Year-to-year changes in mesozooplankton community in the Chukchi Sea during summers of 1991/92 and 2007/08

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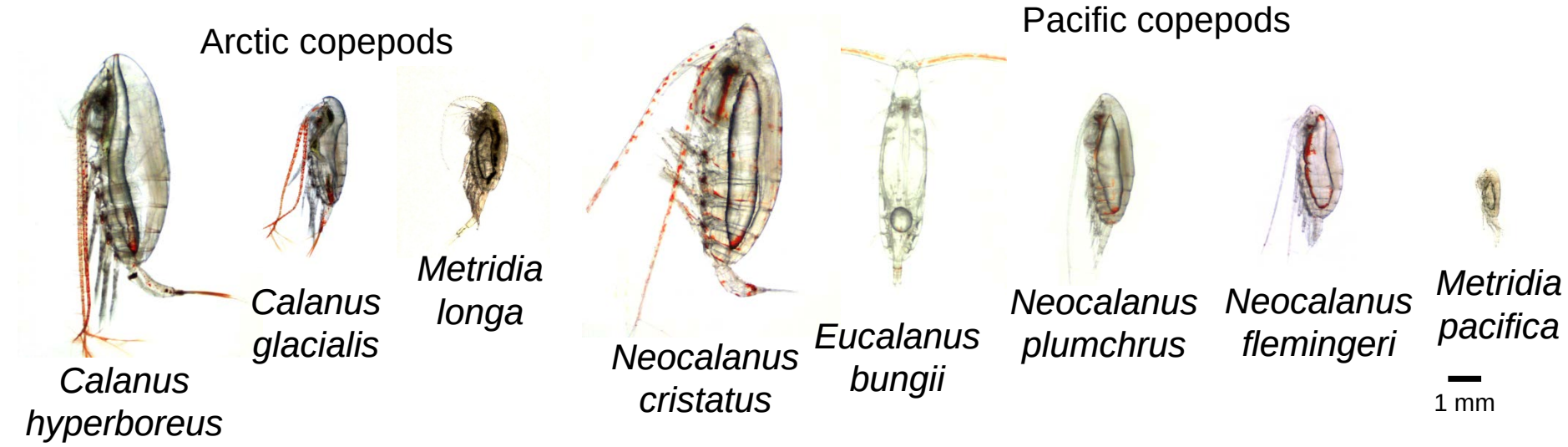
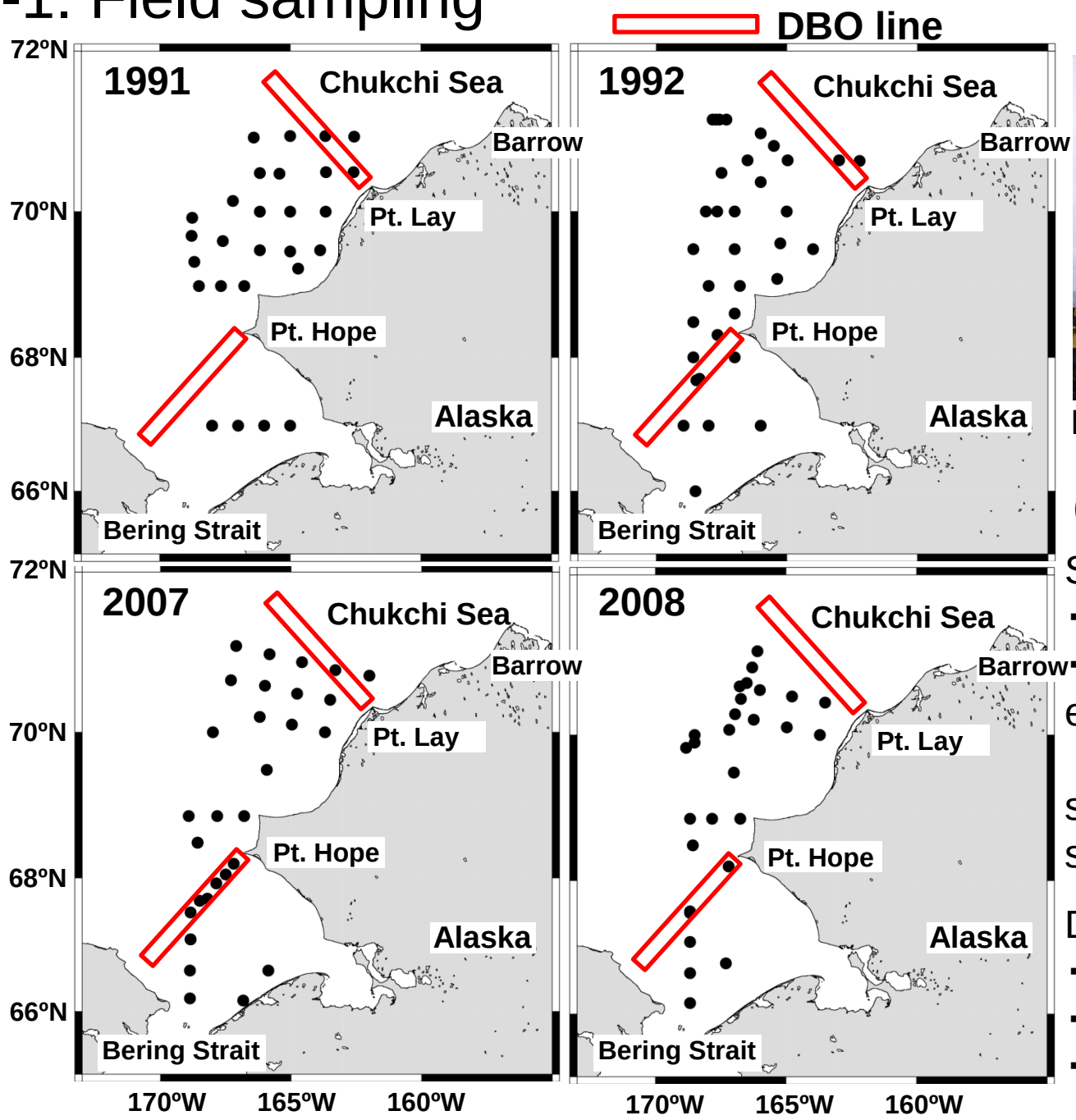


Outline

1. Year-to-year changes in zooplankton community in the Chukchi Sea
2. Zooplankton sampling during 2012 R/V *Mirai* cruise
3. Zooplankton sampling plan during 2013 R/V *Mirai* and T/S *Oshoro-Maru* cruises

1-1. Field sampling



7 July−13 August

NORPAC net (335 µm)

