Dietary & spatial overlap among jellyfish & small pelagic fish in the eastern Bering Sea

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Background

- Jellyfish feed mainly on zooplankton & ichthyoplankton, making them possible competitors of forage fishes (**Fig. 1**).
- Fishery surveys show fluctuations of jellyfish biomass over 4 decades (**Fig. 2**).
- These changes have been related to variability in climate and prey resources.
- An understanding of jellyfish trophic roles is required for fishery and ecosystem management.
- Measurements of jellyfish trophic impacts on pelagic fishes is lacking in this system.

Objective

To examine the role of jellyfish as fish competitors by estimating dietary & spatial overlap with pelagic planktivorous fish, including salmon, during years of high and low jellyfish abundance. Also, to measure overlap among planktivorous fishes to address potential competition.

Methods

Diet Collection

- Sea nettles were dip netted from surface in late summer
  - n=41 from 9 stations in 2014, and n=64 from 11 stations in 2016.
- Small pelagic fish were collected from surface trawls where they co-occurred with sea nettles.
- Up to 10 fish stomachs were combined at each station (**Tables 1 & 2**).

Data Analysis

- Used PRIMER to run ANOSIM and nMDS
- Calculated % similarity index for diet and spatial overlap

Results

- Sea nettle biomass was 6x higher in 2014 than in 2016 (**Fig. 2**)
- SST was 3°C warmer in 2016 than in 2014
- Jellyfish diets were more diverse (**Fig. 3**) and occupied a unique 2D space, mainly due to consumption of gastropods (**Figs. 4 & 5**)
- Jellyfish diets had low overlaps with small pelagic fishes (**Tables 1 & 2**), which ate mainly euphausiids and small fishes (**Fig. 3**).
- Sea nettles and small pelagic fishes had low spatial overlap, but there were some high spatial overlaps among the small pelagic fishes and salmonids (**Tables 1 & 2**).

Conclusions

- Spatial and trophic overlaps among jellyfish and fish are generally low but not uniform throughout the EBS nor across years.
- However, regions of high overlap do occur, which could result in resource competition among fish in low food availability years or areas.

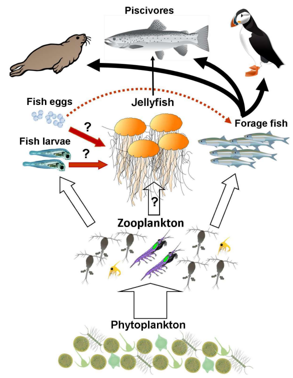


Fig. 1: Food web relationships showing alternative pathways through jellyfish and forage fishes in the Bering Sea

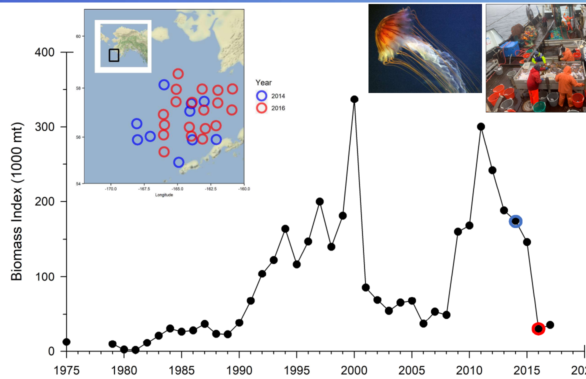
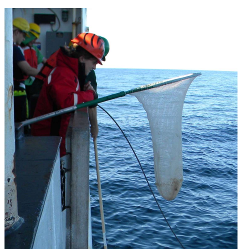


Fig. 2: Jellyfish (mostly *Chrysaora melanaster*) biomass in the Eastern Bering Sea over the last 40 years. Circled points are years of this study. Locations of sampling stations for each year are shown on the map (inset).



