Northern California Current (WA, OR, Northern CA) Hot Spots of Abundance for *Euphausia pacifica* and *Thysanoessa spinifera*

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A vertical plankton net was used for all samples.

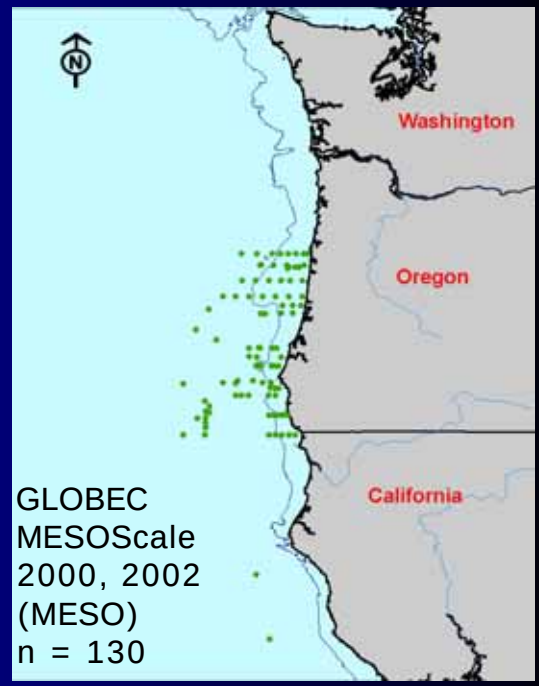
The net is a 0.5m diameter ring net, with 202µm mesh, towed vertically from a maximum of 100m (or 5m off the bottom) to the surface.

Only night–time samples were used in the analysis.

The samples were analyzed for adult and juvenile *E.pacifica* and *T. spinifera.* Combining these life history stages to produce species specific biomass estimates for each sample.

Biomass is calculated using a dry weight to carbon relationship, and is expressed as mg of carbon per m^3 of water.

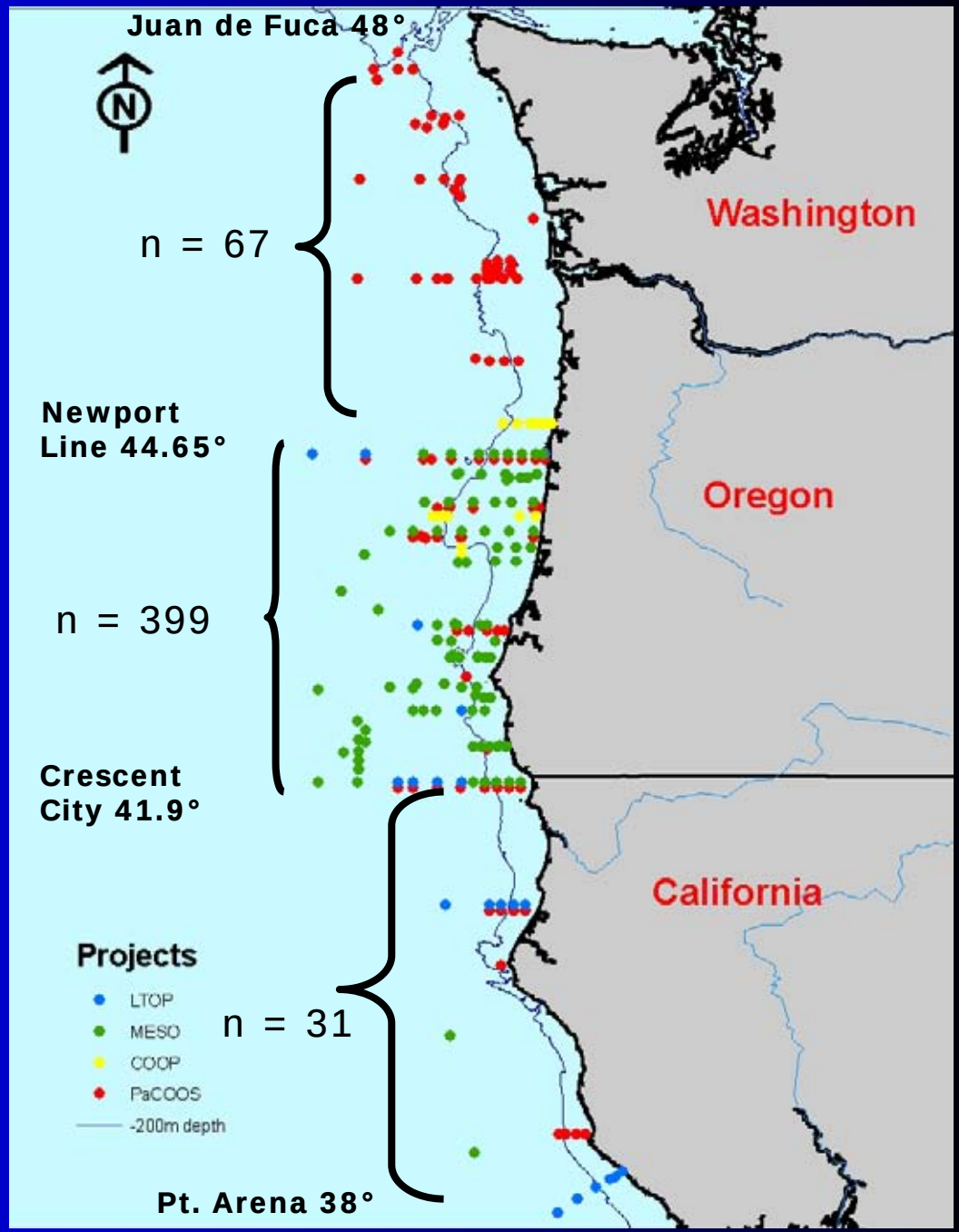
To achieve a coast-wide sampling distribution we used samples from multiple projects and multiple cruises within projects.



Spatial Distribution from Juan de Fuca 48° to Pt. Arena 38°

Majority of the stations sampled more than once.

