

# BBEST Recommendations for Freshwater Inflow to Galveston Bay

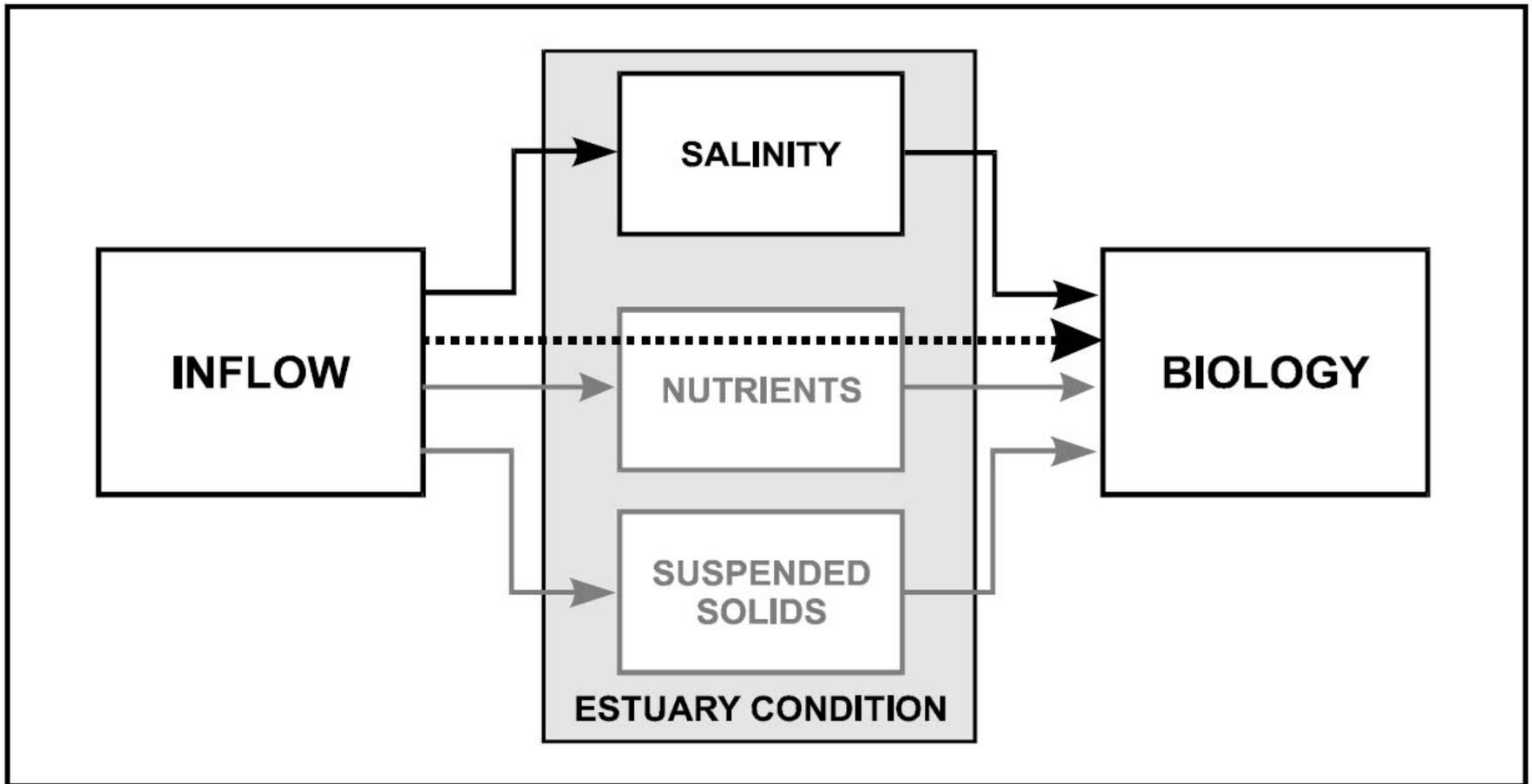
Jim Lester, HARC

With contributions from Dave Buzan, George Guillen, Antonietta Quigg, Joe Trungale and Woody Woodrow.

