



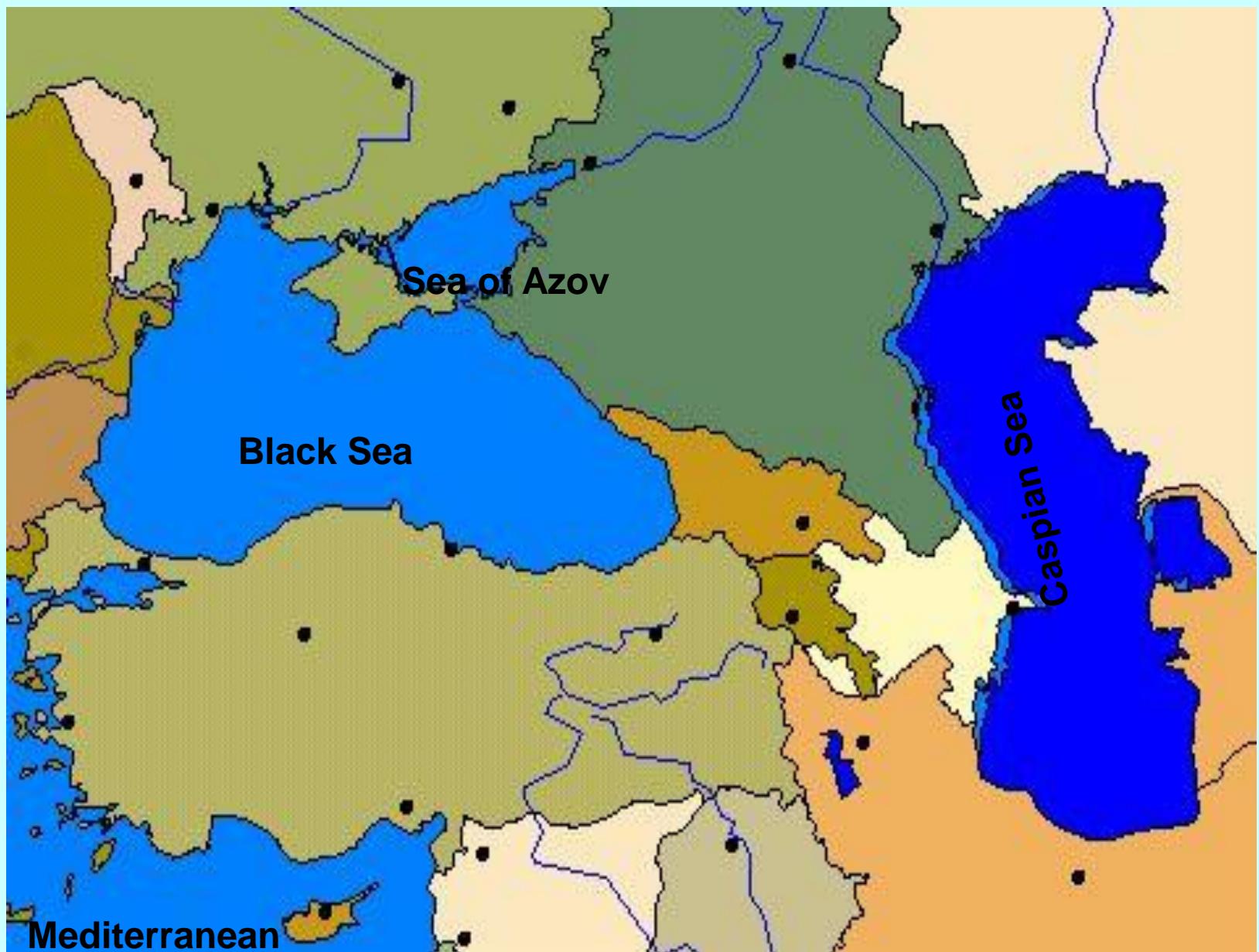
## Impact of non-native species on the ecosystem of the Caspian Sea

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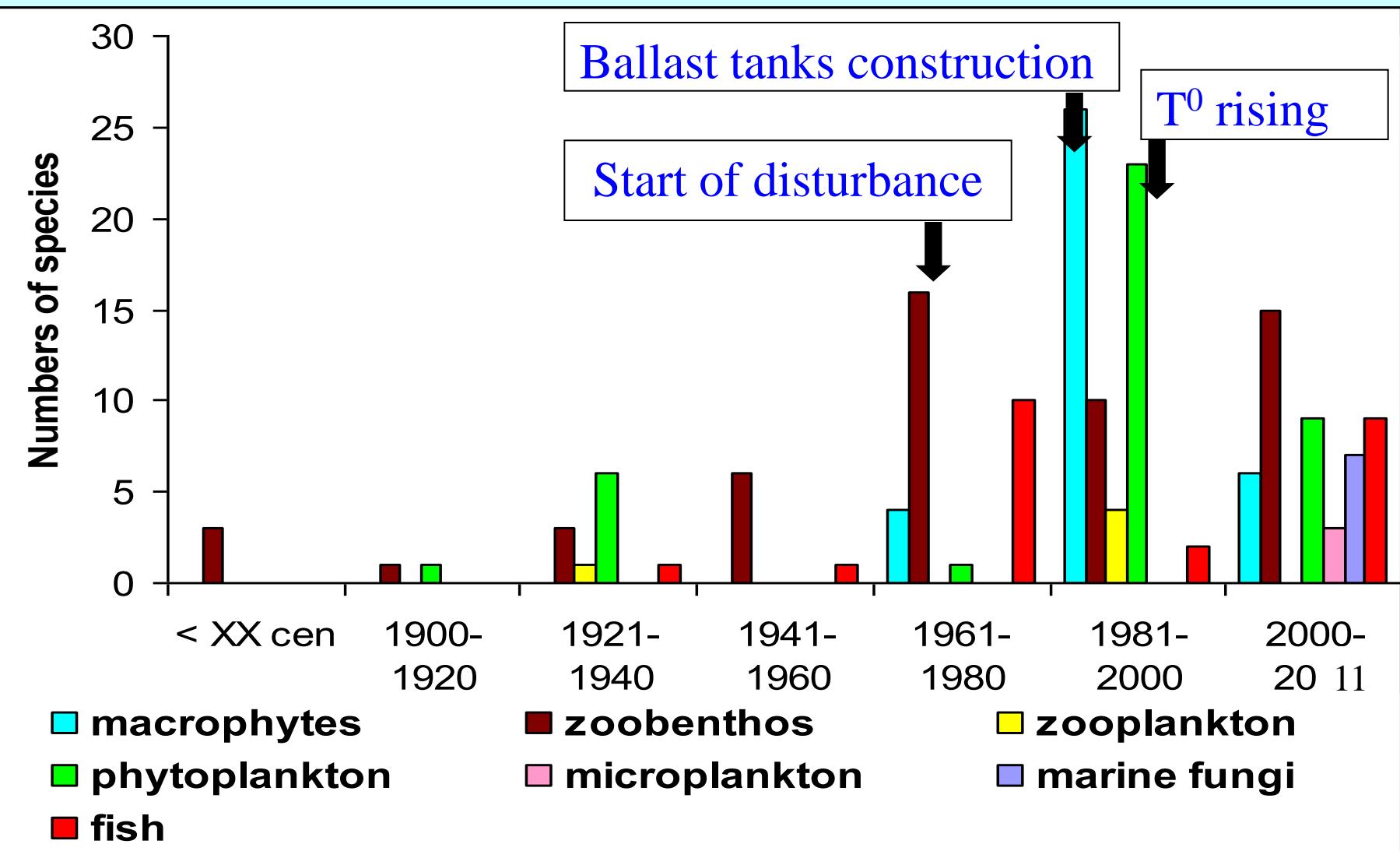


The Black, Azov, and Caspian seas (Ponto-Caspian) were united as a single basin several times in the past, most recently in the Pliocene

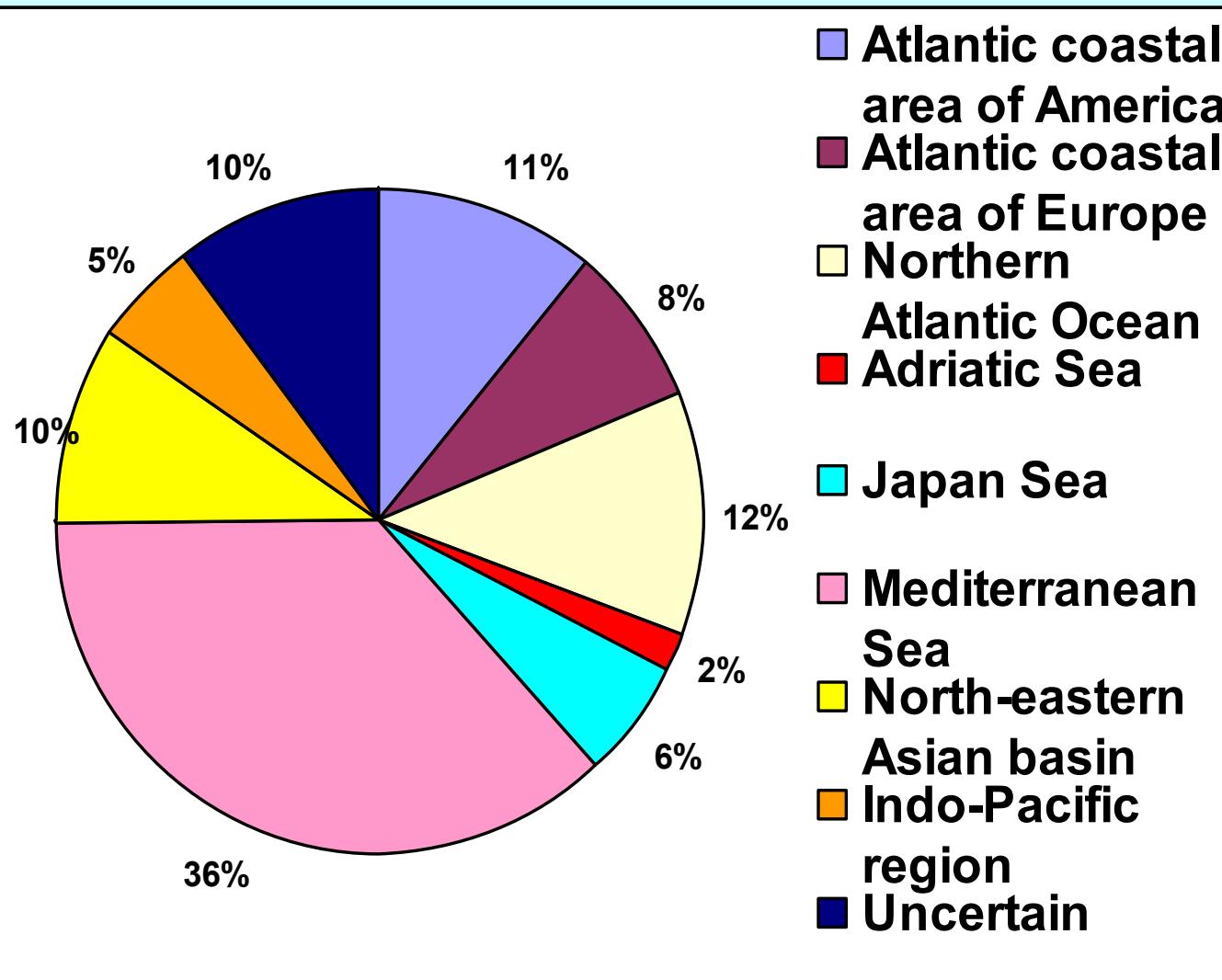
# Geomorphological and hydrological characteristics of the seas

