Ecosystem change impacts interannual variability of the Bering Sea pollock seasonal migrations

Mikhail A. Stepanenko, Elena V. Gritsay

Pacific Research Fisheries Center (TINRO-Center), Schevchenko Alley, 4, Vladivostok, Russia, 690950
e-mail: stepanenko@tinro.ru, gritsay@tinro.ru

Spatial distribution of the Bering Sea pollock in feeding period potentially depends on:

- Pollock abundance and biomass;
- Pollock age composition;
- Water temperature;
- Zooplankton abundance and spatial distribution.

Fig. 1. Pollock different size group density distribution (th.fish/sq.km) in the northwestern Bering Sea,

August - October 2012-2014 (<18 cm and 18-28 cm)

2012 year 2013 year 2014 year

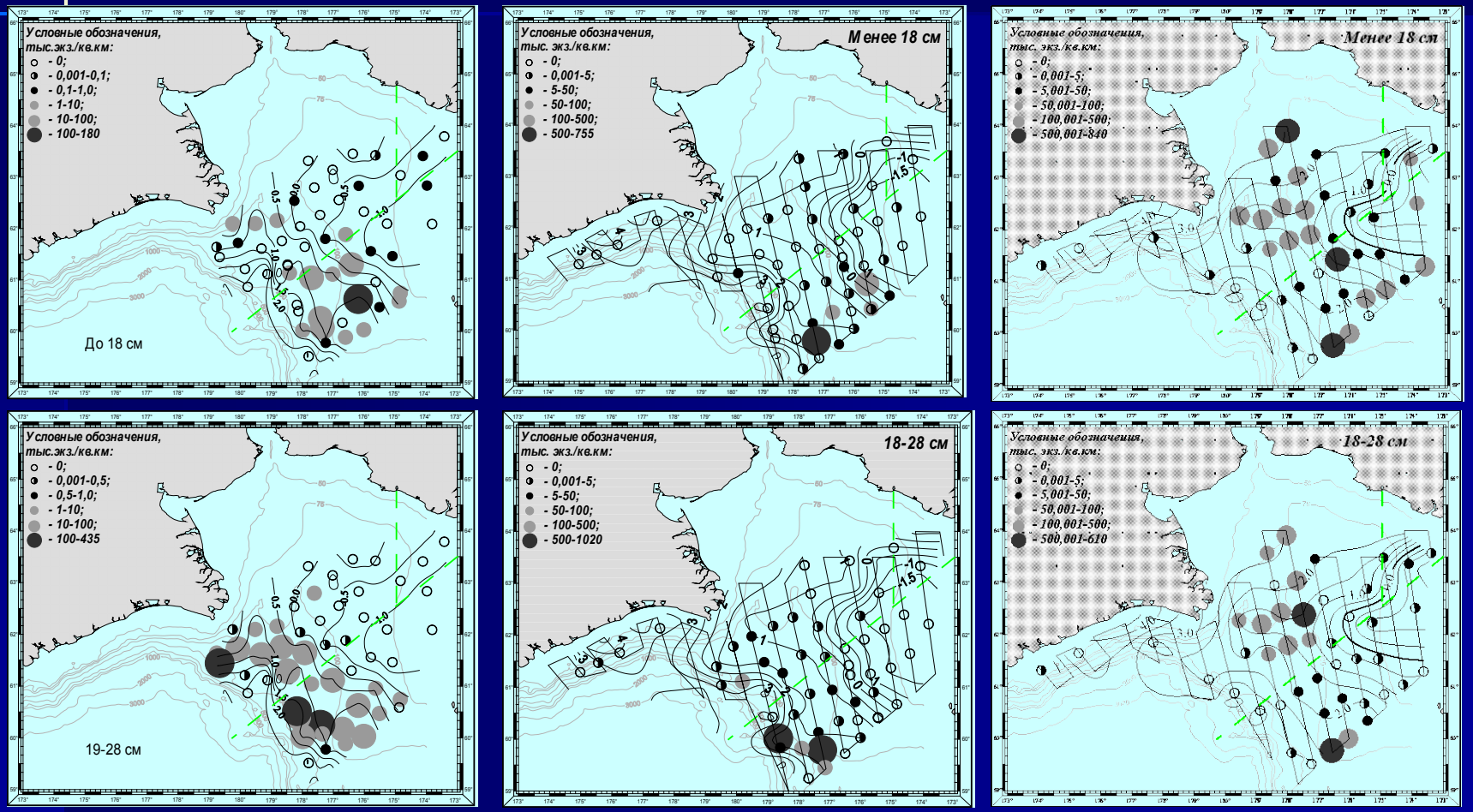


Fig. 1. Pollock different size group density distribution (th.fish/sq.km) in the northwestern Bering Sea,

August - October 2012-2014 (29-36 cm and 37-44 cm)

