Spatial Overlap and Trophic Interactions Between Fish and Large Jellyfish in the Northern California Current

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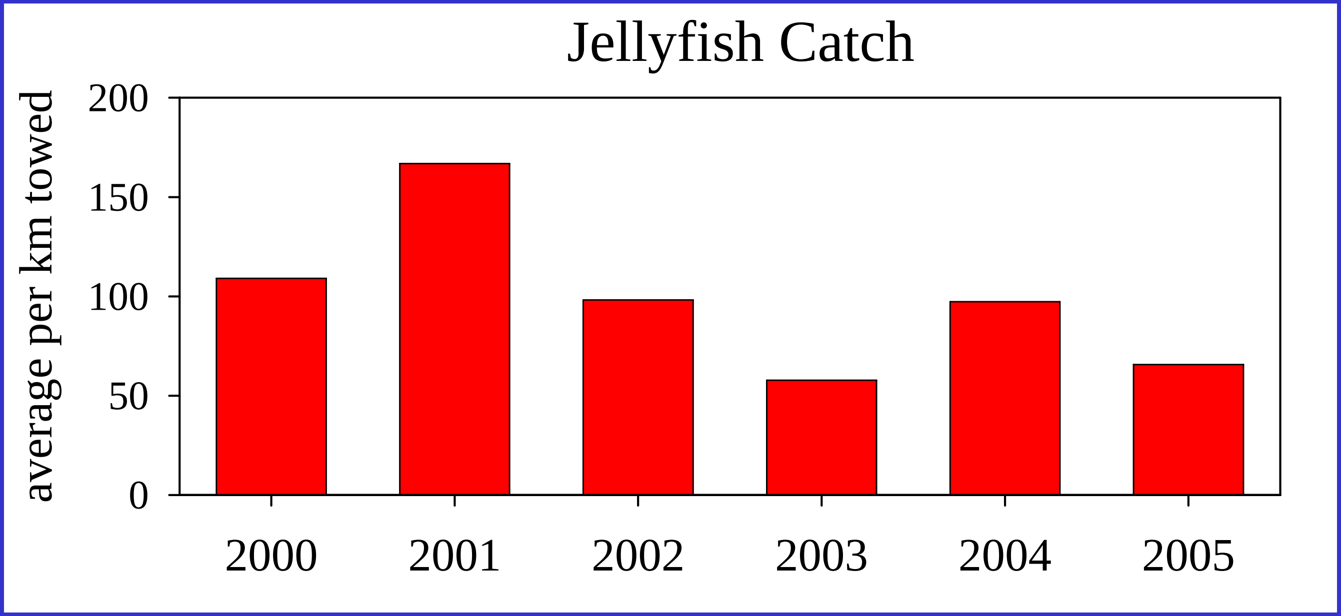
Why Do We Care about Jellyfish in the Northern California Current?

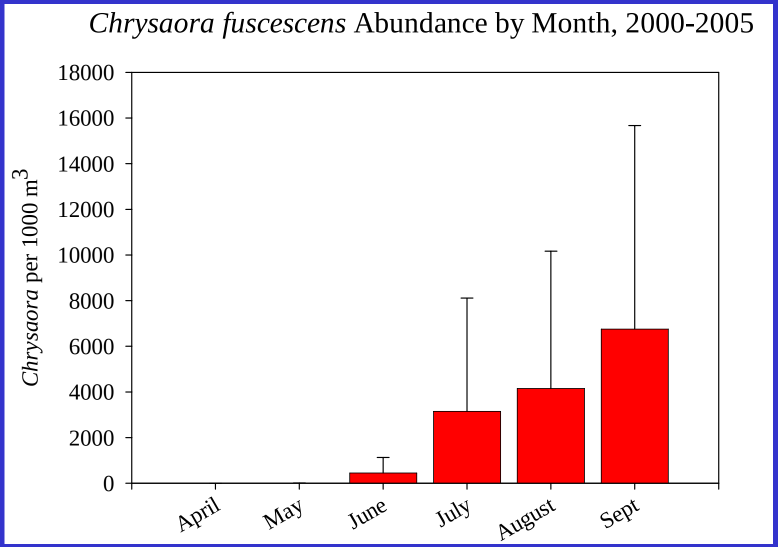
- Jellyfish can undergo dramatic changes in biomass between years



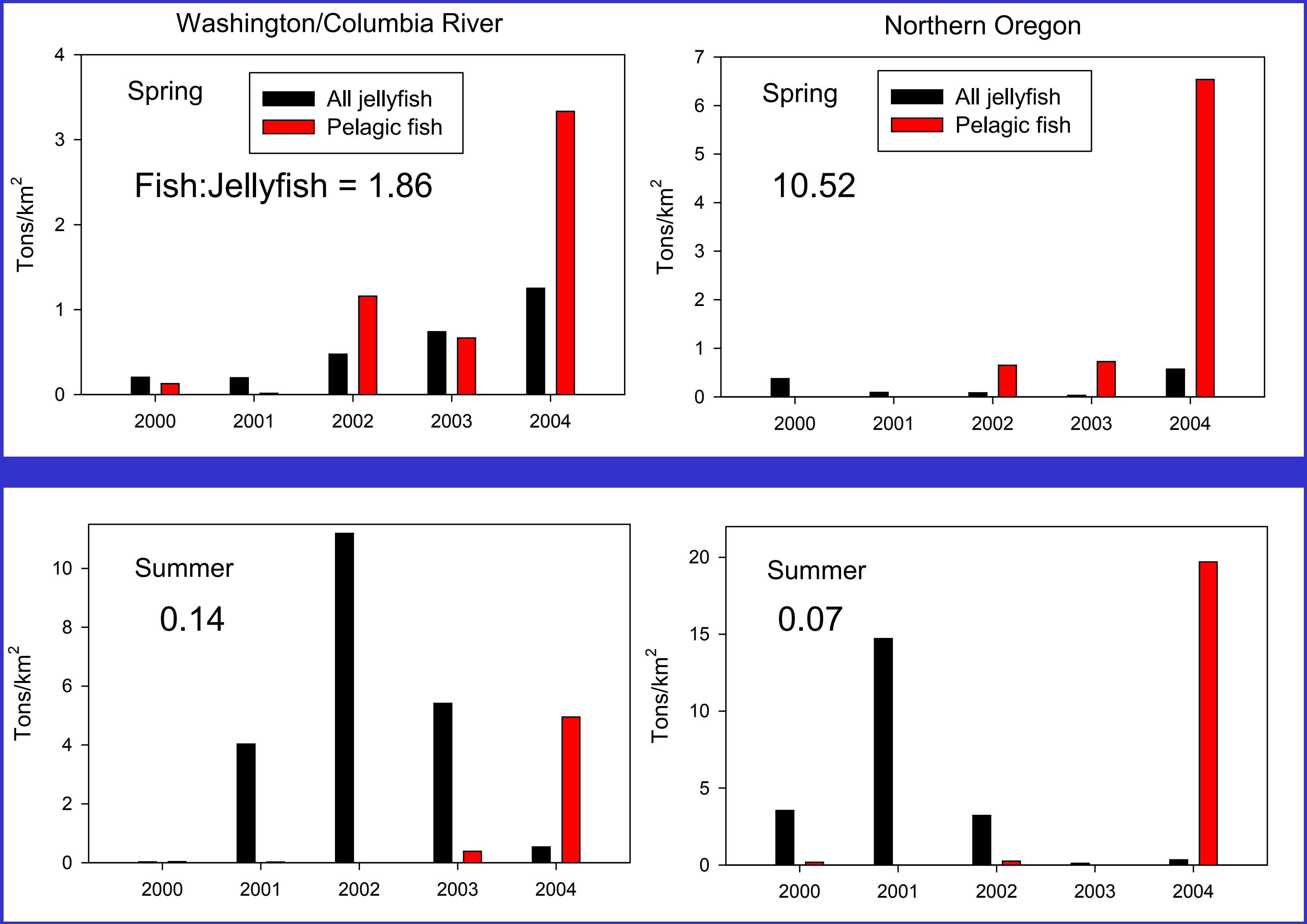
Why Do We Care about Jellyfish in the Northern California Current?

- Jellyfish can undergo dramatic changes in biomass between years

- **Jellyfish substantially increase in biomass during the course of the production season**