N=497

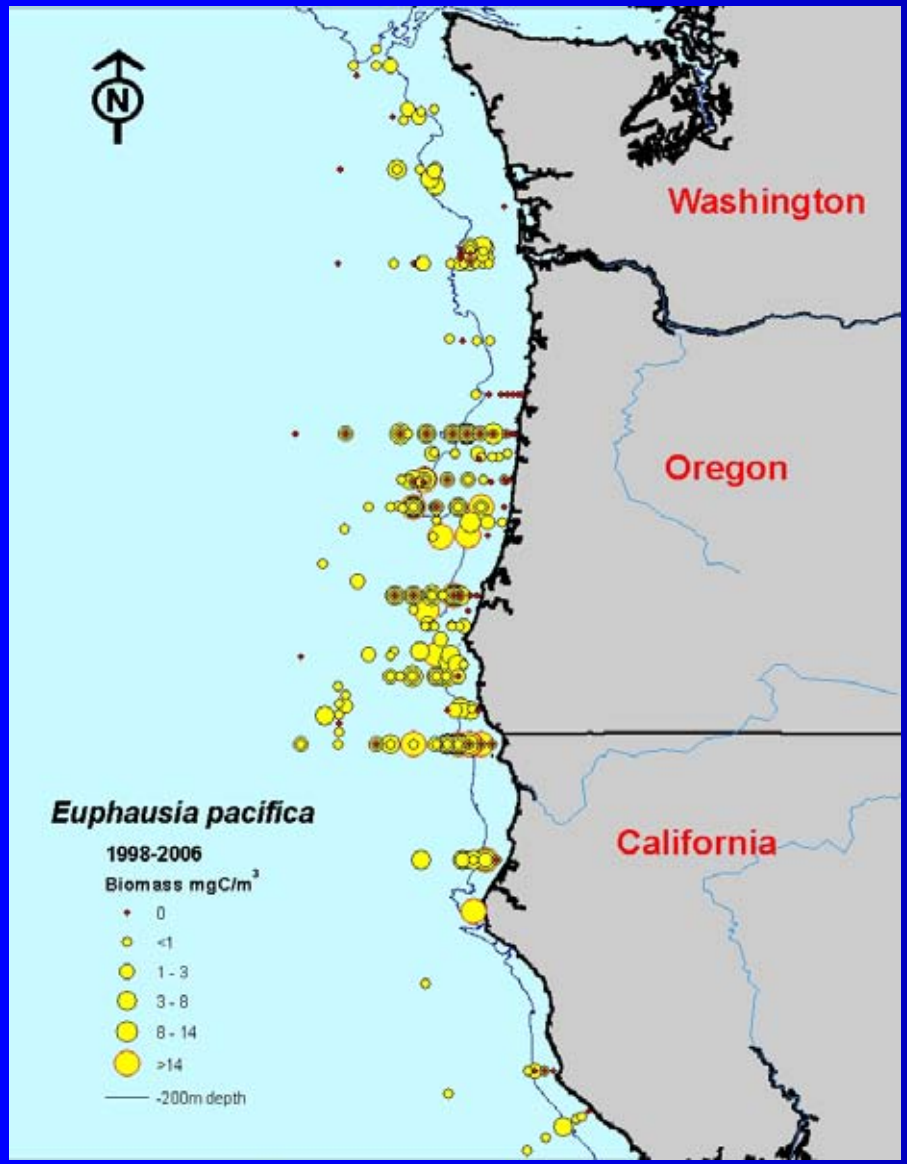


Sample distribution by year, month and cruise

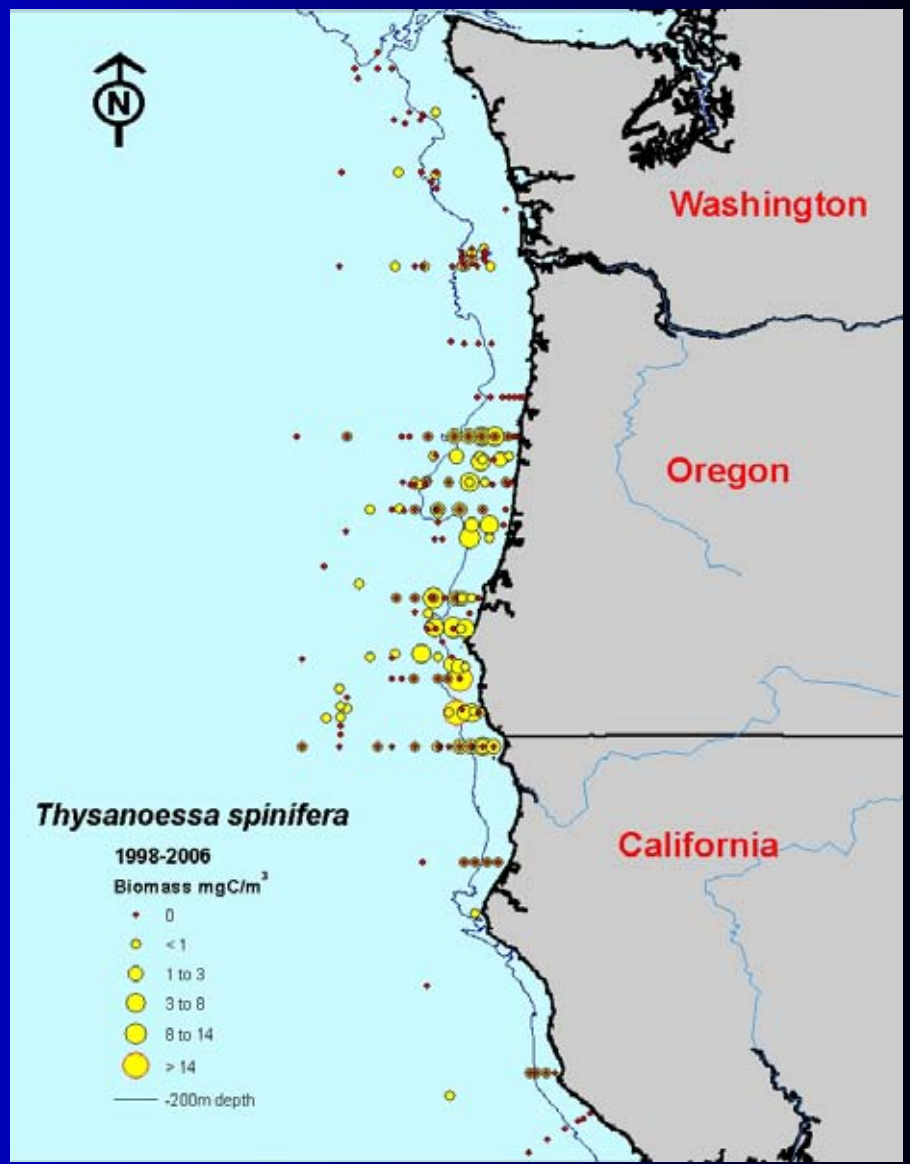
Year	Project	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
1998	LTOP	4	1		12		4		18	8		14		61
1999	LTOP		1		9			10		8		5		33
2000	LTOP		4		9			13		18				44
	MESO					3	14	12	28					57
2001	LTOP	3		5				1		9		2		20
	COOP					7	3		13					23
2002	LTOP		6		15			8		6	4		4	43
	MESO					6	18	1	48					73
2003	LTOP		4		6			9						19
2004	PaCOOS					43	4			9		6		62
2005	PaCOOS					14			14					28
2006	PaCOOS					34								34
TOTAL		7	16	5	51	107	43	54	121	58	4	27	4	497

The yearly and within year distribution of samples is very good.

Best distribution between April and September.



Euphausia pacifica **(**Epac**)** coast-wide distribution. Mean biomass of 2.8 mgC/m^3.



Thysanoessa spinifera (Tspin) distribution coast-wide, and mostly on the shelf. Mean biomass 0.5mgC/m^3.

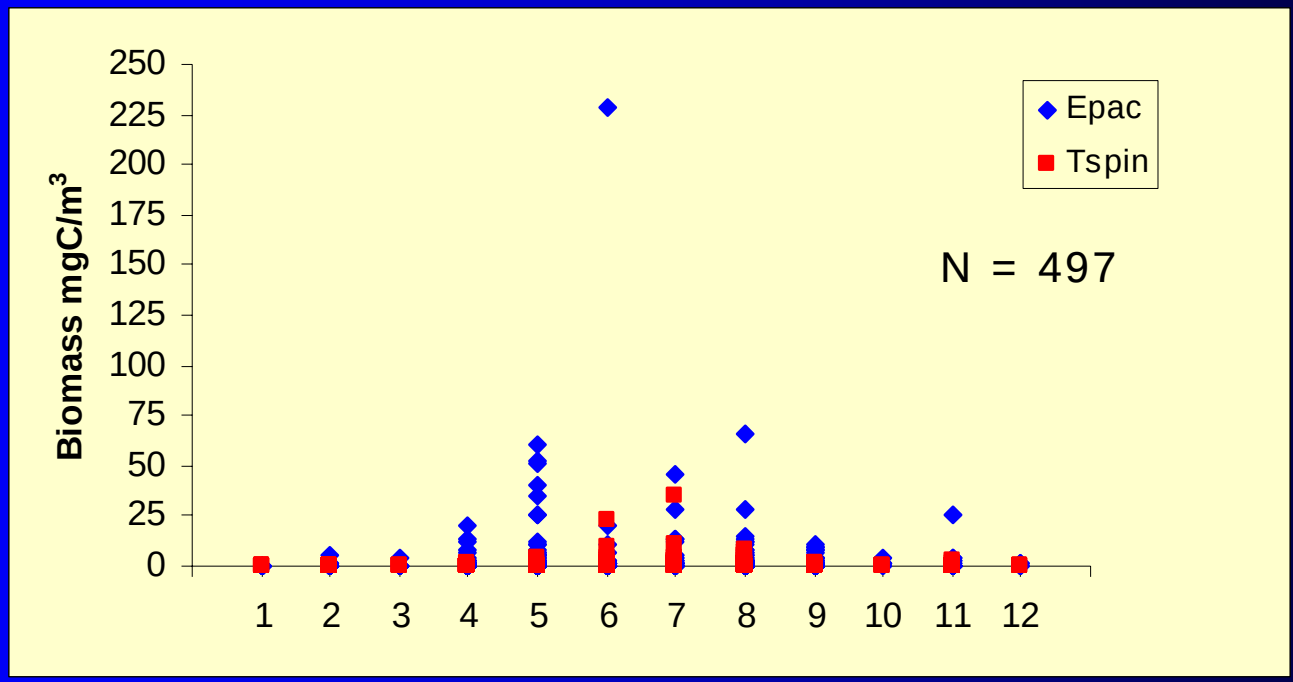
Distribution of samples per month by species

Epac in 78% of the samples

Tspin in 38% of the samples

Only 18% of the samples had neither *Epac* or *Tspin*.

