Zooplankton Community Complexity & Temporal Variability in the Subtropical North Pacific

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Conclusions from Historical Studies

Distinct floral & faunal province

Identifiable boundaries

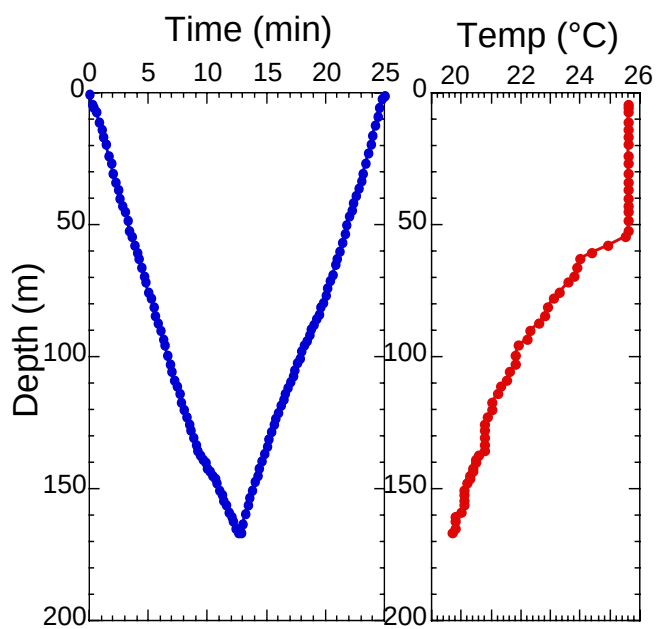
Low biomass, but species rich

Consistent dominance structure

Non-detectable seasonality

"We have been unable to detect seasonal changes in the concentrations of nutrients (NO_3, PO_4), primary production, phytoplankton biomass, zooplankton biomass …" (McGowan & Walker 1985)

