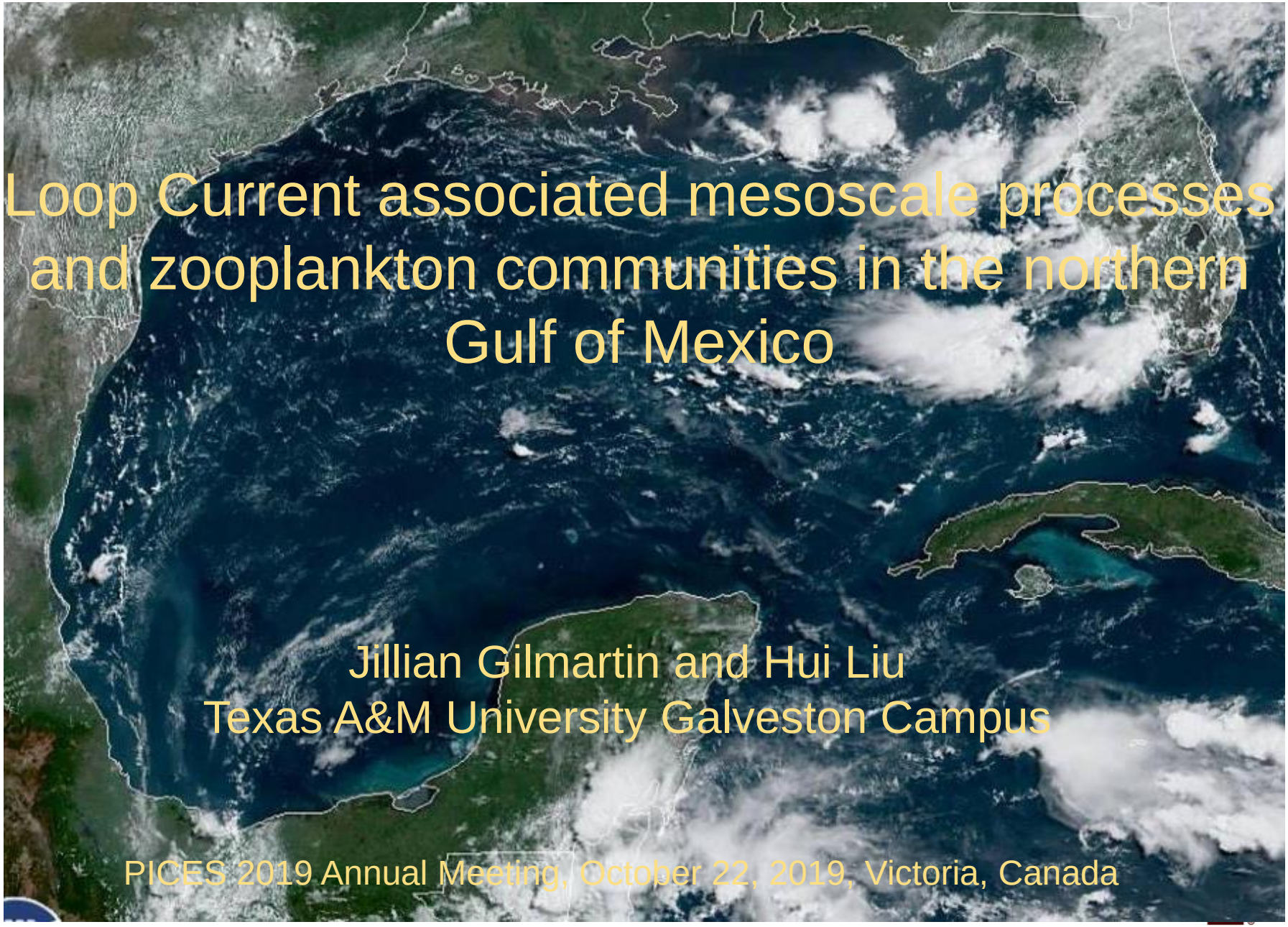

Loop Current associated mesoscale processes and zooplankton communities in the northern Gulf of Mexico

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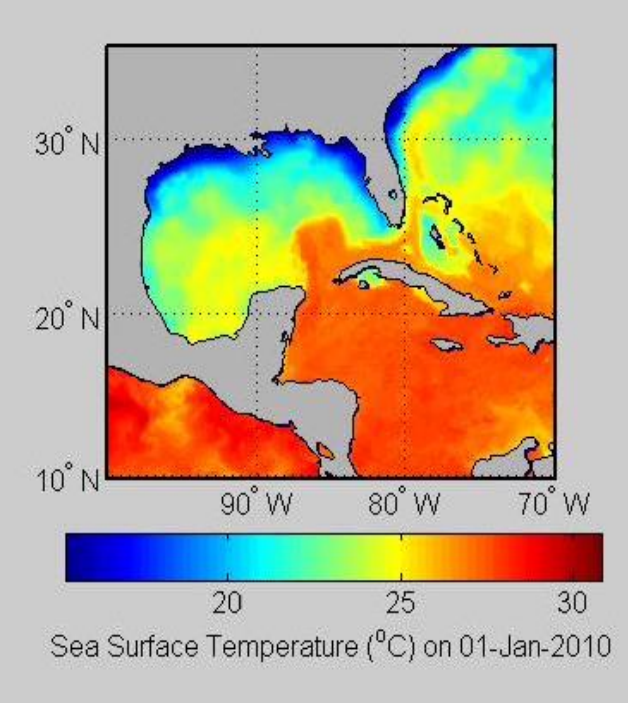
Loop Current and the Gulf of Mexico