2012 year 2013 year 2014 year

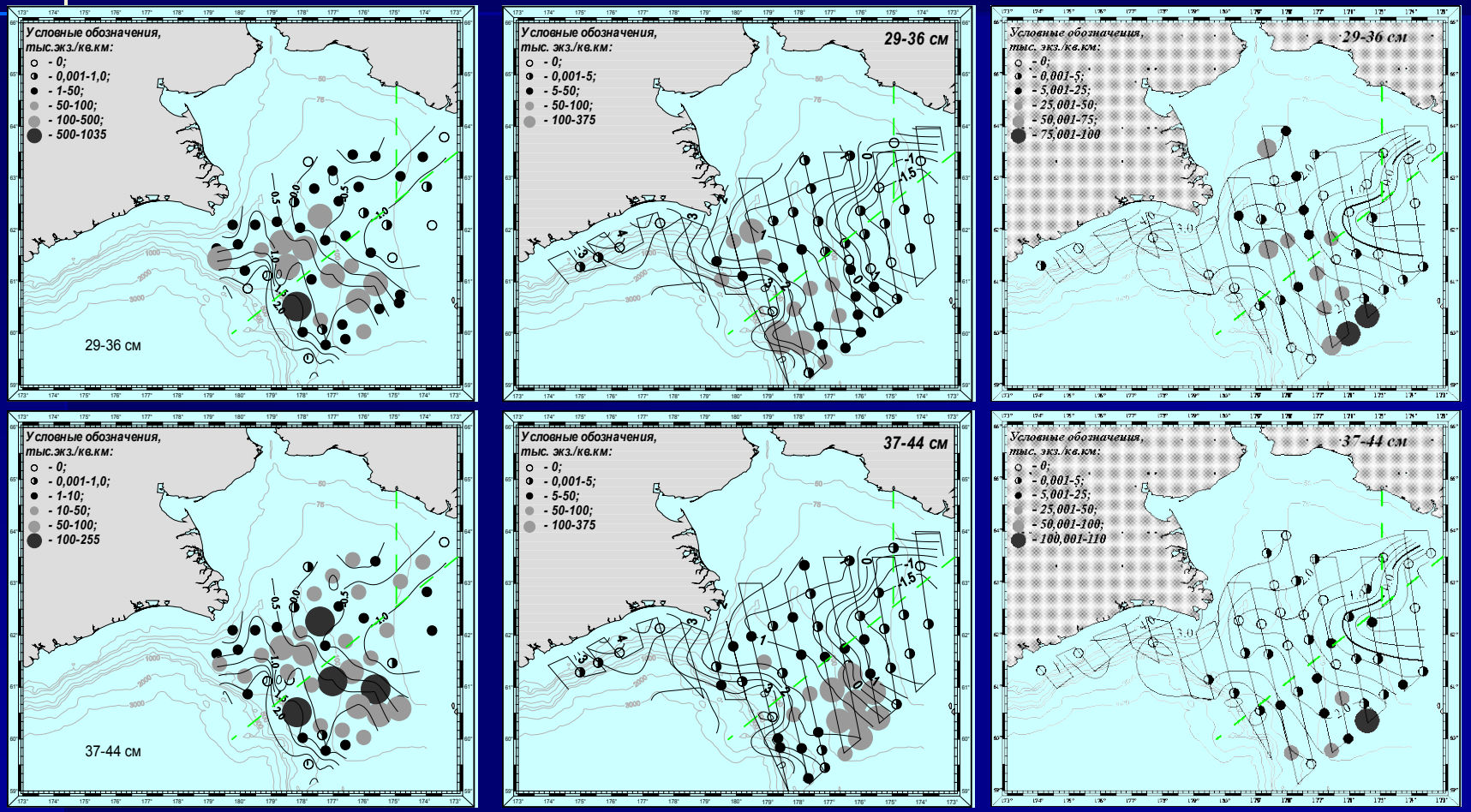


Fig. 1. Pollock different size group density distribution (th.fish/sq.km) in the northwestern Bering Sea,

August - October 2012-2014 (45-52 cm and 53-60 cm)

