



Assessing the effects of freshwater inflows and other key drivers on the population dynamics of blue crab and white shrimp using a multivariate time-series modeling framework

Dr. Edward J. Buskey

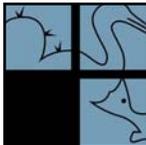
Dr. Lindsay P. Scheef

Dr. Jianhong Xue

Sara Smith

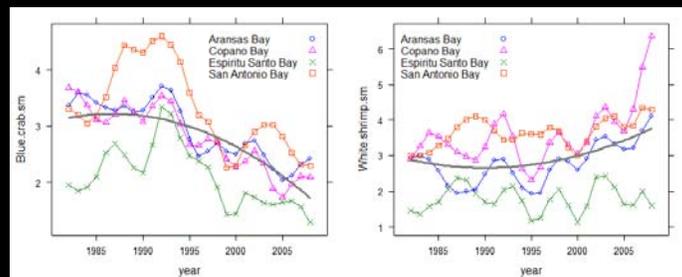
Hunter Samberson

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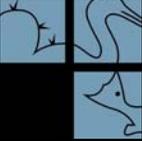


Project Goals

- Compose a review of literature examining blue crab and white shrimp populations
- Assess the drivers of blue crab and white shrimp population dynamics using multivariate autoregressive (MAR) models
 - Texas Parks and Wildlife Department Coastal Fisheries monitoring data



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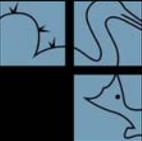


Project Timeline

Literature review

Tentative timeline	Accomplishments
2014 Apr-Jul	<ul style="list-style-type: none"> ✓ Compose annotated bibliography ✓ Outline structure for review
2014 Aug-Dec	<ul style="list-style-type: none"> ✓ Complete annotated bibliography ✓ Begin literature review report
2015 Jan-Mar	<ul style="list-style-type: none"> ✓ Continue composition of literature review report
2015 Apr-Aug	<ul style="list-style-type: none"> ✓ Complete final literature review ✓ Present results at final workshop ➔ Submit final report ➔ Submit manuscript for publication

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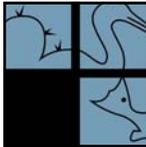


Project Timeline

Data analysis

Tentative timeline	Accomplishments
2014 Apr-Jul	<ul style="list-style-type: none"> ✓ Acquire and prepare datasets for model application
2014 Aug-Dec	<ul style="list-style-type: none"> ✓ Meet with data managers and analysts ✓ Continue to prepare datasets for model application ✓ Construct and assess preliminary models
2015 Jan-Mar	<ul style="list-style-type: none"> ✓ Select and apply final models to data ✓ Compose data analysis report
2015 Apr-Aug	<ul style="list-style-type: none"> ✓ Prepare final report ✓ Present results at final workshop ➔ Submit final report ➔ Submit data and annotated R code

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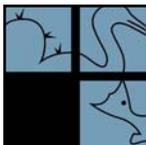


Literature Review

Number of references included by topic and region

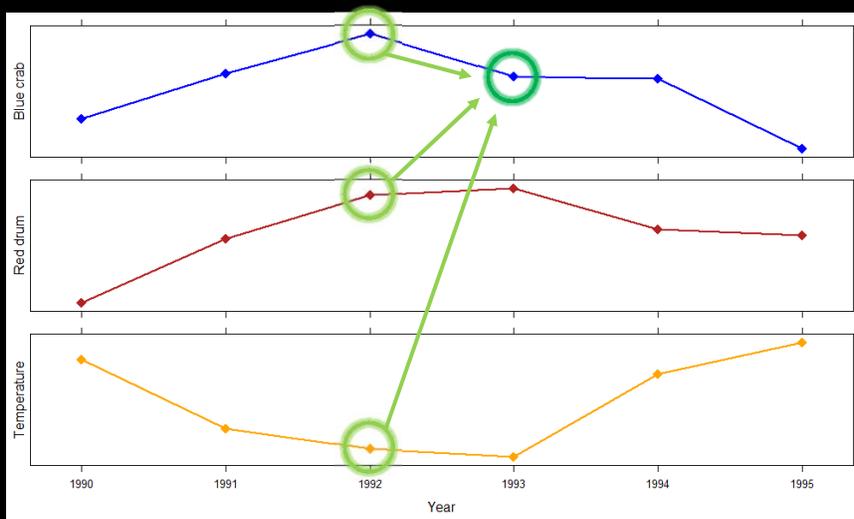
Topic	Mission-Aransas Estuary	Guadalupe Estuary	Texas	Gulf of Mexico	Atlantic Ocean	Lab	General
Blue Crab	6	4	9	13	8	12	3
White Shrimp	4	1	11	13	1	2	-
Freshwater Inflow	6	7	11	1	-	-	4

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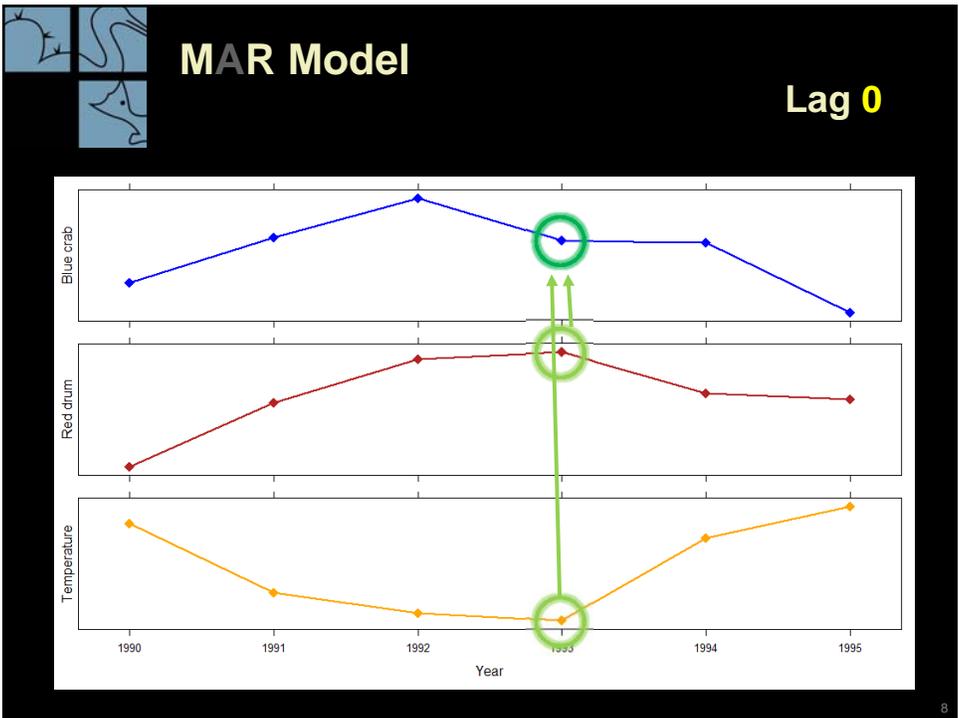
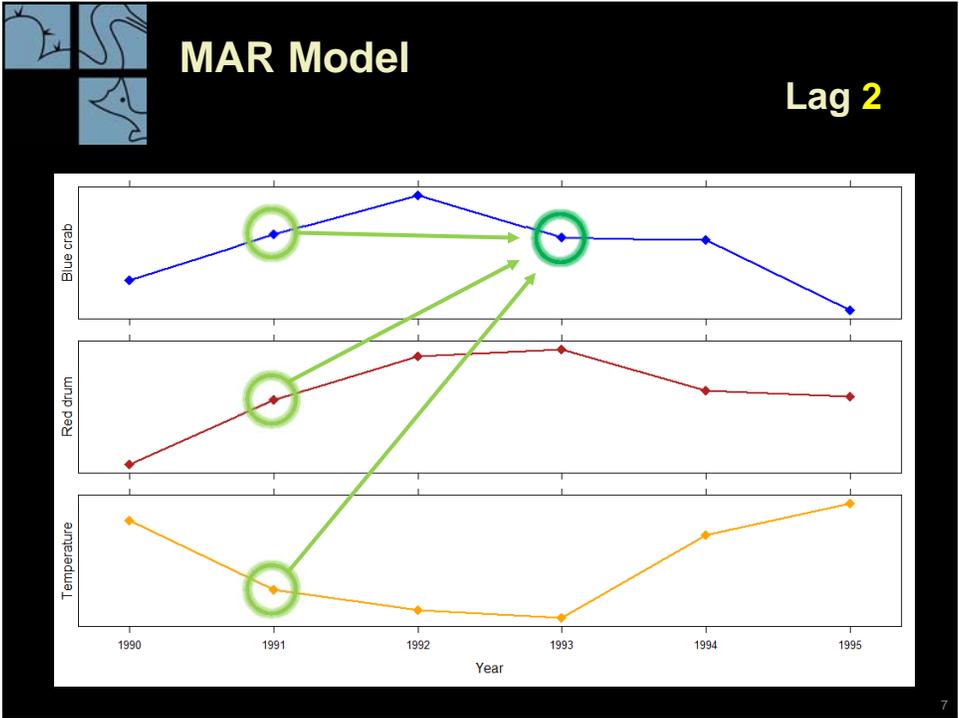