Biomass of Pelagic Fish vs. Jellyfish



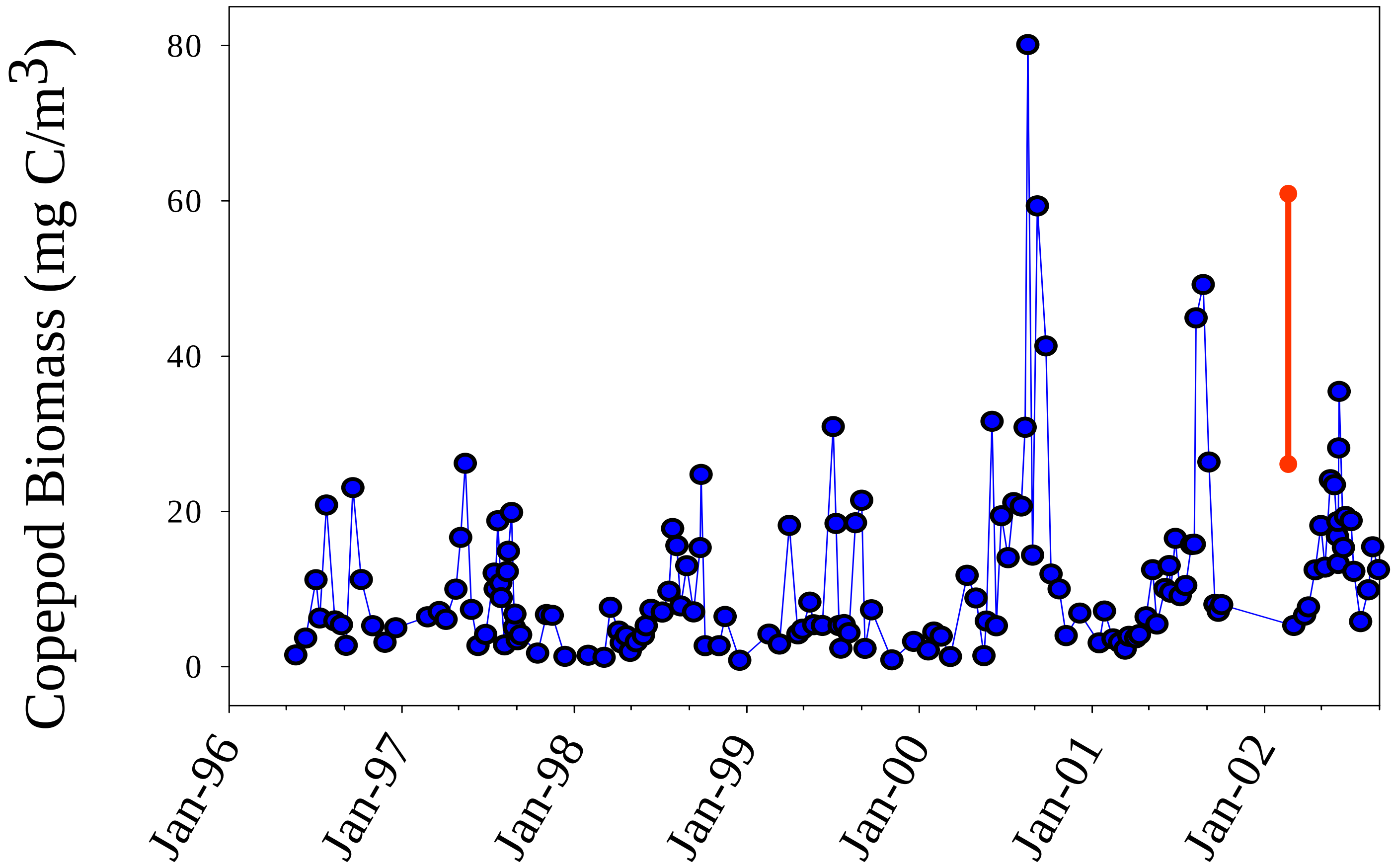
Why Do We Care about Jellyfish in the Northern California Current?

GLOBEC NEP CC cruises

Large pelagic trawls to sample fish

	Ave F.O. (%)	Ave #	max biomass
Aequorea spp.	63	5397	
A. labiata	44	1532	26 mg C m^{-3}
C. fuscescens	52	10,297	65 mg C m^{-3}
P. camtschatica	24	379	

Copepods at Station NH-5



Data courtesy of Bill Peterson (NWFSC)

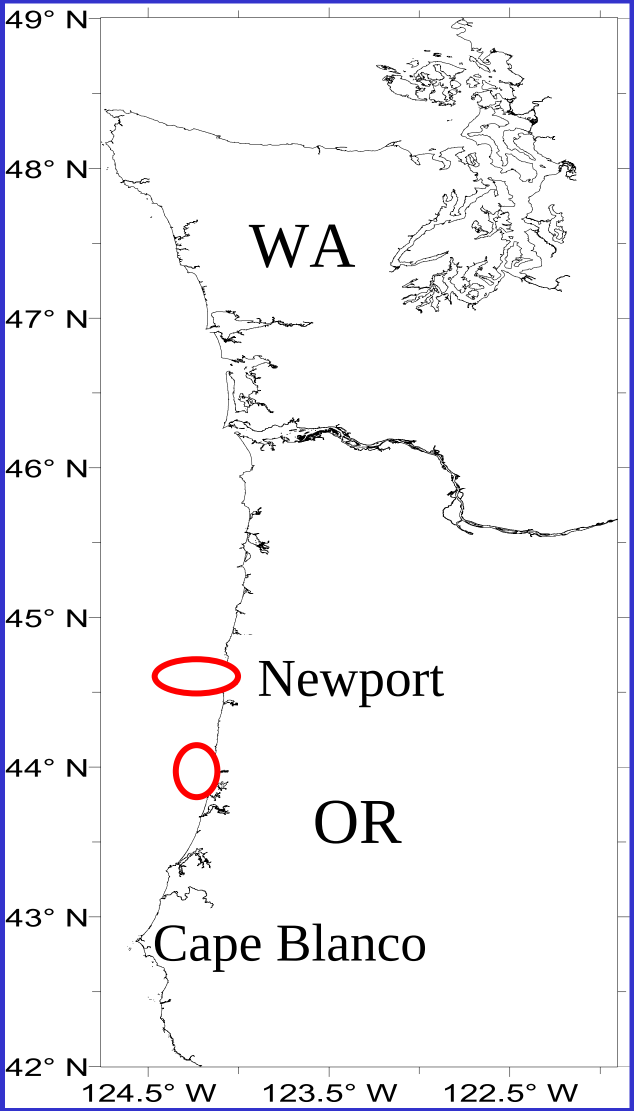
Interaction with Fish?

Total number caught in August 2002	
Large Medusae:	17,937
Pacific herring, sardine, anchovies:	9,997
Other bony fish (34 species):	1,923

Impact of Jellyfish Blooms on Pelagic Fishes

1. Do pelagic fish and jellies have similar diets?
2. Do they overlap in distribution?
3. What are the implications of this overlap for the ecosystem?

Feeding Ecology



8 stations,
July-Sept.
2003

What do they eat?

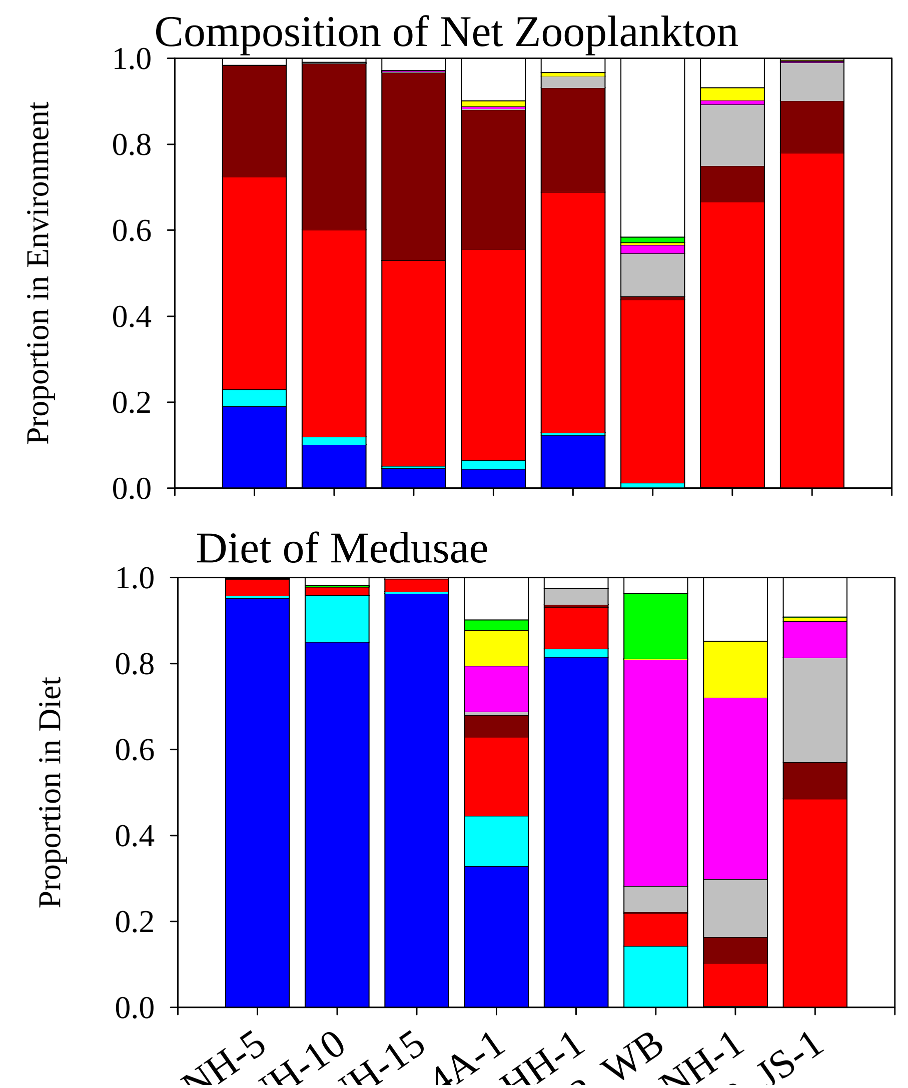
Net: copepods

Diet: euphausiid eggs, gelatinous taxa

- euphausiid eggs
- euphausiid naups-calypt
- calanoid copepods
- cyclopoid copepods
- molluscs
- gelatinous zooplankton
- polychaetes
- cladocerans
- other