HOT Sampling Routine



1-m^2 net, 200-µm mesh
0.5-m^2 net, 64-µm mesh

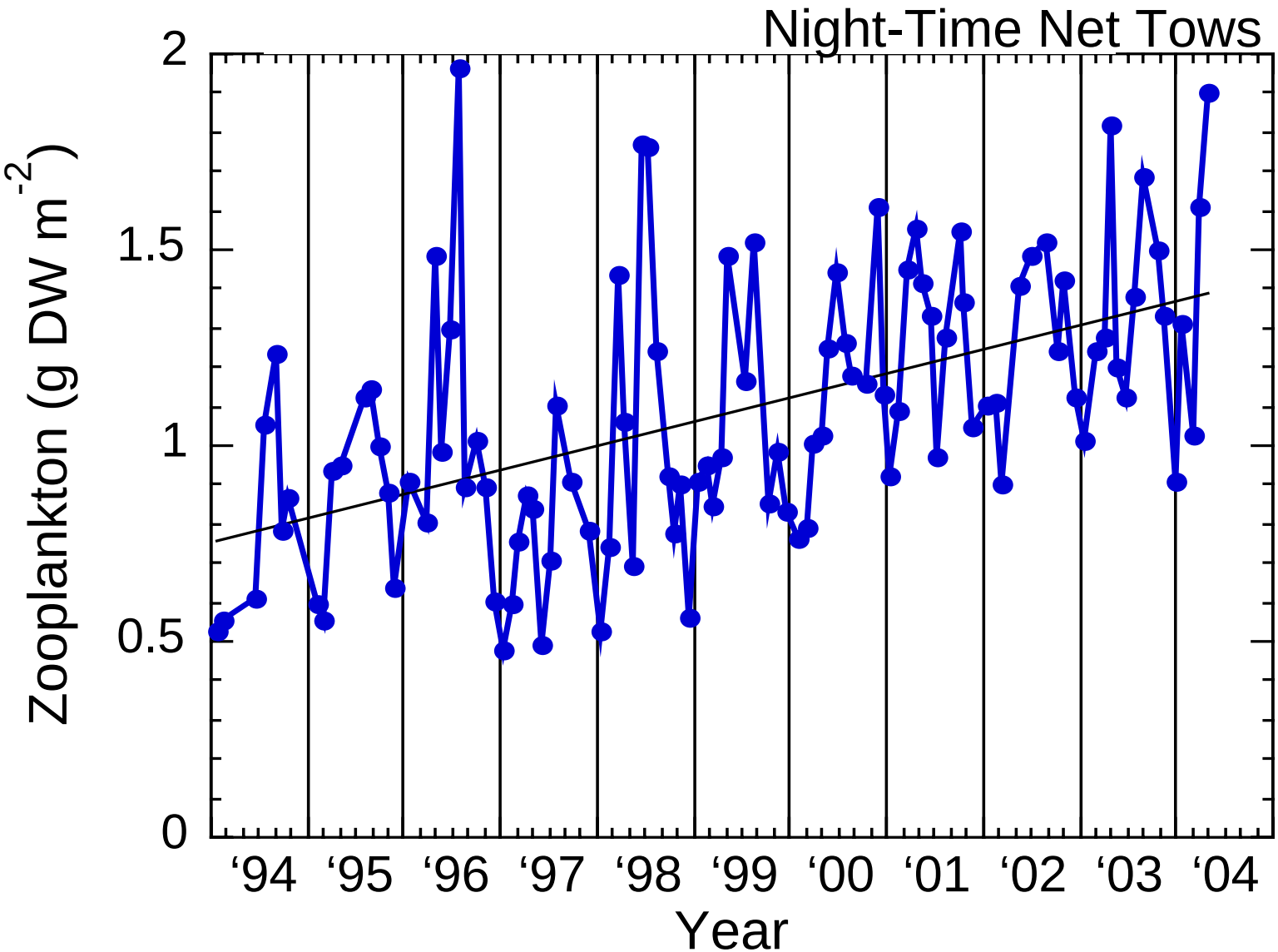
GO flow meter
Time-depth-temp recorder

