Micronekton in the North Pacific … what do we know?

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“micronekton” defined …

- Small but actively swimming organisms ranging from ca. 2 to 10 cm; mainly mesopelagic (200-1000 m depths)
- Taxa too vagile to be caught with conventional plankton nets yet too small to be retained by most large trawls.
  - Fishes – mainly mesopelagics and juveniles of epipelagic nekton
  - Crustaceans – includes adult euphausiids, pelagic decapods, mysids, hyperiid amphipods
  - Cephalopods – small adults and subadults of large oceanics
- Many undertake extensive diel vertical migrations

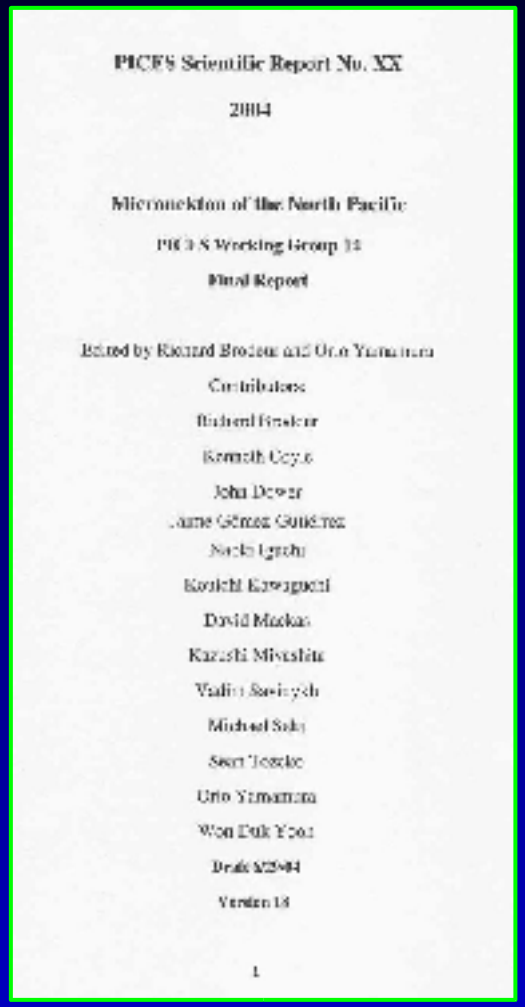
Why do we care?

- Represents a substantial biomass in the world's oceans
- A critical but poorly understood intermediate (missing?) trophic link between the mesozooplankton & higher trophic levels (i.e., fish, marine mammals, etc.)
- Significant contributors to the "biological pump" (i.e., rapid transport of $C_{surface}$, as well as pollutants, to deep sea).

PICES

North Pacific Marine Science Organization

- Relatively scant attention paid to micronekton as a whole
- In 1997, PICES establishes a WG to assimilate knowledge of micronekton & their sampling in the North Pacific
- Broadly, much of what is known results from research of the 1960s & 70s
- … most focused on the marginal seas around the basin rim (i.e., we know least about the open ocean)
- … and little effort expended in comparing relative sampling efficiencies and selectivity of the gears



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Micronekton of the North Pacific

PICES Working Group 14

Final Report

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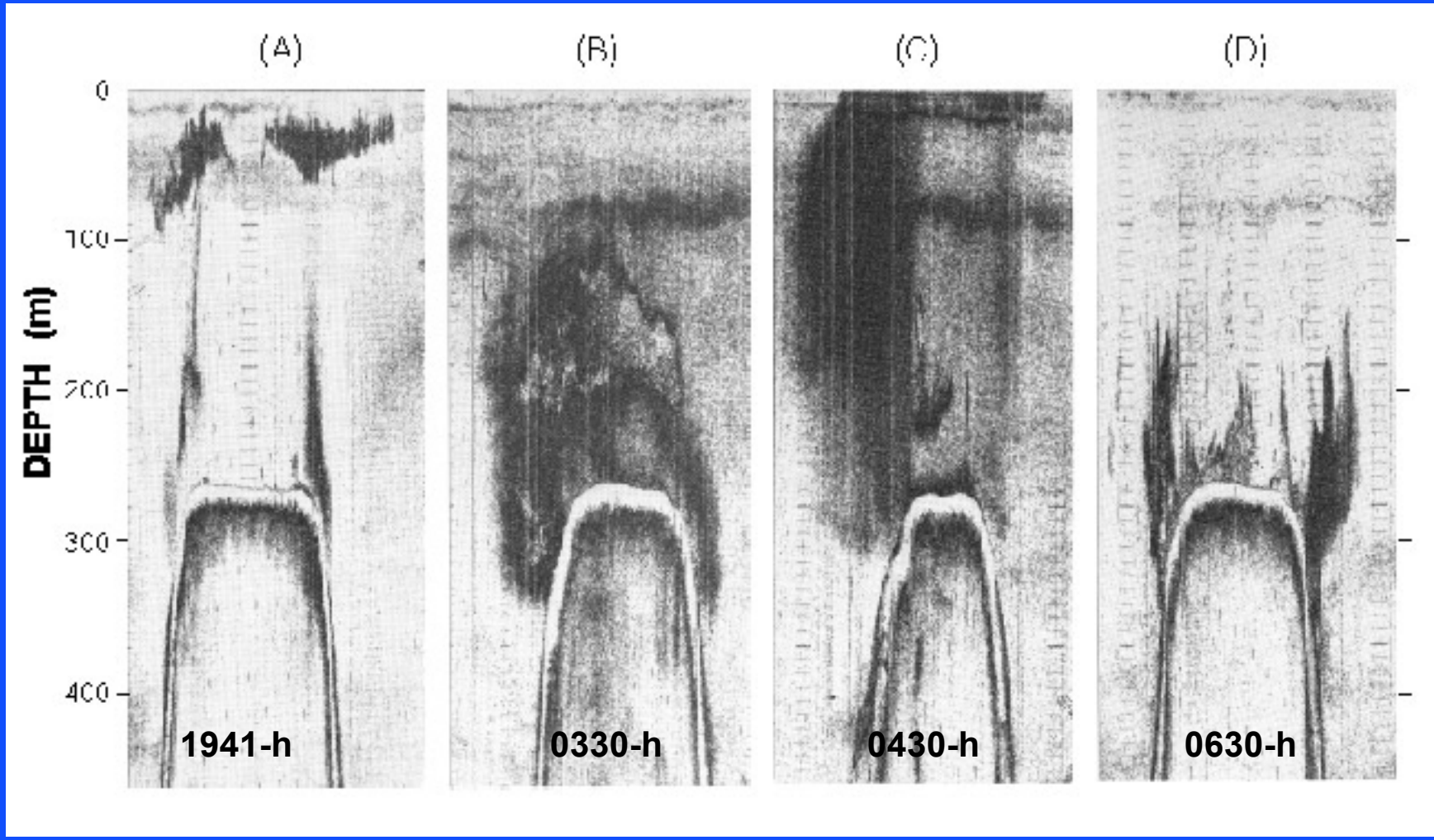
Some history and milestones of micronekton research around Hawaii and the Central North Pacific:

- King & Iversen (1962): oceanic Central Pacific & Hawaii – 6' & 10' IKMT; z_{max} ~ 350 m
- Clarke, Young, and others (1972-78): off Hawaii; 6' & 10' IKMT, Cobb trawl; z_{max} to 1200 m
- Wilson, Boehlert and others (1985-88): Hancock Smts – "engybenthic" micronektonic fauna; qualitative acoustics
- Reid et al. (1991): off Hawaii; Mesopelagic Boundary Community (MBC); IOS-RT 40 m^2, HU-200 m^2 trawl; z_{max} ~500-600 m
- Benoit-Bird and Au: off Hawaii (2001-2003): MBC, quantitative acoustics, horizontal migration, micro-patches)
- PICES (2004): off Hawaii; 6' IKMT, Cobb trawl, HU-RT gear comparison; quantitative acoustics

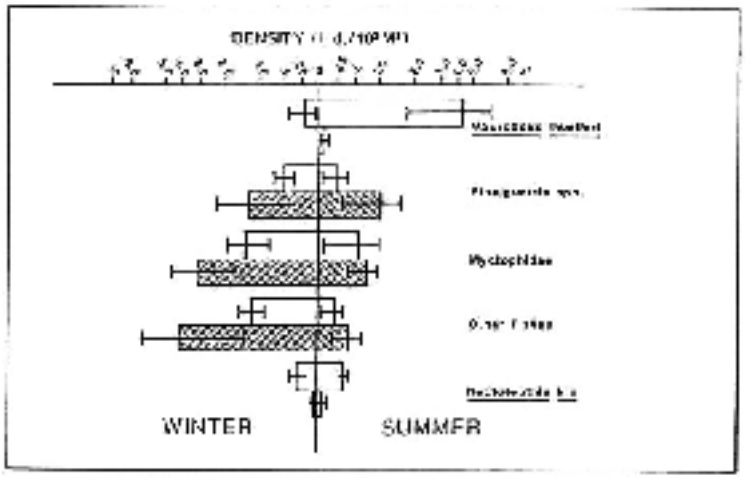
SE Hancock Acoustic transects, July 1984
(38 kHz Simrad echo sounder)



“Minimum no. species caught”

	Summer ‘84		Winter ‘85	
	‘on’	‘off’	‘on’	‘off’
No. tows	12	6	12	10
Crustaceans	23	26	23	29
Fishes & cephalopods	21	24	47	61

