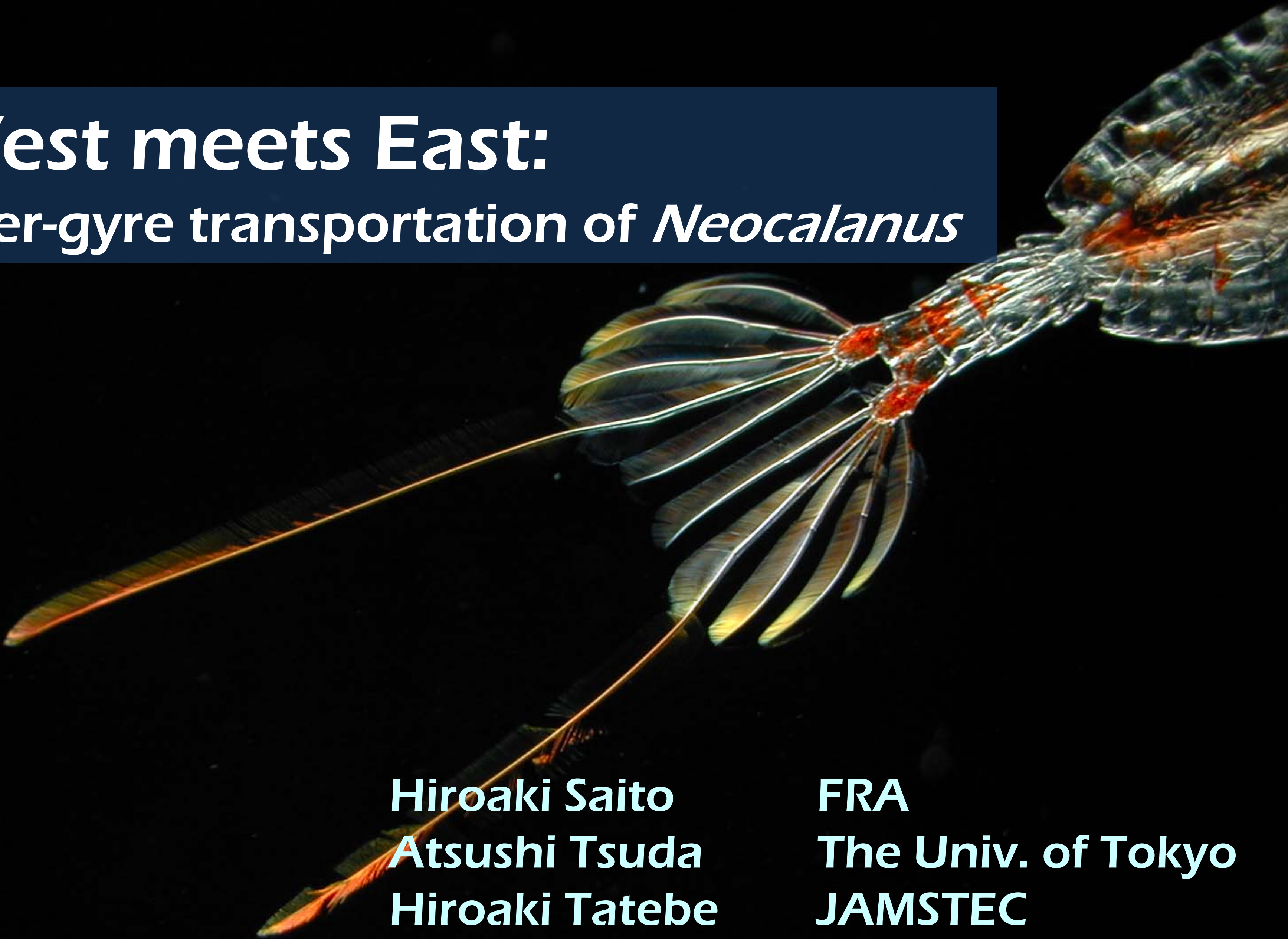
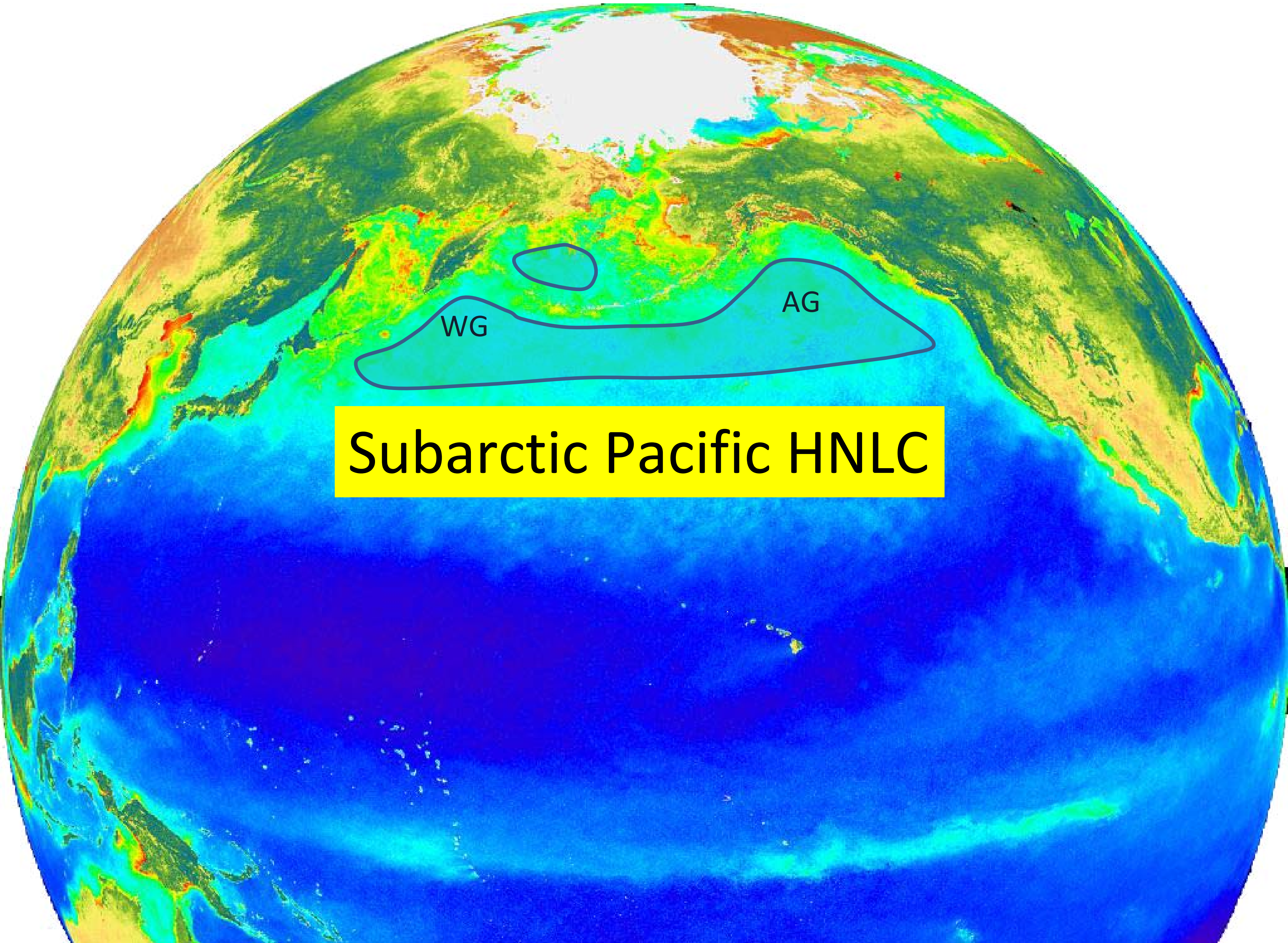
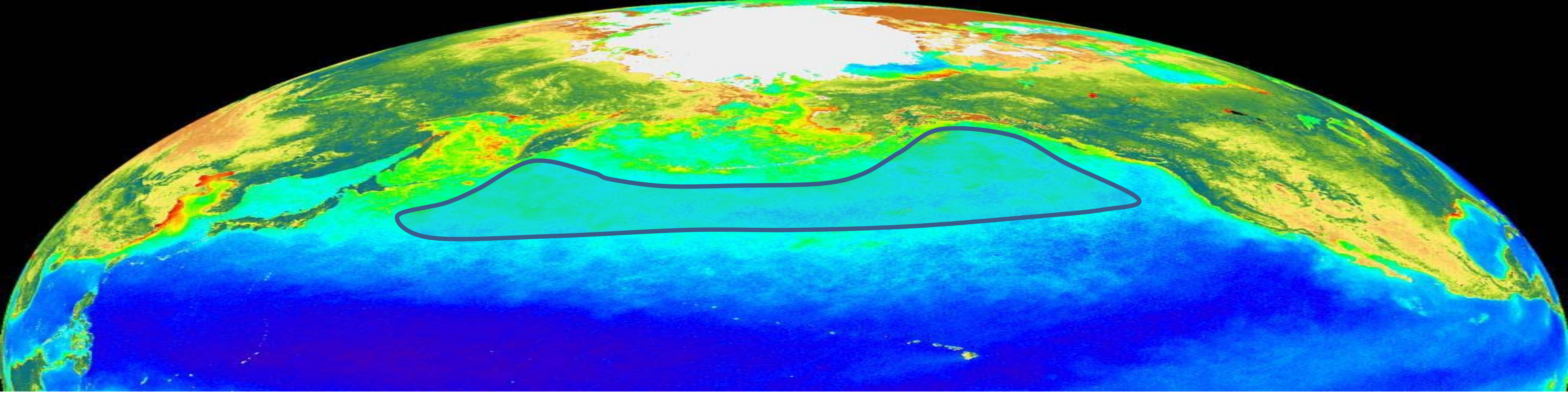
West meets East:
Inter-gyre transportation of *Neocalanus*



