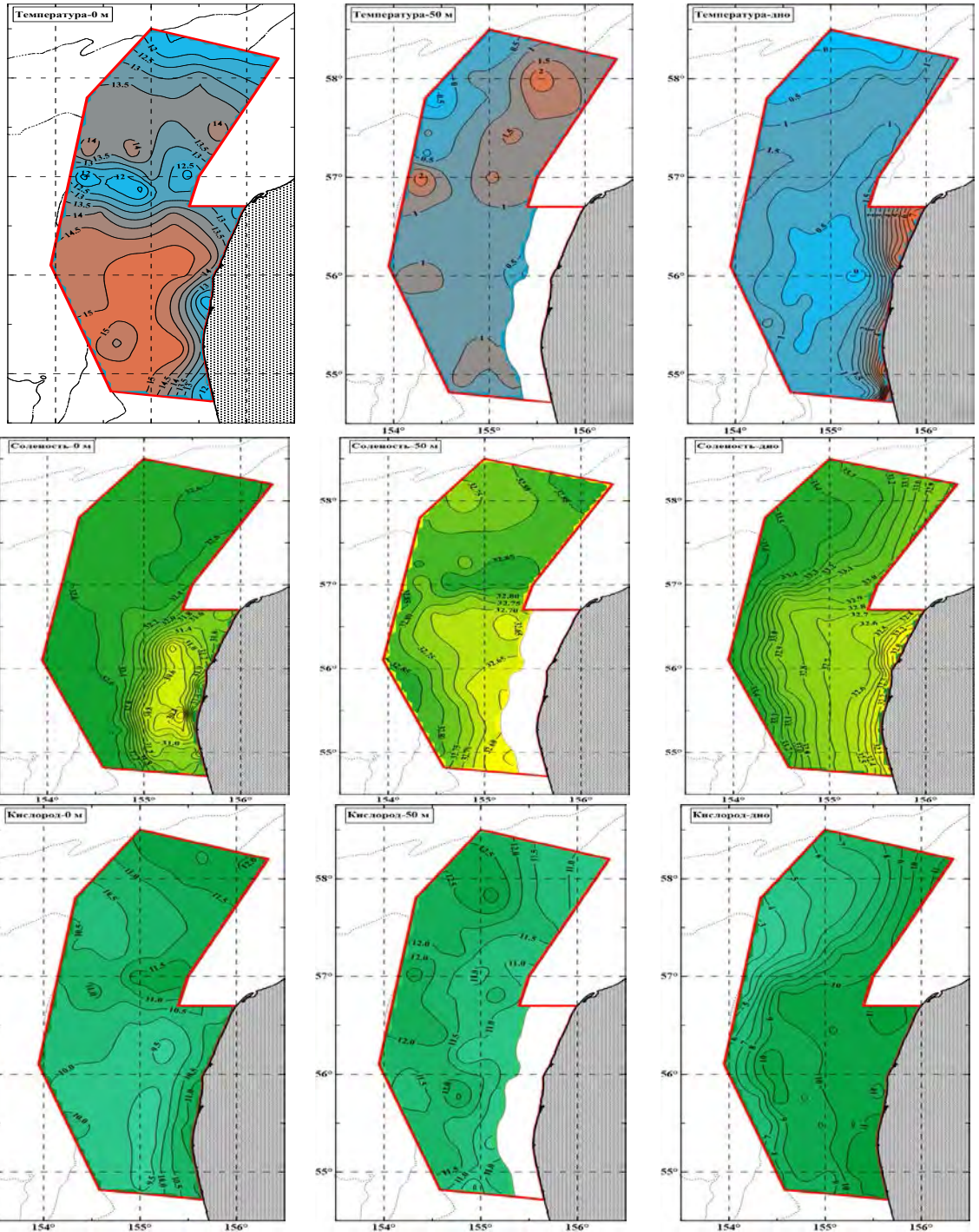


Map of sampling sites on Western Kamchatka , July-August, 2014



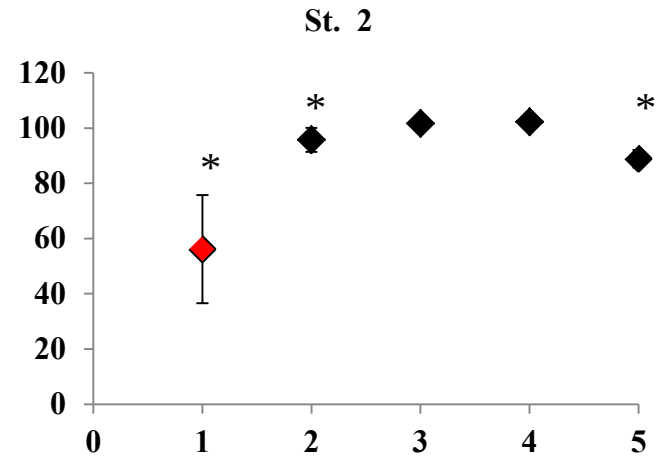


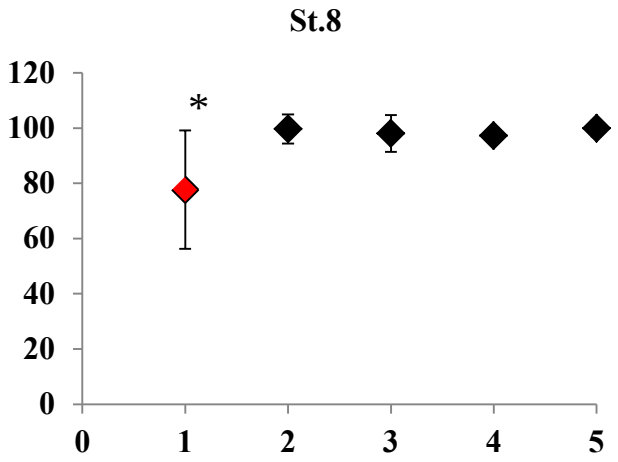