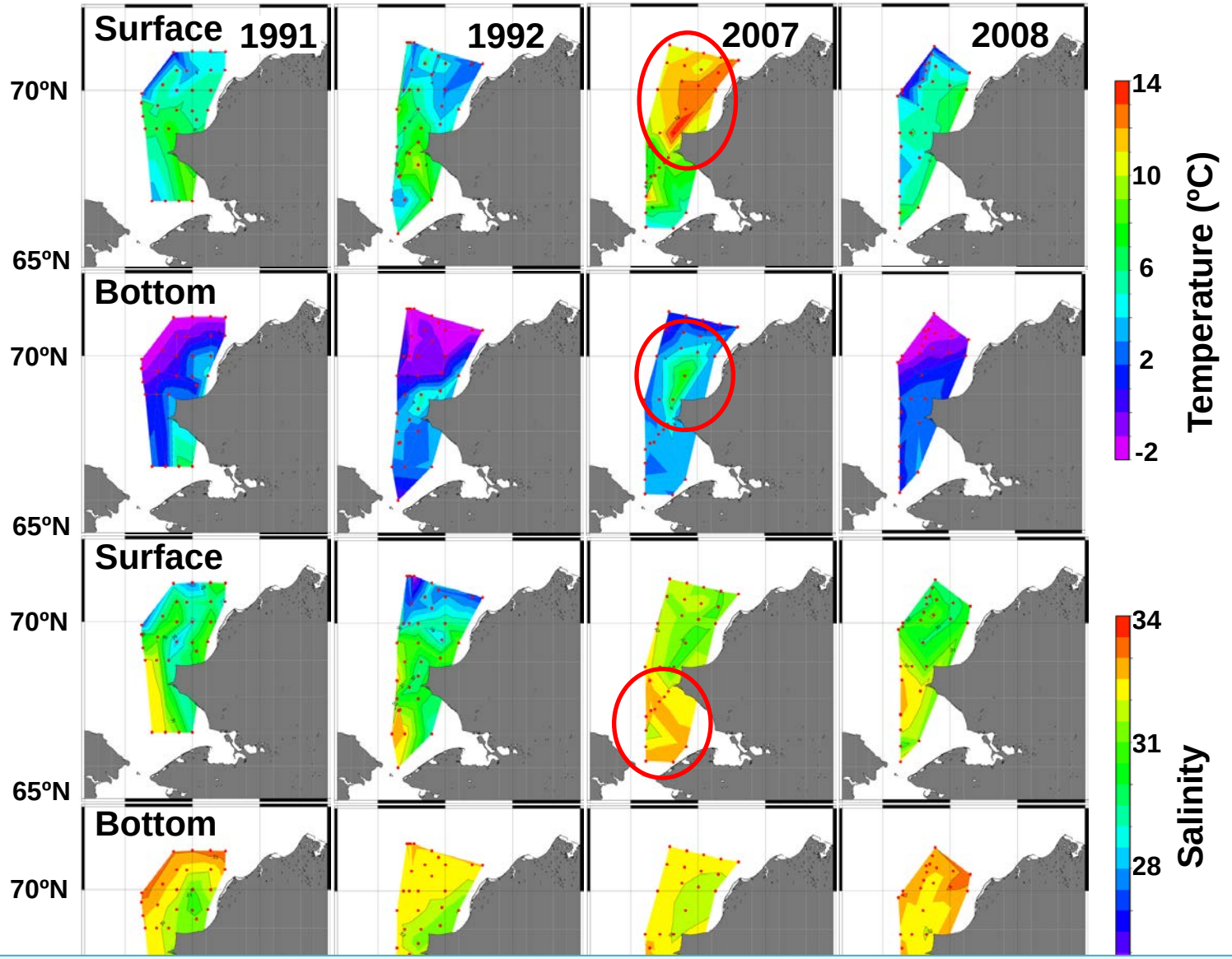
CTD

Sea surface − 5 m above bottom

Sample analysis
- Wet mass determination
- Identification and enumeration (calanoid copepods: species and copepodid stages)

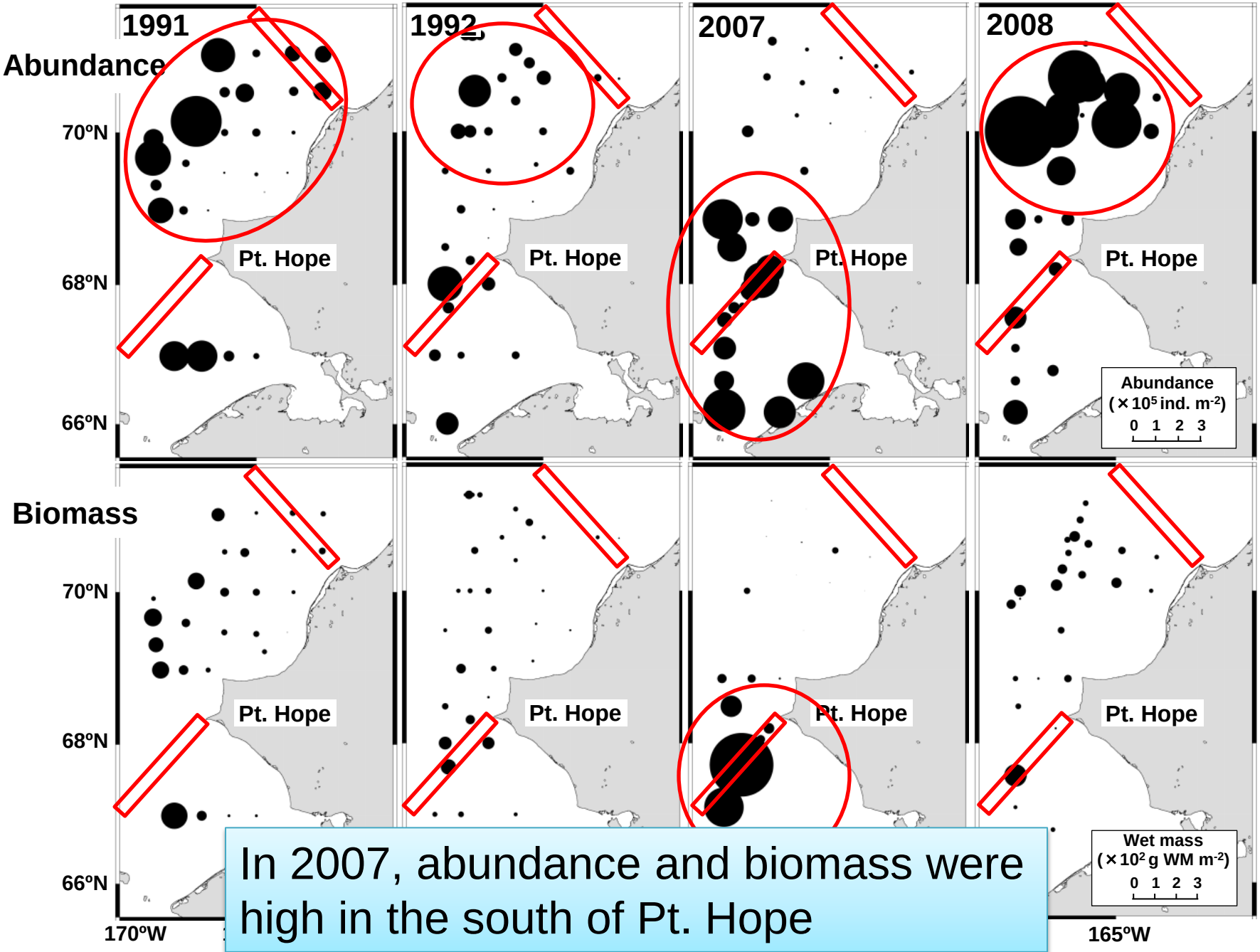
Data analysis
- Cluster analysis
- Species diversity (*H'*)
- Mean copepodid stage