Oblique tows, mean = 160 m
3 day & 3 night tows/cruise

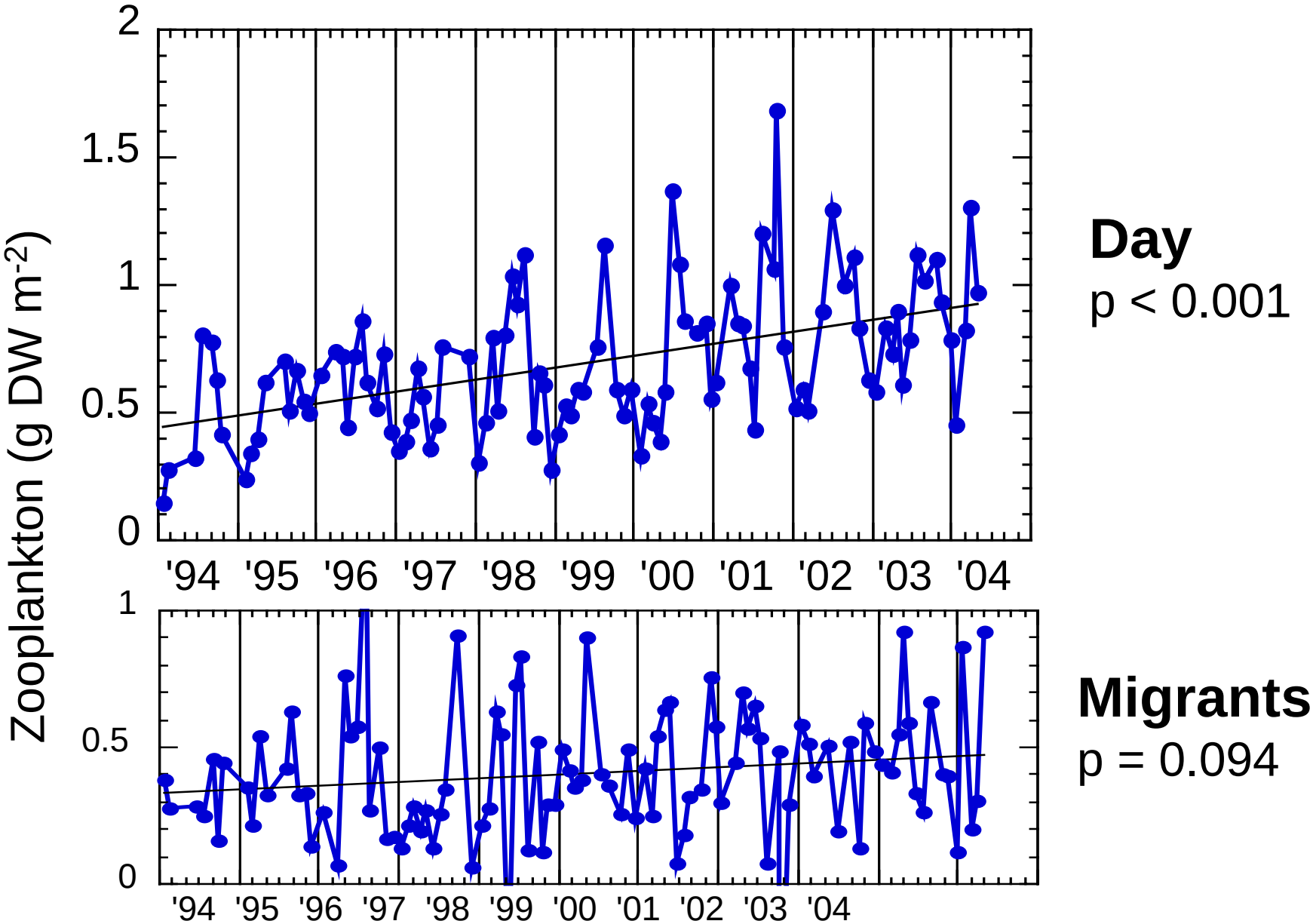
size-fractioned DW, C, N
(0.2-0.5, 0.5-1, 1-2, 2-5, >5 mm)