2012 year 2013 year 2014 year

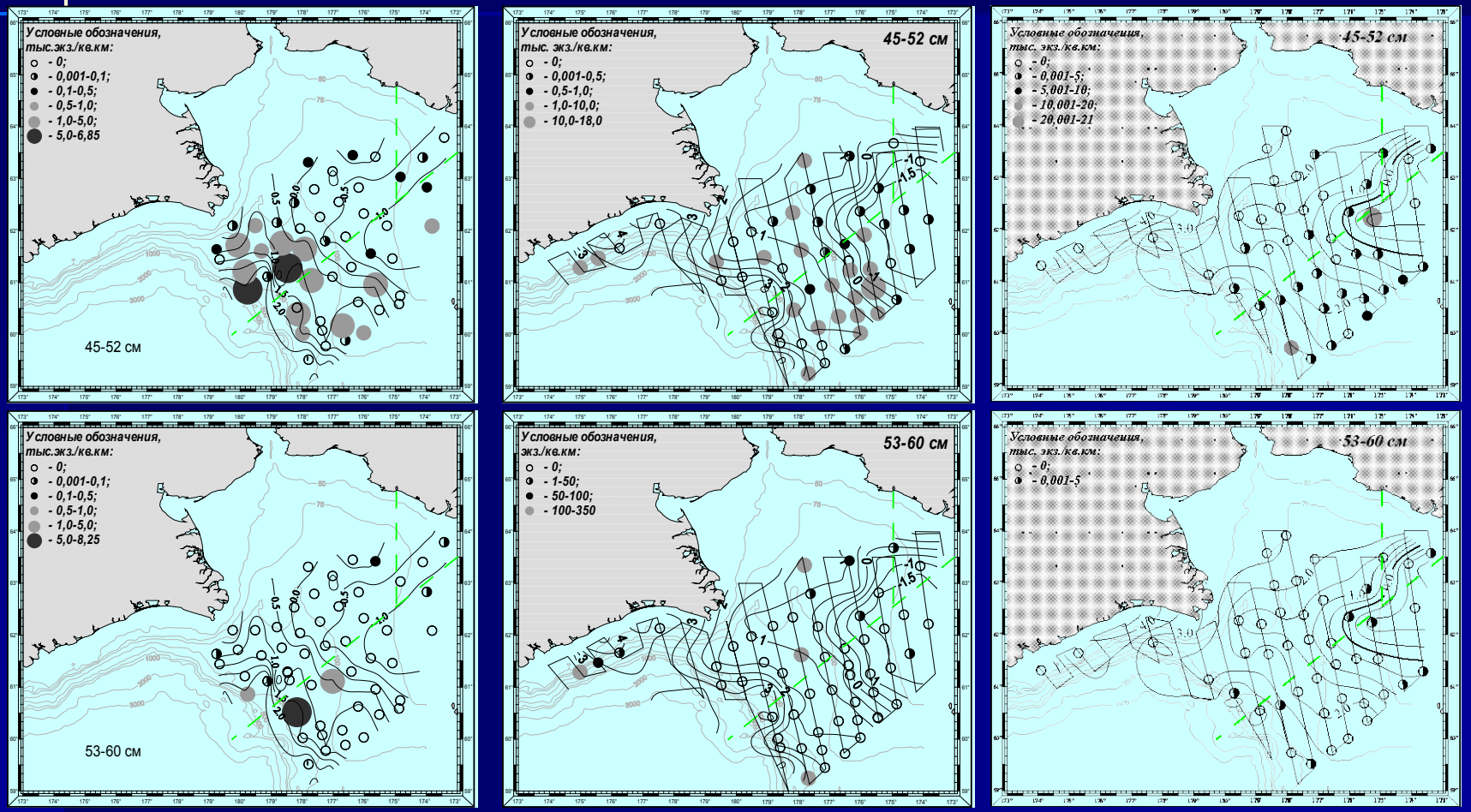
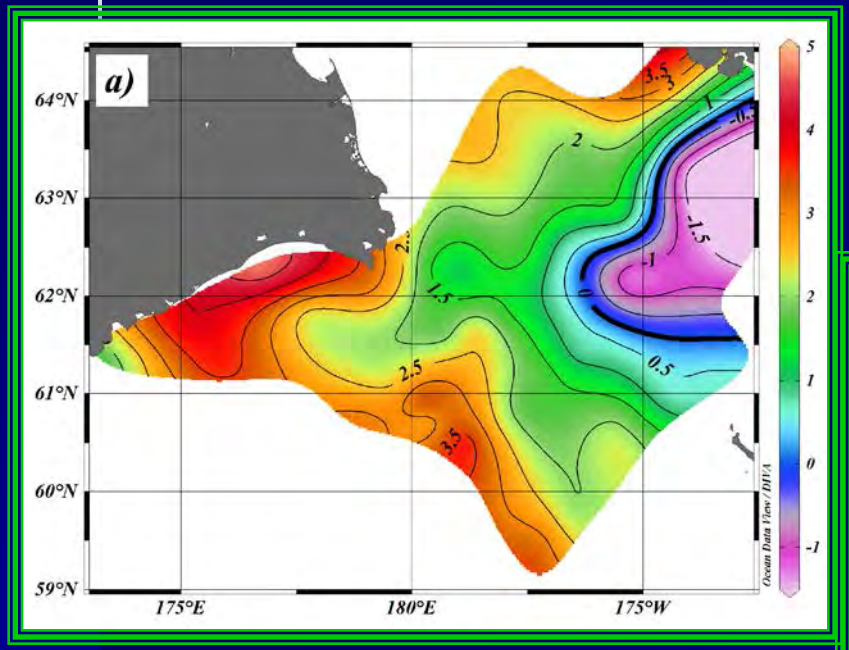


Fig. 2. Temperature on bottom in the northwestern Bering Sea in autumn 2014 (Left) and area-weighted bottom (lower lines) and surface (upper lines) temperatures for the Bering Sea and mean values from the NMFS summer bottom-trawl surveys (1987-2014) (Right)



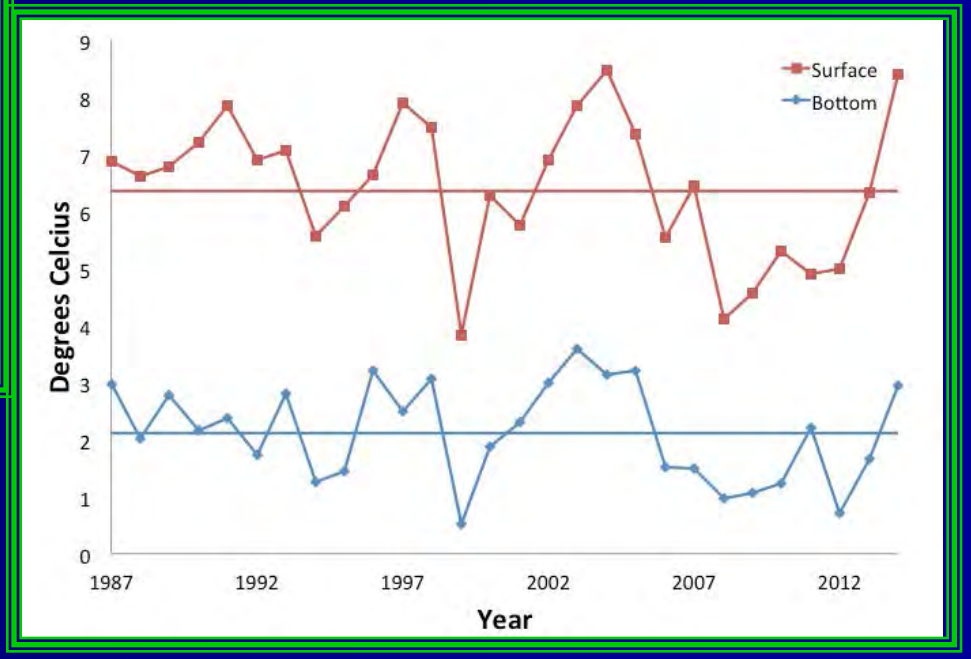


Fig. 3. Pollock vertical distribution (m^2/$mile^2$) and temperature in the northwestern Bering Sea (US-left side and Russian – right side EEZs, vertical line is maritime boundary line):

