Pacific Research Institute of Fisheries and Oceanography (TINRO-Centre)

Long-term fluctuations in gonatid squid (Gonatidae) abundance in the Okhotsk Sea

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The main goal

reveal annual distribution patterns of squids of the family Gonatidae in the Sea of Okhotsk basing on data collected in TINRO-Centre research surveys with a purpose to estimate the role of these cephalopods in pelagic communities

Methods:

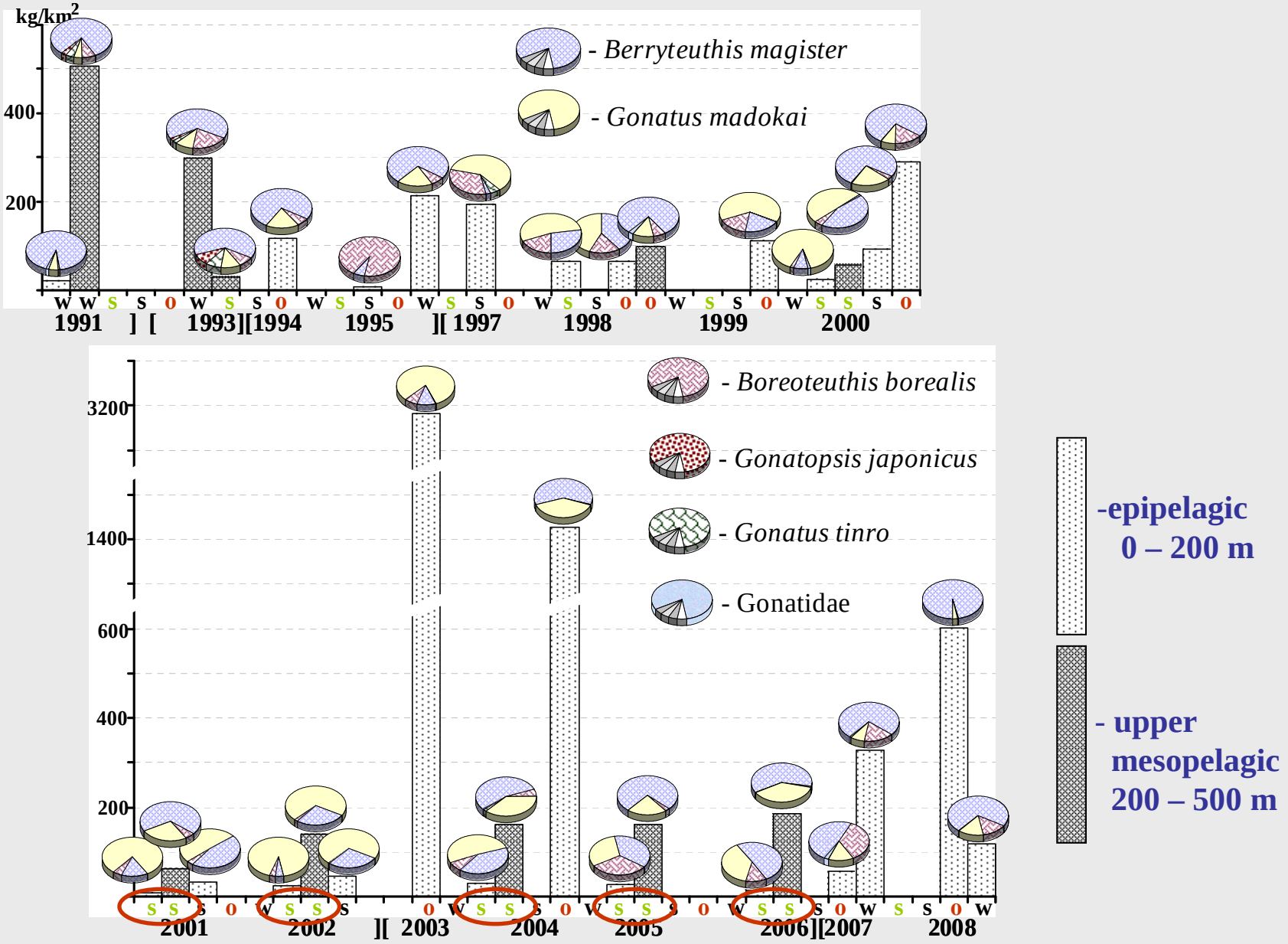
- analyze database on squid catches for a period from 1990 to 2008;
- use the data to obtain patterns of spatial and seasonal on squid distribution and biology;
- assess the role of different species in seasonal dynamics of distribution density in the epi- and mesopelagic layers in different years;
- use synoptic observations to reveal relationships between squid distribution density and variability in atmospheric pressure in the study area

Investigations

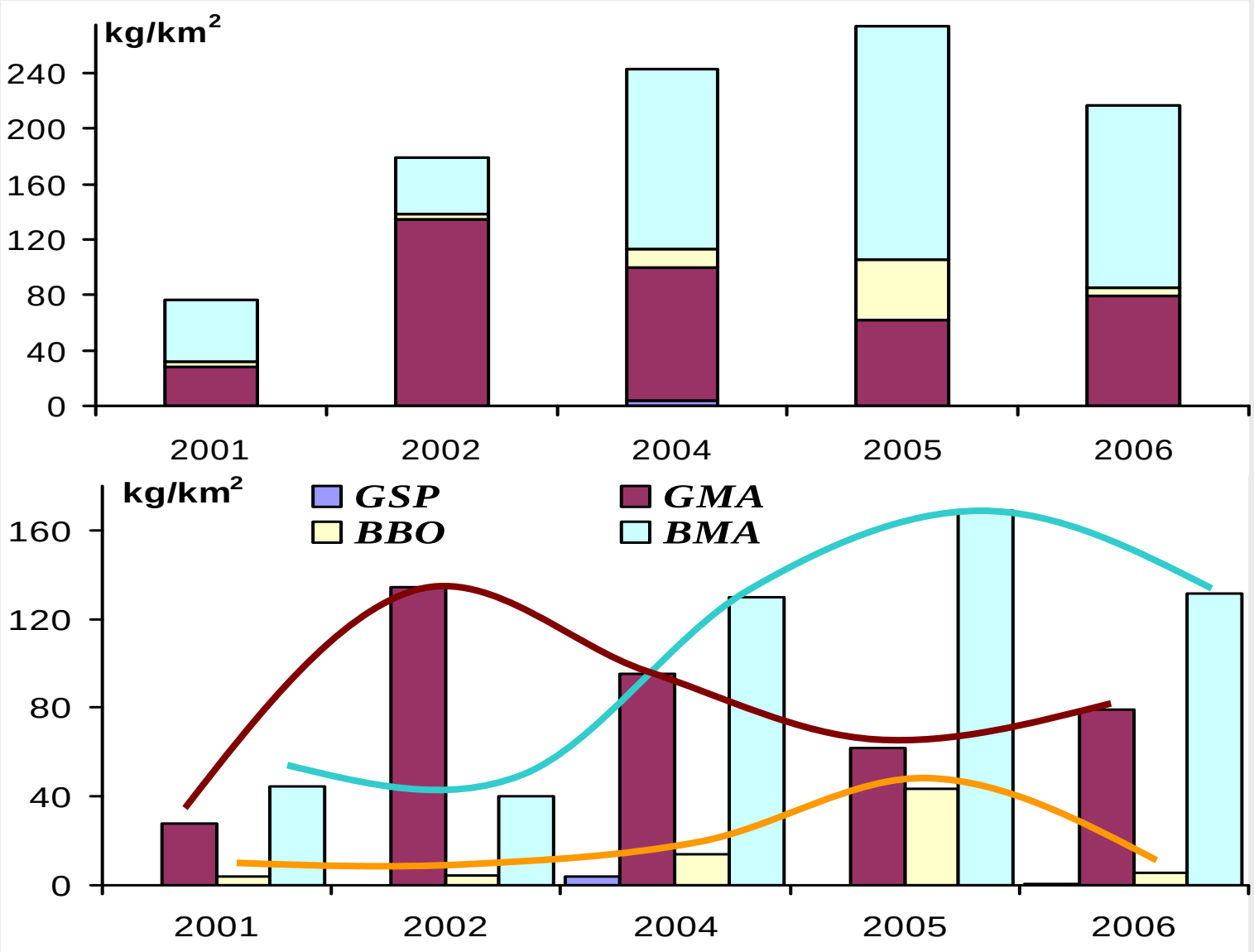
Region	expeditions	Upper-mesopelagic investigations (expeditions)	years
northern Okhotsk Sea	20	12	1990-2008
southern Okhotsk Sea	18	2	1990-2008
off west Kamchatka	12	7	1998-2007
the entire Okhotsk Sea	25	13	1990-2008