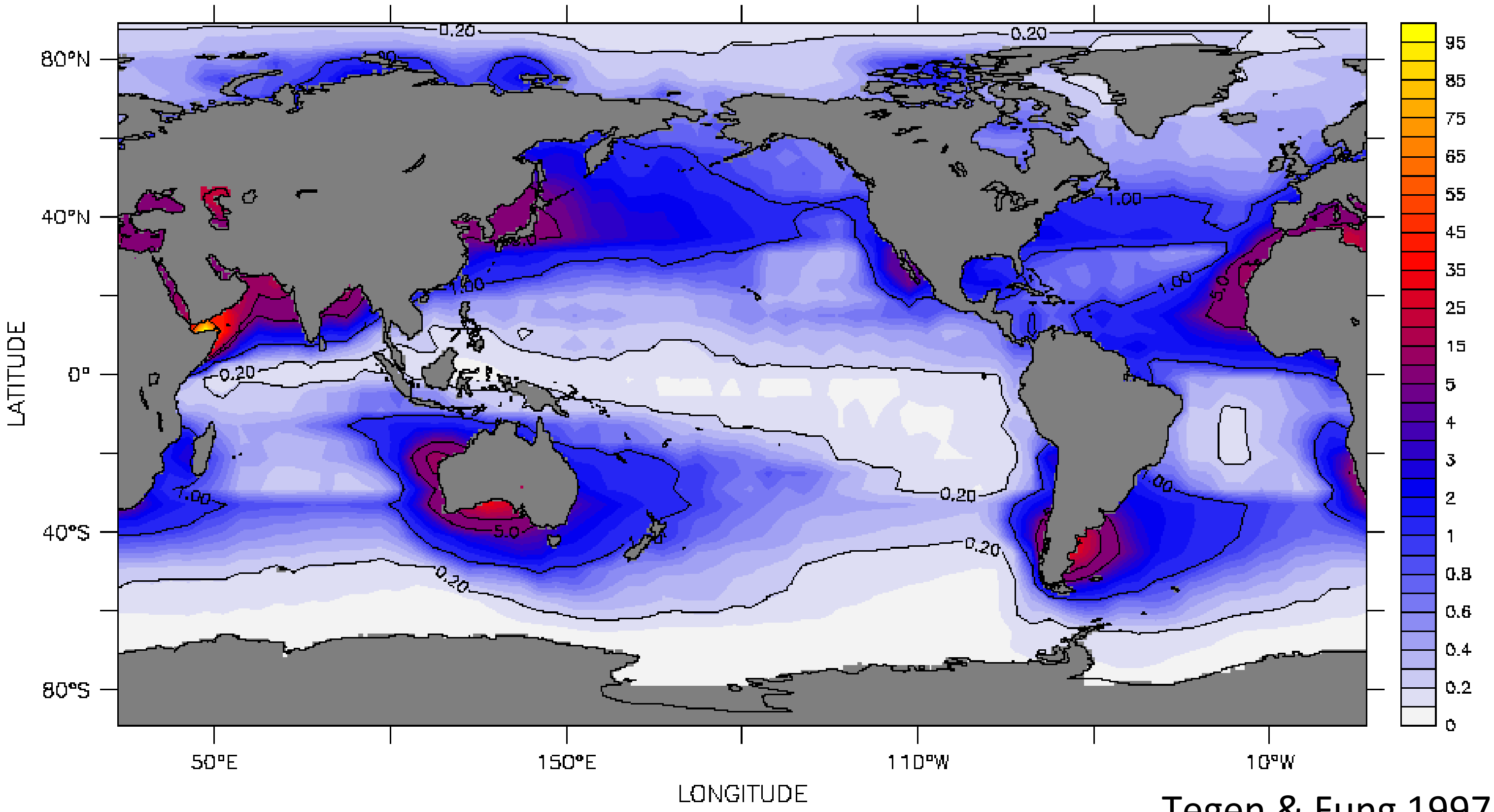
Hiroaki Saito — FRA
Atsushi Tsuda — The Univ. of Tokyo
Hiroaki Tatebe — JAMSTEC


WG
AG
Subarctic Pacific HNLC



	WSG	Alaskan Gyre
Dissolved Fe	<0.1 nM	<0.1 nM
ΔNO_3	10-15 μM	8-10 μM
ΔBiol. pCO_2	high	low
Balast	Opal	$CaCO_3$
Chl. in summer	0.5-1.0 mg m^{-3}	0.3-0.5 mg m^{-3}
Phytopl	diatom, green, cryptophyte	prymnesiophyte, cyanobacteria
Diatom	centric	pennate
Zooplankton	large herbivore	large herbivore