<b>Location</b>	<b>Depth max. (mean) (m)</b>	<b>Winter, T oC</b>	<b>Summer, T oC</b>	<b>Salinity</b>	<b>Chlorophyll (mg/m3)</b>
<b>Black Sea</b>	<b>2245 (1271)Oxic layer 200(60)</b>	<b>0-8</b>	<b>24-27</b>	<b>12-22.3</b>	<b>0,47-1,9</b>
<b>Sea of Azov</b>	<b>14,5 (7)</b>	<b>-08.-+1.2</b>	<b>24-30</b>	<b>3-14</b>	<b>2-6</b>
<b>Caspian Sea (total)</b>	<b>1025(208)</b>	<b>0-11</b>	<b>24-28</b>	<b>0.1-13</b>	<b>3,31±1,1</b>
<b>Northern</b>	<b>15-20 (4.4)</b>	<b>0-0.5</b>	<b>25-27</b>	<b>0.1-11</b>	<b>6.8± 2.09</b>
<b>Middle</b>	<b>770 (192)</b>	<b>0-11</b>	<b>24-25</b>	<b>12.6-13</b>	<b>2.1± 0.86</b>
<b>Southern</b>	<b>1025(345)</b>	<b>5.6-10.7</b>	<b>25-28</b>	<b>12.6-13</b>	<b>2.4± 1.59</b>

# Chronology of species invasions into the Black Sea

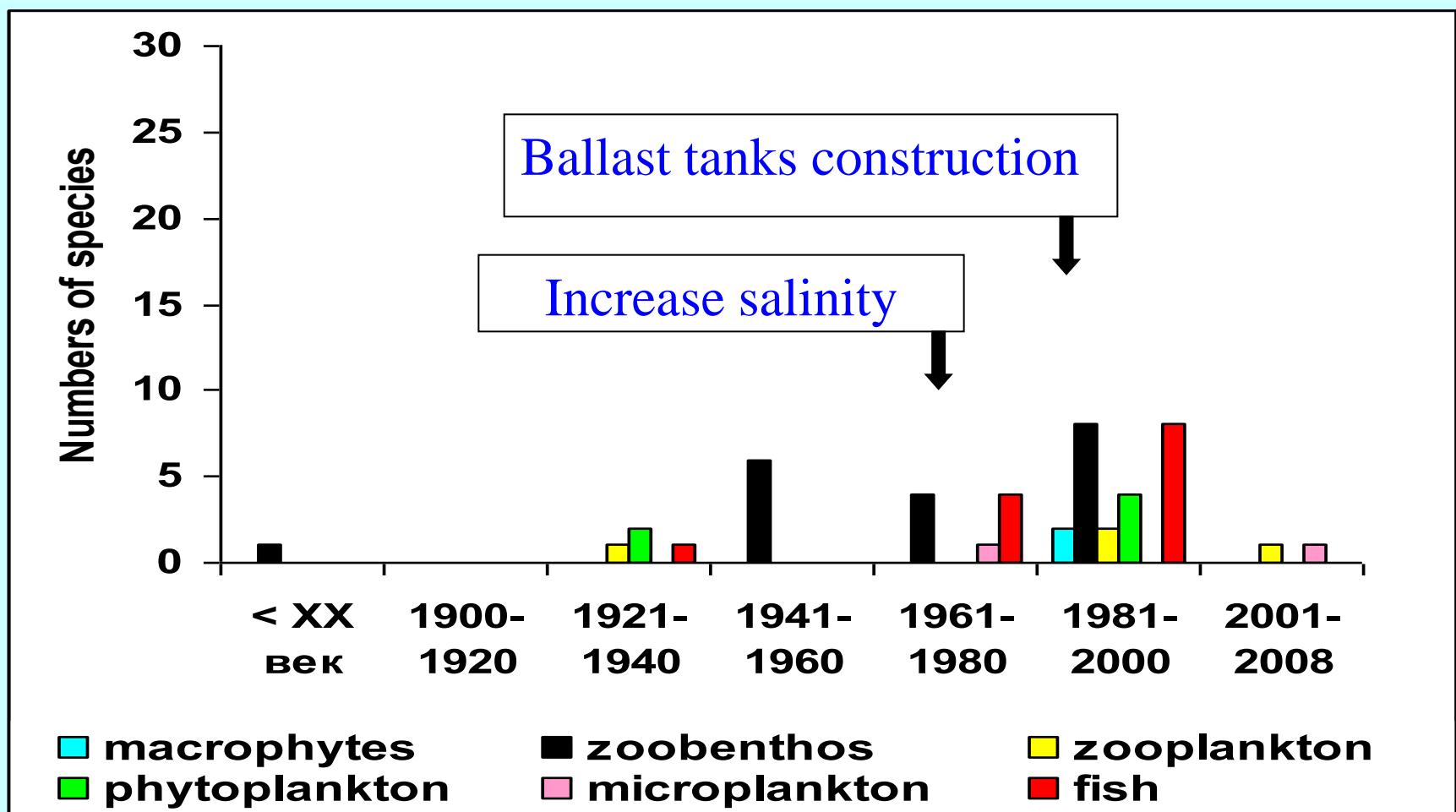


# Regions donors and percent of established non-native species from them in the Black Sea



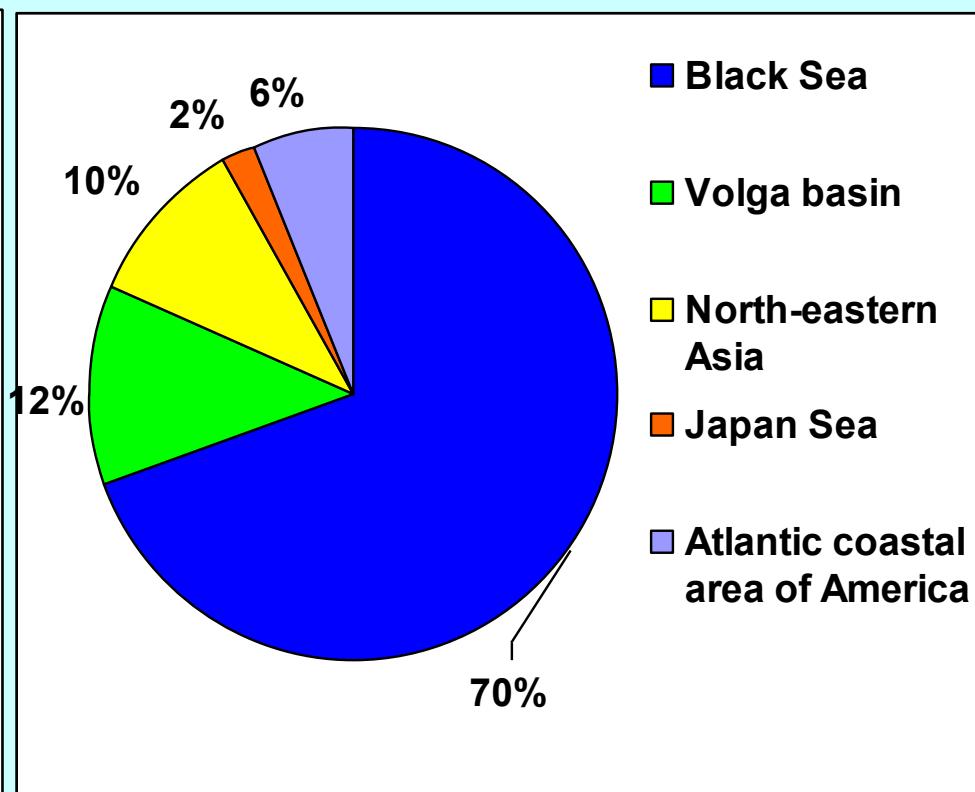
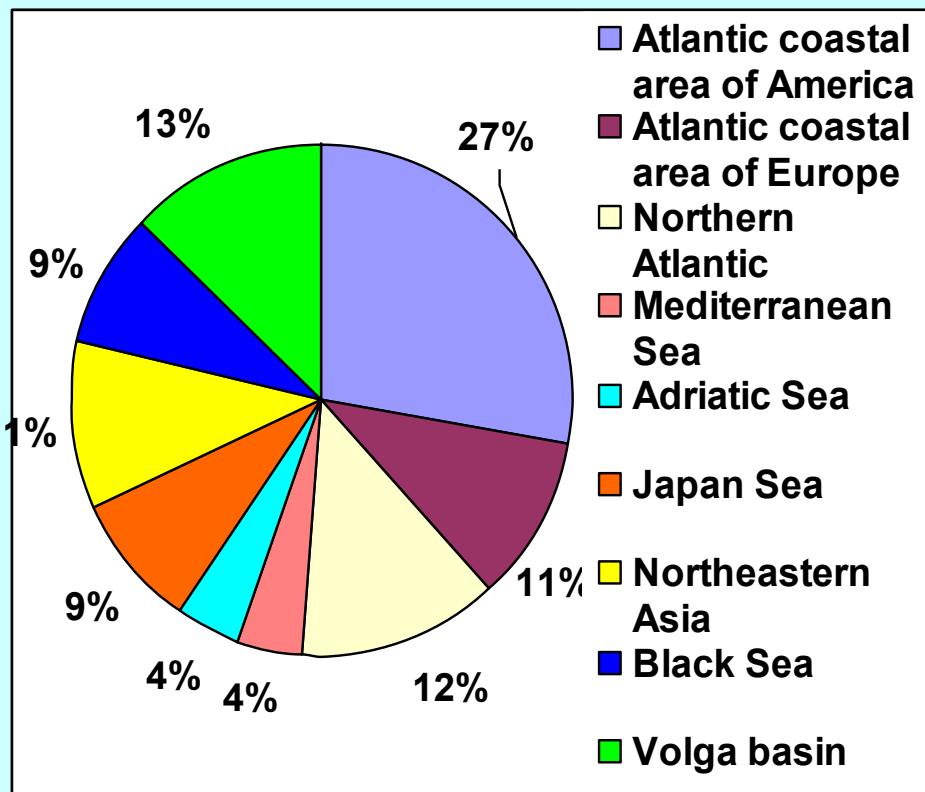
The Black Sea has become an important international shipping destination during second part of twenty century. High shipping intensity has facilitated species invasions into the Black Sea. Consequently the Black Sea serves as a hub for species that then spread further to adjacent seas: the Sea of Azov and the Caspian Sea.