- Investigations of epipelagic (0-200 m)
- Investigations of epipelagic and upper-mesopelagic (200-500 m)
northern Okhotsk Sea
Kamchatka

Biomass density (kg/km^2) of the **Gonatidae** in the northern Okhotsk Sea

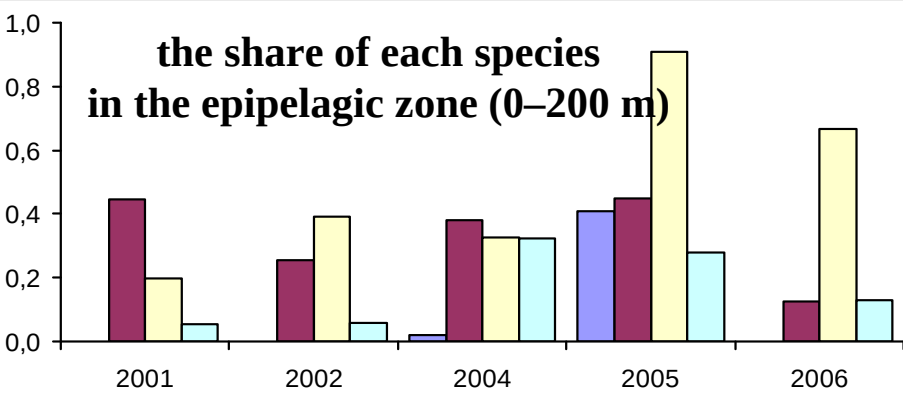


Biomass density (kg/km^2) of the **Gonatidae** in the northern Okhotsk Sea in different years in spring in the upper 500 m layer



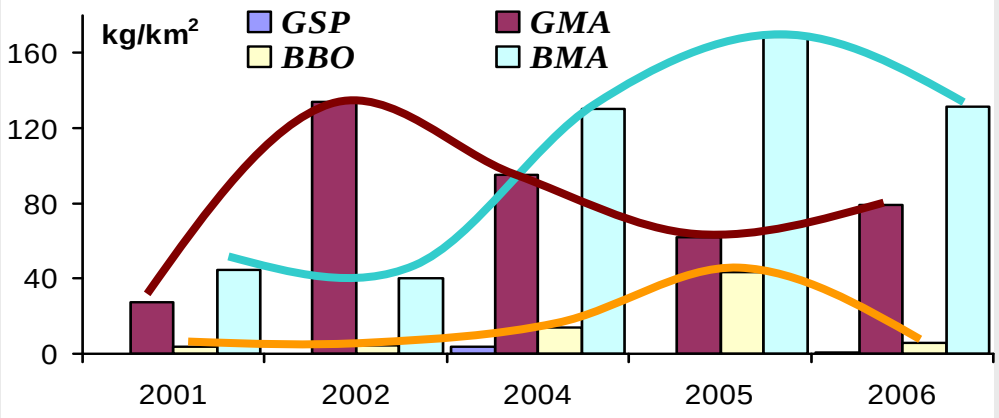
GSP – Gonatidae sp; ***BBO*** – *B. borealis*; ***GMA*** – *G. madokai*; ***BMA*** – *B. magister*

Biomass density (kg/km^2) of the **Gonatidae** in the northern Okhotsk Sea in different years in spring in the upper 500 m layer.