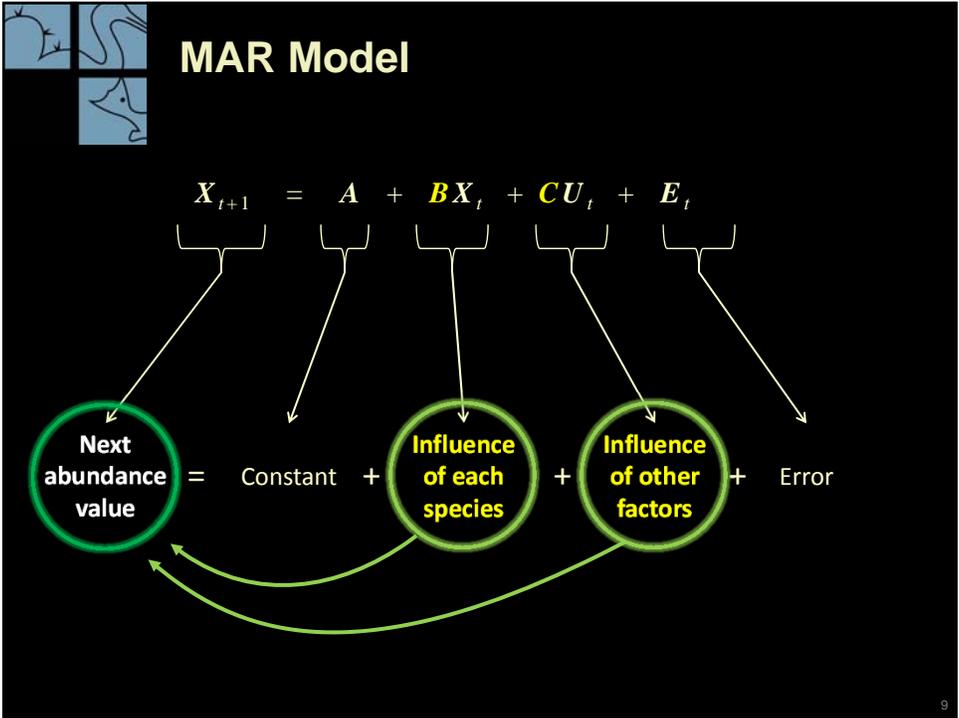
MAR Model

Lag 1



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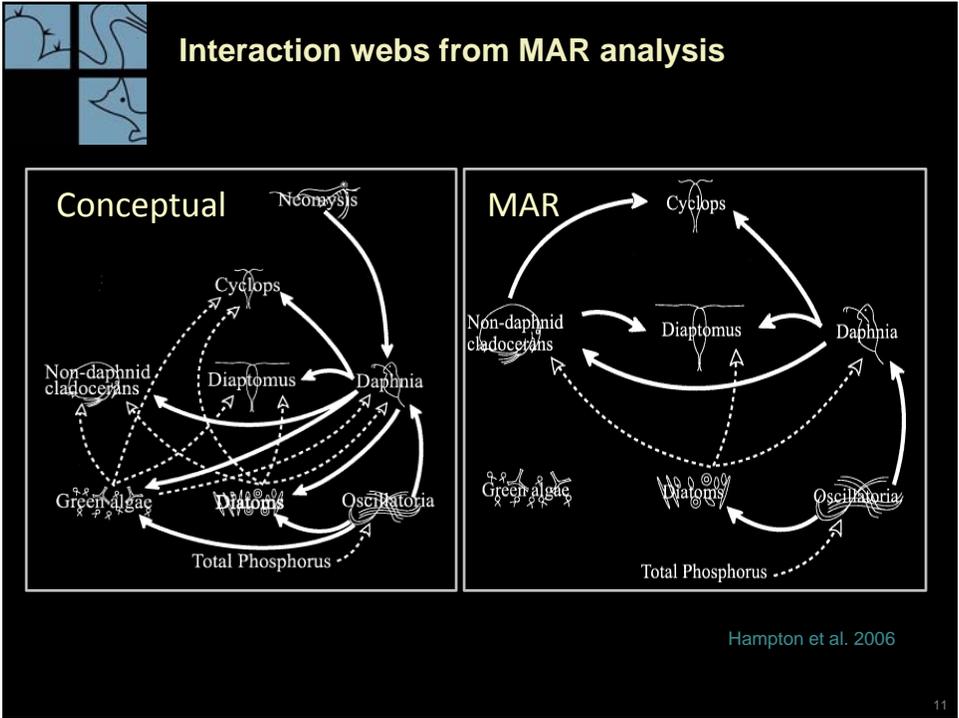
MAR Model

$$X_{t+1} = A + BX_t + CU_t + E_t$$

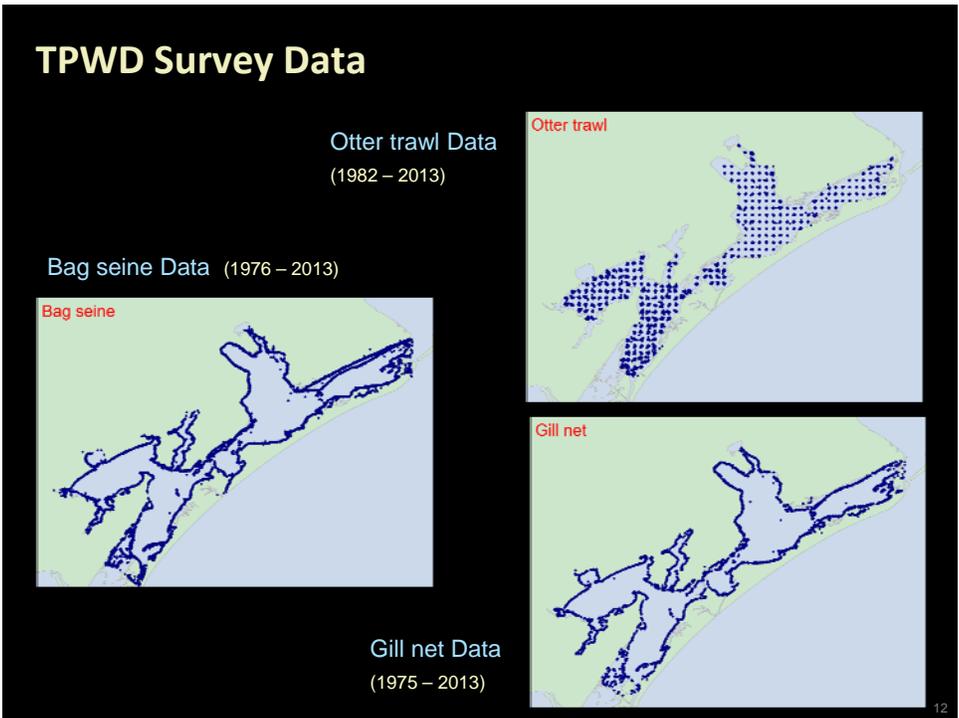
Next abundance value = Constant + Influence of each species + Influence of other factors + Error