# Chronology of species invasions into the Sea of Azov

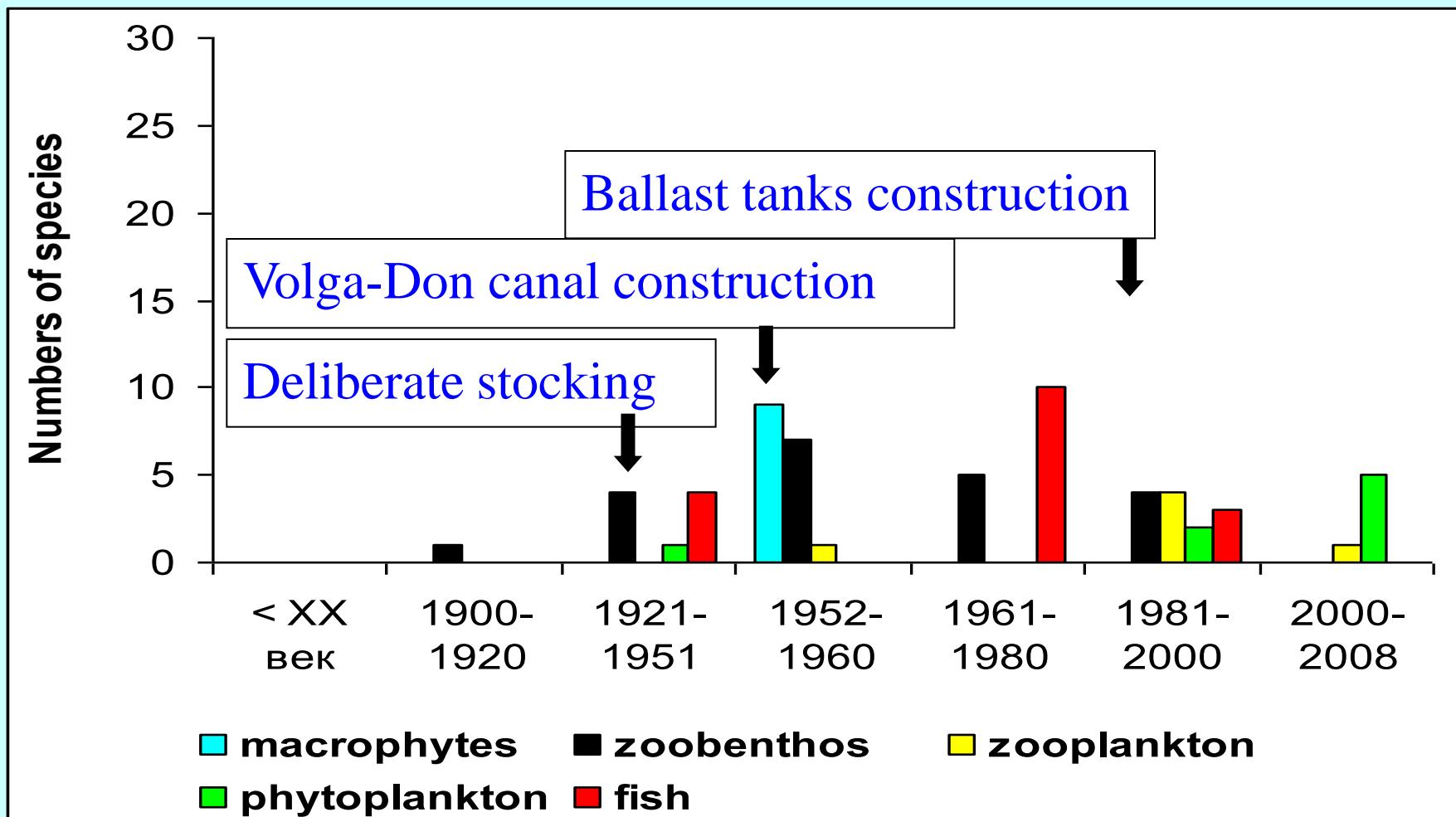


# Donor areas of the non-native species and their percentage in the Sea of Azov:

A-primary areas, B- secondary (actual) areas.

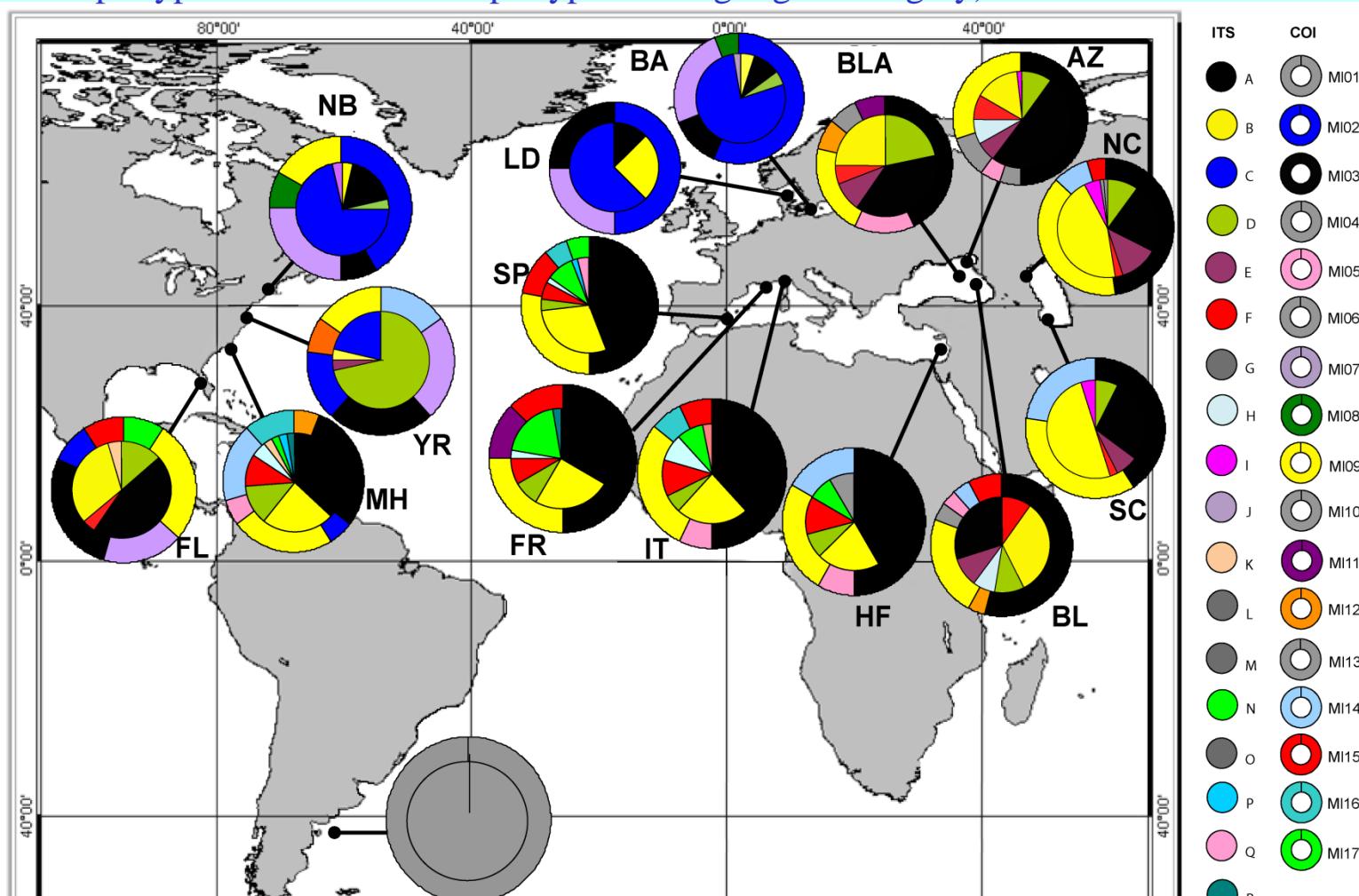


# Chronology of species invasions into the Caspian Sea



# Haplotype distribution and frequency map for *Mnemiopsis leidyi*.

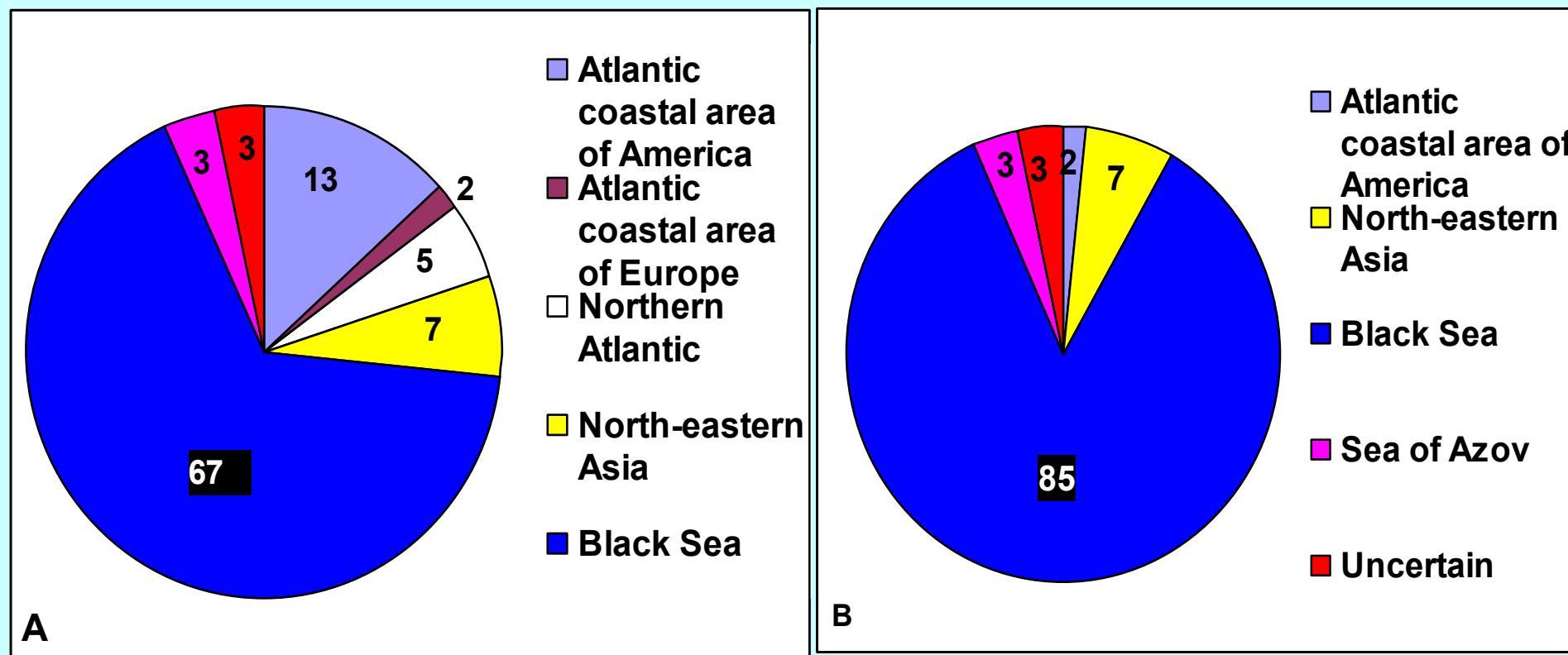
Allele (inner circle for ITS) and haplotype (outer donut for COI) distribution. Each color indicates a different allele/haplotype. Private alleles/haplotypes are highlighted in grey).