January 13, 2010

# BBEST Members Endorsing Recommendations

- L. James Lester, Ph.D.
- Dave Buzan
- George Guillen, Ph.D.
- Robert McFarlane, Ph.D.
- Antonietta Quigg, Ph.D.
- Sammy Ray, Ph.D.
- Joe Trungale, P.E.
- Jarrett (Woody) O. Woodrow, Jr.



**Figure 2.1-2 – Schematic of Relation of “Biology” to “Inflow”  
(Compressed from Figure 2.2-1)**

# Response to SAC Review Framework

- Use of all reasonably available science? Yes, if data available for application. Science identified by expert workshop with broad participation (Jim Lester, Bill Espey, Bill Balboa, Richard Browning, Woody Frossard, Lisa Gonzalez, George Guillen, Carla Guthrie, Norman Johns, Cindy Loeffler, Robert McFarlane, Paul Montagna, Jennifer Pollack, Warren Pulich, Sammy Ray, Lance Robinson, Jamie Schubert, Tony Smith, Ruben Solis, Mike Stahl, Joe Trungale, Mike Turco, and Woody Woodrow).
- Scientific basis for predicting ecosystem response to flow change? Yes, chose biological indicators with specific salinity niche and timing; flow-salinity change affects

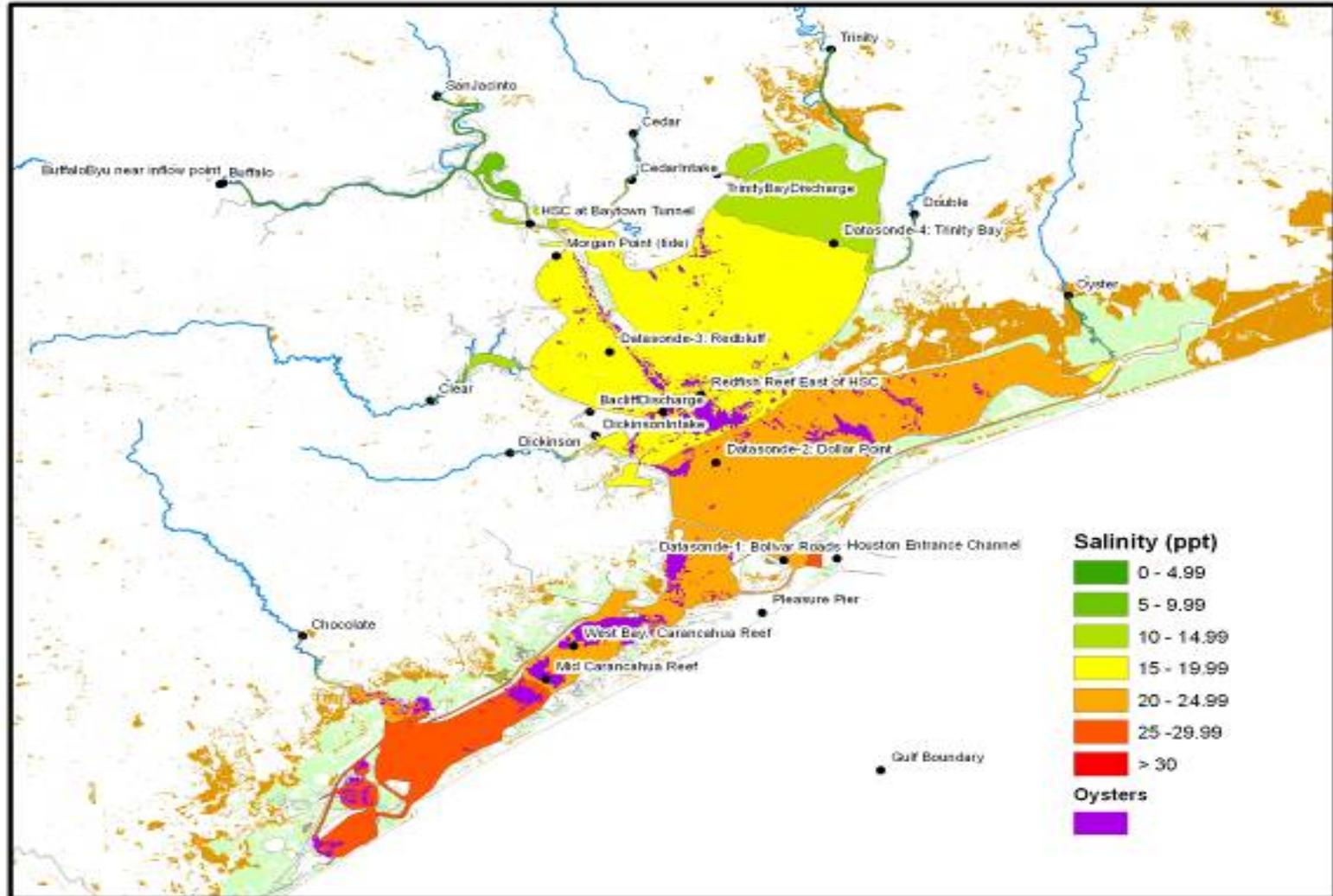
Identified Biological Indicators for Evaluating Freshwater Inflow Needs to Galveston Bay. Emphasis was placed on the sessile organisms: wild celery, Atlantic Rangia and oyster parasites and predators.