$N_{medusae}=30$

$N_{prey}=30{,}830$

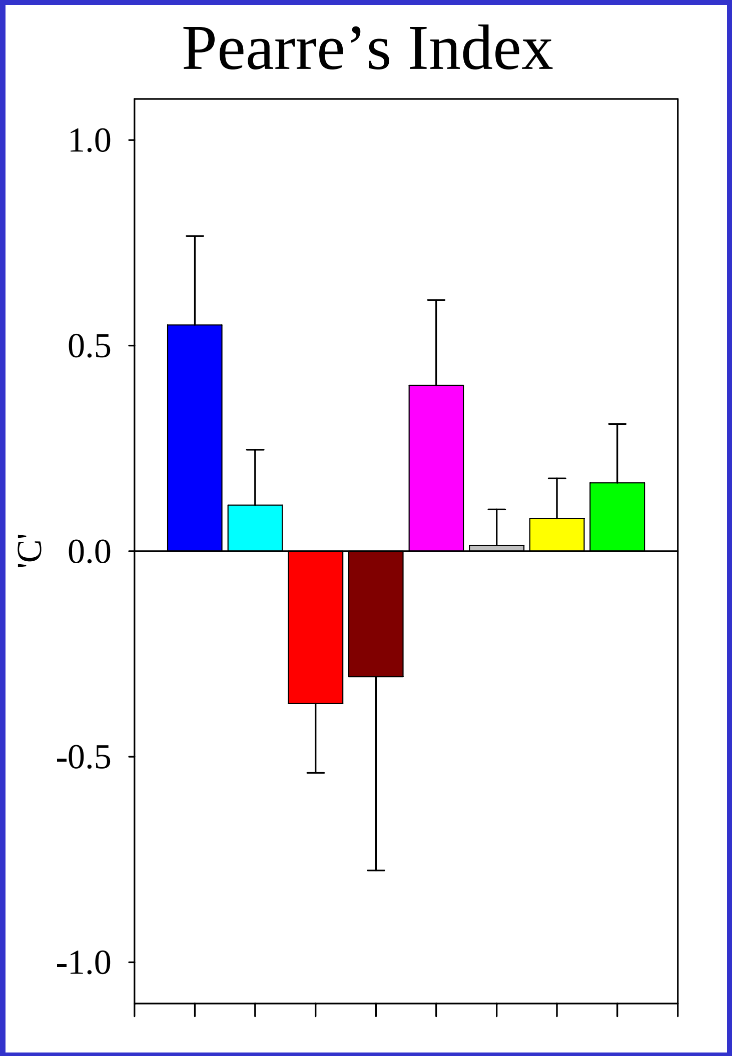


Prey selection by *Chrysaora fuscescens*

+1 = strongest selection for

0 = not significant ($p>0.05$)

-1 = strongest selection against



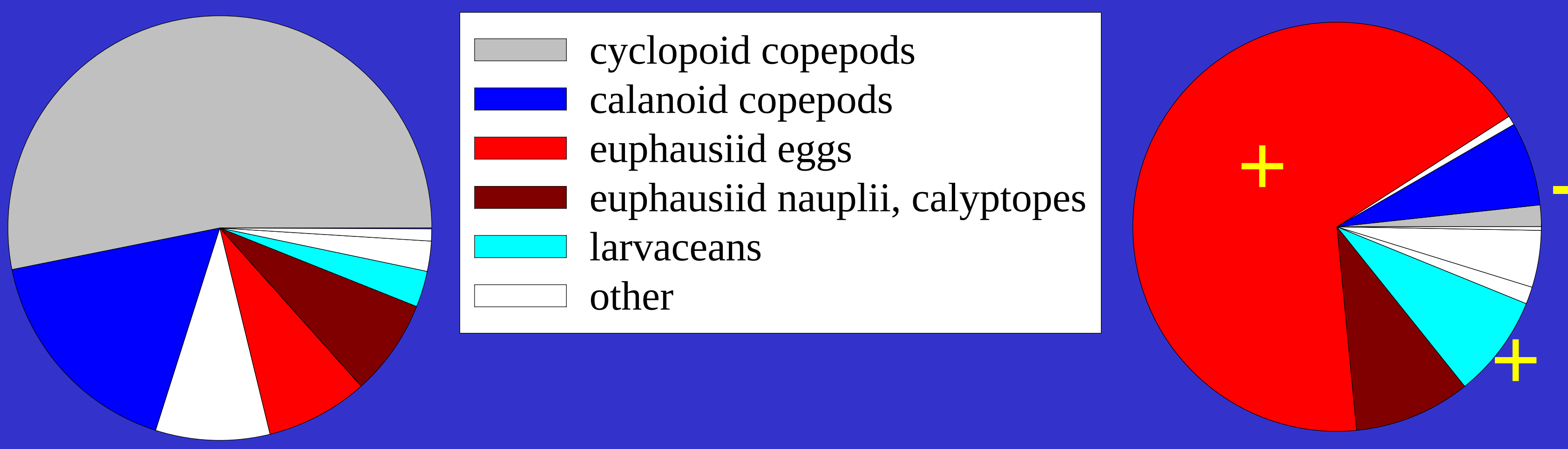
Prey Behavior?
Copepods have fast escape responses

(Suchman et al. In revision, MEPS)

Aurelia labiata Feeding Patterns

Available Zooplankton

Ingested Prey

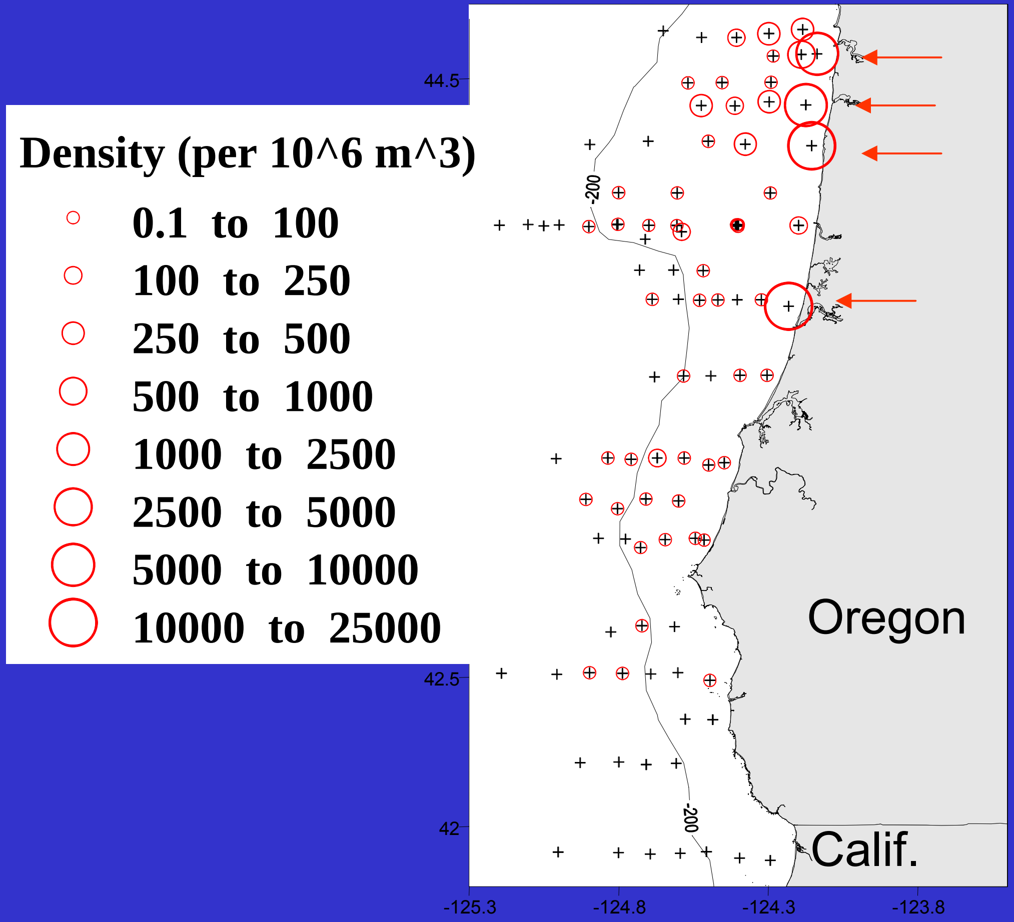


1085 ± 151 m^{-3}

8724 ± 6267 day^{-1}

Chrysaora fuscescens August 2002

Northern Inshore Region

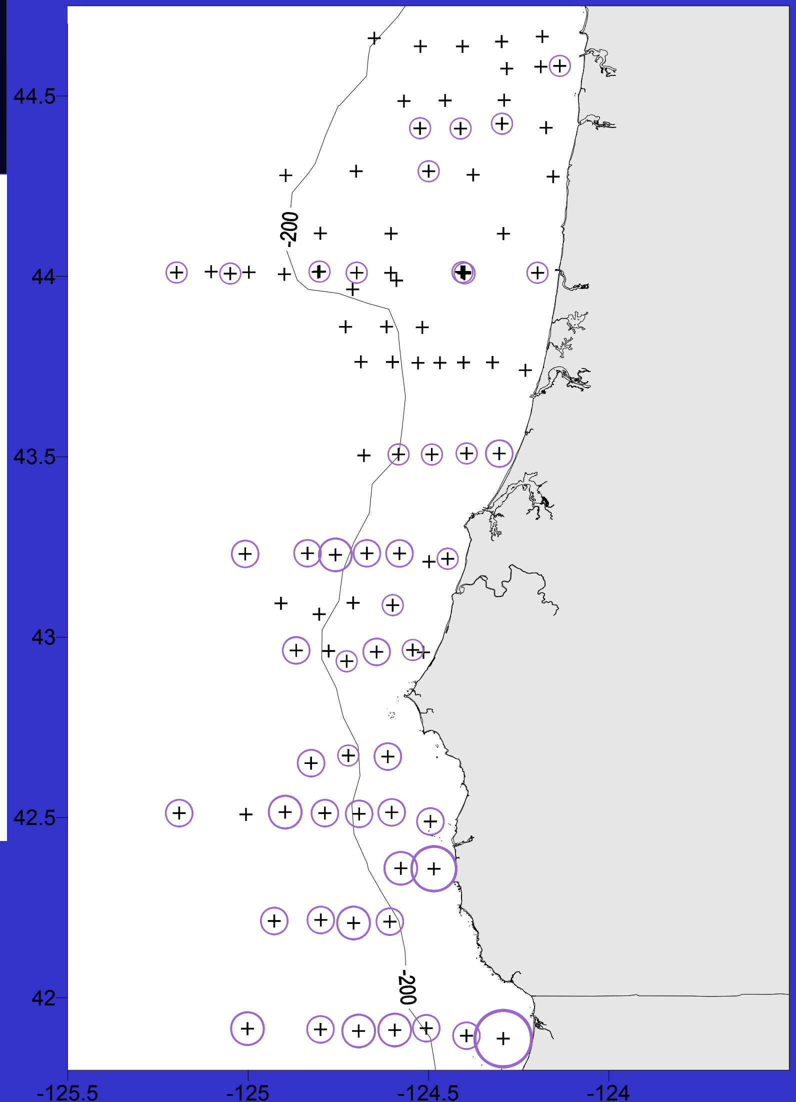


(Suchman and Brodeur, 2005, DSR)