Species	Species					Environmental		
	1	2	3	...	p	1	...	q
1	$b_{1,1}$	$b_{1,2}$	$b_{1,3}$...	$b_{1,p}$	$c_{1,1}$...	$c_{1,q}$
2	$b_{2,1}$	$b_{2,2}$	$b_{2,3}$...	$b_{2,p}$	$c_{2,1}$...	$c_{2,q}$
3	$b_{3,1}$	$b_{3,2}$	$b_{3,3}$...	$b_{3,p}$	$c_{3,1}$...	$c_{3,q}$
...
p	$b_{p,1}$	$b_{p,2}$	$b_{p,3}$...	$b_{p,p}$	$c_{p,1}$...	$c_{p,q}$

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Additional Data

Data type	Source
Species abundance time-series	TPWD Coastal Fisheries monitoring program
Water quality parameters	TPWD Coastal Fisheries monitoring program Mission-Aransas NERR System-Wide Monitoring Program Texas Coastal Ocean Observation Network
Meteorological data	Mission-Aransas NERR System-Wide Monitoring Program Texas Coastal Ocean Observation Network NOAA National Climatic Data Center
Rain gauge data	U.S. Geological Survey
River flow gauge data	U.S. Geological Survey
Climate oscillation indices	NOAA Climate Prediction Center
Along-shore current patterns	Texas Automated Buoy System
Commercial landing data	Marine Aquatic Products Reports (TPWD)

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Models

Time division:	Years			Seasons			Months			
	Lag:	0	1	2	0	1	2	0	1	2
Environmental		✓	✓	✓						
Blue crab		✓	✓	✓	✓	✓	✓	✓	✓	✓
White Shrimp		✓	✓	✓	✓	✓	✓	✓	✓	✓

All Bays

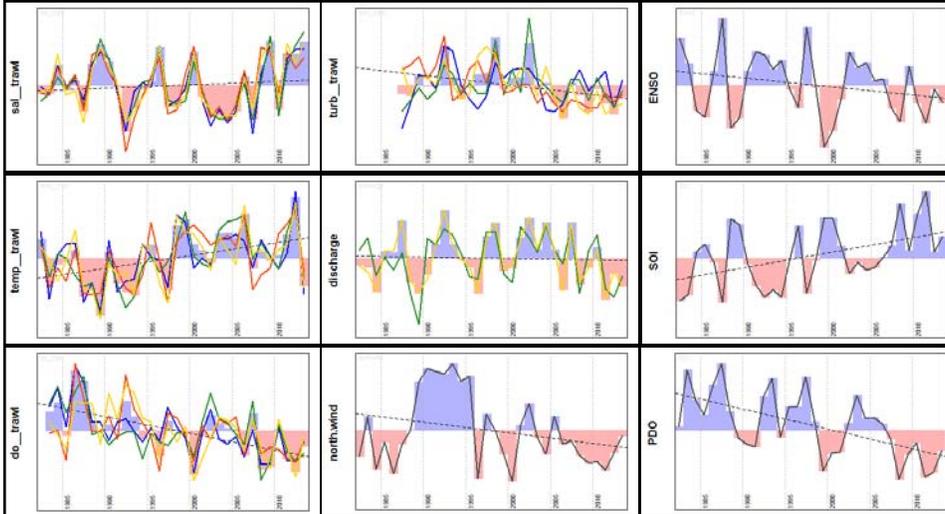
Mission-Aransas Estuary

Guadalupe Estuary

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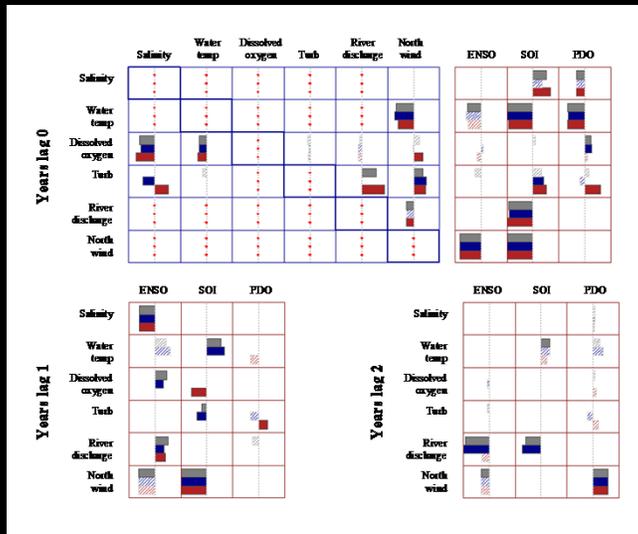
Environmental Models

— Copano Bay — Aransas Bay — San Antonio Bay — Espiritu Santo Bay

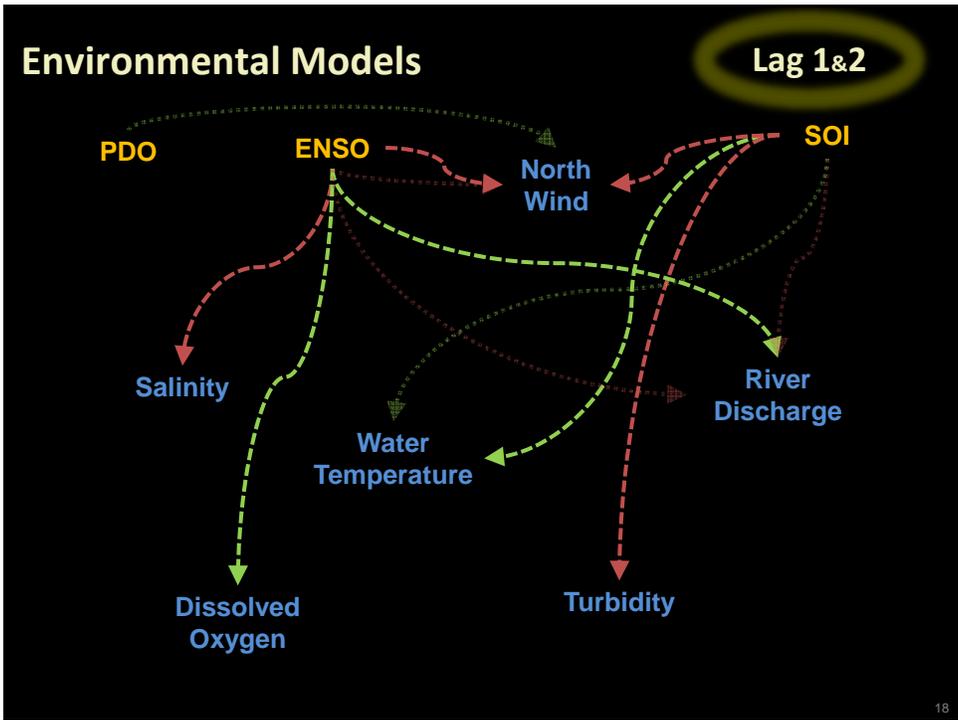
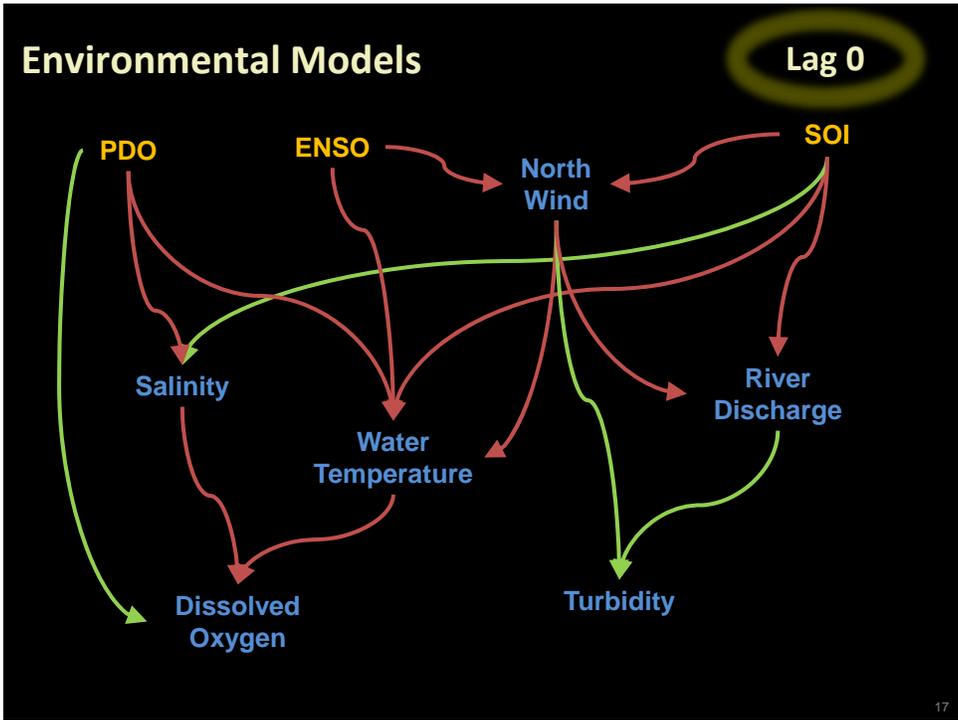