|                          | Common Name                              | Scientific Name   | Criterion   | Period of Concern            |
|--------------------------|--|---|---|------------------------------|
| Habitat Indicator        | Wild Celery                              | <i>Vallisneria americana</i>  | <5 psu for germination and establishment                  | Spring                       |
|                          | “  | “   | <10 psu for survival                                      | Summer and Fall              |
| Low Salinity Indicators  | Atlantic Rangia                          | <i>Rangia cuneata</i>   | 2 – 10 psu for spawning and larval survival               | Spring and Fall              |
|                          | Gulf menhaden                            | <i>Brevoortia patronus</i>  | 5 – 15 psu for occurrence as forage fish                  | Winter and Spring            |
| Oyster Health Indicators | Dermo and oyster drill impacts on oyster | Dermo= <i>Perkinsus marinus</i><br>Oyster drill= <i>Stramonita haemastoma</i><br>Oyster= <i>Crassostrea virginica</i> | 10 – 20 psu to prevent excessive parasitism and predation | July - September             |
|                          | “  | “   | <5 psu to remove parasite load from central reefs         | 2 weeks at 10 year intervals |

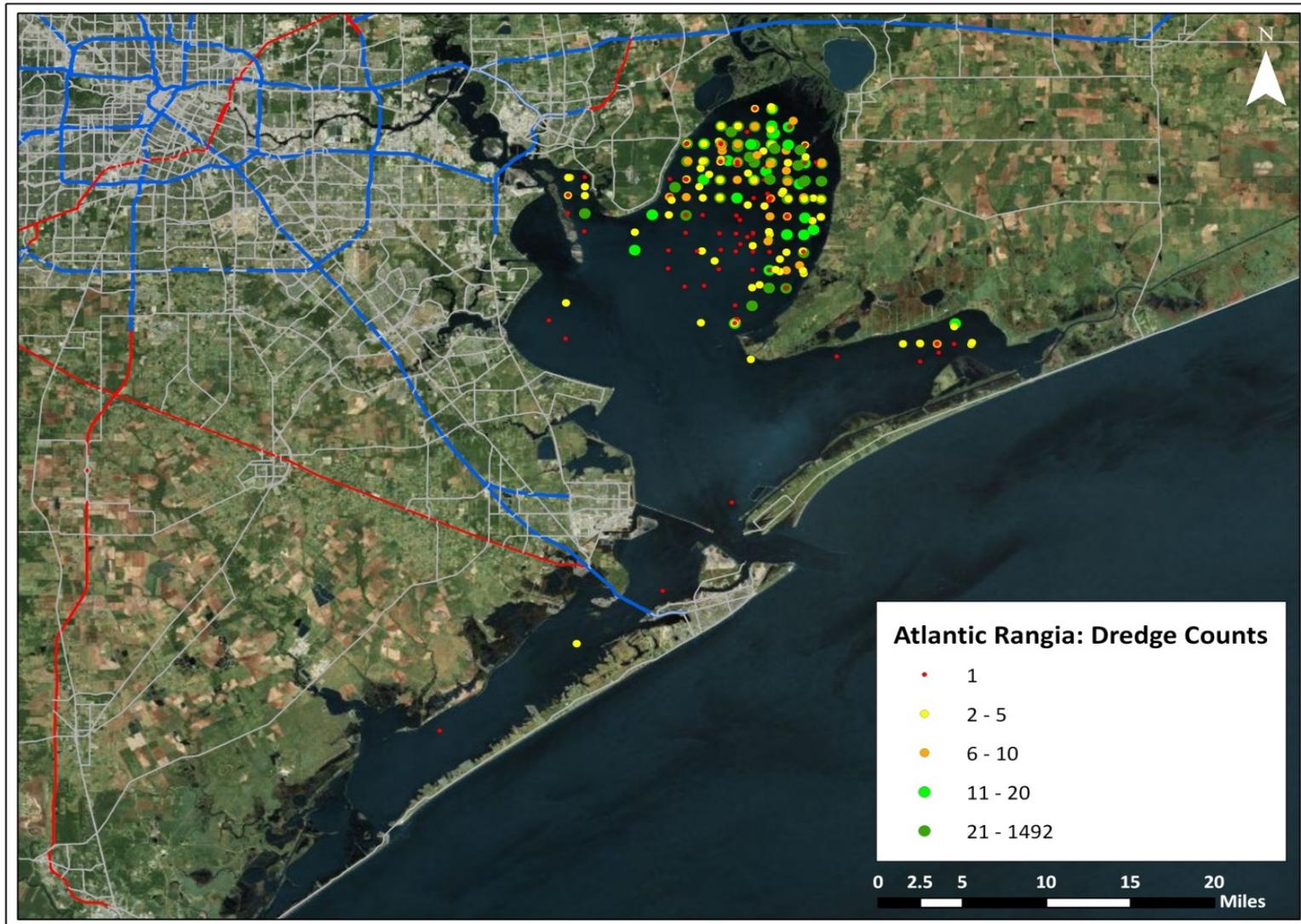
# Response to SAC Review Framework

- Recommendations based on best available science? Yes and best professional judgment.

