Spatial and Temporal Patterns of Eastern Oyster (*Crassostrea virginica*) Populations and Their Relationships to Dermo (*Perkinsus marinus*) Infection and Freshwater Inflows in West Matagorda Bay, Texas

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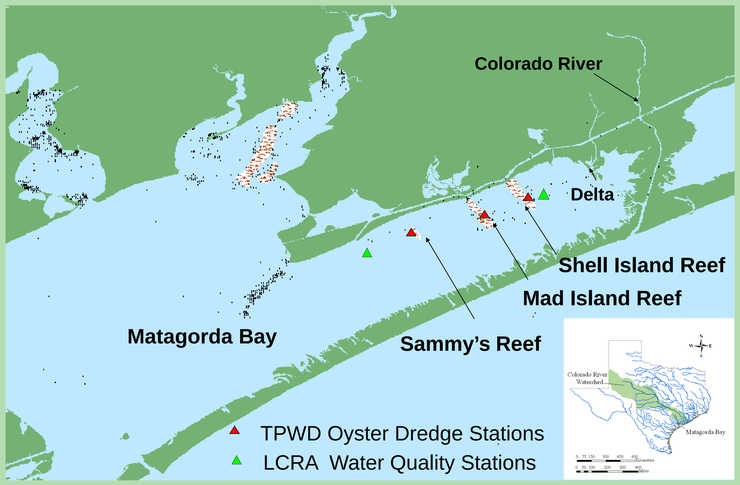
Objective

An integrated Matagorda Bay oyster model was developed in Stella to simulate oyster population responses to stochastic environmental changes over a 50-year period.

Study Area

Three reefs in Matagorda Bay: Shell Island (154-acres), Mad Island (112-acres) and Sammy's Reef (9-acres) receive freshwater inflows from Colorado River.



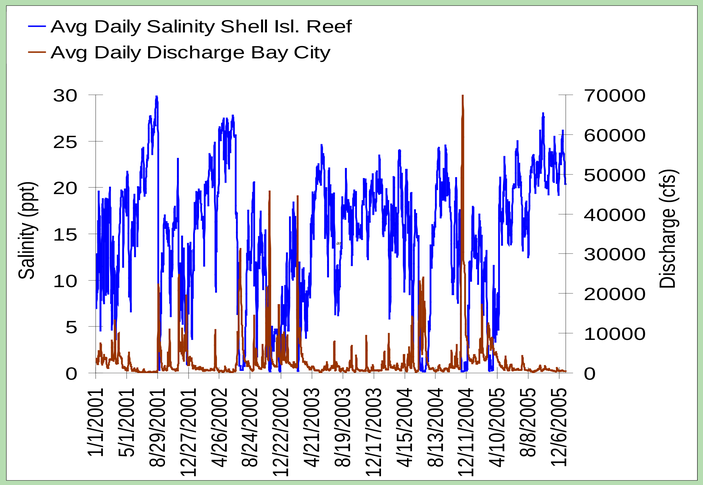
Methods

Matagorda Bay oyster model utilizes 2001-2005 historical trends:

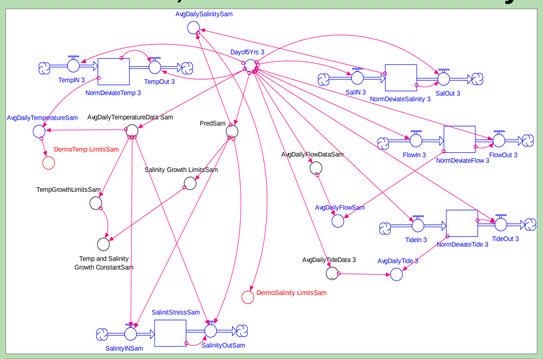
- **Average daily flow from Colorado River and tides from Gulf pass.**
- **Monthly oyster abundance collected by Texas Parks and Wildlife Department (TPWD) at Shell Island, Mad Island and Sammy's Reefs.**
- **Average daily salinity and temperature data from Lower Colorado River Authority (LCRA) stations on Shell Island Reef and Gulf Intracoastal Waterway (GIWW) outlet into Matagorda Bay.**

Matagorda Bay oyster model evaluates:

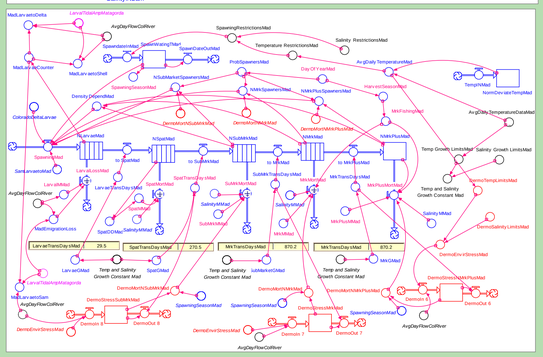
<u>Explanatory Variables of Model</u>: salinity, salinity-prior month, temperature, temperature-prior month, distance from freshwater, inflows, inflows-prior month, tides and sample date
<u>Response Variables of Model</u>: oyster population growth, reproduction, larvae distribution, abundance of larvae, spat, sub-market, and market oysters, dead oysters, and Dermo Infection



Historical record (2001-2005) for average daily salinity at Shell Island Reef, (LCRA) and average daily discharge from Colorado River at Bay City used in environmental sub-models for Matagorda Bay oyster model. High freshwater inflows influence salinity at Shell Island Reef, located closest to Delta.



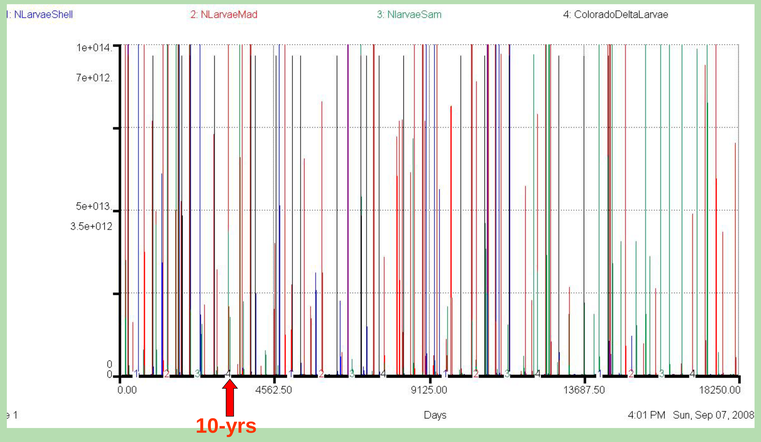
<u>Environmental Sub-Models</u>
Simulates 50-yrs of continuous daily hydrological, meteorological, and tide data using 0.1, 1.0 and 2.0 SD of 2001-2005 historical records.



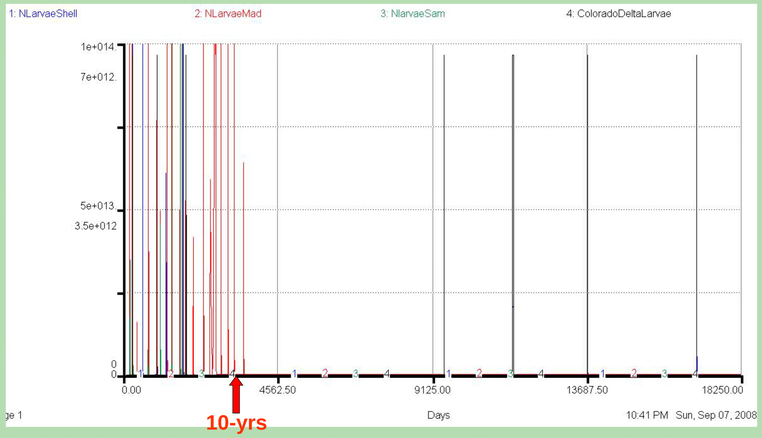
<u>Oyster Population Sub-Models</u>
Simulates oyster population growth, spawning, fecundity, distribution of larvae, spat set, density of population, Dermo infection, and mortality.

