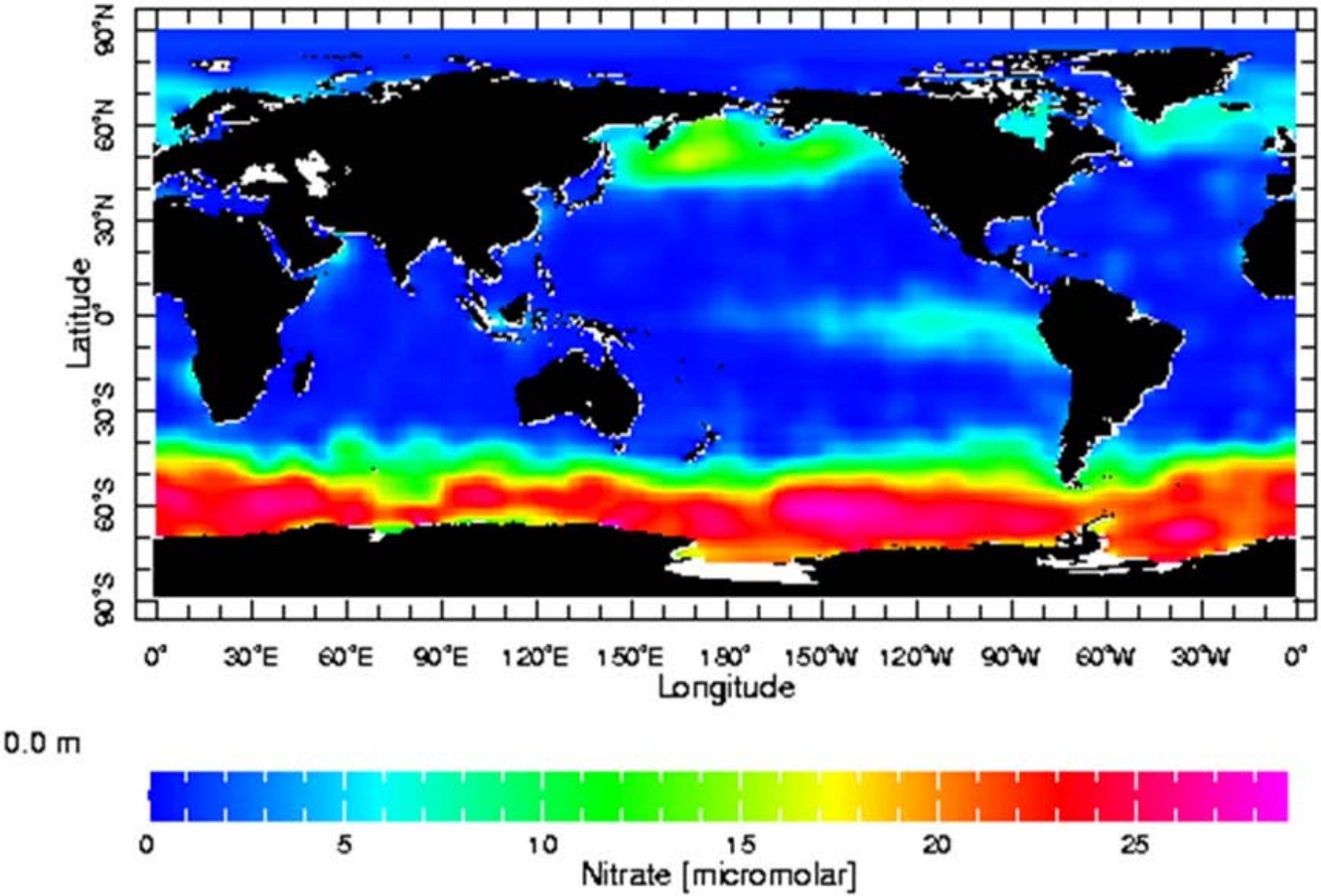
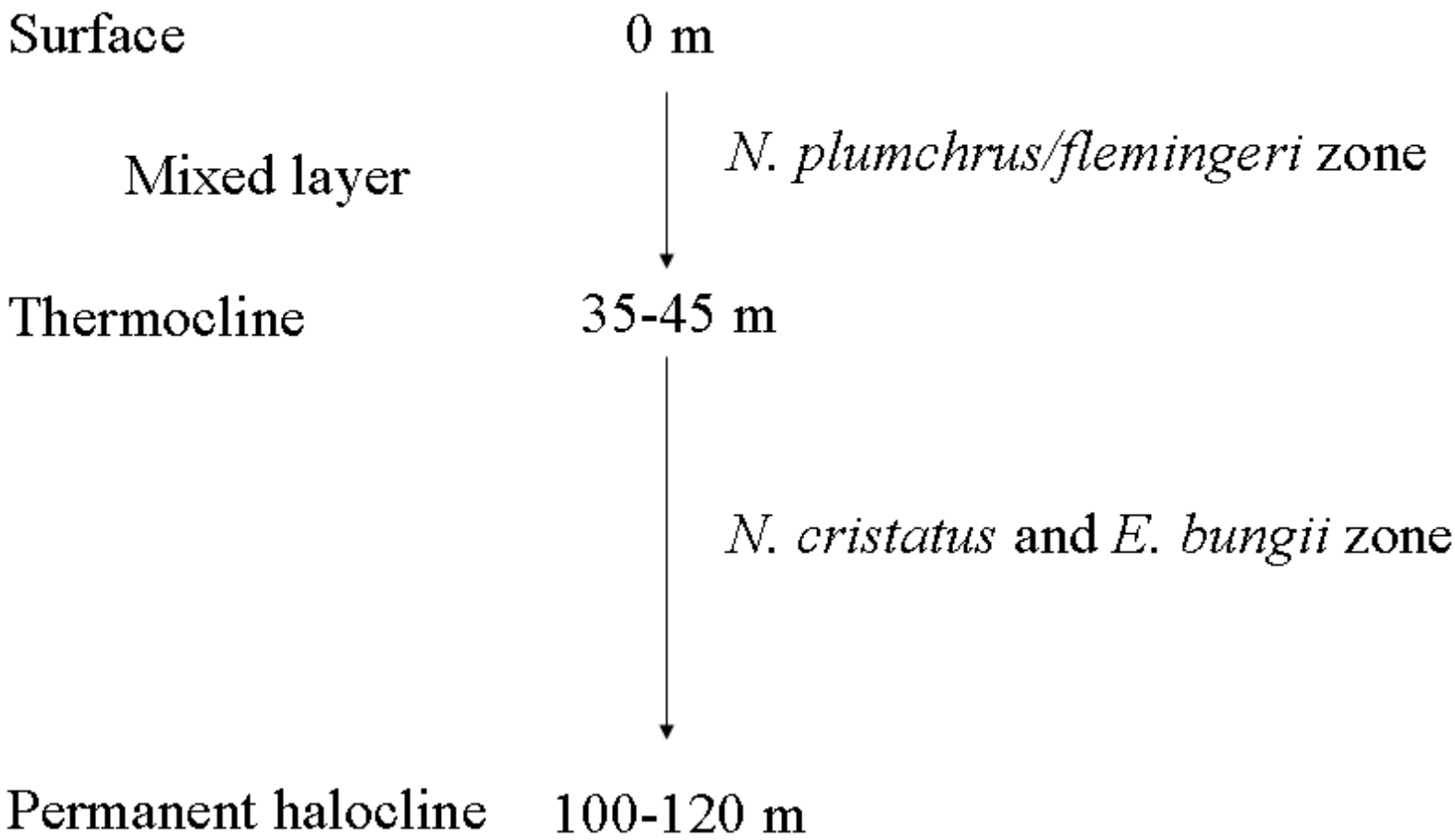
Neocalanus spp. and the Lower Trophic Levels of the Subarctic Pacific Ocean