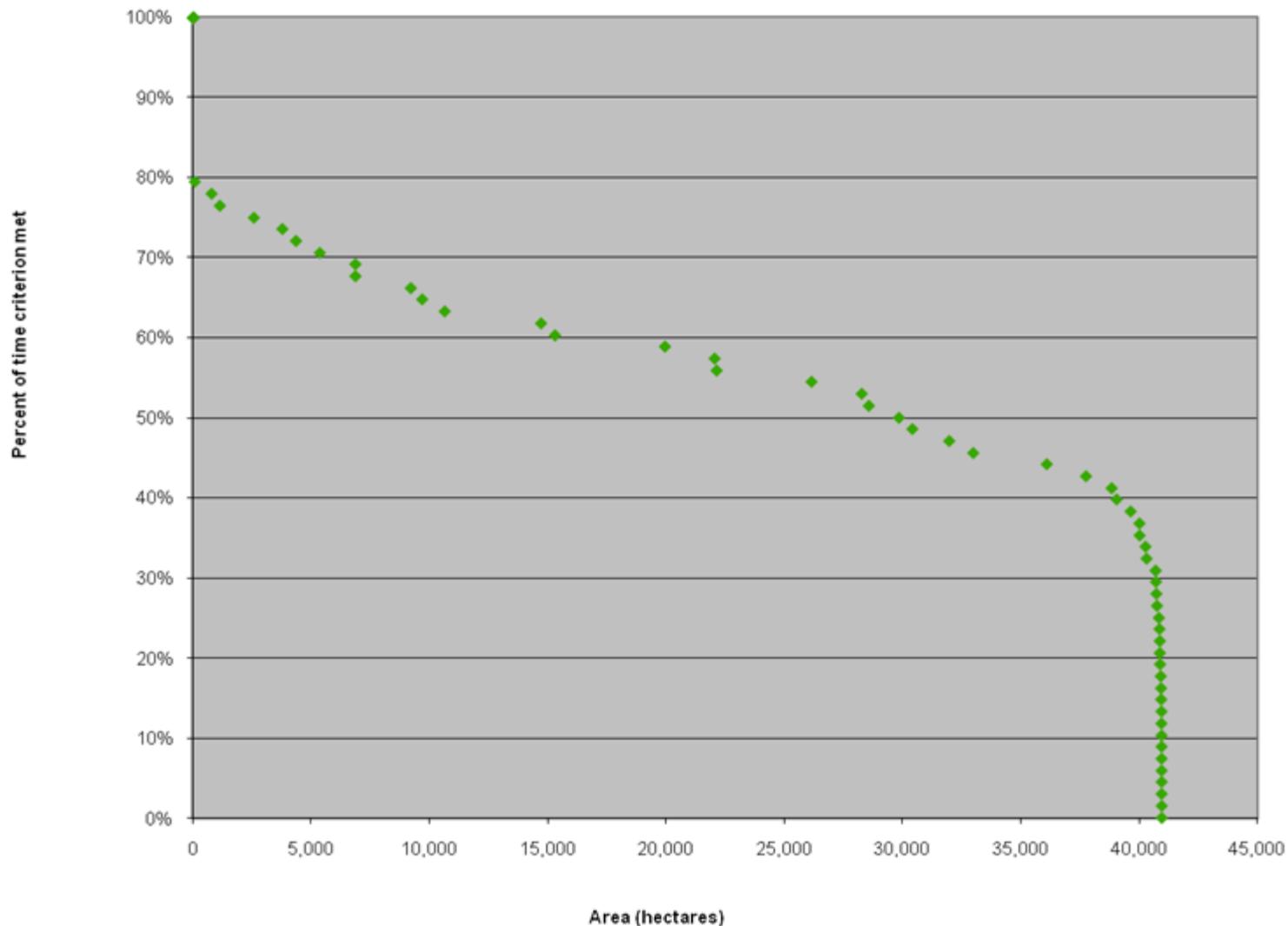
TXBlend Model of 5 psu salinity zones in Galveston Bay for the flow pattern of May 2000. (50<sup>th</sup> percentile of flows for the period of record used by TXBlend.)