Aurelia labiata Collections, Aug 2002

Density (per 1000 m3)

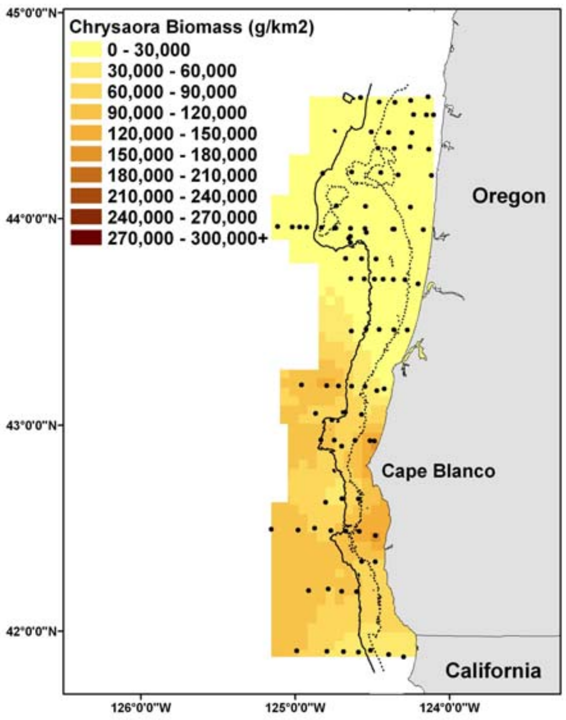
- 1E-005 to 0.001
- 0.001 to 0.01
- 0.01 to 0.1
- 0.1 to 0.5
- 0.5 to 1
- 1 to 5
- 5 to 10
- 10 to 100

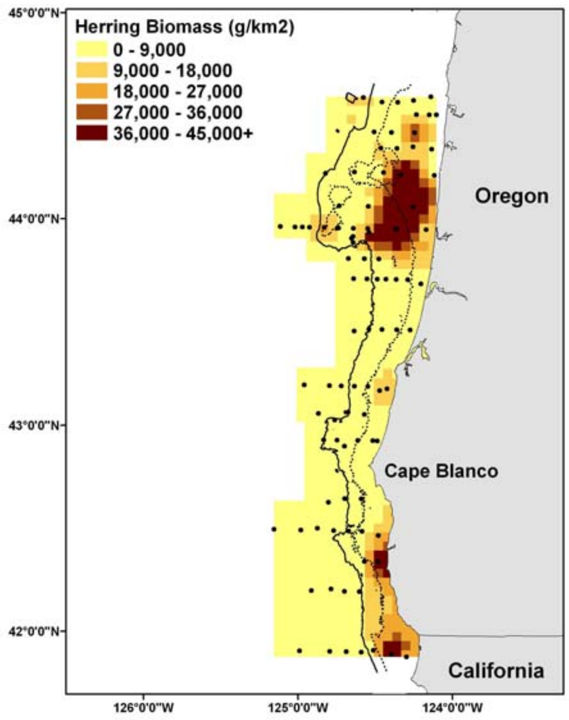


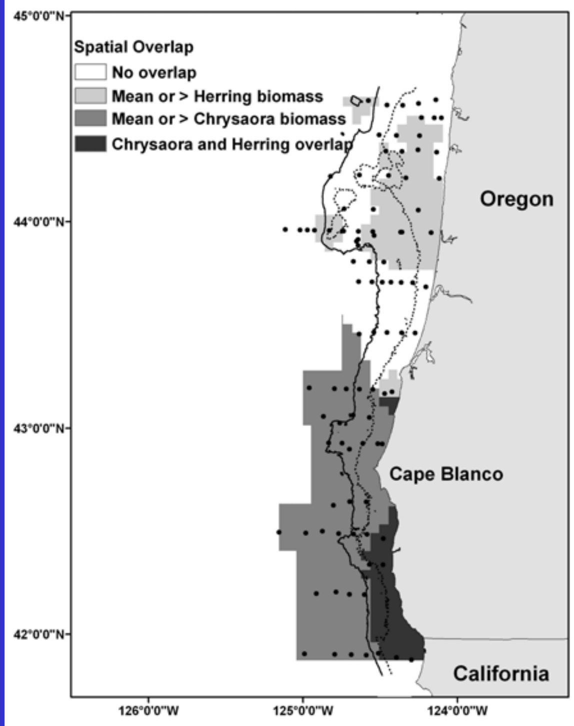
Southern Across shelf break

(Suchman and Brodeur, 2005, DSR)