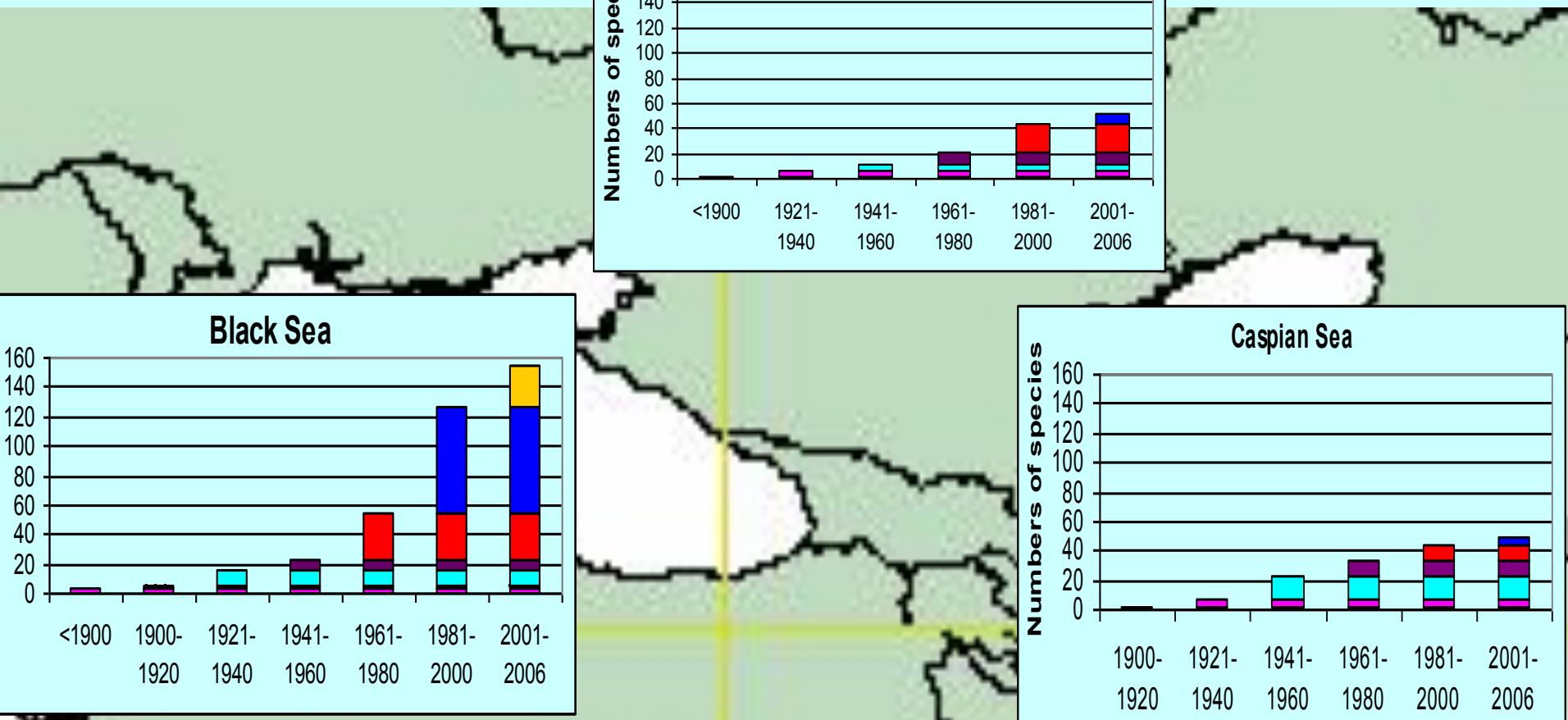
Population genetic analyses supported its invasion from the Gulf of Mexico (e.g., Tampa Bay) into the Black Sea, then secondary into the Azov, Caspian seas and the eastern and western Mediterranean (Ghaboolii, Shiganova et al., 2011; PLOS ONE, 2013)

# Donor areas of the non-native species and their percentage in the Caspian Sea:

A-primary areas, B- secondary (actual) areas



# Cumulative graphs of non-native species invasion rate for 20-years intervals in the seas of Ponto-Caspian in 1990-2008.



Acceleration of invasion rate :

Black Sea

Since 1970s      in 2,5

Since 1980s      in 2,4

Sea of Azov

in 1,75

in 2,1

Caspian Sea

in 1,55

in 1,4

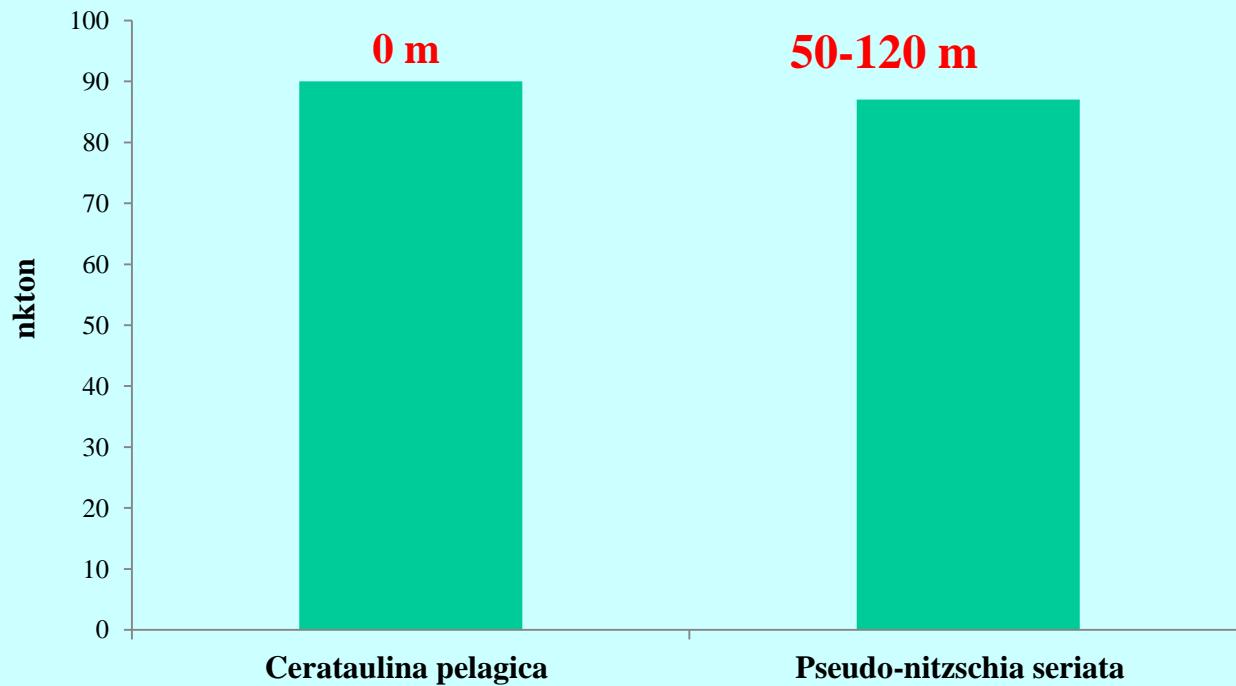
# List of non-native species in the Caspian Sea

List of the non-native species recorded in the Caspian Sea (in brackets numbers of species, which were recorded in the Caspian but their establishment is uncertain)

	Numbers of established species
Parasites of fishes	9
Phytoplankton	8 (3)
Macrophytes	9
Kamptozoa	1
Scyphozoa	(1)
Hydrozoa	3
Ctenophora	1
Polychaeta	2
Copepoda	2 (1)
Cladocera	3
Cirripedia	1 (1)
Decapoda	4
Amphipoda	3
Bivalvia	4
Gastropoda	2
Bryozoa	3
Pisces	14 (2)
Total	60 without parasites (15)