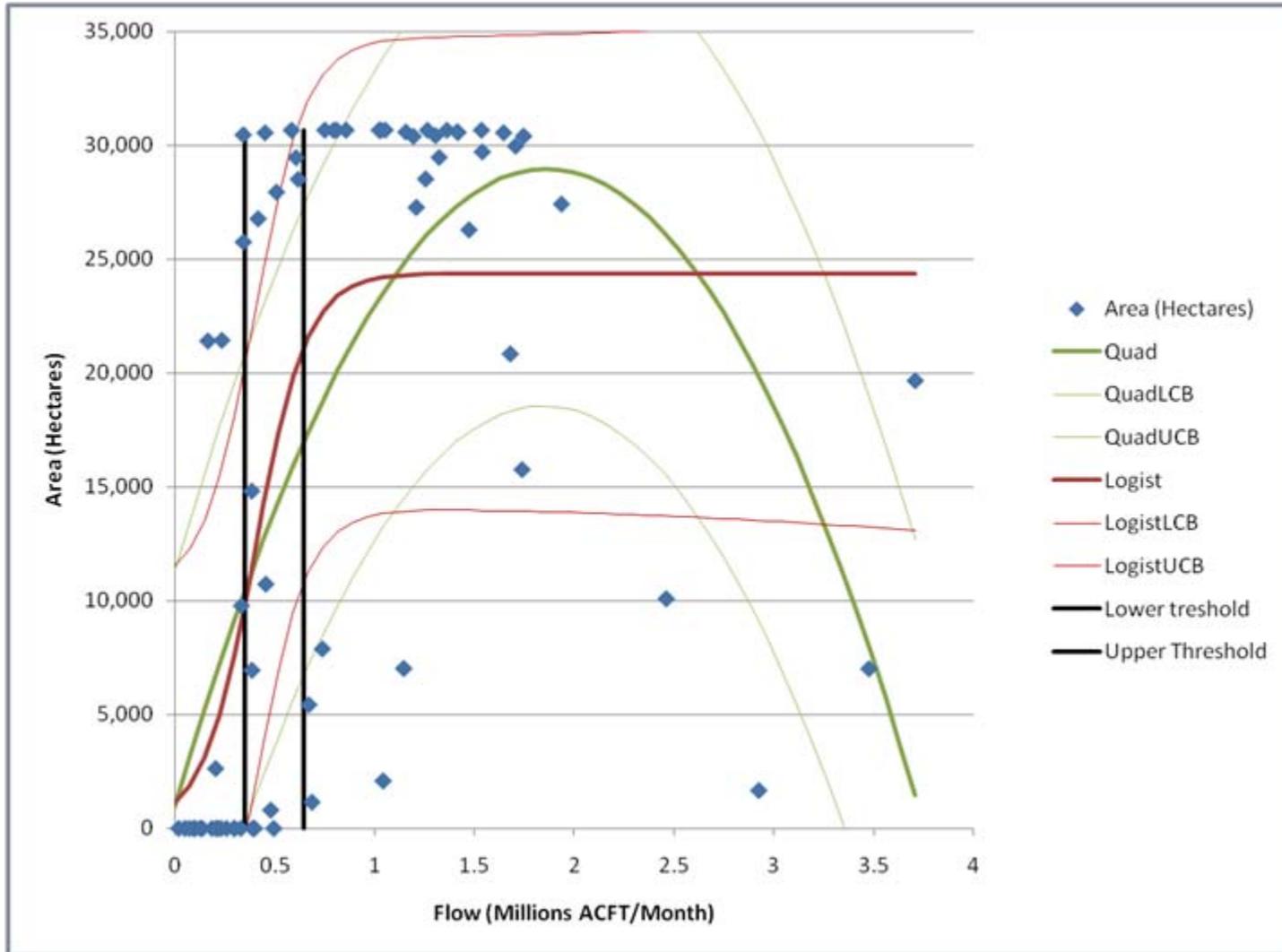
Map of the collections of Atlantic Rangia by TPWD in dredge samples and the abundance of clams in each collection.



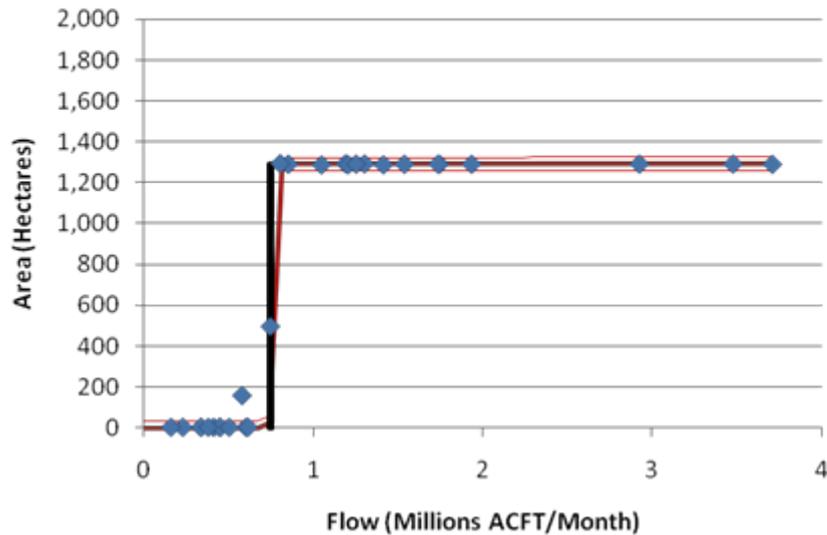
# Plot of the percent of spring months in the TXBlend record in which a given portion of Atlantic Rangia habitat in Galveston Bay meets the salinity criterion (2 – 10 psu)



Plot of spring flow from the Trinity River and the hectares of habitat assigned to Atlantic *Rangia* with suitable salinity values for survival of larvae. Quadratic and logistic regression analyses are shown. Logistic provides a better fit.