Dust Deposition

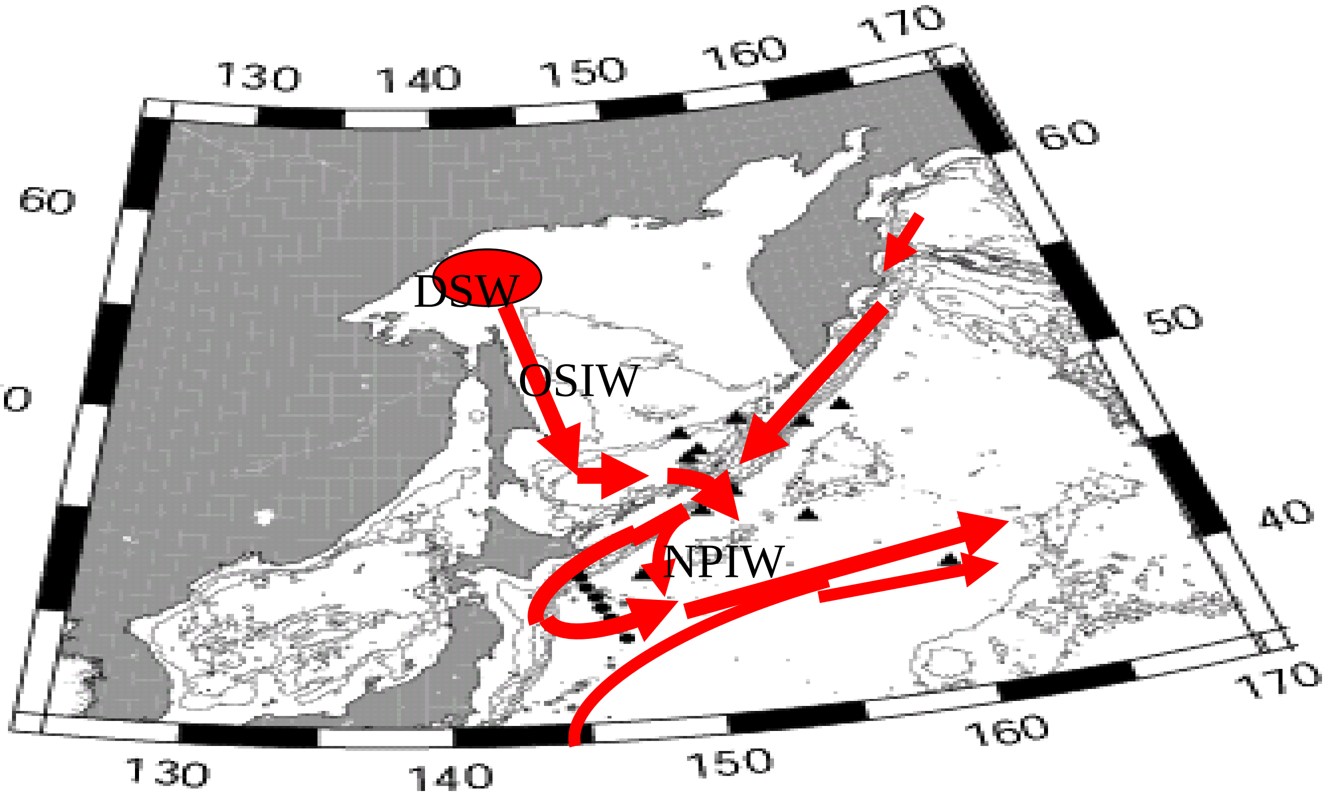


Tegen & Fung 1997

HNLC regions are the region of low dust flux

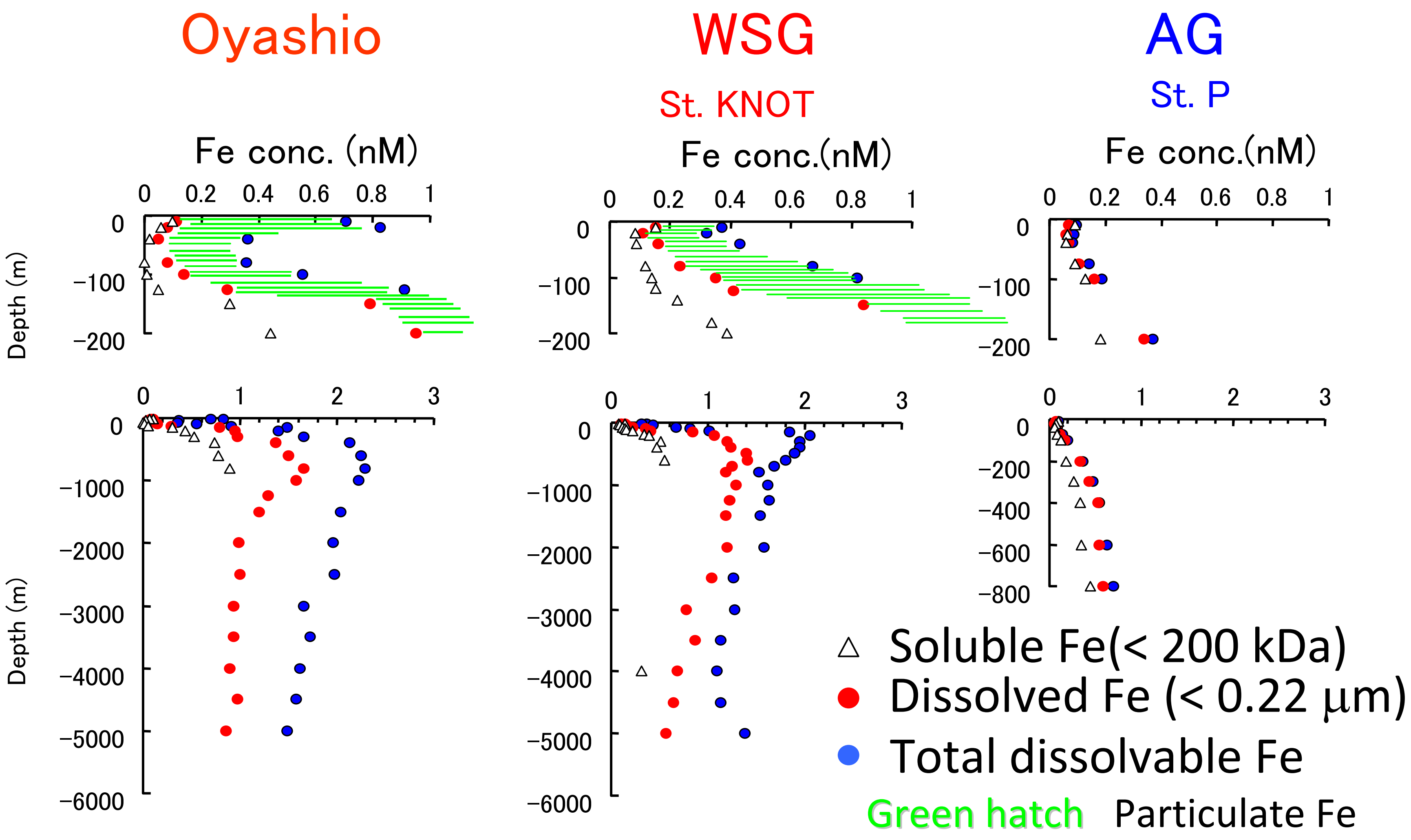
High-Fe High-Turbid Low-Temp water in subsurface layer

Nishioka et al., 2007; in review

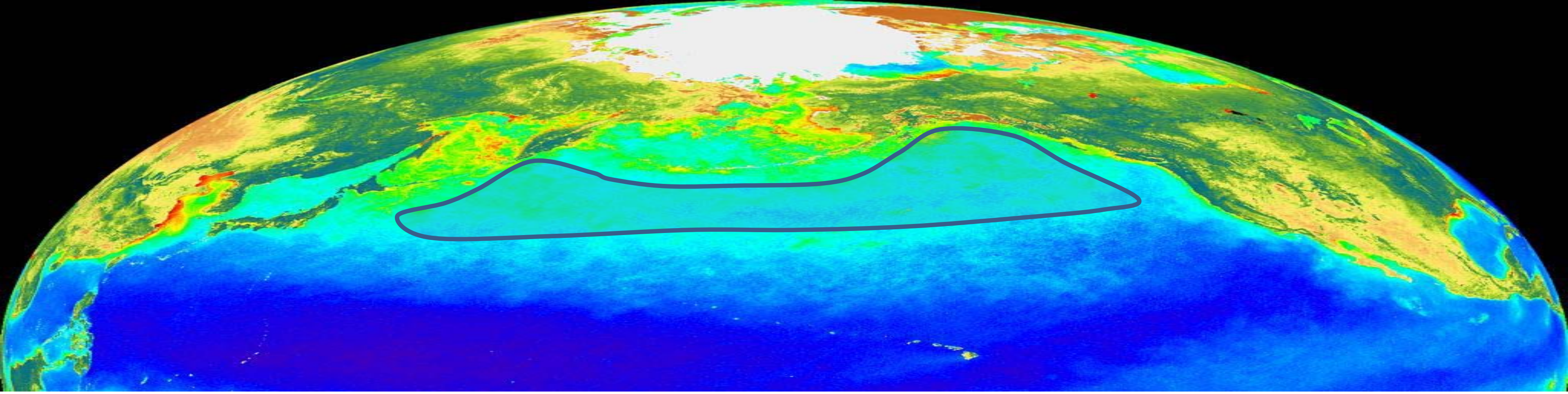


Materials are transported from the Sea of Okhotsk to WSP by the intermediate water transportation