1-2. Hydrography: temperature and salinity



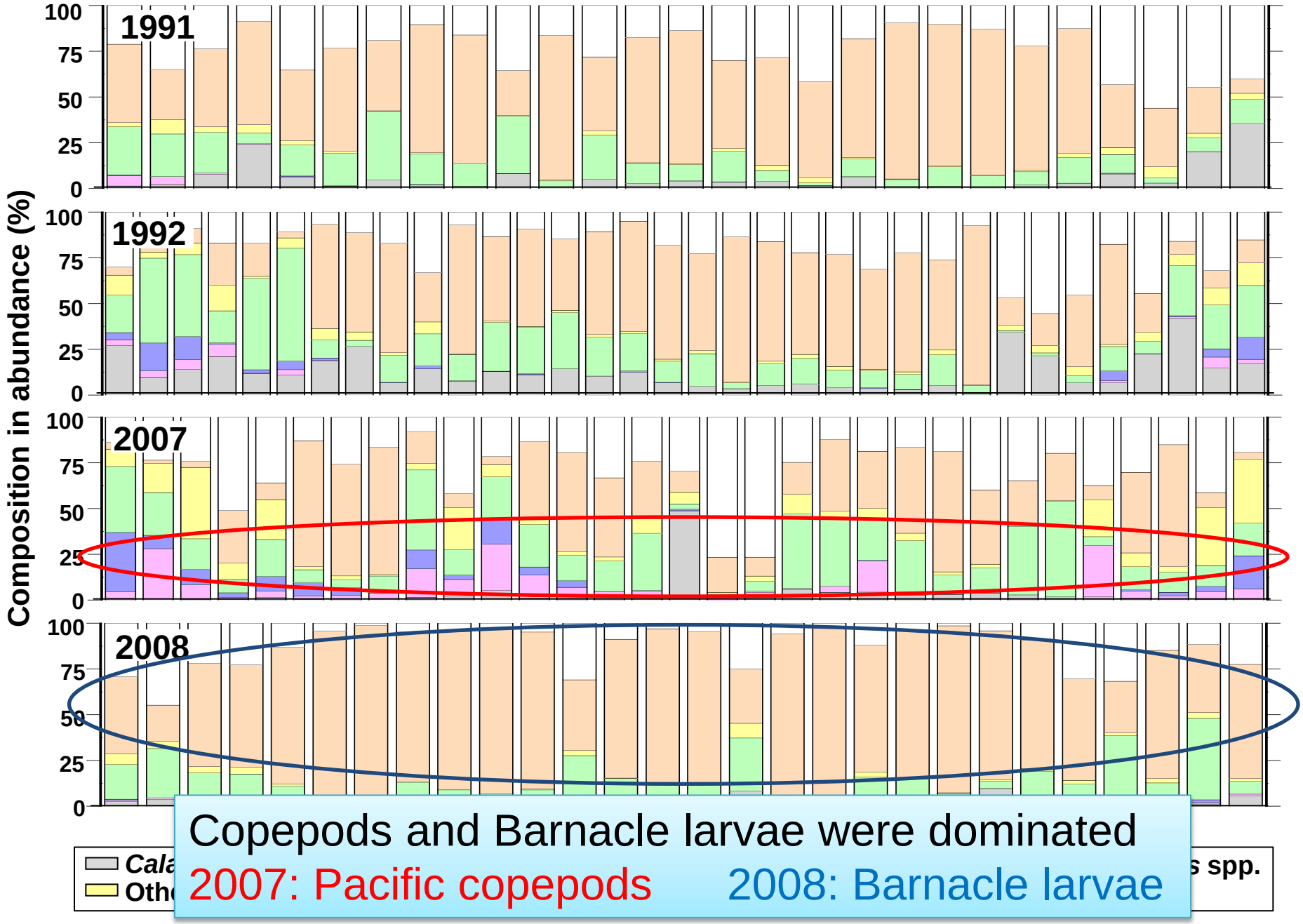
Surface temperature and salinity were high in 2007
→Effect of increase of Pacific Water inflow and solar radiation (Vanin, 2010)

1-3. Zooplankton abundance and biomass



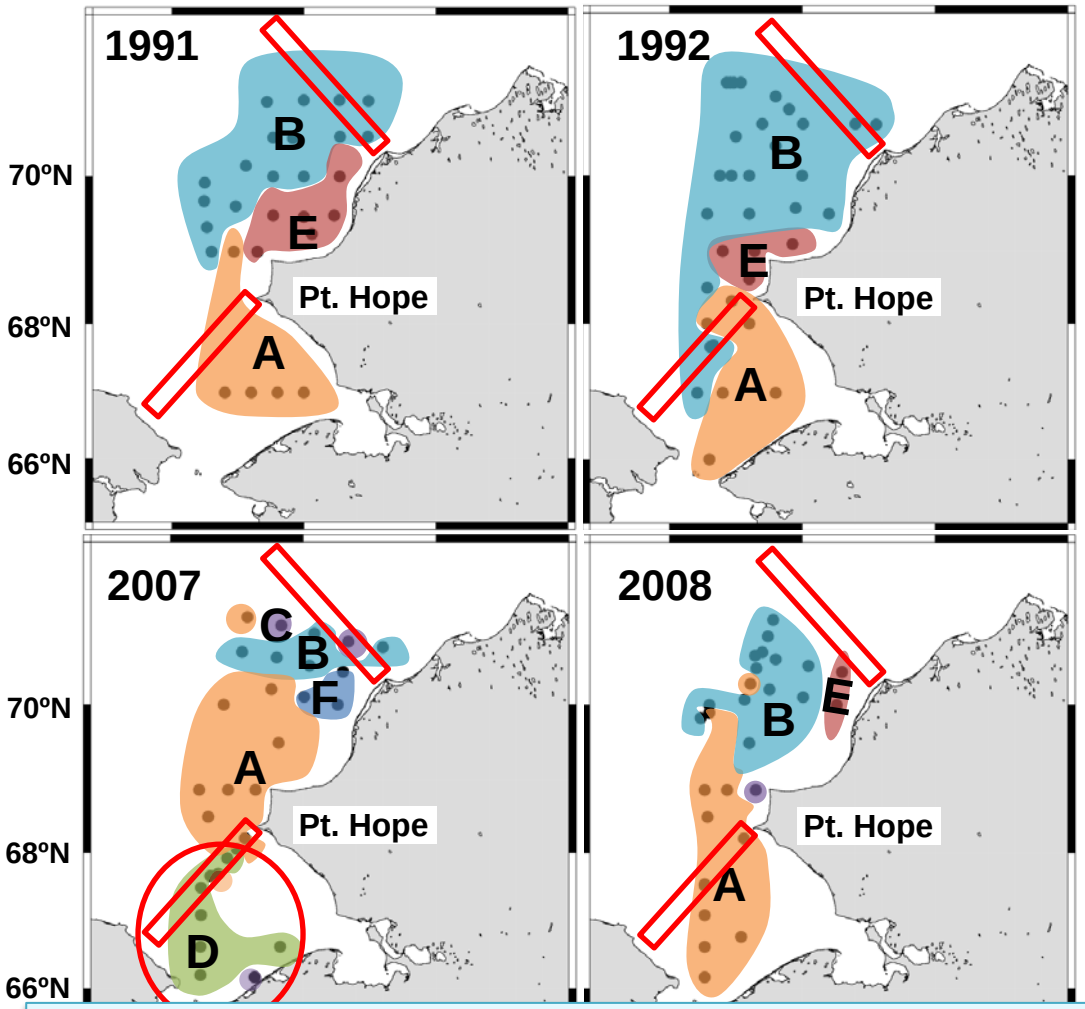
In 2007, abundance and biomass were high in the south of Pt. Hope