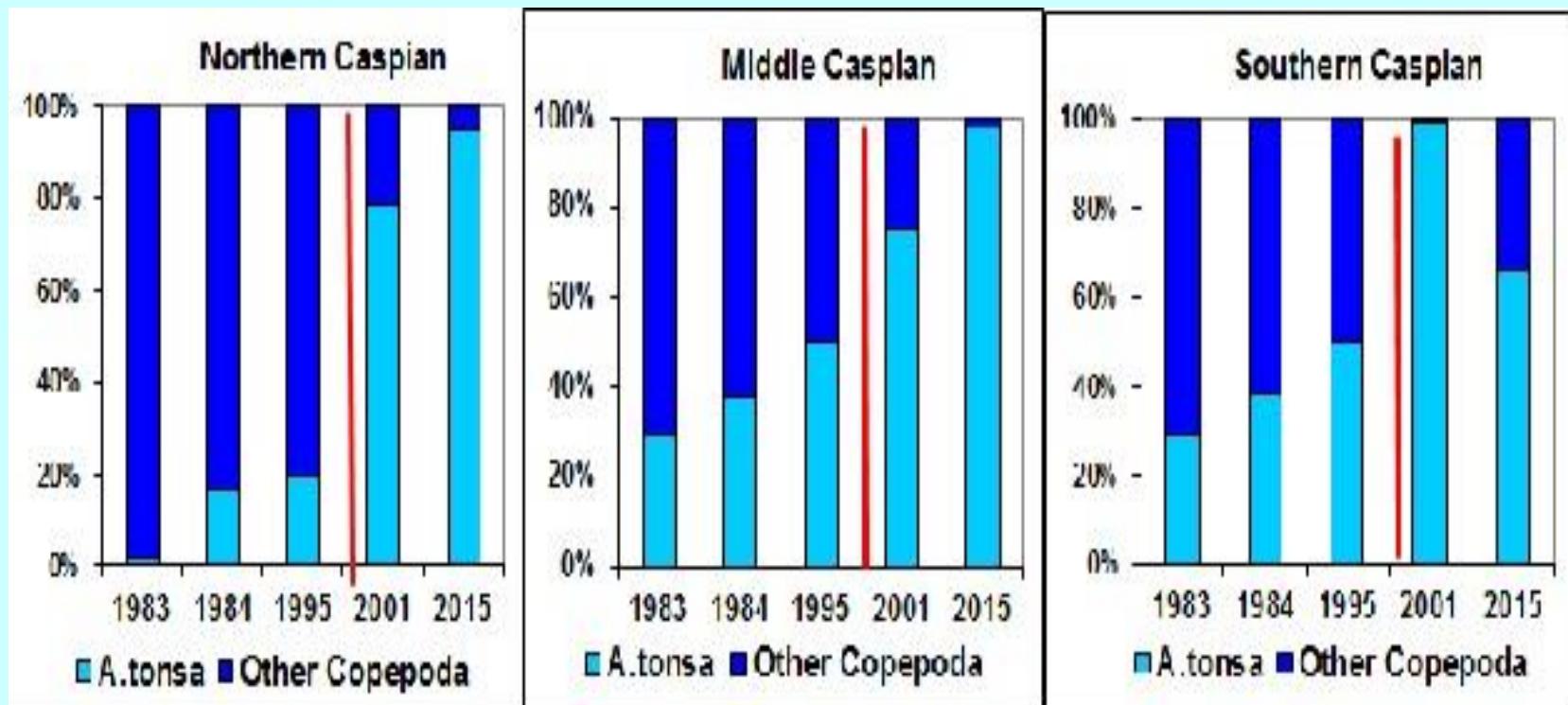
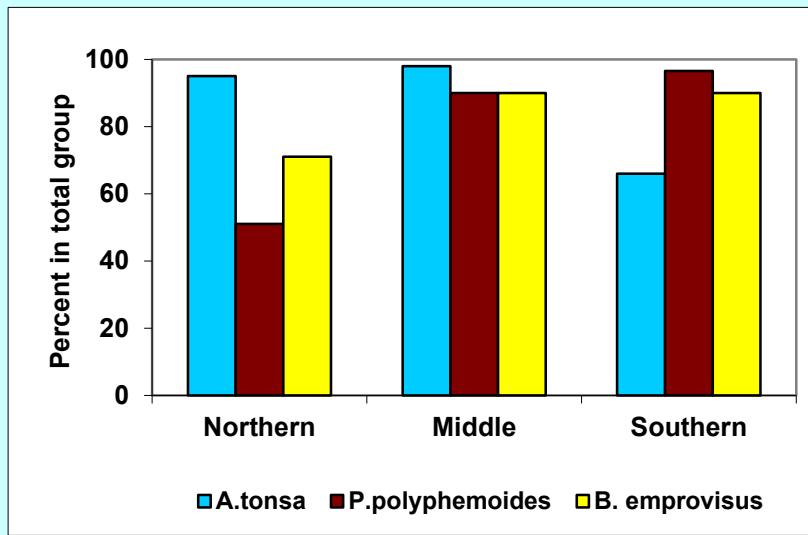
# Phytoplankton non-native species

## Winter bloom

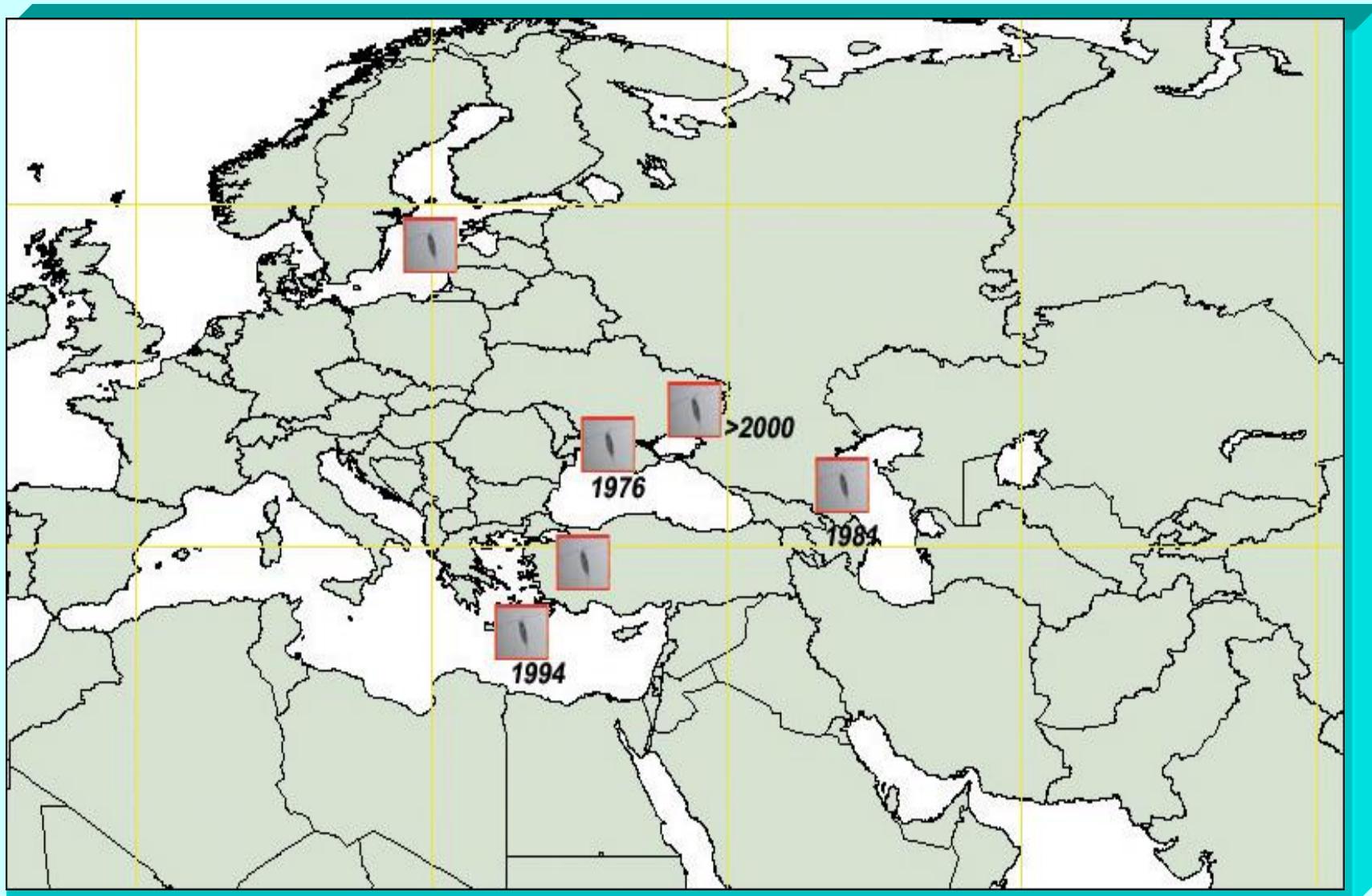


# Zooplankton non-native species

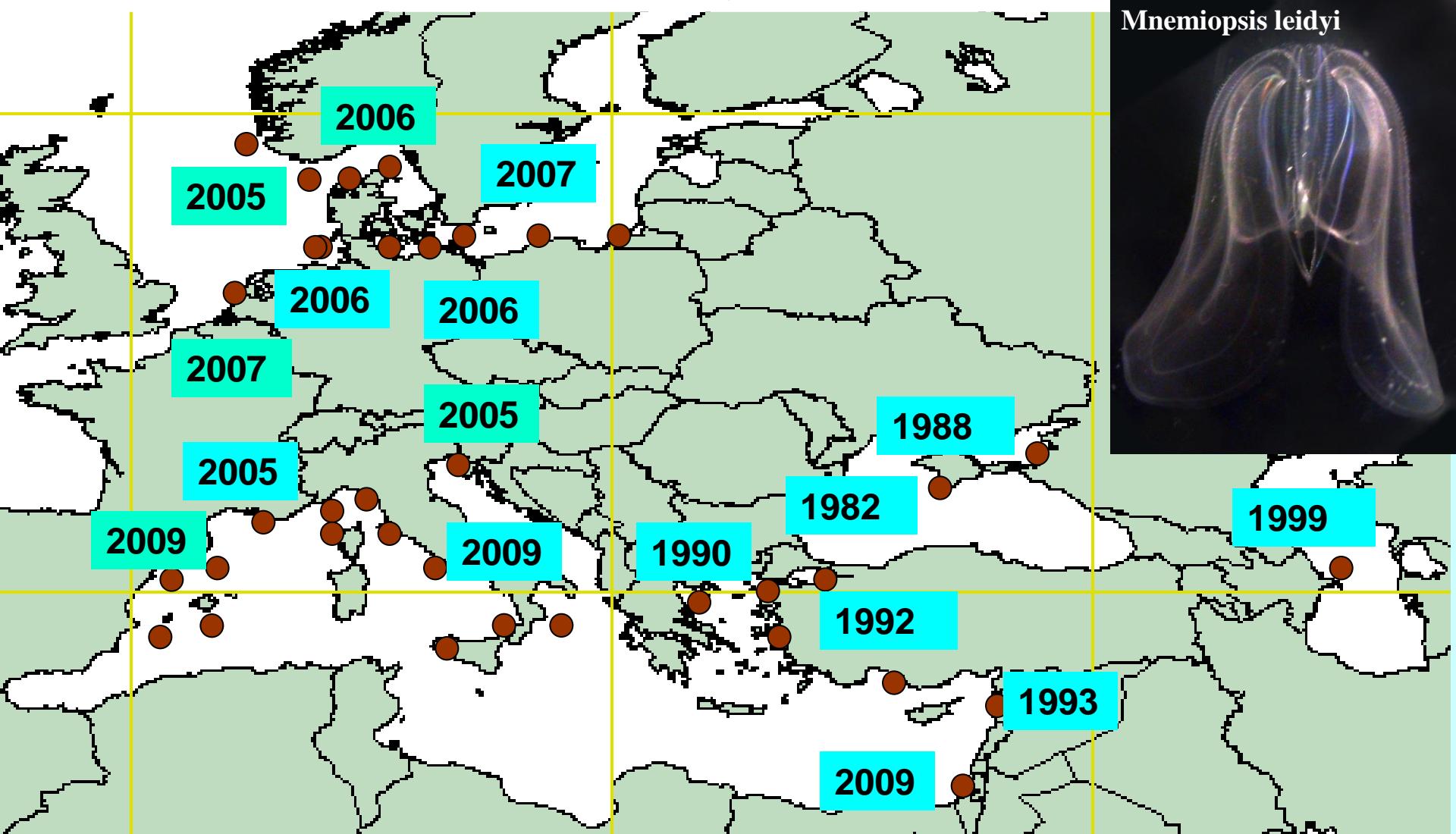
Native  
Eurytemora  
minor, E.grimmi  
and  
Limnocalanus  
grimaldii almost  
completely  
disappeared