Eastward decline in Fe concentration



High particulate Fe in the western subarctic Pacific



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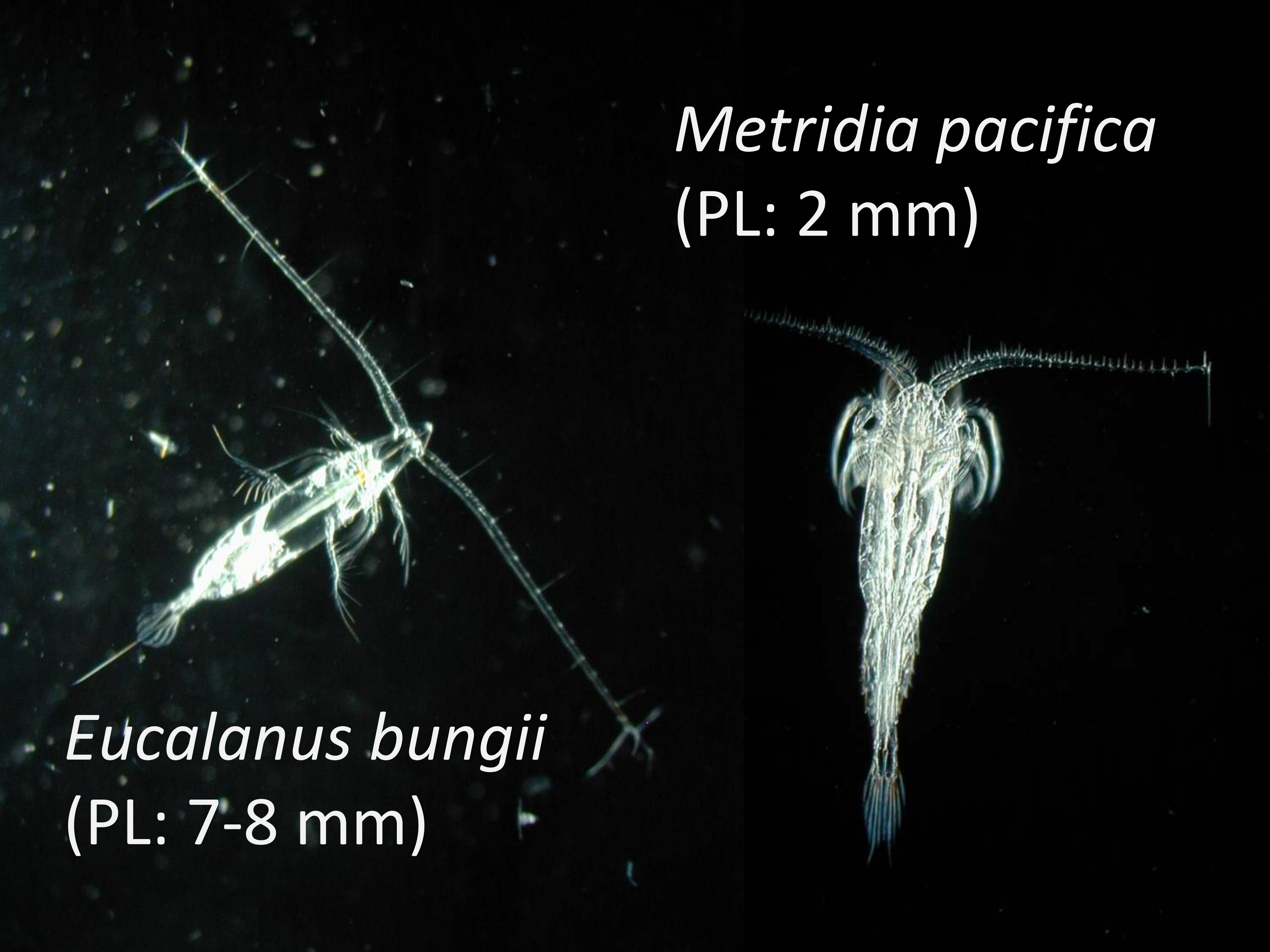
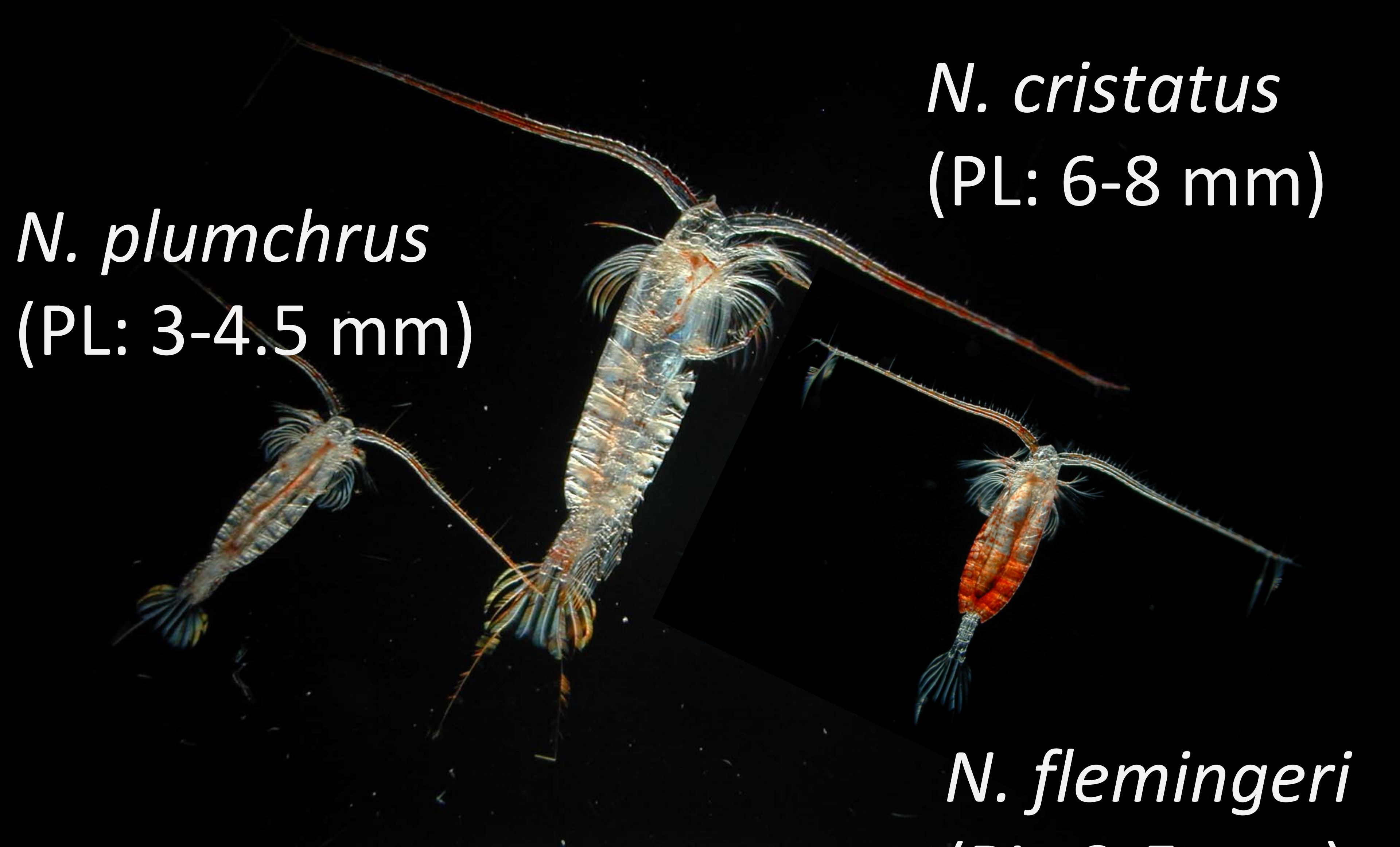
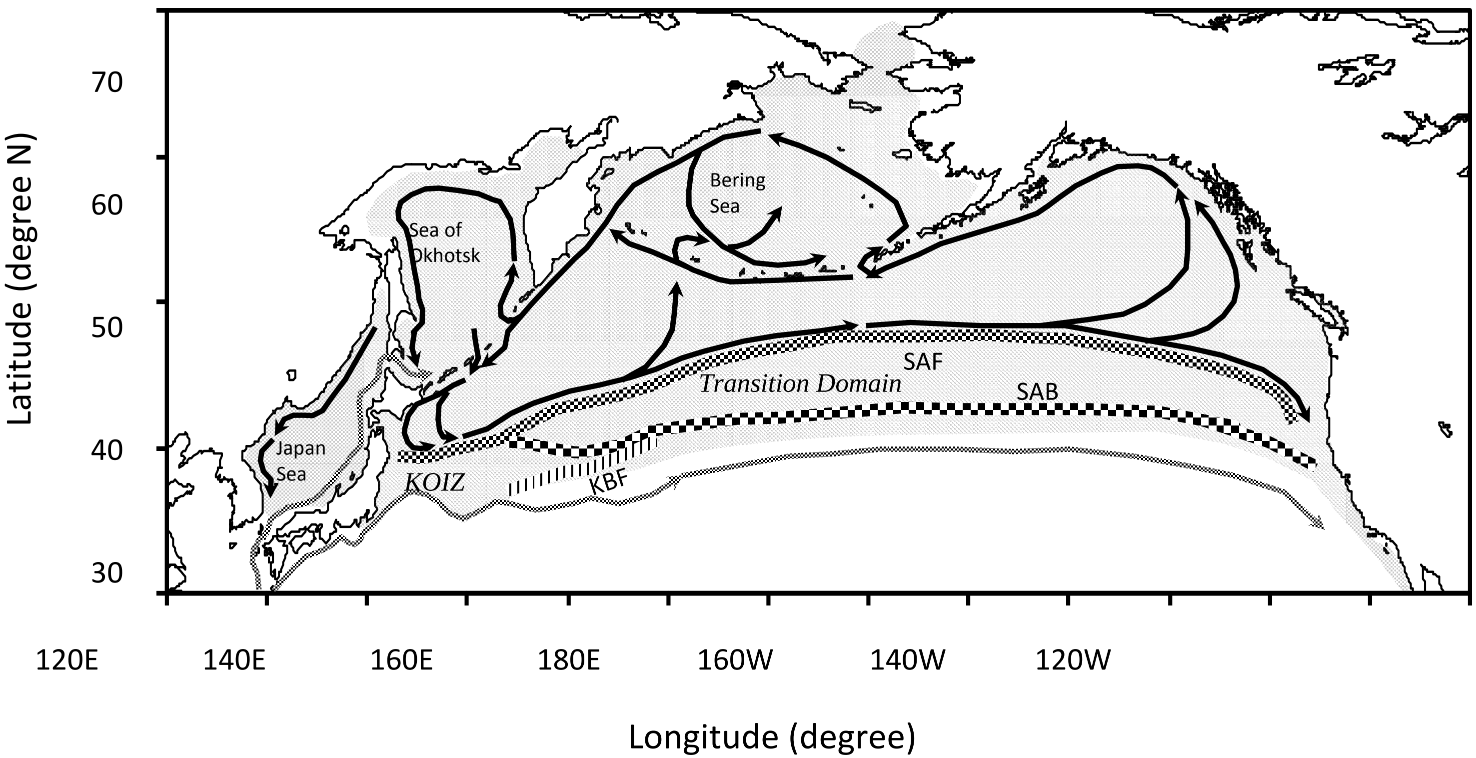