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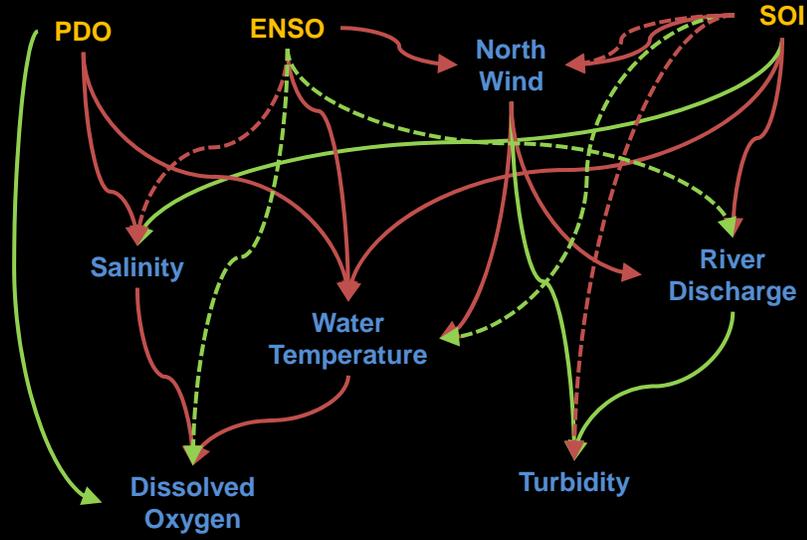
Environmental Models



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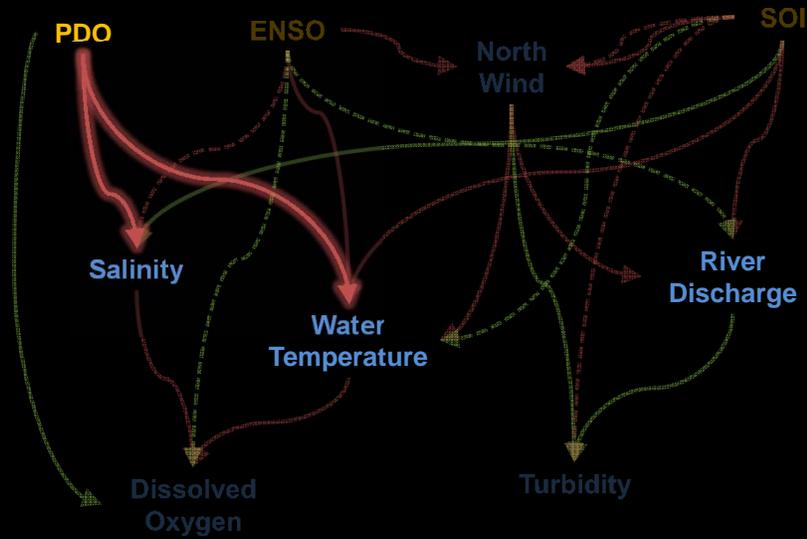


Environmental Models



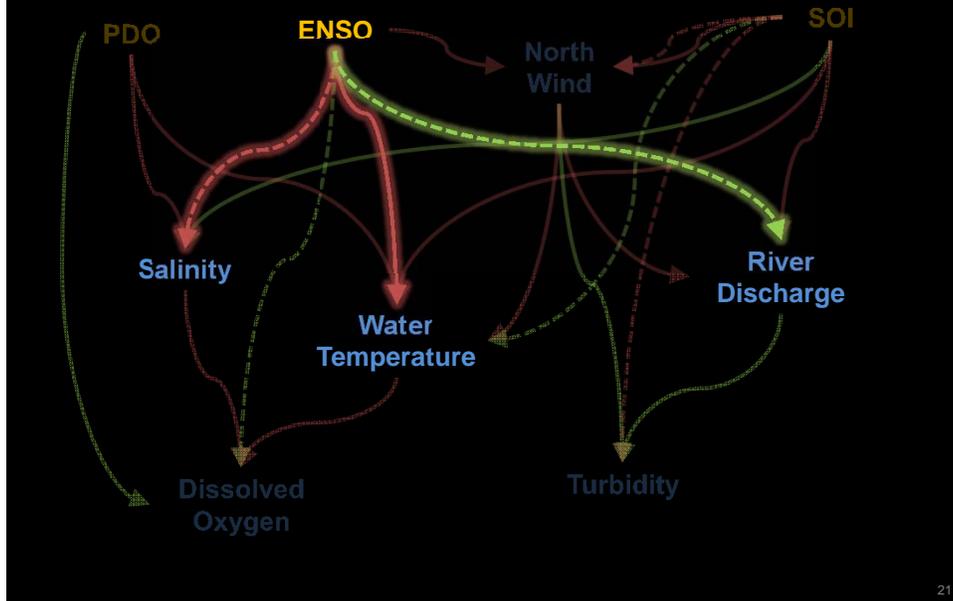
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Environmental Models