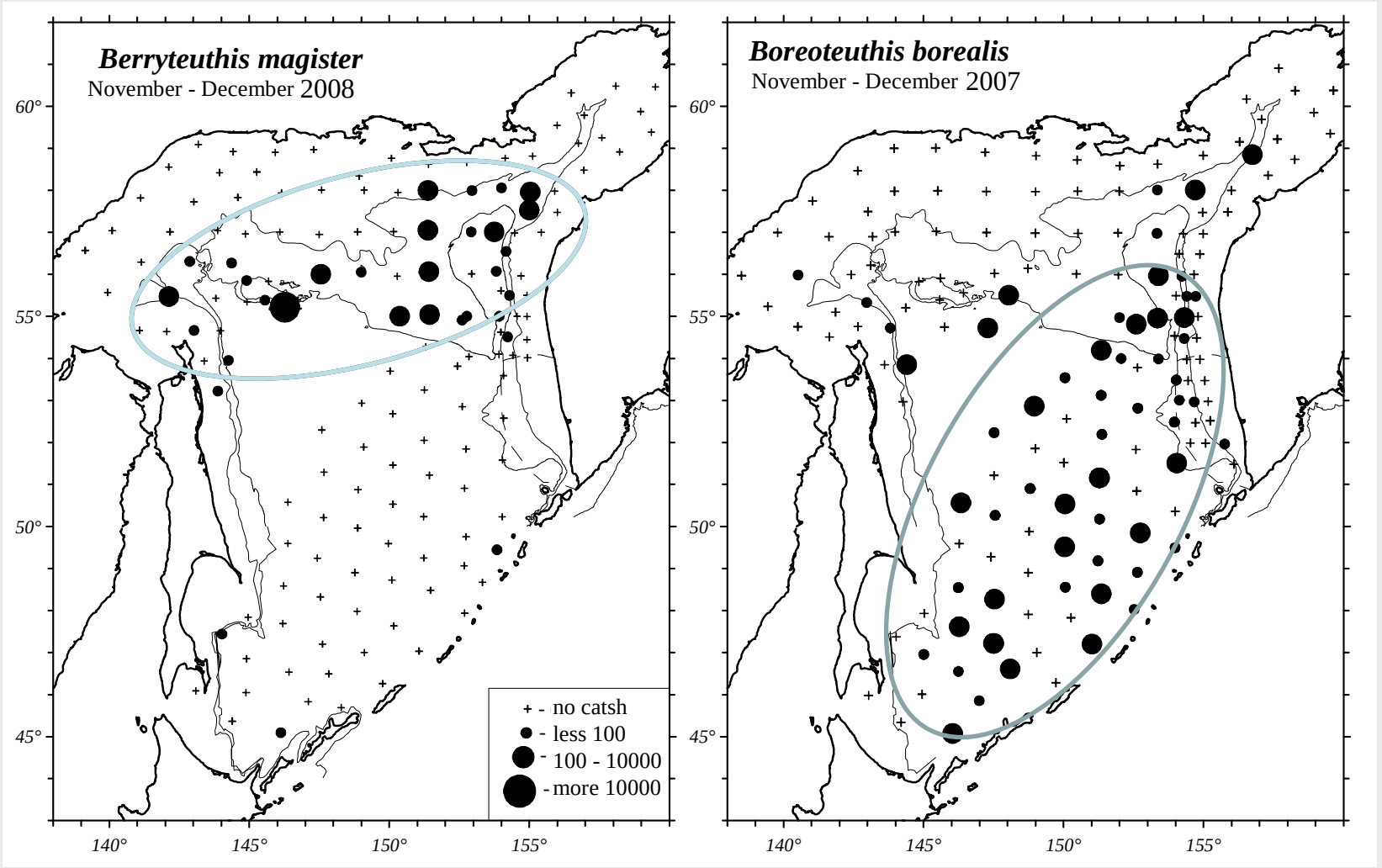
Correlation coefficients

0-500	*BMA*	*GMA*
GMA	-0,125	
BBO	0,742	-0,194

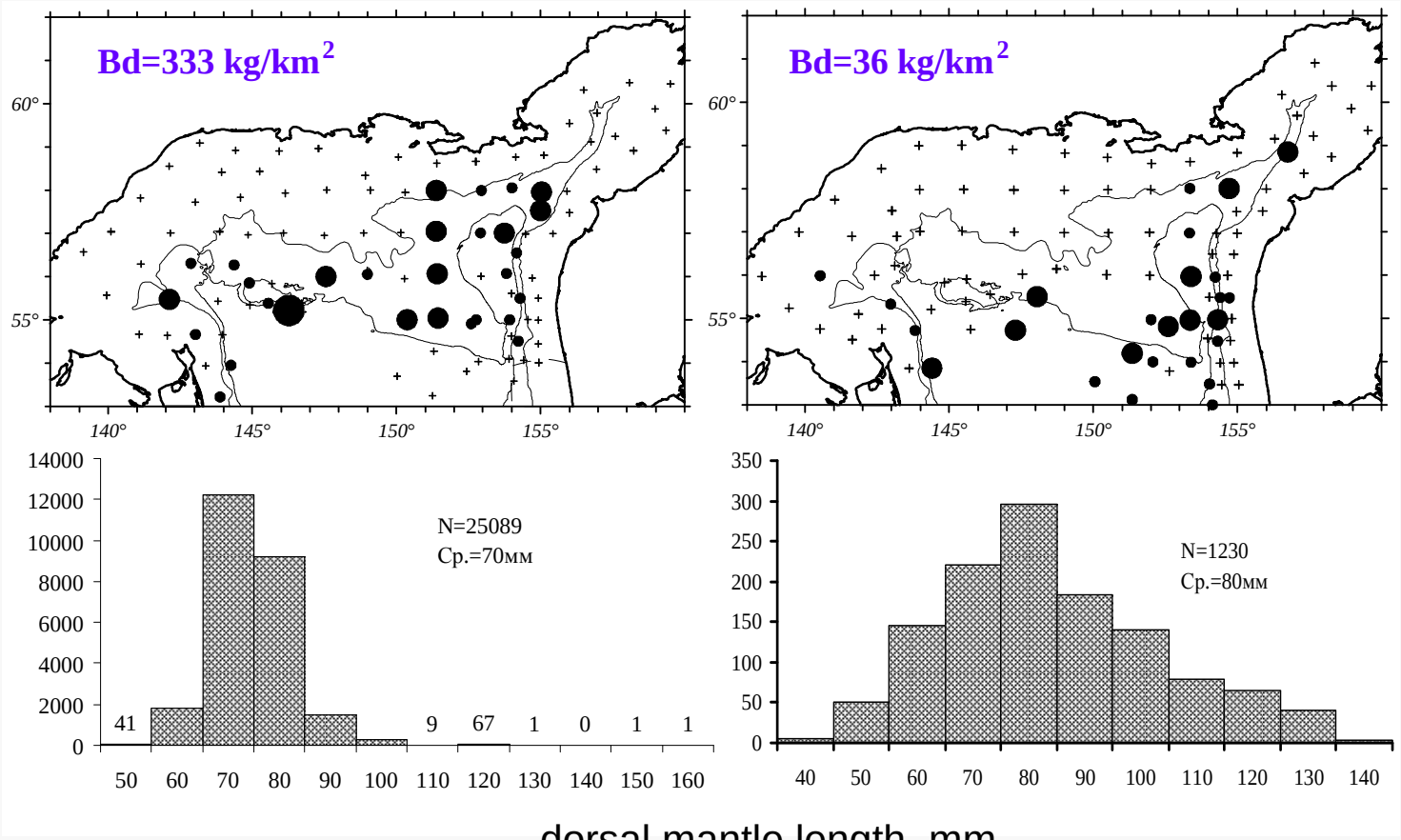


GSP – Gonatidae sp; ***BBO*** – *B. borealis*; ***GMA*** – *G. madokai*; ***BMA*** – *B. magister*

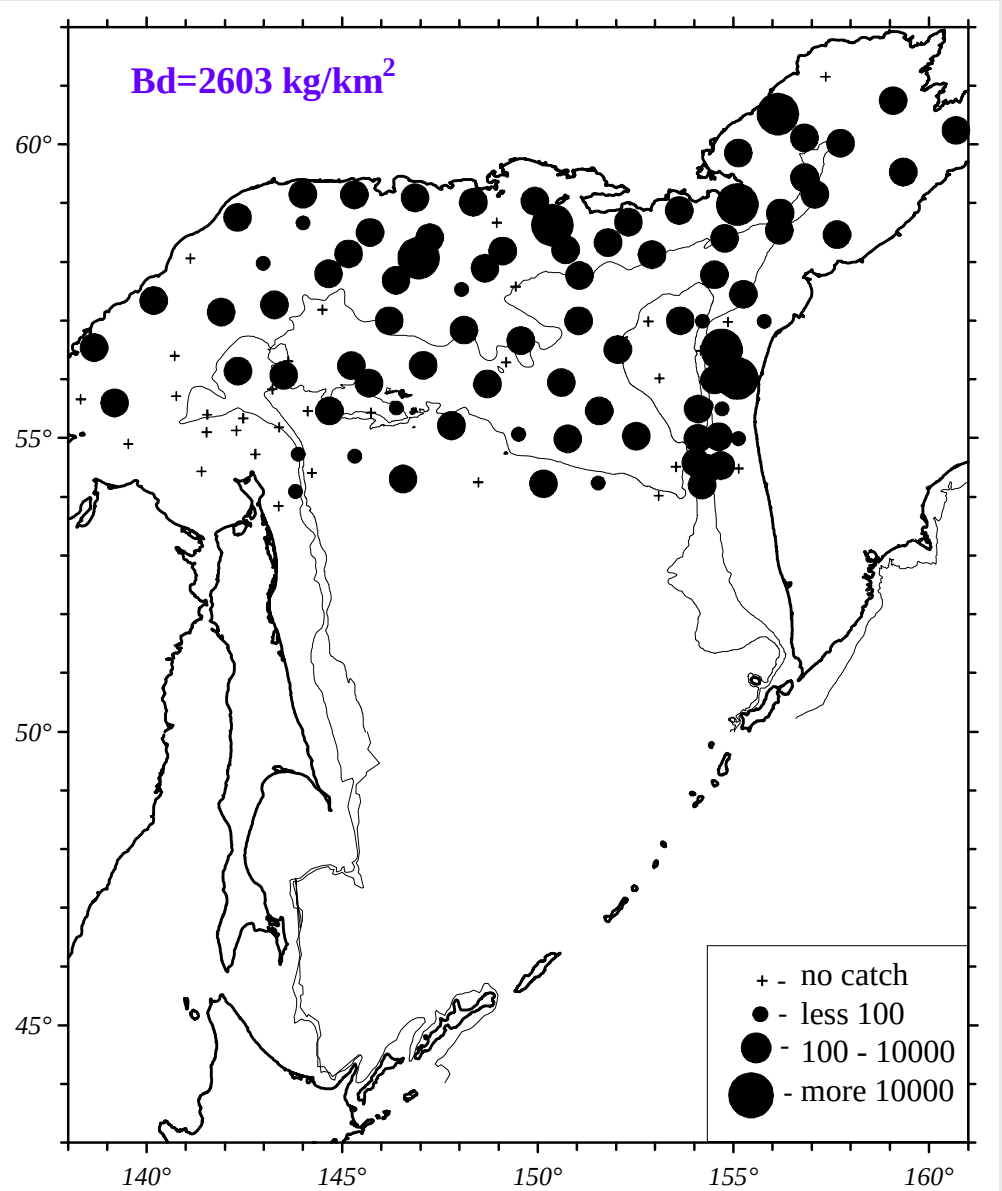
Biomass density (kg/km^2) of squids
Berryteuthis magister and *Boreoteuthis borealis*