## Range of expansion *Acartia tonsa*



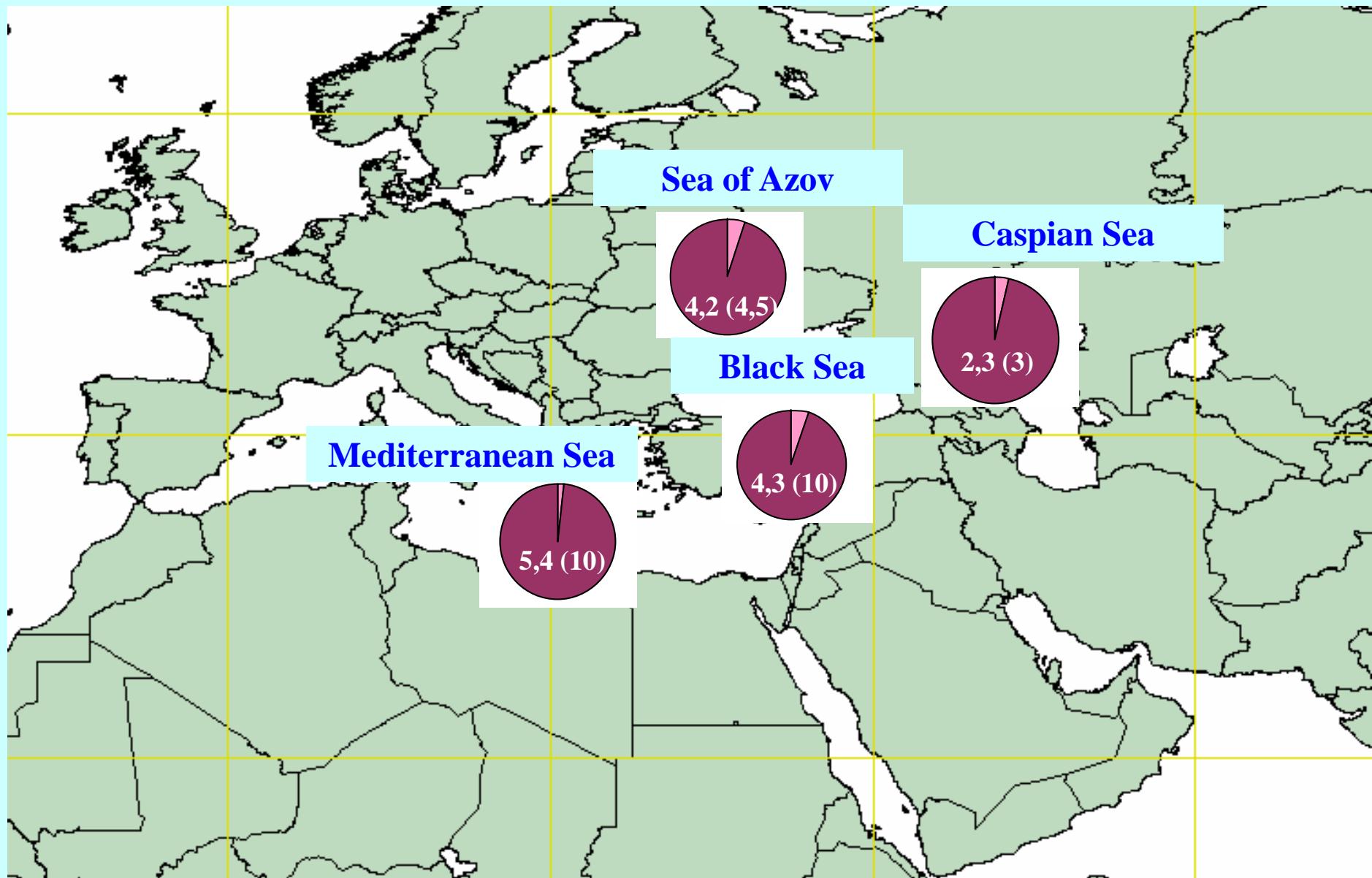
# Range of expansion *Mnemiopsis leidyi* in the Eurasian seas (shown a location and year of the first record)



*Mnemiopsis leidyi*



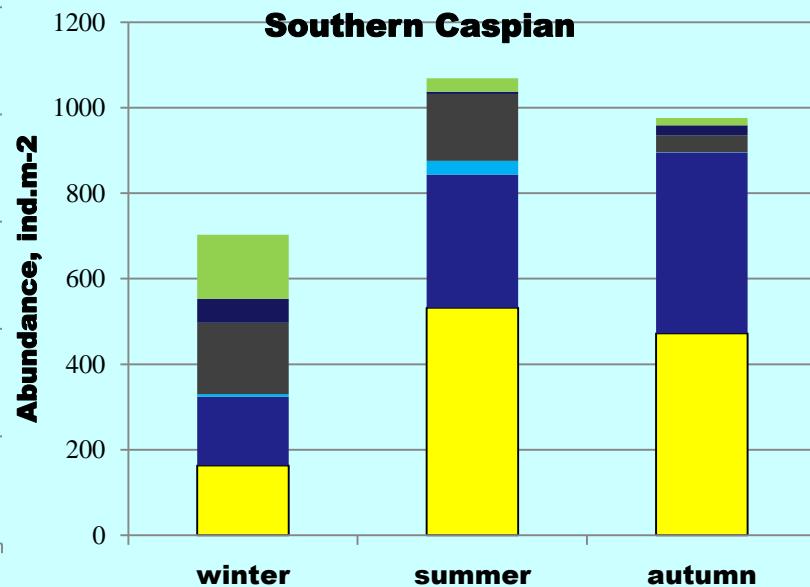
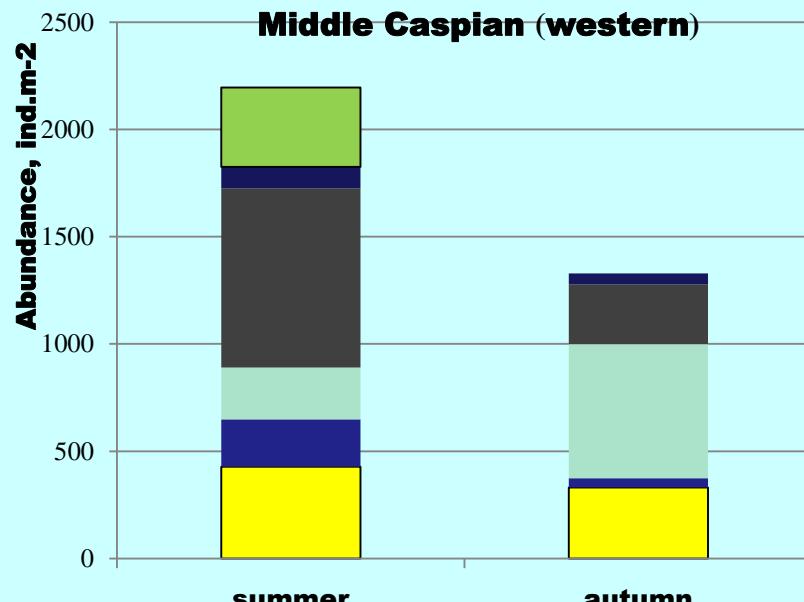
# Proportion of non-native species in total biota



# Dispersal of *Amphibalanus improvisus* (Darwin, 1854)



# Zoobenthos

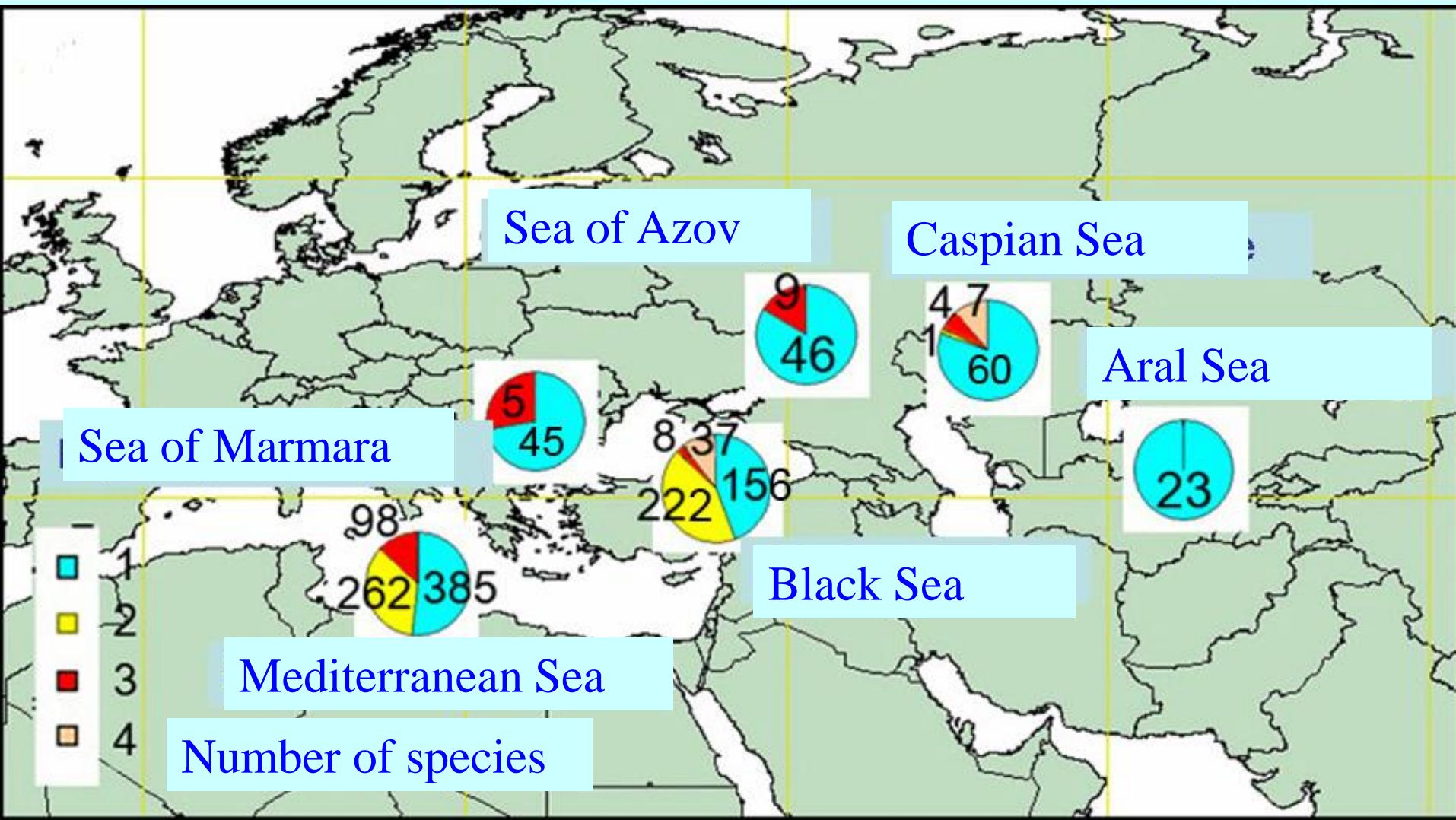


█ Vermes      █ H.diversicolor      █ Crustacea  
█ Molusca      █ A. segmentum      █ M.lineatus

█ Vermes      █ H.diversicolor      █ Crustacea  
█ Molusca      █ A. segmentum      █ M.lineatus