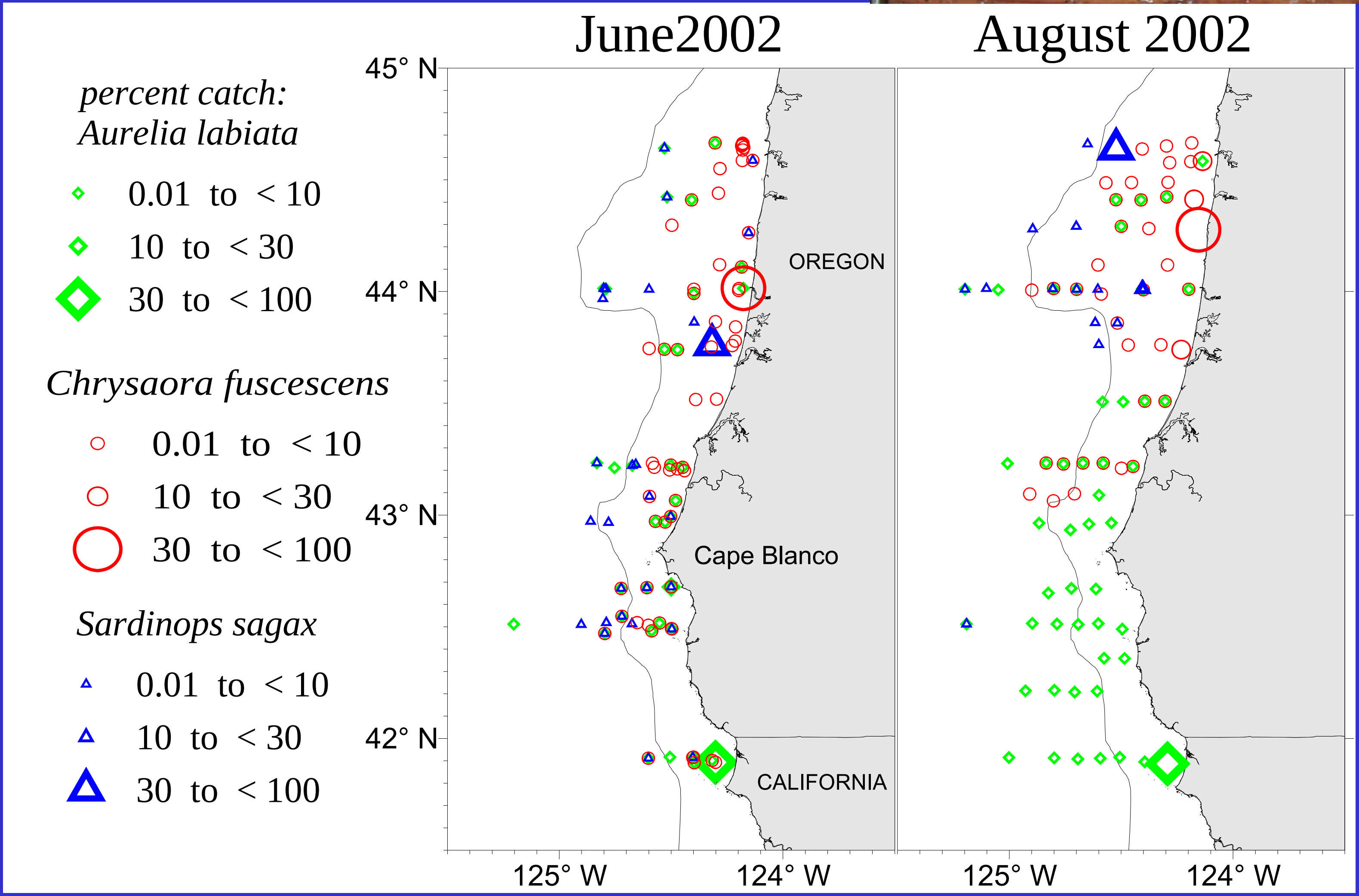
Estimation of Spatial Overlap





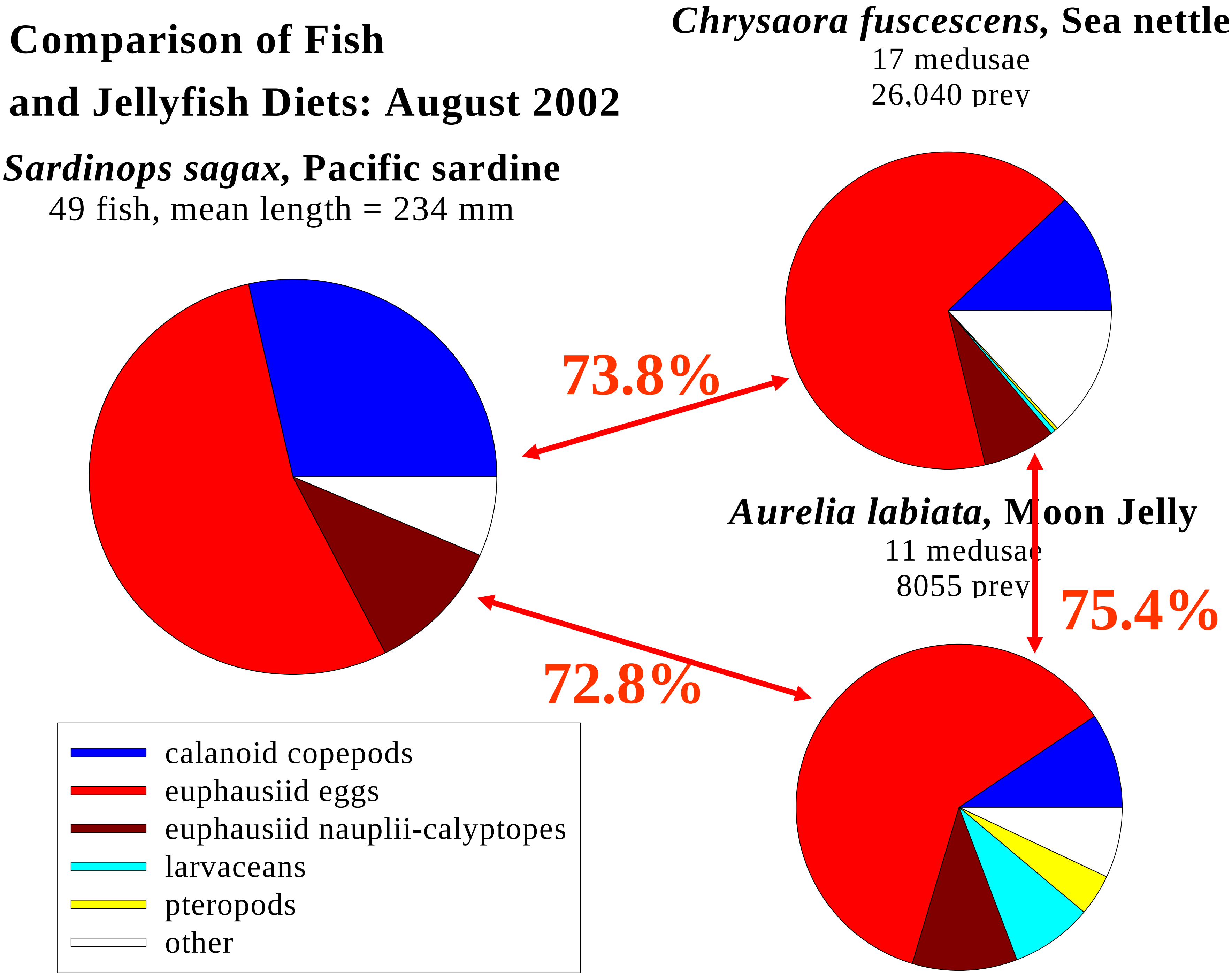


Spatial Overlap with Sardines



	June 2002	August 2002
sardines vs *Chrysaora:*	27	< 1
sardines vs. *Aurelia*:	< 1	< 1

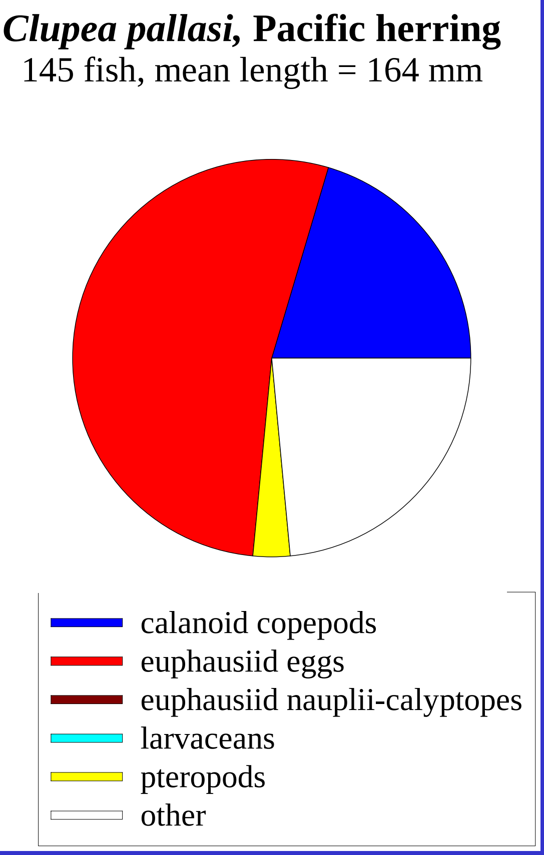
Comparison of Fish and Jellyfish Diets: August 2002

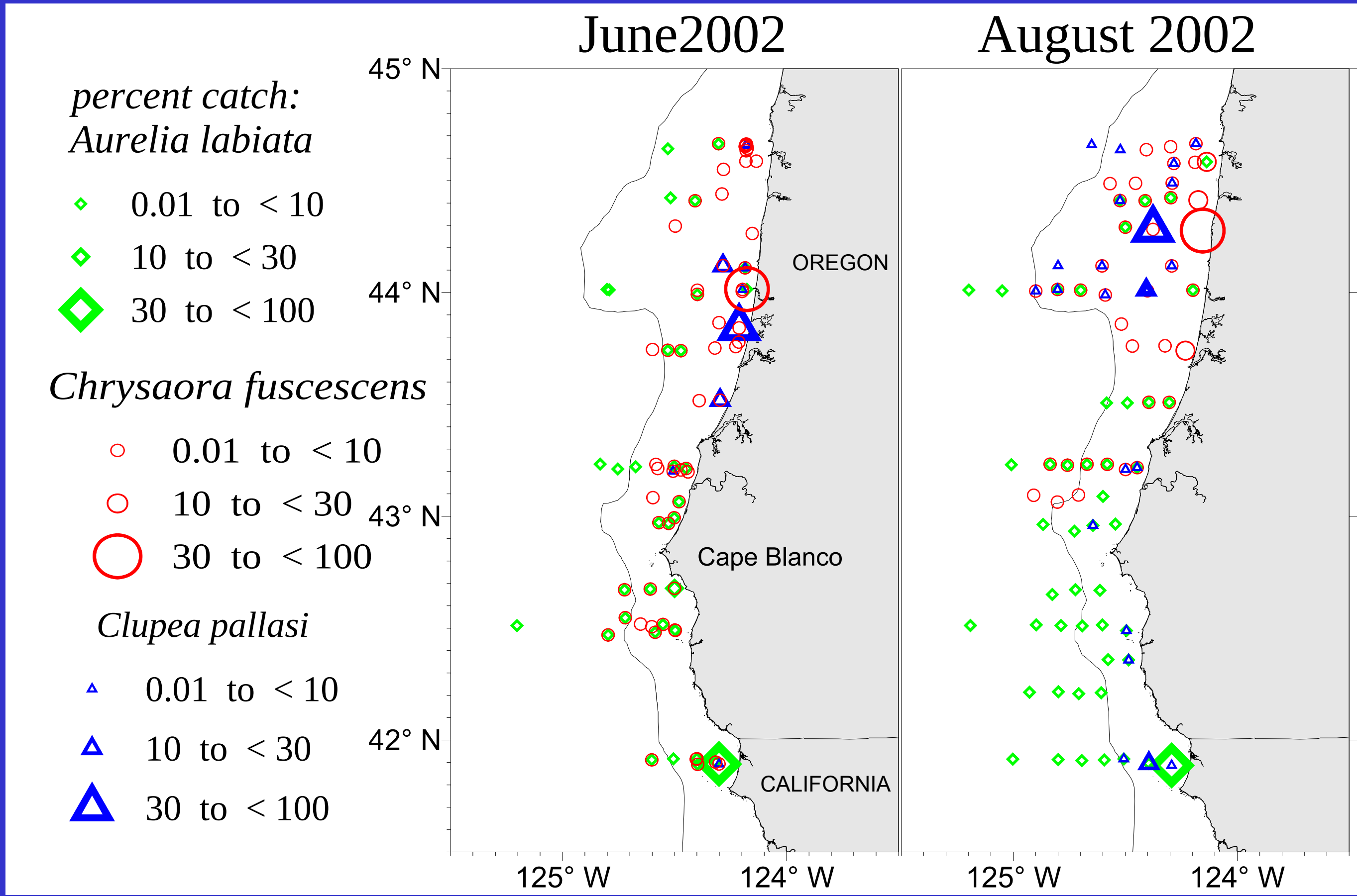


Overlap with Pacific Herring

Diet Overlap with *C. fuscescens*: 59.6%

A. labiata: 62.4%



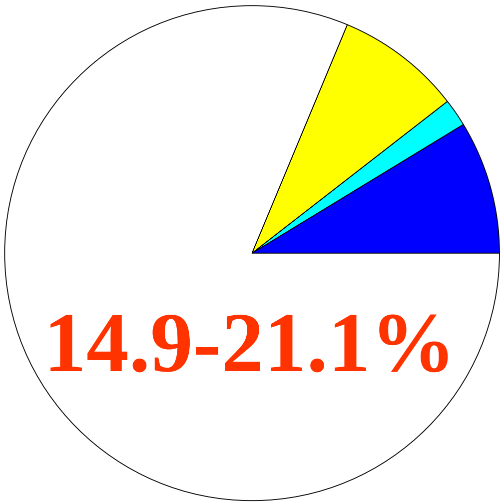


Spatial Overlap with	June 2002	August 2002
C. fuscescens:	5.4%	42.1%
A. labiata:	1.7%	38.0%