Fishes & Squid



Squids–Fishes


Maurolicus muelleri

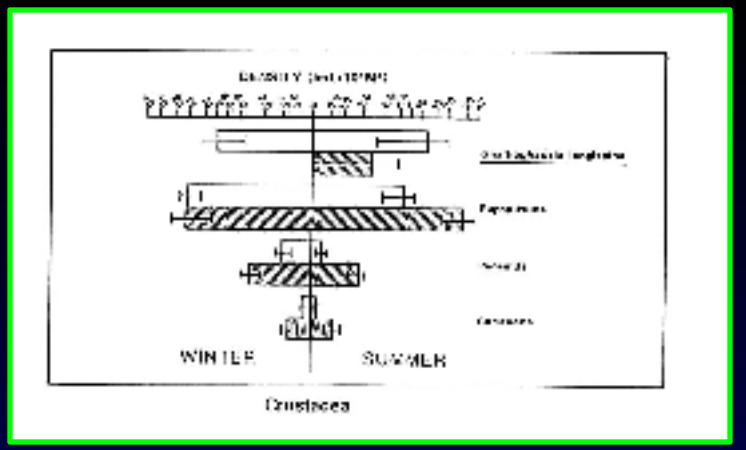

Vinciguerria nimbaria


Iridoteuthis iris

Mean densities (individuals/1000 m^3 water filtered) of selected micronekton species in the vicinity of SE Hancock (number in parentheses indicate rank among top five species)				
	Summer (Jul-Aug '84)		Winter (Jan-Feb '85)	
Species	"on"	"off"	"on"	"off"
Maurolicus muelleri	4.19 (2)	0.06	0.17	--
Lampanyctus alatus	0.03	0.02	0.09	0.90 (5)
Ceratoscopelus townsendi	0.20	0.20	0.20	0.60
Vinciguerria nimbaria	0.80	0.03	0.39	0.73
Vinciguerria attenuata	0.17	0.93	0.02	0.16
Iridoteuthis iris	0.35	0.03	0.25	--
Onychoteuthis n. sp. D	--	--	0.24	0.46
Megalocranchia cf. fisheri	--	--	0.10	0.20

Crustaceans


Gnathophausia longispina



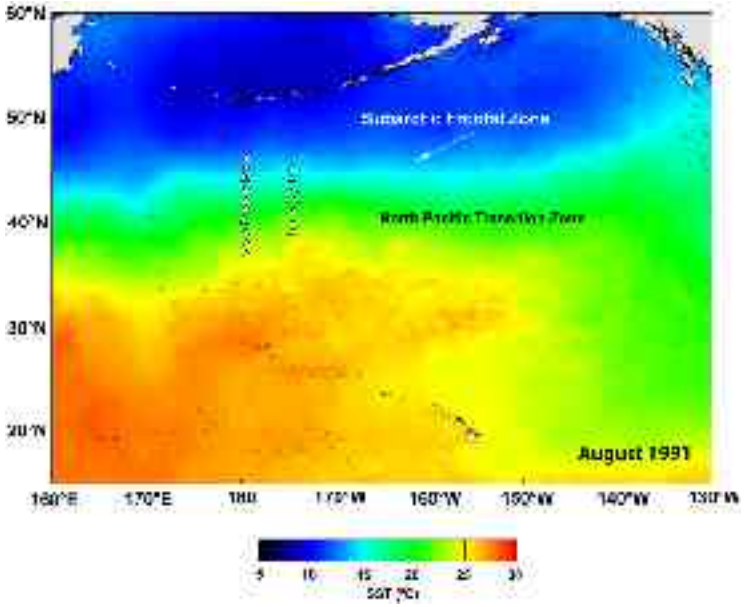
Mean densities (individuals/1000 m^3 water filtered) of selected micronekton species in the vicinity of SE Hancock (number in parentheses indicate rank among top five species)				
	Summer (Jul-Aug '84)		Winter (Jan-Feb '85)	
Species	"on"	"off"	"on"	"off"
Gnathophausia longispina	11.60 (1)	2.59 (4)	7.26 (1)	--
Euphausia gibboides	1.23 (4)	5.50 (1)	6.98 (2)	3.27 (2)
Euphausia hemigibba	0.82 (5)	1.93	2.65 (3)	4.28 (1)
Euphausia mutica	1.38 (3)	2.24 (5)	0.24	0.28
Thysanopoda monacantha	0.07	2.81 (3)	0.37	1.09 (4)
Thysanopoda orientalis	0.15	3.75 (2)	--	0.06
Thysanopoda tricuspidata	--	0.02	0.50	0.29
Stylocheiron abbreviatum	0.19	0.91	0.76	1.57 (3)
Thysanoessa gregaria	--	--	0.10	0.01
Gennadas incertus	--	0.2	--	0.6 (5)
Oplophorus spinosus	0.01	0.29	0.03	0.29