Metridia pacifica
(PL: 2 mm)
Eucalanus bungii
(PL: 7-8 mm)



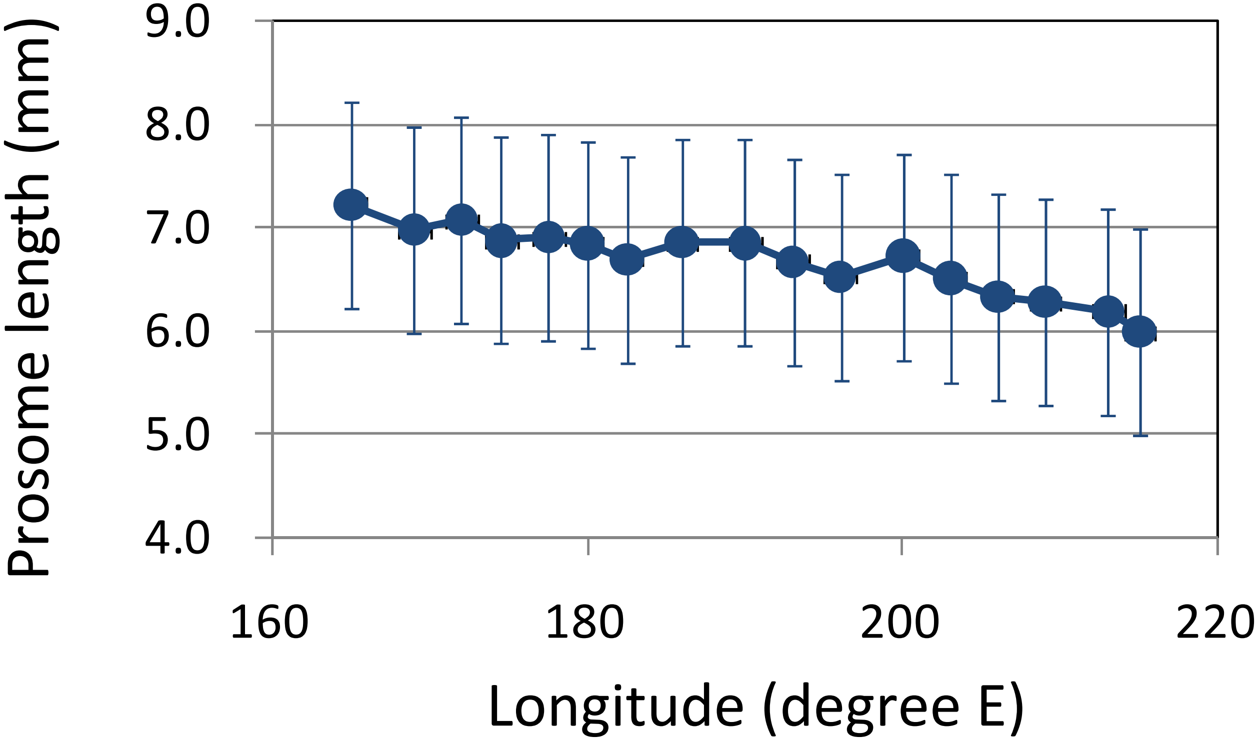
Life cycle: 1-2 years

Photo K. Ide

Saito & Tsuda Fig.1

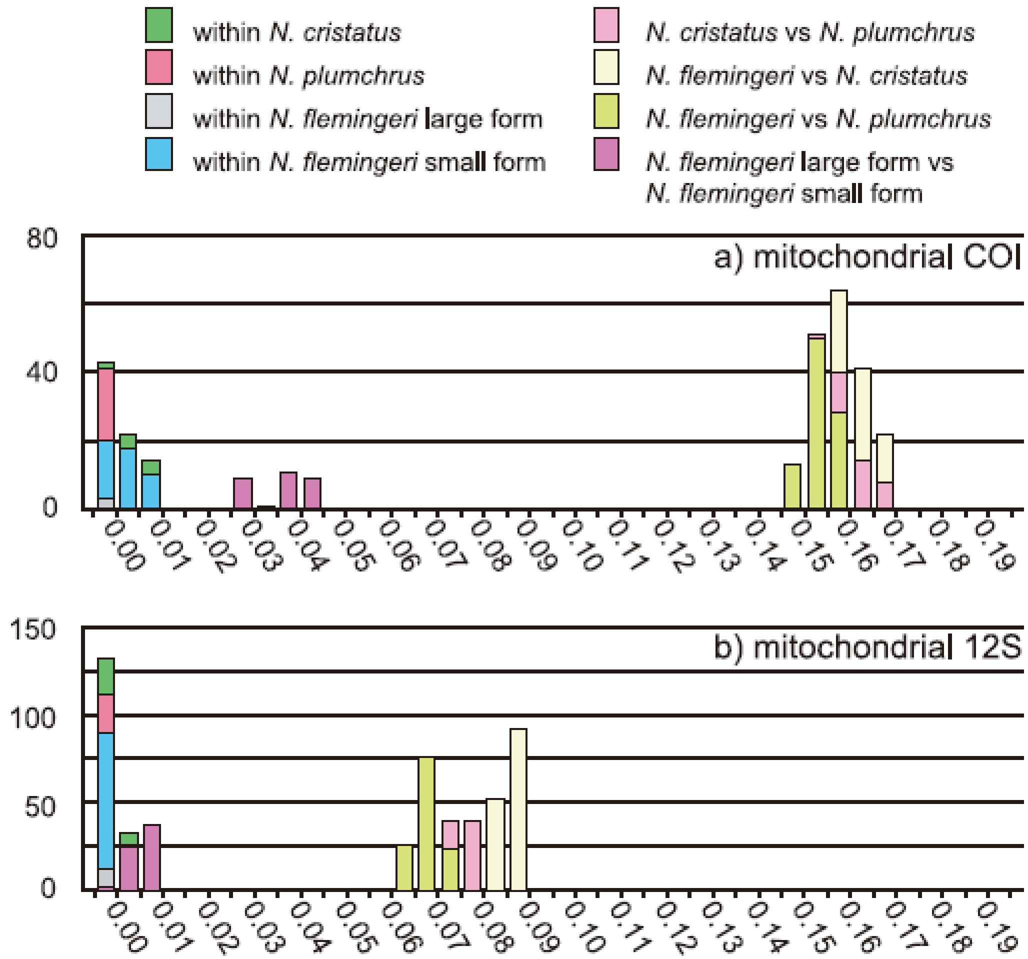


N. cristatus CV



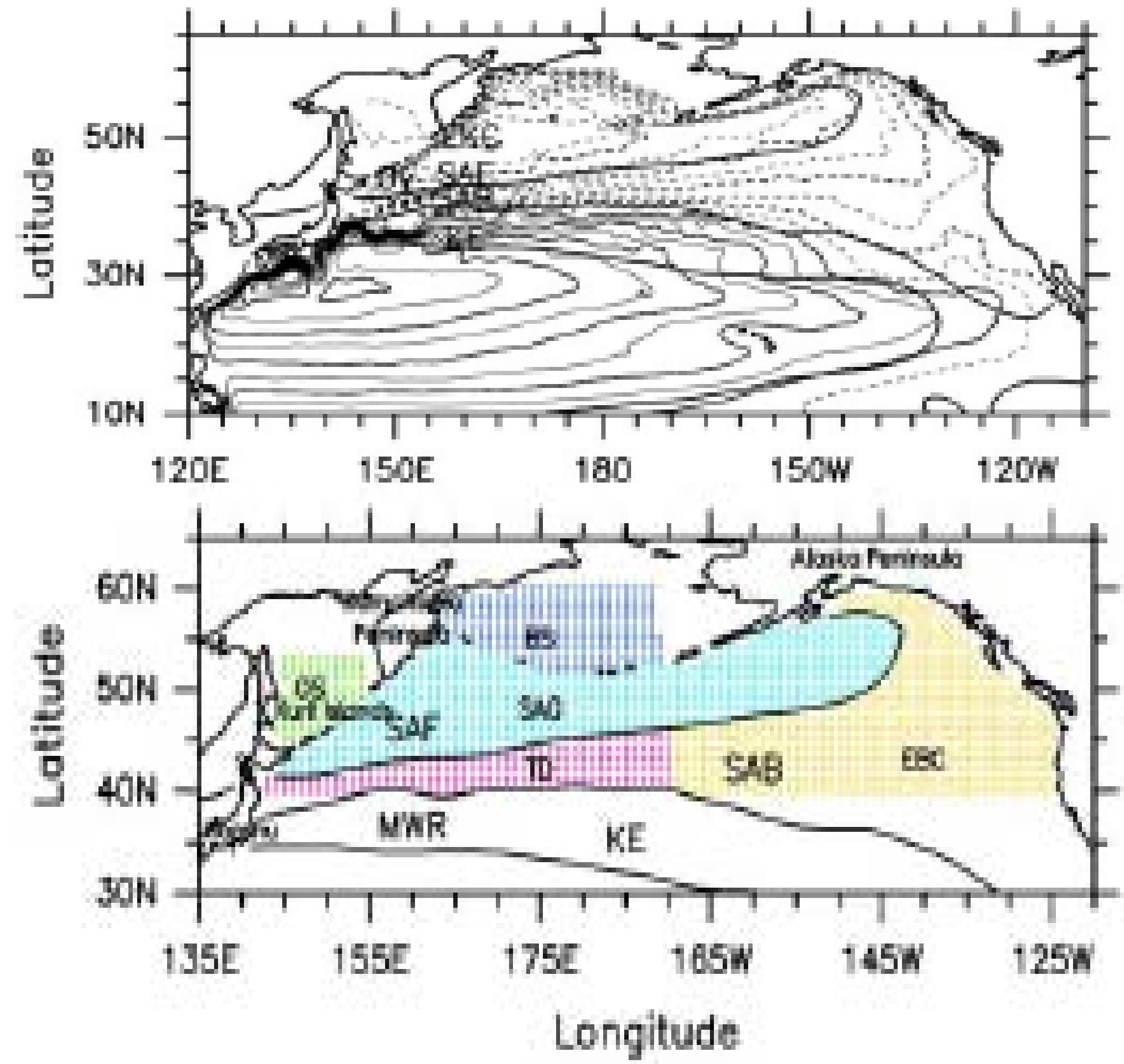
courtesy of Dr. Kobari

Genetic distance (*p*) within & between *Neocalanus* species



Machida & Tsuda, 2010

Neocalanus transport IBM (Tatebe et al. 2010 DSRI)



