Impacts of a River Siphon on Estuarine Nekton Communities in West Pointe à la Hache, Louisiana

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Background

- Louisiana's coastal land loss rate is among the highest in the world, peaking at ~83.5 km^2 in the 1970s and currently ~28 km^2.
- Louisiana's Coastal Master Plan devotes $5.1 billion to river diversions to mitigate coastal erosion and offset climate change.
- Though provision of sediment from diversions is expected to increase land accretion, increased freshwater inflow will likely restructure ecological communities due to changes in environmental conditions (e.g., salinity).
- Restructuring of coastal nekton communities could impact ecological function (e.g., energy flow) and services (e.g., fisheries) of Louisiana's coastal ecosystems.

Objectives

1. Examine changes in fish and decapod community structure before/after a river siphon opening at West Pointe à la Hache.
2. Examine impacts of river siphon across the estuary's salinity gradient.
3. Identify nekton species driving differences in community structure

Methods & Study Site

- Sampled estuarine communities using trawls and minnow traps to characterize community structure on- and off- the marsh (traps and trawls, respectively)
- **Objective 1**: Sampling conducted in 2 years **pre-siphon opening (2018, 2019)** and 2 years **post-siphon opening (2021, 2022)**.
- **Objective 2**: Samples taken at **oligohaline to saline** sites (**WPH1, WPH2, PS7**, respectively; **Fig. 1**) in all years.
- Community structure analyzed using 2-way PERMANOVA in PRIMER software (V 7) using year and site as predictor variables (**Objectives 1 & 2**).
- **Objective 3**: SIMPER used to quantify species contributions to community similarity among sites and years.

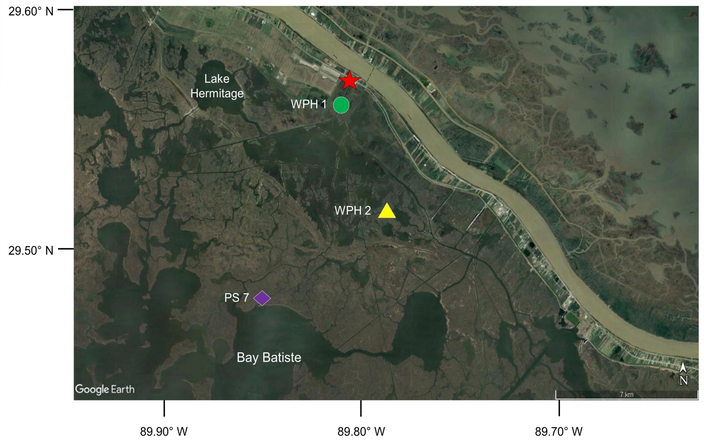

Fig 1. Study sites spanning the salinity gradient departing from the West Pointe à la Hache siphon (red star).

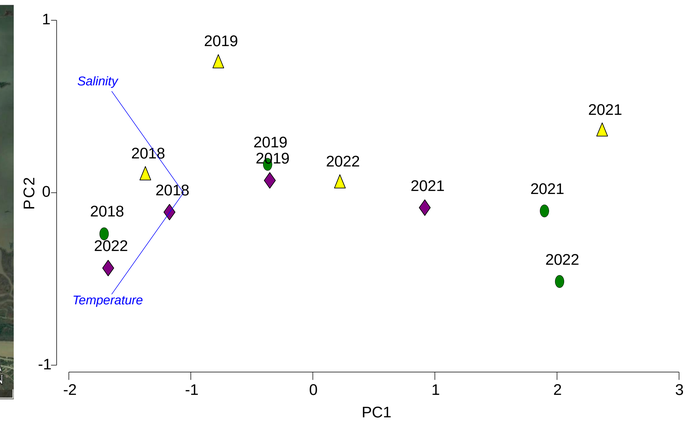

Fig 2. PCA of environmental conditions within each site (WPH 1, WPH 2, PS 7) for each year (2018, 2019, 2021, 2022).

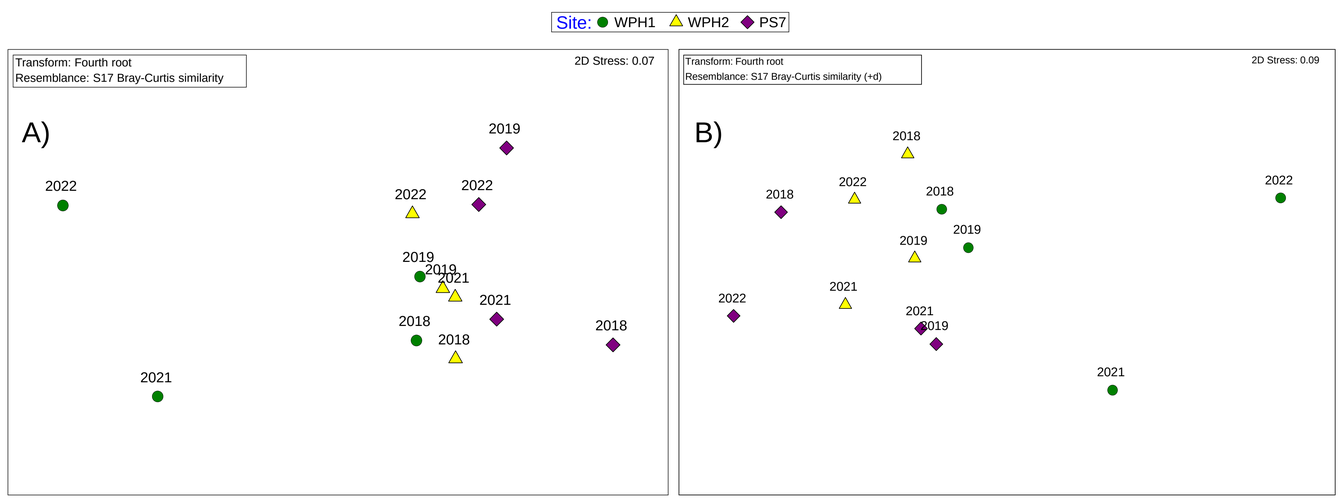

Fig 3. nMDS plots displaying off-marsh (trawl; **A**) and on-marsh (minnow trap; **B**) sample similarity among sites through time. Each point represents centroids from averaging sample similarity within each site (WPH 1, WPH 2, PS 7) for each year (2018, 2019, 2021, 2022).