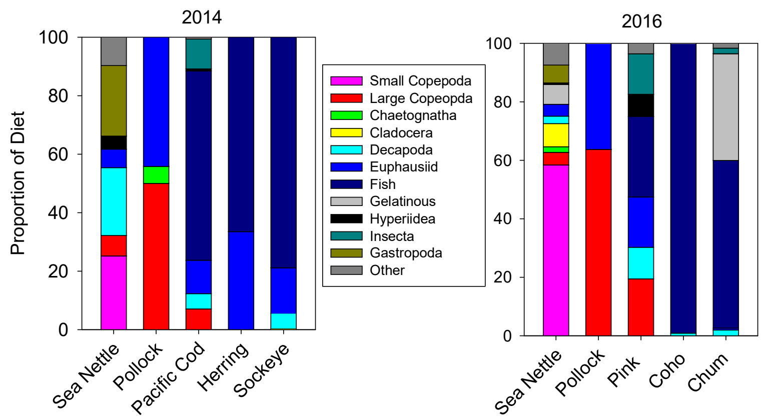


Fig. 3: Percentage of main prey taxa in diets in 2014 (left) and 2016 (right).

Table 1. Dietary (above diagonal) and spatial (below diagonal) overlap between sea nettles (*C. melanaster*) and small pelagic fishes in 2014.

	Sea Nettle	Chum Salmon	Coho Salmon	Pink Salmon	Sockeye Salmon	Pacific Cod	Pacific Herring	Walleye Pollock
Sea Nettle	--	X	X	X	2.4	43.2	>0.1	35.9
Chum Salmon	30.7	--	X	X	X	X	X	X
Coho Salmon	25.1	39.3	--	X	X	X	X	X
Pink Salmon	14.0	17.3	18.9	--	X	X	X	X
Sockeye Salmon	26.6	43.9	10.5	8.3	--	16.4	83.0	22.2
Pacific Cod	36.5	10.3	7.5	6.1	5.6	--	32.5	71.5
Pacific Herring	19.4	21.8	28.3	15.6	4.3	5.8	--	38.2
Walleye Pollock	35.1	26.1	27.9	27.8	11.4	15.1	18.7	--

Table 2. Dietary (above diagonal) and spatial (below diagonal) overlap between sea nettles (*C. melanaster*) and small pelagic fishes in 2016.

	Sea Nettle	Chum Salmon	Coho Salmon	Pink Salmon	Sockeye Salmon	Pacific Cod	Pacific Herring	Walleye Pollock
Sea Nettle	--	1.1	0.0	12.0	2.4	X	X	14.0
Chum Salmon	26.3	--	58.2	33.7	62.5	X	X	1.5
Coho Salmon	42.5	41.9	--	28.4	65.6	X	X	0.9
Pink Salmon	23.4	34.1	31.0	--	62.7	X	X	19.6
Sockeye Salmon	40.3	32.4	45.4	37.1	--	X	X	13.8
Pacific Cod	11.2	21.0	19.2	20.3	20.6	--	X	X
Pacific Herring	30.7	23.2	27.1	10.1	10.3	25.9	--	X
Walleye Pollock	60.0	20.8	40.6	18.3	42.9	9.5	35.5	--

Values are percent overlap calculated using Schoener's Index. Diet pairs highlighted in **red** are not significantly different (p>0.05) based on ANOSIM.

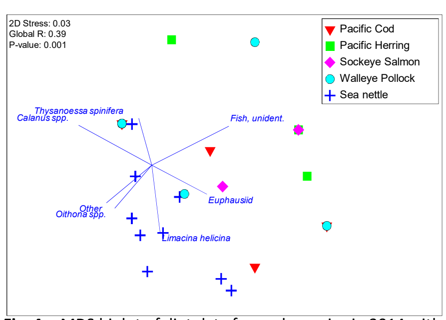


Fig. 4: nMDS biplot of diet data for each species in 2014 with the vectors showing contributions by main prey taxa.

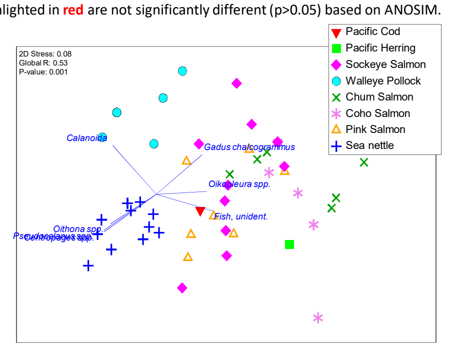


Fig. 5: nMDS biplot of diet data for each species in 2016 with the vectors showing contributions by main prey taxa.

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