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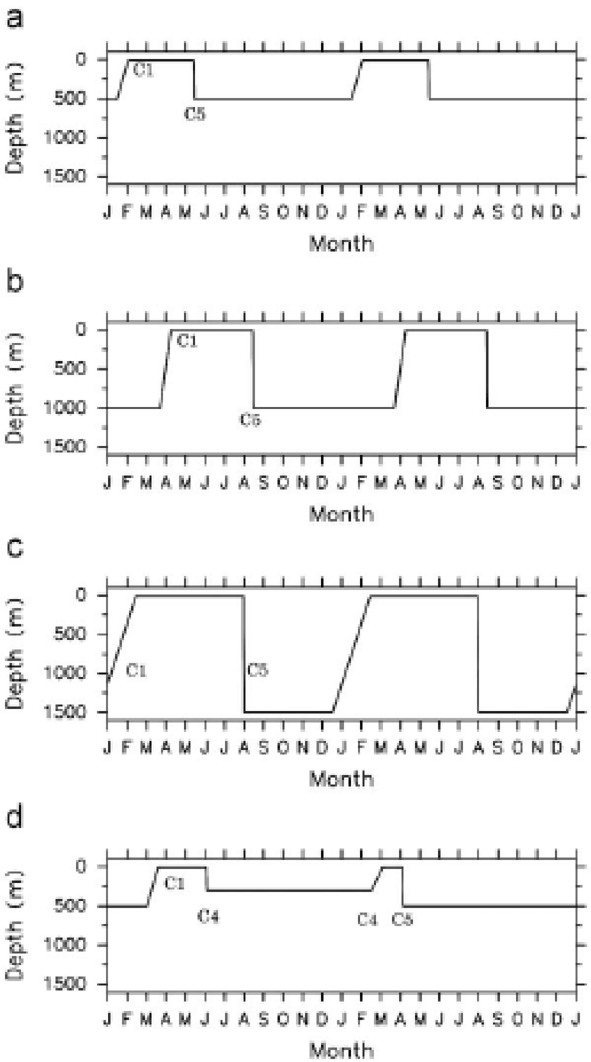


N. flemingeri
small form

Shallow migratior (500 m)
Short surface dwelling period (3 mo) in spri

N. plumchrus

Summertime resident in epipelagic zone

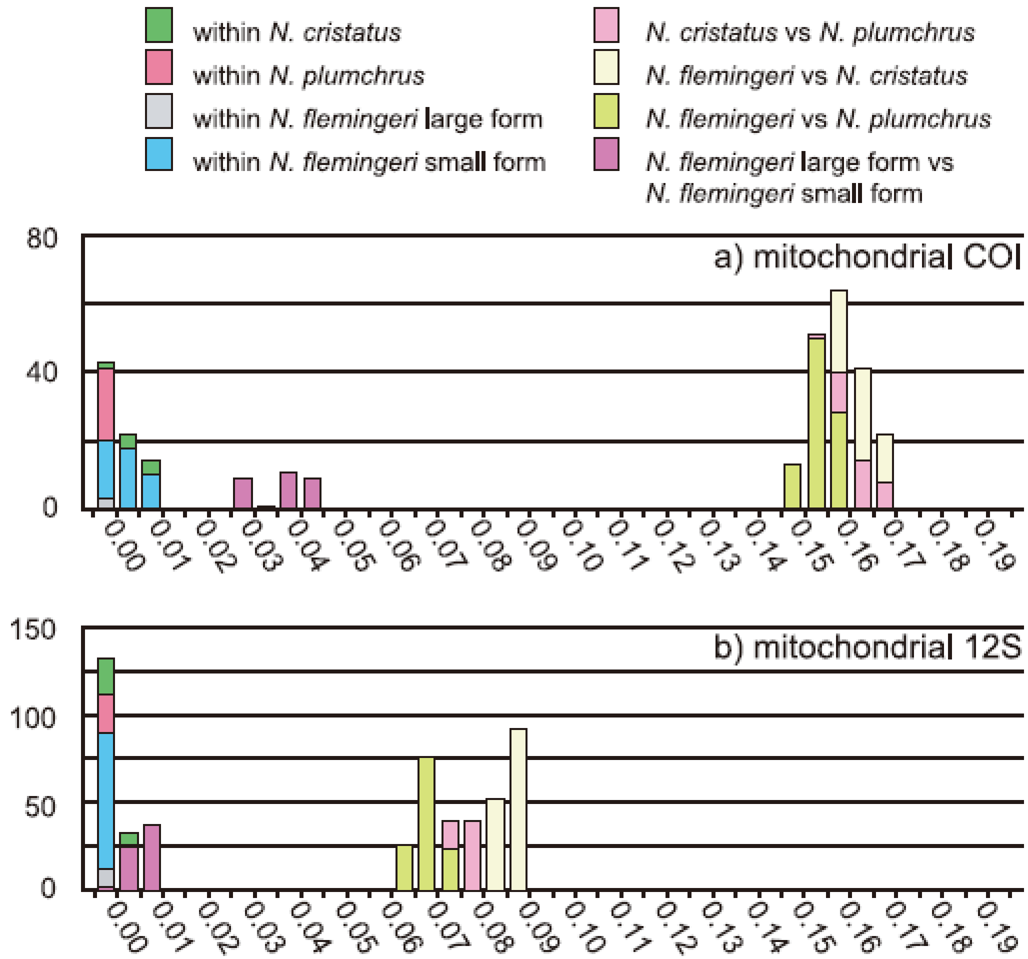
N. cristatus

Deep migrator (1500 m)
Long surface-dwelling period (ca. 6 mo.)
(10 m <5^{o}C, 75 m >5^{o}C)

