Comparative analyses of invasive ctenophores' blooms in the seas of Eurasia and their effect on ecosystems and fisheries

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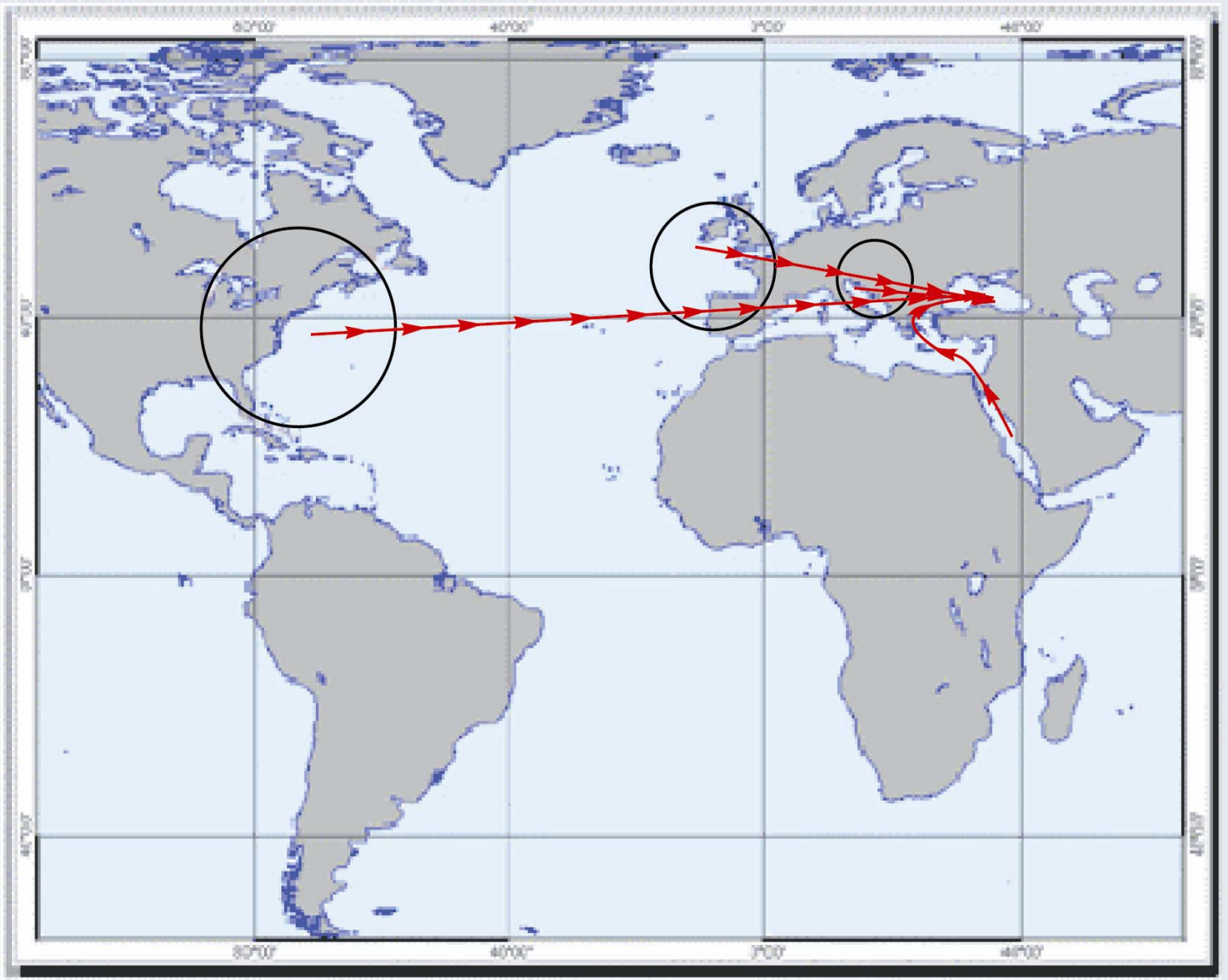
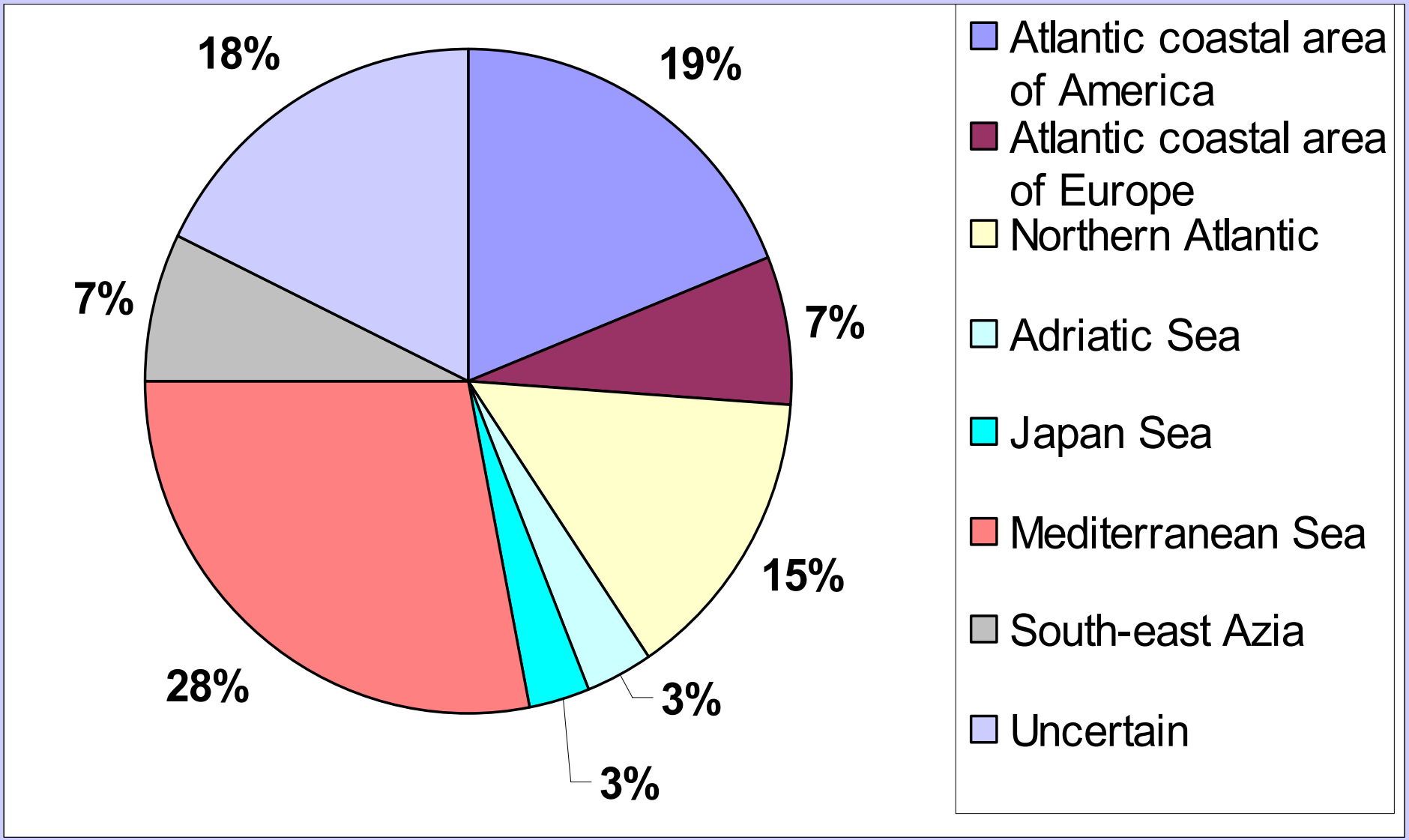
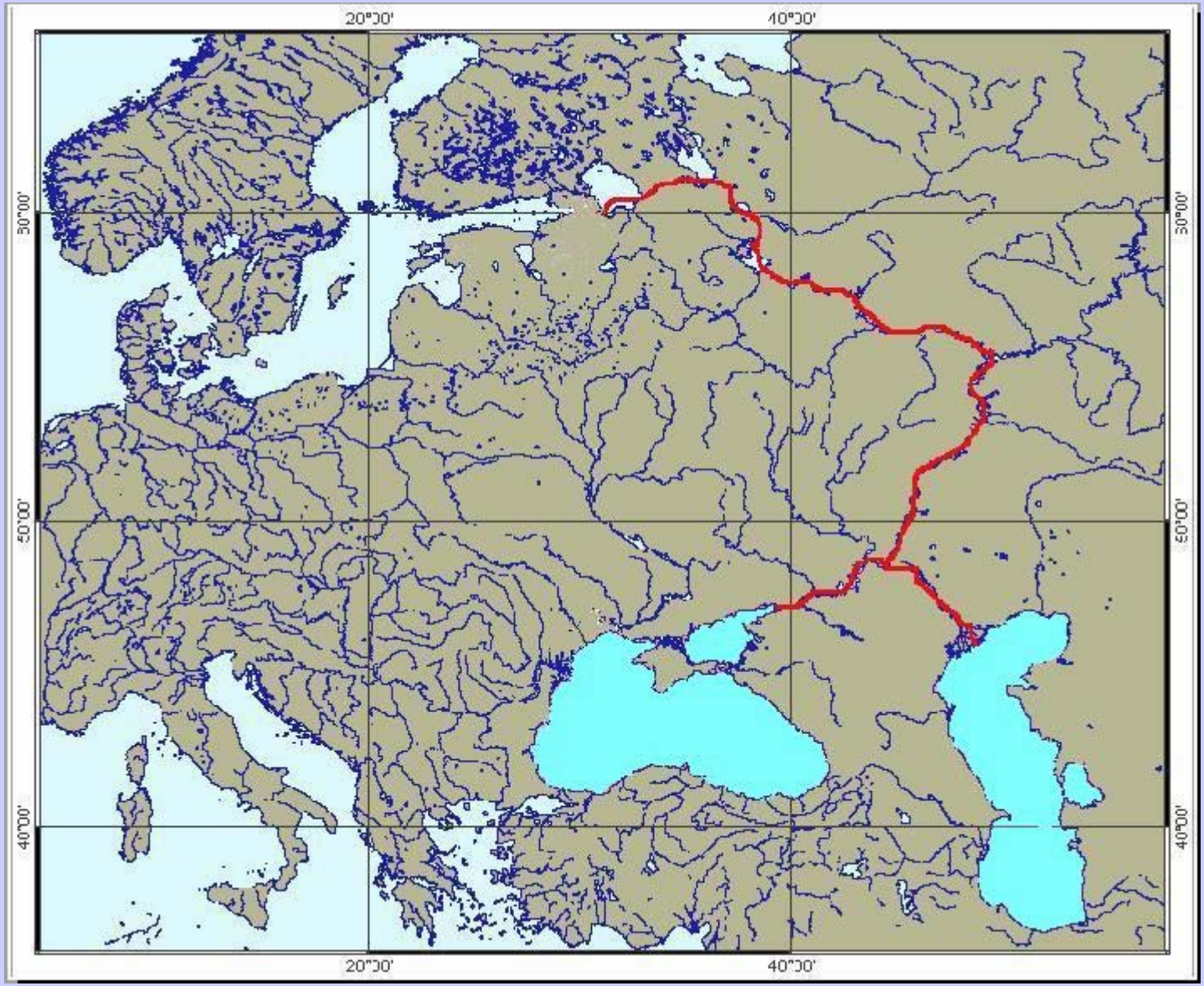
The main corridors of alien species introduction into the Black Sea



Origin of the invasive species in the Black Sea



Migration corridors from the Black-Azov Sea region to the Caspian Sea and to the Baltic Sea

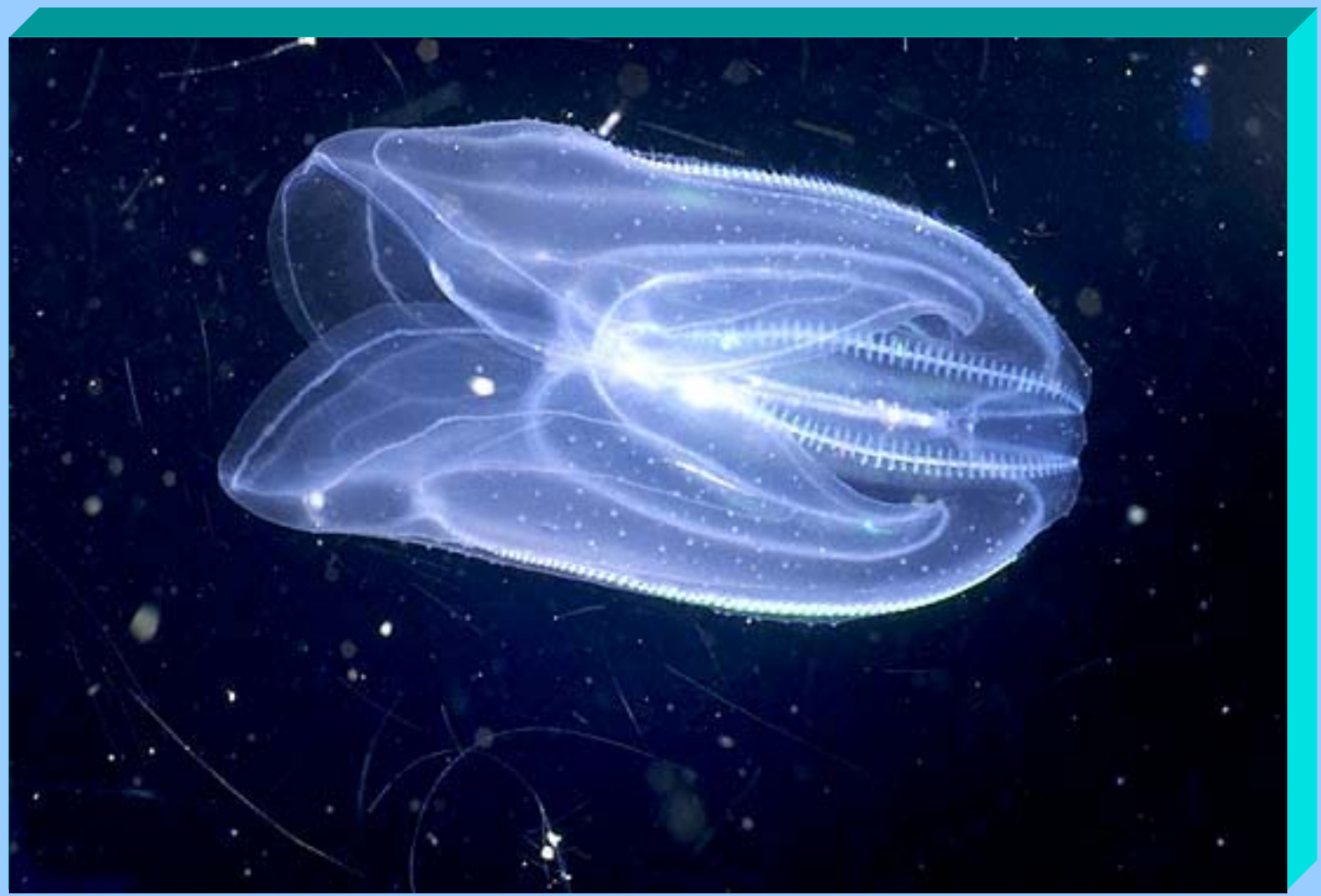


Geomorphological and hydrological characteristics of the seas

Location	Depth max. (mean) (m)	Winter, T^0 (C^o)	Summer, T^0 (C^o)	Salinity
Black Sea	2245 (1271) Oxic layer 200(60)	0-8	24-27	17-22.3
Sea of Azov	14.5 (7)	-08.-+1.2	24-30	0-14
Sea of Marmara	1335(10)	8-15	24-29	18-29
Caspian Sea (total) Northern Middle Southern	1025(208) 15-20 (4.4) 770 (192) 1025(345)	0-11 0-0.5 0-11 5.6-10.7	24-28 25-27 24-25 25-28	0.1-13 0.1-11 12.6-13 12.6-13
North Aegean (offshore)	300 (30)	12 -18	24-27	36 - 39
North Aegean - Limnos island area	80 (30)	11 – 18	24-27	30 - 33
Central Aegean - N.Euvoikos Gulf	150 (30)	12 – 16	23.5-25	37 – 37.6
Central Aegean - Saronikos Gulf	200 (15)	13 – 18	24-26	37.8 - 39