- The Loop Current is the primary driving process related to spatial and temporal variations of water properties in the Gulf of Mexico (GoM)
- Northern penetration of the Loop Current is associated with the high abundance of fish larvae in the region (Atichati et al., 2013)
- Influences phytoplankton, zooplankton and ichthyoplankton communities (Biggs and Ressler 2001)
- Most within 25ºN and 27ºN and 86ºW and 88ºW (Hurlburt and Thompson 1982)



Zooplankton Communities

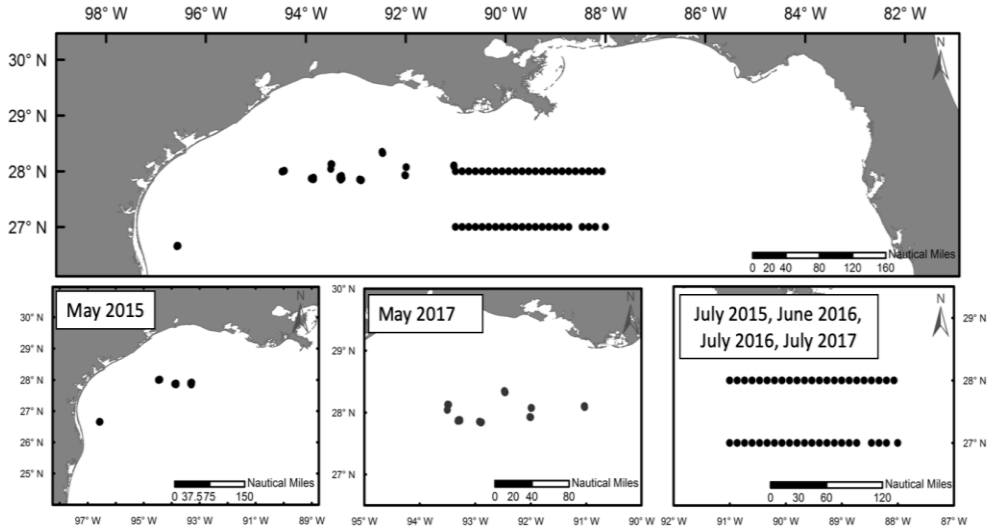
- Zooplankton play a key role in marine ecosystems
- Sensitive to environmental perturbations (Richardson 2008)
- Indicators of climate changes and ocean conditions (Liu et al. 2015)
- Highly relevant to fisheries production (Liu et al. 2014 &2017)

Objectives

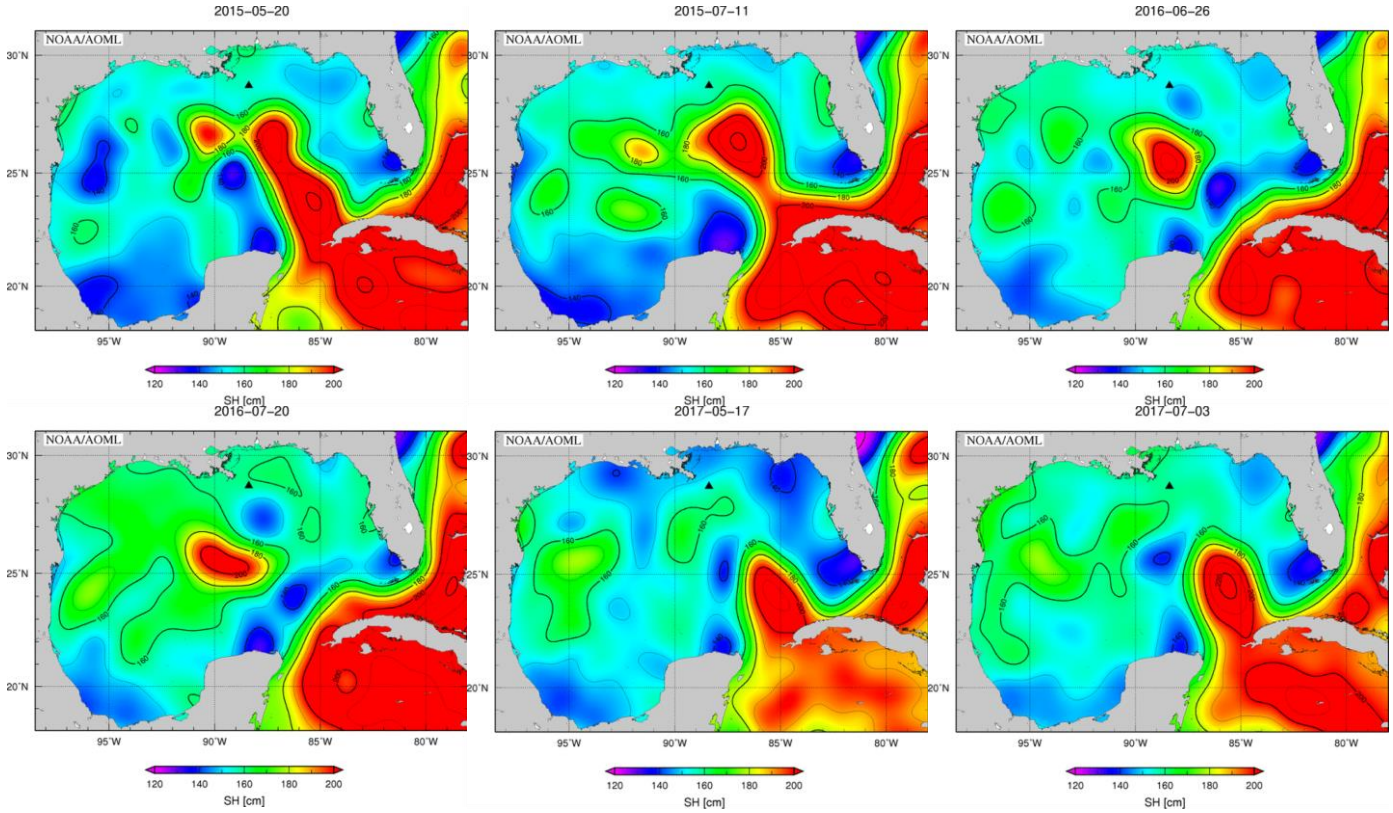
- Identify the environmental factors driving the community structure of zooplankton in the northern GoM.
- Quantify mesoscale features (i.e. Loop Current and Loop Current eddies) with the zooplankton dynamics.
- Add basic understandings of fisheries production and ecosystem function.