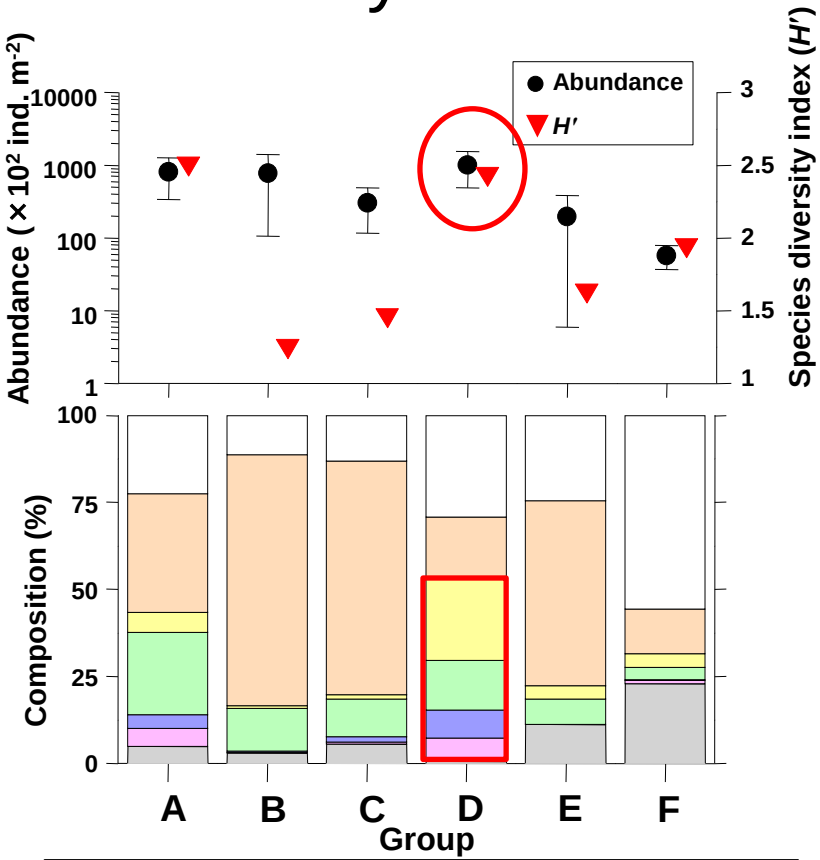
1-4. Zooplankton community



1-5. Characteristics of zooplankton community

Zooplankton community was divided into 6 groups





Species	Mean copepodid stage	
		2008
		2.92
		3.85
		3.25

Group D, which characterized with Pacific copepods, observed in the south of Pt. Hope in 2007
→High abundance, high species diversity and fast development

1-6. Summary

Year	Zooplankton			Development of large copepods
	Biomass	Community	Diversity	
1991/92	Low	Arctic	Low	Slow
2007	High	Pacific+Arctic	High	Fast
2008	Low	Arctic (Barnacle dominant)	Low	Slow

Changes in 2007→Caused by warm Pacific Water

Increasing Pacific Water inflow (Large Pacific copepods)

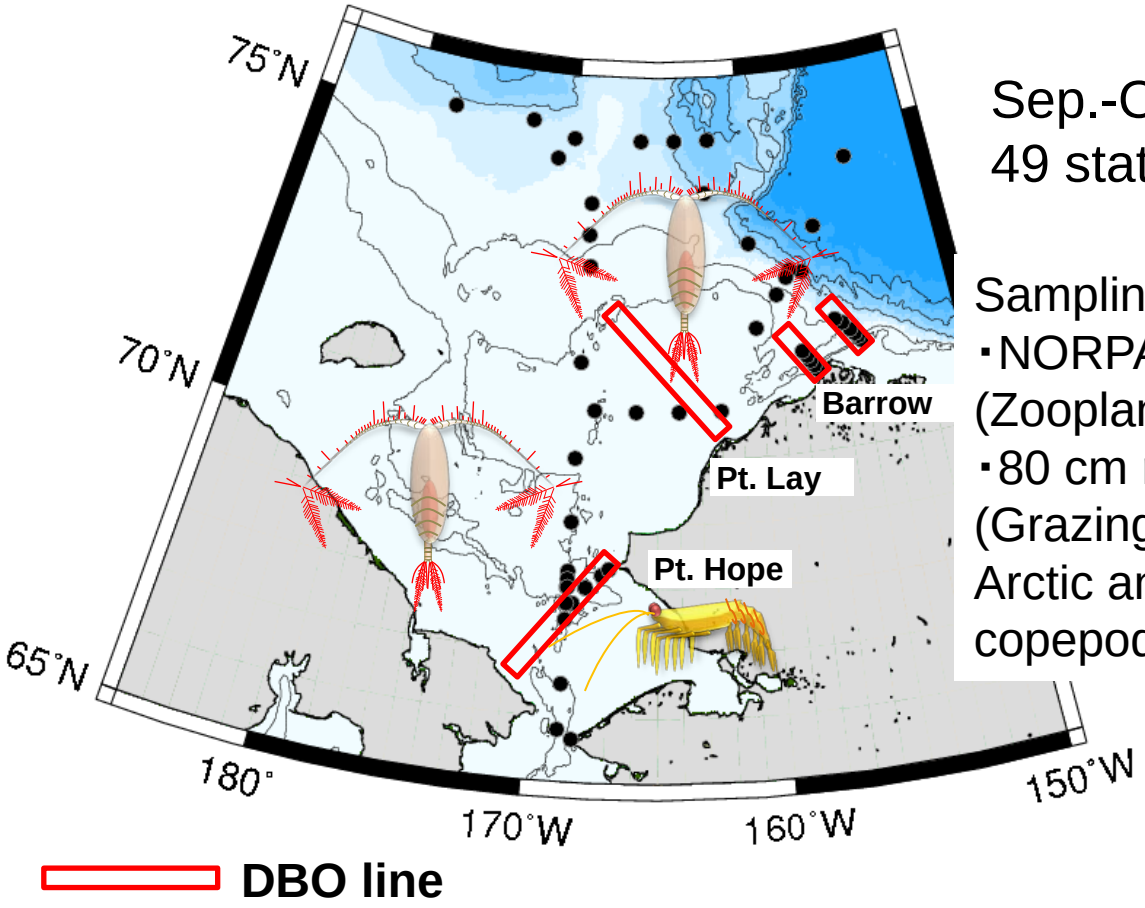
Positive

Negative

Increased biomass and secondary production

・Distribution of Arctic community shifted to north
・Changes in marine ecosystem structure

2-1. Zooplankton sampling in 2012 R/V *Mirai* cruise



Sep.-Oct. 2012
49 stations

Sampling
・NORPAC net (335 μm)
(Zooplankton community)
・80 cm ring net
(Grazing experiment for Arctic and Pacific copepods)