Gazprom license area

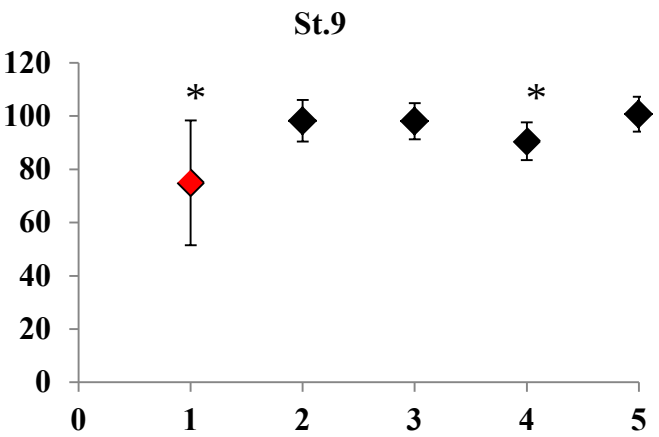


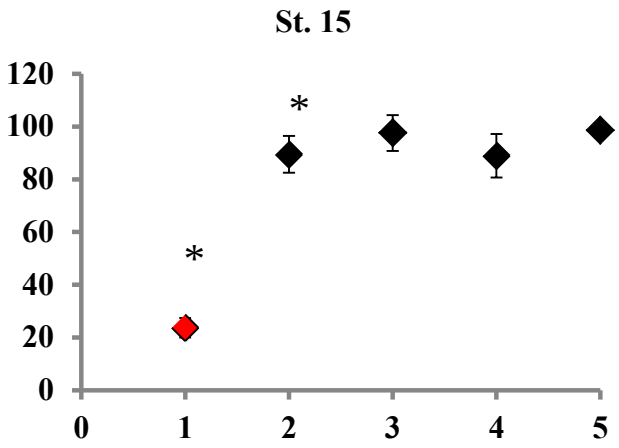
Temperature, Salinity and Oxygen concentration in sea water on the Western Kamchatka shelf in July,2014