preserved -- abundance, spp.

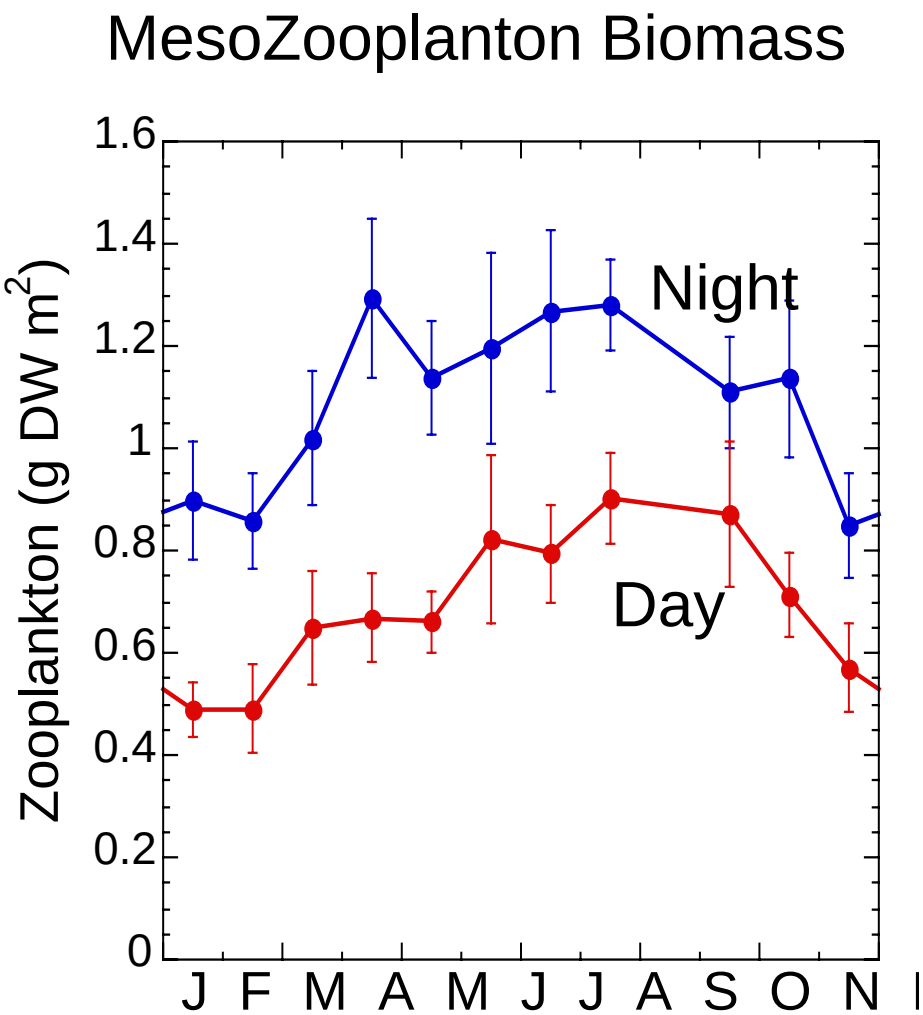
Decadal Trend at Stn. ALOHA

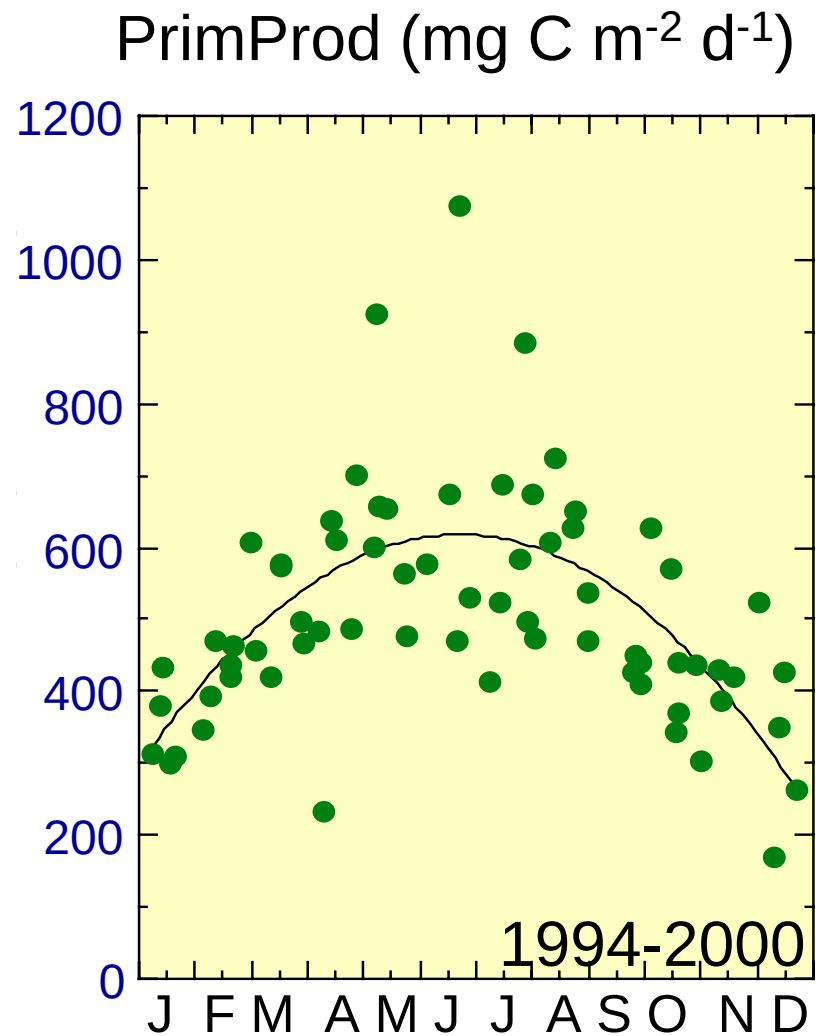


Daytime Residents drive the Decadal Trend



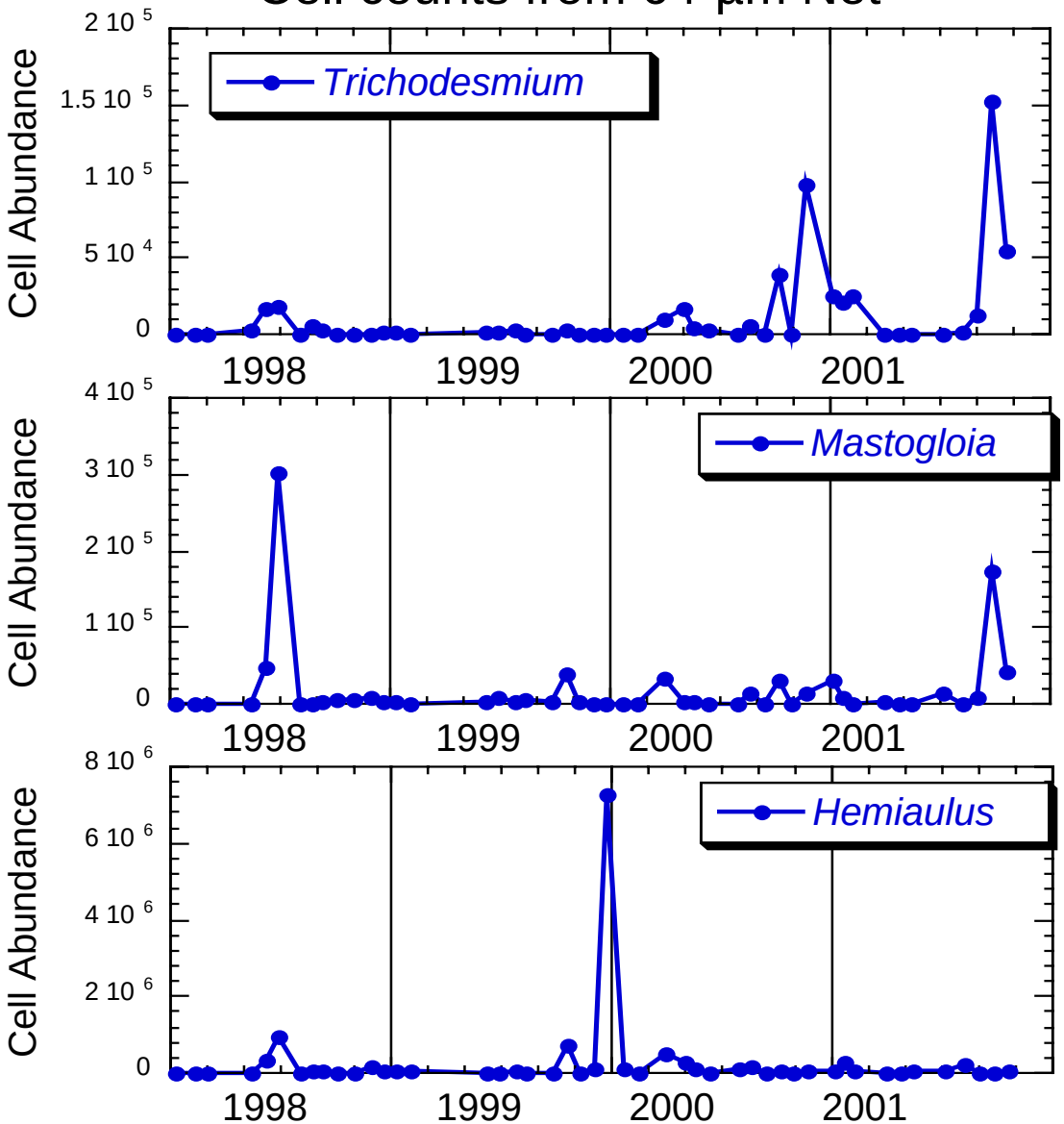