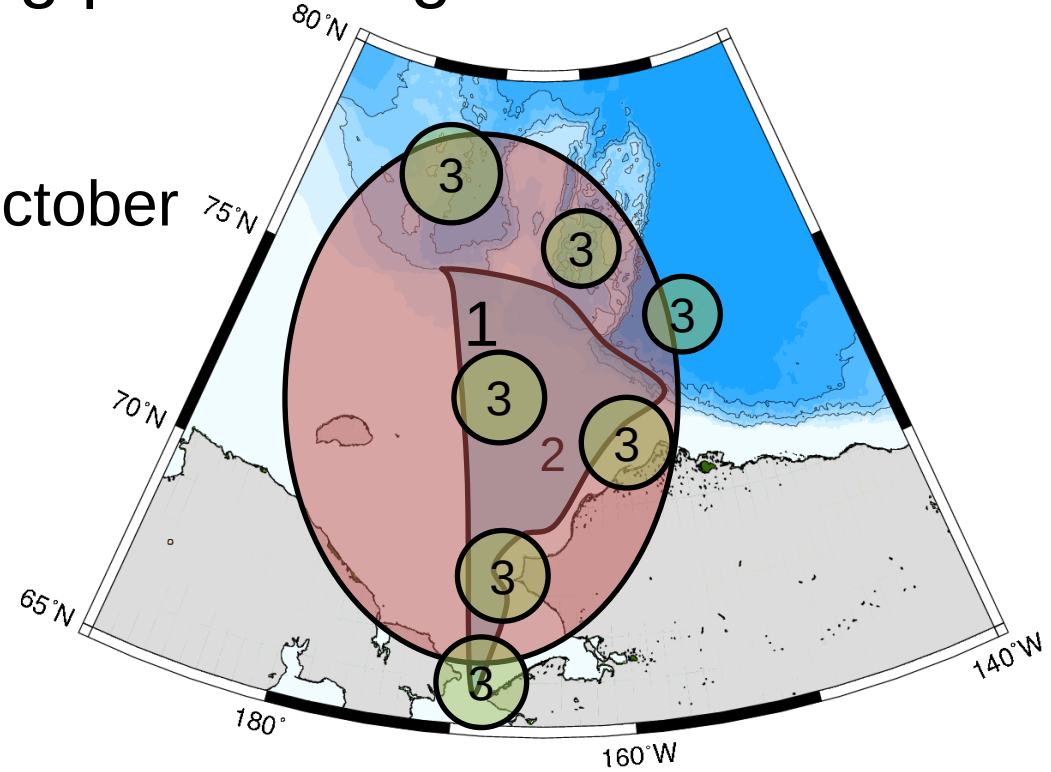
Twin NORPAC net
(62 and 335 μm)

Data analysis:
To compare the result in 2008 and 2010, cluster analysis based on zooplankton abundance will be made.

Pacific copepods and euphausiids were observed around the DBO lines (Pt. Hope and Barrow).

3-1. Sampling plan during R/V *Mirai* cruise in 2013

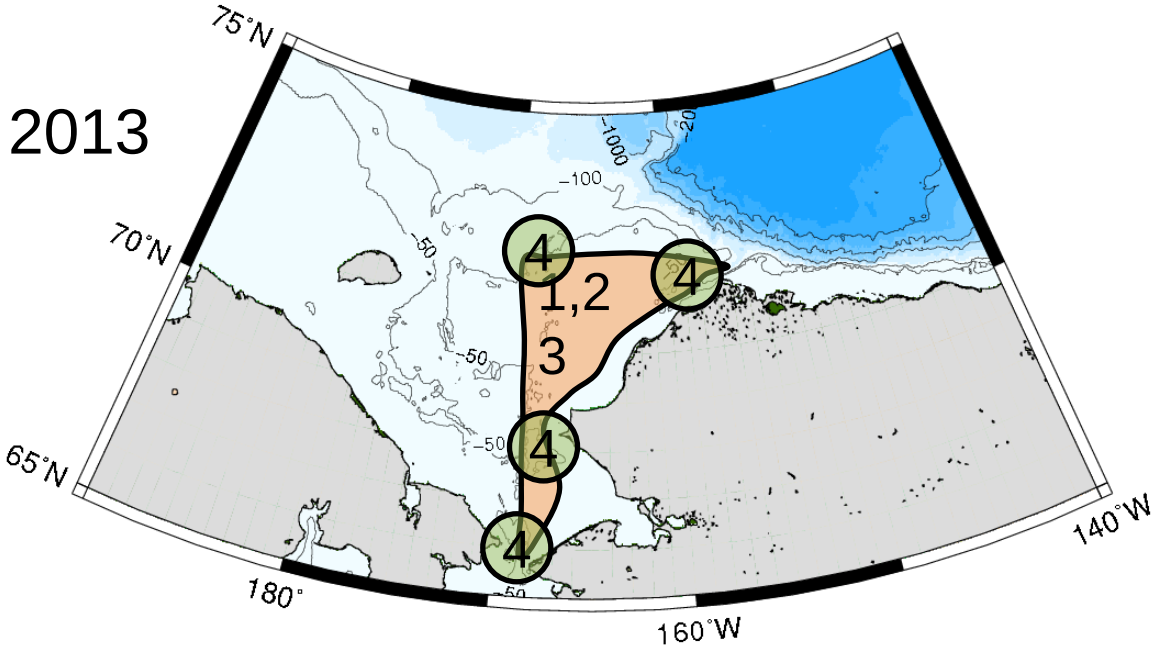
September-October 2013



1. Twin NORPAC net (62 and 335 μm, 0-150 m, 3-4 stations/day)
   Spatial distribution of zooplankton community
2. 80 cm ring net (335 μm, 0-50 m, max 8 stations)
   Grazing experiment at Shelf or Slope
3. Closing NORPAC or VMPS (62 μm, 7+α stations)
   Vertical distribution of zooplankton community
   →Shelf (0-25-50 m) to Basin (0-25-50-100-150-250-500-1000 m)

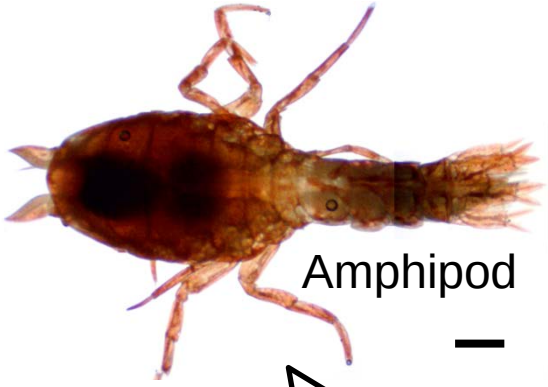
3-2. Sampling plan during T/S *Oshoro-Maru* cruise in 2013

June-July 2013

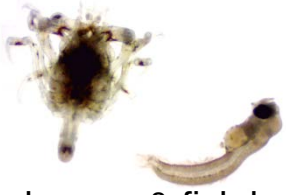


1. Twin NORPAC net (62 and 335 µm, 0-150 m, all stations)
   Spatial distribution of zooplankton community
2. Bongo net (335 µm, Trawl and Hot spot stations)
   Quantitative collection of Euphausiids
3. 80 cm ring net (335 µm, 0-50 m, max 20 stations)
   Grazing experiment at Shelf
4. Closing NORPAC net (62 µm, 0-25-50 m, 4+α stations)
   Vertical distribution of zooplankton community

Crab zoea

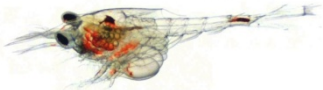


Amphipod



Crab zoea & fish larva

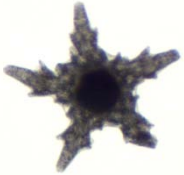
C. glacialis



Shrimp zoea

Chiridius obtusifrons

Balanus crenatus



Echinodea larva

M. longa

Thank you very much for your attention!

Amphipod

Themist sp.