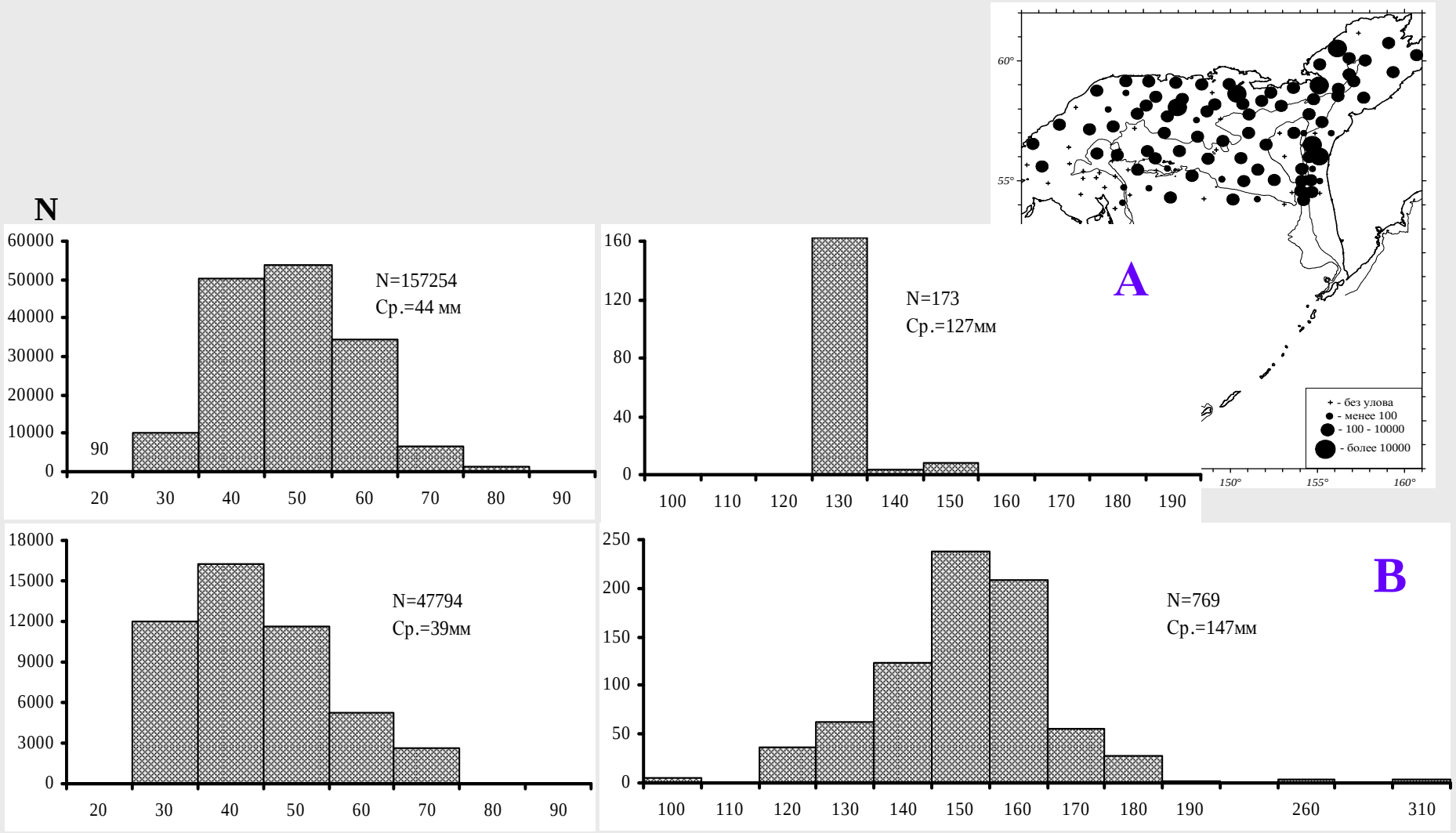
Biomass density (kg/km^2) and size of squids
Berryteuthis magister and *Boreoteuthis borealis*



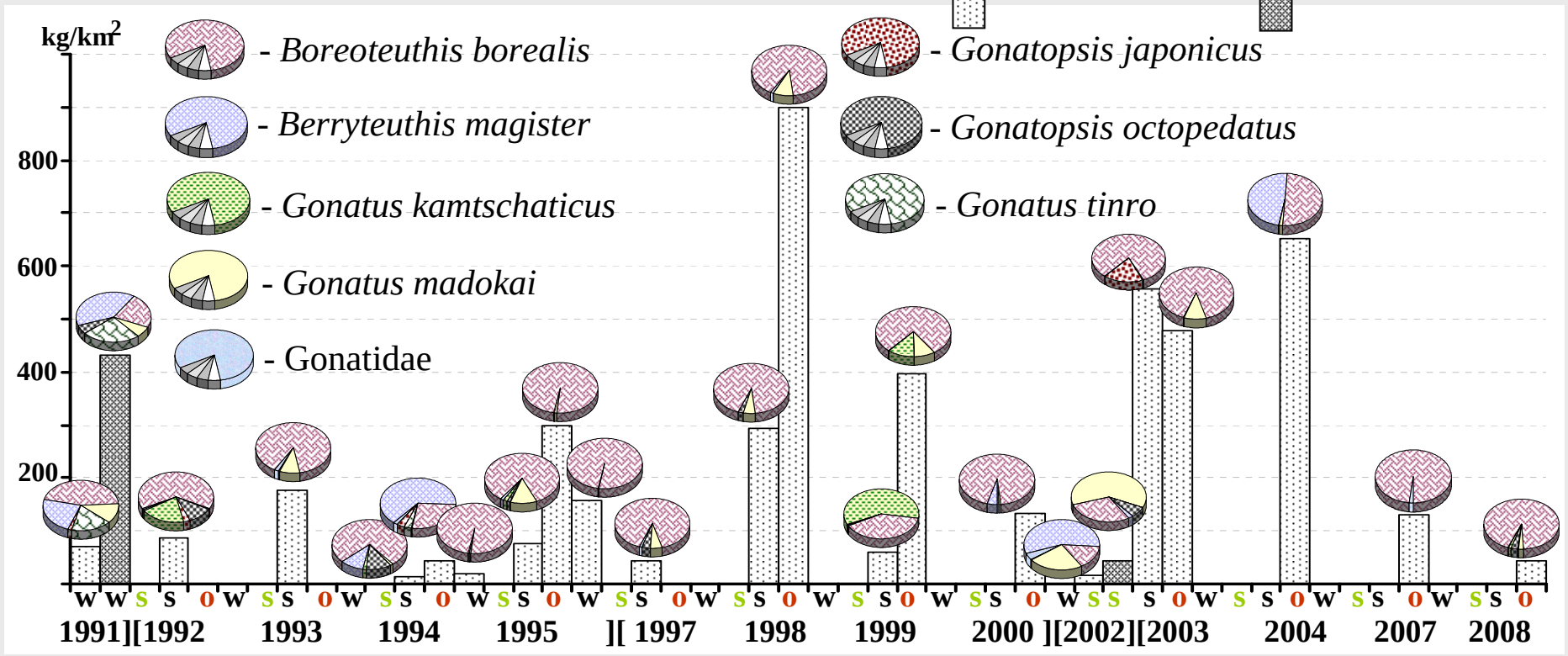
Biomass density (kg/km^2) of *Gonatus madokai* in the upper epipelagic zone (0-50 m) in September-October 2003



Size of *Gonatus madokai* on the shelf (A) and continental slope (B) in September-October 2003