Other Fish Diets: August 2002

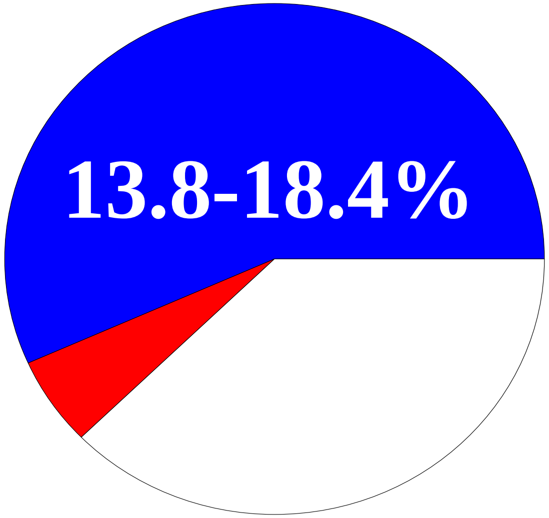
***Hypomesus pretiosus*, Surf smelt**

59 fish, mean length = 168 mm



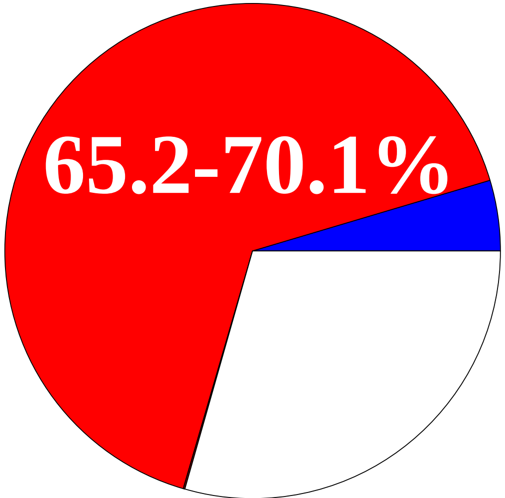
***Allosmerus elongatus*, Whitebait smelt**

41 fish; mean length = 117 mm



***Engraulis mordax*, Anchovy**

63 fish; mean length = 150 mm

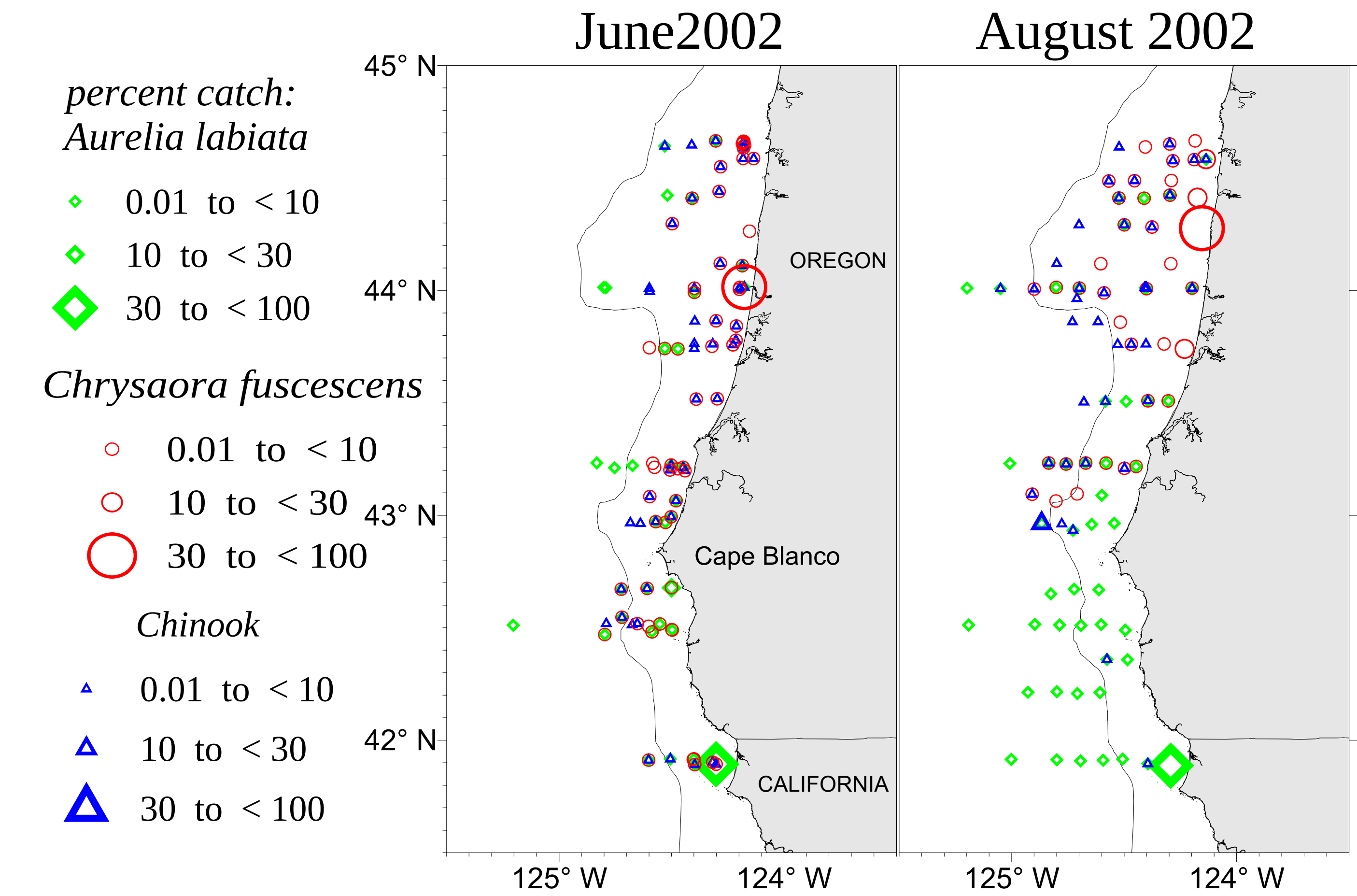


- calanoid copepods
- euphausiid eggs
- euphausiid nauplii-calyptopes
- larvaceans
- pteropods
- other

Overlap with Chinook Salmon

Spatial overlap with *C. fuscescens*: 23 31.0%

A. labiata: 15 8.6%



Chinook diets:

euphausiids, fish, hyperiid amphipods, decapod larvae

Diet Overlap = 0.2-2.3%

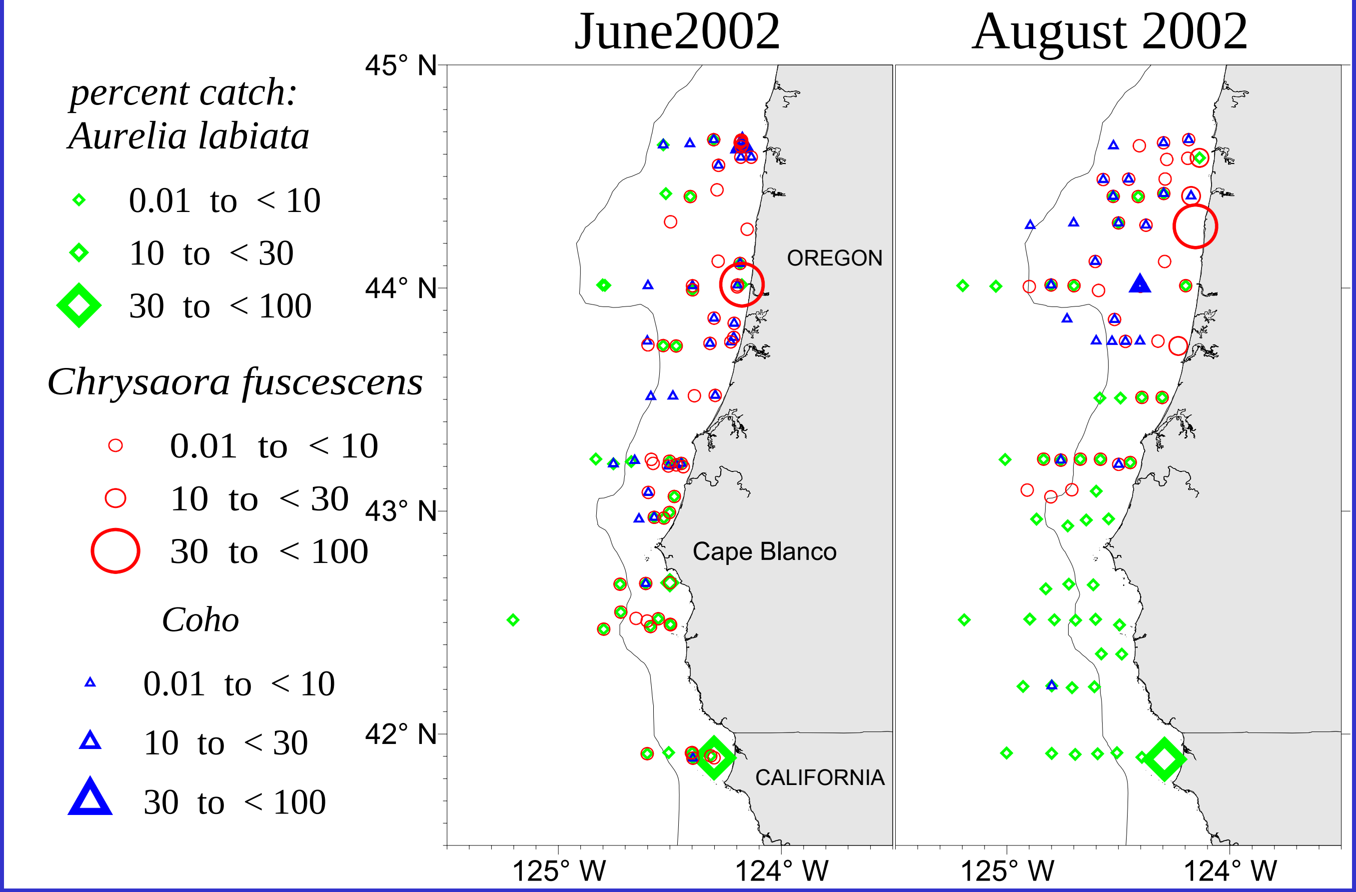
Overlap with Coho Salmon

Spatial overlap with *C. fuscescens*: 17 10.1%

A. labiata: 6 8.5%

<u>Coho diets:</u>
euphausiids, fish, hyperiid amphipods, decapod larvae

Diet Overlap = 0.2-0.3%



Diet Overlap of Nekton with Jellyfish

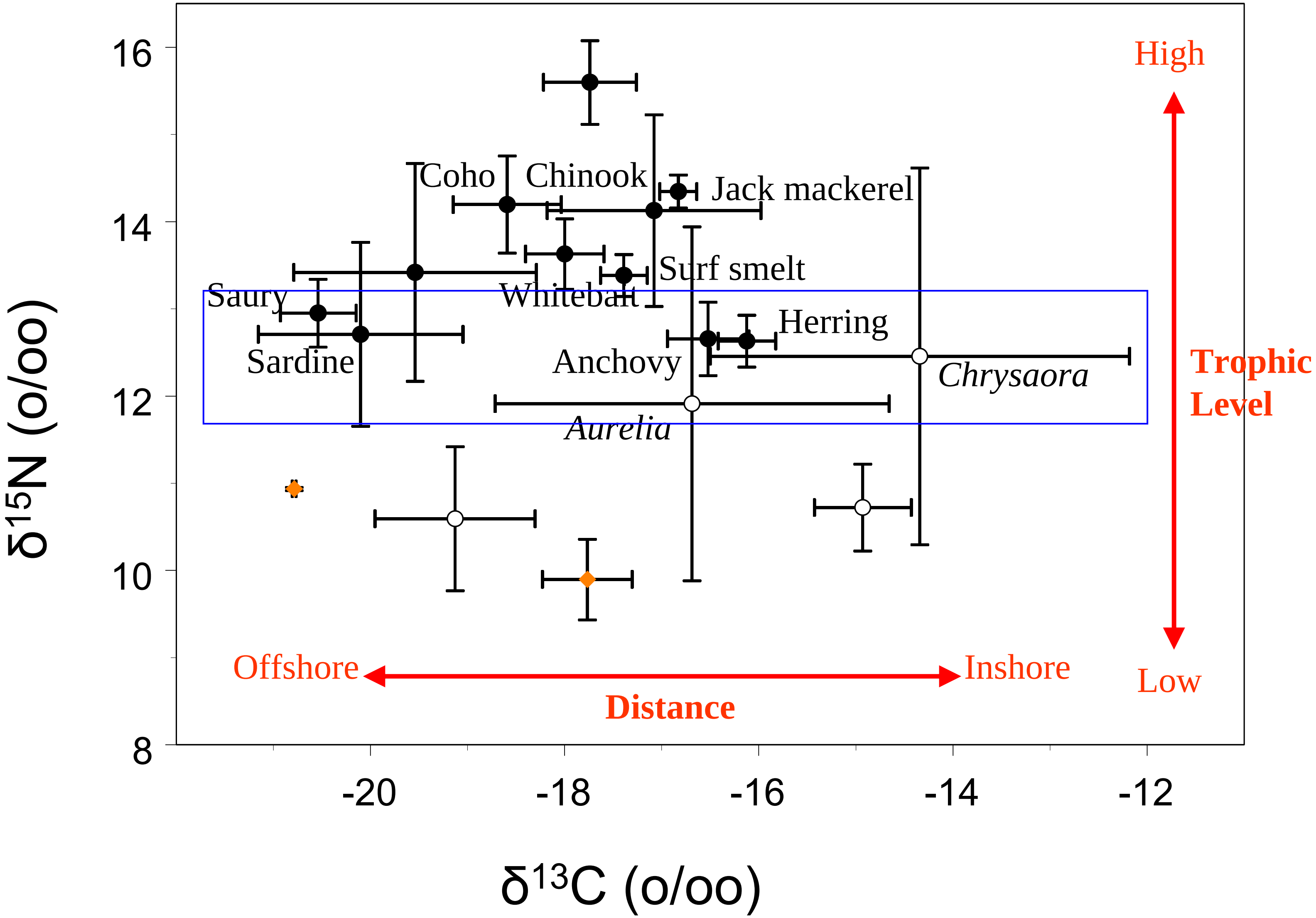
NEKTON	*Chrysaora*	*Aurelia*
Subyearling Chinook salmon	2.2%	2.3%
Yearling Chinook salmon	0.2%	0.3%
Sub-adult Chinook salmon	0.2%	0.3%
Yearling Coho salmon	0.2%	0.3%
Jack mackerel	0.2%	0.3%
Whitebait smelt	21.1%	14.9%
Surf smelt	13.8%	18.4%
Pacific herring	59.6%	62.4%
Pacific saury	67.0%	61.6%
Northern anchovy	70.1%	65.2%
Pacific sardine	73.8%	72.8%

Overlaps > 60% = Significant

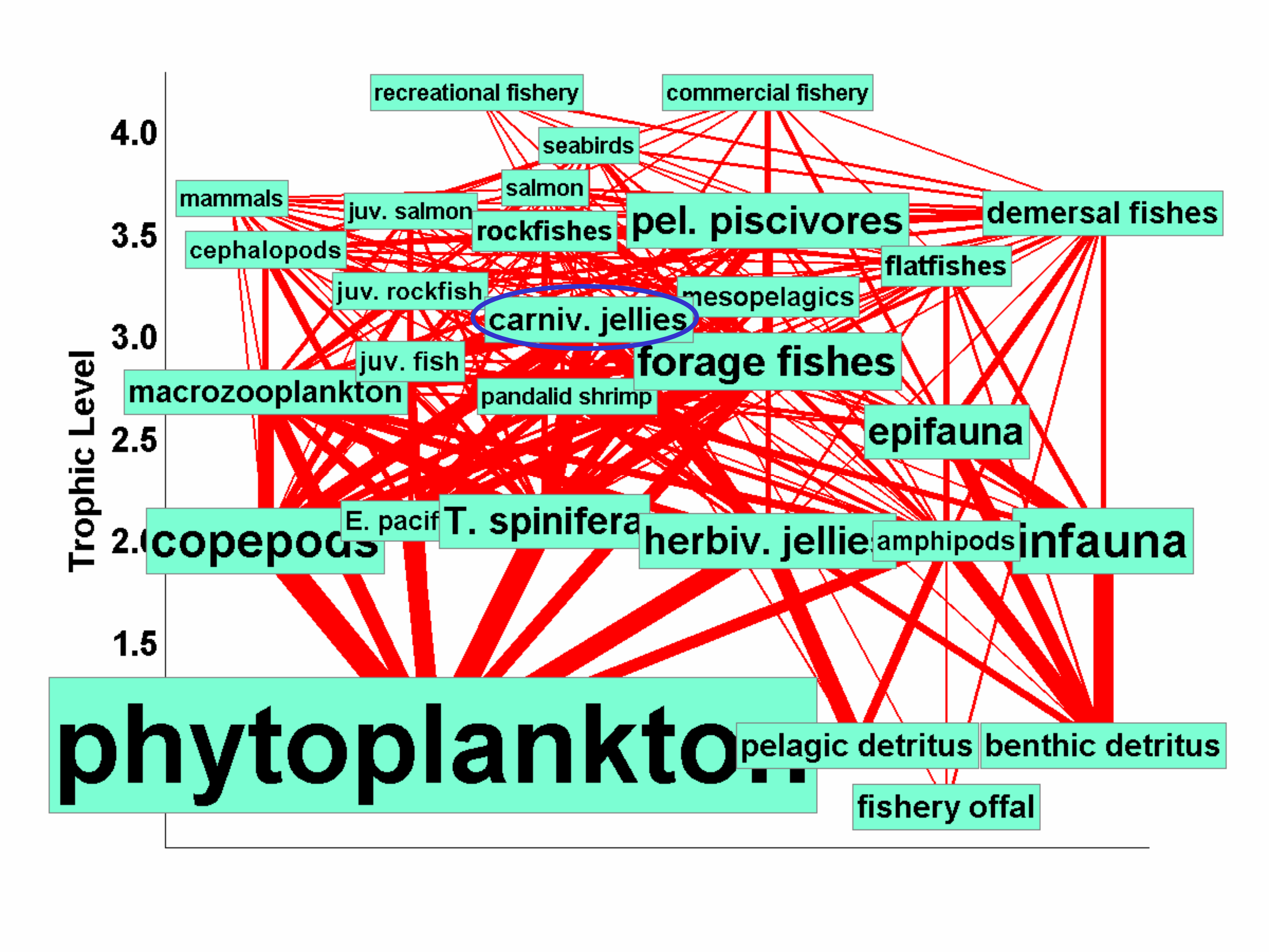
Spatial Overlap of Nekton with Jellyfish