Seasonality at Stn ALOHA

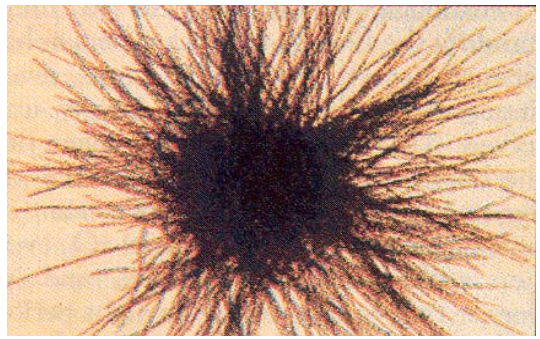


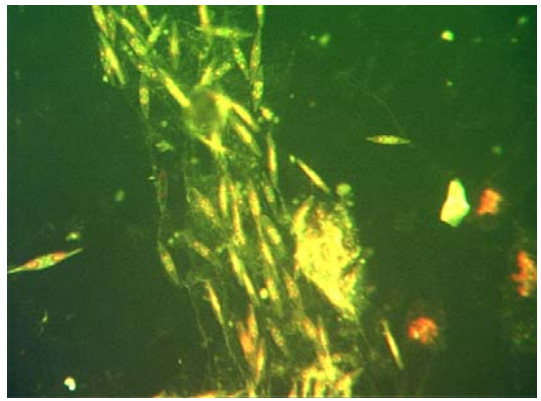


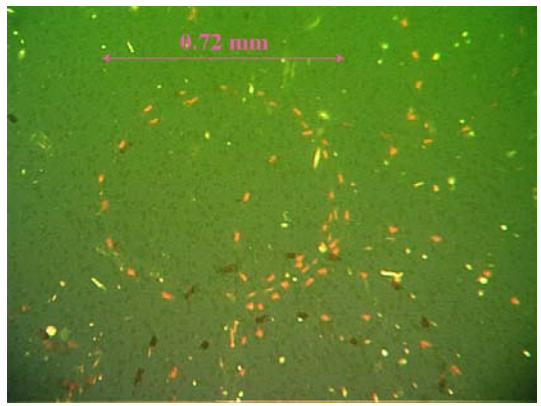
Relative Abundance - large N^2-fixing Phytoplankton