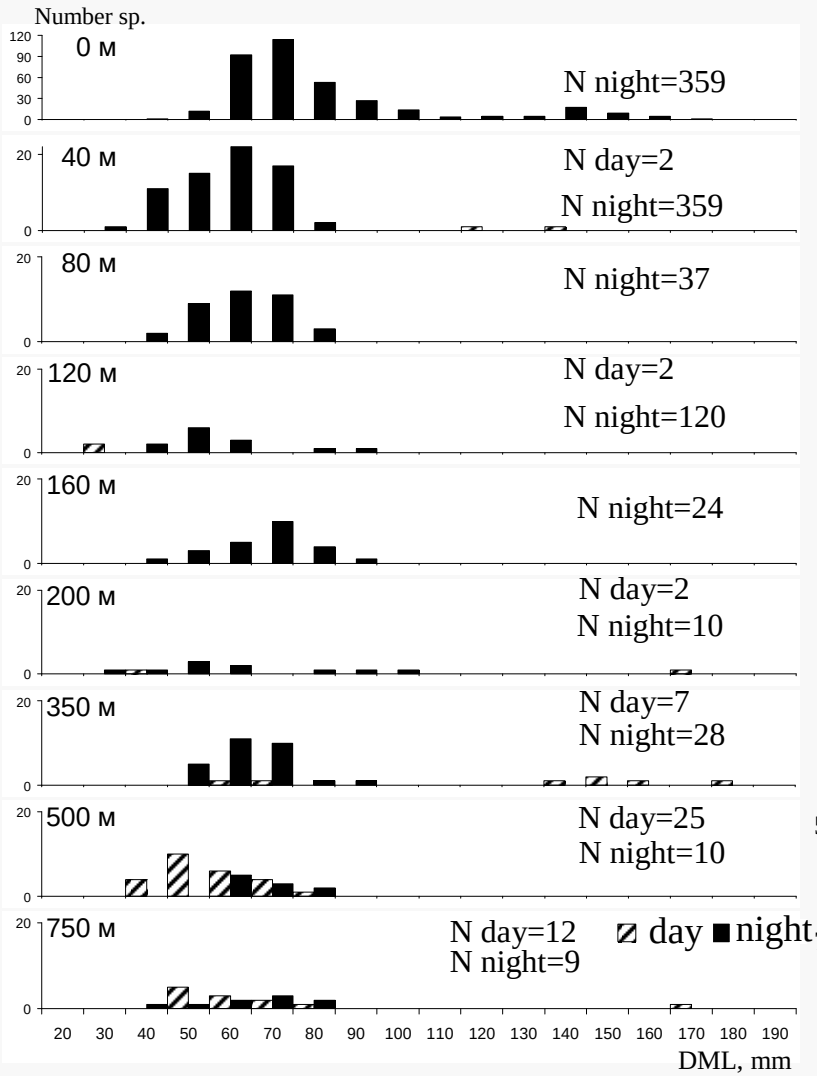


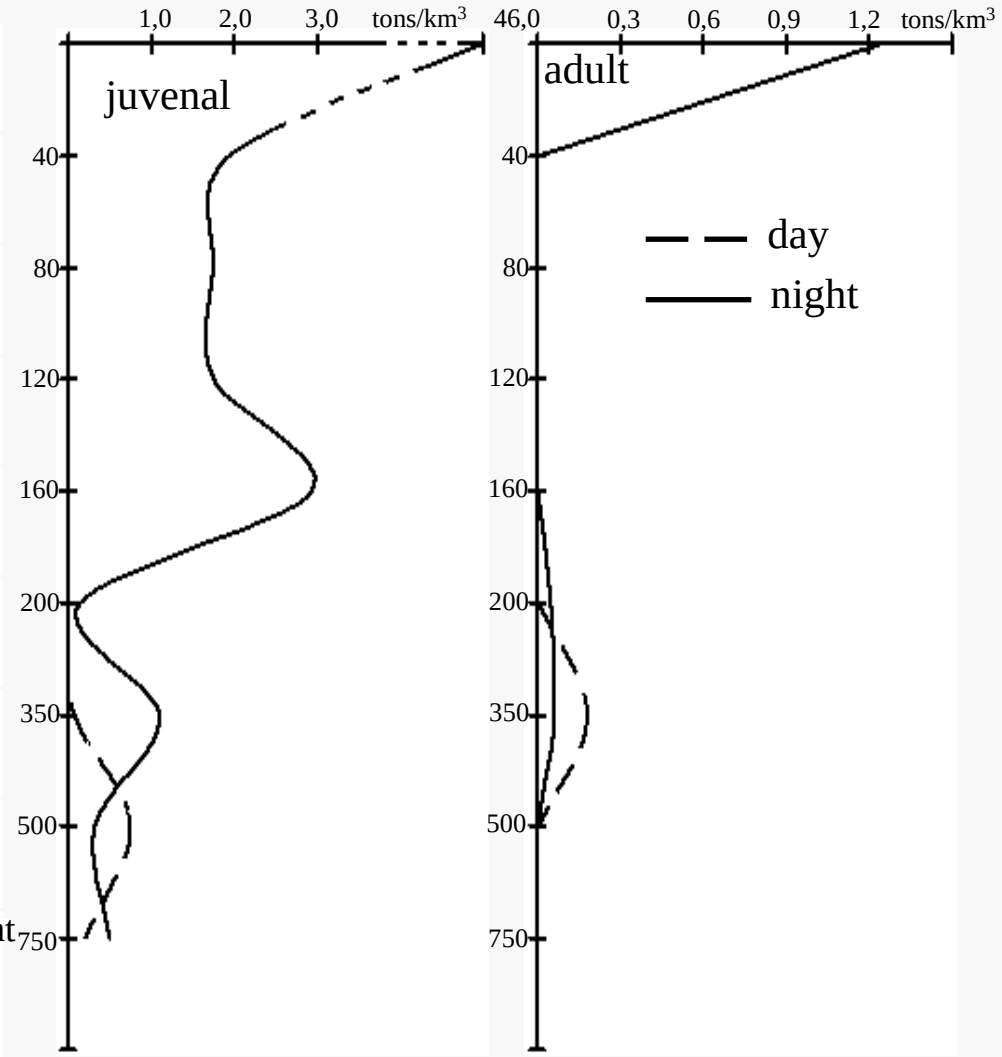
Biomass density (kg/km^2) of the **Gonatidae** in the southern Okhotsk Sea