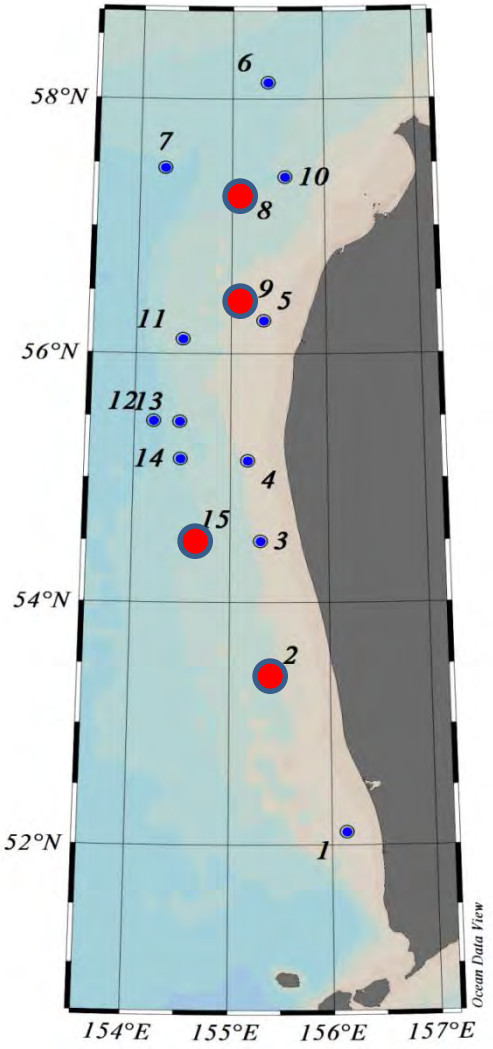
Amount of normal embryo and larvae (%) of sea urchin S. mirabilis developing in sea water collected along the western Kamchatka shelf -1