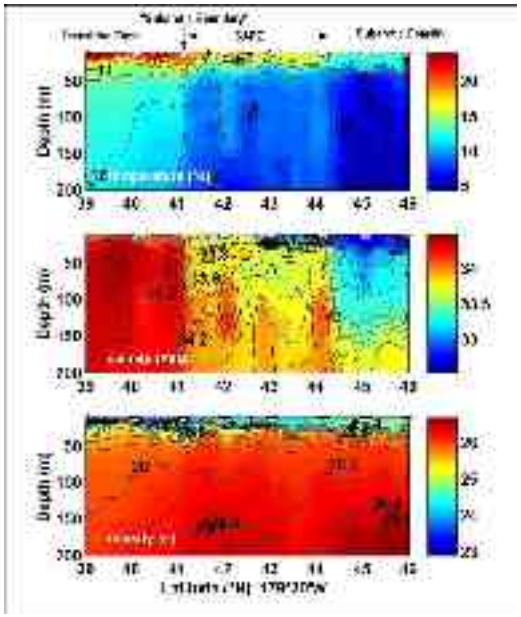

Euphausia gibboides

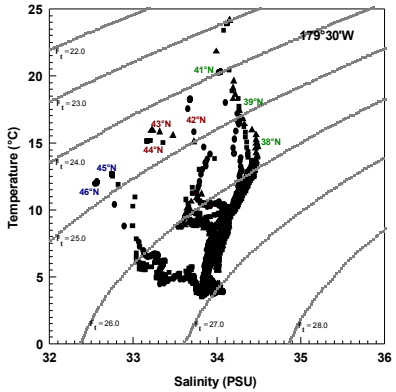

Gennadas propinquus


Oplophorus spinosus

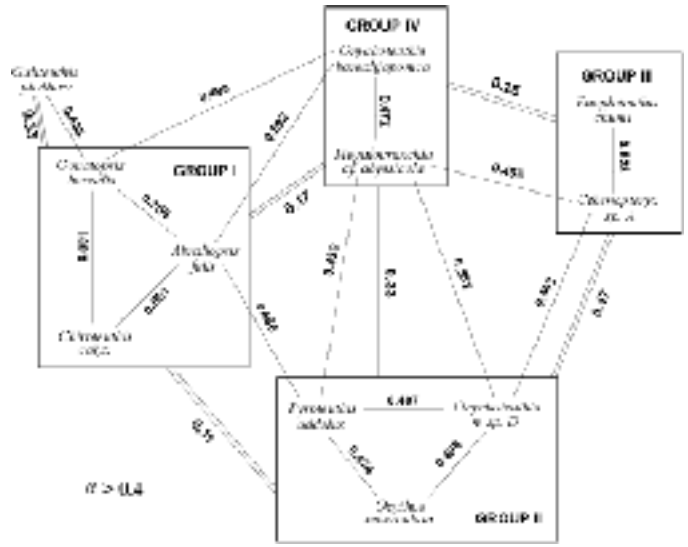
Cobb trawls at large-scale frontal systems, SAFZ August 1991



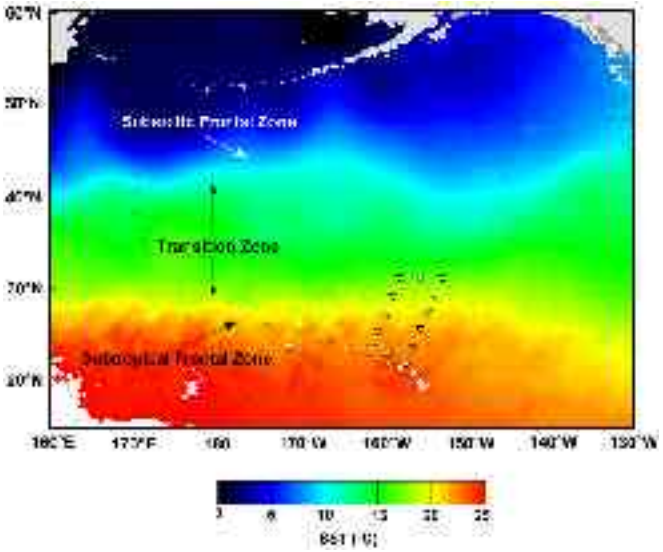


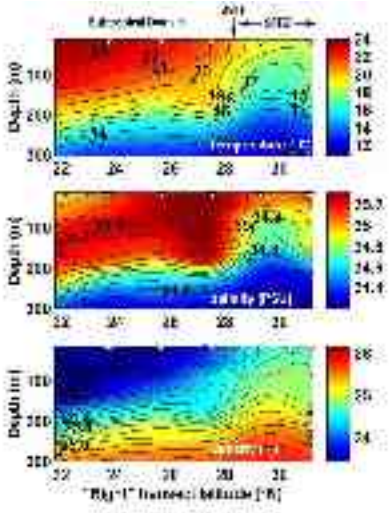


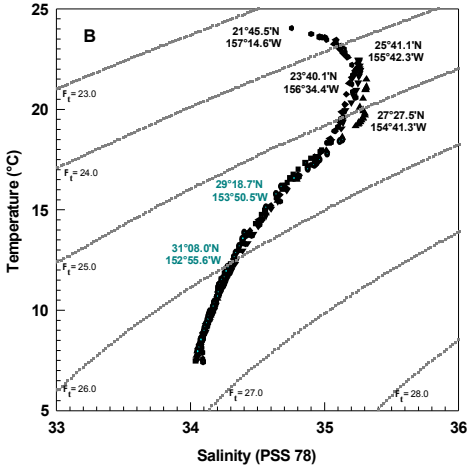
	Subtropic-Transition Zone ⟷ "Cold-water" boreal-subarctic													
Subarctic Domain							*Abraliopsis felis*	*Onychoteuthis borealijaponica*	*Gallieuthis phyllura*	*Gonatopsis borealis*	*Chiroteuthis calyx*	*Japatella diaphana*	*Taonius borealis*	*Gonatus pyros*	*Mastigoteuthis pyrodes*	*Discoteuthis discus*[p]	*Octopoteuteuthis deletron*[p]
Subarctic Frontal Zone																	
"Subarctic Boundary"																	
Transition Zone	*Pyroteuthis addolux*	*Onychoteuthis sp. D**	*Enoploteuthis chunii**	*Ocythoe tuberculata**	*Megalocranchia abyssicola**	*Chtenopteryx sp. A*											