Sampling

- Samples collected within the Loop Current domain of the central GoM in summer and the western GoM in spring with a 202um net towed vertically from 100 m depth (or 5 m above the seafloor) to the surface
- Samples fixed with 10% formalin solution in seawater for detailed taxonomic analyses.
- Zooplankton sorted to the lowest taxonomic levels as possible.
- Copepods and chaetognaths further analyzed and identified to the species or lowest taxonomic group.



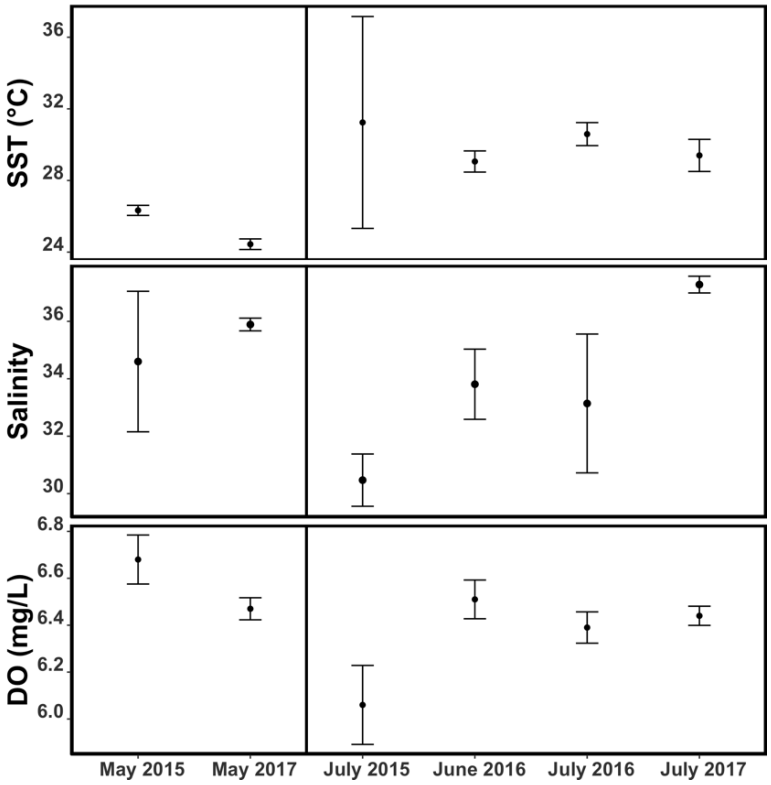
Loop Current Related Physical Features

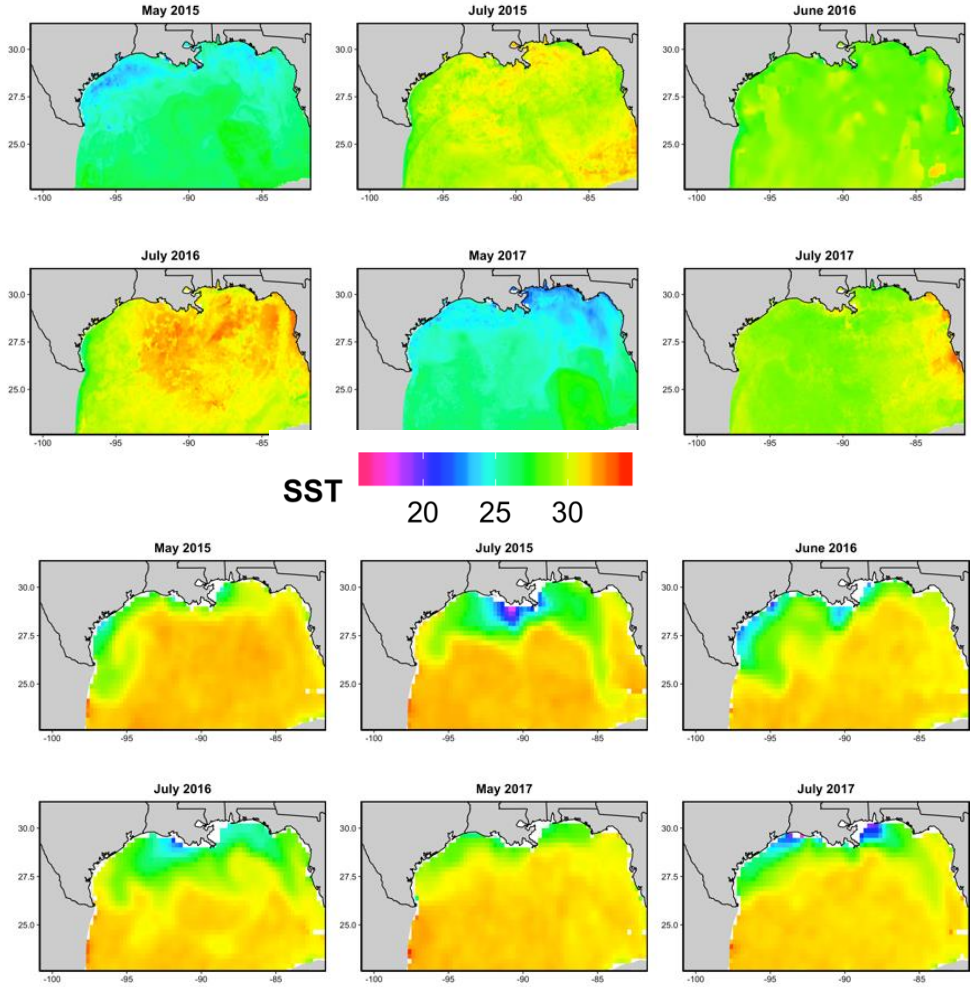


Location of Loop Current (LC) fronts identified using SSH data from Copernicus Marine Environmental Monitoring Service during sampling times in summer 2015, 2016, and 2017

- 17 cm SSH contour used as location of LC front (Leben, 2005)
- Euclidean distance to Loop Current front calculated in ArcGIS