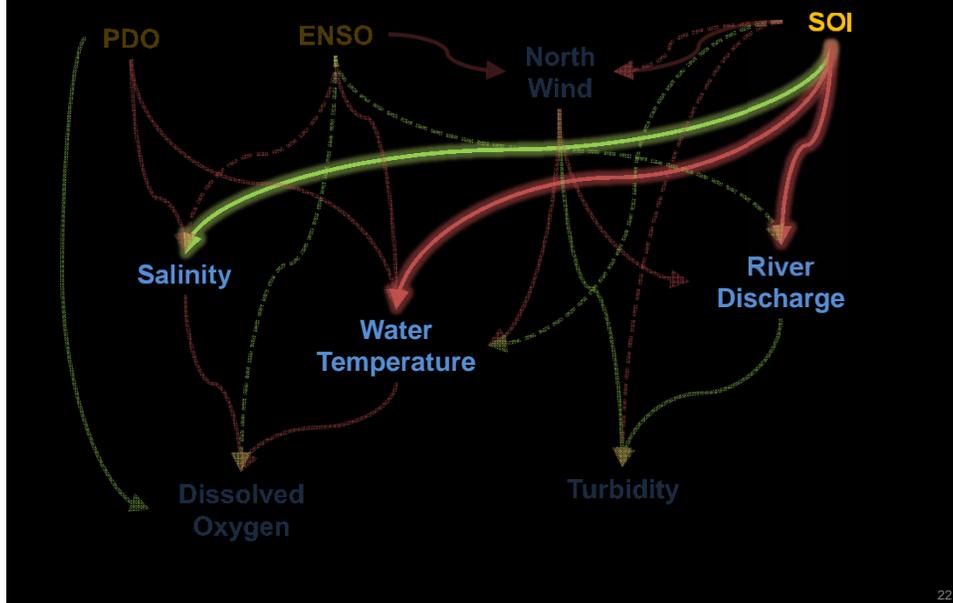


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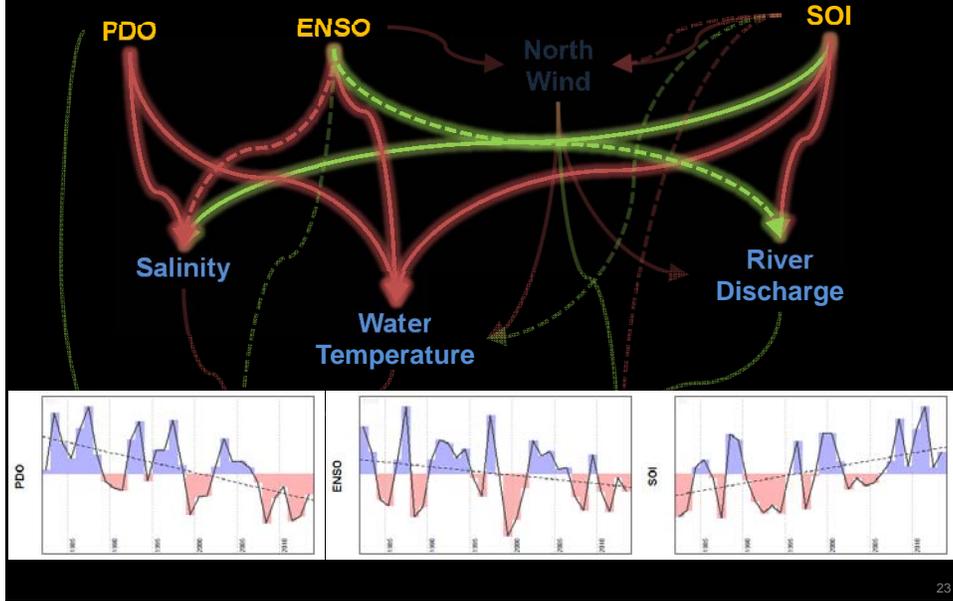
Environmental Models



Environmental Models

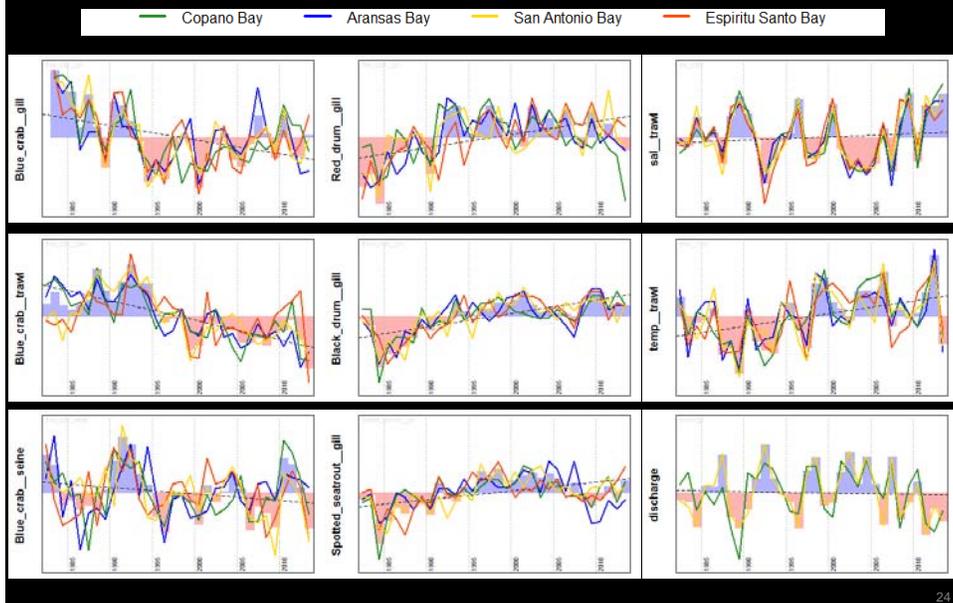


Environmental Models



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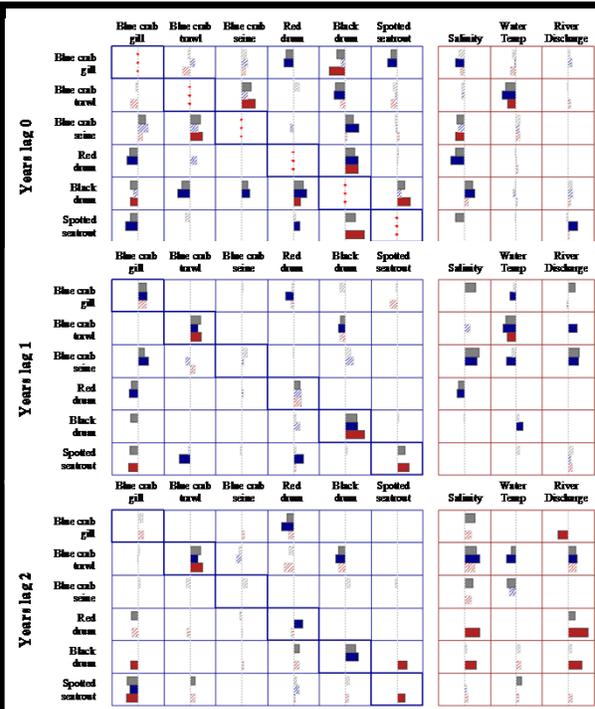
Blue Crab Models



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Blue Crab Models

(yearly increments)

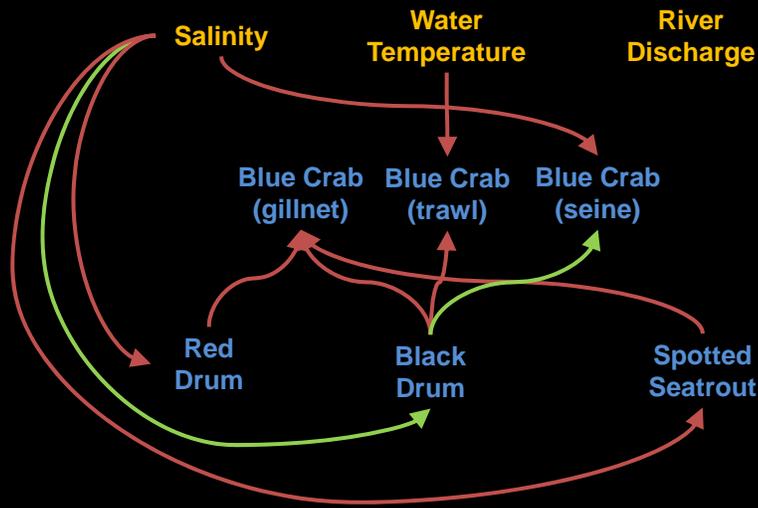


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Blue Crab Models

(yearly increments)