Ctenophora

Mnemiopsis leidyi A.Agassiz 1865

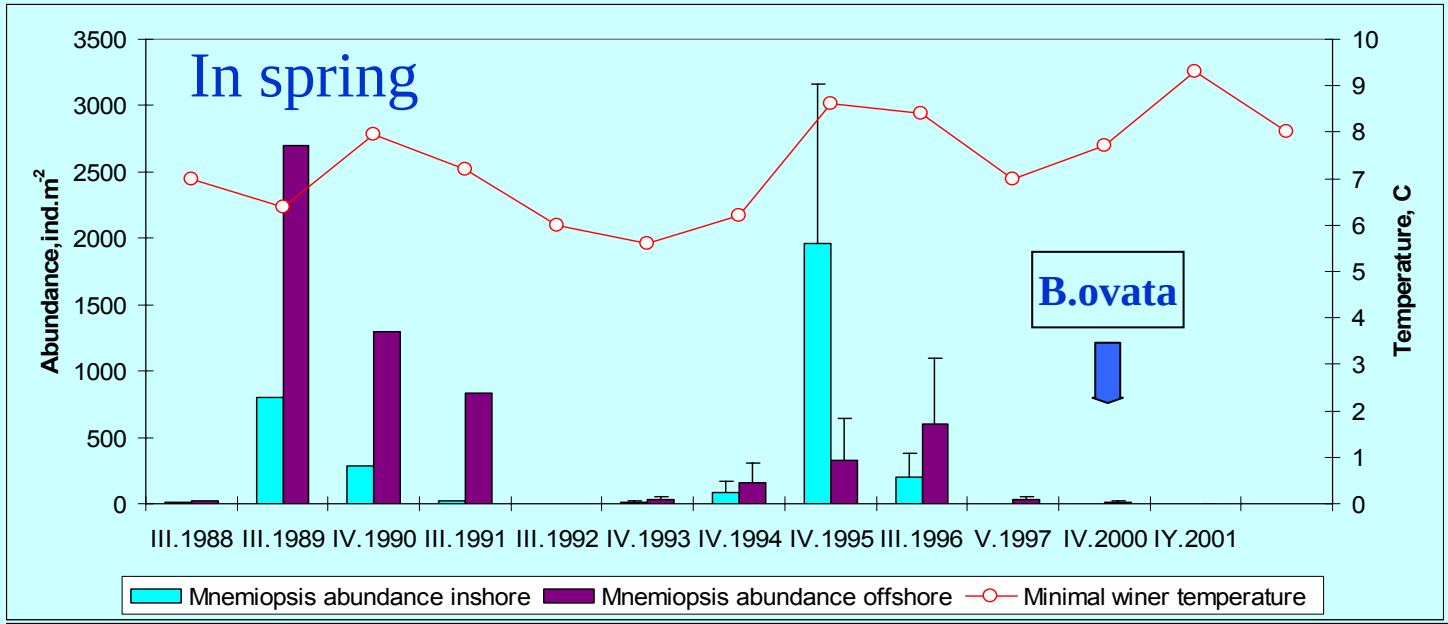


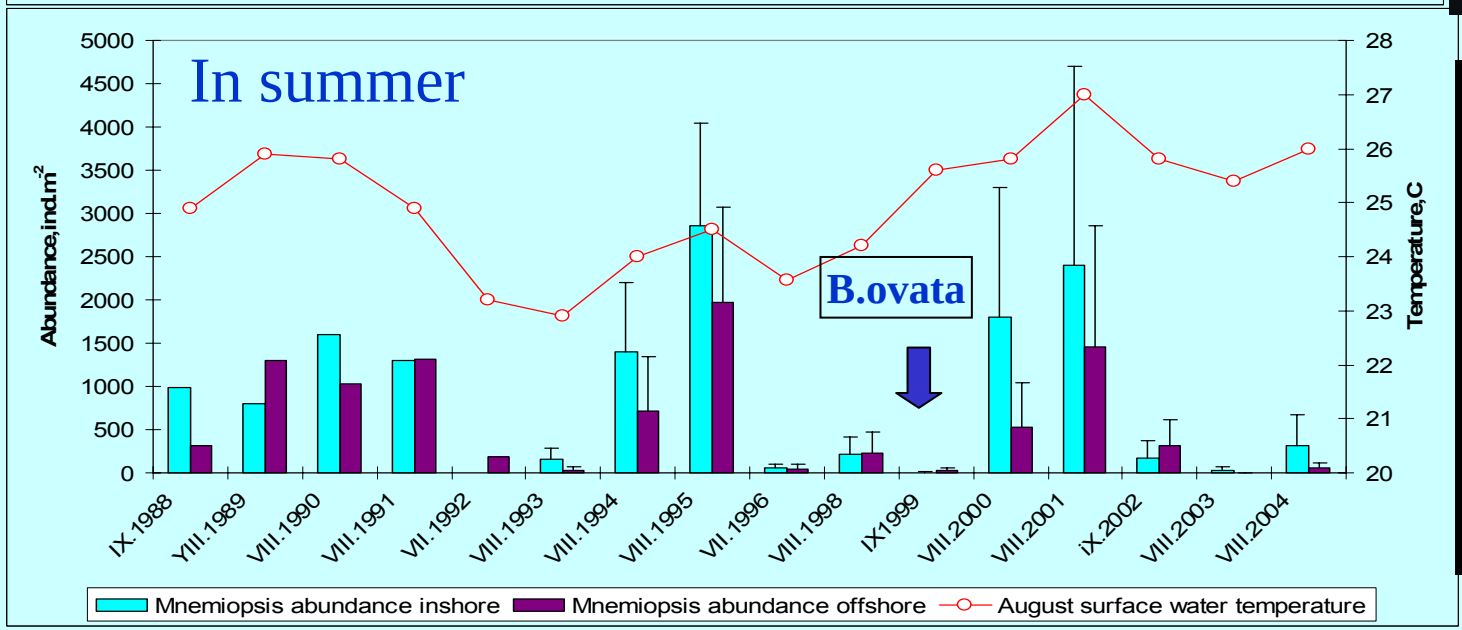
Recipient area of *Mnemiopsis leidyi*

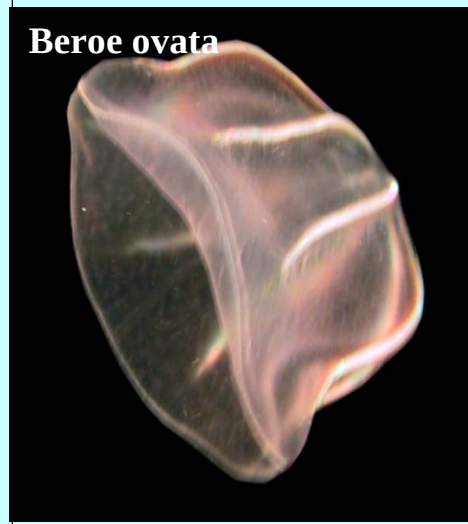
Main large scale events before *M.leidyi* introduction

- **Decrease of fresh water runoff**
- **Input pollutions from the rivers**
- **Eutrophication**
- **selective fishing and overfishing**
- ***Noctiluca scintillans*** **and** ***Aurelia aurita*** **bloom**

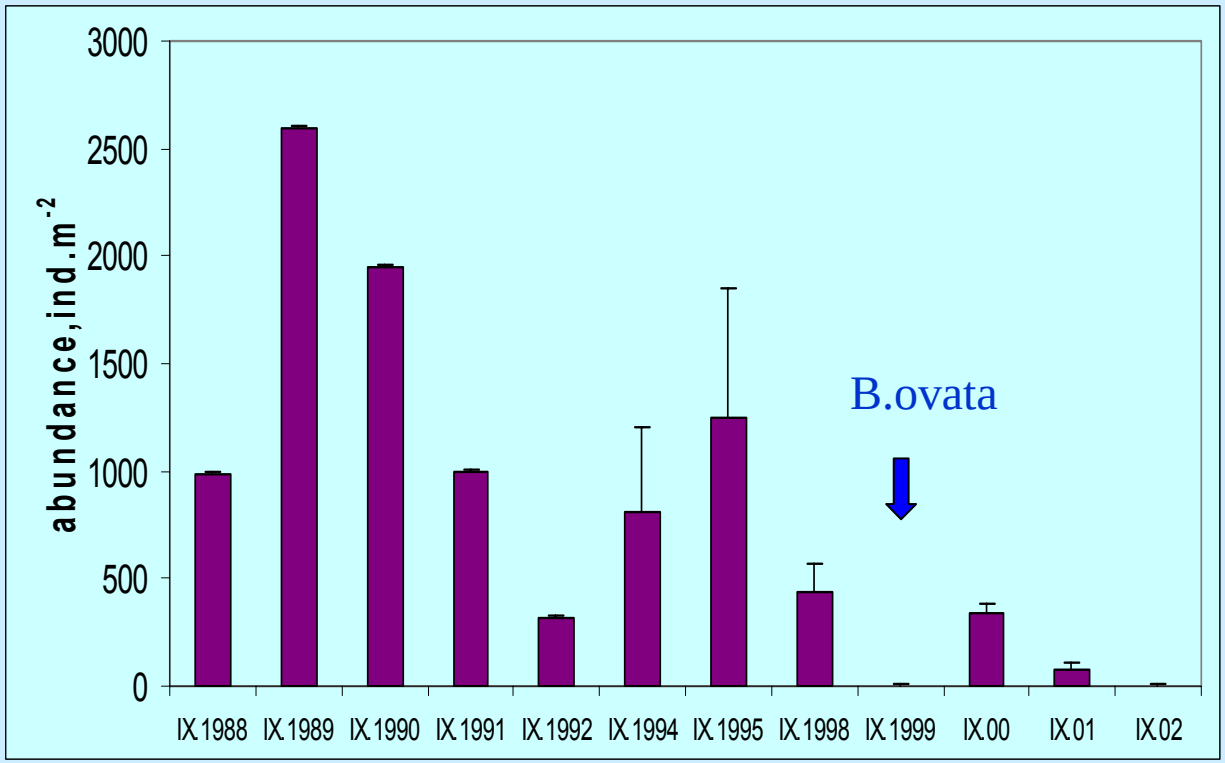
Annual *Mnemiopsis leidyi* and surface water temperature variabilities in the Black Sea