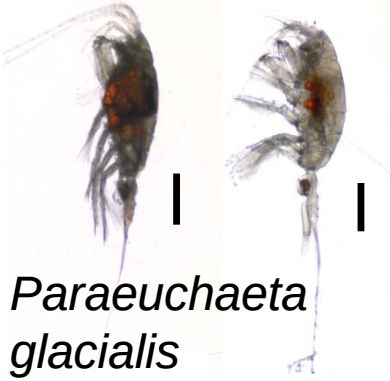
Scaphocalanus magnus

Clione limacina

Echinodea larva

Bivalvia larva

Limacina helicina



Paraeuchaeta glacialis

1-2. Sample and data analysis

Sample analysis

- Wet mass determination
- Identification and enumelation

(calanoid copepods: species and copepodid stages)

Data analysis

- Cluster analysis

  Normalized biomass (log (X+1))

  Bray-Curtis similarity connected UPGMA

- Species diversity (H')

  $H' = -\sum n/Ni \times \ln n/Ni$

  n: abundance of a species in region i

  Ni: total abundance of total copepods in region i

- Mean copepodid stage

  $$\text{Mean copepodid stage} = \frac{\sum^{6} i \times Ai}{\sum^{6} Ai}$$

  i: copepodid stage

  Ai: abundance of a copepodid stage

Identification and enumeration

1-6. List of species and results of cluster analysis

Copepoda

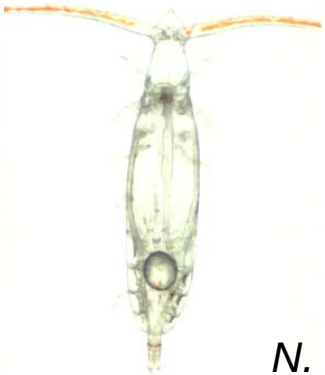
- *Acartia hudsonica*
- *Acartia longiremis*
- *Acartia tumida*
- *Calanus glacialis*
- *Calanus marshallae*
- *Centropages abdominalis*
- *Eucalanus bungii*
- *Eurytemora herdmani*
- *Epilabidocera amphitrites*
- *Gaetanus brevispinus*
- *Metridia pacifica*
- *Microcalanus pygmaeus*
- *Neocalanus cristatus*
- *Neocalanus flemingeri*
- *Neocalanus plumchrus*
- *Pseudocalanus* spp. (C1-C4)
- *Pseudocalanus acuspes*
- *Pseudocalanus major*
- *Pseudocalanus mimus*
- *Pseudocalanus minutus*
- *Pseudocalanus newmani*
- *Scolecithricella minor*
- *Tortanus discaudatus*

Other taxa

Ampipoda	Eubrachyura zoea
Appendicularia	Euphausiacea
Balanus crenatus	*Evadne* spp.
Bivalvia larva	Hydrozoa
Chaetognatha	Isopoda
Clione limacina	*Limacina helicina*
Echinoidea larva	Polychaeta