Month	Total # of samples	Epac present	Tspin present	Total # of samples without Epac or Tspin
Jan	7	4	0	3
Feb	16	8	5	5
Mar	5	5	1	0
Apr	51	44	14	5
May	107	78	32	28
Jun	43	30	19	10
Jul	54	44	29	10
Aug	121	102	54	13
Sep	58	45	23	10
Oct	4	4	1	0
Nov	27	22	10	3
Dec	4	3	0	1
Total	497	389	188	88



Samples with high biomass probably indicate that we sampled swarms of adults.

Epac samples had biomass values ranging from 0-228mgC/m^3

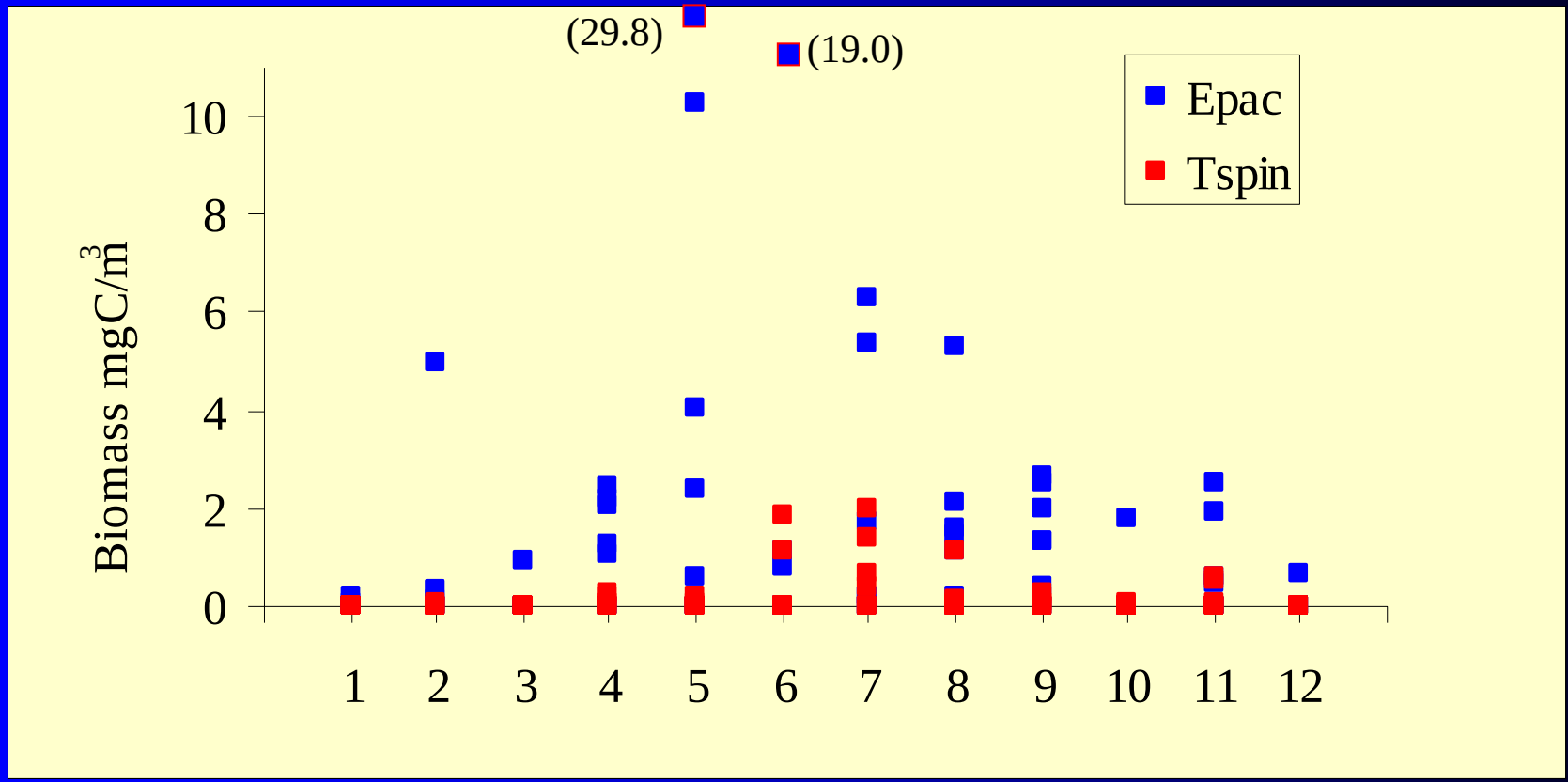
Tspin samples had biomass ranging from 0-35mgC/m^3

2000 is the year with the most swarm samples

The summer months of May, June and July have the most large samples.

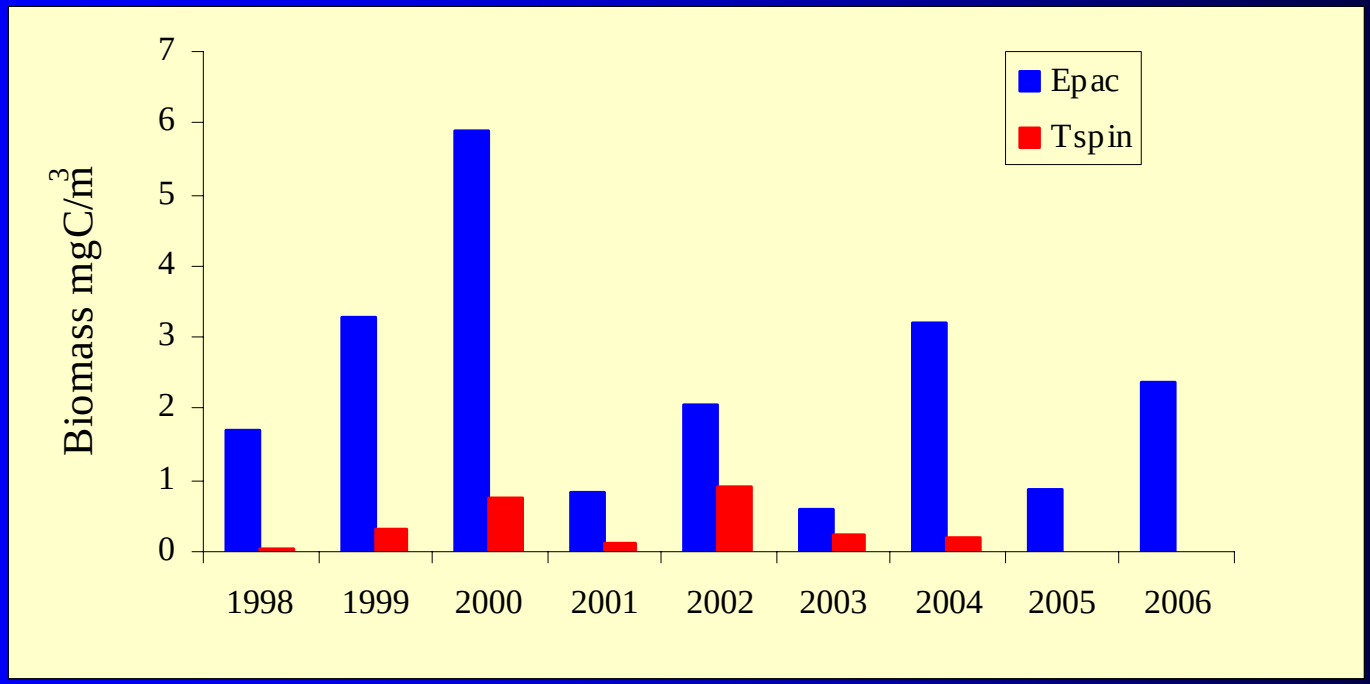
Genus species	Station	Sample Date	Year	Month	Final Carbon (mg/m^3)	Density (#/m^3)	Latitude
Epac	CC03	4/9/1998	1998	4	20.7520	5.4567	41.9000
Epac	EU02	11/19/1998	1998	11	25.7536	14.6118	40.8700
Epac	CC07	7/5/1999	1999	7	45.0609	8.7685	41.9000
Epac	CC04	5/30/2000	2000	5	25.0880	11.6146	41.9000
Epac	CC03	5/30/2000	2000	5	52.0671	19.7199	41.9000
Epac	RP2	6/2/2000	2000	6	228.6546	25.8842	43.7520
Epac	UR07	6/7/2000	2000	6	19.6356	7.5901	43.7448
Epac	7A-6	8/9/2000	2000	8	28.8309	7.5527	43.0846
Epac	9-5	8/10/2000	2000	8	65.4692	17.7641	42.6902
Epac	BOB5	5/30/2002	2002	5	60.6597	10.6996	44.2500
Epac	CC02	7/13/2002	2002	7	28.5575	14.2532	41.9000
Epac	EU03	5/6/2004	2004	5	34.9089	6.7167	40.4195
Epac	CC03	5/8/2004	2004	5	25.7725	8.4224	41.9000
Epac	BOB5	5/9/2004	2004	5	40.9938	8.8744	44.2500
Epac	HH05	5/11/2006	2006	5	50.9240	12.8554	44.0000
Tspin	RP2	6/2/2000	2000	6	9.0057	1.4380	43.7520
Tspin	FM07	7/9/2000	2000	7	10.1519	1.1921	43.2166
Tspin	RR02	7/30/2000	2000	7	35.2264	34.0260	42.5000
Tspin	PR04	6/2/2002	2002	6	22.3424	9.8105	42.1997
Tspin	L8-3	8/13/2002	2002	8	8.4326	1.4753	42.9589