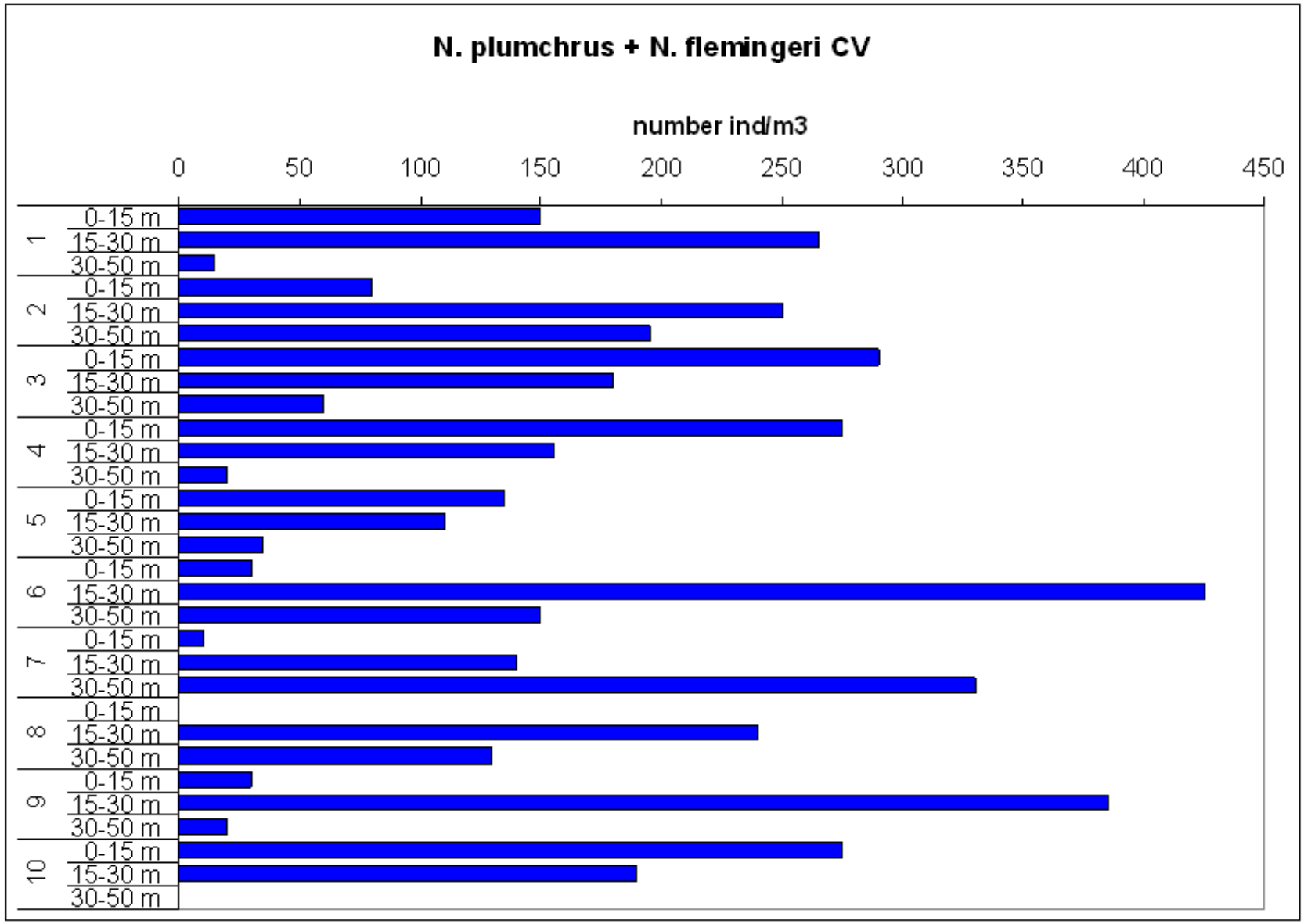
Michael Dagg, Louisiana Universities Marine Consortium
Suzanne Strom, Western Washington University
Hongbin Liu, Hong Kong University of Science and Technology