Pacific copepods

N. cristatus



E. bungii

N. plumchrus

N. flemingeri

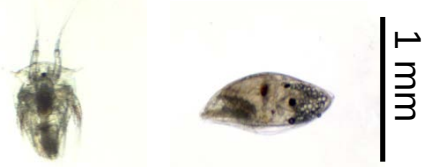
M. pacifica

1 mm

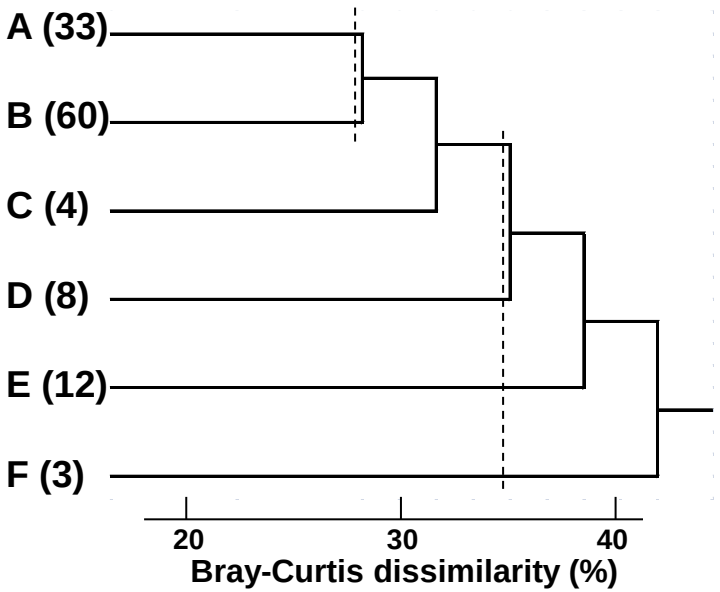
Divided into 6 groups

13 genus
22 species

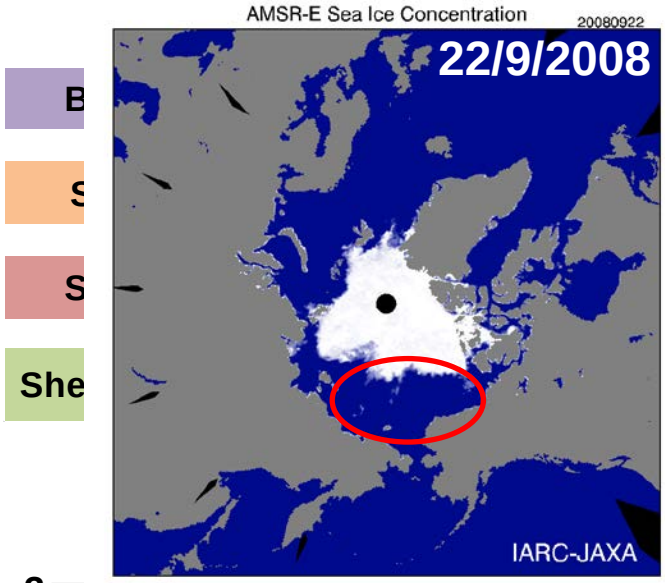
Barnacle larvae

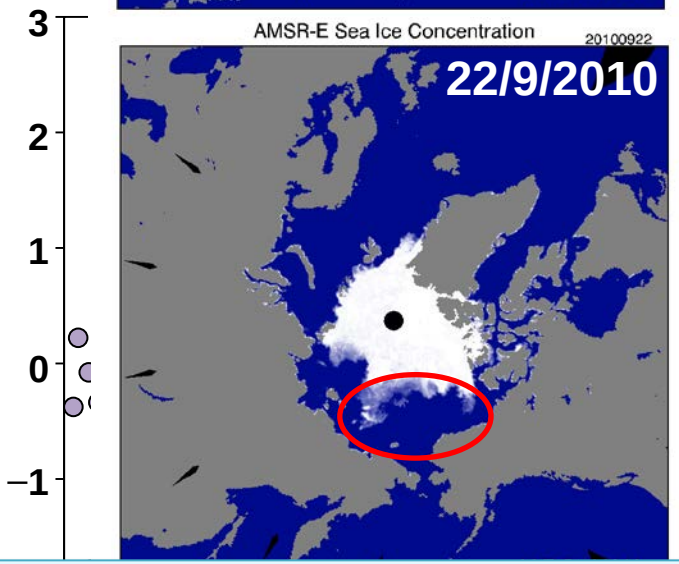


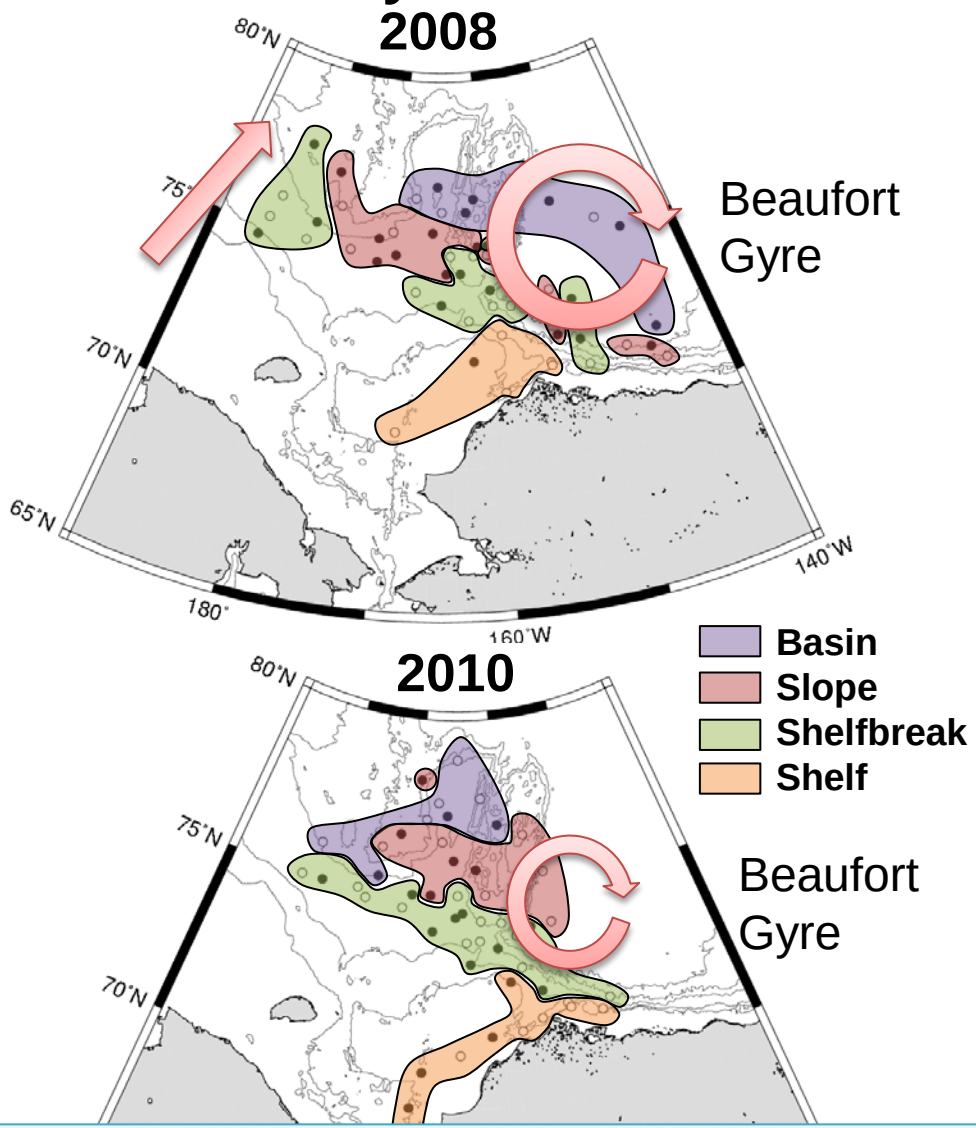
Nauplius Cypris larva



Results: Mesozooplankton community structure



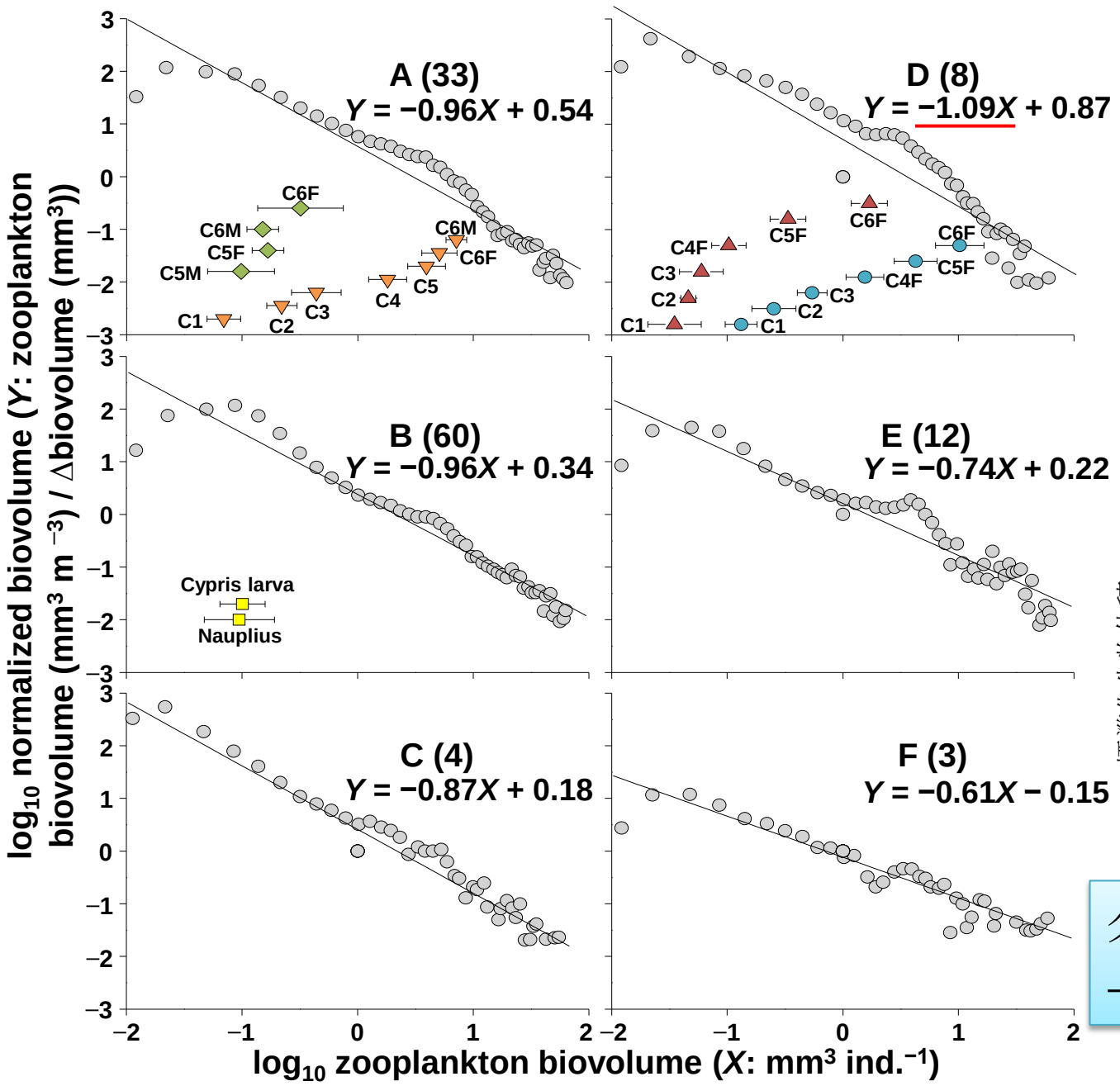


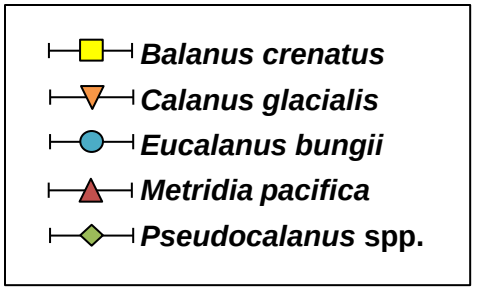


- Horizontal distribution of Shelfbreak and Slope groups in 2008 was more complex than those of 2010.