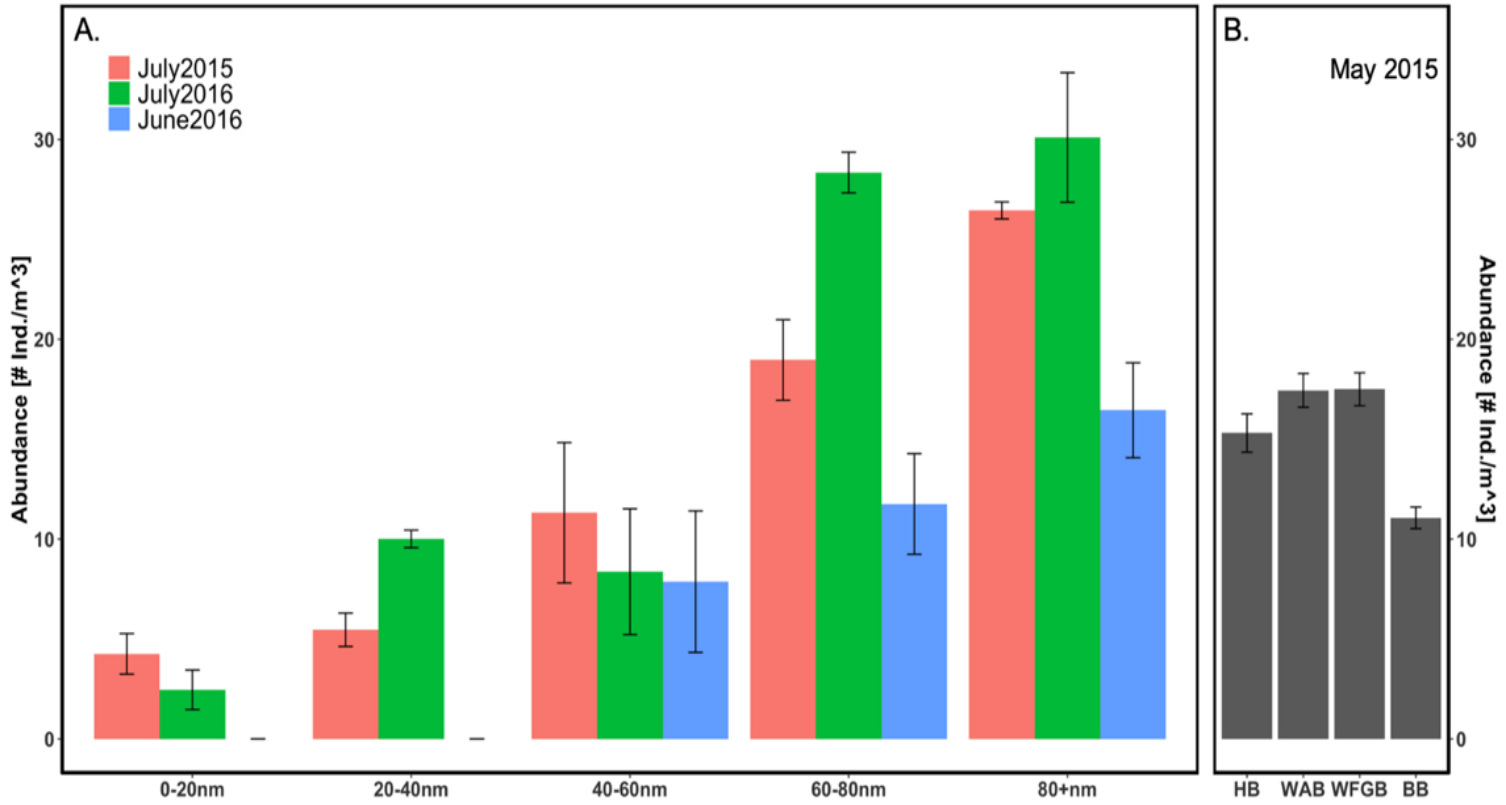
Environmental Conditions





- SST highest in summer months
- Lowest Salinity and DO in July 2015

Chaetognaths in the GoM

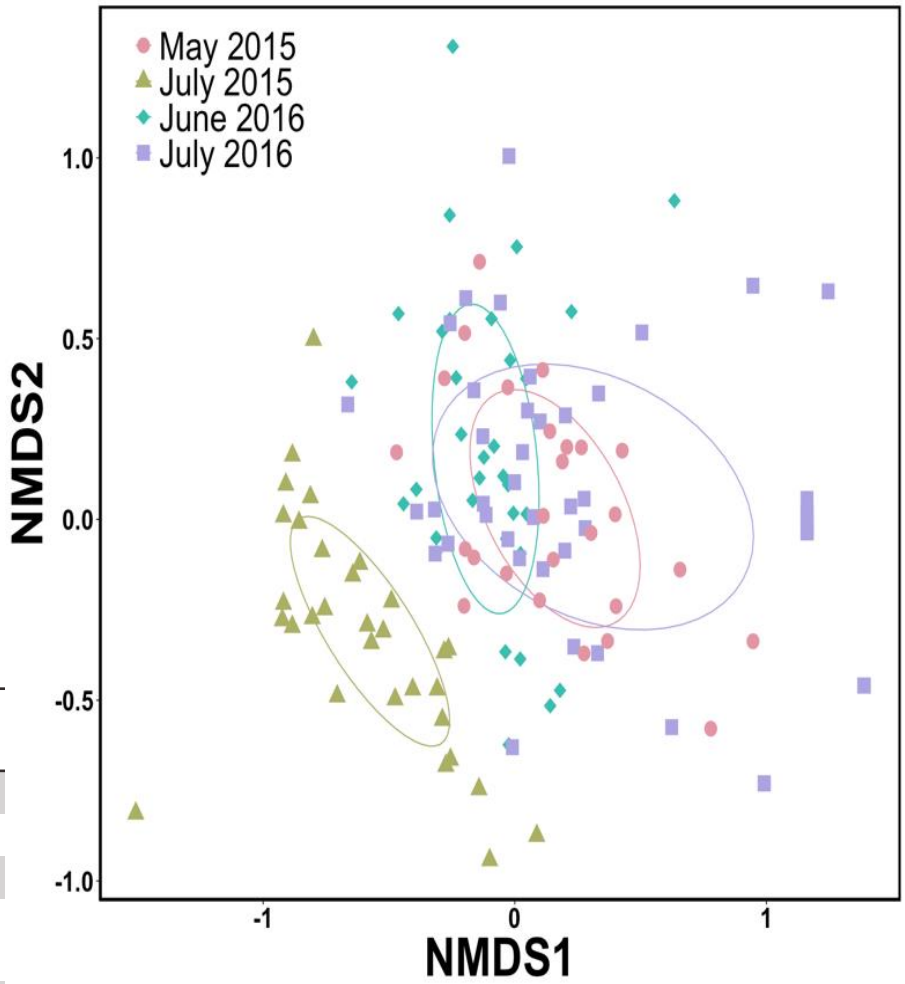


Summer: Distance to Loop Current

- Highest total abundance furthest from the Loop Current
- Loop Current furthest south during June 2016 (more than 40nm from sampling stations)