Cell counts from 64-µm Net

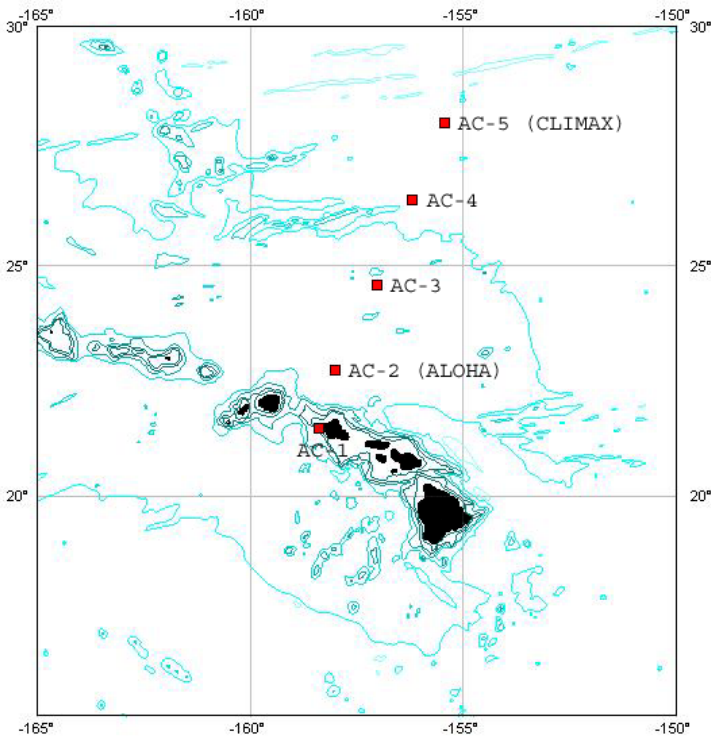








Sampling Comparisons



HOT net *vs* **CalCOFI net**

200-µm 505-µm

Species compositions are similar at Stn ALOHA *vs* CLIMAX -- as judged by a given net

