Population dynamics of *Oithona similis* (Copepoda: Cyclopoida) off Busan, South Korea

Minkyung Shin and Wongyu Park (Department of Marine biology, Pukyong National University)
Junghwa Choi (Fisheries Resources Management Division, National Fisheries Research & Development Institute)

PUKYONG NATIONAL UNIVERSITY

NFRDI
National Fisheries Research & Development Institute

Zooplankton – Environmental variables?

- Zooplankton communities are affected by environmental variables (e.g. foods, temperature and salinity).

  (Vanni 1987; Fransz 1988 ; Turner *et al.* 2011)

- Food: limited foods can cause high mortality.

- Temperature: abnormally high or low temperatures can limit the growth, development and further survival.

- Salinity: high or low salinity may effect on physiological function of zooplankton.

Copepoda – important in marine ecosystem

- Copepods are most important in marine ecosystem because of its high abundance and biomass.

  (more 70% in abundance and biomass)

- Despite its importance, relatively smaller copepods such as *Oithona* spp. were underestimated, because in many cases, zooplankton have been collected by large mesh sizes of plankton net (>300 um).

Oithona similis (Copepoda: Cyclopoida)

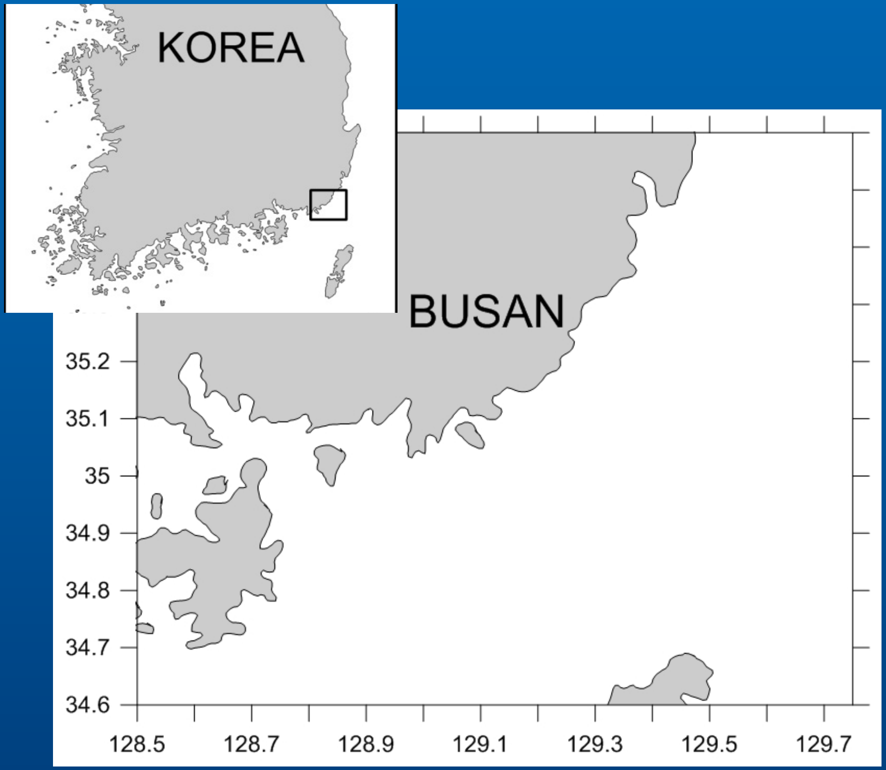
- The most abundant and ubiquitous copepod in the world oceans (Paffenhöfer 1993; Ward and Hirst 2007)
- *O. similis* have a crucial importance as a food source for other copepods, chaetognaths and fish larvae (Gallienne and Robins 2001; Turner 2004).

•However, despite their ecological importance, their function and abundance in marine ecosystem have been underestimated due to the difficulty of sampling.

•Life history or annual cycle has been less importantly regarded than larger copepods.

Coastal waters of Busan

- Busan in the southeastern part of Korean peninsula.