Annual *Mnemiopsis leidyi* variabilities in autumn in the Black Sea

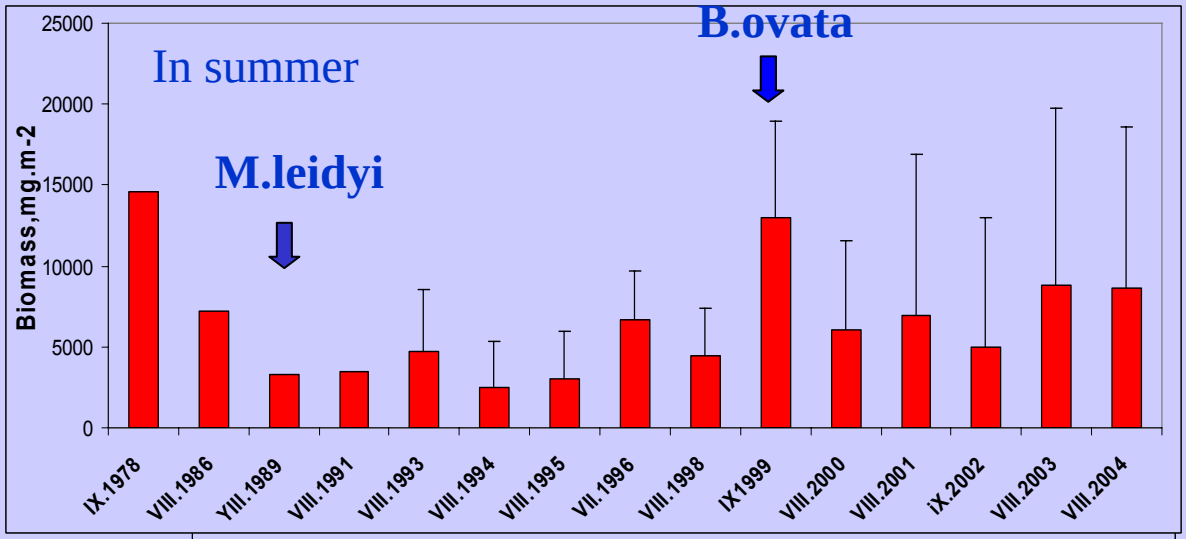


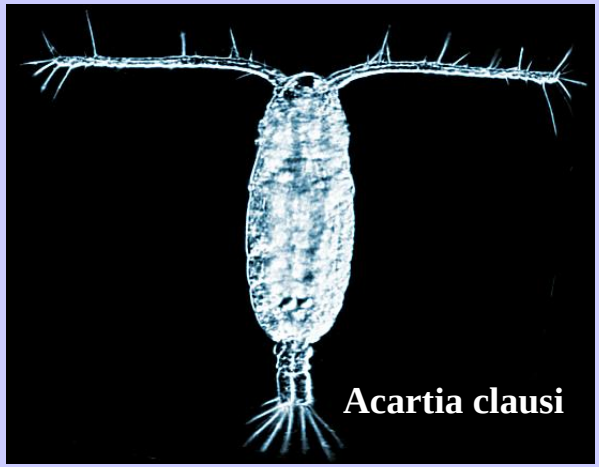
Ctenophora

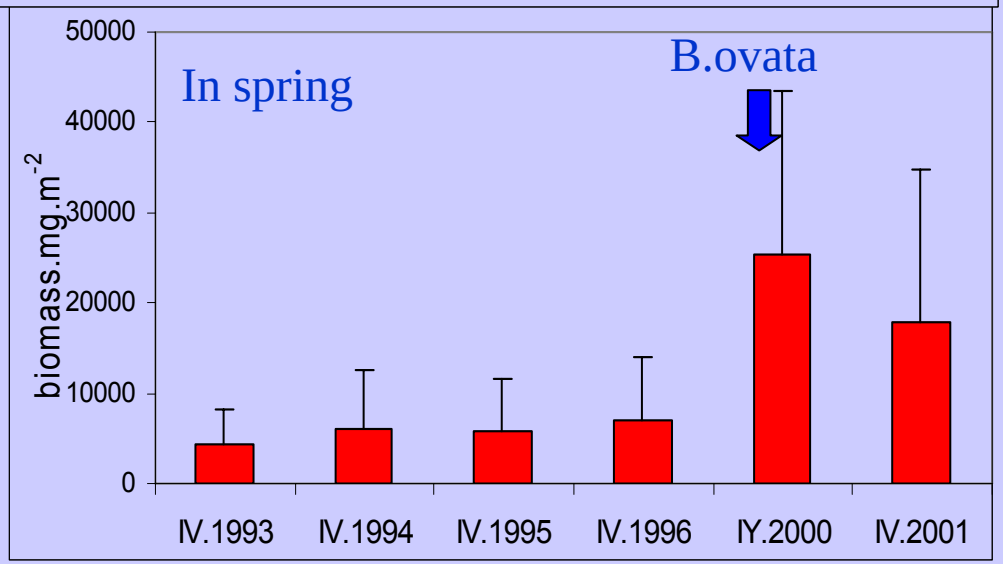
Beroe ovata Mayer 1912

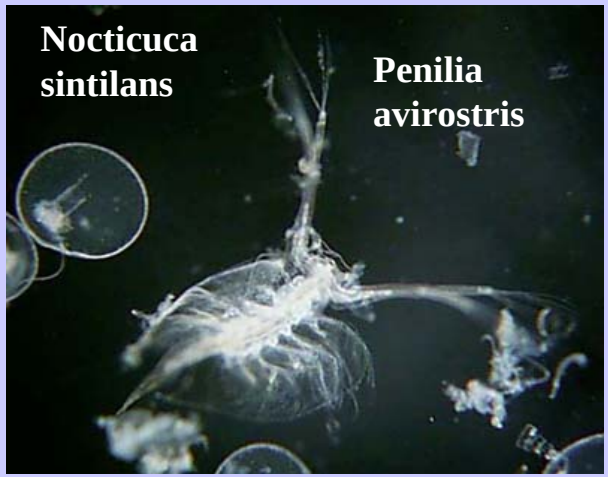
Recipient area of *Beroe ovata*

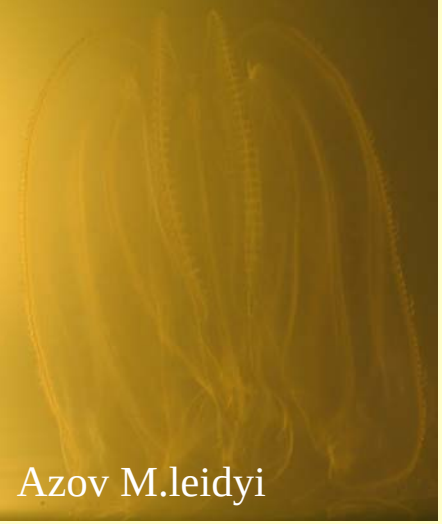
Annual zooplankton variability (mg.m^{-2}) in the Black Sea



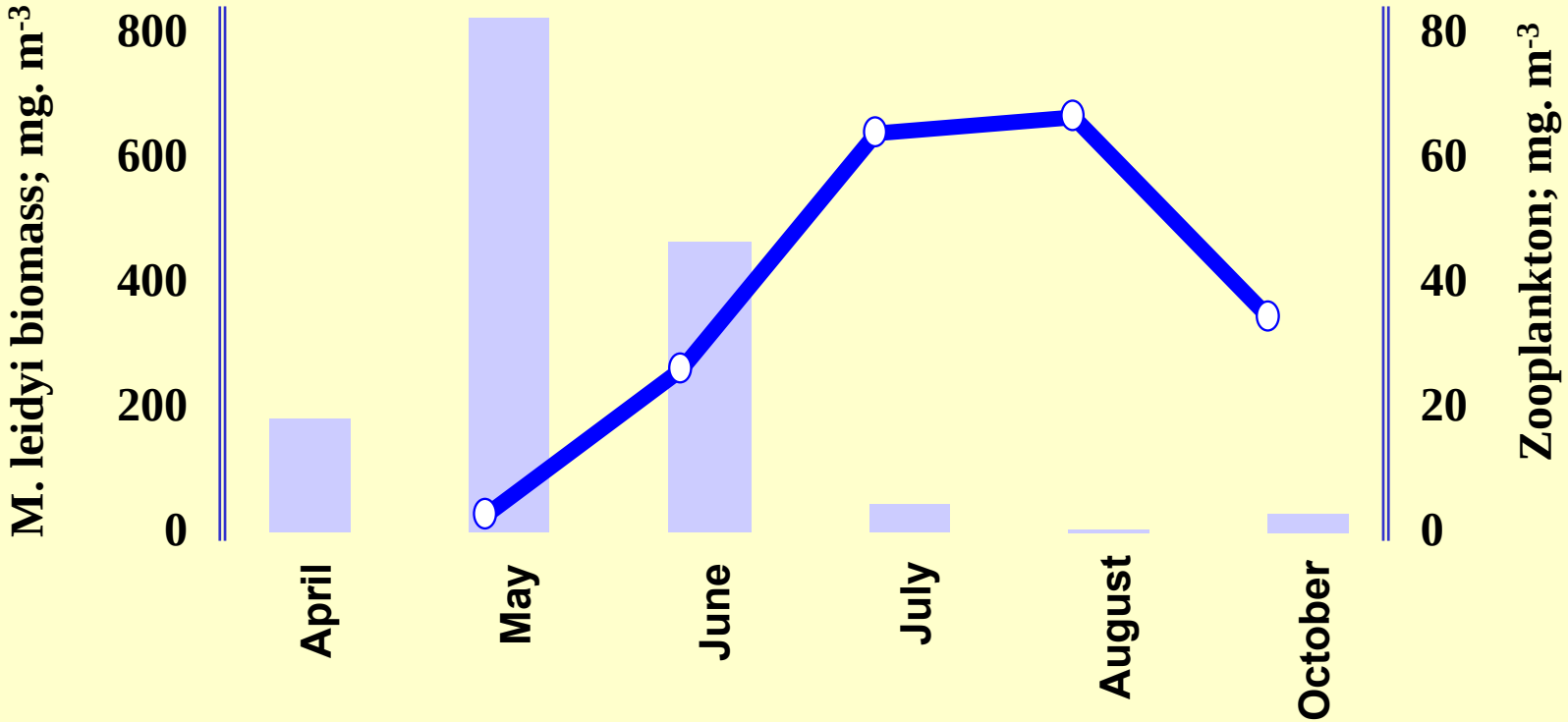




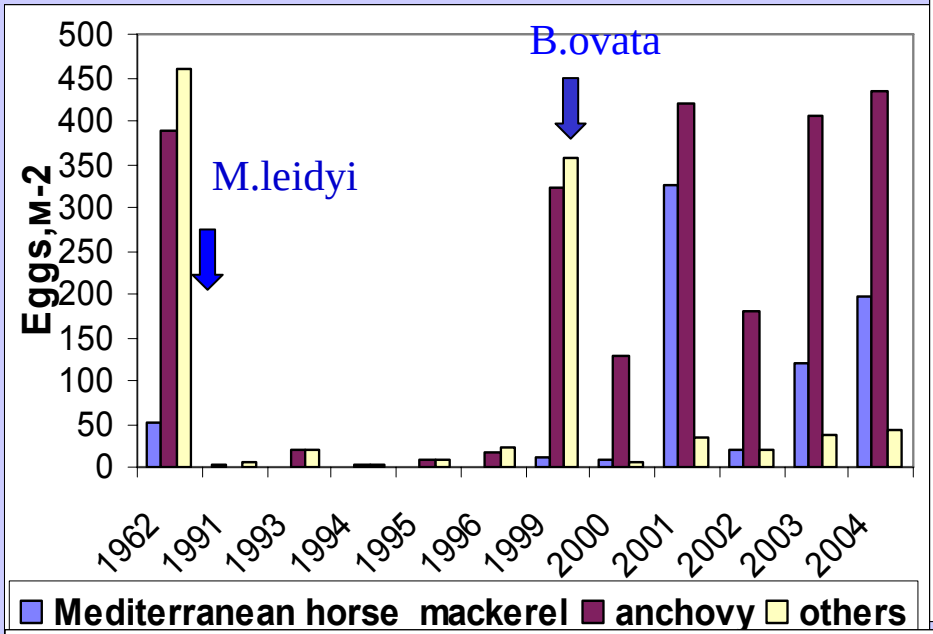


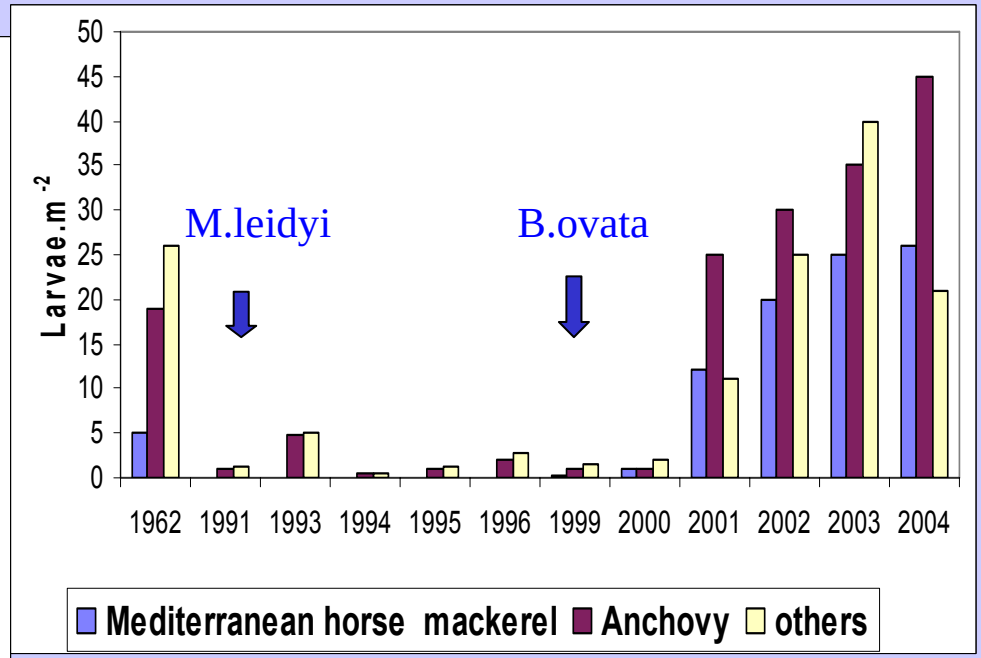


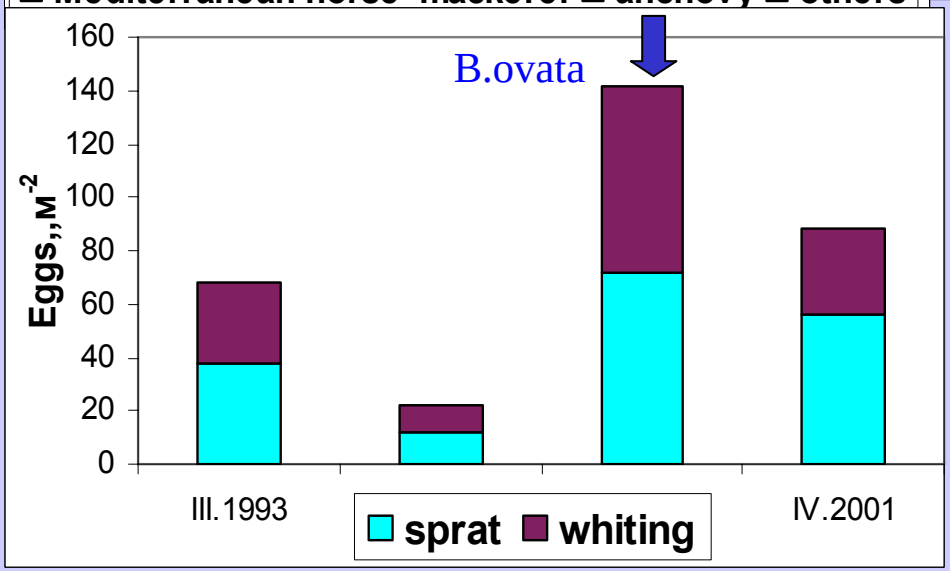
Seasonal variation of *M. leidyi* and zooplankton in the Sea of Azov