Table 1. SIMPER comparison of abundance (Abund) and percent contributions to community similarity (% Cont.) by species making up majority of off-marsh community (trawl samples) in each site (WPH 1, WPH 2, PS 7) within each year sampled (2018, 2019, 2021, 2022).

	WPH 1			WPH 2			PS 7		
	Species	Abund	% Cont.	Species	Abund	% Cont.	Species	Abund	% Cont.
2018	*F. aztecus*	2.56	21.6	*F. aztecus*	2.68	25.84	*F. aztecus*	1.82	45.7
	M. undulatus	2.23	19	*L. xanthurs*	1.88	17.14	*L. rhomboides*	0.97	24.6
	L. xanthurus	2.24	18.9	*S. parvus*	1.49	13.23			
	A. mitchilli	1.79	13.76	*L. rhomboides*	1.4	11.78			
				M. undulatus	1.27	9.33			
2019	*F aztecus*	2.57	23.85	*F. aztecus*	2.53	32.01	*F. aztecus*	1.93	43.94
	M. undulatus	2.15	18.15	*M. undulatus*	1.72	19.54	*A. mitchilli*	0.94	16.03
	A. mitchilli	1.93	17.19	*A. mitchilli*	1.62	18.68	*L. setiferus*	0.82	15.55
	C. arenarius	1.51	13.36						
2021	*M. ohione*	3.4	42.8	*F. aztecus*	2.46	23.77	*F. aztecus*	2.25	32.17
	I. furcatus	1.7	20.38	*L. xanthurs*	2.45	22.75	*L. xanthurus*	2.08	28.13
	M. undulatus	1.57	19.25	*M. undulatus*	1.67	15.41	*M. undulatus*	1.73	23.27
				A. mitchilli	1.46	10.08			
2022	*M. ohione*	1.89	43.44	*F. aztecus*	2.24	33.22	*F. aztecus*	2.12	32.29
	A. mitchilli	1.65	32.72	*C. sapidus*	1.34	19.93	*L. setiferus*	1.31	22.3
				M. undulatus	1.23	17.04	*M. undulatus*	1.3	17.35

Table 2. SIMPER comparison of abundance (Abund) and percent contributions to community similarity (% Cont.) by species making up majority of on-marsh community (minnow traps) in each site (WPH 1, WPH 2, PS 7) within each year sampled (2018, 2019, 2021, 2022).

	WPH 1			WPH 2			PS 7		
	Species	Abund	% Cont.	Species	Abund	% Cont.	Species	Abund	% Cont.
2018	*F. grandis*	1.01	55.83	*F. grandis*	1.05	60.04	*F. grandis*	1.66	51.96
	P. pugio	0.63	23.53	*F. aztecus*	0.29	6.92	*P. pugio*	0.89	14.42
				L. parva	0.43	6.71	*C. sapidus*	0.53	10.4
2019	*F. grandis*	1.1	70.45	*F. aztecus*	0.73	46.29	*F. aztecus*	0.67	50.15
				F. grandis	0.9	28.03	*P. pugio*	0.55	23.64
2021	*P. pugio*	1.03	61.36	*P. pugio*	1.14	46.03	*P. pugio*	0.84	43.78
	M. ohione	0.62	31.81	*F. aztecus*	0.7	25.48	*F. aztecus*	0.46	29.31
2022	*M. ohione*	1.44	81.08	*F. grandis*	0.99	38.5	*P. pugio*	1.79	46.97
				F. aztecus	0.76	26.4	*F. grandis*	1.6	31.53
				P. pugio	0.57	11.45			

Results

- Faunal communities varied among sites pre-siphon opening.
  - All faunal communities were composed of **primarily estuarine** species pre-siphon opening (**Table 1 & 2**).
  - Brown shrimp *F. aztecus* and Gulf killifish *F. grandis* were dominant taxa collected pre-siphon opening. (**Table 1 & 2**).
- Communities at **WPH 1 experienced largest change post-siphon opening (Fig. 3)**, while sites farther from siphon (WPH 2, PS 7) incurred less drastic change.
  - Freshwater species (blue catfish [*I. furcatus*] and Ohio River shrimp [*M. ohione*]) became major contributors to the community at WPH 1 (**Table 1 & 2**).
  - Communities at WPH 2 and PS 7 remained composed of same primary estuarine species but in different abundances (**Table 1 & 2**).

Conclusions

- **Objective 1**: Nekton communities displayed inter-annual variability at all sites but with large shifts in community structure post-siphon opening.
- **Objective 2**: Effects were most prominent closest to the siphon (WPH 1) while communities more distal (WPH2, PS7) retained species composition, indicating an impact gradient.
- **Objective 3**: Freshwater species replaced estuarine species at our most impacted site (WPH 1), displaying reorganization that could impact ecological functions (e.g., energy flow) and services (e.g., fisheries).

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