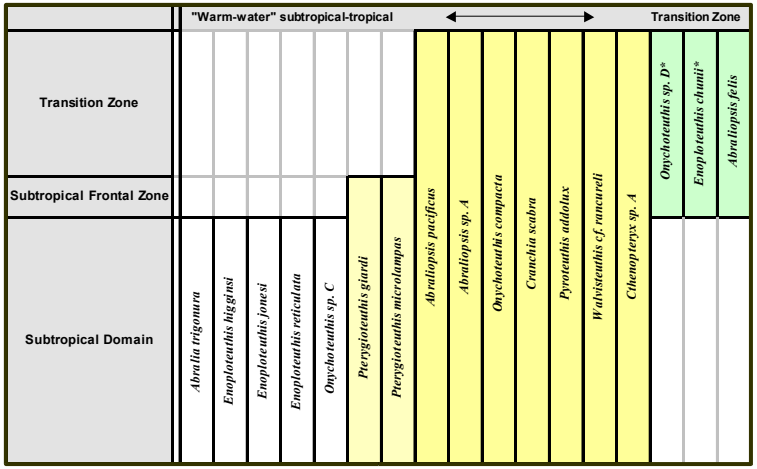


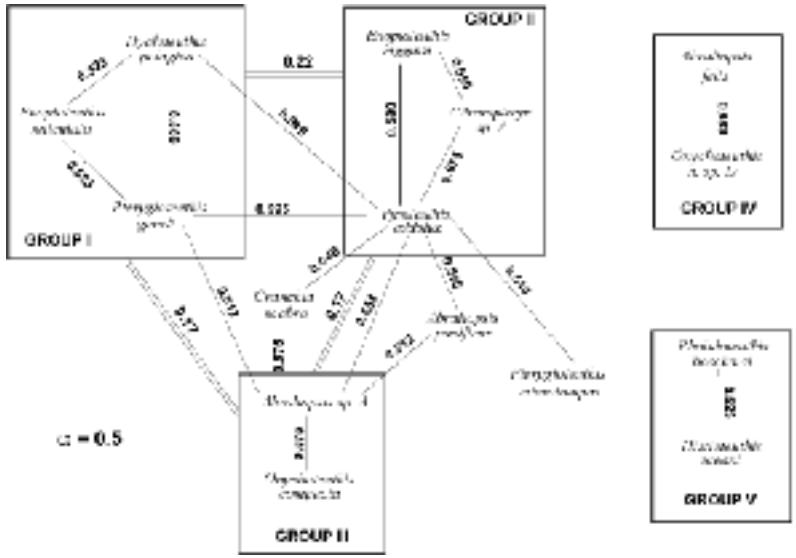
Cobb trawls at large-scale frontal systems, STFZ February 1992