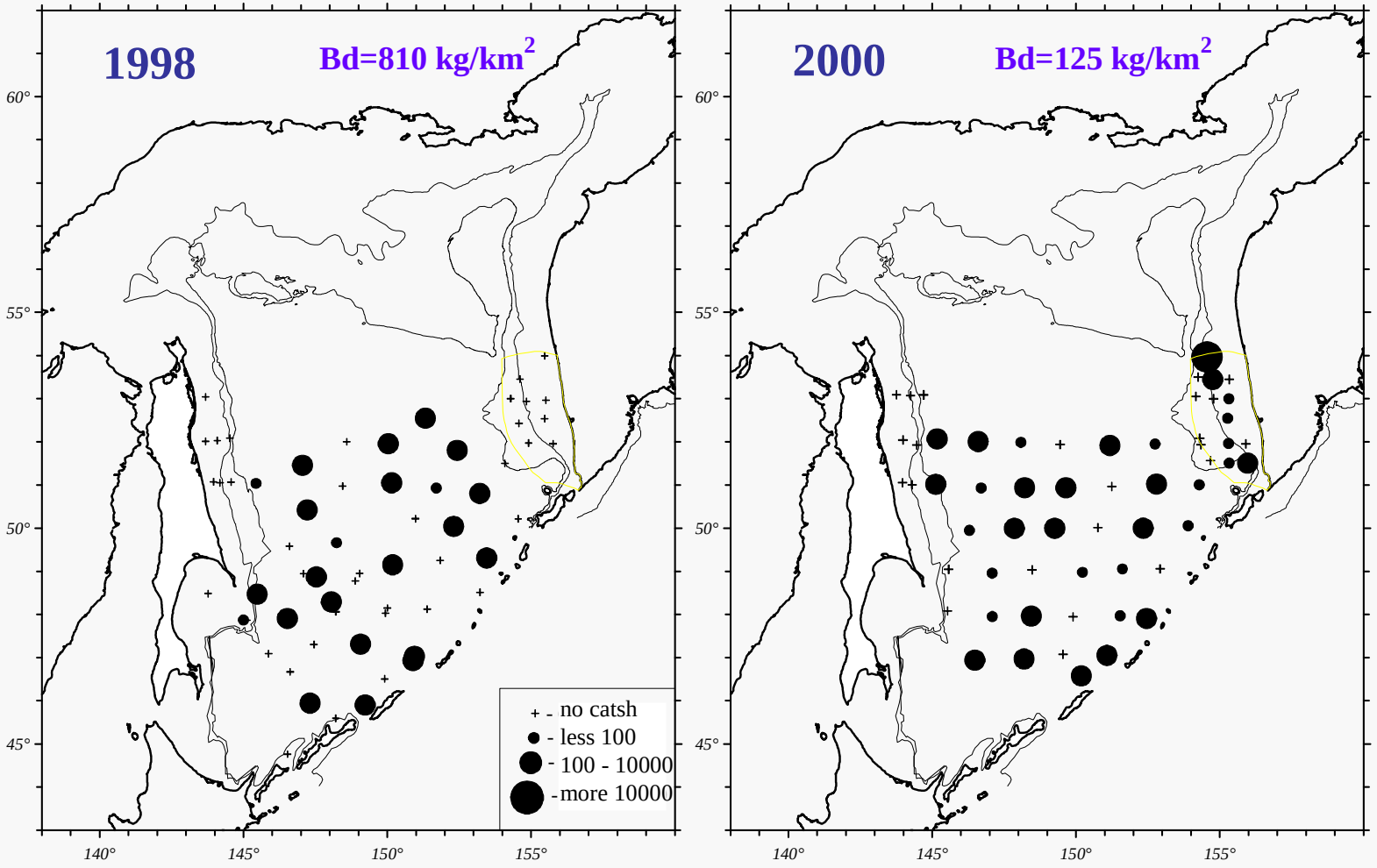
Boreoteuthis borealis

Vertical distribution during daytime and at night in the Bering Sea

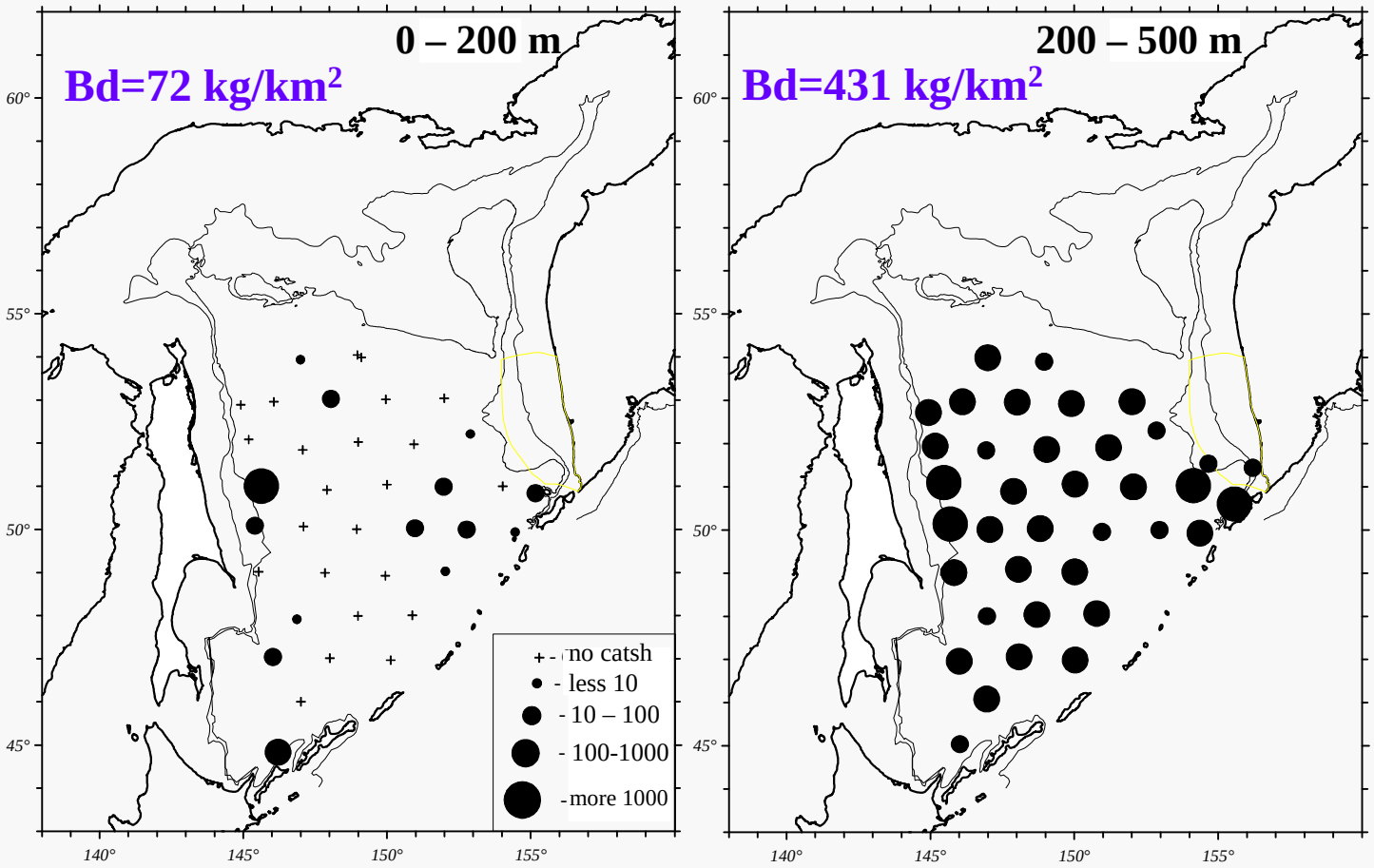




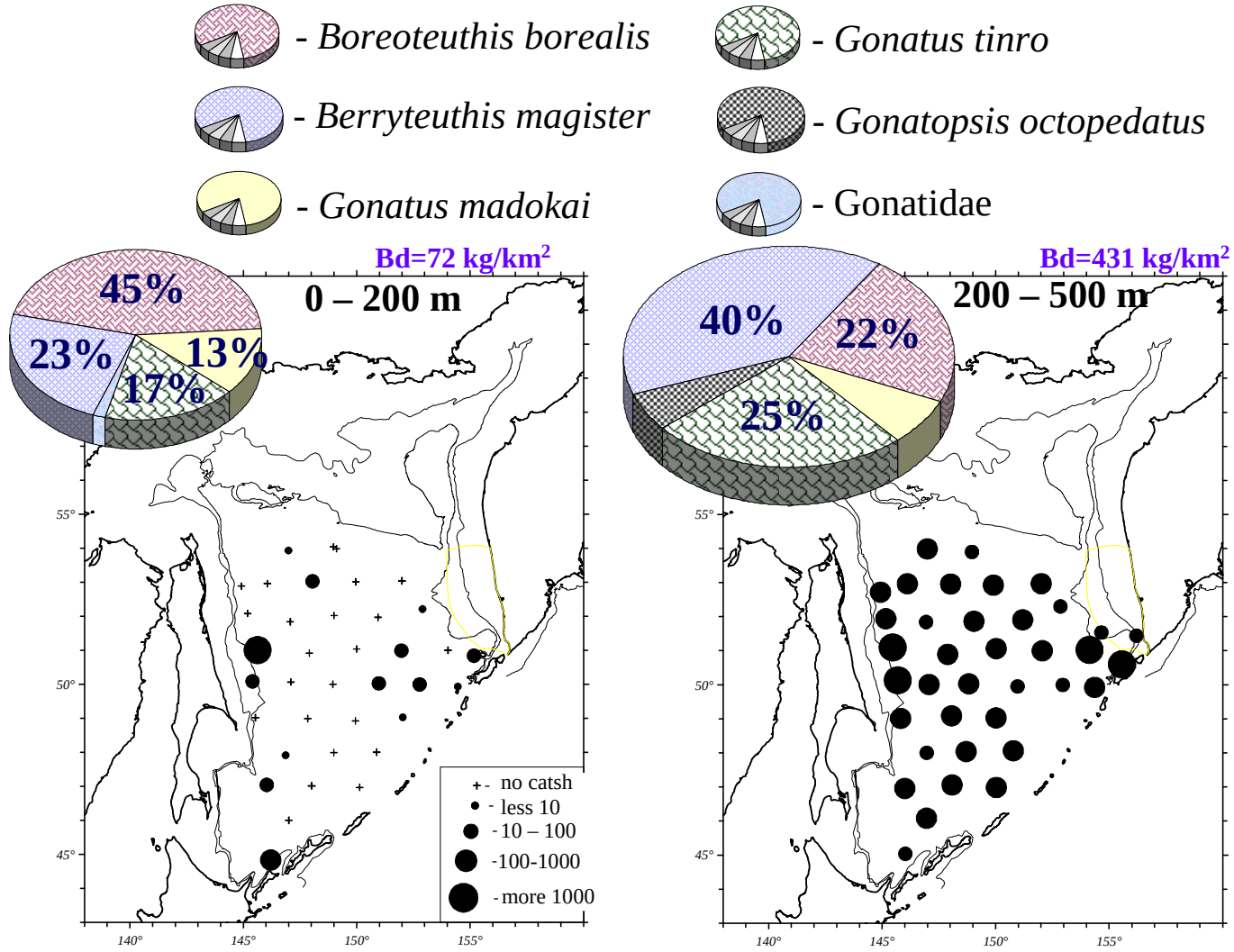
Biomass density (kg/km^2) of *Boreoteuthis borealis* in the epipelagic zone (0-200 m) in September – November in 1998 and 2000