- Coastal area off Busan is affected by Tsushima Warn Current and occasionally North Korean Cold Current.
  (Kim 1998; Huh *et al*. 2010)

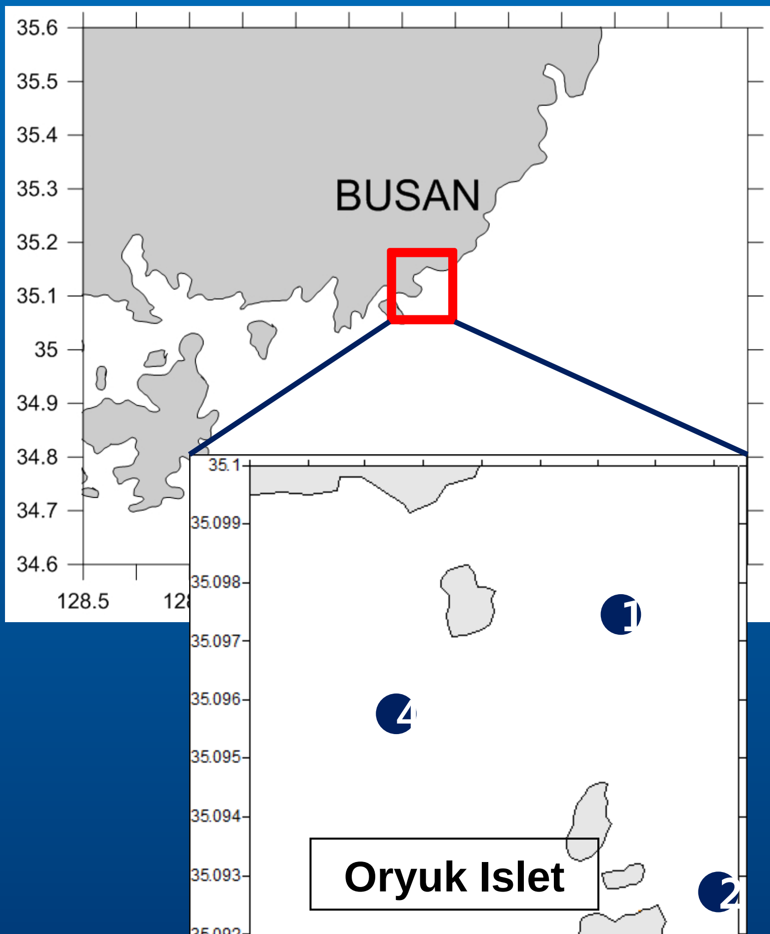
- During the rainy season in summer, river runoffs influence on marine environments, particularly salinity.

The aim of this study is to describe

the population dynamics of *O. similis* off Busan.

Sampling

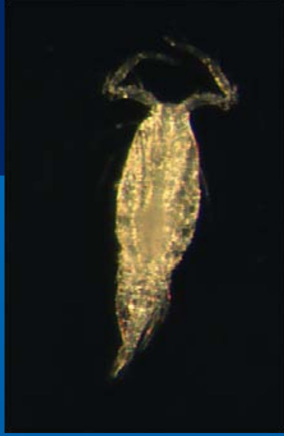
- May 2011 – May 2012
  (Monthly during 13 months)
- Towed during daylight hours
- At four stations around Oryuk Islet.



- Used a conical net
  (Ø, 0.45 m with 200 µm mesh)
- Towed from surface to near bottom (18~26m) vertically twice.