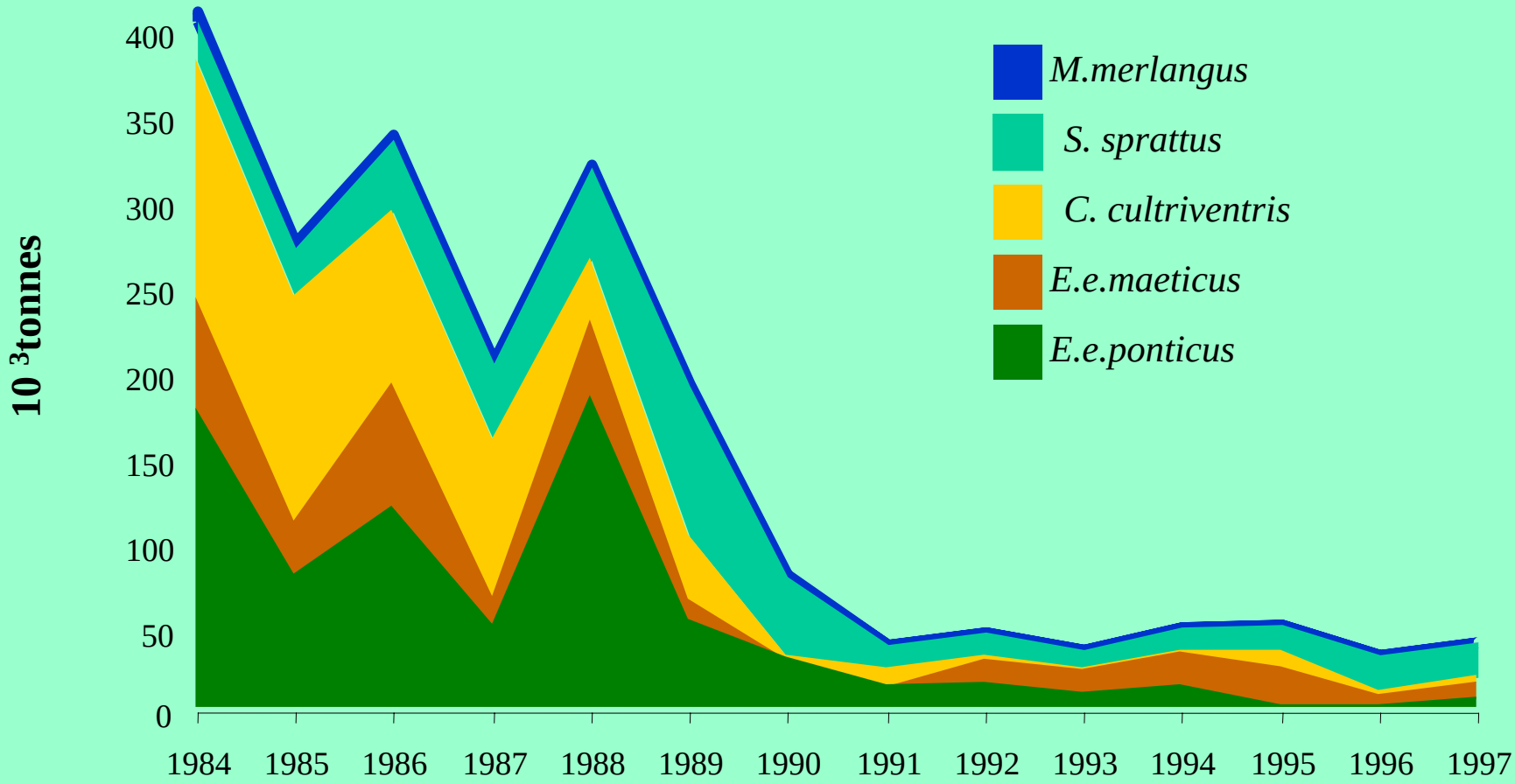
Annual variability of fish eggs and larvae (ind.m^{-2})



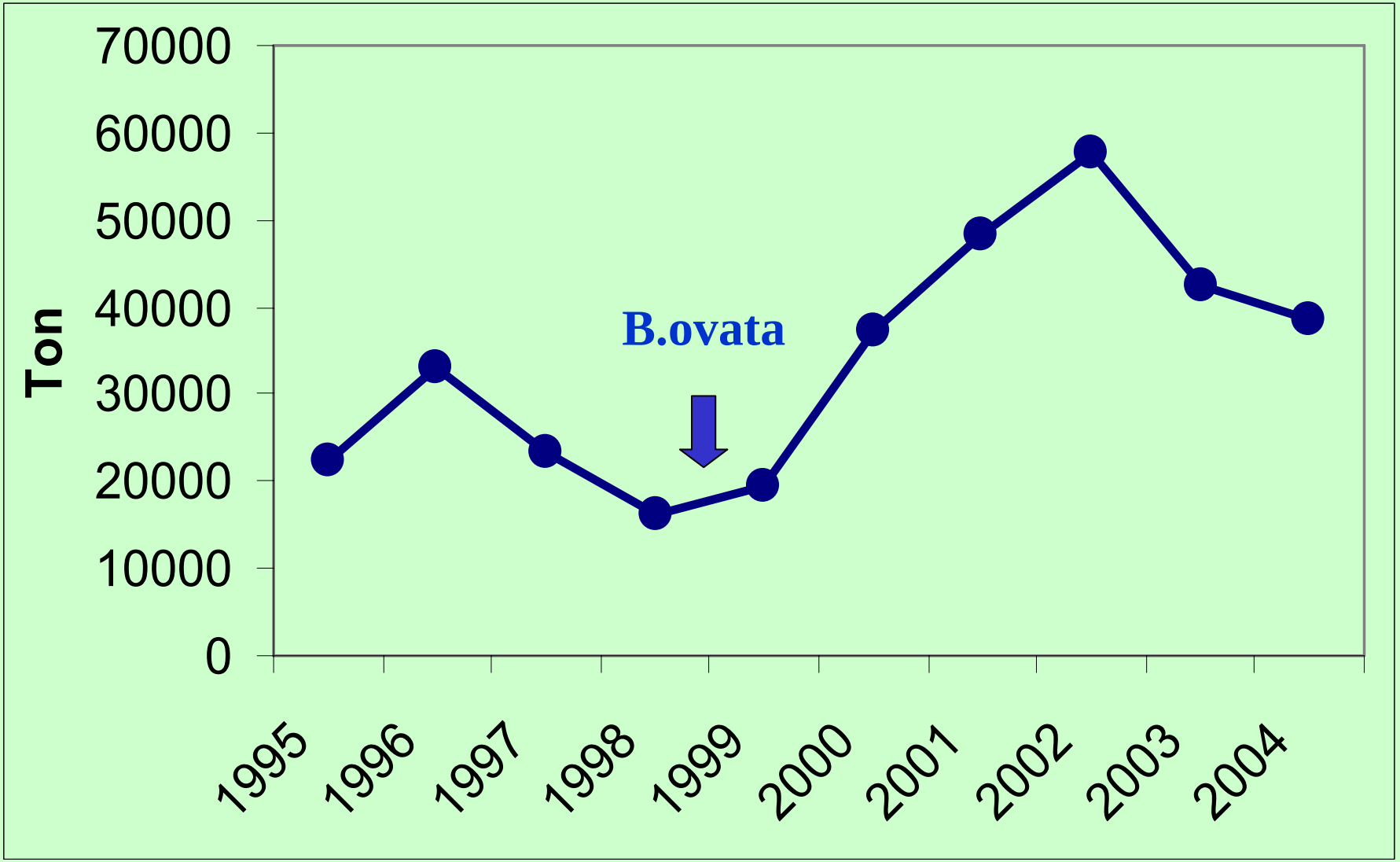




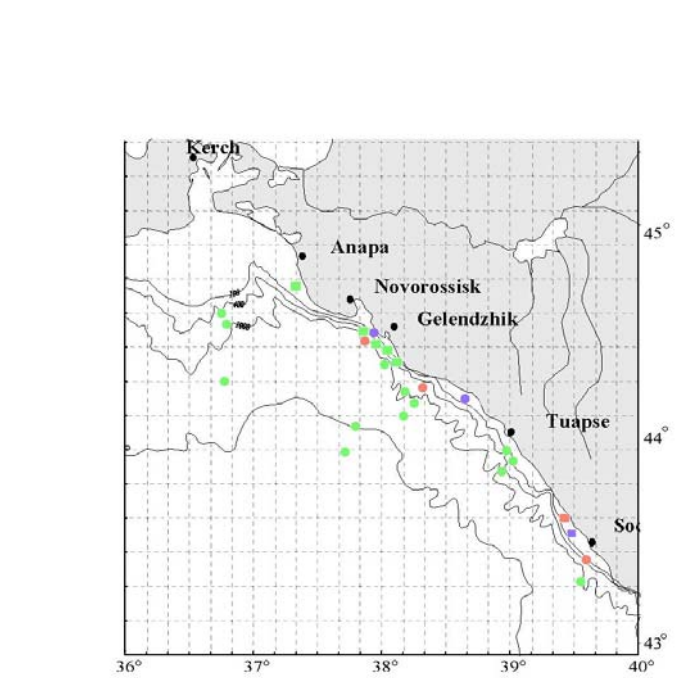
Catches of planktivorous fish in the Black and Azov Seas former soviet countries (Russia, Ukraine,Georgia)

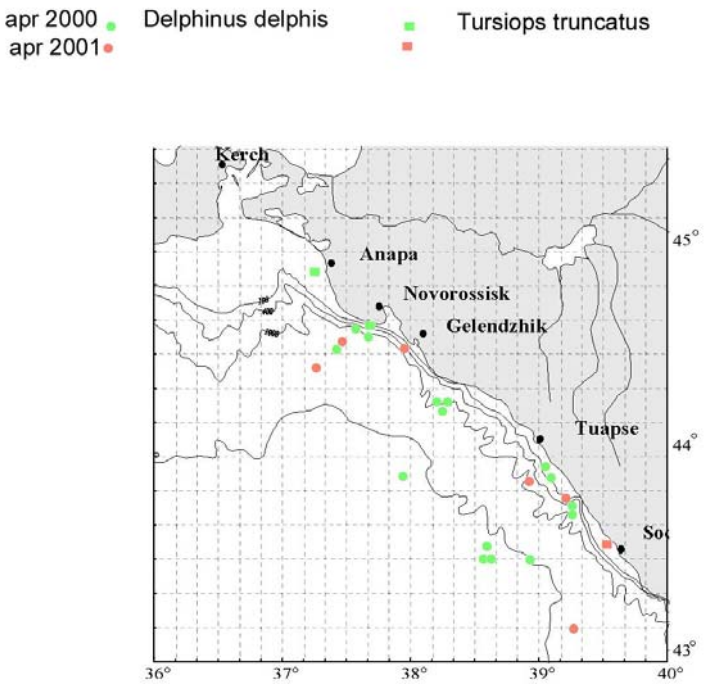


Russian catch inAzov-Black Seas

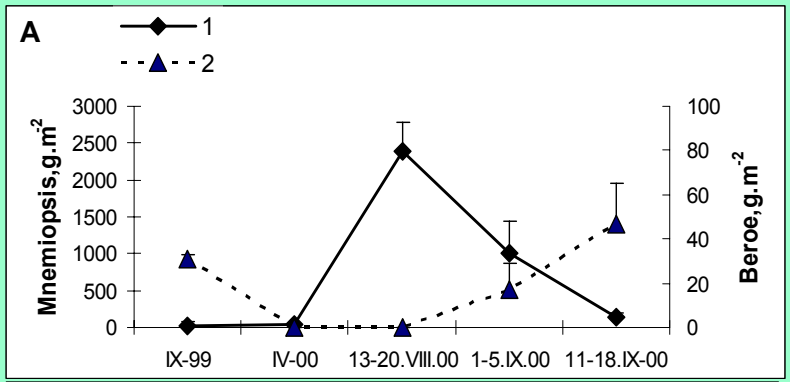


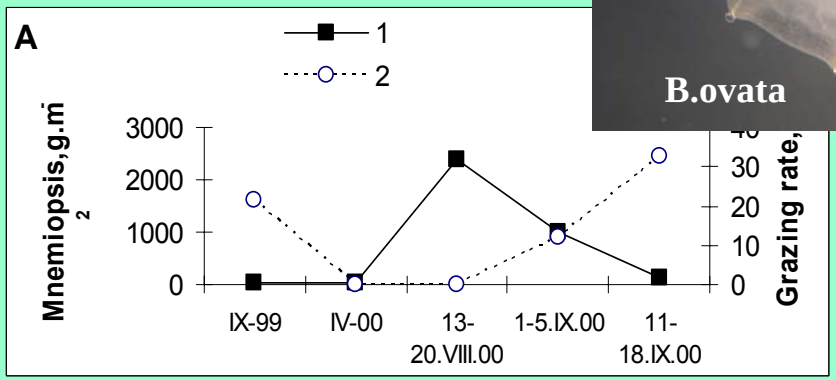
Changes abundance and distribution of Dolphins