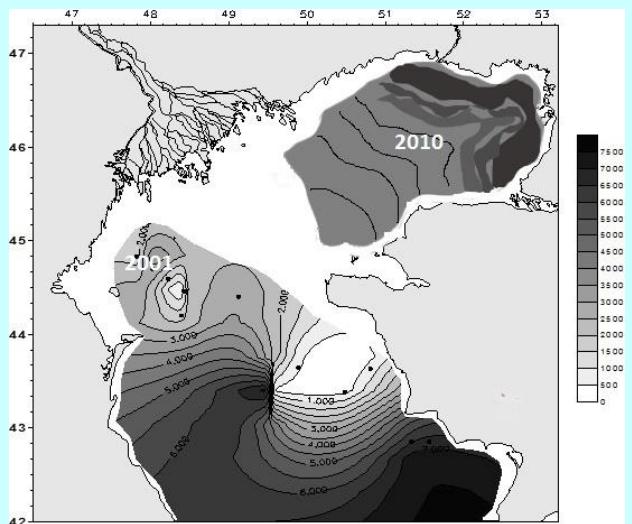
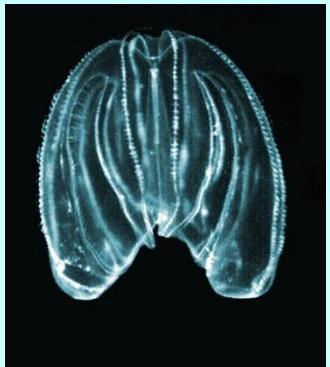
# Total numbers of non-native species in the southern seas of Eurasia:

1 – established; 2 – single; 3- uncertain; 4 – recently found.

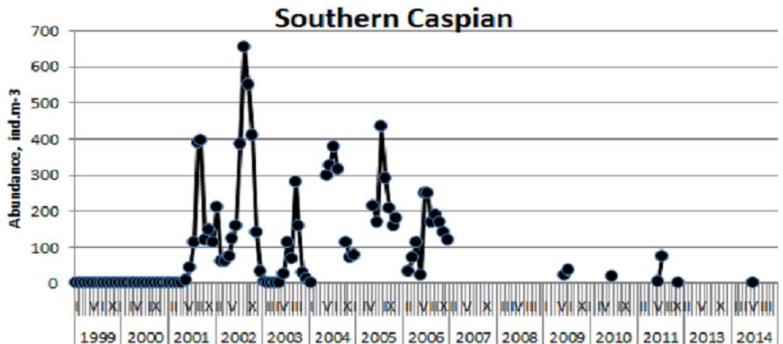
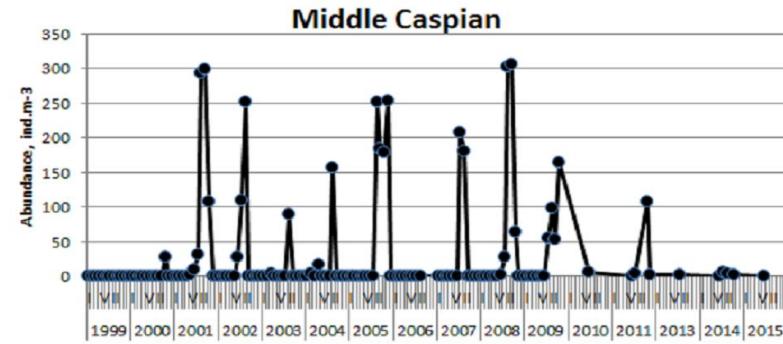
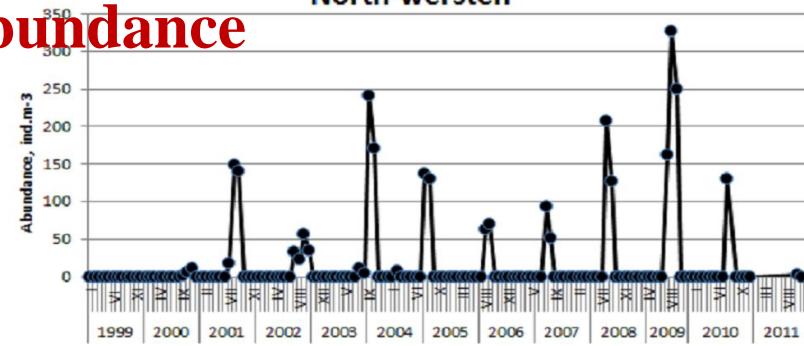


# Role non-native species in communities

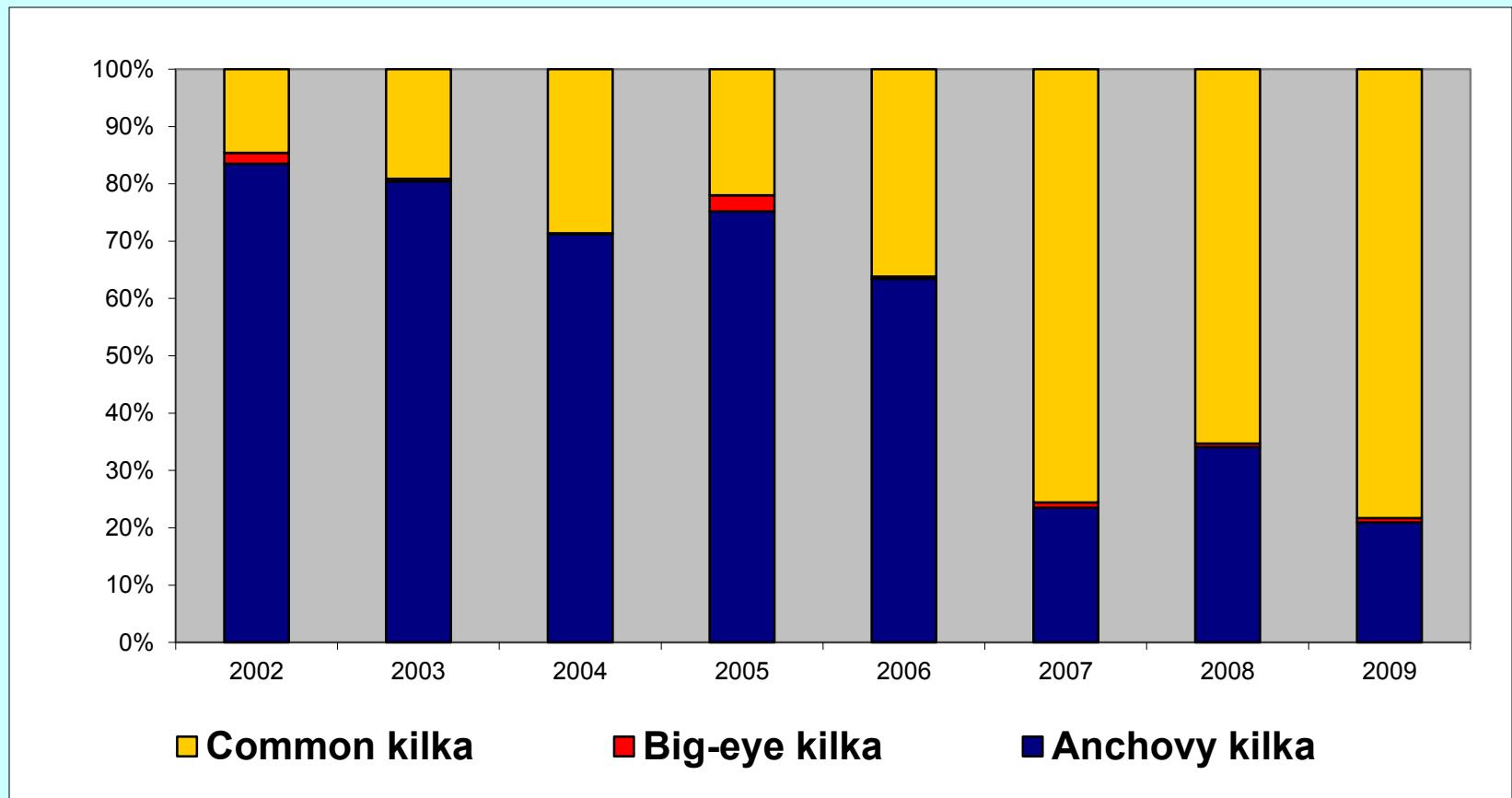
# *M.leidyi* dispersal since 2009



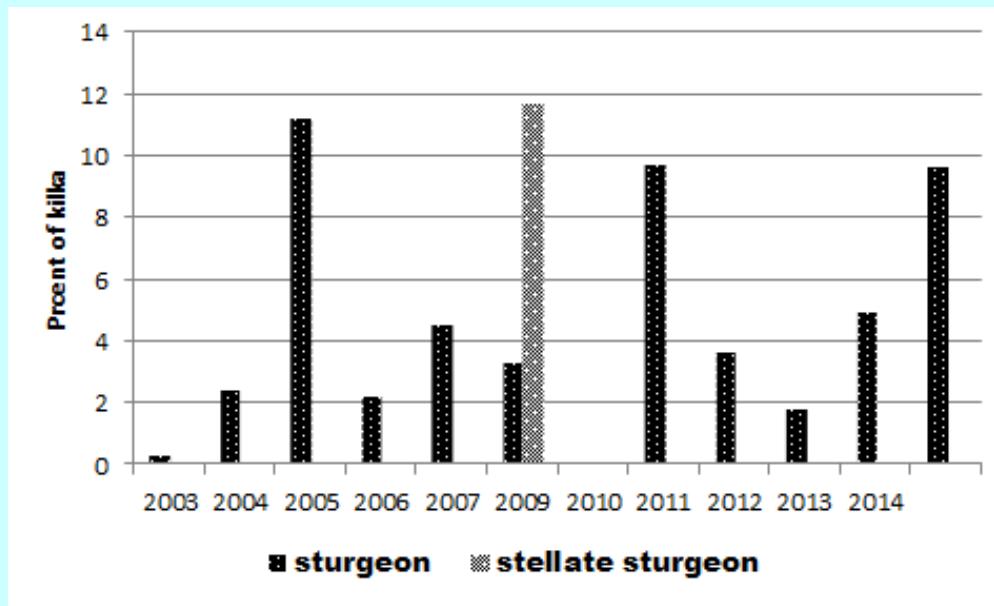
# Interannual variability *M.leidyi* abundance