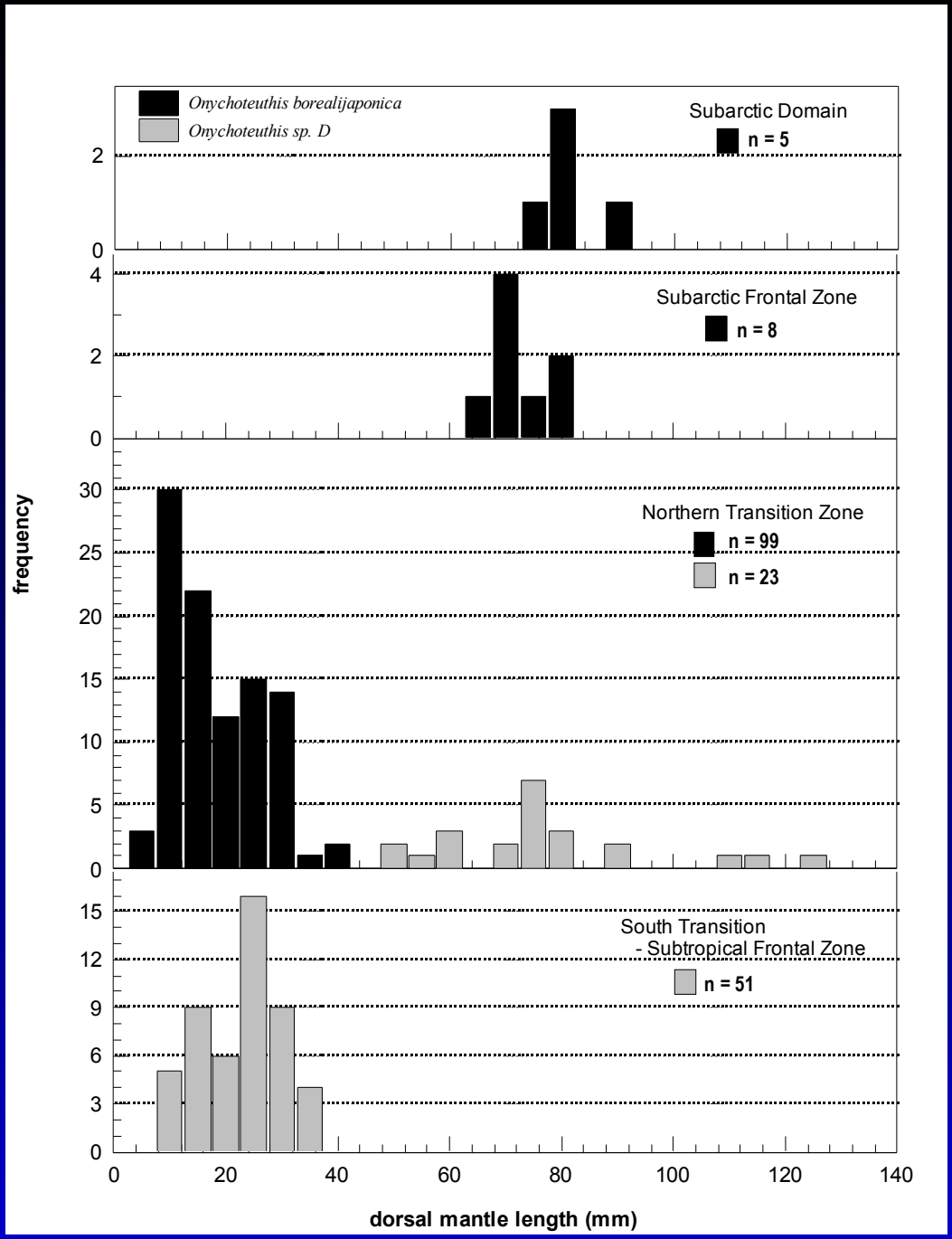






Onychoteuthis sp. D & O. borealijaponica

- South spawning – north feeding migrations
- Spatially complementary distributions
- Past reports of extensive distribution likely a composite of 2 species



PICES Micronekton Inter-calibration Experiment (MIE)
NOAA ship *Oscar Elton Sette* cruise 04-13
October 6-13, 2004

Cruise objectives:

- to conduct the sampling for a gear comparison and to gain a subtropical perspective of the micronekton community
- use the benign weather and sea conditions to evaluate and refine the protocols, logistics, and design of the experiment

Micronekton Intercalibration Experiment – 1
Cruise participants

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Reka Domokos
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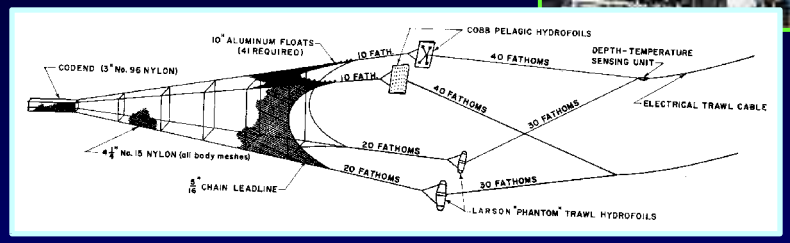
Hokkaido University
Graduate School of Fisheries Sciences
& Faculty of Fisheries

Andrei Suntsov
Harbor Branch Oceanographic Institution

Sampling gears

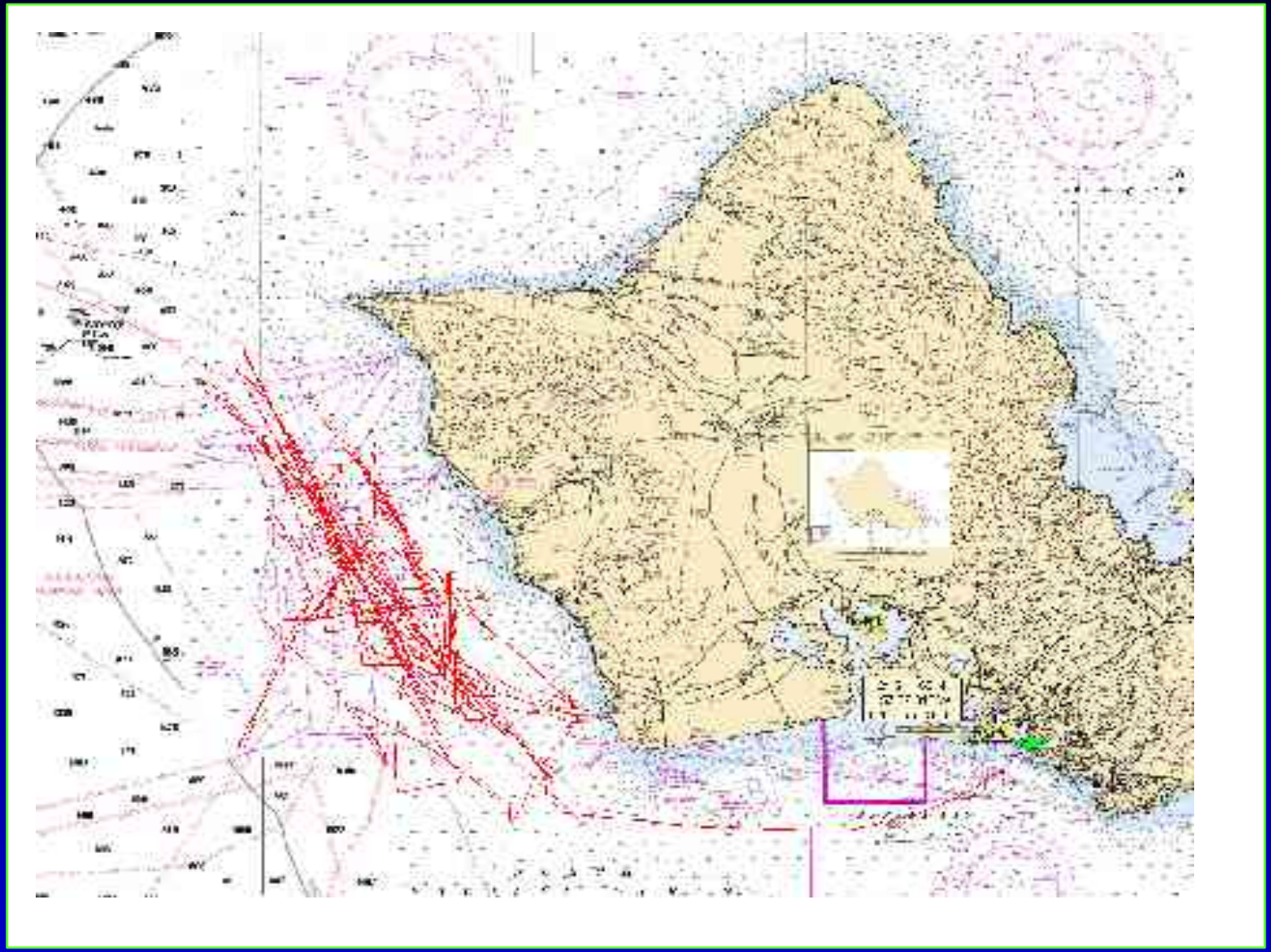
140 m^2 "Stauffer modified" pelagic Cobb trawl