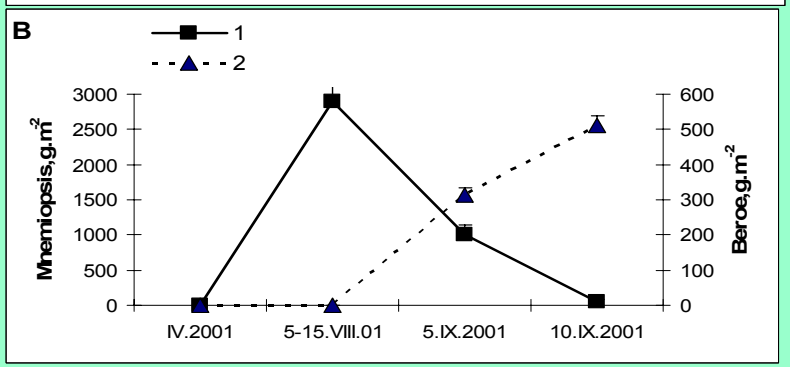


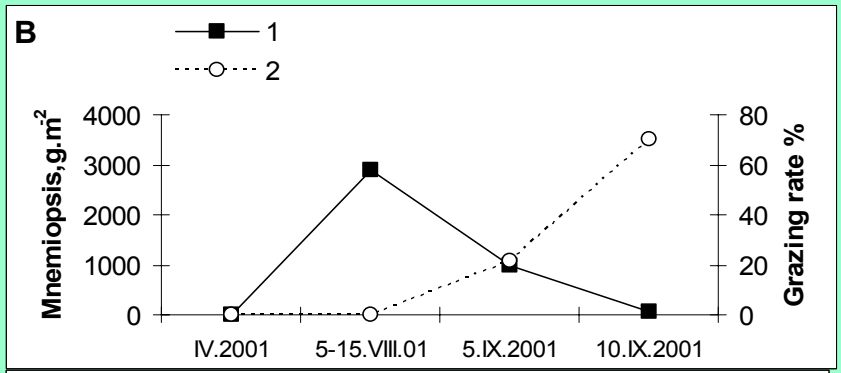


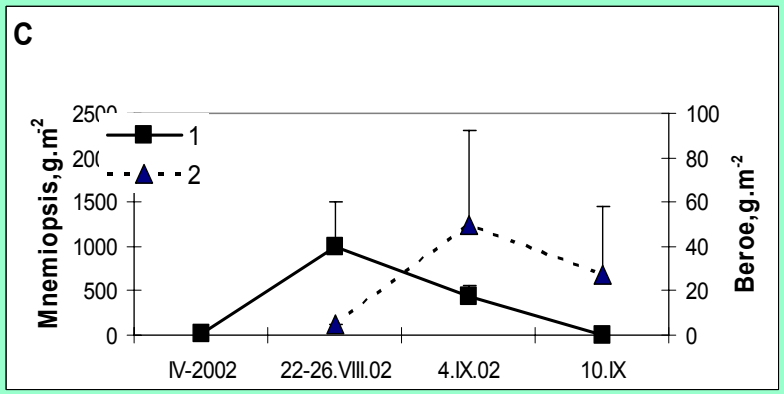
Interaction of M.leidyi and B.ovata

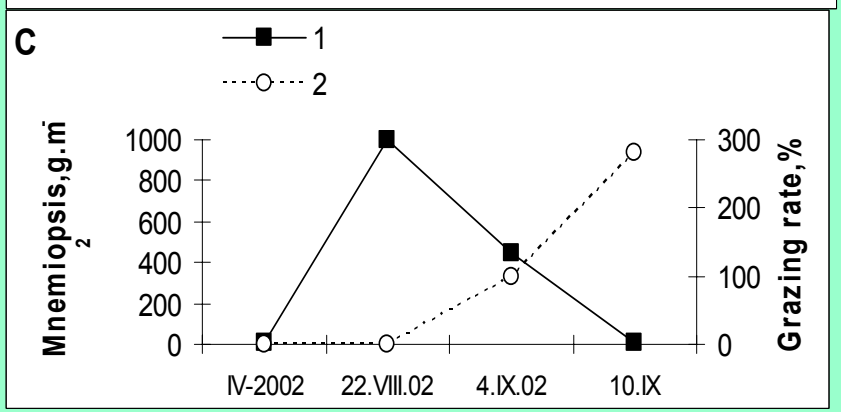


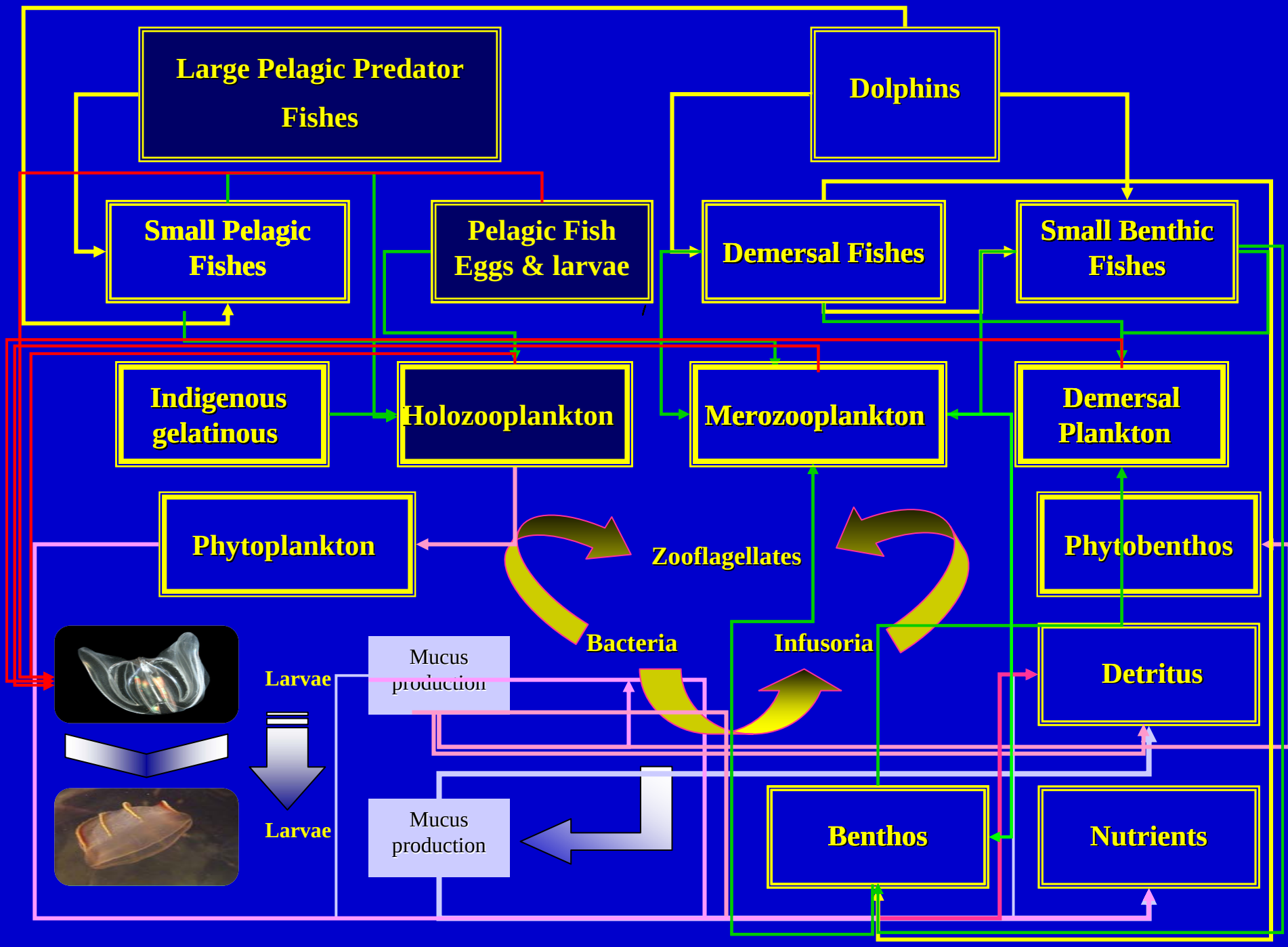






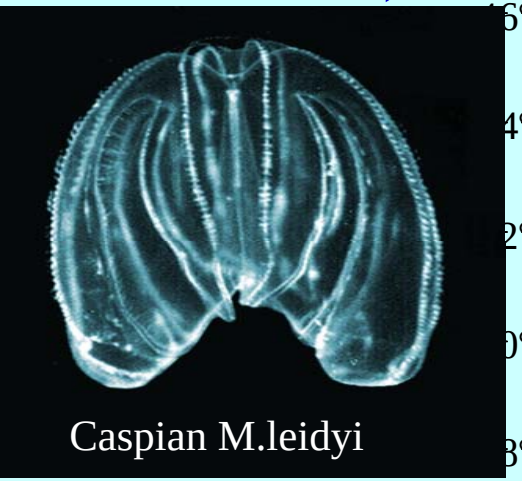


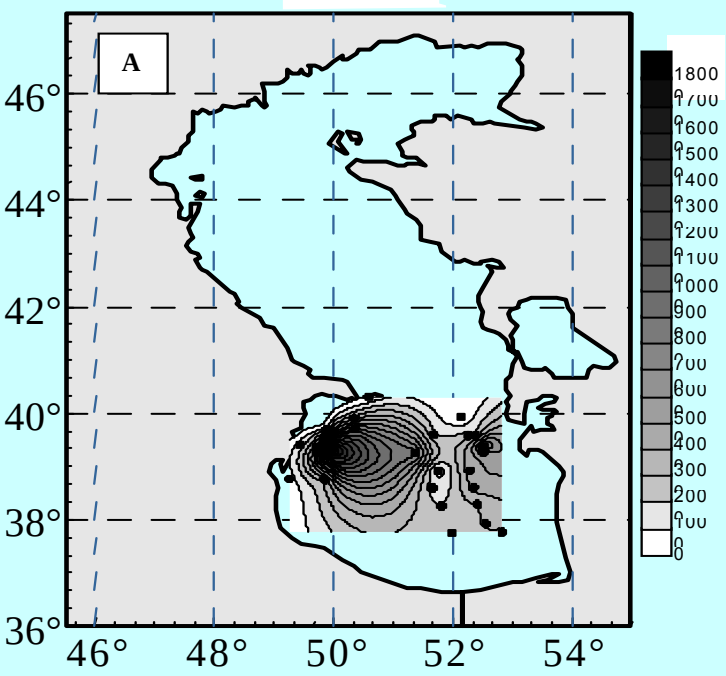


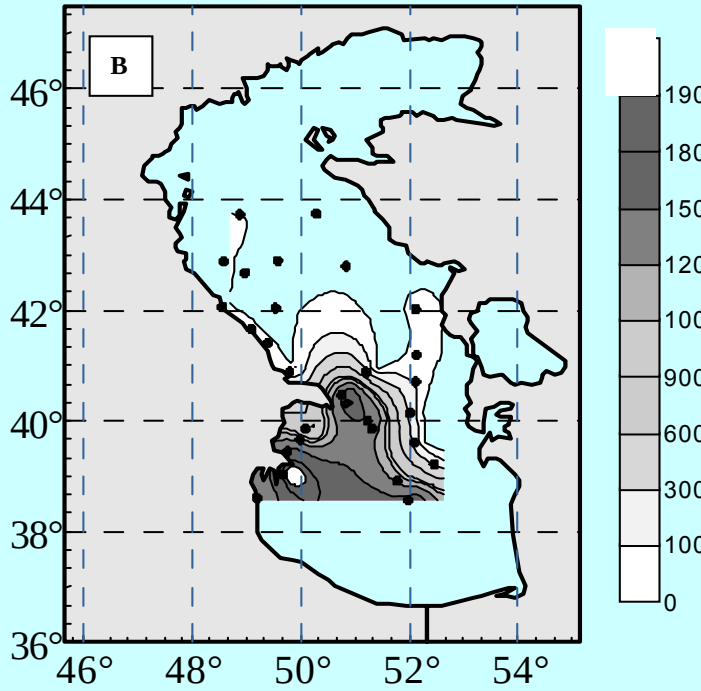

Large Pelagic Predator Fishes
Dolphins
Small Pelagic Fishes
Pelagic Fish Eggs & larvae
Demersal Fishes
Small Benthic Fishes
Indigenous gelatinous
Holozooplankton
Merozooplankton
Demersal Plankton
Phytoplankton
Zooflagellates
Phytobenthos
Bacteria
Infusoria
Detritus
Larvae
Mucus production
Larvae
Mucus production
Benthos
Nutrients

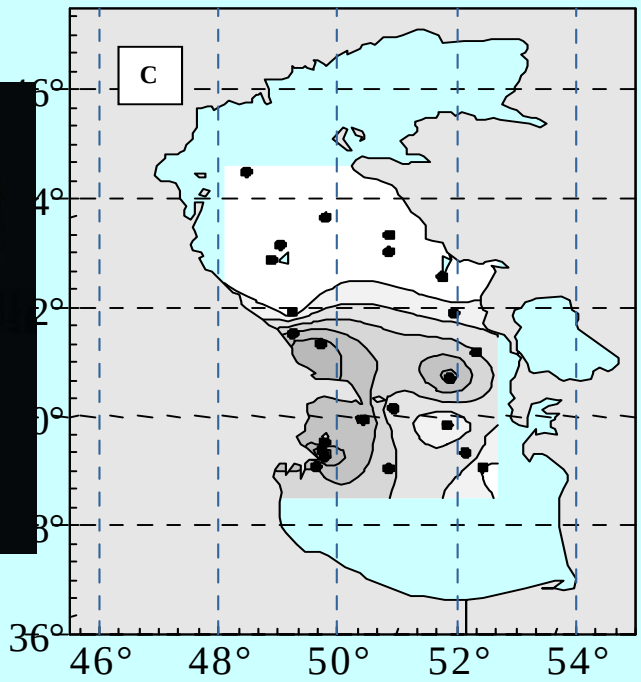
Seasonal spatial distribution *M.leidyi* in the Caspian Sea

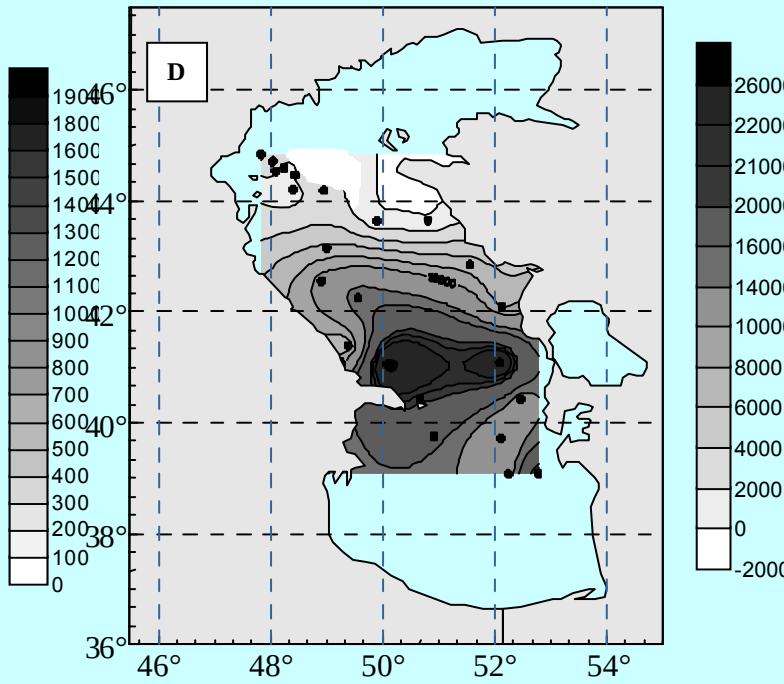
A-in January;
B-in May;
C-in July;
D- in August
(data CaspNIRKH and SIO RAS)