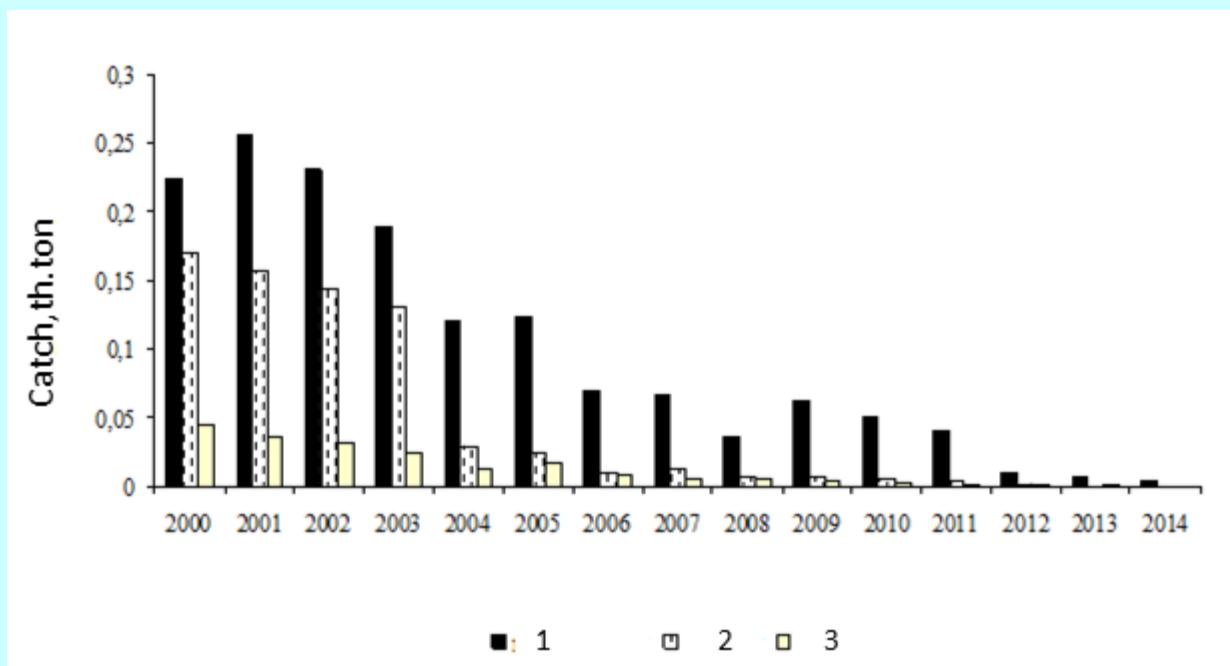
# Percent kilka species in the catches



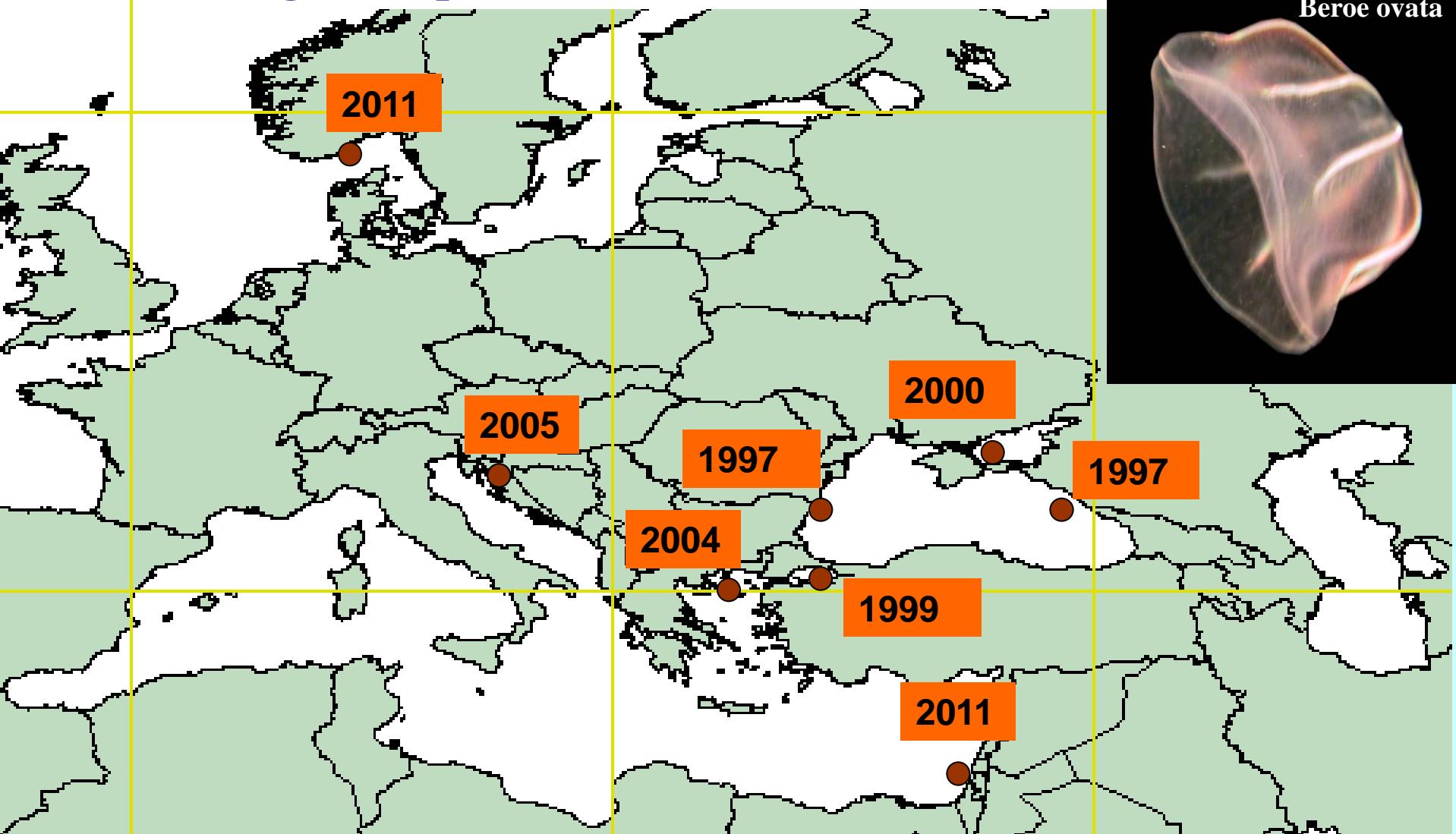
Share of kilka в feeding sturgeon (*Acipenser gueldenstaedtii*) and stellate sturgeon (*Acipenserstellatus*) in summer 2003-2014 in western part of the Northern Caspian  
(% of food contents) (estimated after Molodtsova, Polyaninova 2014 )



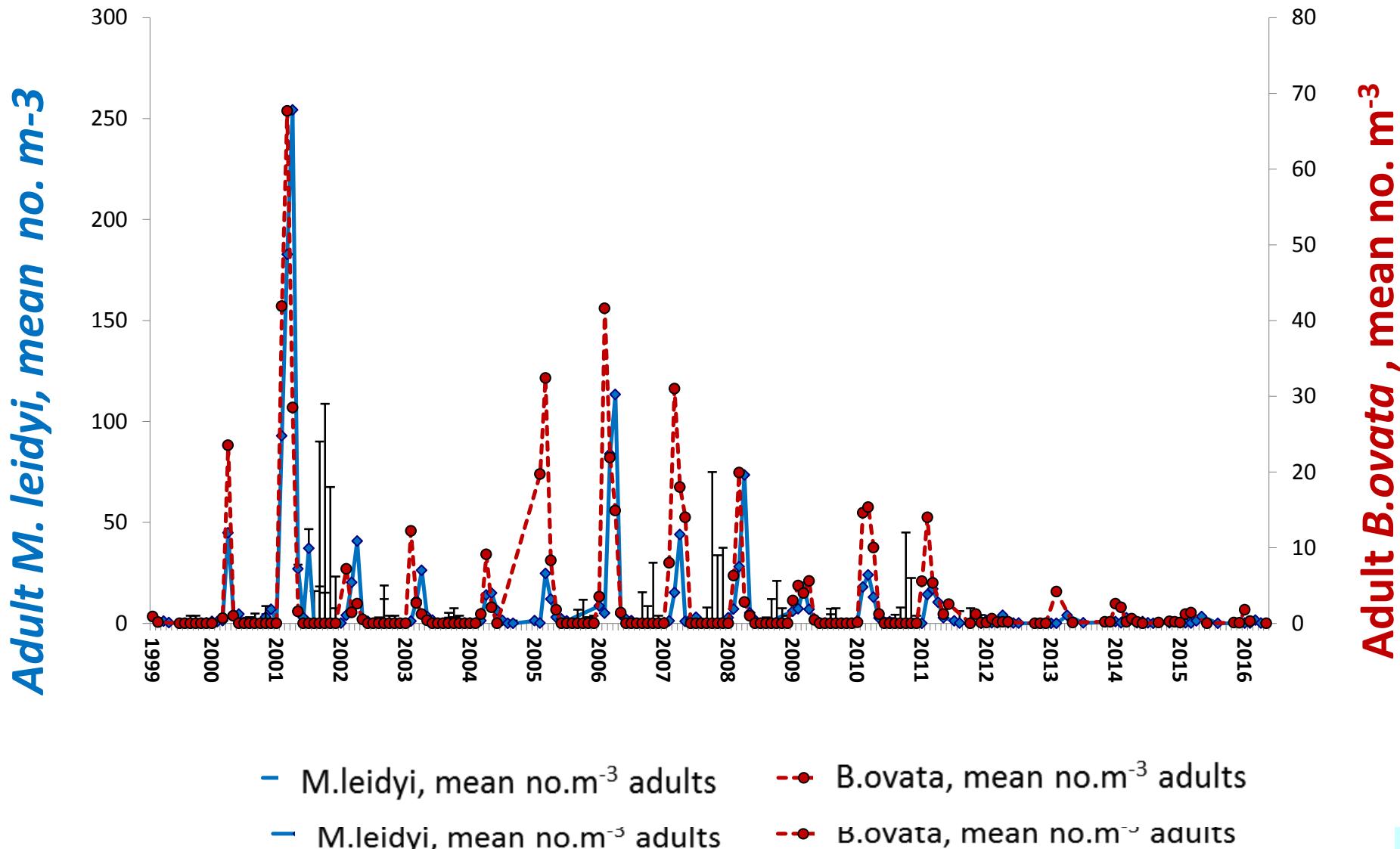
# Sturgeons catch (Acipenseridae) in Caspian in Russian waters: 1-осетр (sturgeon), 2-севрюга (stellate sturgeon), 3-белуга (beluga)



## Range of expansion *Beroe ovata* in the Eurasian seas



# Interannual development *M.leidyi* and *B.ovata*



*Beroe ovata* with *Mnemiopsis leidyi* in gvc



**Conclusion.** Summarizing we may conclude that species invaded from the Black Sea although not numerous in numbers (about 50 species) became predominated in occupied community, replacing native species and therefore recognized as one of the leading treats to biodiversity in the Caspian Sea among them *M.leidyi* imposes enormous economic damage on biodiversity and the Caspian fishery

A photograph of a fishing boat, likely a trawler, sailing on a calm sea under a clear blue sky. The boat is positioned in the lower half of the frame, moving from left to right. It has a large superstructure with various equipment and a visible mast.

**Thank you for attention**