Lag 0

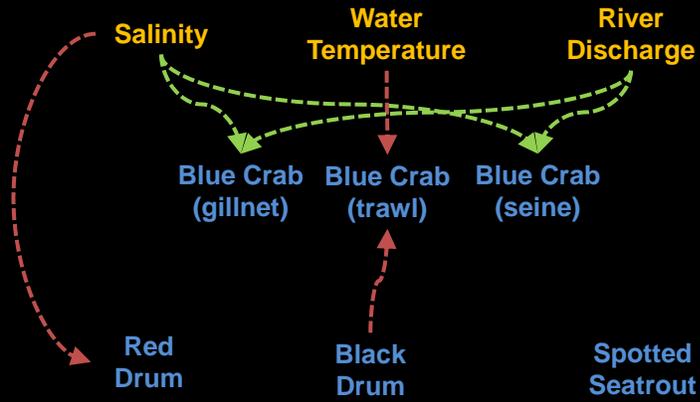


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Blue Crab Models

(yearly increments)

Lag 1

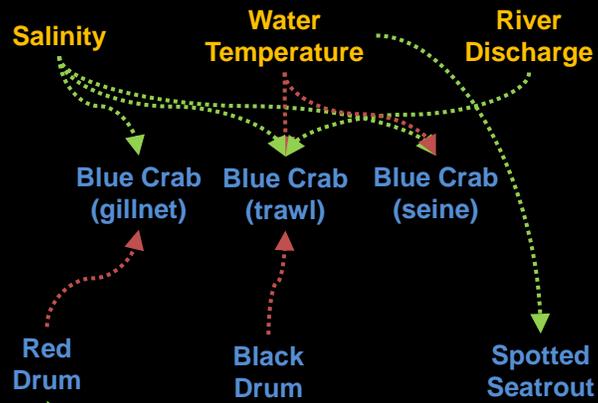


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Blue Crab Models

(yearly increments)

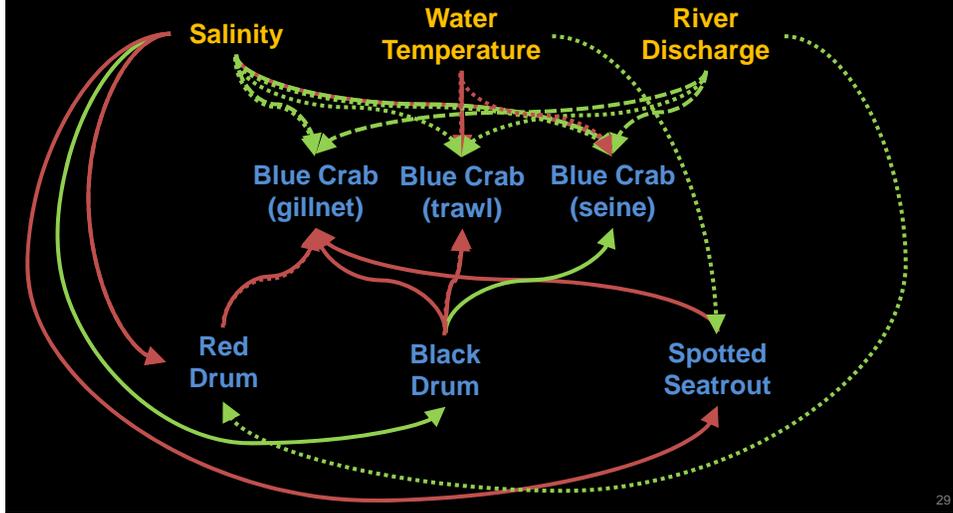
Lag 2



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Blue Crab Models

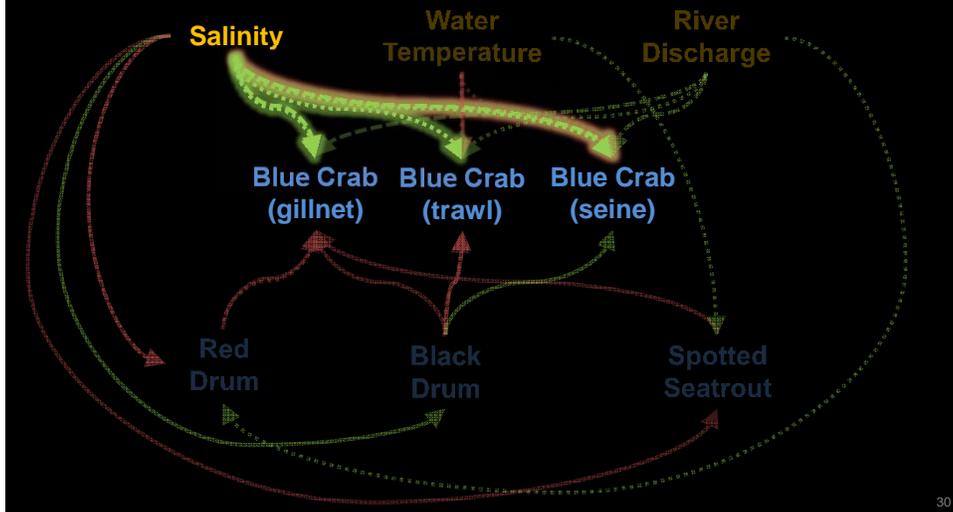
(yearly increments)



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Blue Crab Models

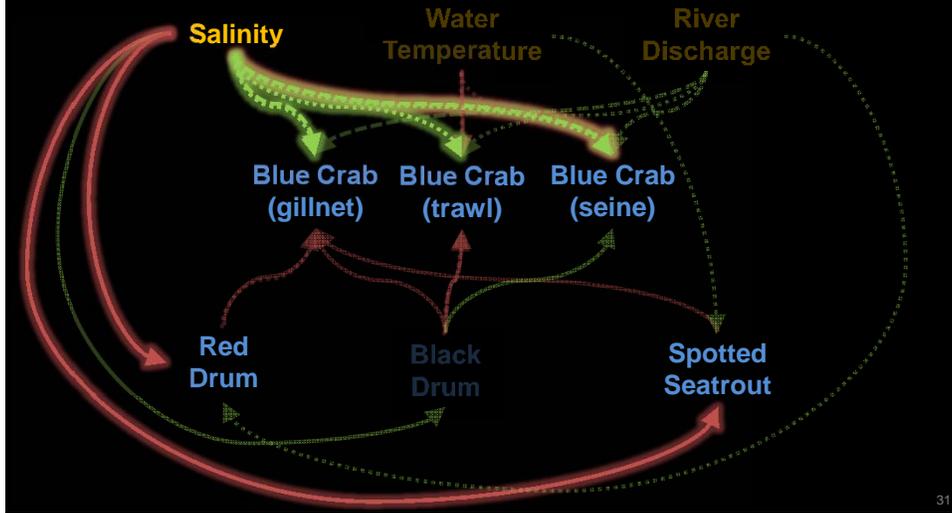
(yearly increments)