- Preserved in neutralized formalin
  (4-5 %) on boat

Laboratory works



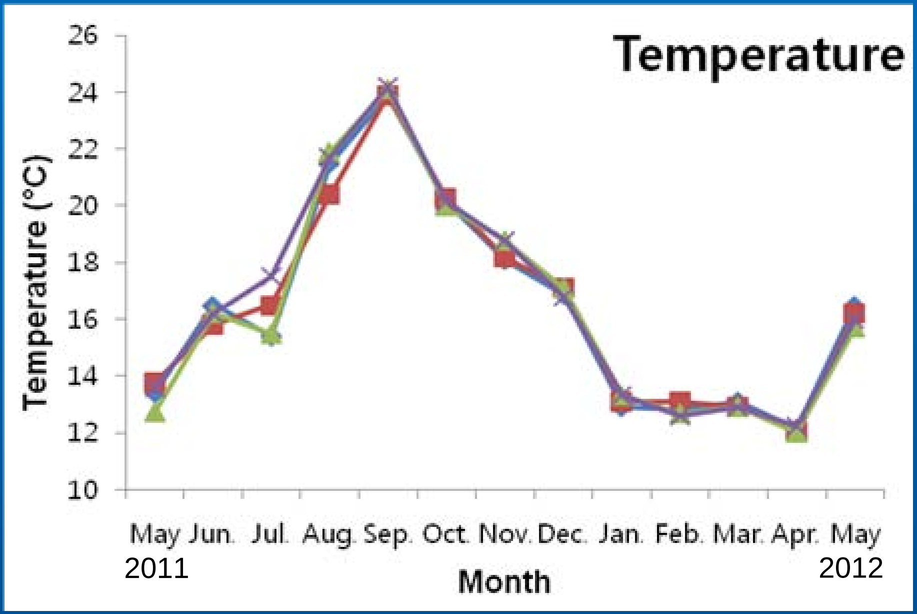
- Aliqout - Using Motoda splitter
  - Depending on zooplankton number

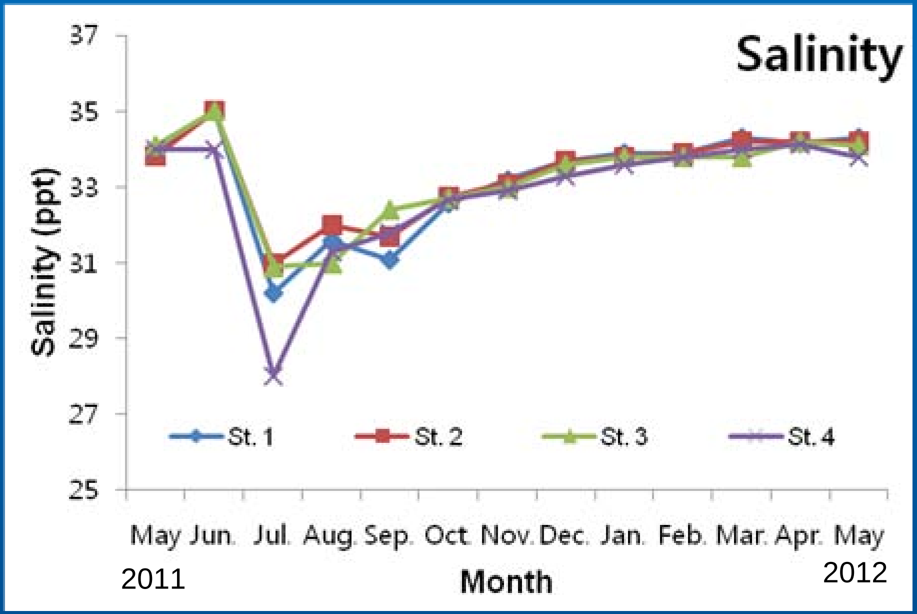
- Determining stage and sexes of *O. similis*

Uchima (1979)
Ferrari and Bowman (1980)
Shuvalov (1980)
Nishida (1985)

- Relationship between the environmental variables and biological property such as abundance of *O. similis* (Pearson correlation analysis by Minitab 16)