Ratio Biomass m^{-2} ~ 3X

Ratio Abundance 30X

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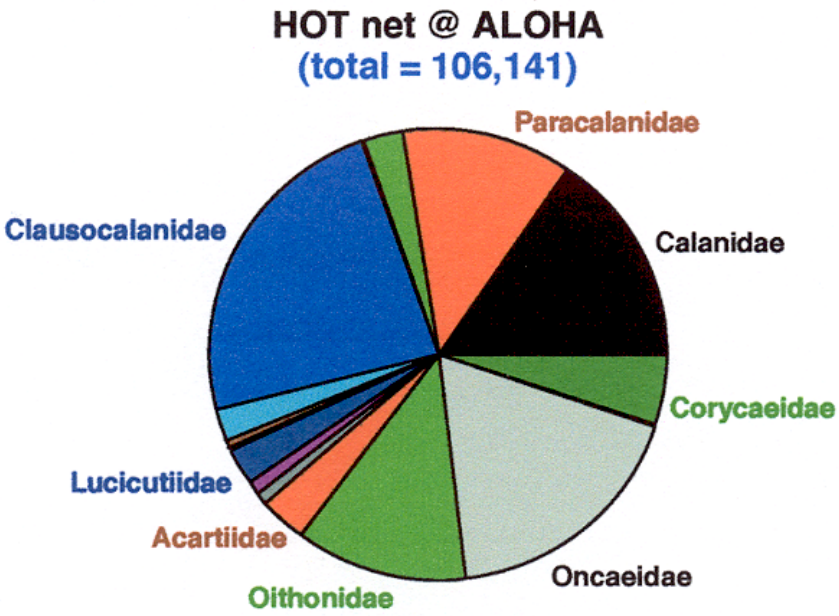
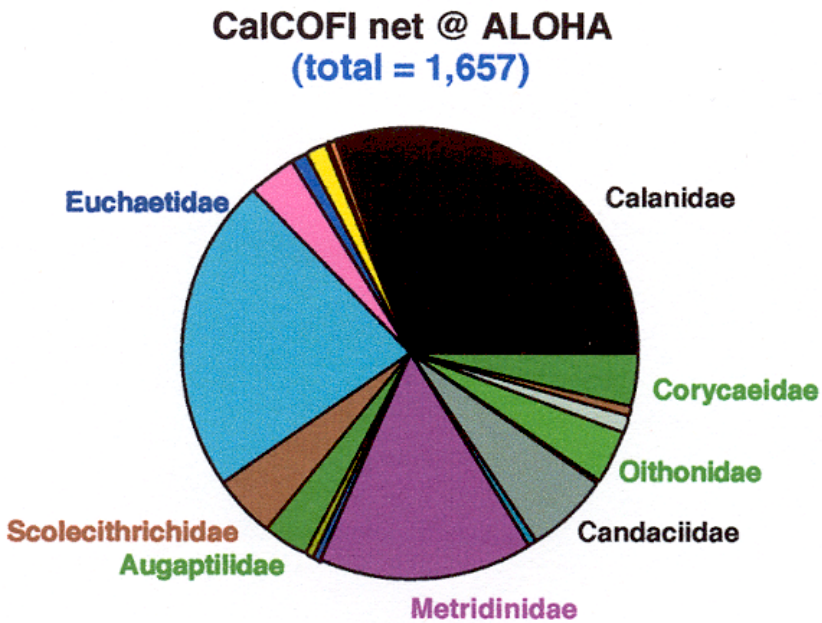
Sampling Effects on Apparent Dominants





CalCOFI net grossly undersamples the components of the community (small daytime residents of euphotic zone) that display the most seasonal & decadal variability.

The “Old” Top 10 Summer Dominants

	McGowan & Walker (1979)	Est. number m^{-2}	
		Mean	HOT net
1	*Haloptilus longicornis*	292	239
2	*Mesocalanus tenuicornis*	154	556
3	*Clausocalanus* spp. fem	120	4675
4	*Cosmocalanus darwini*	113	650
5	*Lucicutia flavicornis*	108	371
6	*Oithona setigera*	107	1326
7	*Pleuromamma gracilis*	103	94
8	*Pleuromamma piseki*	99	248
9	*Oithona plumifera*	81	1624
10	*Scolecithrix danae*	76	236

The “New” Top 10 Summer Dominants

		Adult Fem m^{-2}
1	*Oncaea* sp. A	2,876
2	*Clausocalanus furcatus*	1,932
3	*Oithona plumifera*	1,514
4	*Calocalanus* sp. A	1,321
5	*Oithona setigera*	1,239
6	*Mecynocera clausi*	1,167
7	*Clausocalanus farrani*	664
8	*Acartia negligens*	641
9	*Farranula* sp. A	623
10	*Oncaea venusta*	584

Community Dominance Structure

" … while the dominant species may vary somewhat in abundance, rare and very rare species never become dominant or even sub-dominants on any of the relevant time scales. This is true in spite of easily measured within-season, between-season, and interannual physical variability on many time scales."

"… regulatory forces … are almost certainly biological, rather than physical …"

McGowan & Walker (1985)

Some Highly Variable Species

	High Rank	LowRank
Clausocalanus farrani	3	41
Oithona fallax	3	43
Clausocalanus paululus	4	36
Oncaea venusta	6	40
Mesocalanus tenuicornis	6	54
Oncaea venusta venella	7	51
Haloptilus longicornis	9	40
Farranula curta	10	36
Lucicutia flavicornis	12	59
Nannocalanus minor	13	52

Summary

The Subtropical North Pacific Gyre is among the most species-rich and least variable ocean ecosystems in terms of zooplankton community dynamics.

However, the zooplankton community does display significant variability on seasonal, interannual and decadal time-scales.

This variability is specifically associated with smaller daytime residents of the euphotic zone, which were seriously undersampled in historical studies.

Future directions: Will long-term sampling with appropriate nets reveal shifts in community composition relating to physical forcing or resource availability on varying scales? Is there a predictable trajectory in community responses to anticipated changes in physical forcing?