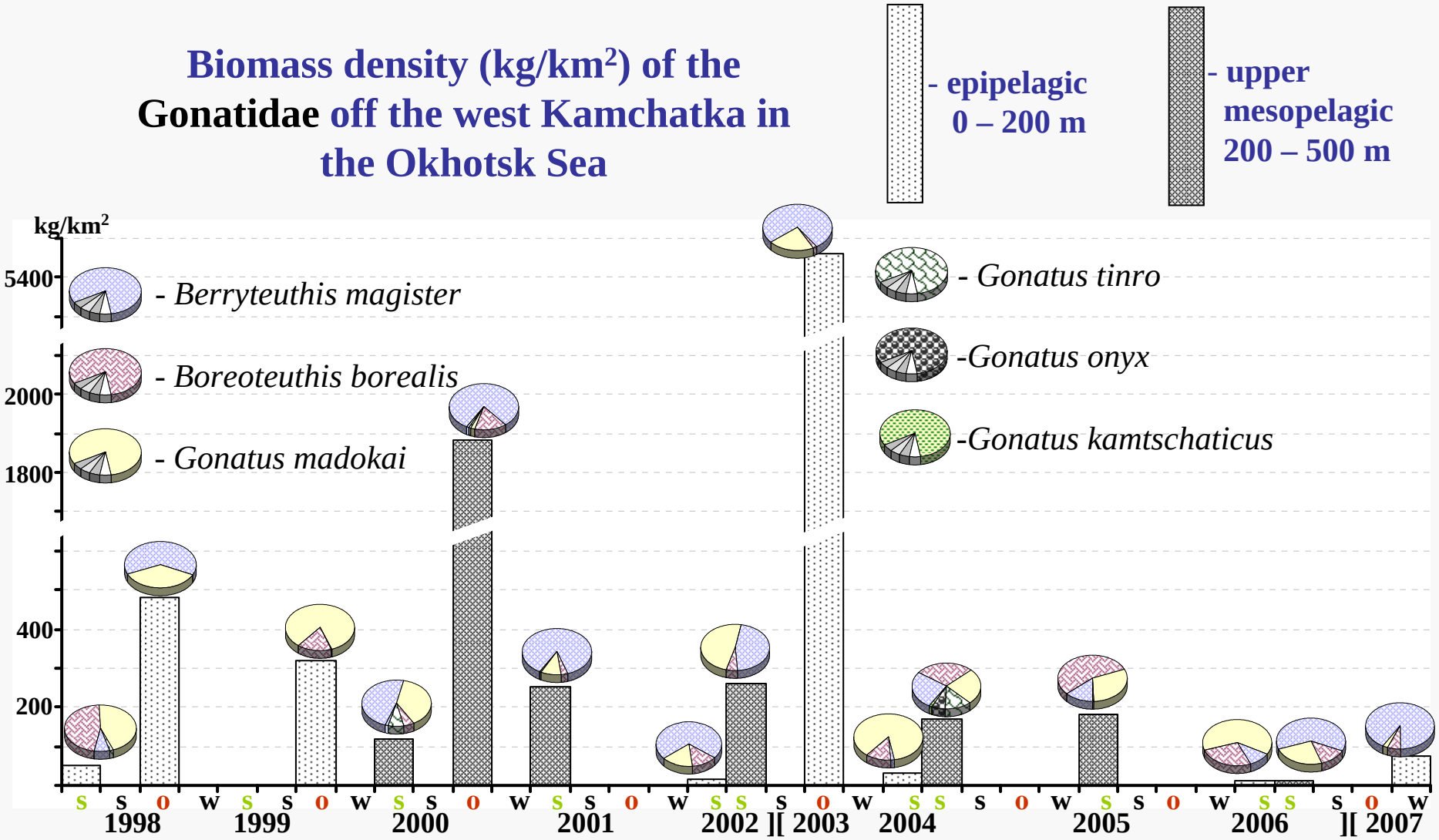
Biomass density (kg/km^2) Gonatidae in the epipelagic and upper mesopelagic zones during winter, December 1990 – January 1991



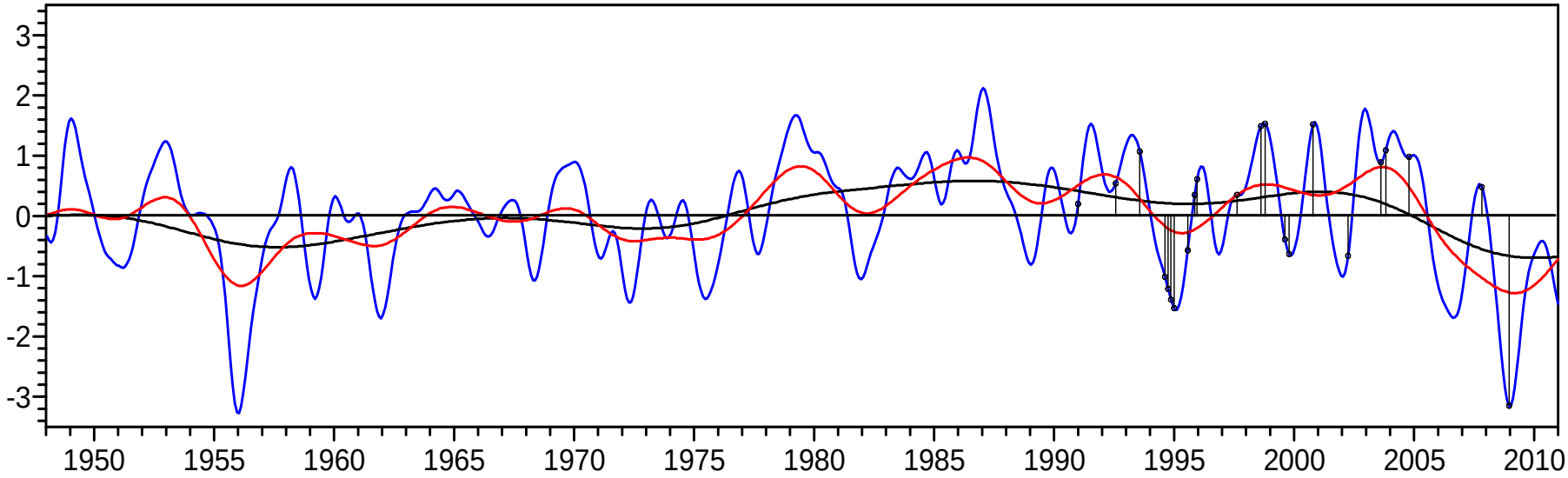
Share (%) of **Gonatidae** species in the epipelagic and upper mesopelagic during winter, December 1990 – January 1991



Biomass density (kg/km^2) of the **Gonatidae** off the west Kamchatka in the Okhotsk Sea