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Blue Crab Models

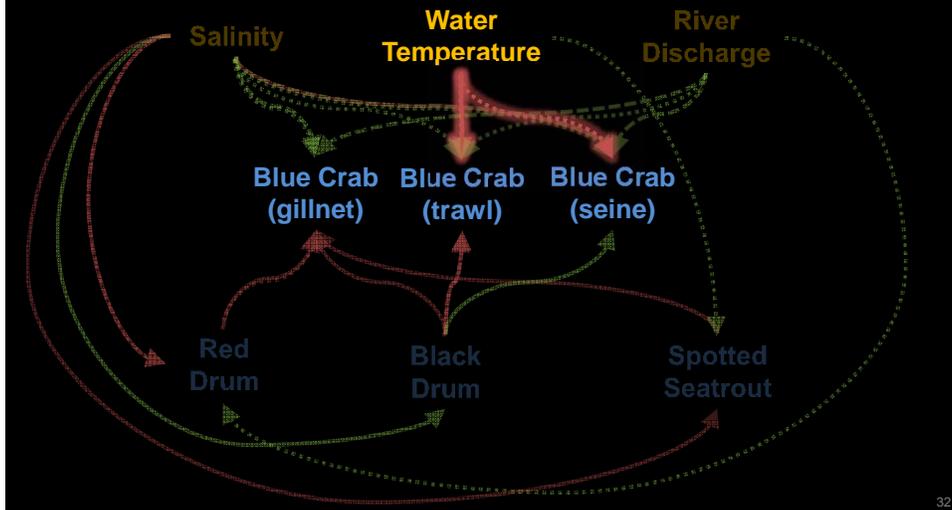
(yearly increments)



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Blue Crab Models

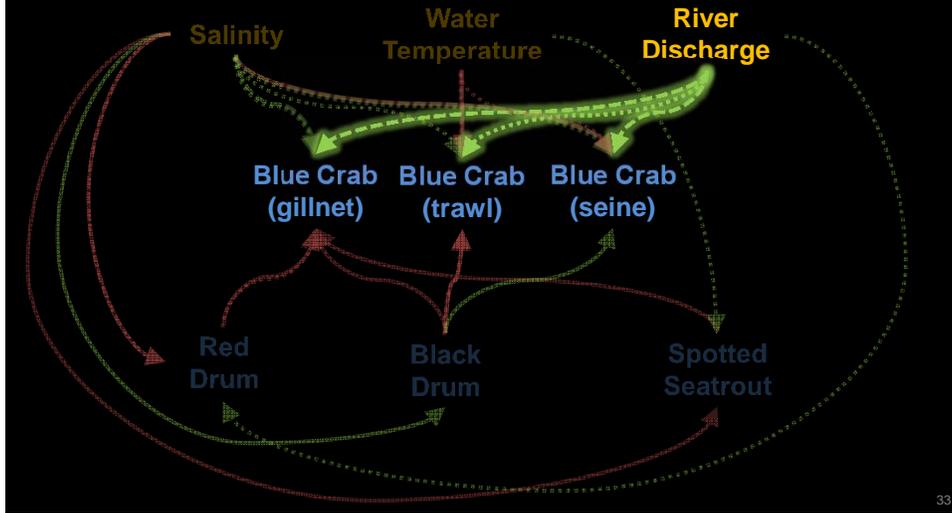
(yearly increments)



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Blue Crab Models

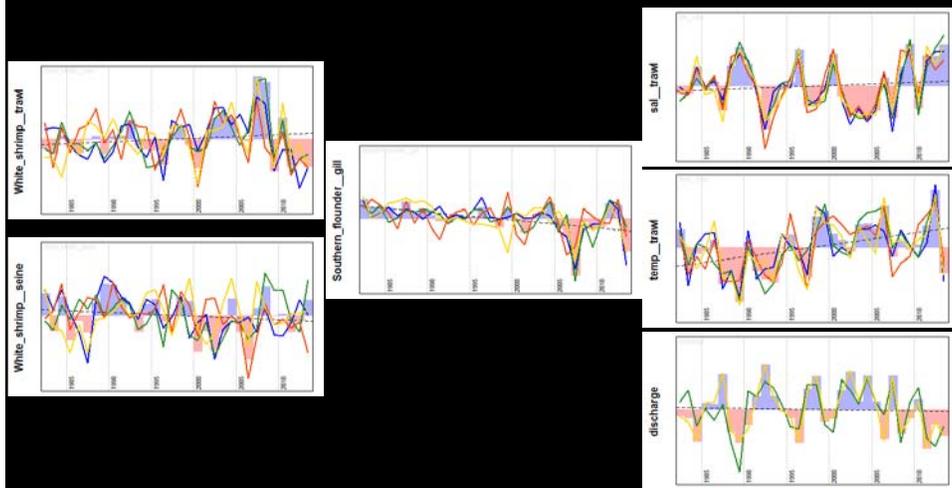
(yearly increments)



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White Shrimp Models

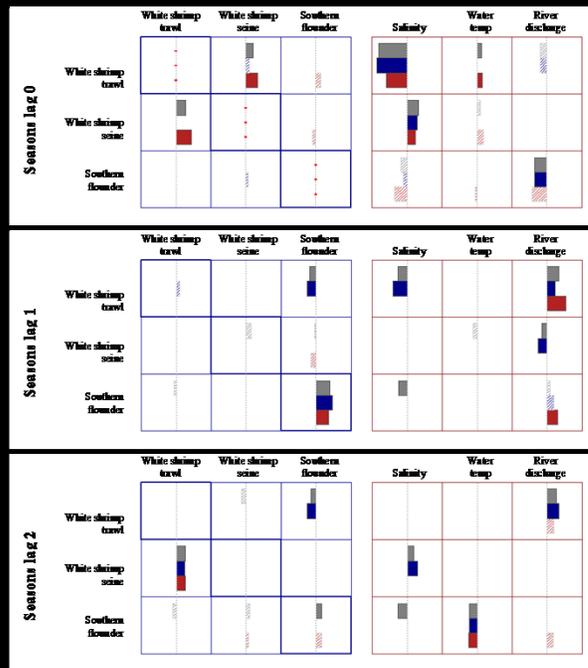
— Copano Bay — Aransas Bay — San Antonio Bay — Espiritu Santo Bay



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White Shrimp Models

(seasonal increments)

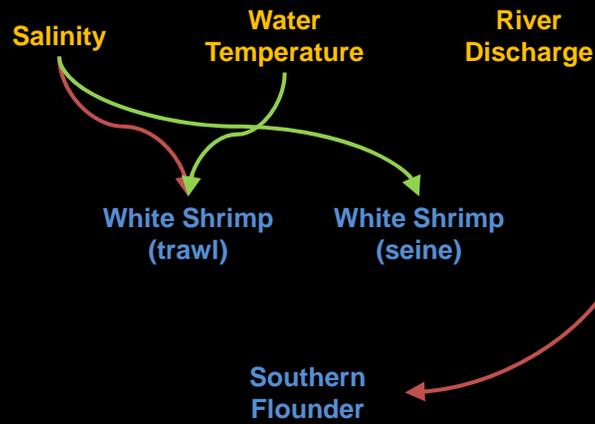


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White Shrimp Models

(seasonal increments)

Lag 0

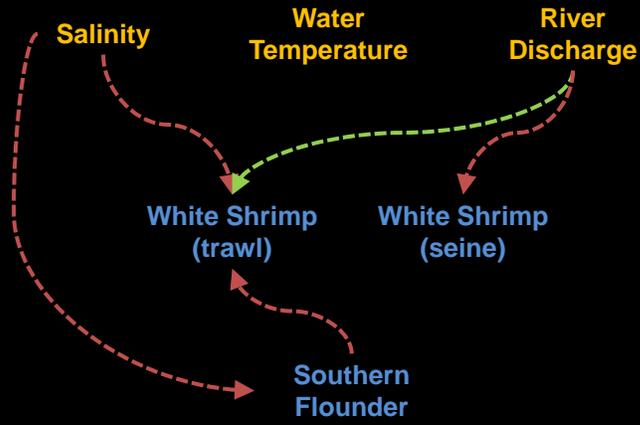


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White Shrimp Models

(seasonal increments)