(А - September 2013; Б - September 2014)

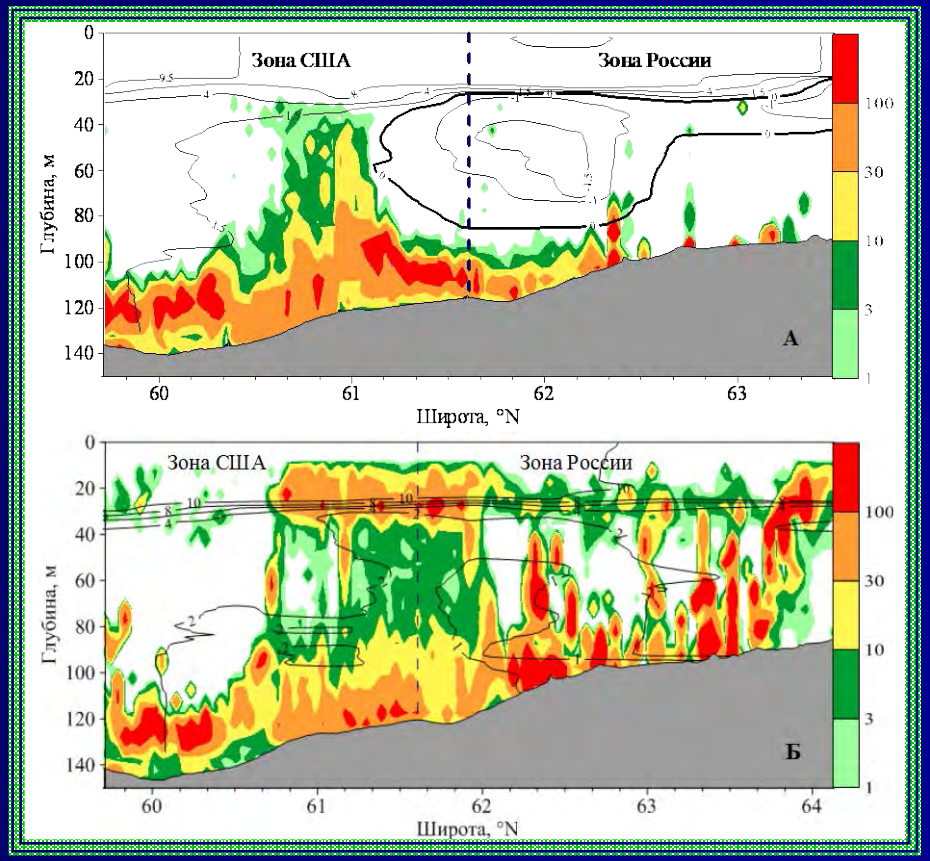
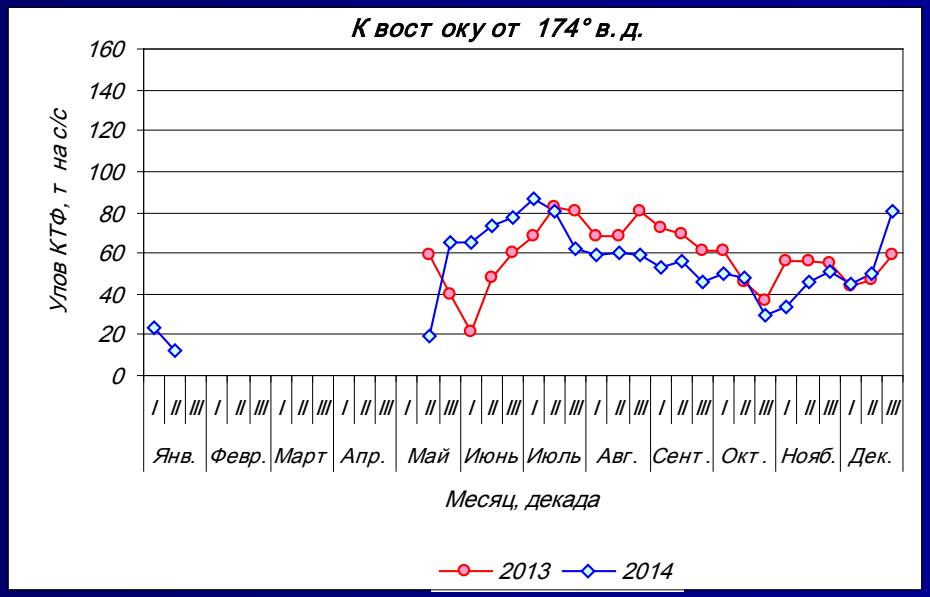
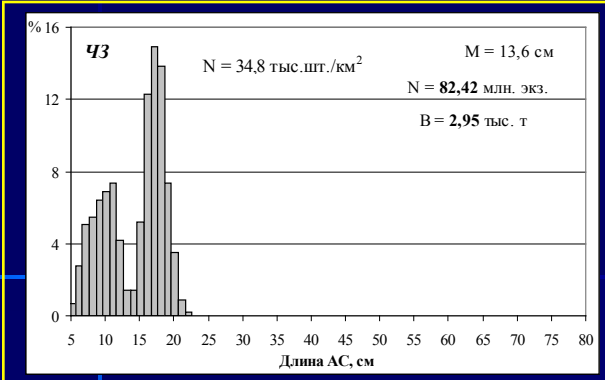