Mean monthly biomass mgC/m^3



Peak biomass is in the summer months between May and Aug.

Mean yearly biomass mgC/m^3



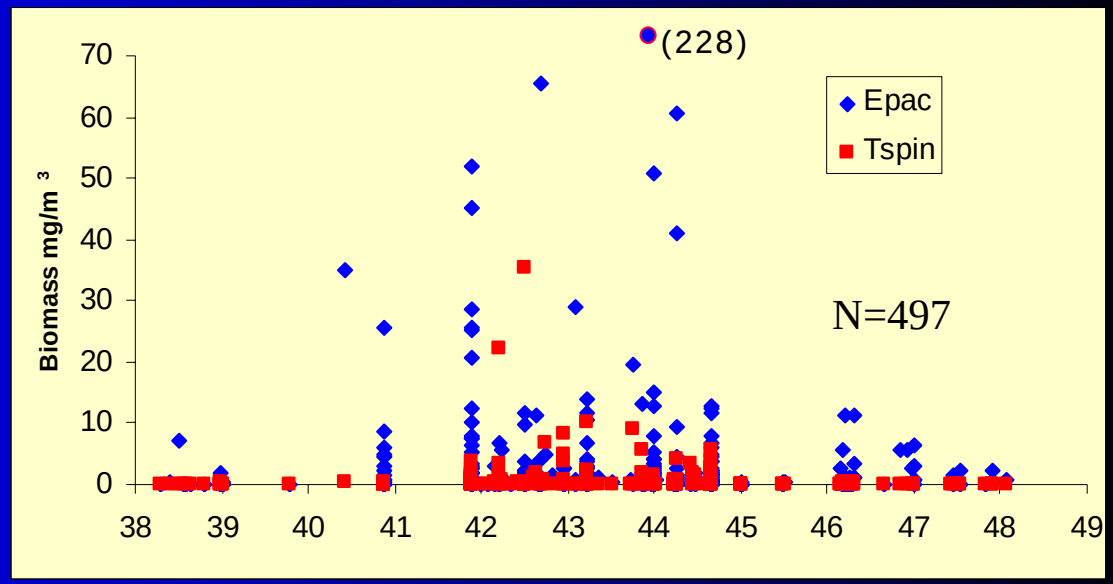
Epac biomass not well related to cool or warm ocean conditions. 2000 was a very good year; 1999 (cold) and 2004 (warm) about equal in biomass.

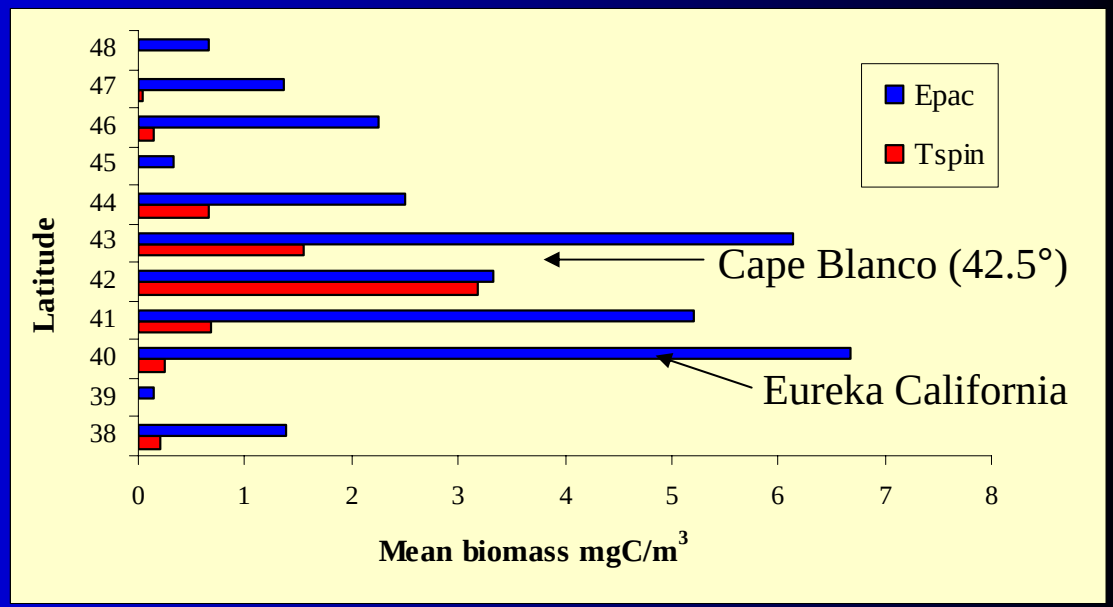
Tspin virtually disappear 1998, 2001 and are almost non-existent in the vertical net sampling for 2005, and 2006.