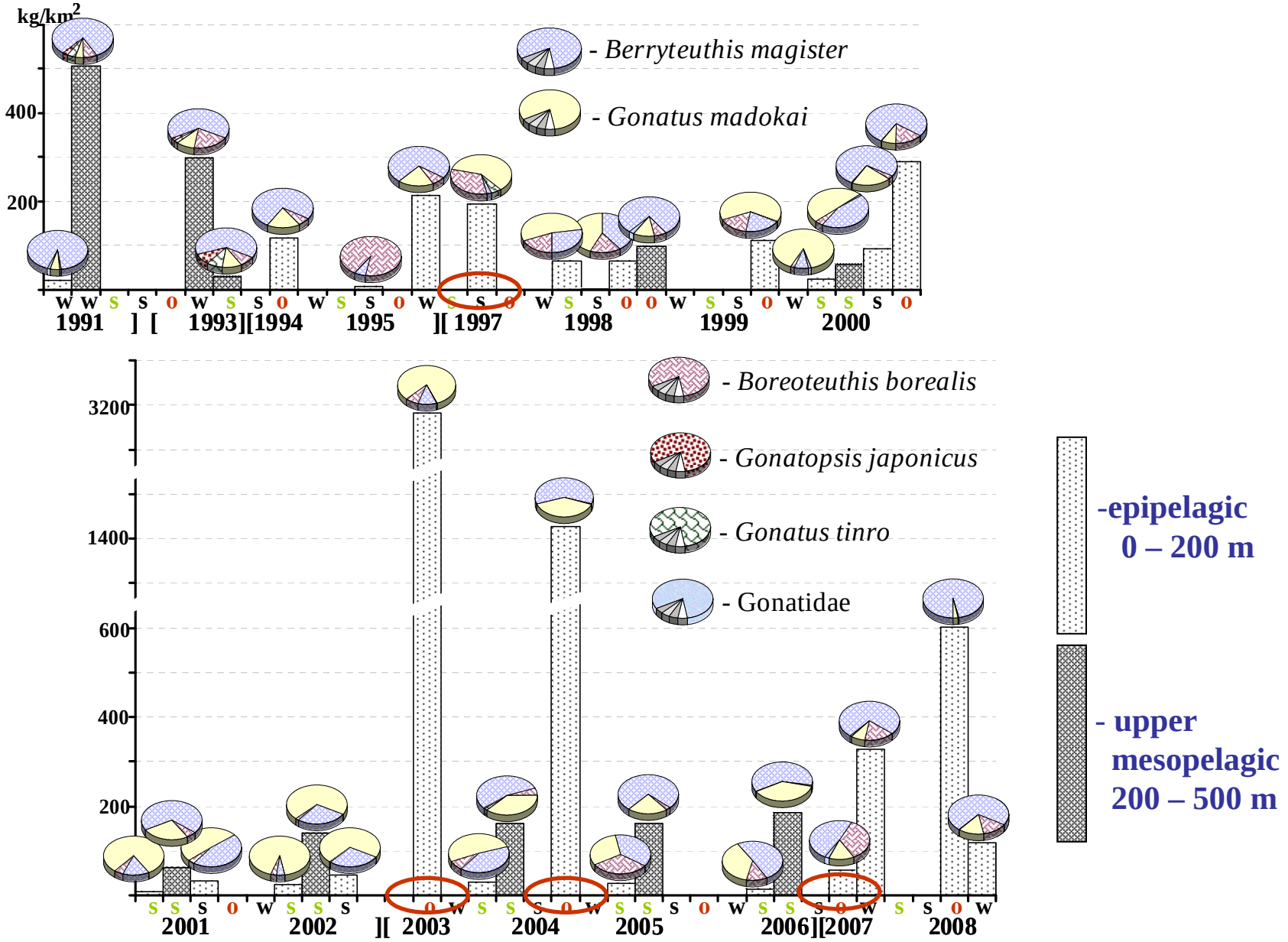


Baric observations in the Okhotsk Sea

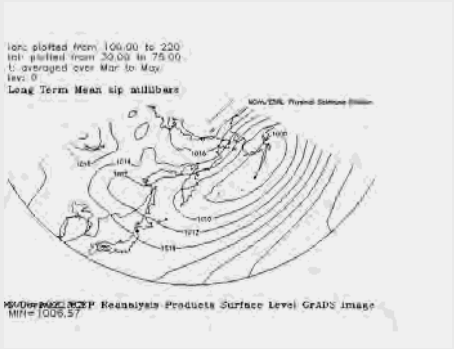


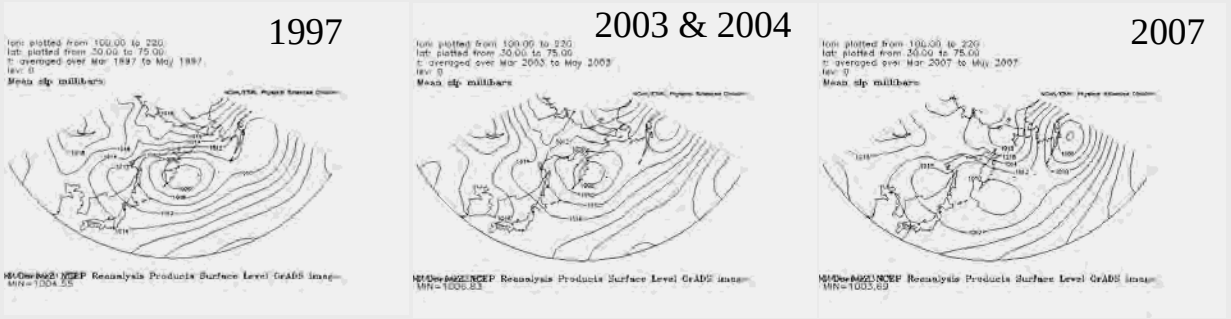
Anomaly of the difference in atmospheric pressure between Nikolaevsk-na-Amure and Petropavlovsk-Kamchatski with different time of data averaging :
Blue line – 7 months; Red line – 25 months; Black line – 61 months.
Points – observations of atmospheric pressure during trawl survey

Biomass density (kg/km^2) of the **Gonatidae** in the northern Okhotsk Sea

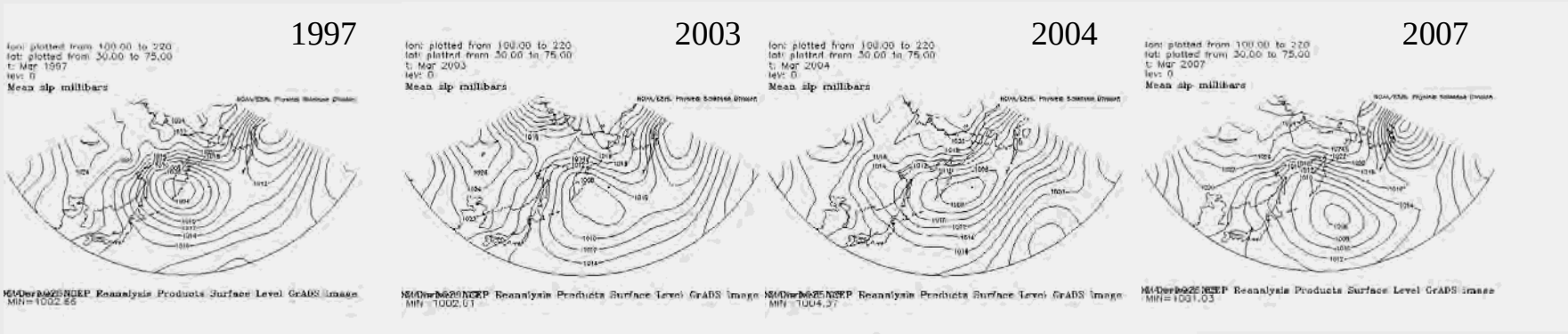


Main atmospheric pressure field
in **Spring (March-May)**





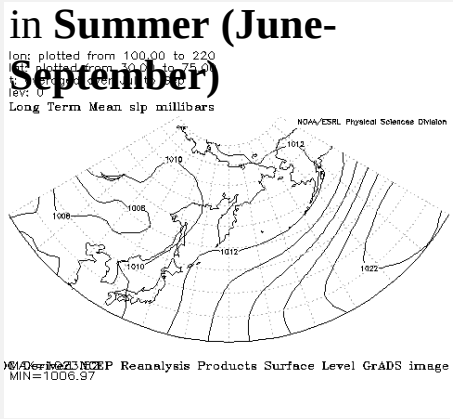
Atmospheric pressure field, favorable for penetration of warm Pacific waters into the Okhotsk Sea in s**pring (March-May) in** 1997, 2003, 2004 and 2007.



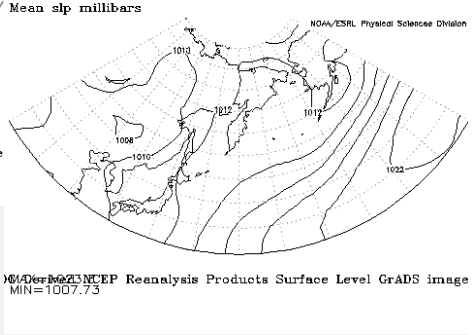
Atmospheric pressure field, favorable for **maximal** penetration of warm Pacific waters into the Okhotsk Sea in **March** in 1997, 2003, 2004 and 2007.

Patterns of atmospheric pressure in the northwestern Pacific Ocean and Asian marginal seas

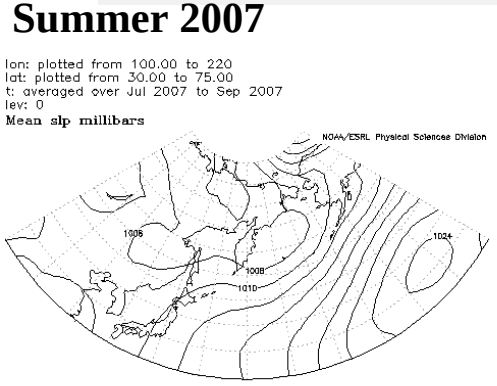
Long-term average main atmospheric pressure field in **Summer (June-September)**



atmospheric pressure in **Summer 2003**



atmospheric pressure in **Summer 2007**



Outcomes

- **In the northern Okhotsk Sea, two species of the family Gonatidae *Berryteuthis magister* and *Gonatus madokai* dominated pelagic cephalopod communities**
- **In the northern Okhotsk Sea, *Berryteuthis magister* and *Gonatus madokai* fluctuated out-of-phase**
- **In the southern Okhotsk Sea, *Boreoteuthis borealis* dominated epipelagic layers**
- **In the southern Okhotsk Sea, the structure of cephalopod community was polydominant in the mesopipelagic layers**
- **Off west Kamchatka, pelagic cephalopod community was similar to that in the northern Okhotsk Sea, but with three dominant species: *Berryteuthis magister*, *Gonatus madokai* and *Boreoteuthis borealis***
- **Autumn biomass density of the gonatid squids in the Okhotsk Sea depends upon spring atmospheric patterns in case of low cyclonic activity during spring and summer, when the exists an increased inflow of Pacific waters into the Okhotsk Sea**

Thank you for your attention!!!