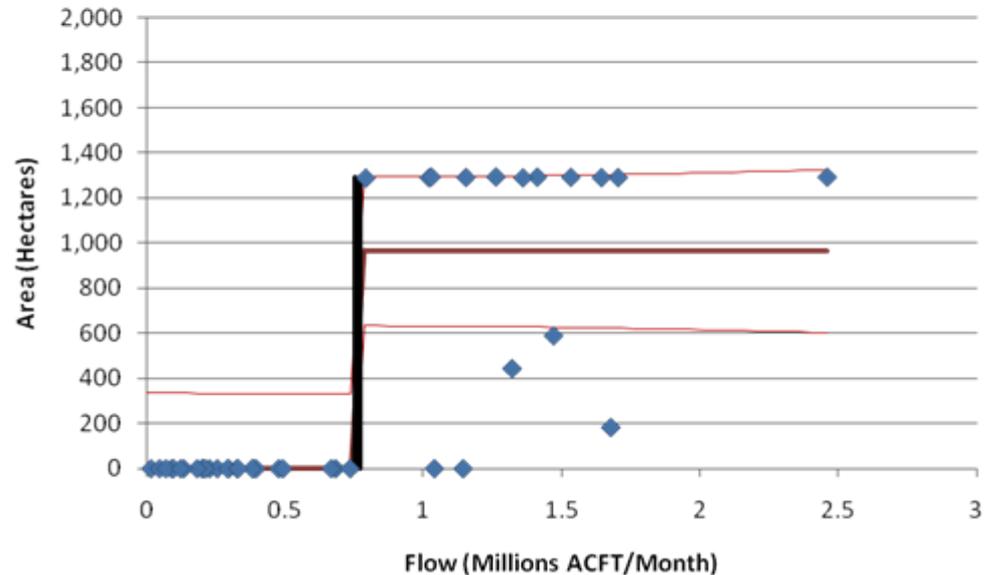
## Flow to obtain salinity criteria for Vallisneria in Spring with preceding Good Conditions = 742,000 ac-ft



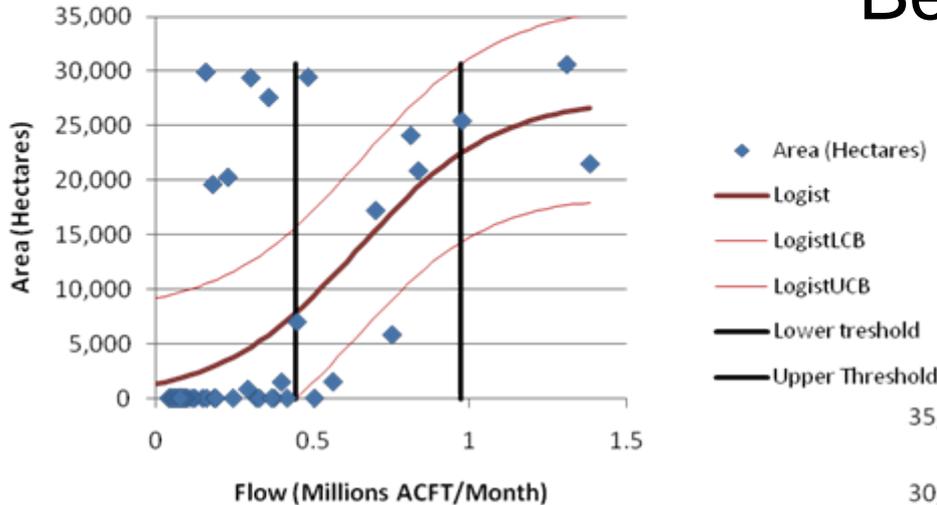
## Best Available Science

- ◆ Area (Hectares)
- Logist
- LogistLCB
- LogistUCB
- Lower threshold
- Upper Threshold