Sea Surface Temperature and Salinity

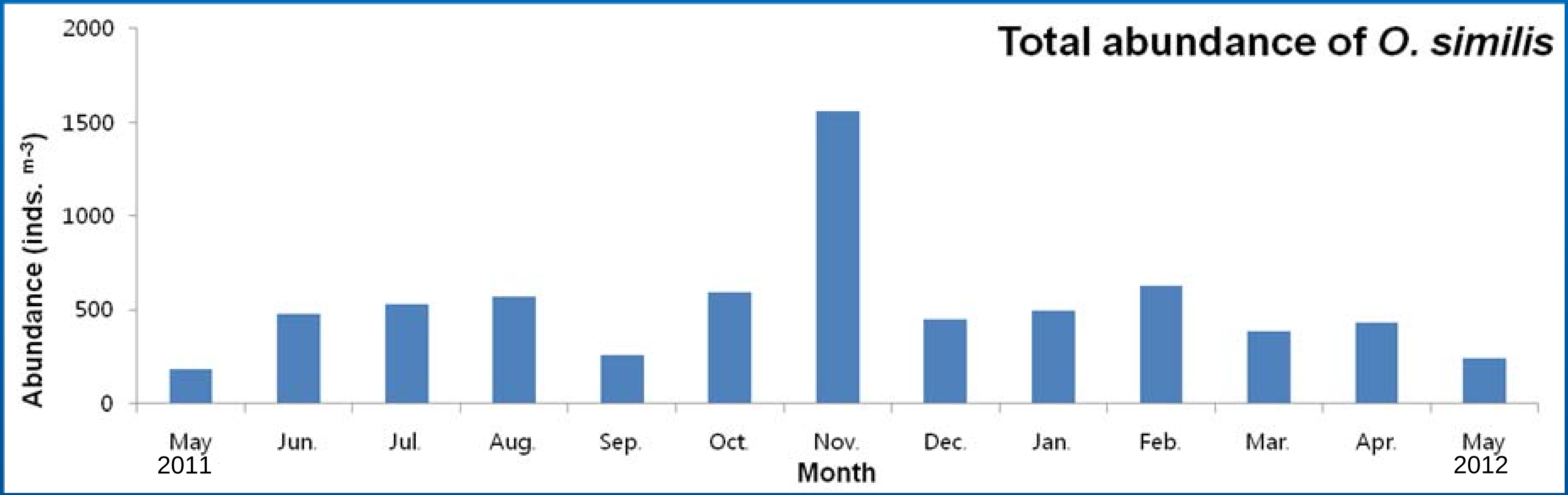




- SST: 24.0℃ in September ~ 12.1℃ in April

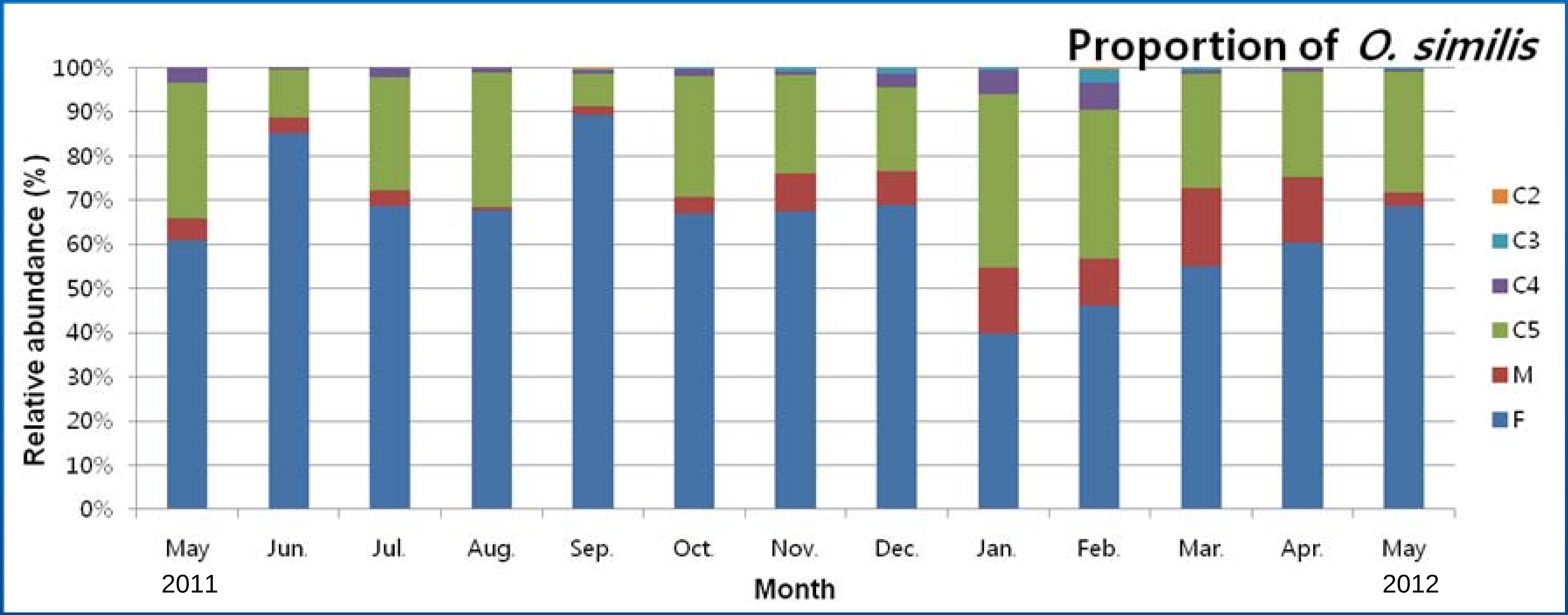
- SSS: highest in June (34.8 psu) ~ lowest in July (30.0 psu)
- Strong variation of salinity between stations was should be resulted from the fresh water input from nearby rivers during the summer.