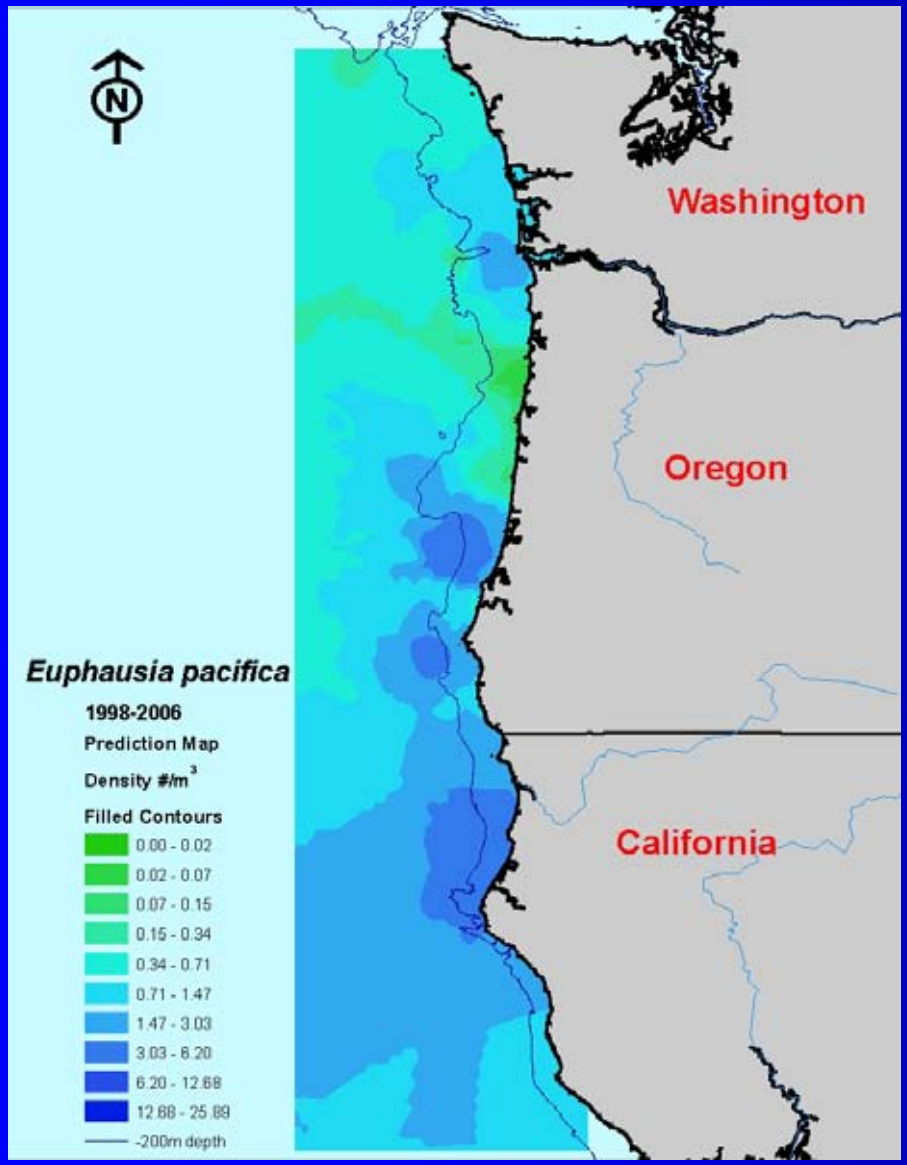
Biomass by latitude

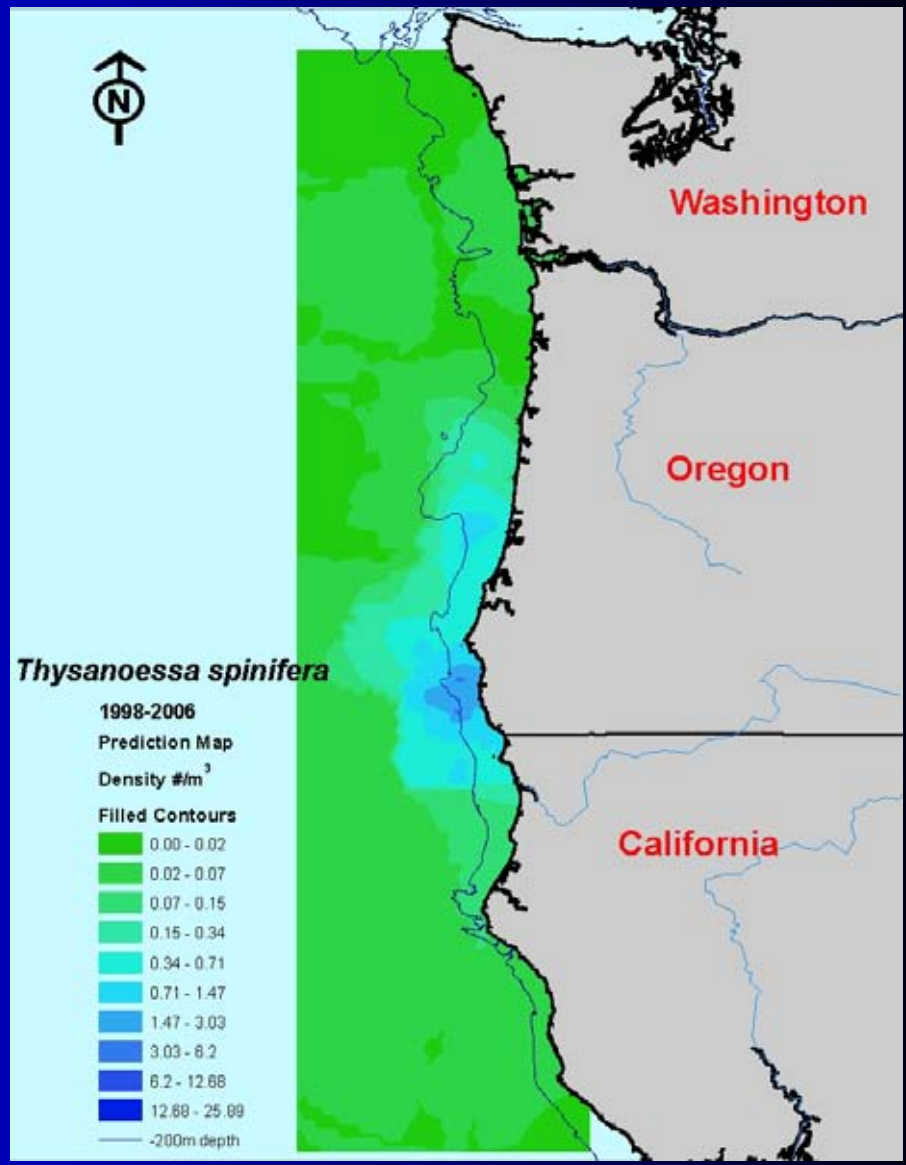
Epac mean biomass south of Cape Blanco is 3.7 mgC/m^3, north 2.4 mgC/m^3. Omitting the one outstanding sample the northern biomass mean is 1.8 mgC/m^3

Tspin biomass south of Cape Blanco is 0.77 mgC/m^3, north 0.27mgC/m^3









Using the mean density (#/m^3) for each sampling location we created species-specific prediction charts to show ”hot spots” for each species.

Euphausia pacifica (Epac)

coast-wide distribution

present in 78% of the samples

consistent biomass values for the entire study area

biomass values ranging from 0-228mgC/m^3

mean overall biomass of 2.8 mgC/m^3

Thysanoessa spinifera (Tspin)

mostly on the shelf

present in 38% of the samples.

biomass ranging from 0-35mgC/m^3

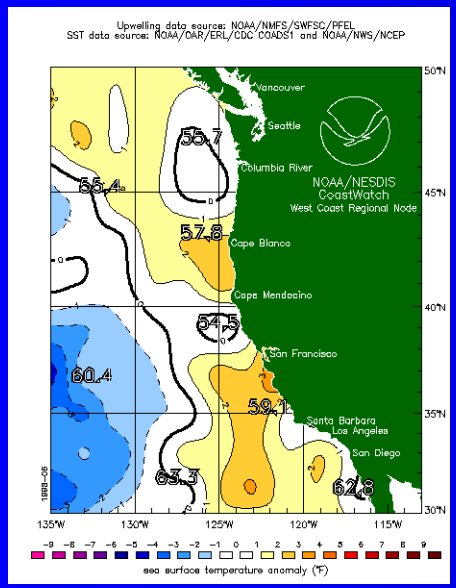
mean overall biomass of 0.5 mgC/m^3

Conclusion

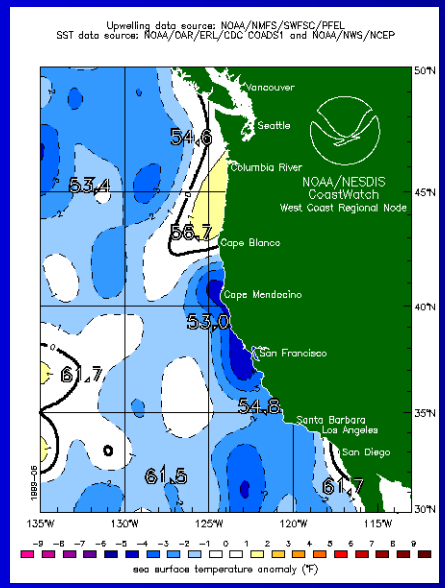
- Sure would be nice if we could get some funding to do this study along the same grid at the same times every year!
- Particularly the “hot spots”; feeding grounds for fish (salmon), mammals and birds?
- Swarms seem real and need more work (acoustics + nets = the best alternative).