Non-Metric Multidimensional Scaling

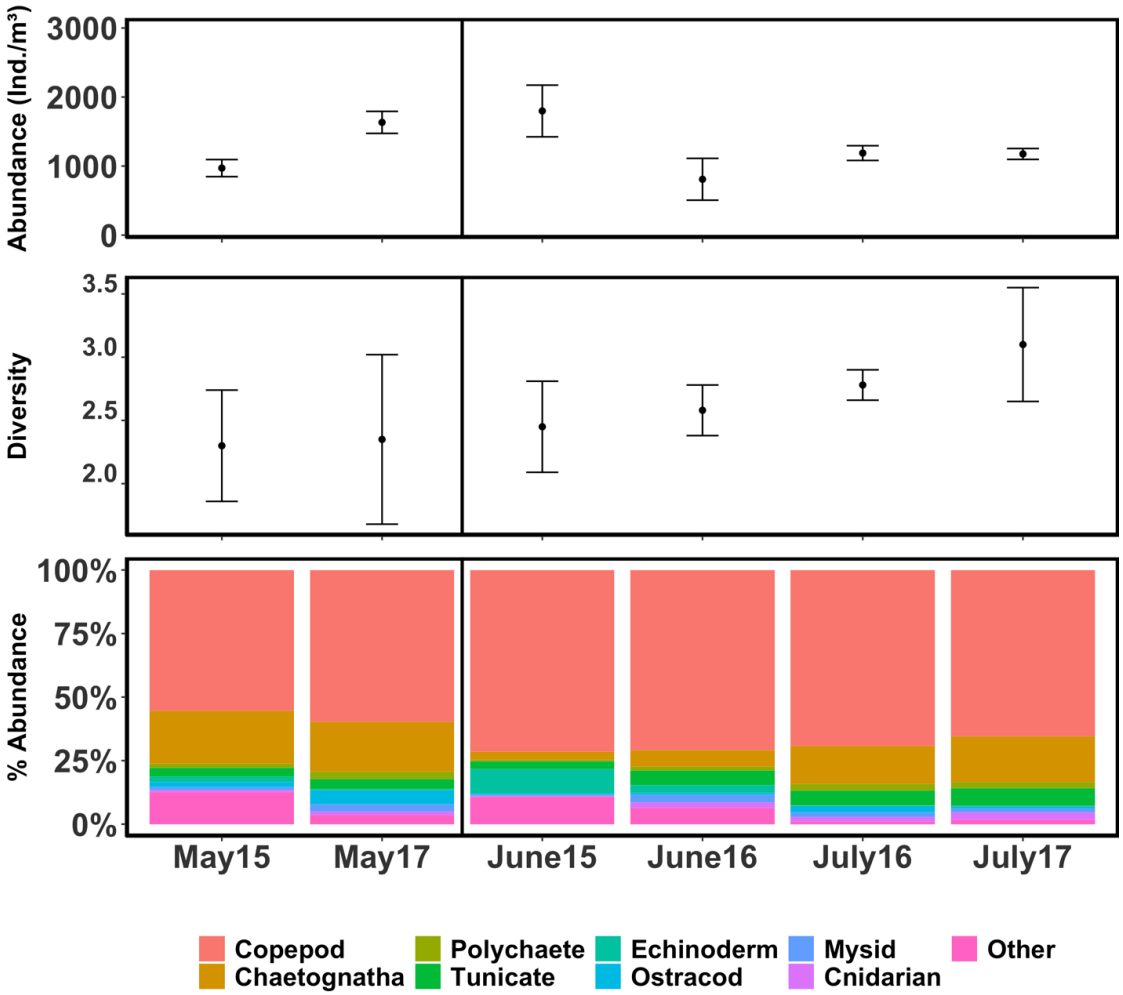
- Significant differences in chaetognath assemblage structure between cruises.
- May 2015 different from the other three cruises



Cruise	May 2015	July 2015	June 2016	July 2016