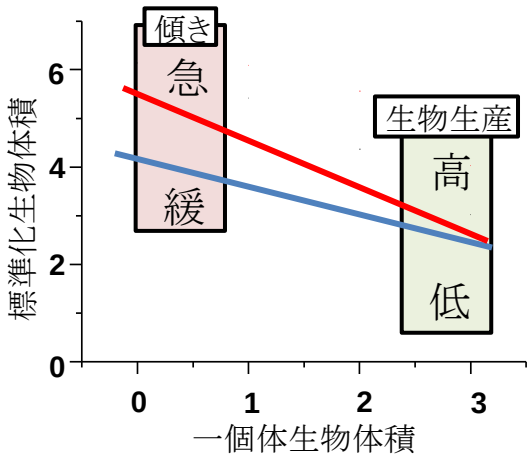
→Effect of meander or strength of Beaufort Gyre inflow.

3-7. 結果 動物プランクトン群集のNBSS解析

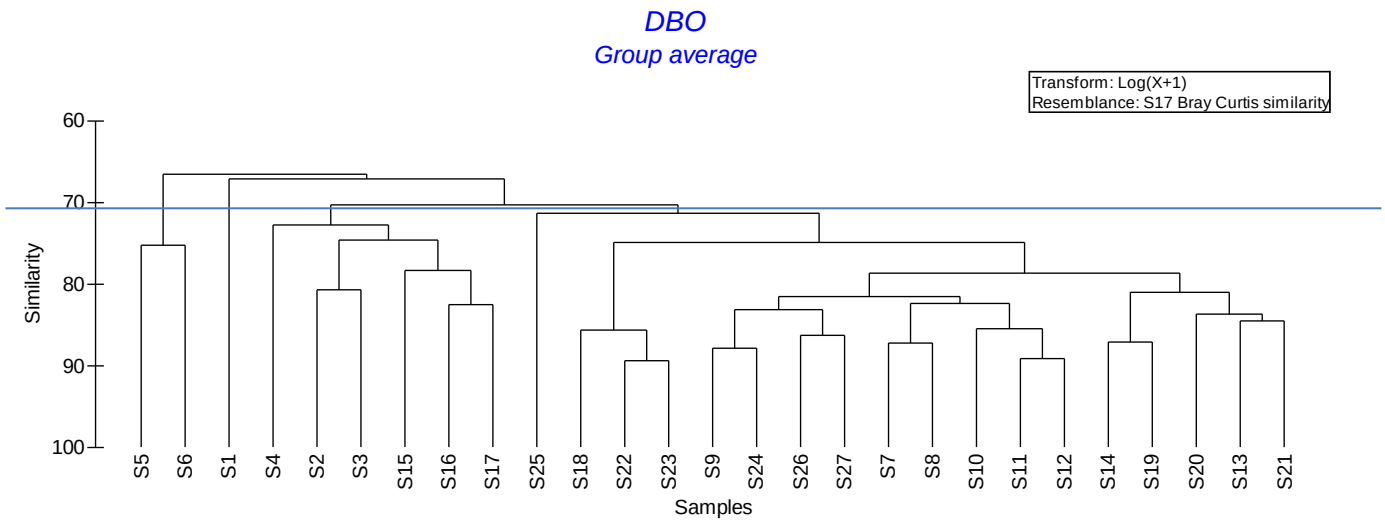




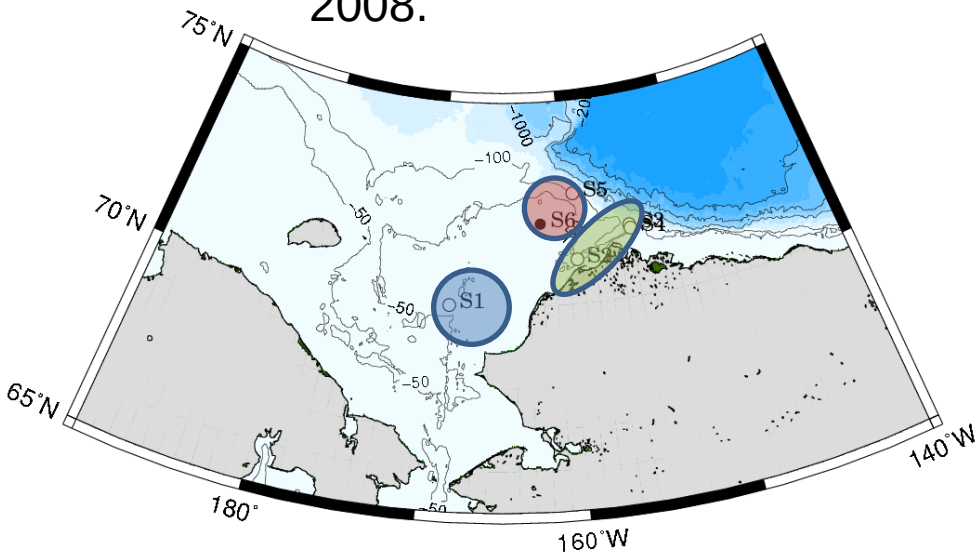
NBSS：グラフの傾きにより動物プランクトン群集の生物生産を評価
(Platt and Denman, 1978)



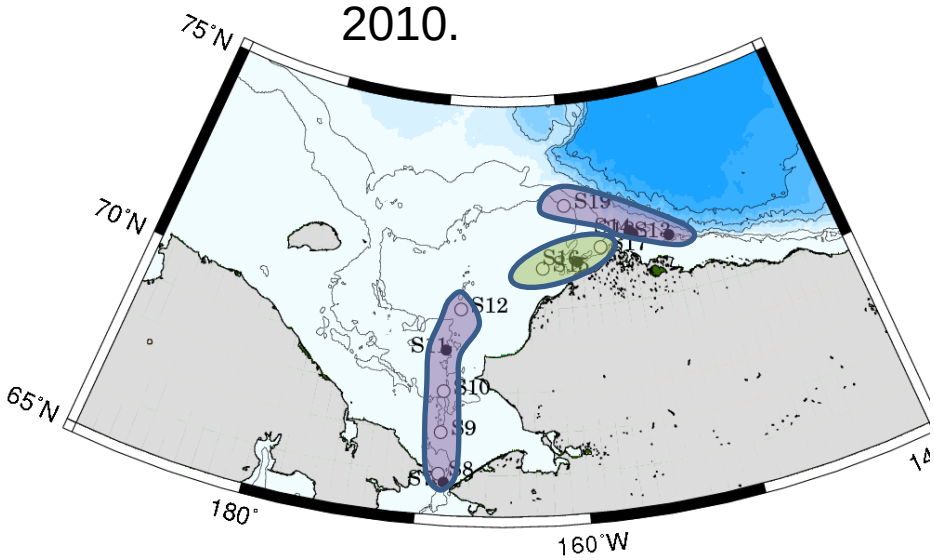
グループD：傾き急
→生物生産高い


DBO
Group average
Transform: Log(X+1)
Resemblance: S17 Bray Curtis similarity
Similarity
60
70
80
90
100
S5
S6
S1
S4
S2
S3
S15
S16
S17
S25
S18
S22
S23
S9
S24
S26
S27
S7
S8
S10
S11
S12
S14
S19
S20
S13
S21
Samples

2008.



2010.



2010.