Acknowledgements

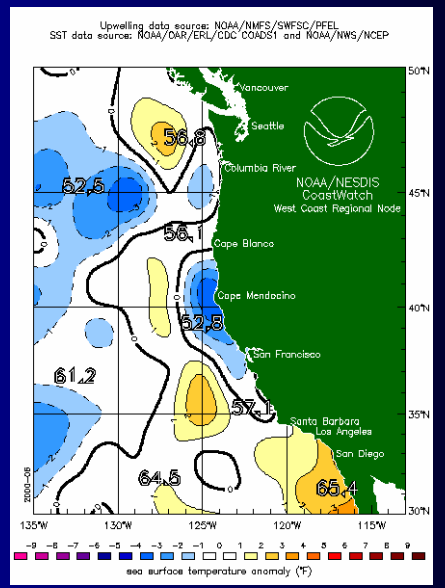
- GLOBEC (LTOP, MESO)
- NOAA/Stock Assessment Improvement Program
- NSF-CoOP/COAST
- Contribution to PaCOOS
- Research vessels:*R/V Wecoma, R/V Atlantis, R/V Frosti,R/V Miller Freeman, R/V McArthur II, R/V New Horizon*
- *Many people who have supported these efforts*



June 1998



June 1999



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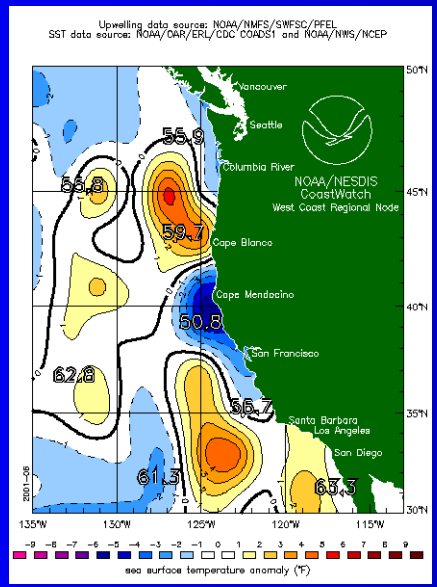

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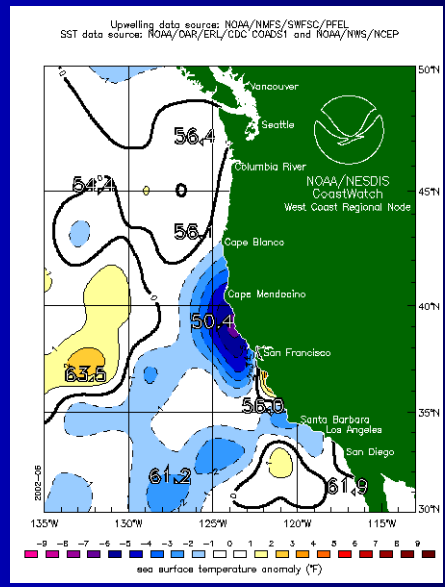

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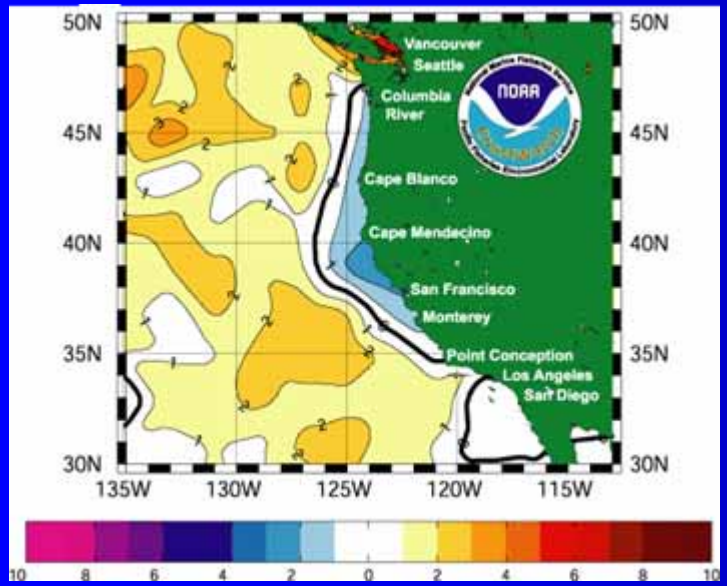

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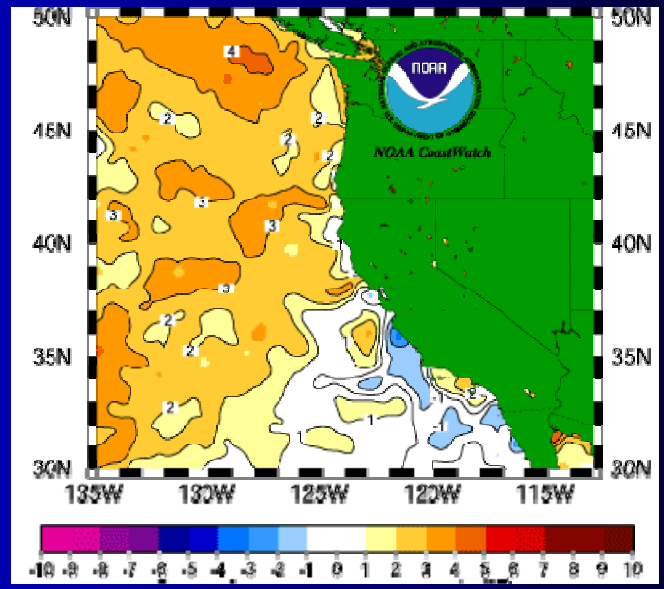

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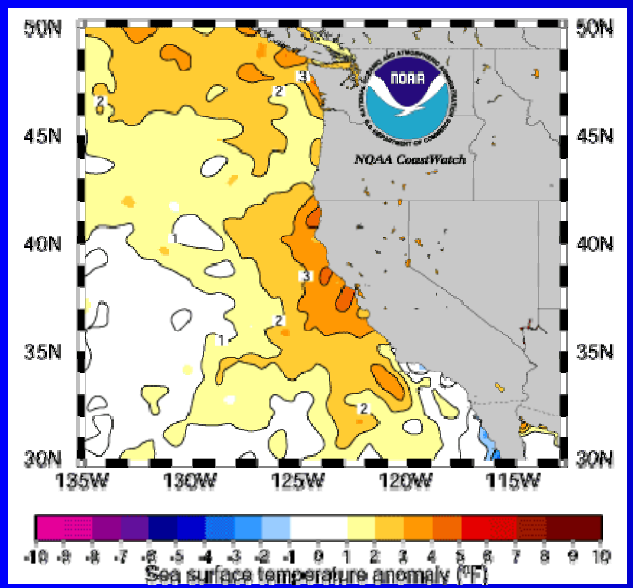
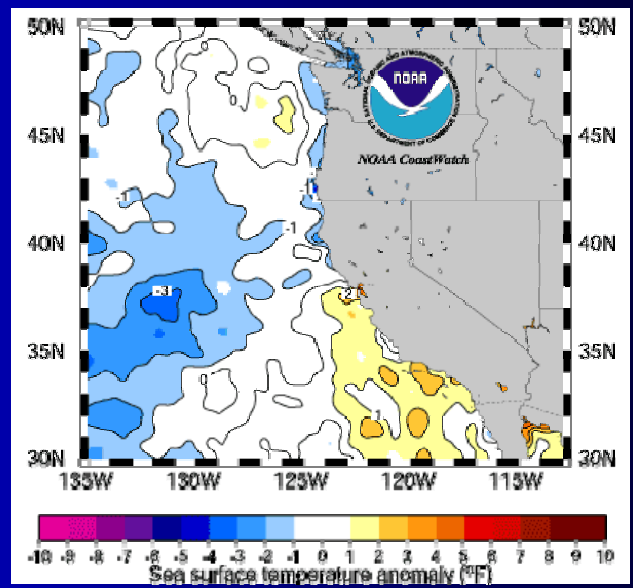