Monthly variations of abundance of *O. similis*



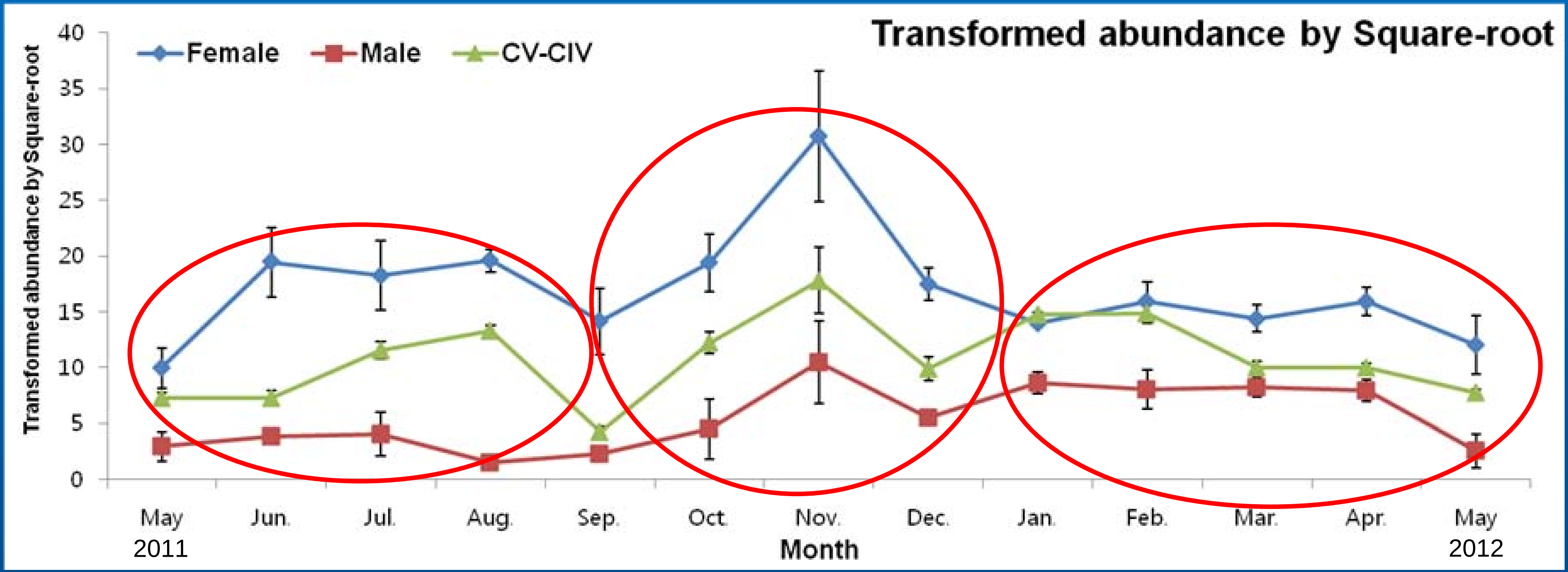
- *O. similis* was one of dominant species in study area.
- *O. similis* occurred throughout the year, ranging from 193.5 to 1557.8 inds.m^{-3}.
- The abundance of May was lowest in both years.
- Total abundance was highest in November.