(from Levitus World Ocean Atlas 1994)

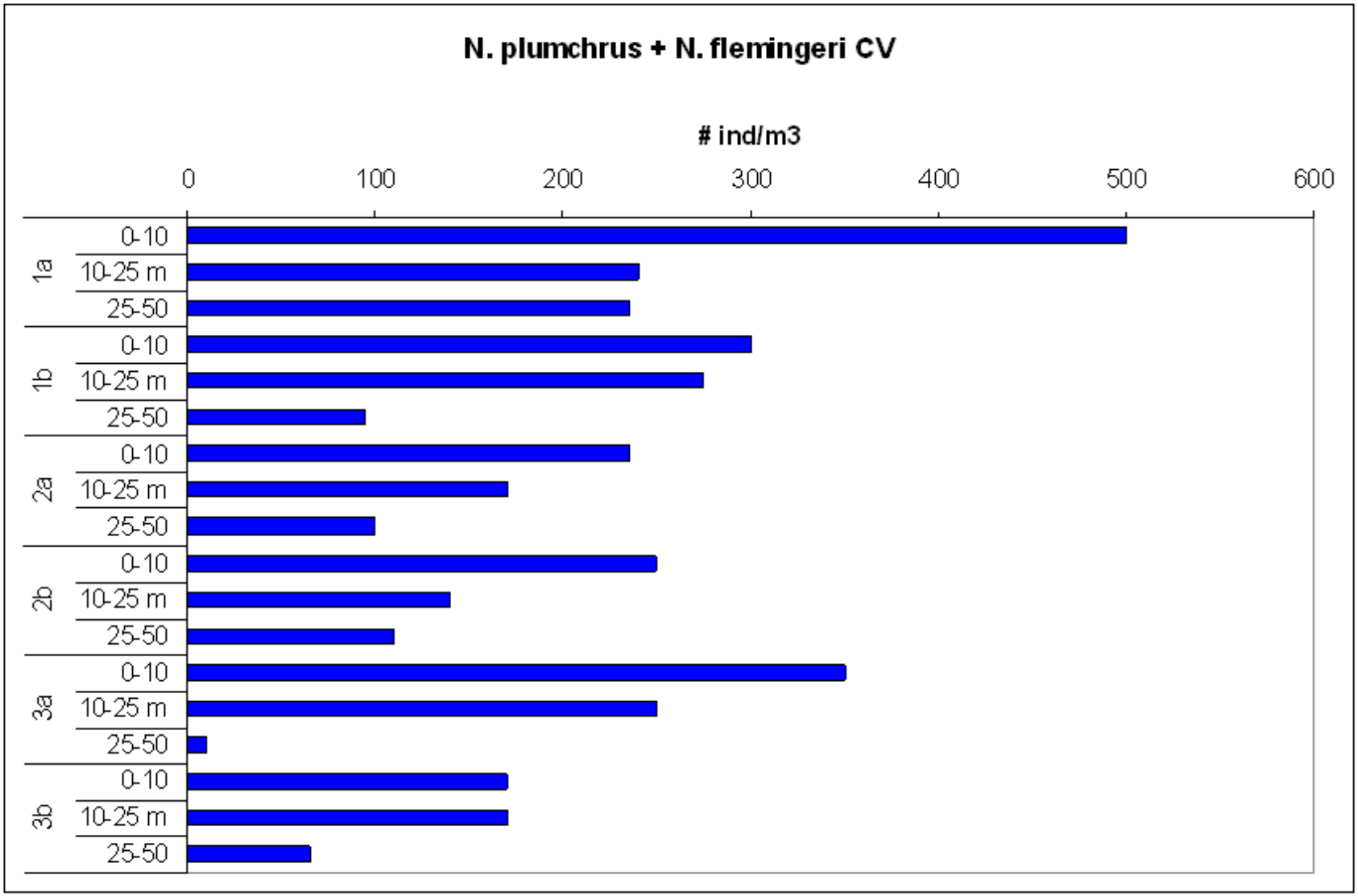


data from Mackas, D.L., H. Sefton, C. B. Miller and A. Raich. 1993. Vertical habitat partitioning by large calanoid copepods in the oceanic subarctic Pacific during spring. Prog. Oceanogr. 32: 259-294.



May 1984 - 10 stations: mean abundance = 152 CVs / m3

(from Mackas et al. 1993)



June 1987 – mean abundance = 204 ind / m3

(from Mackas et al. 1993)

In 2001 and 2003, as part of the NEP GLOBEC, we conducted feeding experiments with all three *Neocalanus* species by incubating copepods in bottles containing natural seawater as food medium.

Feeding was measured in three ways:

1. Chlorophyll removal (fluorometry): < 5 μm, 5-20 μm, > 20 μm
2. Individual taxa removal: microscopy
3. Particle removal (FloCAM): (10 μm size bins)

Chlorophyll concentration:

< 5 mm = 0.577 mg l^{-1}

5-20 mm = 0.143 mg l^{-1}

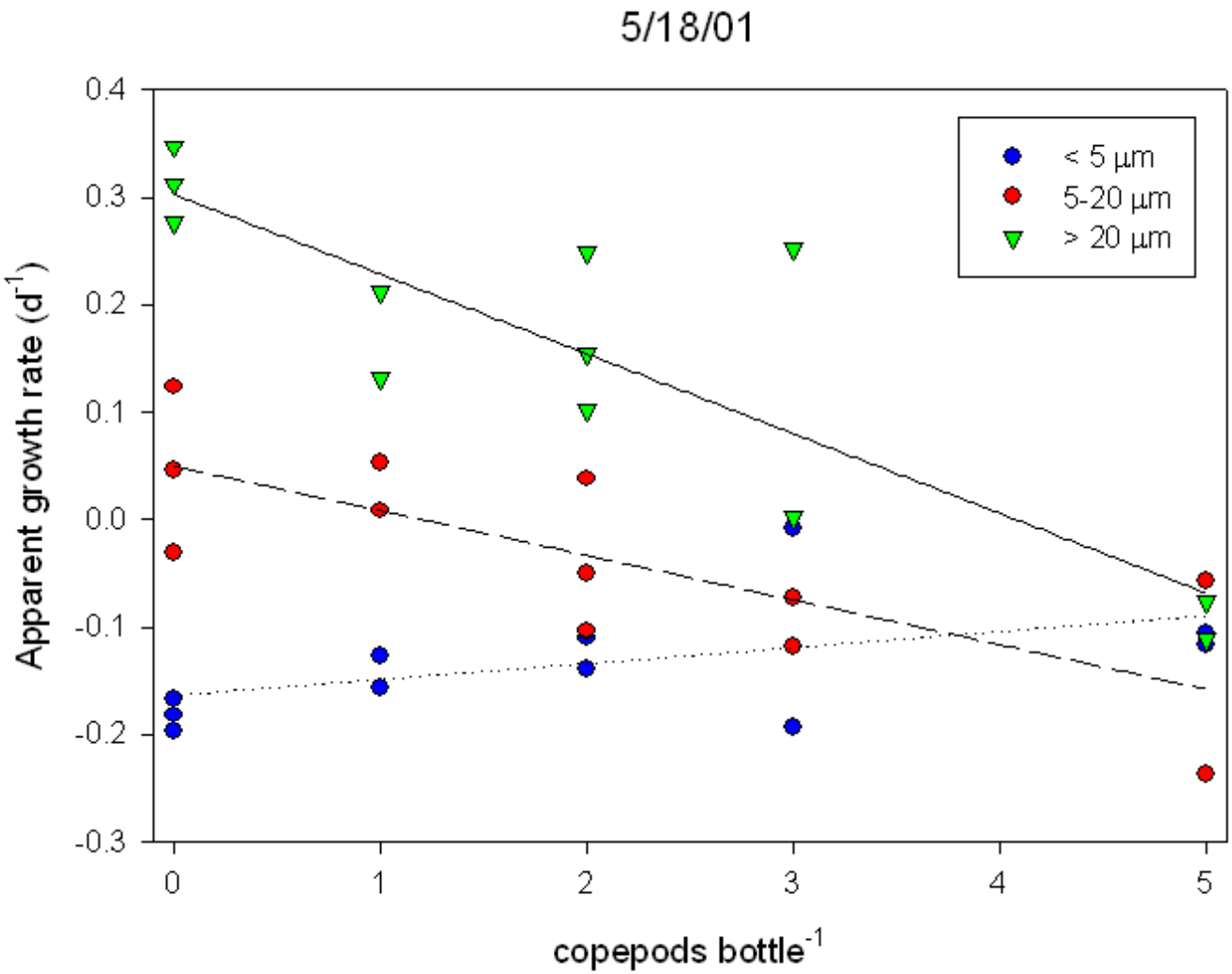
> 20 mm = 0.051 mg l^{-1}

Clearance rate:

-0.068 L cop^{-1} d^{-1}

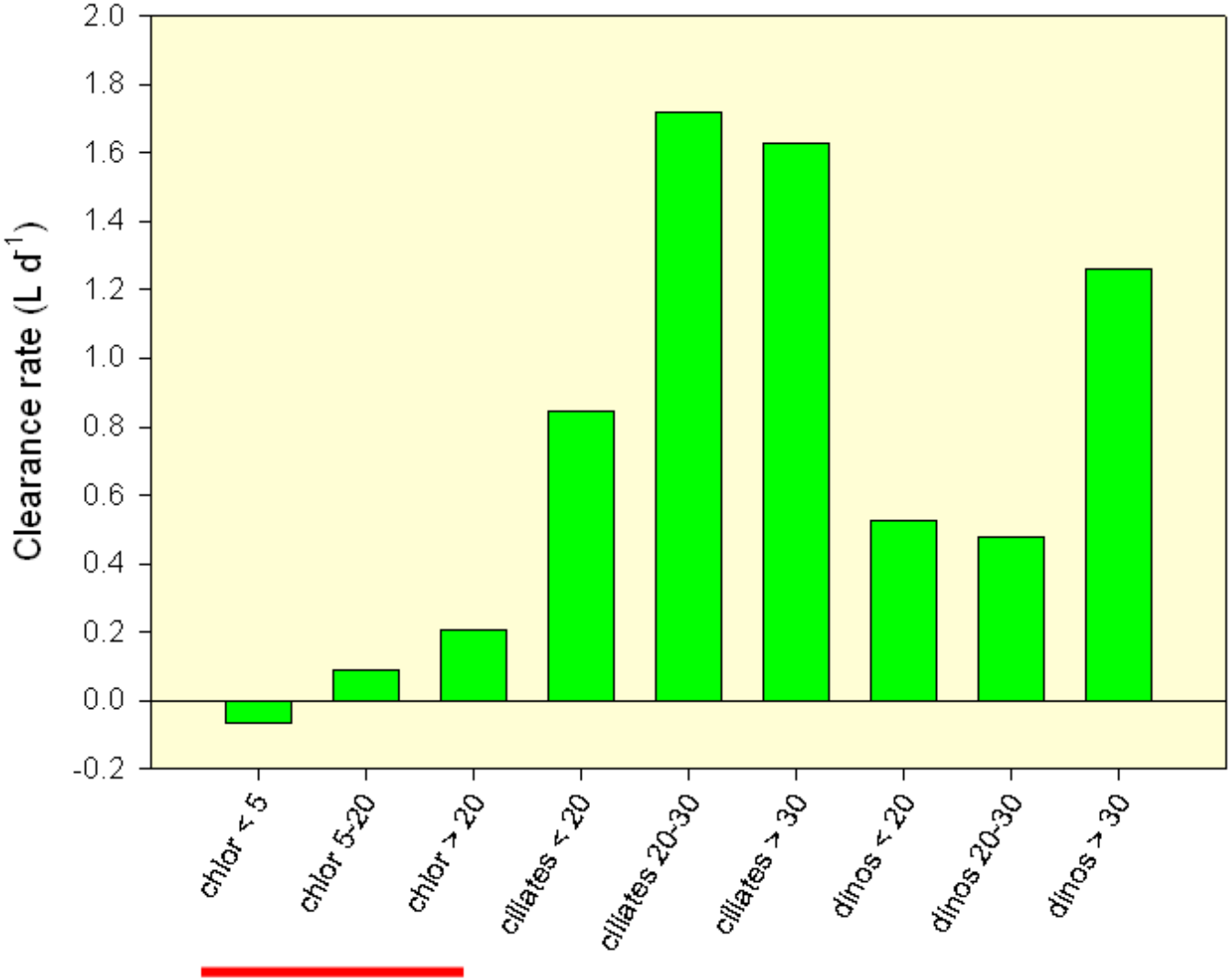
0.088 L cop^{-1} d^{-1}

0.208 L cop^{-1} d^{-1}



5/18/01

N. flemingeri and *N. plumchrus* CV

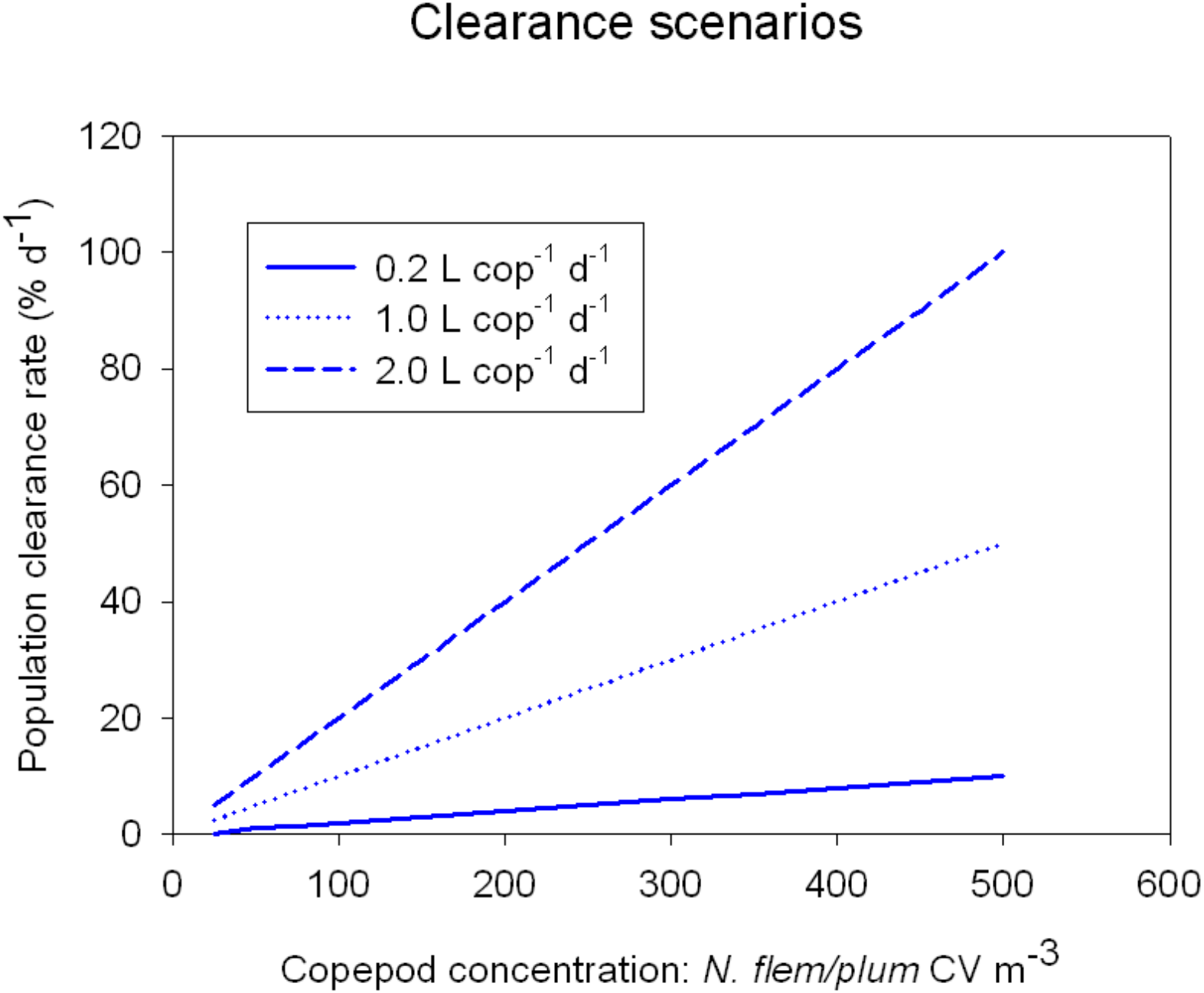


are there enough copepods *in situ* to significantly affect the micro- and nano- food web in the eastern subarctic Pacific?

Concentration of *N. plumchrus/flemingeri* CV = 25 - 500 m^{-3}

Clearance rate on large particles = 0.2 – 2.0 L cop^{-1} d^{-1}

Averages:
200 copepods m^{-3} and 1 L cop^{-1} d^{-1} = 200 liters d^{-1} m^{-3}
= 20 %


Clearance scenarios
120
100
80
60
40
20
0
Population clearance rate (% d-1)
0.2 L cop-1 d-1
1.0 L cop-1 d-1
2.0 L cop-1 d-1
0
100
200
300
400
500
600
Copepod concentration: N. flem/plum CV m-3

growth rates of large diatoms in this Fe limited system are
0.2 - 0.4 d^{-1}

Under Fe limitation and low concentrations of phytoplankton, *Neocalanus flemingeri/plumchrus* CV can often(?) usually(?) almost always (?) balance the growth of large diatoms

Other considerations

growth rates of large ciliates and dinoflagellates

other copepodid stages also contribute

1. *Neocalanus* prevent large diatoms (cells not typically controlled by microzooplankton) from 'blooming' - tending to keep the system under small cell domination

2. Reduces the grazing mortality on small phytoplankton from microzooplankton, providing a further relative enhancement of small cell growth compared to larger diatoms

This control may break down under Fe events, as diatom growth can then exceed *Neocalanus* induced grazing mortality.