Pairwise tests				
May 2015	-			
July 2015	0.001*	-		
June 2016	0.001*	0.001*	-	
July 2016	0.001*	0.001*	0.001*	-

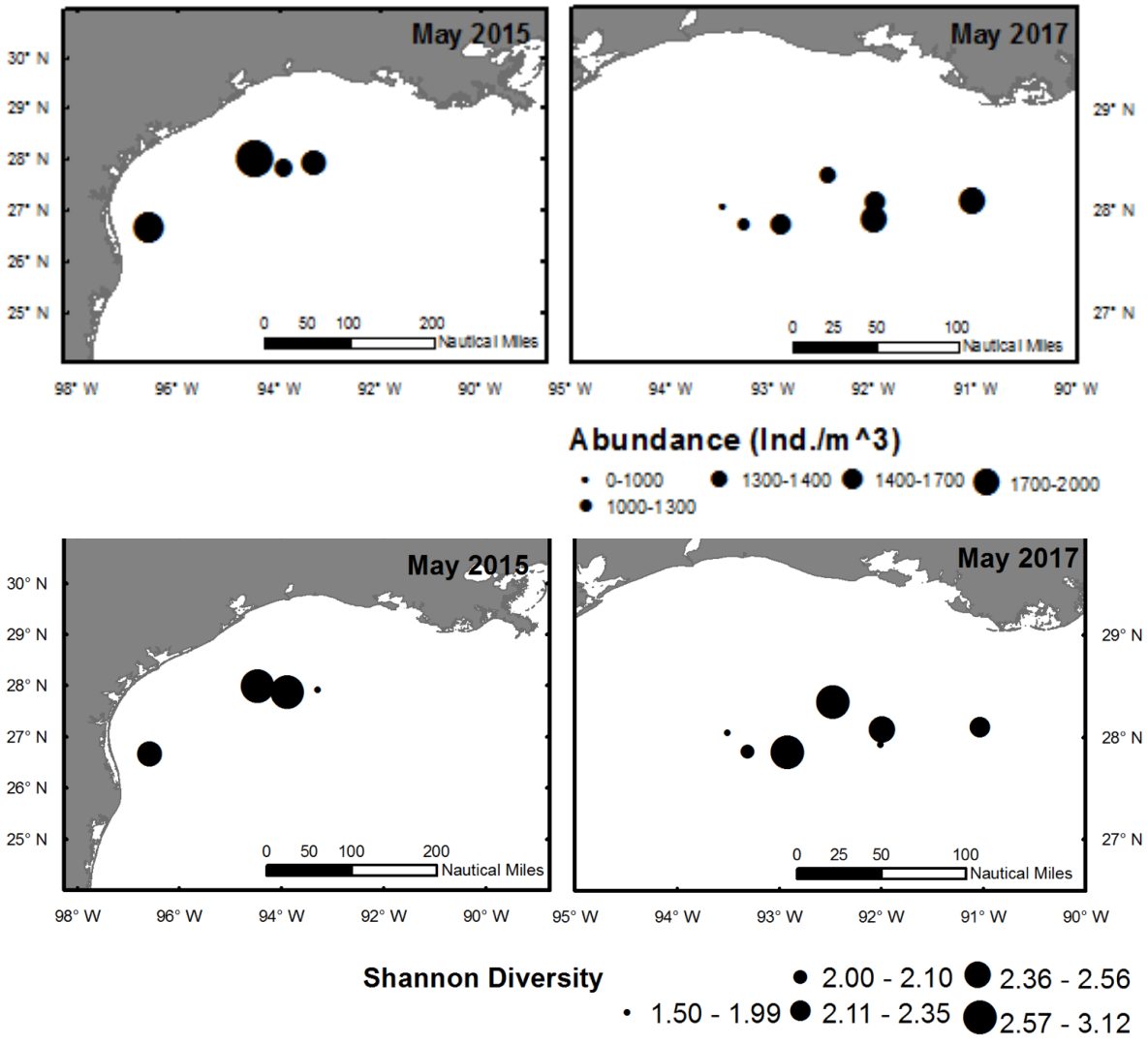
P values of the pairwise test (based on PERMANOVA) among cruises for the chaetognath community