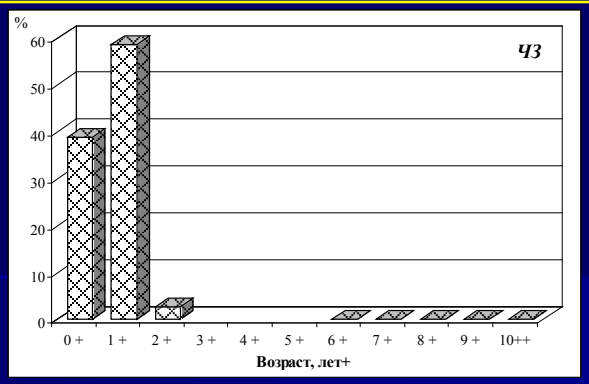
Fig. 4. Seasonal (January-December) variability of pollock CPUE (mt/day, factory trawlers) in the northwestern Bering Sea (to east 174 E) in 2013-2014

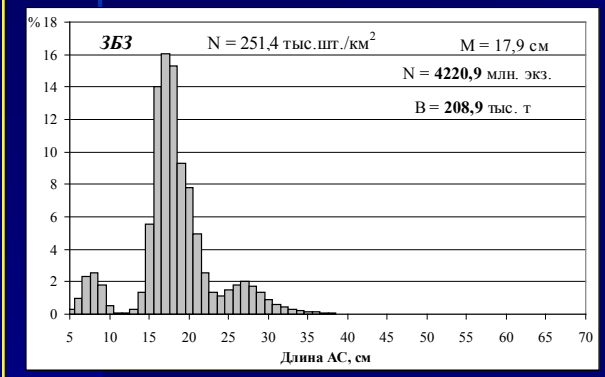


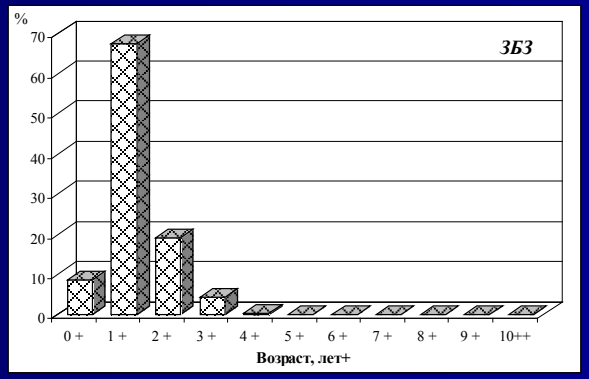
Zooplankton abundance and spatial distribution influences on pollock behavior

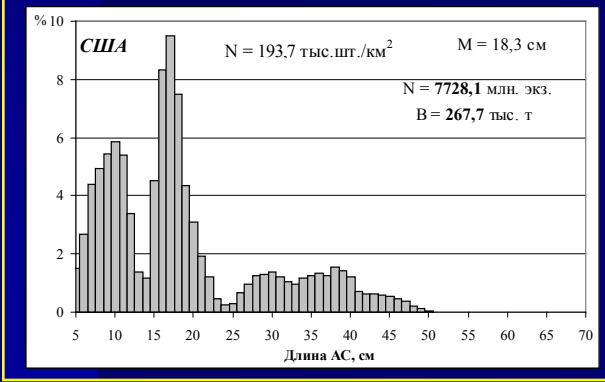
- High production and abundance of zooplankton in the northwestern Bering Sea is a reason seasonal pollock migrations from eastern Bering Sea to the nortwestern area;
- Time of back pollock migrations from northwestern area into eastern Bering Sea varies annually depends on real abundance of zooplankton in the northwestern Bering Sea.