Caspian M.leidyi

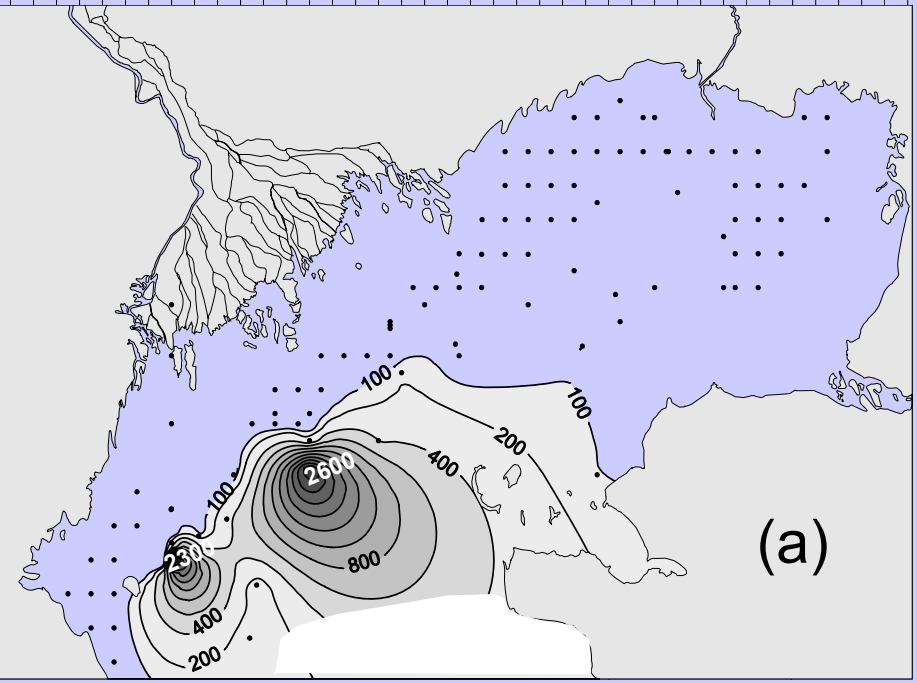


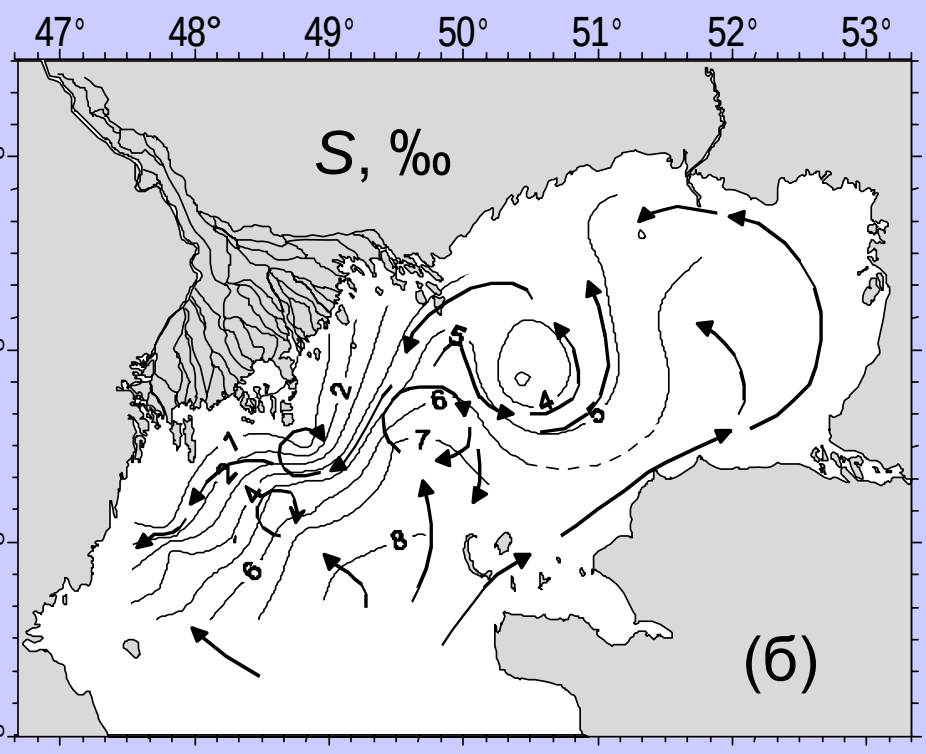


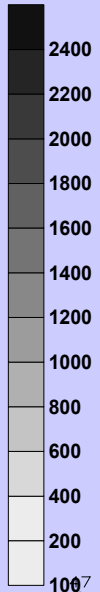


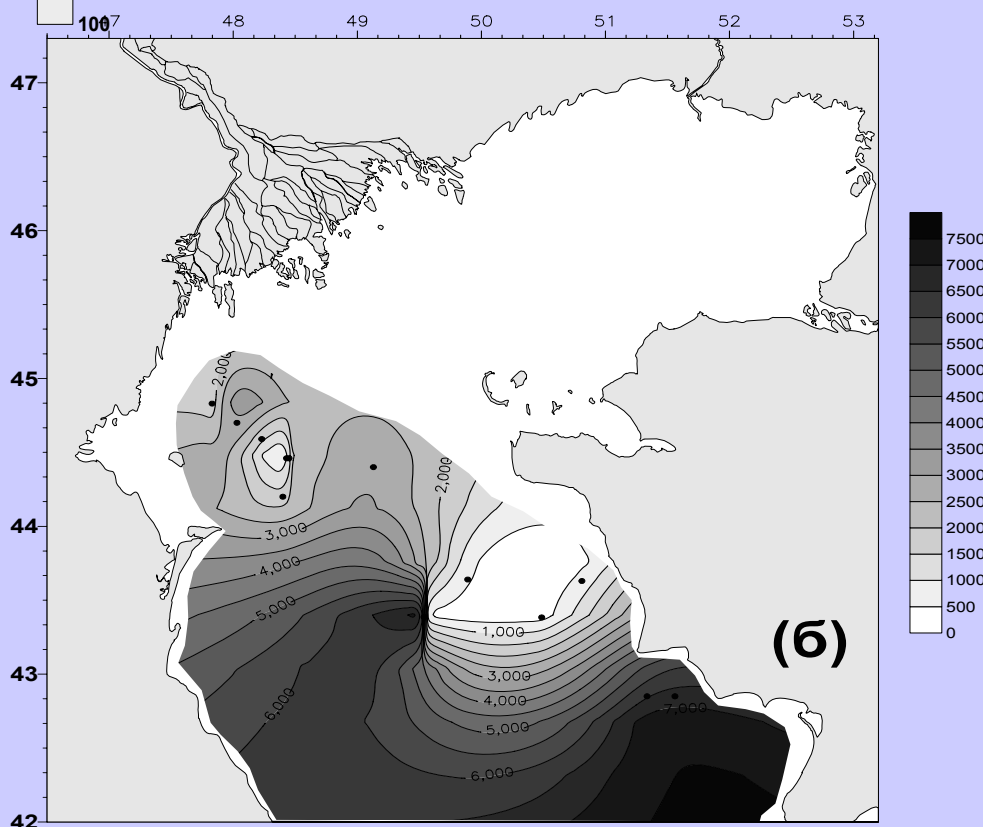


Pattern of *M.leidyi* spatial distribution in the Northern Caspian: a- in 2002, b-in 2001