Zooplankton Communities



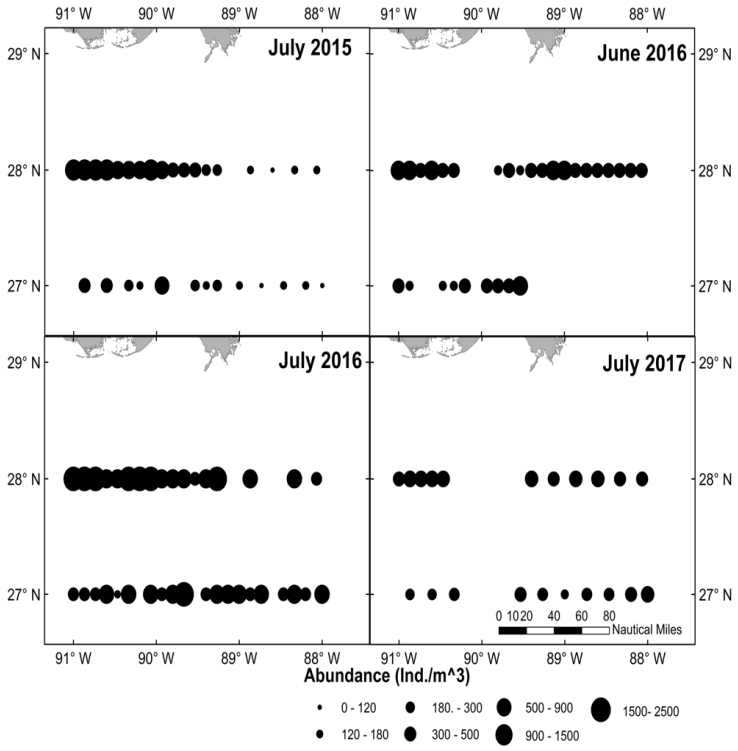
- Zooplankton community dominated by copepods
- Chaetognaths second most dominant
- Diversity lowest in spring months, highest in July 2017
- Abundance of copepods ~50% of all cruises

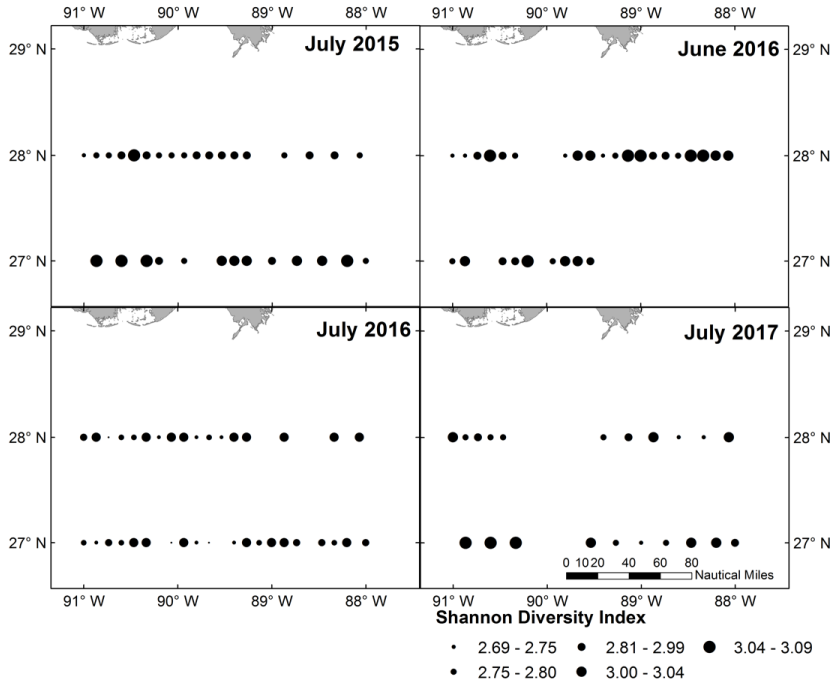
Zooplankton Communities in Spring



- Stations in western GoM exhibited differences in total zooplankton abundance and diversity between years and across the region

Zooplankton Communities in Summer





- In 2015 lower diversity regions were also regions of highest abundance
  - Community dominated by *Temora* spp. and *Oithona* spp.