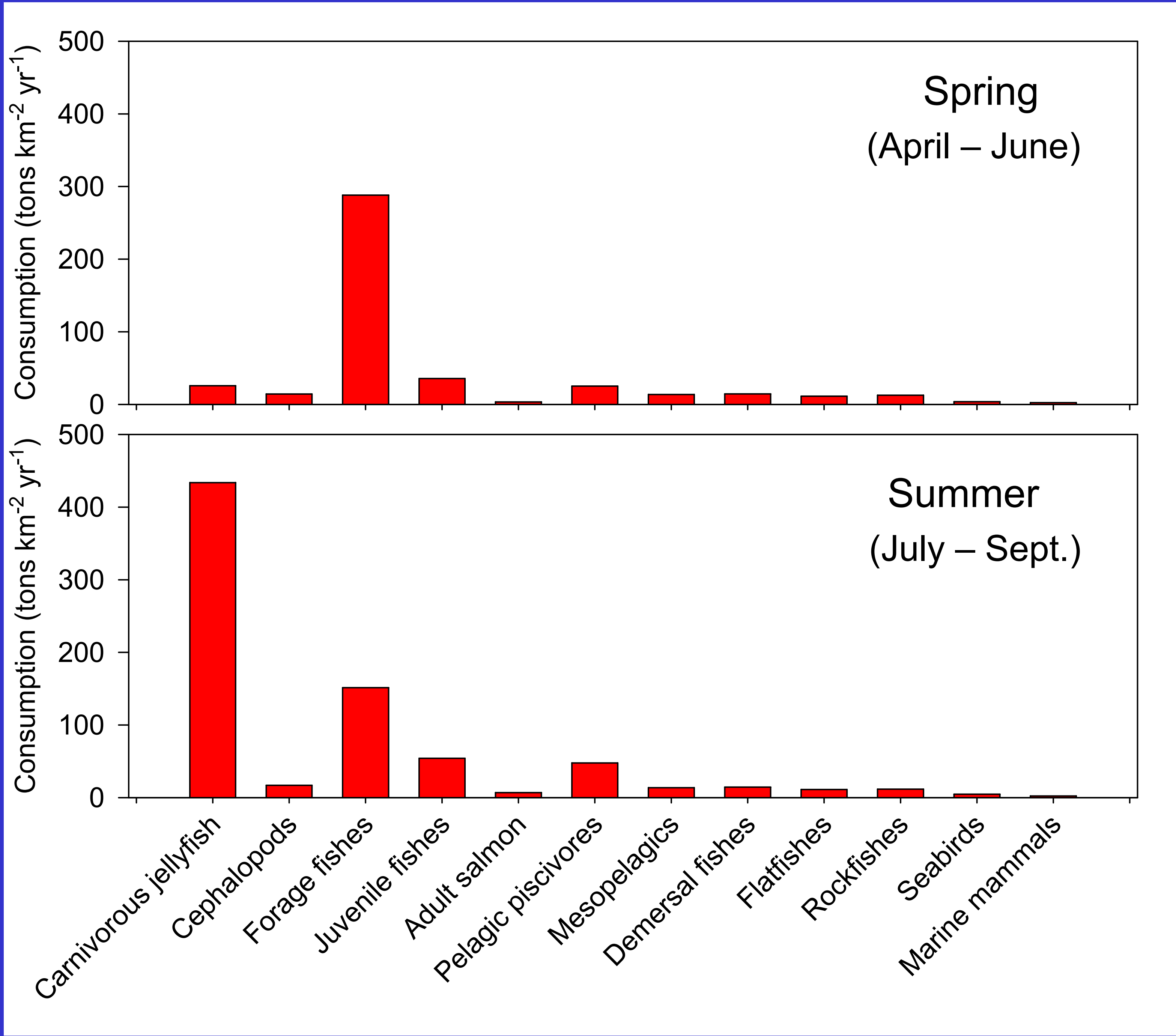
NEKTON	*Chrysaora fuscescens*	*Aurelia labiata*
Adult Chinook salmon	31.0%	8.6%
Juvenile Chinook salmon	23.1%	15.1%
Adult Coho salmon	6.0%	7.0%
Juvenile Coho salmon	10.1%	8.5%
Jack mackerel	0.7%	2.8%
Whitebait smelt	0%	0%
Surf smelt	0%	0%
Pacific herring	42.1%	38.0%
Pacific saury	28.6%	14.3%
Northern anchovy	5.3%	4.2%
Pacific sardine	0%	0%

August 2002 – Nekton and Jellyfishes

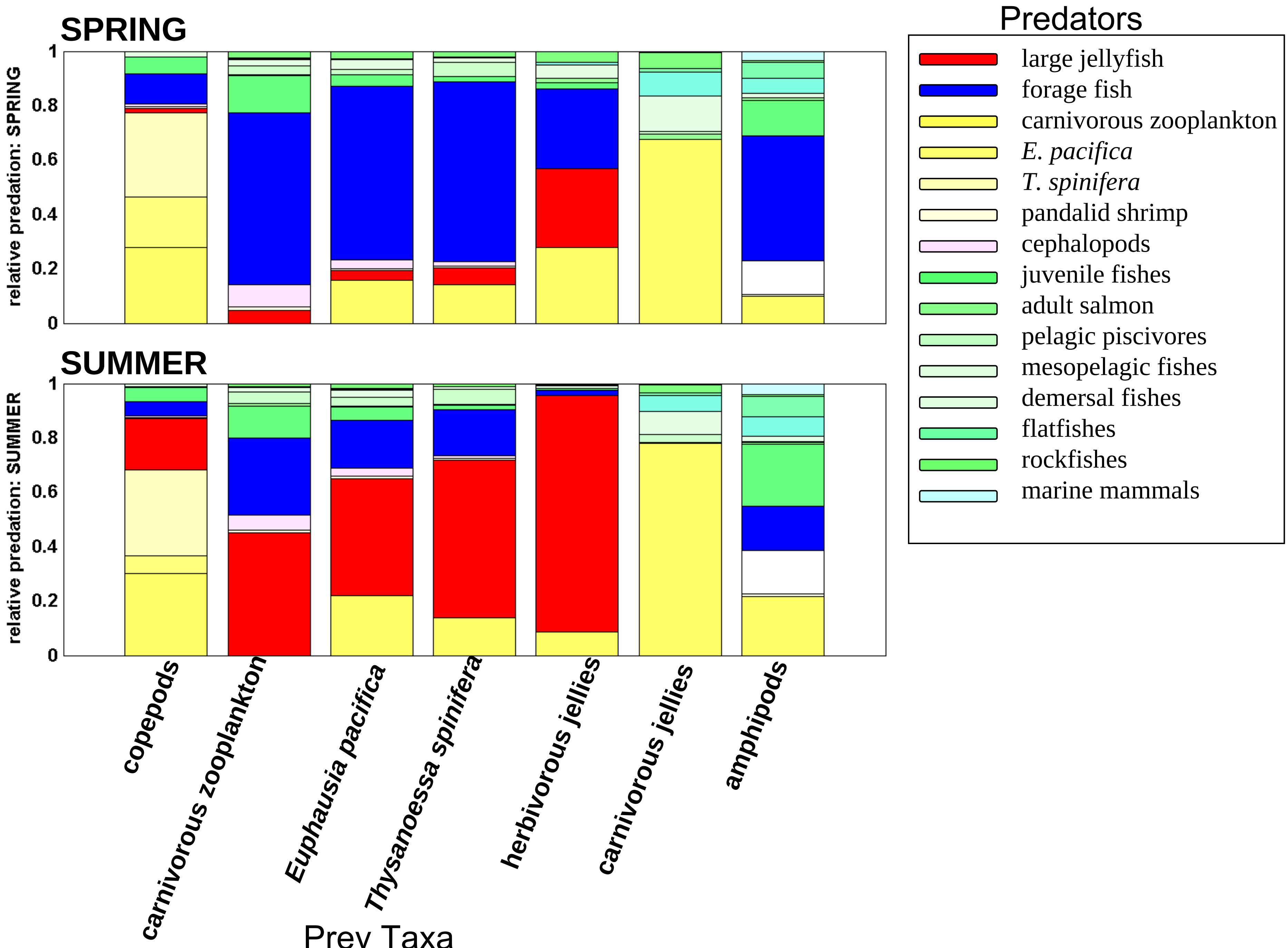


ECOPATH Ecosystem Model (see Ruzicka et al. poster)





Spring
(April – June)
Summer
(July – Sept.)
Consumption (tons km^{-2} yr^{-1})
0
100
200
300
400
500
Carnivorous jellyfish
Cephalopods
Forage fishes
Juvenile fishes
Adult salmon
Pelagic piscivores
Mesopelagics
Demersal fishes
Flatfishes
Rockfishes
Seabirds
Marine mammals



SPRING
SUMMER
relative predation: SPRING
relative predation: SUMMER
0
0.2
0.4
0.6
0.8
1
Predators
large jellyfish
forage fish
carnivorous zooplankton
E. pacifica
T. spinifera
pandalid shrimp
cephalopods
juvenile fishes
adult salmon
pelagic piscivores
mesopelagic fishes
demersal fishes
flatfishes
rockfishes
marine mammals
copepods
carnivorous zooplankton
Euphausia pacifica
Thysanoessa spinifera
herbivorous jellies
carnivorous jellies
amphipods
Prey Taxa

Conclusions

- jellyfish positively select for early stages of euphausiids, gelatinous taxa (against copepods)

- jellyfish show high dietary overlap with herring, saury, anchovies and sardines and low overlap with other species

- jellyfish show high spatial overlap with herring, saury and salmon

Acknowledgments

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