Cold Blood in Warming Waters: Conserving Gulf Sturgeon Using Precipitation & Groundwater Models

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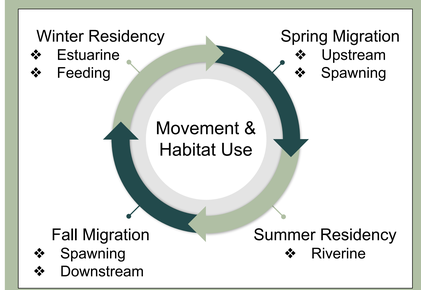
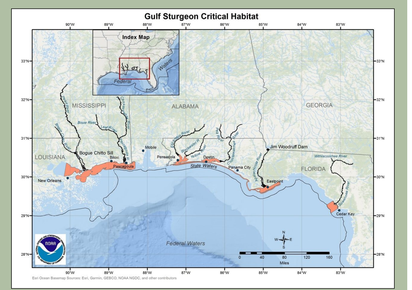
PURPOSE

- Understanding climate change impacts on cold-blooded species is crucial for conservation
- Lotic ecosystems link land and sea and contain thermal refuge habitats for migratory species
- Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) are "canaries in the coal mine" of rivers, estuaries, and nearshore habitats in the Gulf of Mexico

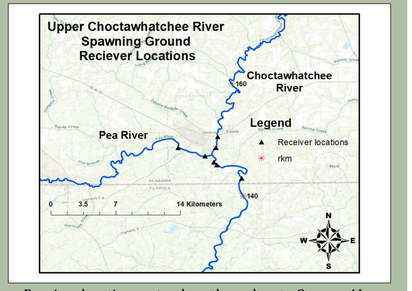


An anadromous species, Gulf Sturgeon use a wide range of habitats across their life history.

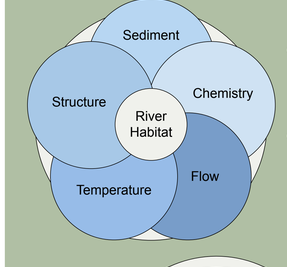


Gulf Sturgeon spawn in the Pearl, Pascagoula, Escambia, Yellow, Choctawhatchee, Apalachicola & Suwannee River.

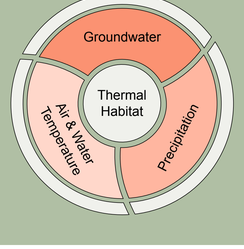
VR2W receivers track tagged Gulf Sturgeon movement, starting at river km 0 in the Choctawhatchee Bay, FL.



Receiver locations extend northward up to Geneva, AL, where the Choctawhatchee and Pea River meet.



- Although lotic habitats are influenced by many interrelated factors, understanding the nuances in water temperature and thermal habitat suitability is important to conservation
- Current models do not address linkages between precipitation, air temperature, water temperature, and groundwater dynamics

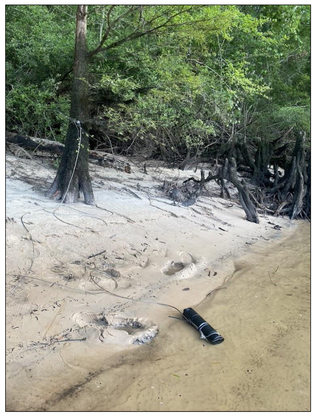


OBJECTIVES

Develop common metrics for assessing landscape-level threats to Gulf Sturgeon by:

- Creating precipitation- and groundwater-corrected river temperature models
- Comparing high-use and low-use areas (e.g., holding and non-holding areas)
- Relating thermal suitability to riverine characteristics and surrounding land-use/water-use

METHODS



A VR2W telemetry receiver cabled to a tree

- Twelve HOBO Pro v2 data loggers were deployed in four holding areas and three non-holding areas
- Water loggers were attached to telemetry receiver cables
- Air loggers were attached to the same, or nearby, trees the receiver cables were affixed to

	Holding Area	Air	Water
River km 3		✔	✔
River km 20			✔
River km 30	✔	✔	✔
River km 40		✔	✔
River km 50	✔	✔	✔
River km 60	✔		✔
River km 147.5	✔	✔	✔

1 km-wide Holding Areas were determined by federal agency partners

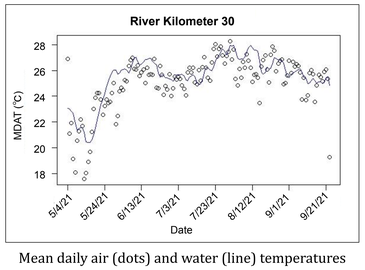
Field Schedule

May '21	Sep '21	Jan '22	May '22	Sep '22	Jan '23	May '23
Loggers Deployed	Data Downloaded	Data Downloaded				

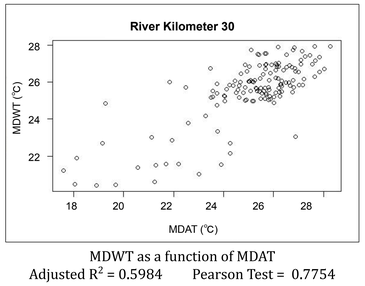
Downloading HOBO Pro v2 data loggers

A Choctawhatchee River boat ramp with Sturgeon signage

PRELIMINARY RESULTS



Mean daily air (dots) and water (line) temperatures



MDWT as a function of MDAT
Adjusted R^2 = 0.5984 Pearson Test = 0.7754

ANALYTICAL OBJECTIVES

- Model MDWT as a function of MDAT, groundwater, & precipitation using least-squares linear regression

$$\mathbf{MDWT}_i = m_1\mathbf{MDAT}_i + m_2\mathbf{ADD}_i + b_0$$

$$\mathbf{MDWT}_i = m_1\mathbf{MDAT}_i + m_2\mathbf{PR}_i + b_0$$

- Model effects of changes in thermal sensitivity of groundwater and precipitation by increasing model y-intercepts

$$\mathbf{MDWT}_i = m_1\mathbf{MDAT}_i + m_2\mathbf{ADD}_i + b_0$$

$$\mathbf{MDWT}_i = m_1\mathbf{MDAT}_i + m_2\mathbf{PR}_i + b_0$$

$MDWT_i$ =	projected MDWT (℃) on day *i*
$MDAT_i$ =	projected MDAT (℃) on day *i*
ADD_i =	ADD (degree-days) on day *i*
b_0 =	model intercept
m_1, m_2 =	regression coefficients
PR_i =	cumulative precipitation on day i

DISCUSSION

↓ Precipitation + ↑ Groundwater Withdrawals ↠ ↑ Air & Water Temperatures + ↓ River Flows

- These factors affect Gulf Sturgeon migrations, spawning and ultimately, survival
- Understanding these changes is important to Gulf Sturgeon conservation across their life history, particularly at the understudied juvenile stage
- Models in the context of climate change can inform management decisions on land- and water-use
- Application for other species can inform thermal habitat suitability as cold-blooded organisms expand their habitat ranges due to climate change
- Application for other Gulf Sturgeon populations can inform species-wide management
- Further study of these critical habitats may support river-specific management

REFERENCES

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TAKE ONE