May 2005



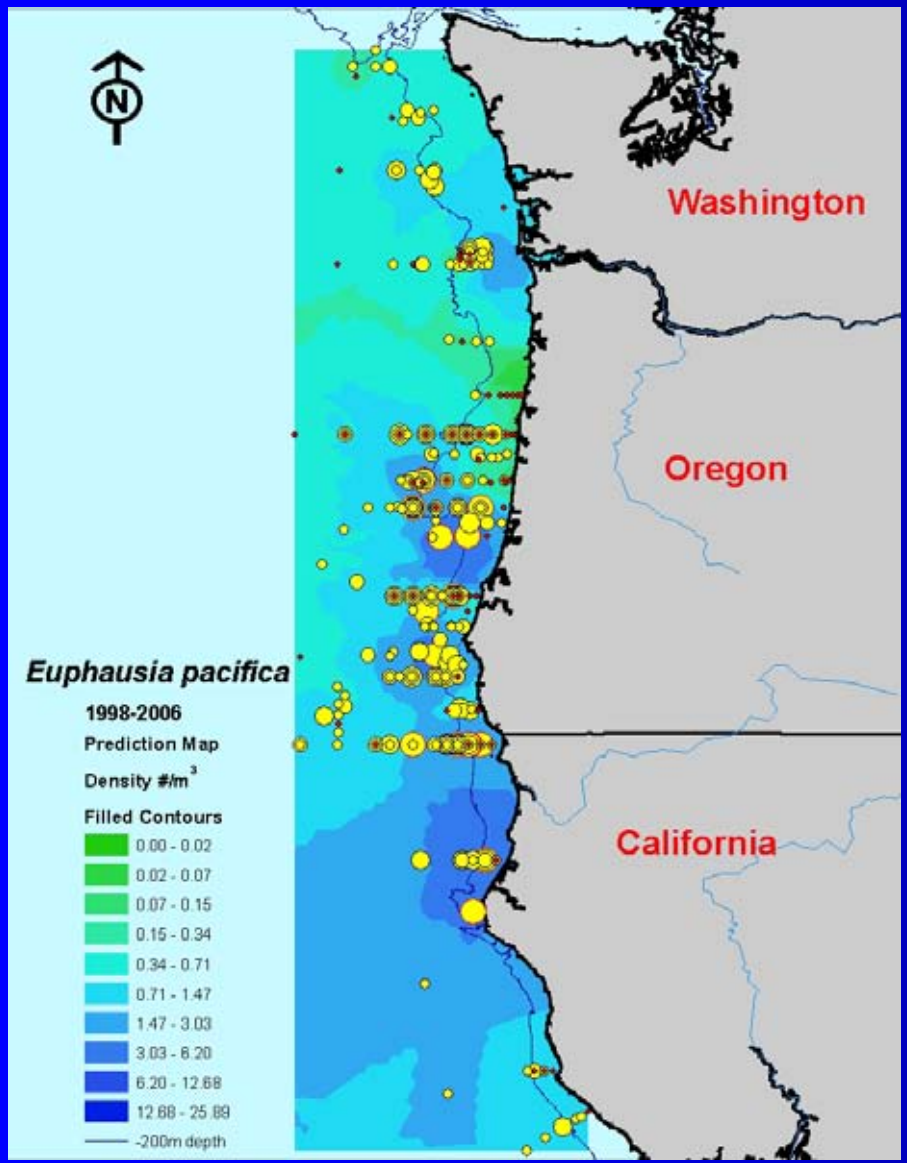
May 2006

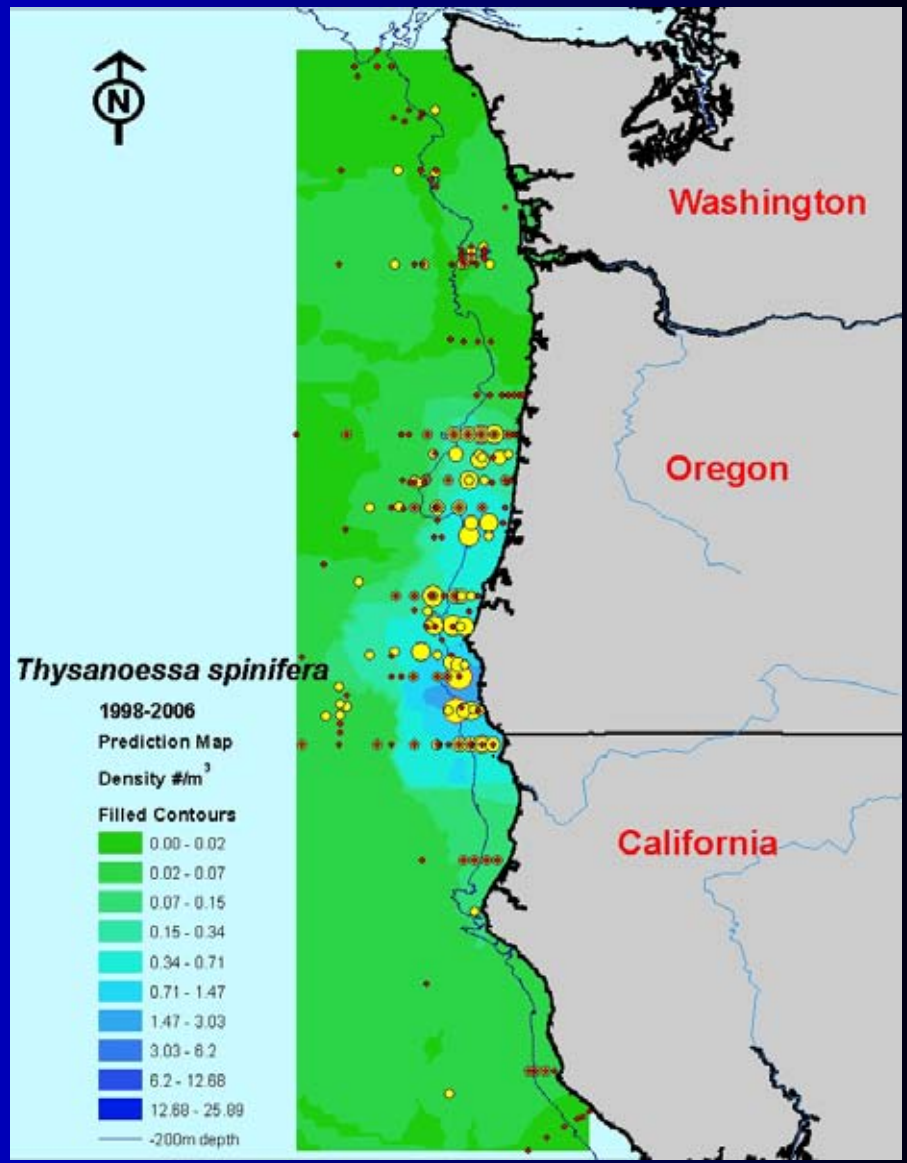
(March-May)

(June-Sep)