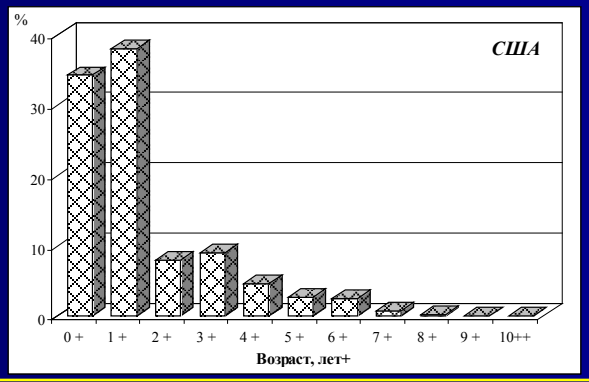
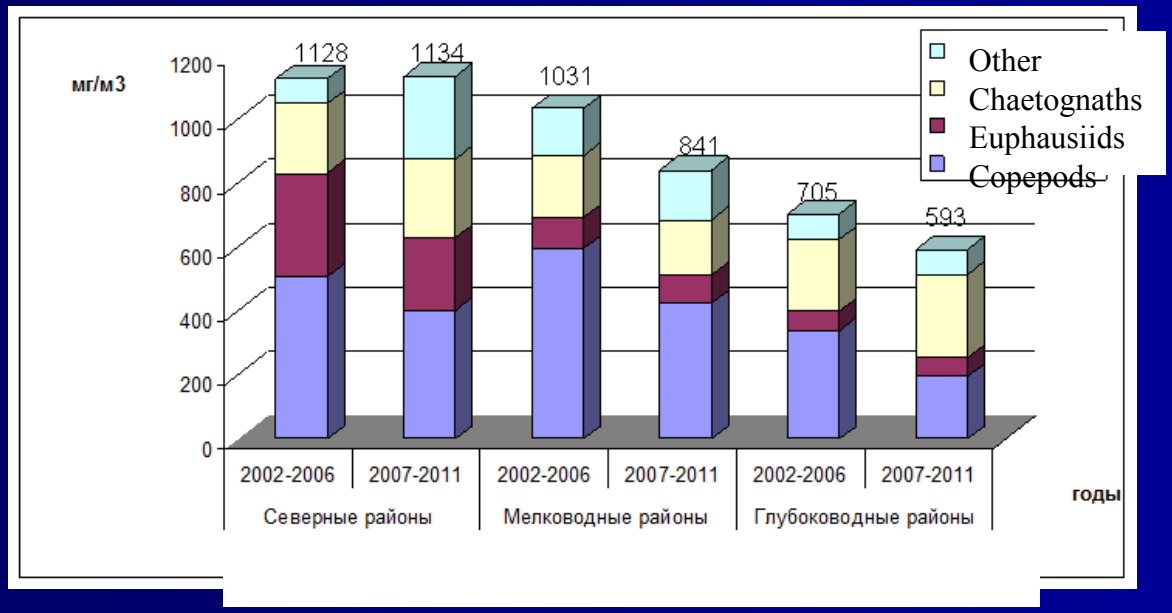


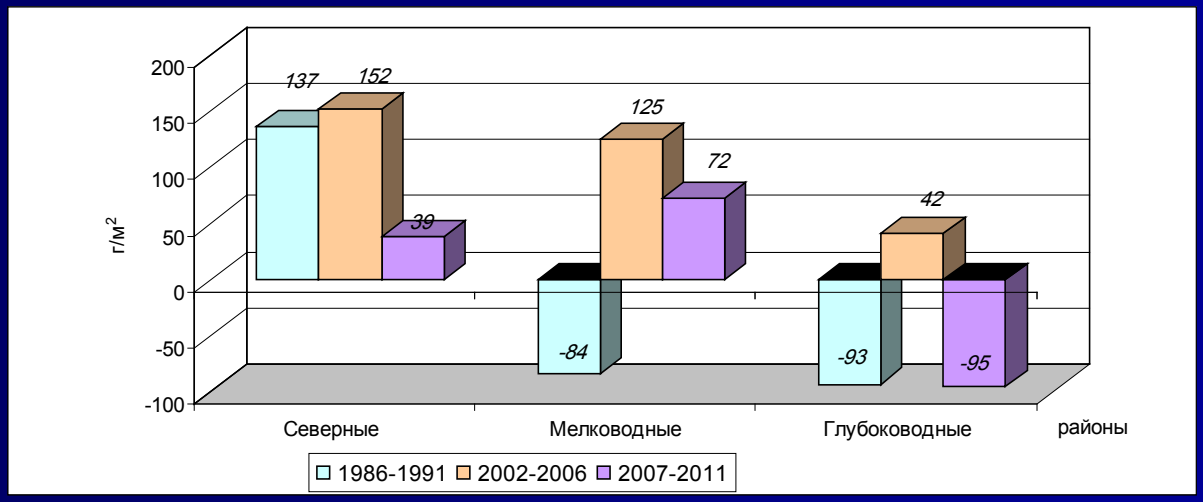
Fig. 5. Pollock relative abundance at size and at age in the northwestern Bering Sea in September - October, 2014 (ЧЗ - Russian EEZ to east 175° W, ЗБЗ - Russian EEZ to west 175° W; США- US EEZ to north 59° N)

Fig. 6. Interannual variability of main zooplankton taxonomic groups biomass density (mg/m^3) in the western Bering Sea (Dulepova, 2014) (figures above the columns indicate average biomass density in the regions)



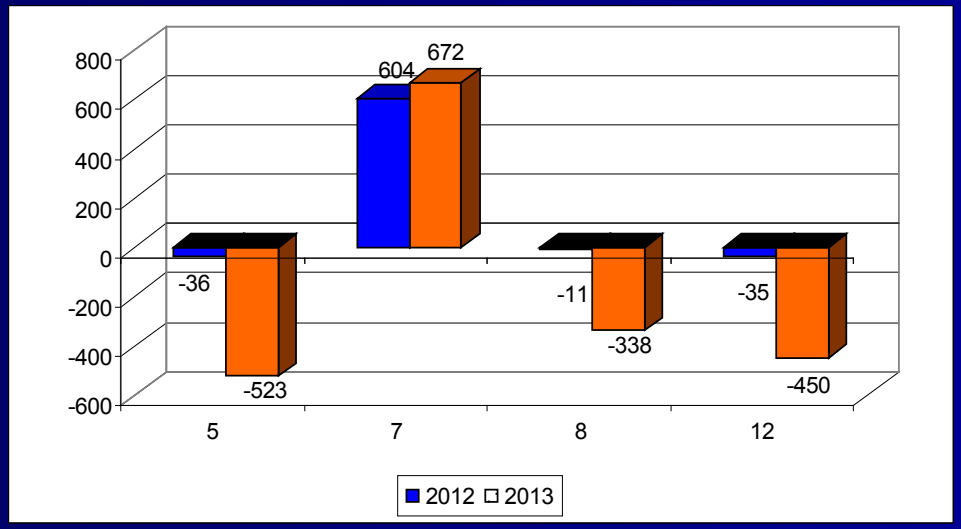
northern regions shallow-water regions deep-sea regions