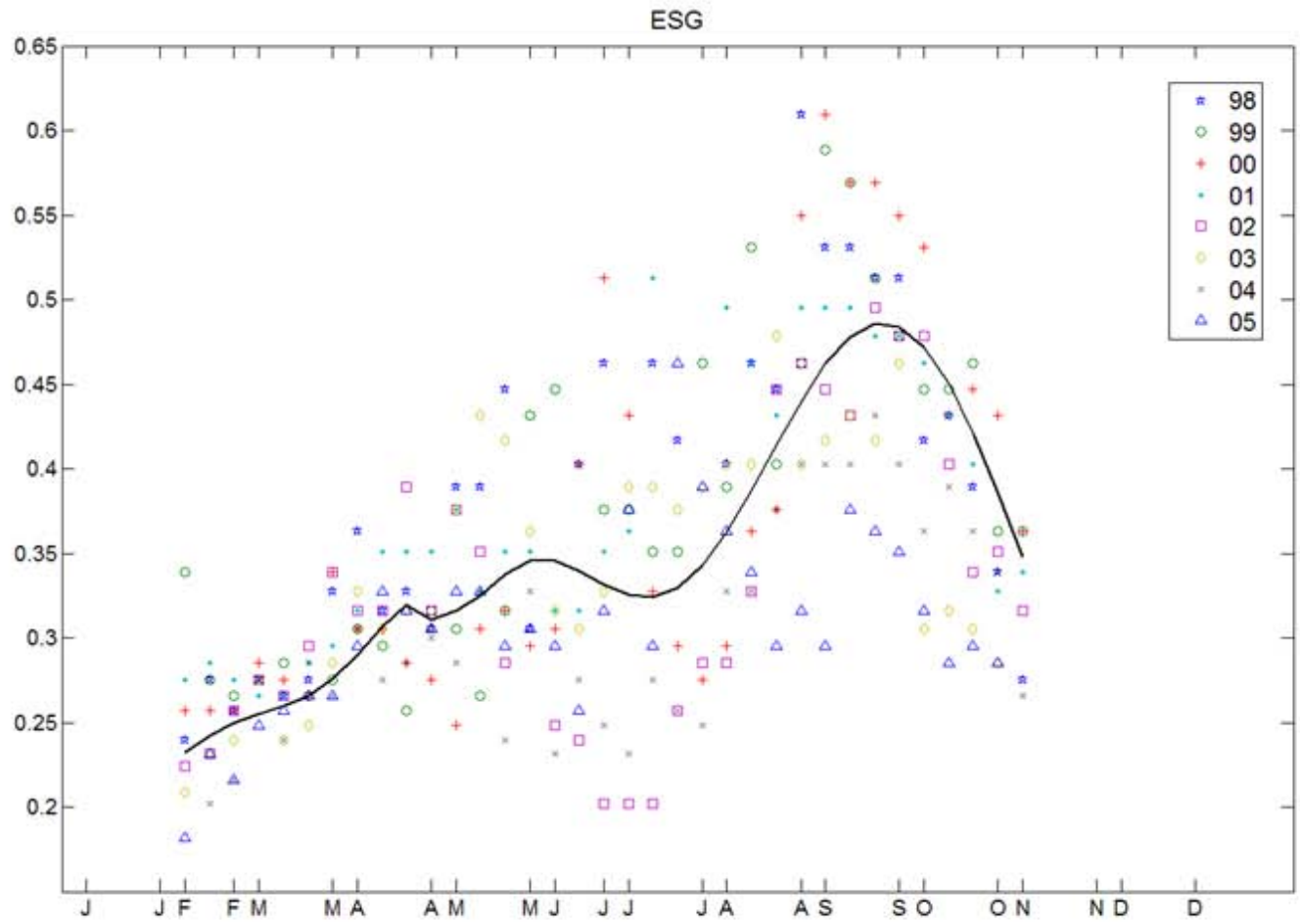
Neocalanus clearance rate will decrease with increasing food concentration

Other evidence (1)

Mesocosm experiments (Landry et al. 1993) indicated a larger fraction of phytoplankton production was processed through the microbial loop when *N. plumchrus* were present

Other evidence (2)

Surface chlorophyll



ESG = Eastern Subarctic Gyre

Figure provided by Sinjae Yoo

Other evidence (3)

Lack of a strong response of large diatoms in SEEDS II is partially attributed to very high concentrations of *Neocalanus* present in the Fe enriched area (Saito and Tsuda, p. comm)

Conclusions

Neocalanus spp. may exert a strong structuring effect on the nano-and pico- food webs of the N. Pacific Ocean, tending to drive the food web towards a small-cell dominated system by

a) selective removal of large phytoplankton
b) removal of microzooplankton which reduces mortality on small phytoplankton

These effects are strongest:

at low food concentrations when copepod clearance rates are highest, and

under nutrient (Fe) or food limiting conditions when growth rates of phytoplankton are reduced


The END