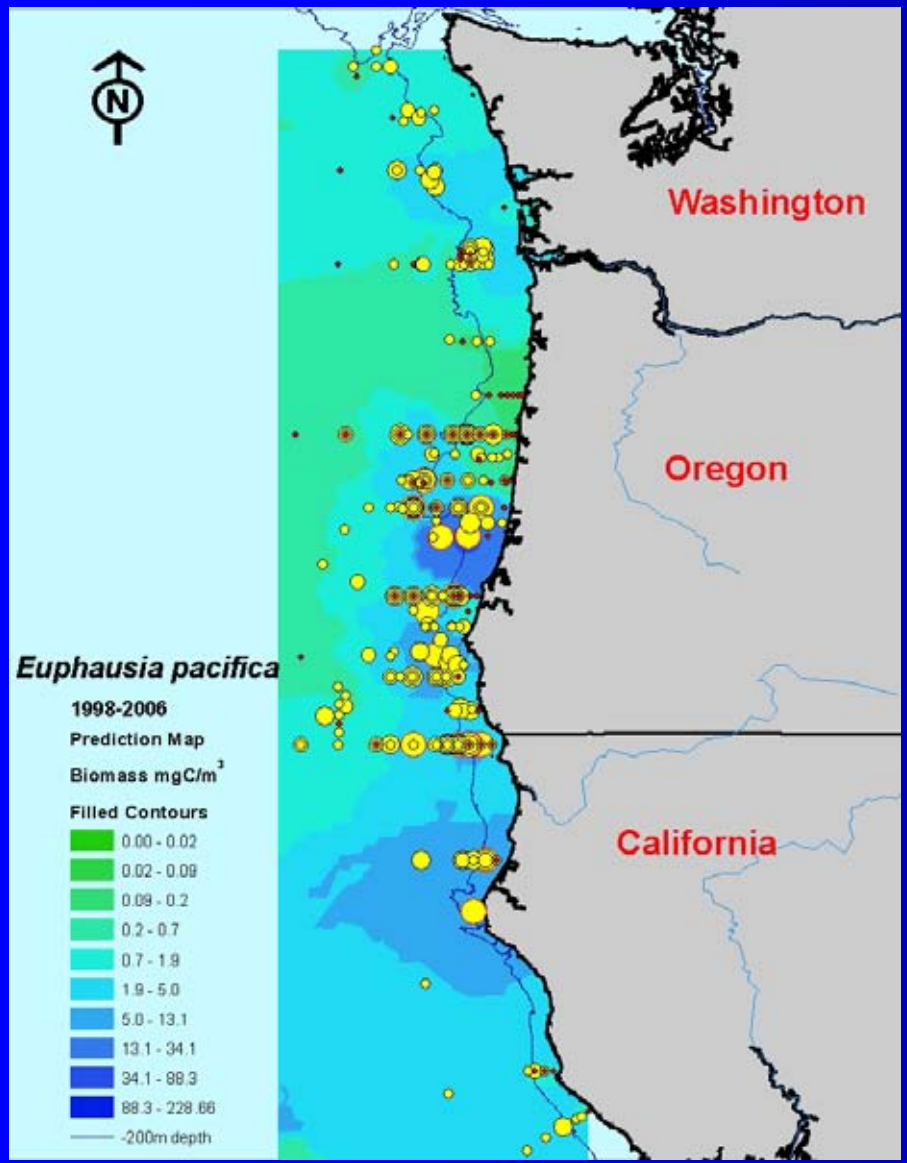
(Jan-Feb + Oct-Dec)

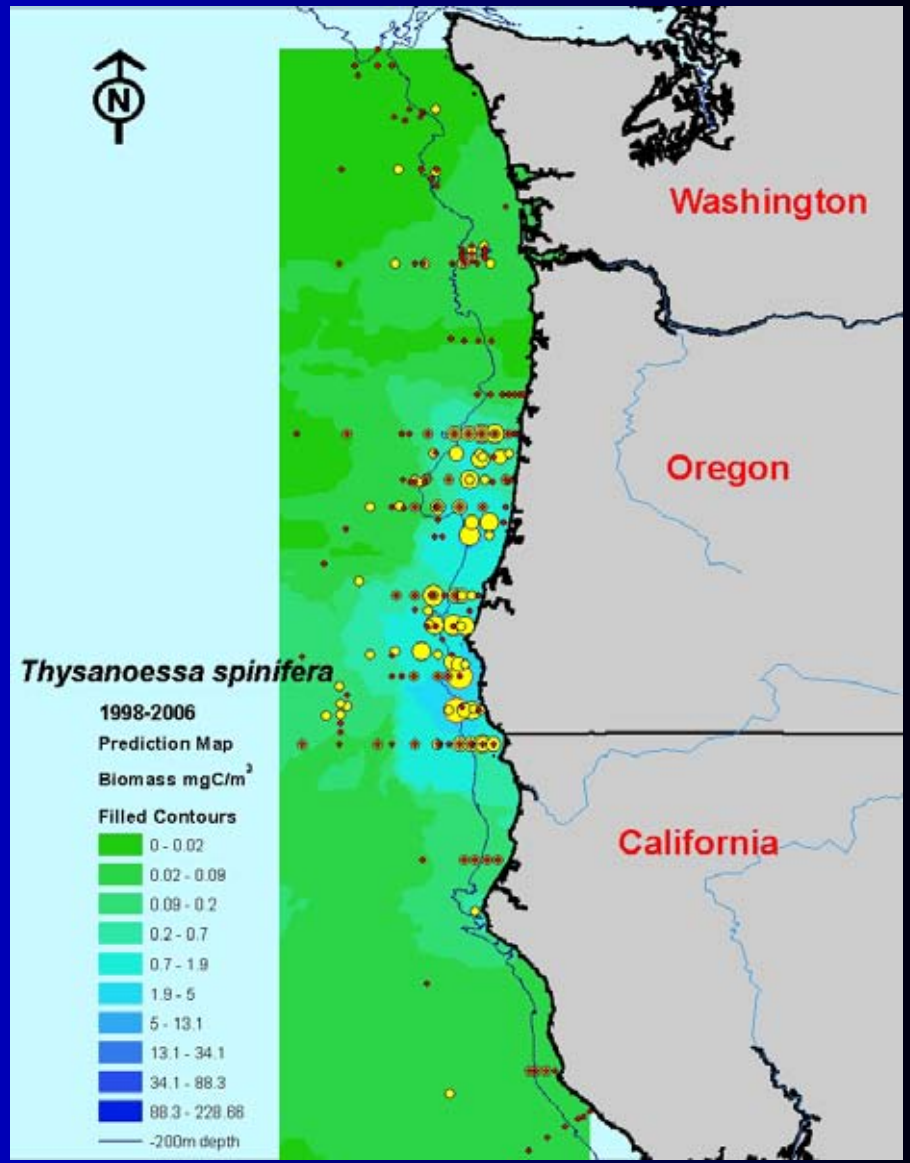
Density


Washington
Oregon
California
Euphausia pacifica
1998-2006
Prediction Map
Density #/m3
Filled Contours
0.00 - 0.02
0.02 - 0.07
0.07 - 0.15
0.15 - 0.34
0.34 - 0.71
0.71 - 1.47
1.47 - 3.03
3.03 - 6.20
6.20 - 12.68
12.68 - 25.89
-200m depth


Washington
Oregon
California
Thysanoessa spinifera
1998-2006
Prediction Map
Density #/m3
Filled Contours
0.00 - 0.02
0.02 - 0.07
0.07 - 0.15
0.15 - 0.34
0.34 - 0.71
0.71 - 1.47
1.47 - 3.03
3.03 - 6.2
6.2 - 12.68
12.68 - 25.89
-200m depth

Biomass


Washington
Oregon
California
Euphausia pacifica
1998-2006
Prediction Map
Biomass mgC/m3
Filled Contours
0.00 - 0.02
0.02 - 0.09
0.09 - 0.2
0.2 - 0.7
0.7 - 1.9
1.9 - 5.0
5.0 - 13.1
13.1 - 34.1
34.1 - 88.3
88.3 - 228.66
-200m depth


Washington
Oregon
California
Thysanoessa spinifera
1998-2006
Prediction Map
Biomass mgC/m3
Filled Contours
0 - 0.02
0.02 - 0.09
0.09 - 0.2
0.2 - 0.7
0.7 - 1.9
1.9 - 5
5 - 13.1
13.1 - 34.1
34.1 - 88.3
88.3 - 228.66
-200m depth


Washington
Oregon
California
Legend
1998 Epac
Biomass mg C/m³


Washington
Oregon
California
Legend
1999 Epac
Biomass mg C/m³


Washington
Oregon
California
Legend
2000 Epac
Biomass mg C/m³


Washington
Oregon
California
Legend
2001 Epac
Biomass mg C/m³


Washington
Oregon
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2002 Epac
Biomass mg C/m³


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Washington
Oregon
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2004 Epac
Biomass mgC/m³


Washington
Oregon
California
Legend
2005 Epac
Biomass mgC/m³


Washington
Oregon
California
Legend
2006 Epac
Biomass mgC/m³

Yearly Biomass using just April – Aug.