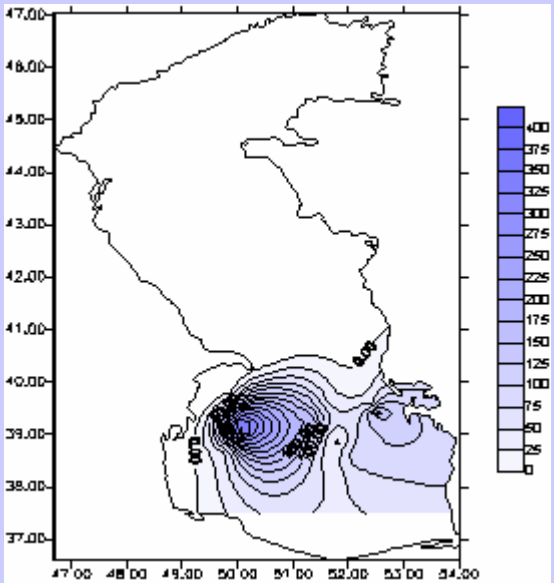




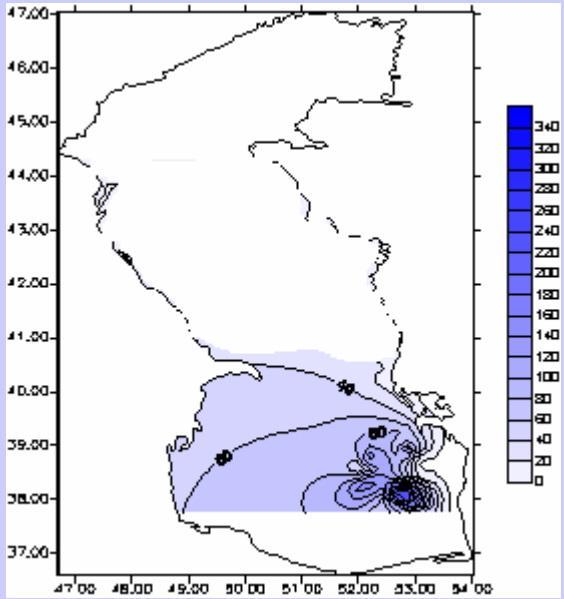


Pattern of *M.leidyi* distribution in winter

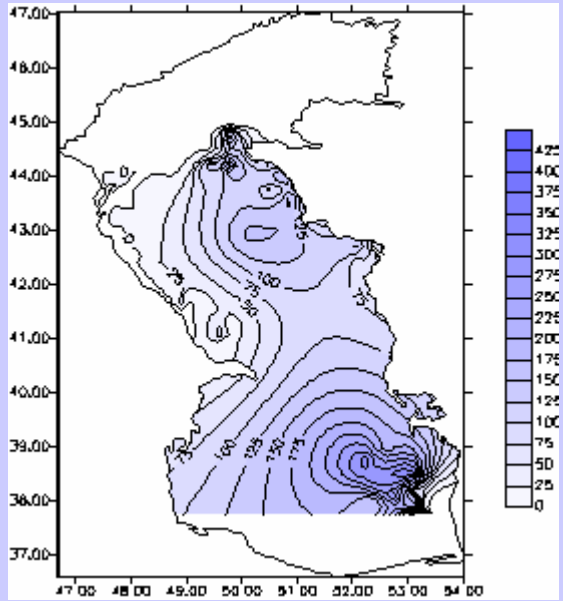
2002

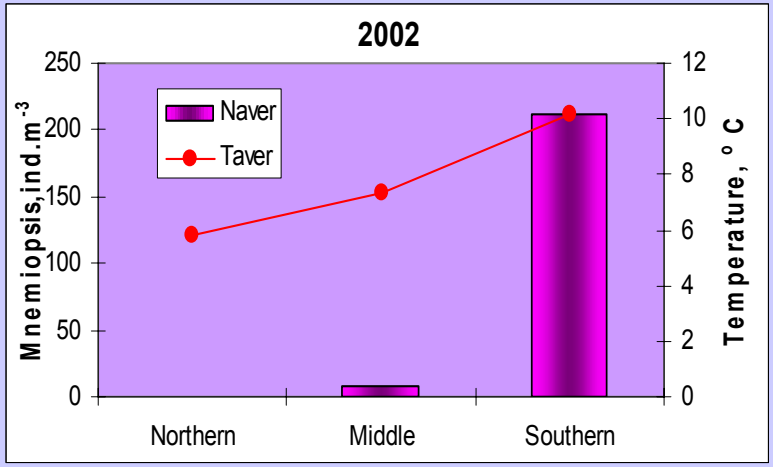


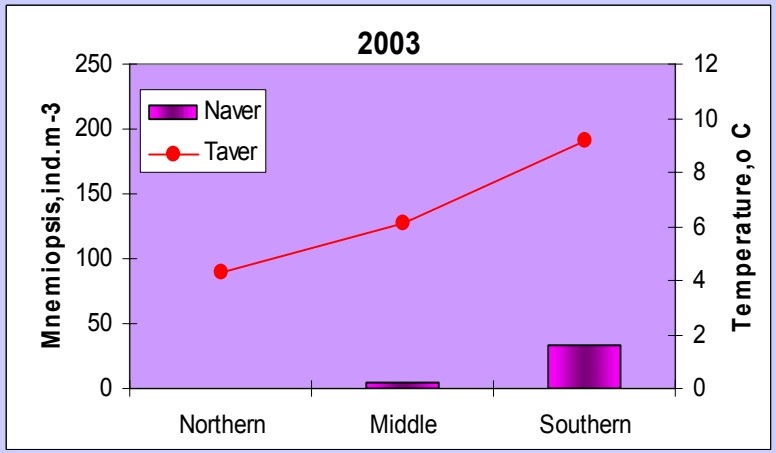
2003

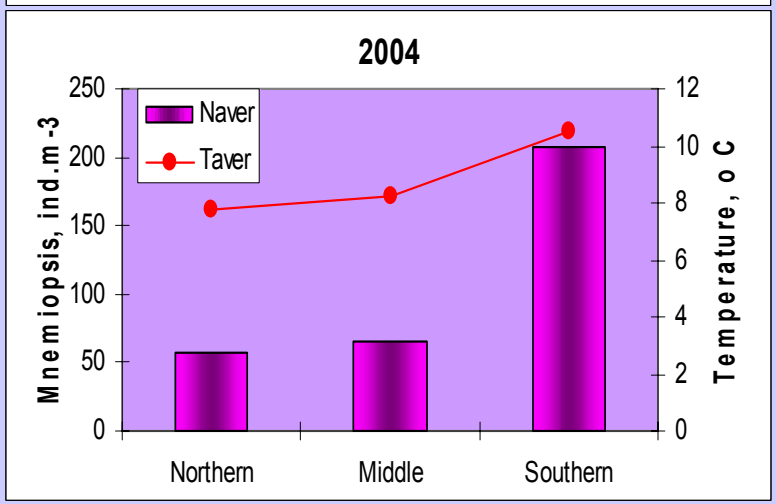


2004



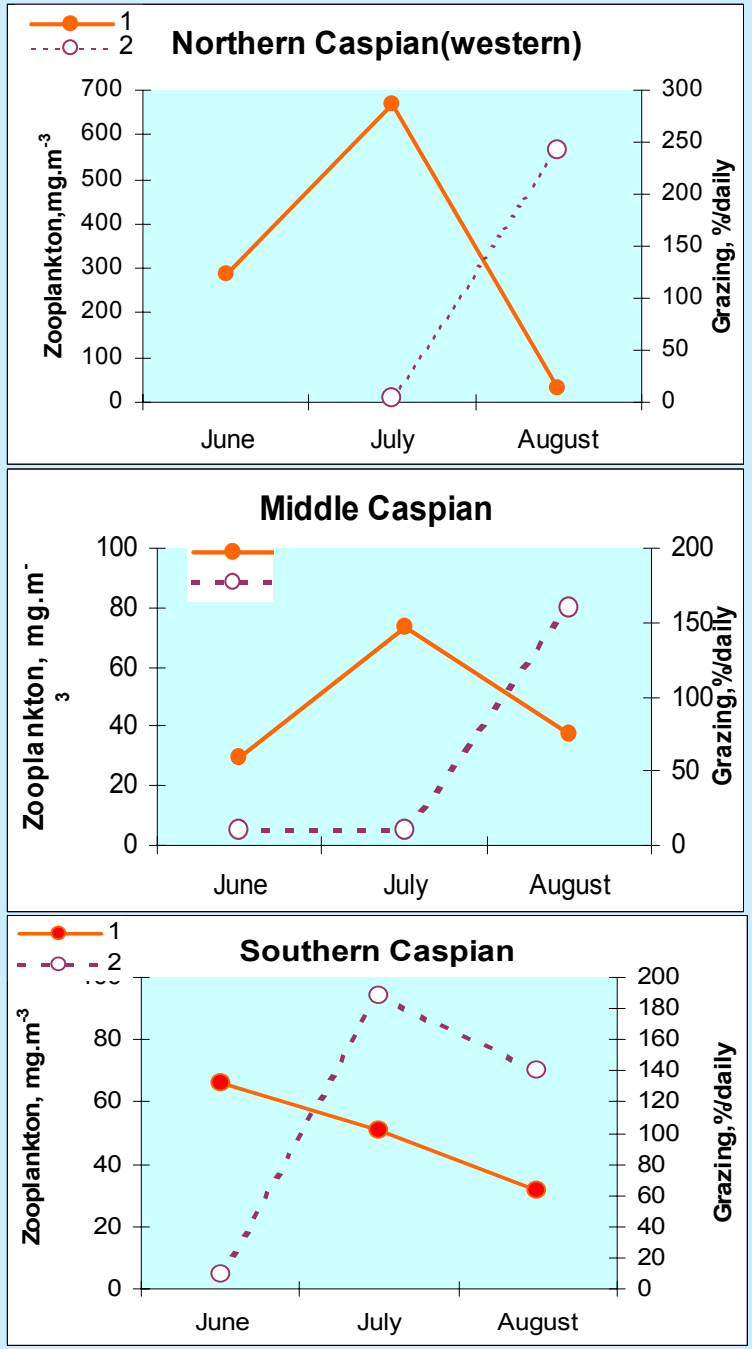






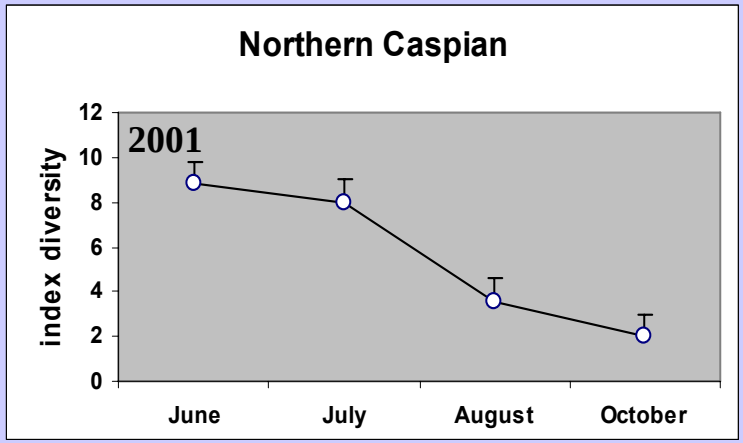
Mnemiopsis leidyi **abundance (ind.m-3) and mean surface water temperature (C) in winter**

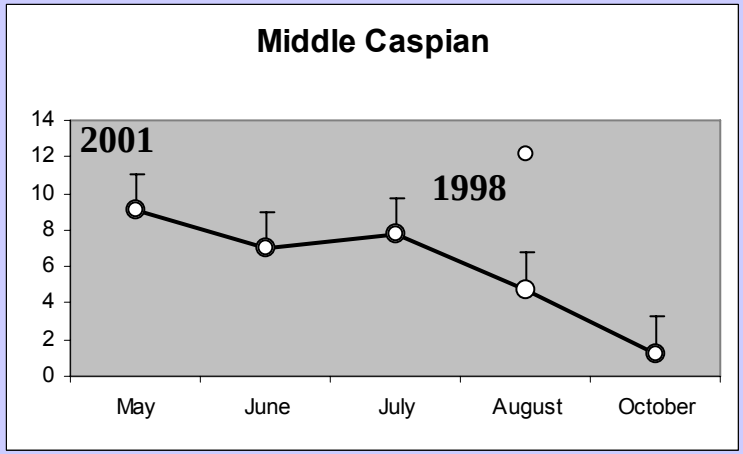
Zooplankton biomass(1) and grazing rate of *M.leidyi*(2) in the Caspian Sea