Results

Spawning/Larvae Distribution Responses to Freshwater Inflows

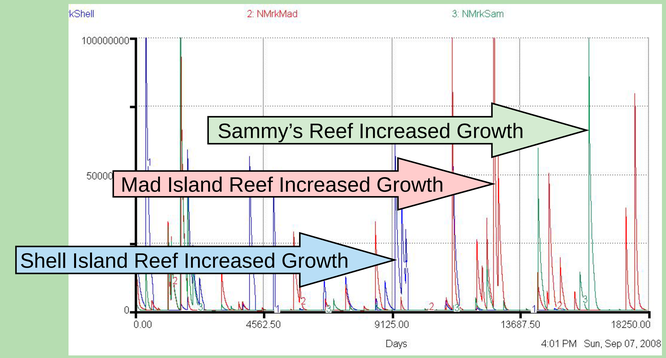


Peaks indicate when each reef spawned following freshwater inflows (0.1 SD Simulation Run). Results are comparable with three oyster populations' historic trends or responses to floods and droughts. Blue-Shell Isl. Red-Mad Isl. Green-Sammy's Black-Colorado Delta

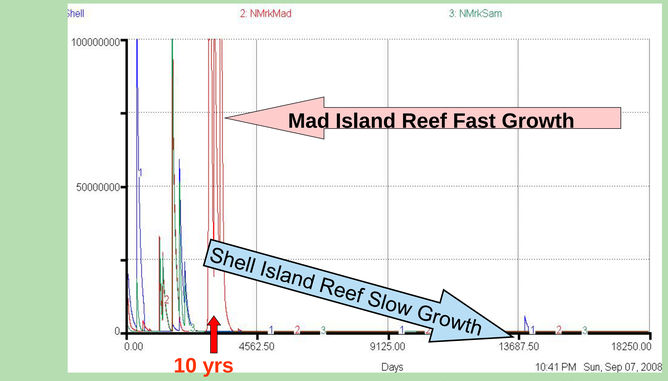


Peaks indicate when reef populations spawned following sustained reduction in freshwater inflows (2.0 SD simulation). After 10-yrs only Shell Island and Colorado Delta oyster populations were able to spawn at optimum salinity conditions. Amplitude of responses decreased at all reefs.

Growth Response to Freshwater Inflows

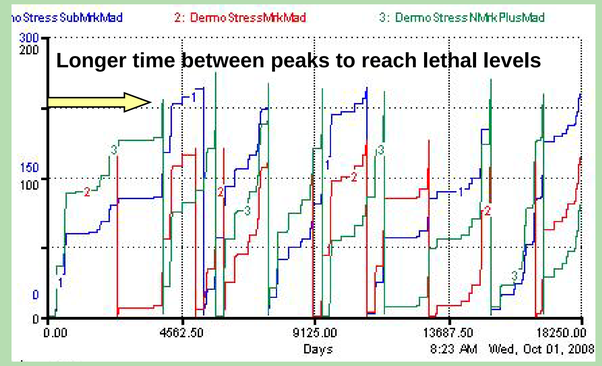


50-yrs Market abundance and growth increased following sustained freshwater inflows (0.1 SD Model Simulation)

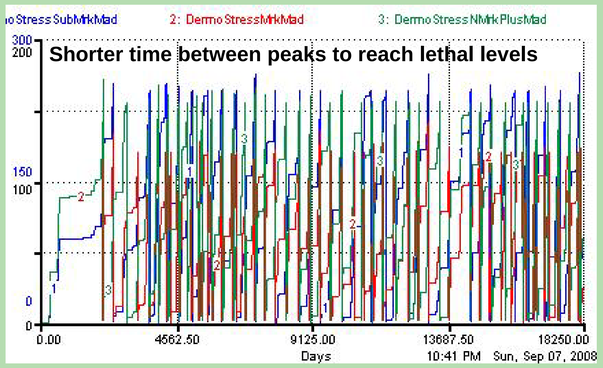


50-yrs Market oyster abundance and growth decreased following reduced freshwater inflows (2.0 SD Model Simulation)

Dermo Responses to Freshwater Inflows



Longer time required to reach lethal Dermo infection levels following sustained freshwater inflows in Mad Island Reef oyster populations over 50-yr period (0.1 SD Simulation)



Shorter time required to reach lethal Dermo infection levels following reduced freshwater inflows in Mad Island Reef oyster populations over 50-yr period (2.0 SD Simulation)

Conclusions

- **Model showed growth, spawning and spat set were positively related to duration and timing of freshwater inflows; and also distance from freshwater sources.**
- **Up-estuary reefs relied on the distribution of larvae from down-estuary reefs following freshwater related mortalities, and meteorological and tidal forces.**
- **Matagorda Bay oyster populations are integral members of a dynamic bay ecosystem that function as one unit and not separate reef populations.**