Fig. 7. Annual variability in zooplankton production (g/m^2), available for nekton as food in the western Bering Sea (Dulepova, 2014)



northern regions shallow-water regions deep-sea regions

Fig. 8. Annual variability in the “real” production of zooplankton (mg/m^3) in different regions of the western Bering Sea (Dulepova, 2014)



Interannual variability in the Bering Sea zooplankton community and pollock spatial distribution

- The reason of unnusually early (August-September) pollock migration from northwestern Bering Sea to southeastern direction on the eastern Bering Sea in 2012-2015 is relatively low abundance of large zooplankton (euphausiidae and large copepoda) in the northwestern Bering Sea and deficit of food.
- Additional studies of zooplankton community may need to be considered in order to determine annual and seasonal zooplankton fluctuations in the Bering Sea.

Fig. 9. Pollock density distribution in the Bering Sea, summer 2007

(period of low zooplankton biomass)

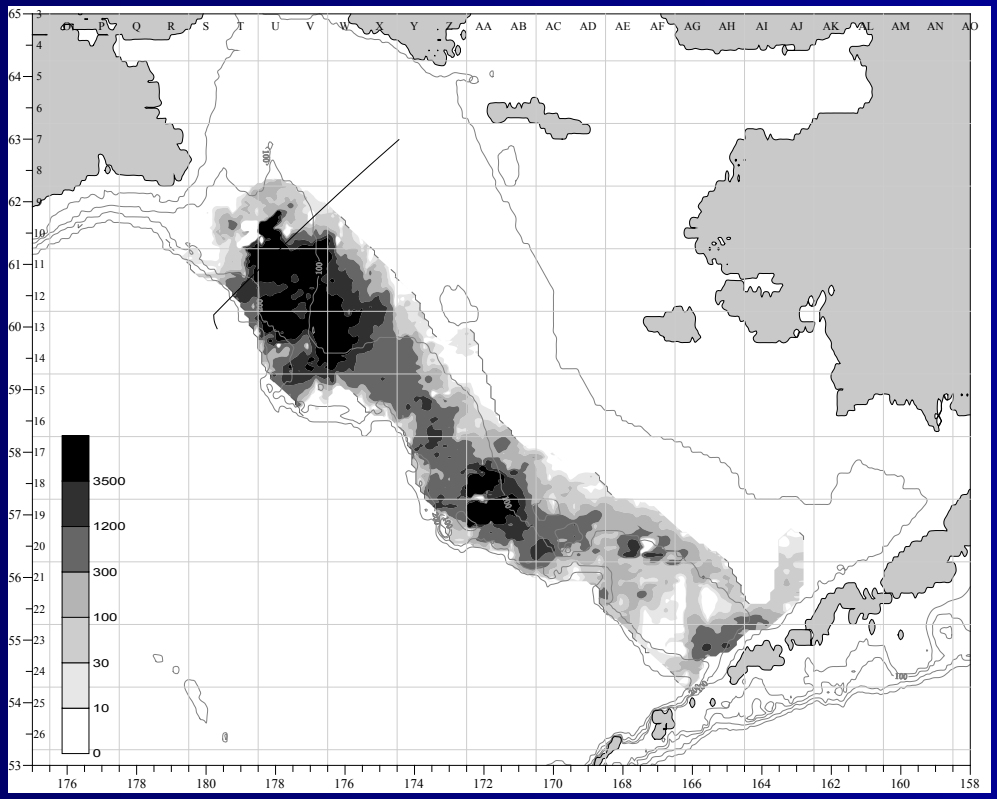


Fig. 10. Pollock density distribution in the Bering Sea, summer 2004

(period of high zooplankton biomass)