N. flemingeri
large form

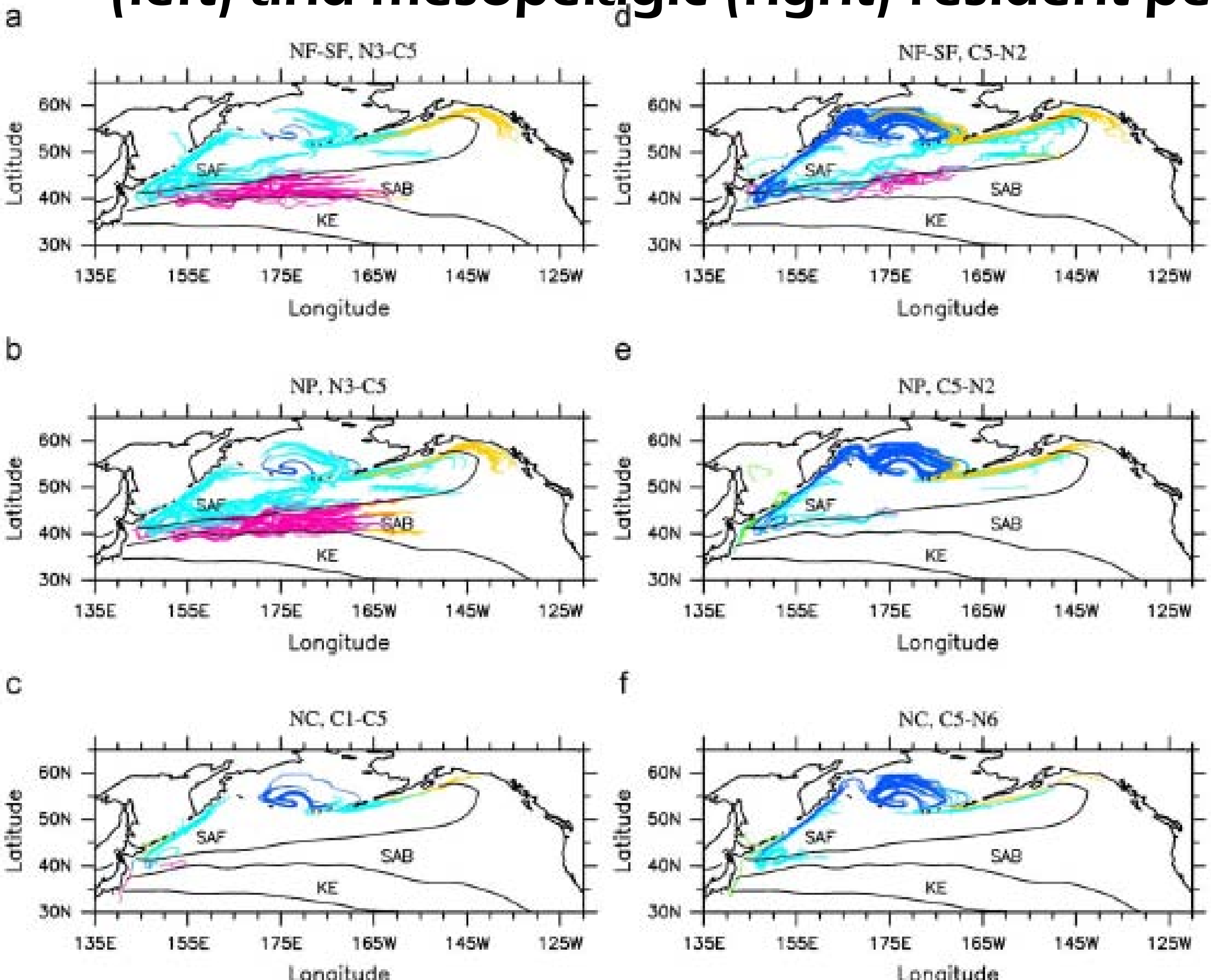
Two-years life cycle
Reproduce only in the Sea of Okhotsk