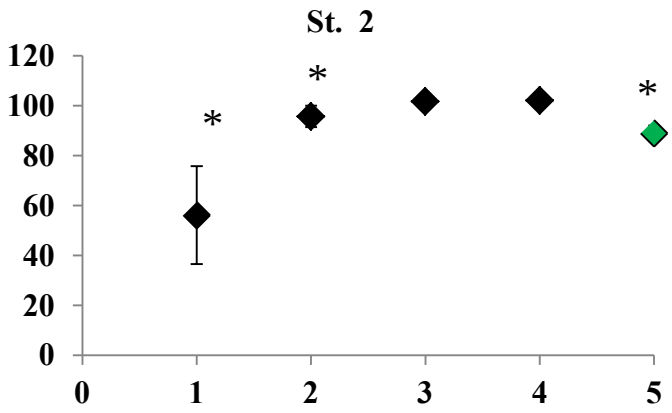


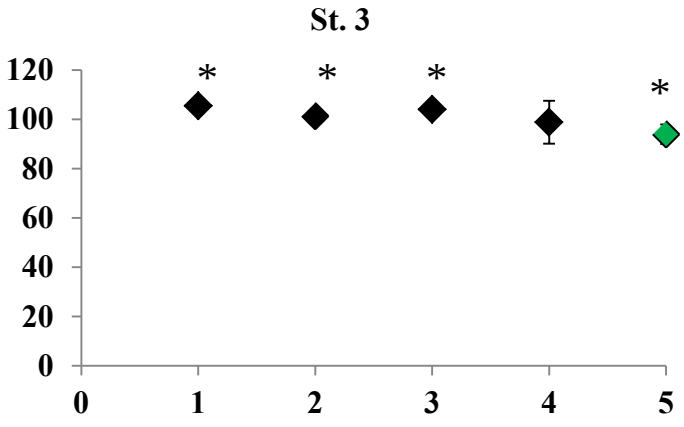


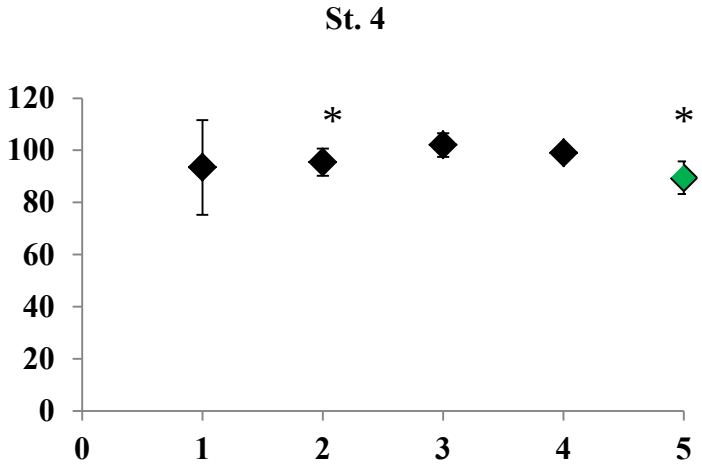


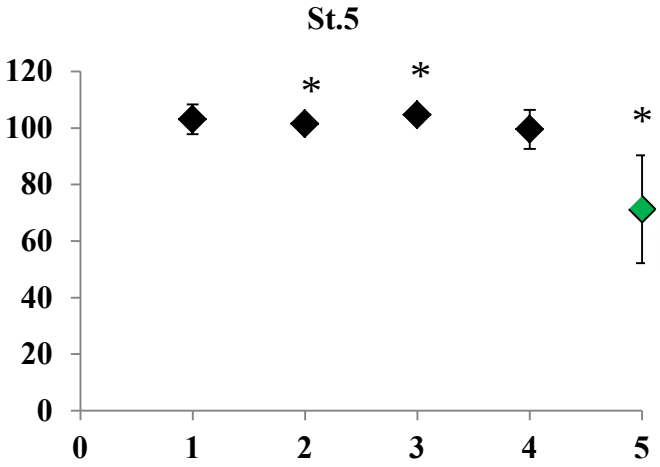
1 – Fertilization membrane formation
2 – First cleavage
3 – Blastula formation
4 – Gastrulation
5 – 2-armed pluteus

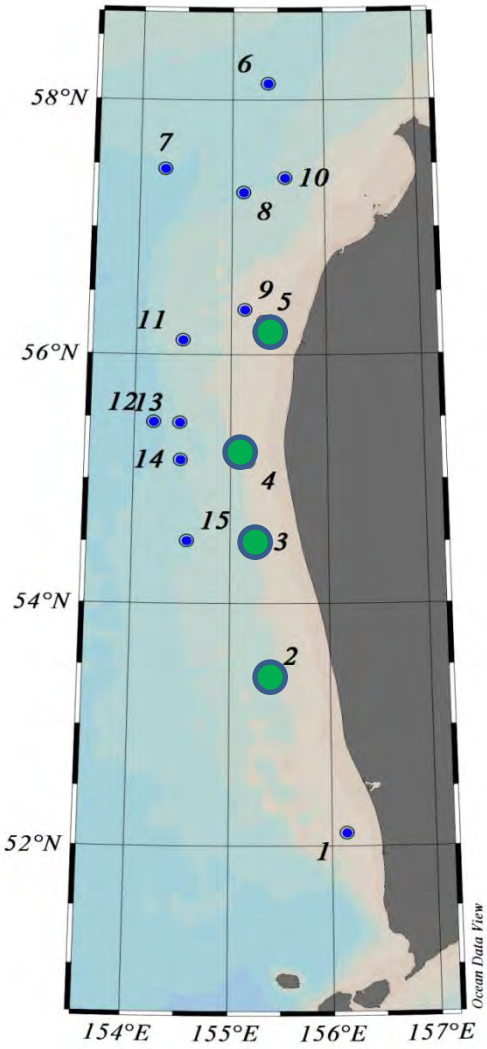
Amount of normal embryo and larvae (%) of sea urchin S. mirabilis developing in sea water collected along the western Kamchatka shelf - 2











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

Number (%) of sea urchin embryogenesis abnormalies in sea water from the north-eastern shelf of Sakhalin Island and western Kamchatka shelf

Conclusion

- Embryos and larvae of sea urchins are suitable and sensitive indicators of marine pollution in the areas of oil and gas exploration.
- Toxic effect of sea water on sea urchin embryogenesis near oil drilling platforms on the north-eastern shelf of Sakhalin Island was determined.
- Toxicity of sea water on western Kamchatka shelf can be caused by the activity of fishing vessels and natural oil infiltration.
- Regular use of bioindicators in the impact areas allow to assess the situation with the increasing anthropogenic influence and predict the environmental impacts on biological resources and whole ecosystems.

Thank you for your attention!