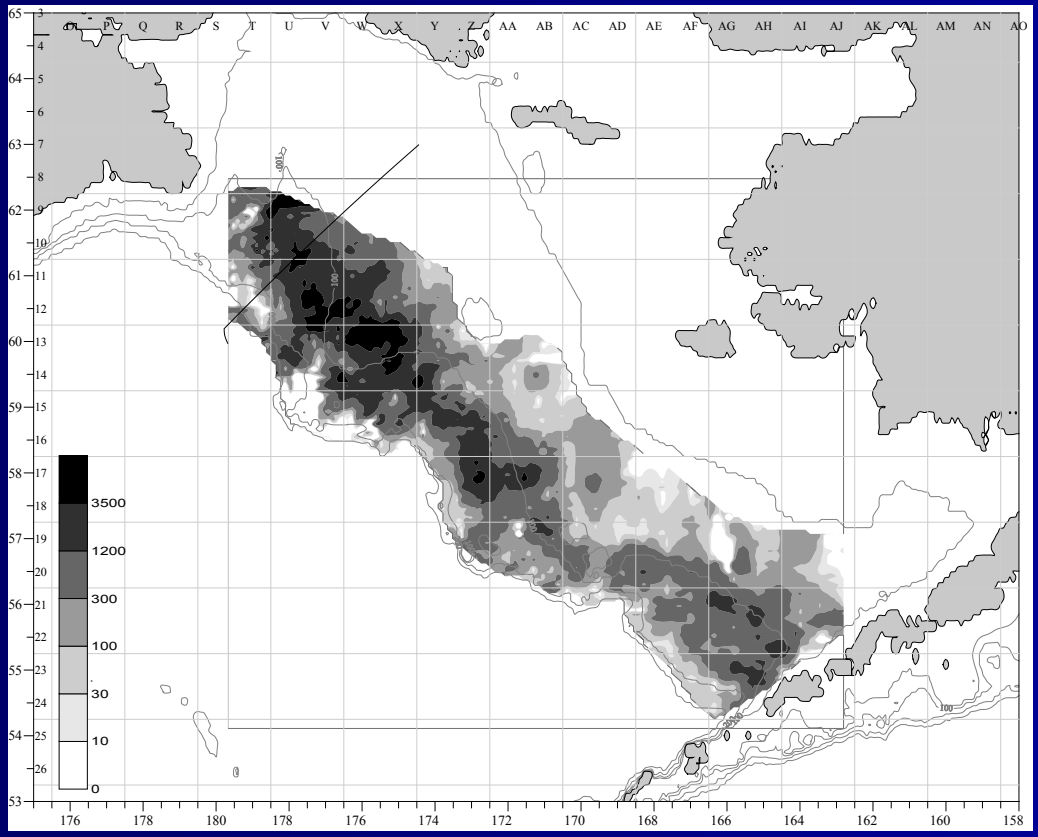
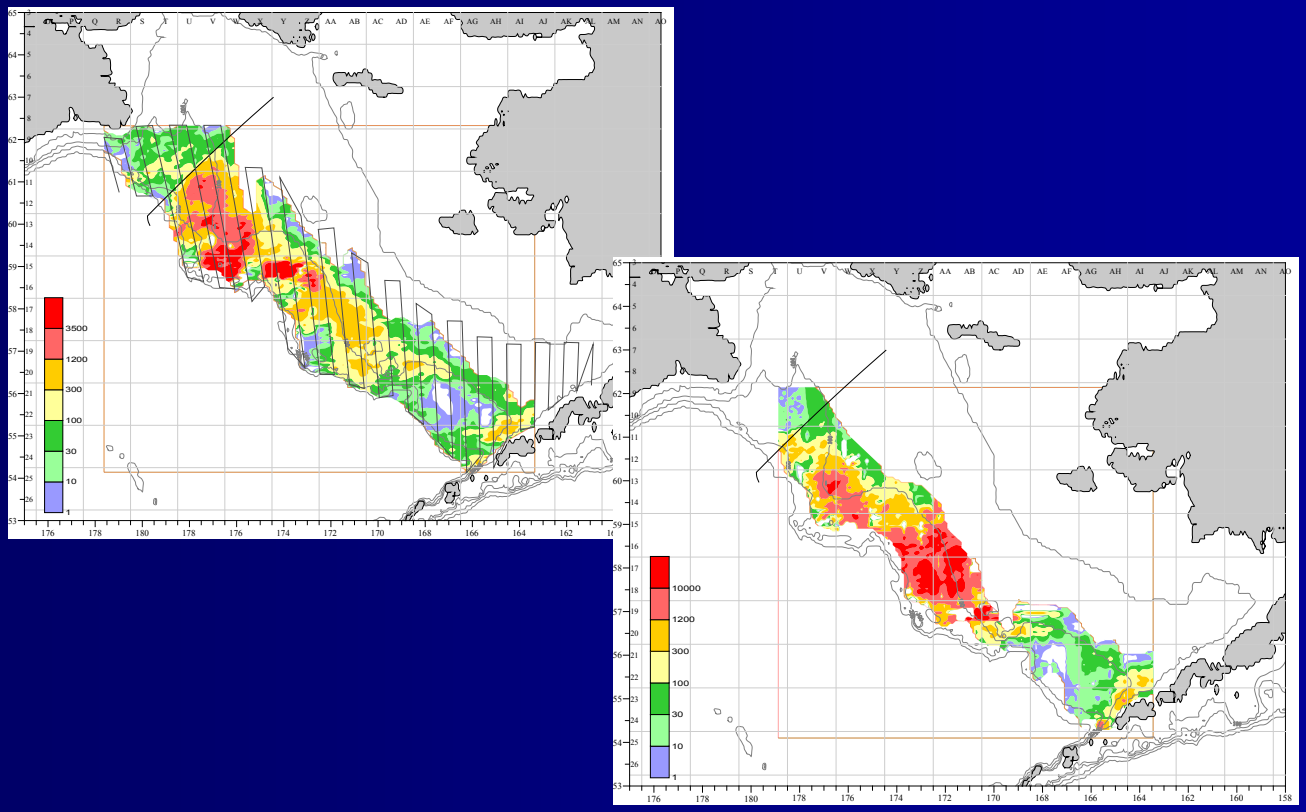


Fig. 11. Bering Sea (left- summer 2008, right – summer 2009)
(the 2008 and 2009 are period of low pollock abundance and biomass)



Interannual variability of the Bering Sea pollock biomass and scale of northwestern spatial distribution

- Scale of pollock pollock distribution into northwestern Bering Sea in summer-autumn time depends on it total abundance and biomass.
- In summer 2010-2015 scale of pollock spatial distribution into northwestern Bering Sea in summer increased as result of increasing it abundance and biomass.

Thank You for attention!