GLM for Abundant Copepod Species

Summer	SST	Salinity	DO	Dist_LC	SSH	r^2
Acartia spp.	-***	-***	+*			0.34
Candacia simplex		+***	+***			0.34
Centropages furcatus		+***	**		+*	0.27
Clausocalanus spp.		+***		-***		0.37
Eucalanus spp.						0.00
Oncae venusta	-***					0.33
Oithona spp.			**	-***	-*	0.33
Paracalanus spp.	-***		-**	**	+*	0.40
Rhincalanus rostifrons						0.09
Temora spp.	-**			+***		0.30

Spring	SST	Salinity	DO	r^2
Acartia spp.		-***		0.17
Candacia simplex				0.28
Centropages furcatus		+*	+***	0.3
Clausocalanus spp.				0.12
Eucalanus spp.	-**		-**	0.61
Oncae venusta				0.69
Oithona spp.			+*	0.33
Paracalanus spp.	-*	+***		0.85
Rhincalanus rostifrons				0.27
Temora spp.				0.4

* indicates p value significance: *0.05, **0.01, ***0.001

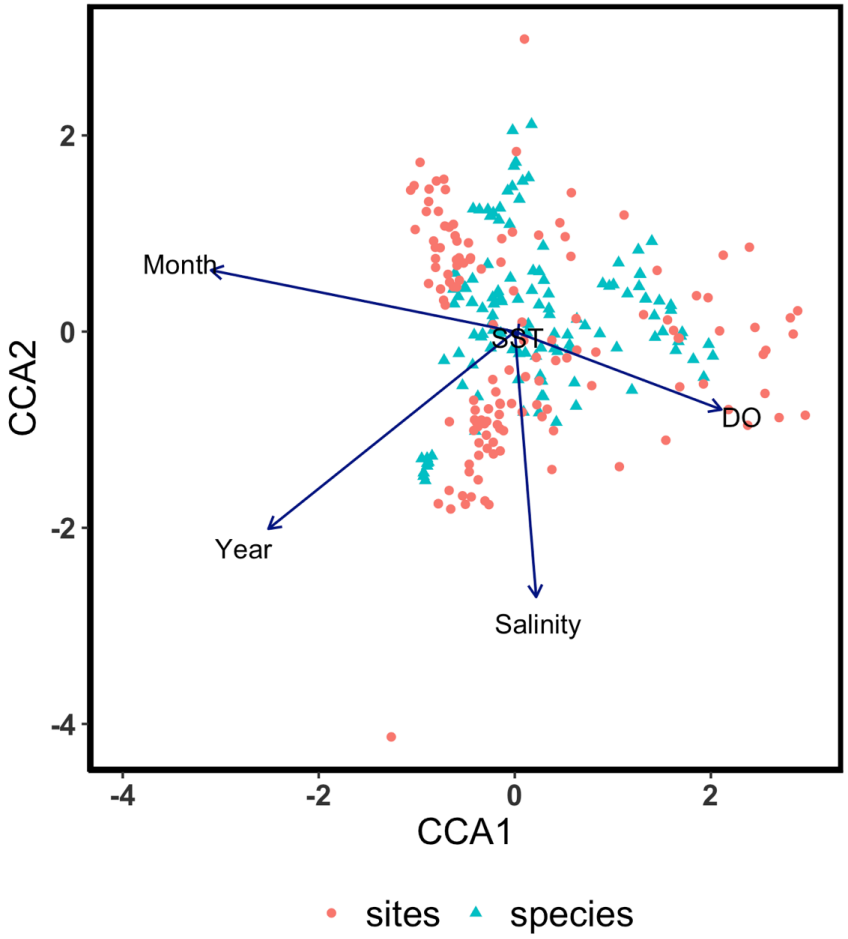
SST, sea surface temperature; DO, dissolved oxygen, Dist_LC, distance to Loop Current front, SSH, sea surface height

- Distance to the LC and SSH appeared significant proxies for impacts of mesoscale features on zooplankton communities in offshore communities

Canonical Correspondence Analysis

- Year, Month, Salinity, and DO are significant contributors to the zooplankton community structure
- SST is not a significant driver of the community structure

Variable	ChiSquare	F	Pr(>F)	
Year	0.19724	13.429	0.001	***
Month	0.15906	10.8299	0.001	***
SST	0.02388	1.626	0.105	
Salinity	0.06649	4.5267	0.001	***
DO	0.03829	2.6071	0.003	**



Summary

- The Loop Current circulation exhibited variability in extent annually and seasonally
- Chaetognaths had highest abundance furthest from the Loop Current front
- Species specific relationships within zooplankton communities based on environmental variables and proximity to the mesoscale features (i.e. Loop Current and eddies)
- SST is not a determinant of zooplankton community structure (CCA), but some species showed strong associations with SST (GLM: *Paracalanus* spp., *Oncaea venusta*)

- **Future Directions**: Spatial modeling of zooplankton distribution linked to recruitment dynamics of larval fish in the northern GoM.

Acknowledgements

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