Monthly variations of stage composition



- In study period, proportion of female were relatively higher than male and copepodite stages were found throughout the year.
- Proportions of male in March and copepodid V in January were relatively higher than other months.
- Copepodid III occurred from September to March in the following year, while small number of copepodid II was collected only in September 2011 and February 2012.

Monthly variations of abundance of *O. similis*



- Older stage (female, male, copepodid V and IV) had highest abundance in November.
- Abundance of female was lowest in May and increased during summer, then decreased in September.
- Abundance of copepodid V-IV was higher in August, November and January to February.

- There may be three generations per year.

Correlation analysis - 2 month time lag

<Relationship between environmental variables
and abundance of *O. similis*>

Parameters	Temperature		Salinity	
	r	***p***	***r***	***p***
Abundance				
Female	0.693	0.018	-0.271	0.420
Male	0.455	0.160	-0.089	0.795
Copepodid V	0.653	0.029	0.026	0.940
Total	0.711	0.014	-0.192	0.572

- Two month time lag to the original data
- There was a strong correlation between temperature and *O. silmilis* abundance in female and copepodid V.

•Except that, any significant correlation was not seen.

Discussion – Highest abundance

<Comparison with other study about highest abundance>

Where	When	Individuals	Source
Weddell Sea, Antarctica	Nov.	> 40,000inds. m^{-2}	Fransz and Gonzalez 1995
Malangen Fjord, Norway	Nov.	320,000 inds. m^{-2}	Falkenhang *et al*. 1997
Bornholm Basin, Baltic Sea	Nov.	167,000 inds. m^{-2}	Hansen *et al*. 2004
Kongsfjorden, Svalbard	Nov.	>704,633 inds. m^{-2}	Lischka and Hagen 2005
Disko Bay, Western Greenland	Aug.	1,500 inds. m^{-3}	Madsen *et al.* 2008
Kola Bay, Barents sea	Sep.	9,600 inds. m^{-3}	Dvoretsky and Dvoretsky, 2008
Jangmok Bay, South Korea	Nov.	1,177 inds. m^{-3}	Hwang 2011
Busan, South Korea	**Nov.**	**1,557 inds. m^{-3}**	**In present study**

- We found that there was highest abundance of *O. similis* off Busan in November, decreased during the winter.
- Our findings are similar to the population pattern in other studies, except Disko and Kola Bays.

Discussion – Temperature and abundance

- In Kola Bay, there was highest abundance in September.
  - Water temperature and abundance has strong positive correlation in Kola bay.

    (Dvoretsky and Dvoretsky 2009)

- Ward and Hirst (2007) suggest relationship between temperature and abundance of nauplii and copepodid is highly significant .(p<0.001, r^2=0.301)

- Our results confirmed that there is a strong positive correlation between water temperature and abundance (r=0.711, p<0.05).

Discussion – Salinity and abundance

- At decreased salinity,

  - Decreased abundance of *O. simlis* in Kongfjorden (Lischka and Hagen 2005)
  - Decreased population density of *O. simlis* in Baltic sea (Hansen *et al.* 2004)

  - Salinity and abundanace in Masan Bay, South Korea had no correlation. (Yoo and Lim 1995)
  - In our data, abundance of *O. similis* had no correlation with salinity. (r = -0.192, p = 0.572)

  → Salinity did not affect on *O. similis* abundance in our study area.

Discussion – Generation

- In Kongsfjorden, *O. similis* had two main reproductive periods in a year (Lischka and Hagen 2005)
- Two reproduction peaks also appeared in western Greenland waters (Ussing 1938)

  → Two generations

- Elevated temperatures can effect on development, duration of reproduction and hatching time of *O. similis*
  (Sabatini and Kiorboe 1994; Uye and sano 1995; Nielsen et al. 2002)
- Temperature was higer, generation time become short.
  (Breteler *et al.* 1995)

→ In our study, seawater temperature was much higher than in Greenland, so three generations of *O. similis* in a year might be possible.

Summary

- *O. similis* occurred throughout the year off Busan .

- The abundance of *O. similis* off Busan
  - Fluctuated monthly.
  - Highest in November .
  - Strong correlation with temperature.
    (after applying two month time lag)
  - No correlation with salinity.

- There were three generations of *O. similis* off Busan.

Thank you

for listening