Lag 1

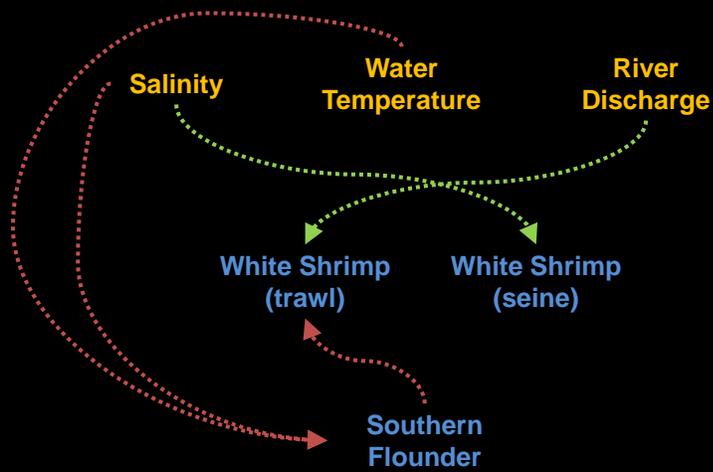


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White Shrimp Models

(seasonal increments)

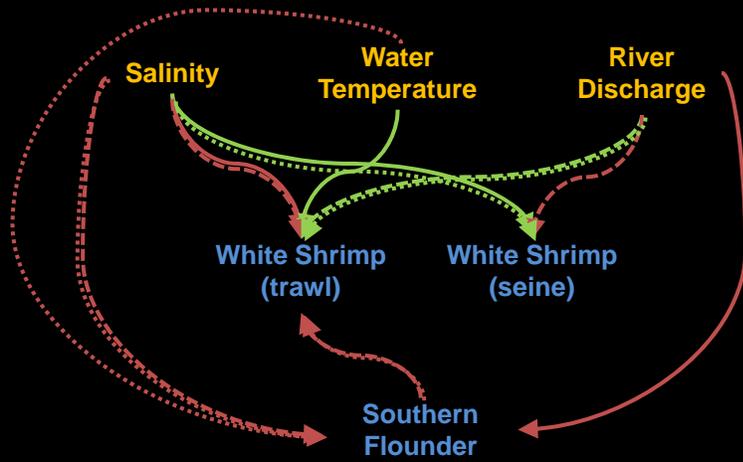
Lag 2



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White Shrimp Models

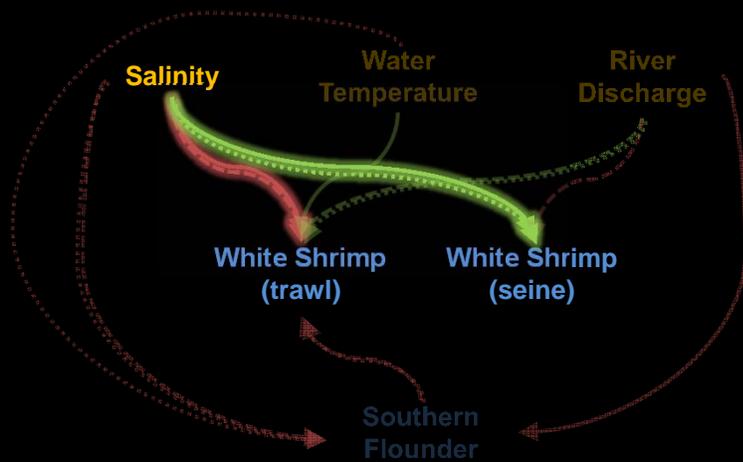
(seasonal increments)



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White Shrimp Models

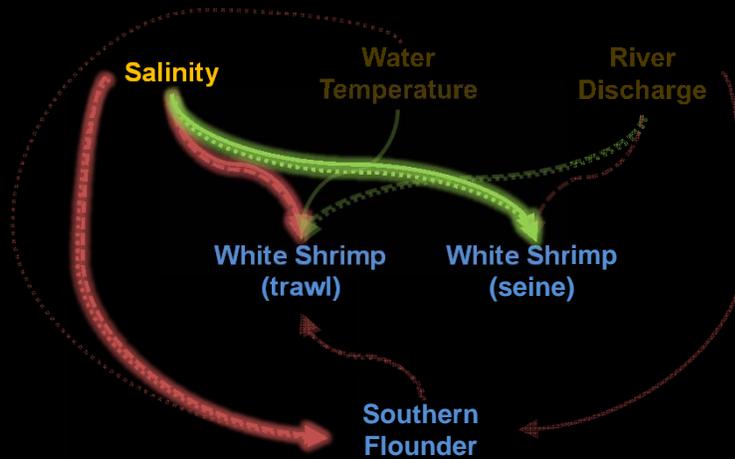
(seasonal increments)



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White Shrimp Models

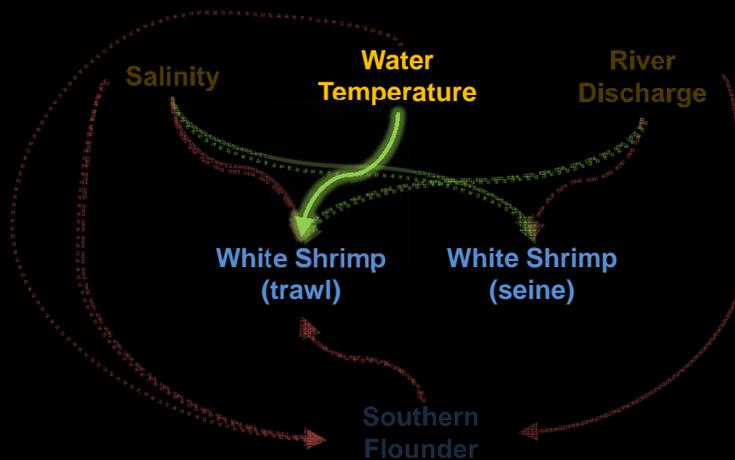
(seasonal increments)



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White Shrimp Models

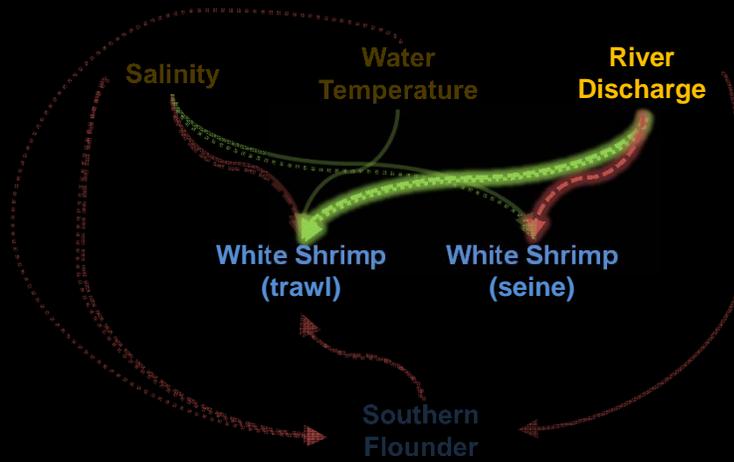
(seasonal increments)



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White Shrimp Models

(seasonal increments)



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Summary

- Higher water temperatures, higher salinities, and lower river discharge are linked to lower PDO and ENSO values and higher SOI values
- Blue crab abundance is
 - negatively associated with high water temperatures and predators
 - negatively associated with high salinity at short time lags
 - positively associated with high salinity at longer time lags (possibly due to negative association of predators with high salinity)
 - positively associated with river discharge at longer time lags
- Abundance of larger white shrimp is
 - negatively associated with predators and higher salinity
 - positively associated with higher water temperatures
 - positively associated with river discharge at longer time lags
- Abundance of smaller white shrimp is
 - positively associated with higher salinity
 - negatively associated with river discharge at longer time lags

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Model variations and future work

- Regions ✓
- Time lags ✓
- Time increments ✓
- Time span (additional datasets) ←
- Inter-bay effects ←
- Additional TX estuaries ←
- Wet vs. dry periods ←
- Extremes vs. averages ←
- Size and sex data ←

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