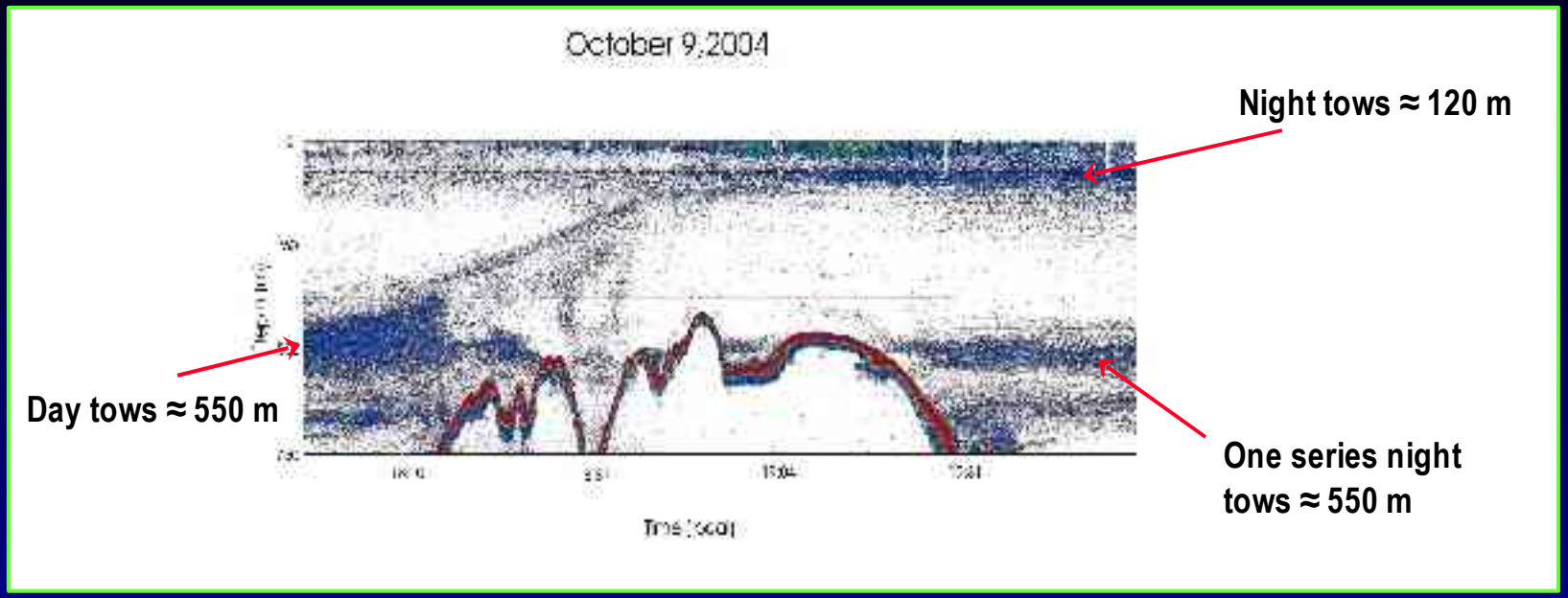
1.8 m IKMT

2 m Hokkaido University Rectangular Frame Trawl

MIE-1, operations tracks



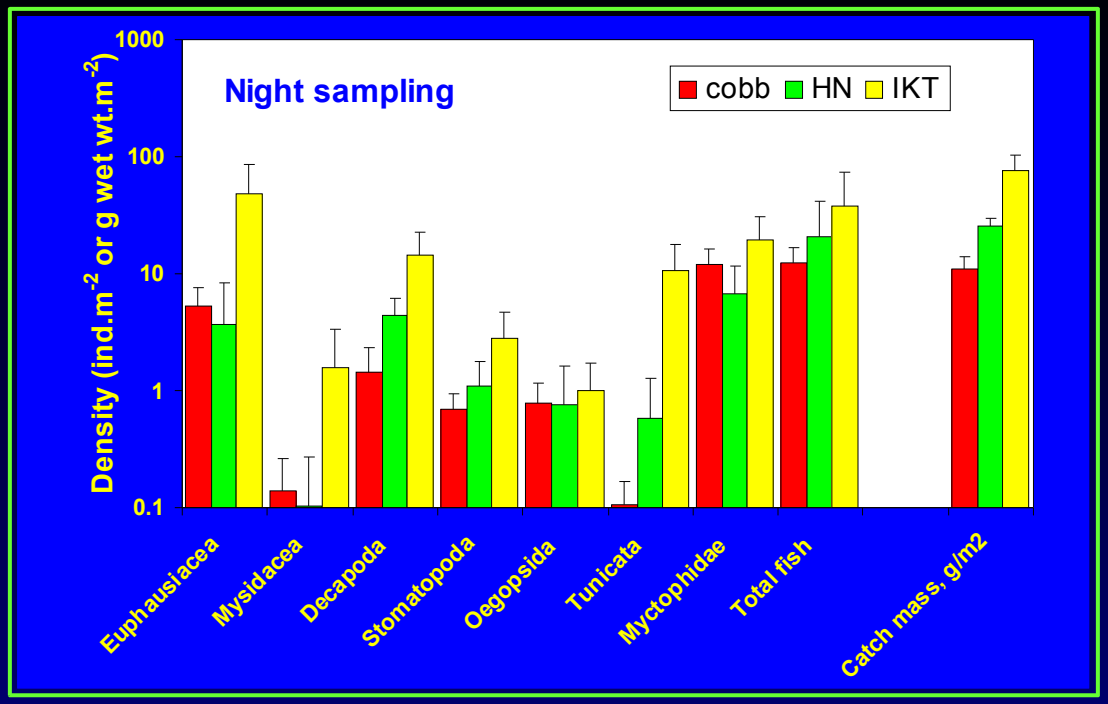
EK-60 38 kHz echogram, 9 October 2004:



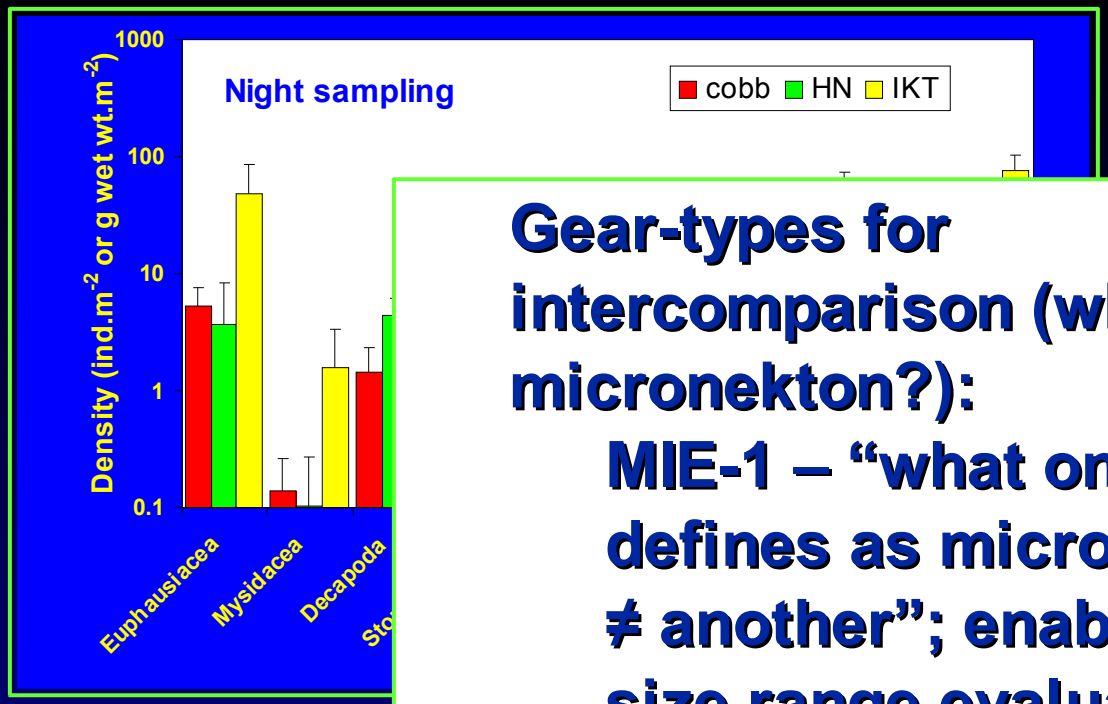
Simrad EK-60 38 kHz, avg Nautical Area Scattering Coefficients ($m^2 \cdot nmi^{-2}$)					
Cobb Trawl		HU-RT		6' IKMT	
Day	Night	Day	Night	Day	Night
472.704	288.191	428.696	318.828	390.104	321.254

Sampling Distribution:

- 17 Cobb trawls
- 19 IKMTs
- 20 HU-RFTs


Night sampling
cobb
HN
IKT
Density (ind.m-2 or g wet wt.m-2)
1000
100
10
1
0.1
Euphausiacea
Mysidacea
Decapoda
Stomatopoda
Oegopsida
Tunicata
Myctophidae
Total fish
Catch mass, g/m2


IKMT



Gear-types for intercomparison (what is micronekton?):

- MIE-1 – "what one defines as micronekton ≠ another"; enabled all size range evaluation of multiple acoustic λs
- MIE-2 – 'appropriate' gear of similar mesh sizes; standard gear (RMT 1+8, IKMT?); towed acoustics (high frequencies)


Opisthoproctus soleatus
Oplophorus gracilirostris
Abralia trigonura

What now?

- Advances in technology
- Signal strength (acoustics)
- Time series – observation systems
- Refined trophic links
- Ecosystem roles