Genetic distance (*p*) within & between *Neocalanus* species

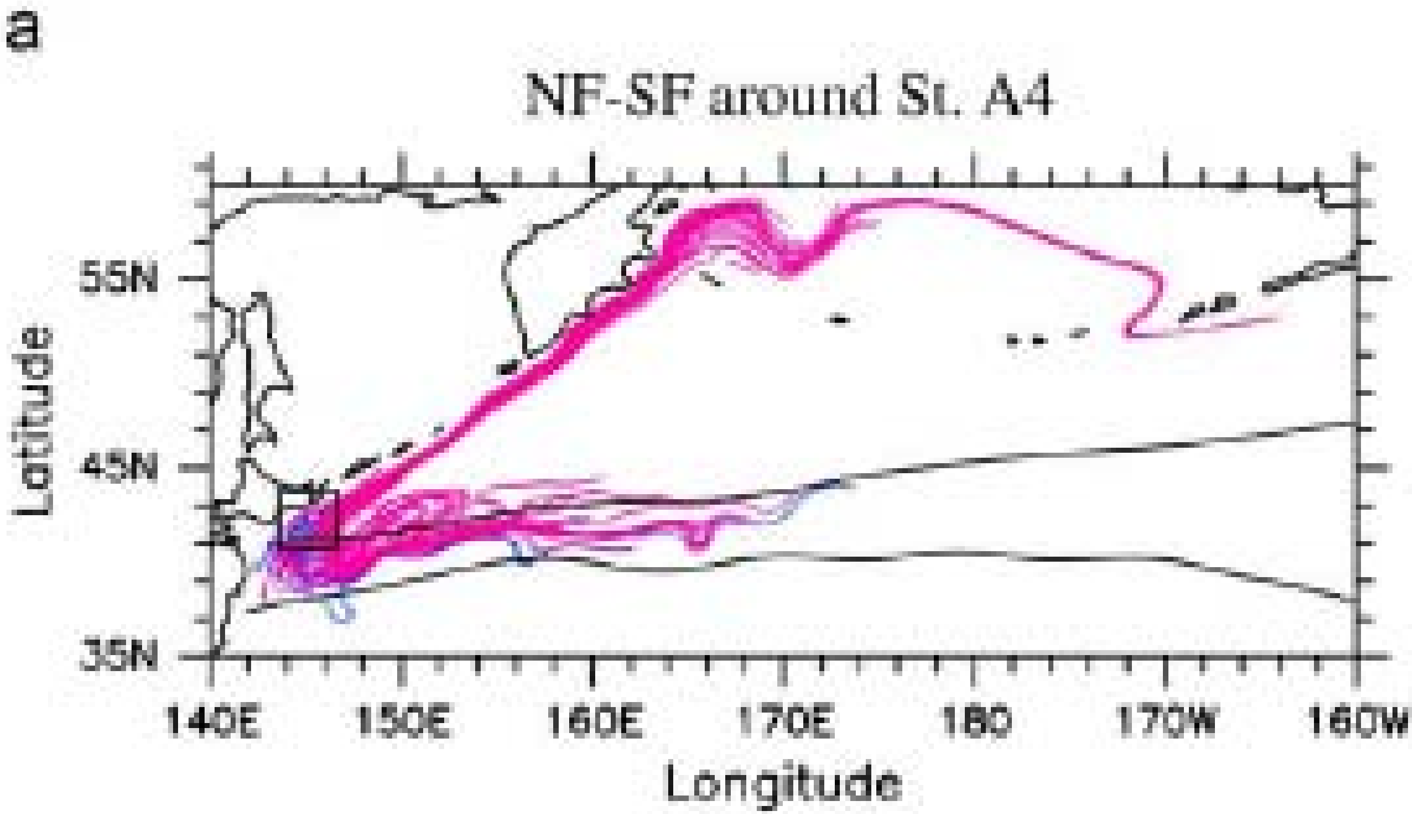


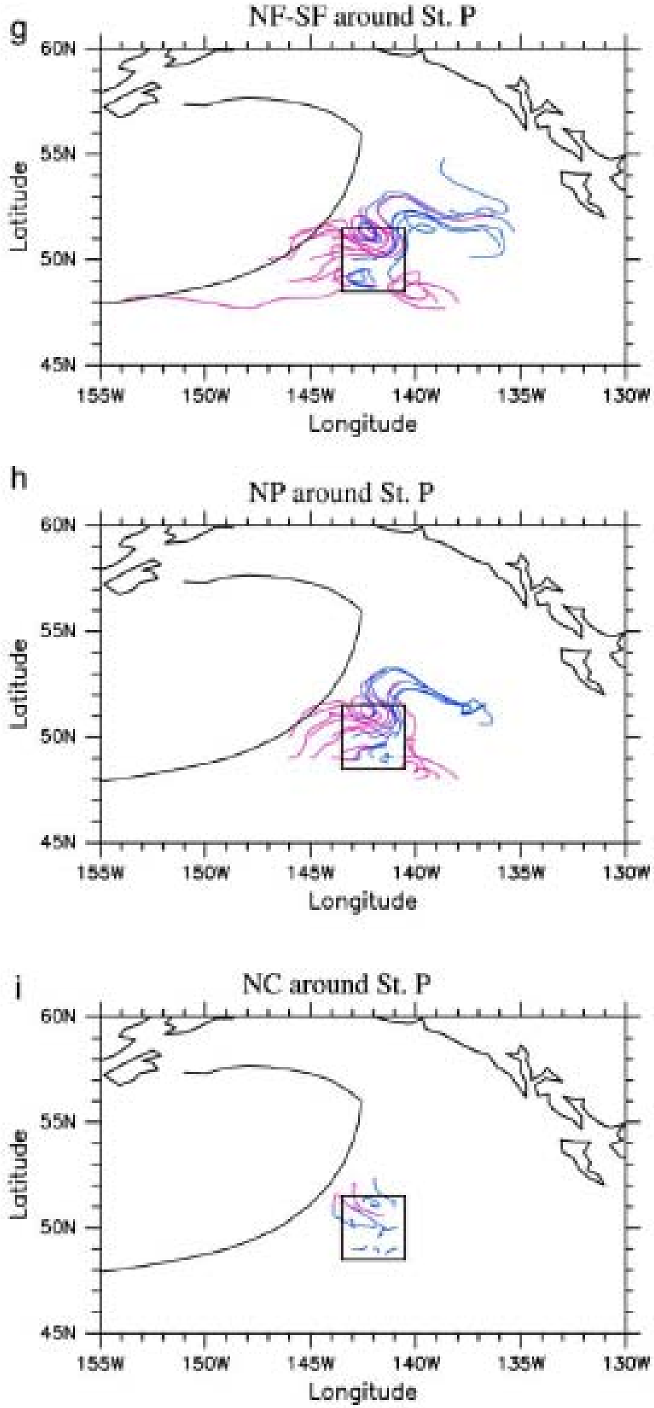
Machida & Tsuda, 2010

Trajectories of *Neocalanus* during epipelagic (left) and mesopelagic (right) resident period



Trajectory of *N. flemingeri* through Oyashio region for one generation

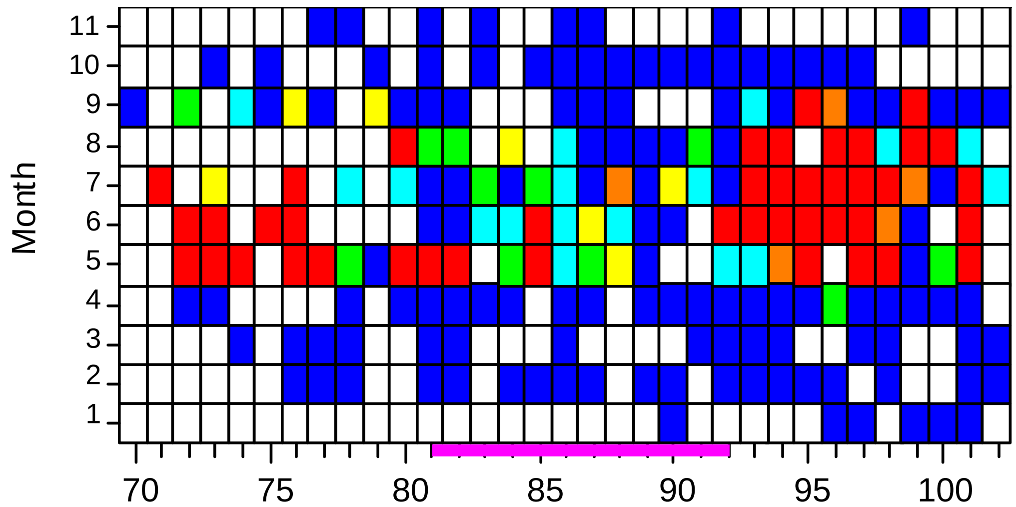



g
NF-SF around St. P
h
NP around St. P
i
NC around St. P
60N
55N
50N
45N
Latitude
155W
150W
145W
140W
135W
130W
Longitude

Intra- and inter-areal transport ratios (%) per generation.

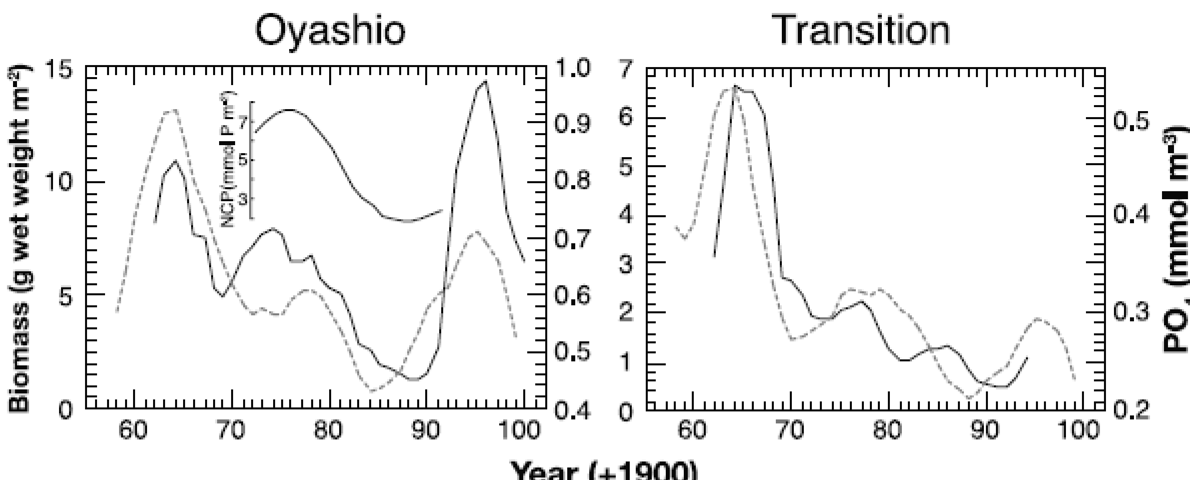
From/to	TD	SAG	OS	BS	EBC	AS40
(a) *N. flemingeri* (small form)						
TD [177]	36	18	0	0	38	8
SAG [518]	4	76	1	14	5	0
BS [174]	9	25	0	64	0	2
EBC [511]	0	7	0	5	72	16
(b) *N. plumchrus*						
TD [177]	30	26	0	0	37	7
SAG [518]	3	77	1	13	6	0
OS [74]	3	4	86	0	0	7
BS [174]	3	16	1	80	0	0
EBC [511]	0	7	0	3	76	14
(c) *N. cristatus*						
TD [177]	69	11	0	0	10	10
SAG [518]	4	84	1	7	4	1
OS [74]	0	5	90	0	0	4
BS [174]	1	12	0	87	0	0
EBC [511]	0	5	0	0	88	7
(d) *N. flemingeri* (large form)						
OS [74]	11	4	82	0	0	3

N. plumchrus in the Oyashio



Tadokoro (unpublished)

N. plumchurus (5-year running mean)



Tadokoro et al. 2009 GRL

Conclusions

•3-D IBM of *Neocalanus* makes it possible to consider the inter-basin exchange of *Neocalanus* populations and genetic phenology, and also the influence of the species-specific life cycle strategy on the transportation.

•A part of regional *Neocalanus* population exchange with other populations by passive transport. This is consistent with the low genetic variability of *Neocalanus*

•The transportation distance is longer for *Neocalanus* distributed along the Oyashio, SAB, Alaskan stream than one in the central gyre, such as St.Papa.

Conclusions

•*Neocalanus* and the zooplankton with long life cycle (~1 years) play the role of reserving organic matter (buffering seasonality in primary production) and transporting OM to the other ocean domains (buffering horizontal heterogeneity of primary production).

Significant fraction of *Neocalanus* (10-64%) are transported to the other domains.

0-14% of *Neocalanus* are transported to the south of 40°N (one way transport).

•Year-to-year varation of the current system influence the data of zooplankton biomass and species/stage composition obtained from geographically fixed station/sampling site as well as the productivity change.

Future study:

For the examination of long-term change in the biomass and species composition of zooplankton, we need to consider the change in the current system and water (zooplankton) transportation, e.g., examination of 3-D IBM with *Neocalanus* bioenergetics (C or N) using NCEP wind.