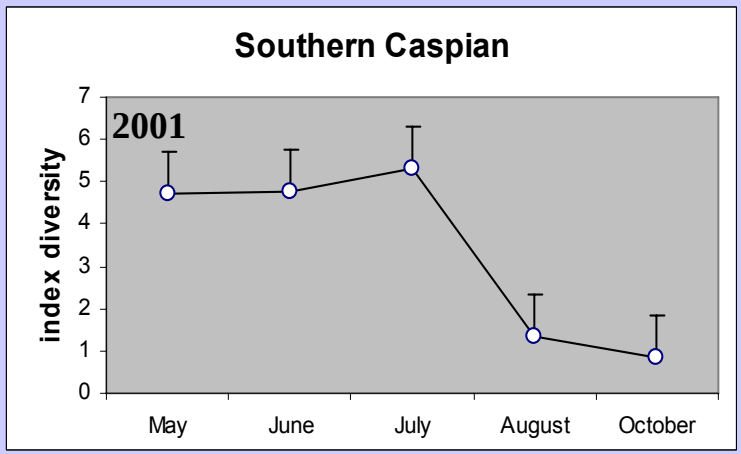


Seasonal changes of zooplankton

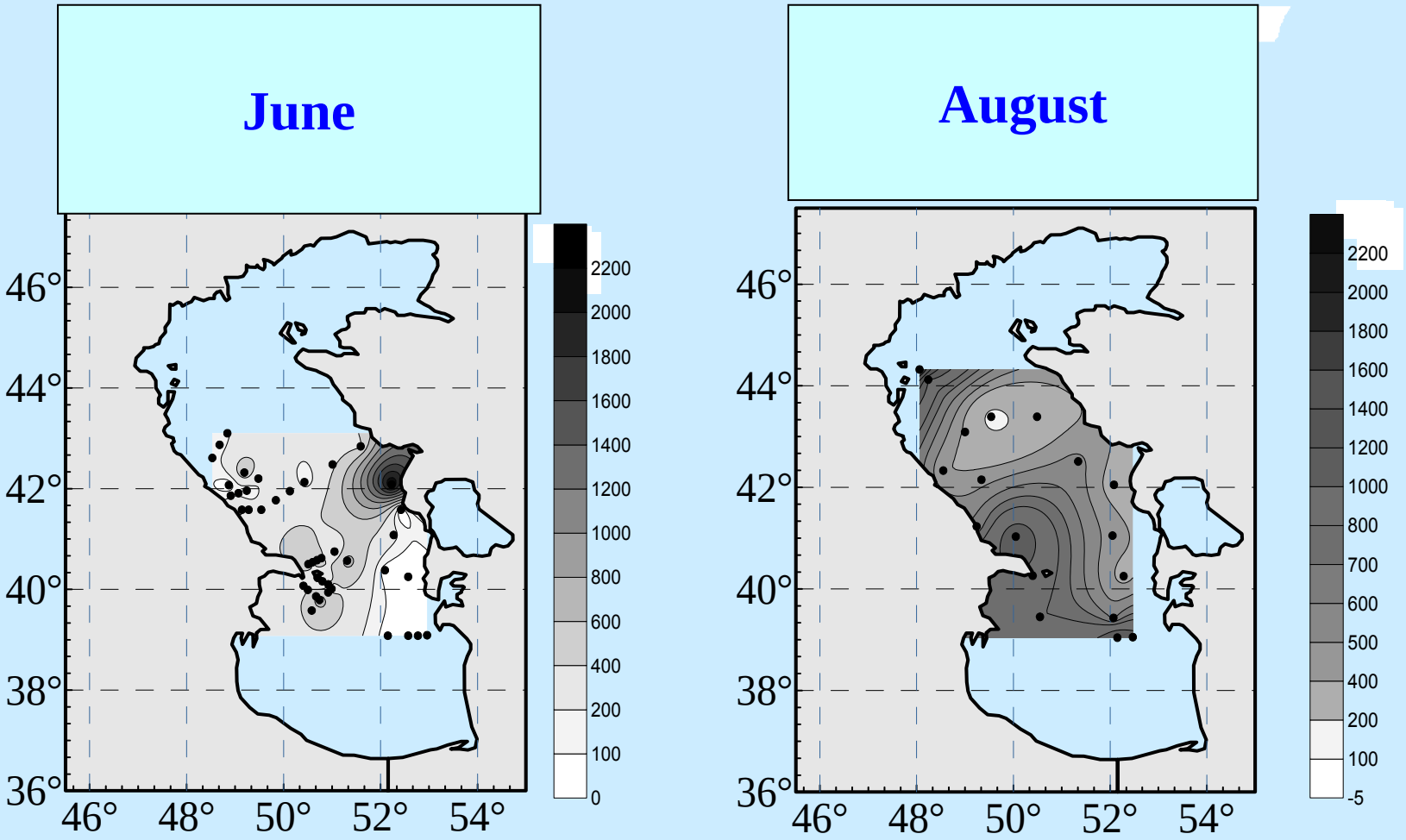
species diversity in the Caspian Sea

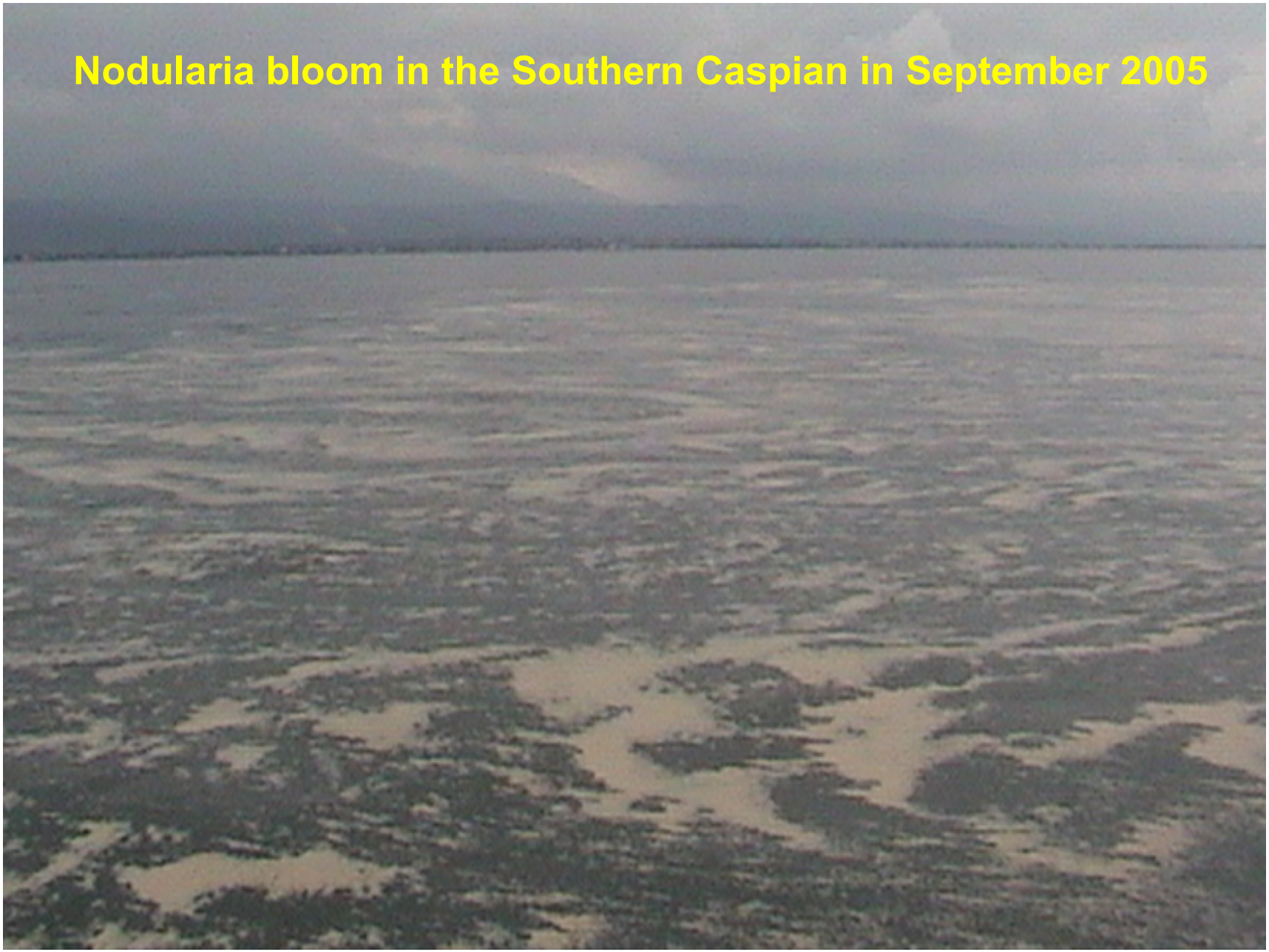




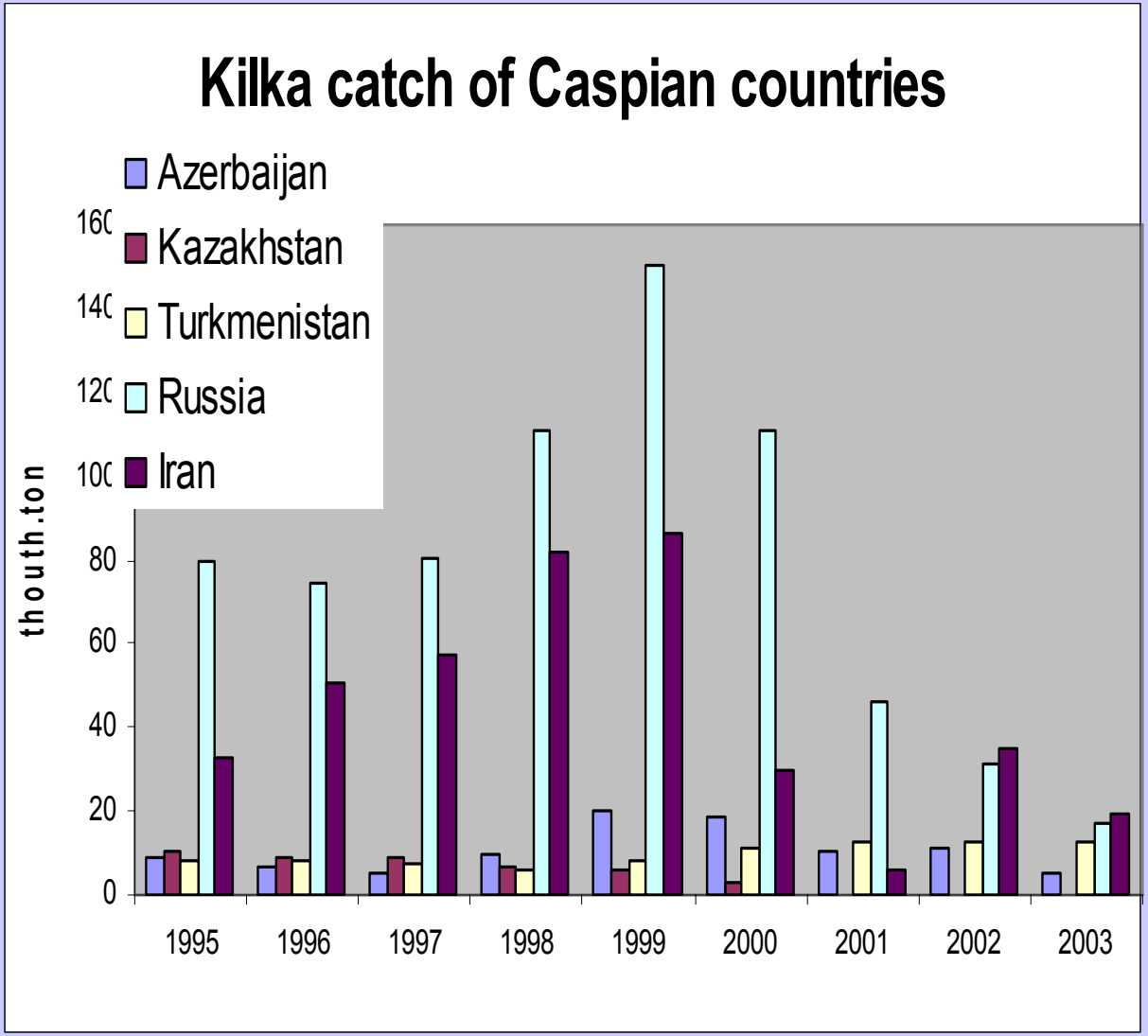


Pattern of phytoplankton biomass spatial distribution (mg. m^{-3}) – A –in June, B- in August.

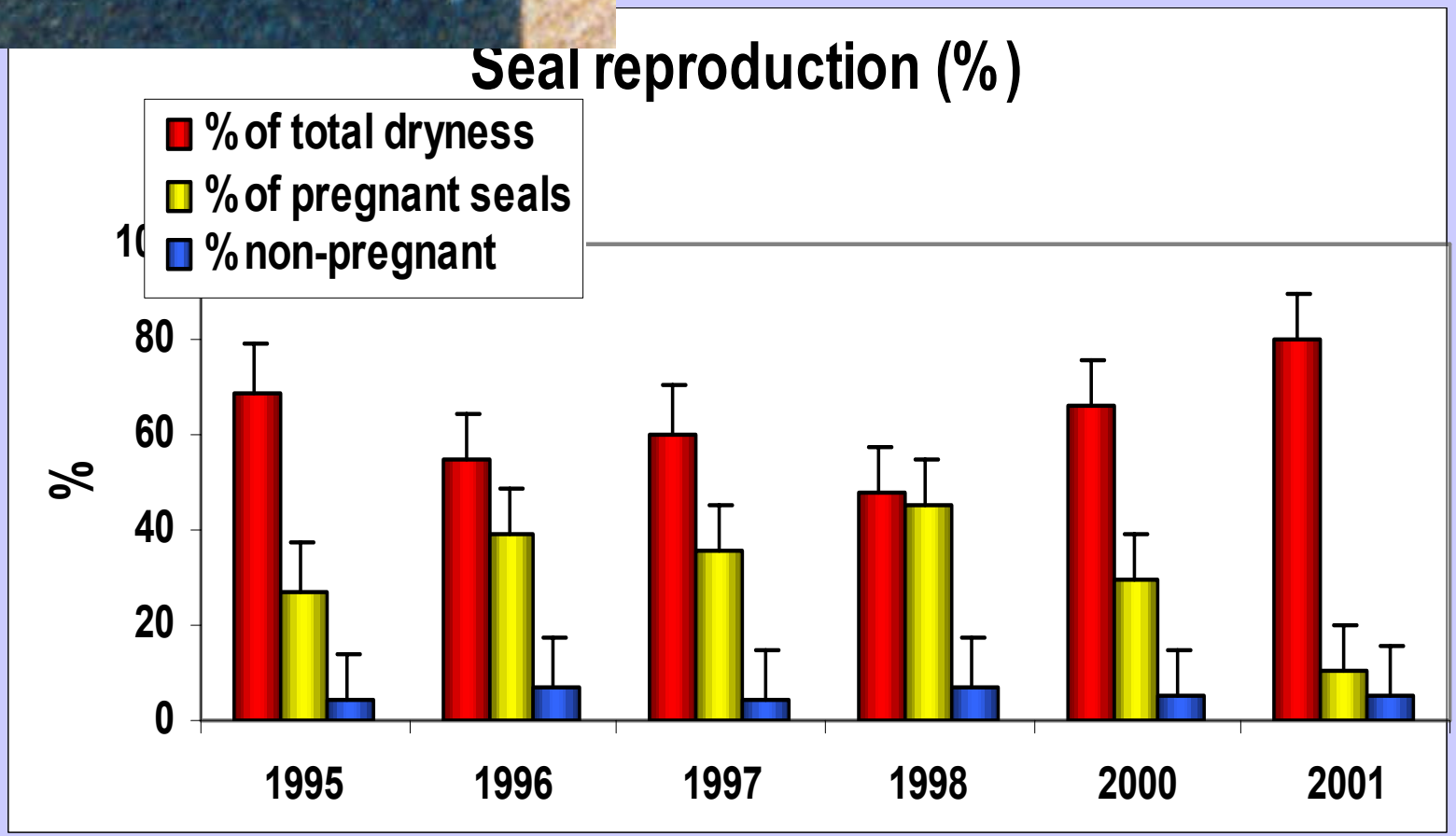


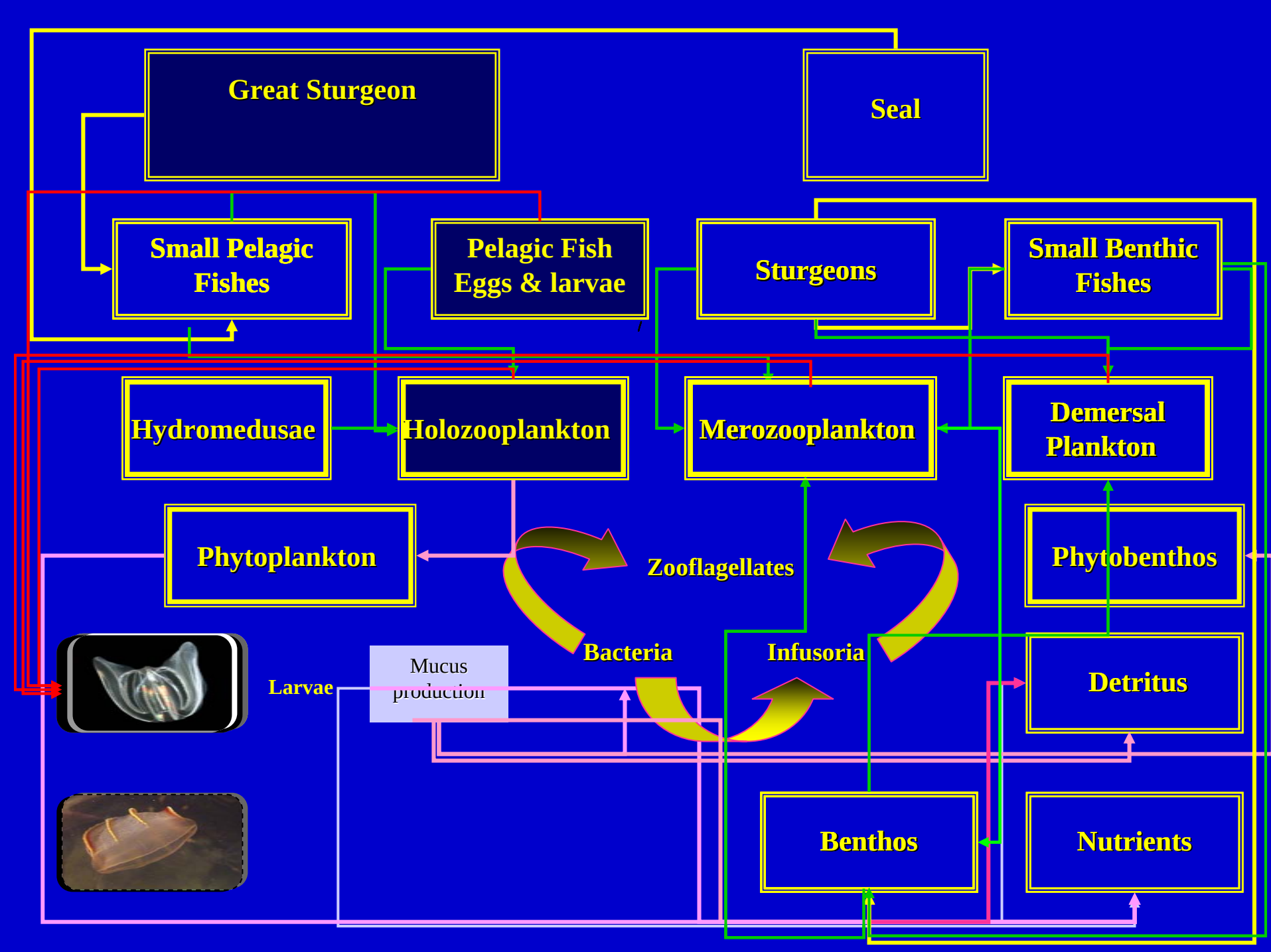

Nodularia bloom in the Southern Caspian in September 2005

Biomass of kilka catch of Caspian countries (after data of kilka surveys, data of lab kilka stocks assessment , KaspNIRKH): anchovy kilka; B- common kilka; C-big-eye kilka.



From Khuraskin et al.,2001




Great Sturgeon
Seal
Small Pelagic Fishes
Pelagic Fish Eggs & larvae
Sturgeons
Small Benthic Fishes
Hydromedusae
Holozooplankton
Merozooplankton
Demersal Plankton
Phytoplankton
Zooflagellates
Phytobenthos
Bacteria
Infusoria
Larvae
Mucus production
Detritus
Benthos
Nutrients

Conclusions

- **Thus in a decade *M.leidyi* became the most distributed comb-jelly in the World Ocean and economical damage to native and nonnative habitats may be estimated in millions US dollars**

- ***M.leidyi* development declined abundance, biomass and species diversity of all group of the productive ecosystems of the Black, Azov and Caspian Seas, greatly simplify it.**

  - **After *M. leidyi* invasion cascading effect occurred at the higher trophic levels, from a decreasing zooplankton stock to collapsing planktivorous fish to dolphins (bottom-up). Similar effects occurred at lower trophic levels: from a decrease in zooplankton stock to an increase in phytoplankton, relaxed from zooplankton grazing pressure (top-down) and from increasing bacterioplankton to increasing zooflagellata and infusoria.**

- **Absence of predators of M.leidyi until recently was another important reason of such a high bloom and a great effect at all trophic levels of the ecosystem**

•**With *Beroe ovata* introduction new trophic web appeared in the Black Sea and ecosystem began to recover but during seasonal absence of *B.ovata, M.leidyi* can reach high density and have considerable effect on ecosystem. The introduction of B.ovata was a positive event, and this example should be taken into consideration to save rich fish stocks of the Caspian Sea**

•**The *M.leidyi* and *B.ovata* outbreaks in nonnative areas have significantly advanced our understanding of the complex nature of coastal marine ecosystems and the role of gelatinous plankton therein. This is an example of how low organized gelatinous animals can affect whole ecosystems: one of them completely suppressed productive ecosystems, while the other recovered them in a short period of time. This events should be taken advantage of to improve man's understanding and control.**

http//www.caspianenviromentalprogramme.org
http//www.zin.ru/projects/invasions/gaas/invader.htm