## Vallisneria Spring Salty Conditions = 754,000 ac-ft

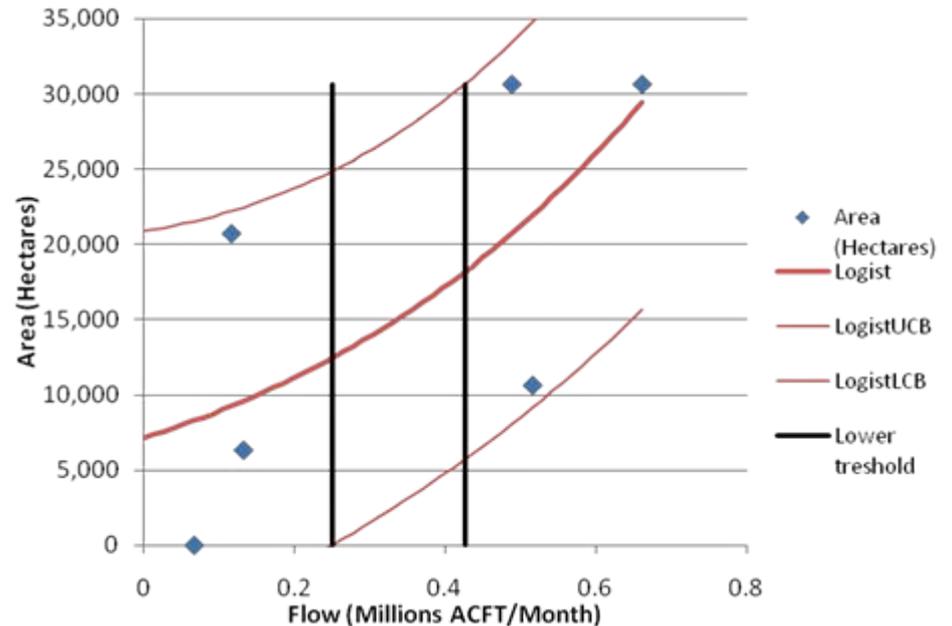


**Regression of San Jacinto flow for Rangia spawning criterion in fall if preceding month is salty. (446,000 ac-ft)**



**Best Professional Judgment**

**Regression of flow for Rangia spawning criterion in fall if preceding month is suitable. (250,000 ac-ft)**



# Response to SAC Review Framework

- Flow variation by season, year and geography?  
Yes, values by season, source and recommended periodicity.

## Trinity

| Season                    | Spring      | Summer      | Fall        | Winter      |
|---------------------------|-------------|-------------|-------------|-------------|
| Flow (ac-ft)              | 742000      | 205000      | 141000      | 253000      |
| Periodicity within season | 1 of 3 mo.  | 2 of 3 mo.  | 2 of 3 mo.  | 1 of 3 mo.  |
| Periodicity among seasons | 1 in 2 yrs. | 1 in 2 yrs. | 1 in 3 yrs. | 1 in 2 yrs. |
| Indicator                 | Vallisneria | Vallisneria | Vallisneria | Menhaden    |

## San Jacinto

| Season                    | Spring      | Summer      | Fall        | Winter      |
|---------------------------|-------------|-------------|-------------|-------------|
| Flow (ac-ft)              | 302000      | 257000      | 250000      | 131000      |
| Periodicity within season | 1 of 3 mo.  | 2 of 3 mo.  | 1 of 3 mo.  | 1 of 3 mo.  |
| Periodicity among seasons | 1 in 2 yrs. | 1 in 5 yrs. | 1 in 2 yrs. | 1 in 2 yrs. |
| Indicator                 | Rangia      | Oyster      | Rangia      | Menhaden    |

## Coastal Streams

| Season                    | Spring      | Summer      | Fall        | Winter      |
|---------------------------|-------------|-------------|-------------|-------------|
| Flow (ac-ft)              | 455000      | 196000      | 244000      | 84000       |
| Periodicity within season | 1 of 3 mo.  | 2 of 3 mo.  | 1 of 3 mo.  | 1 of 3 mo.  |
| Periodicity among seasons | 1 in 2 yrs. | 1 in 4 yrs. | 1 in 4 yrs. | 1 in 2 yrs. |
| Indicator                 | Rangia      | Oyster      | Rangia      | Menhaden    |

Plus Decadal Flood

# Response to SAC Review Framework

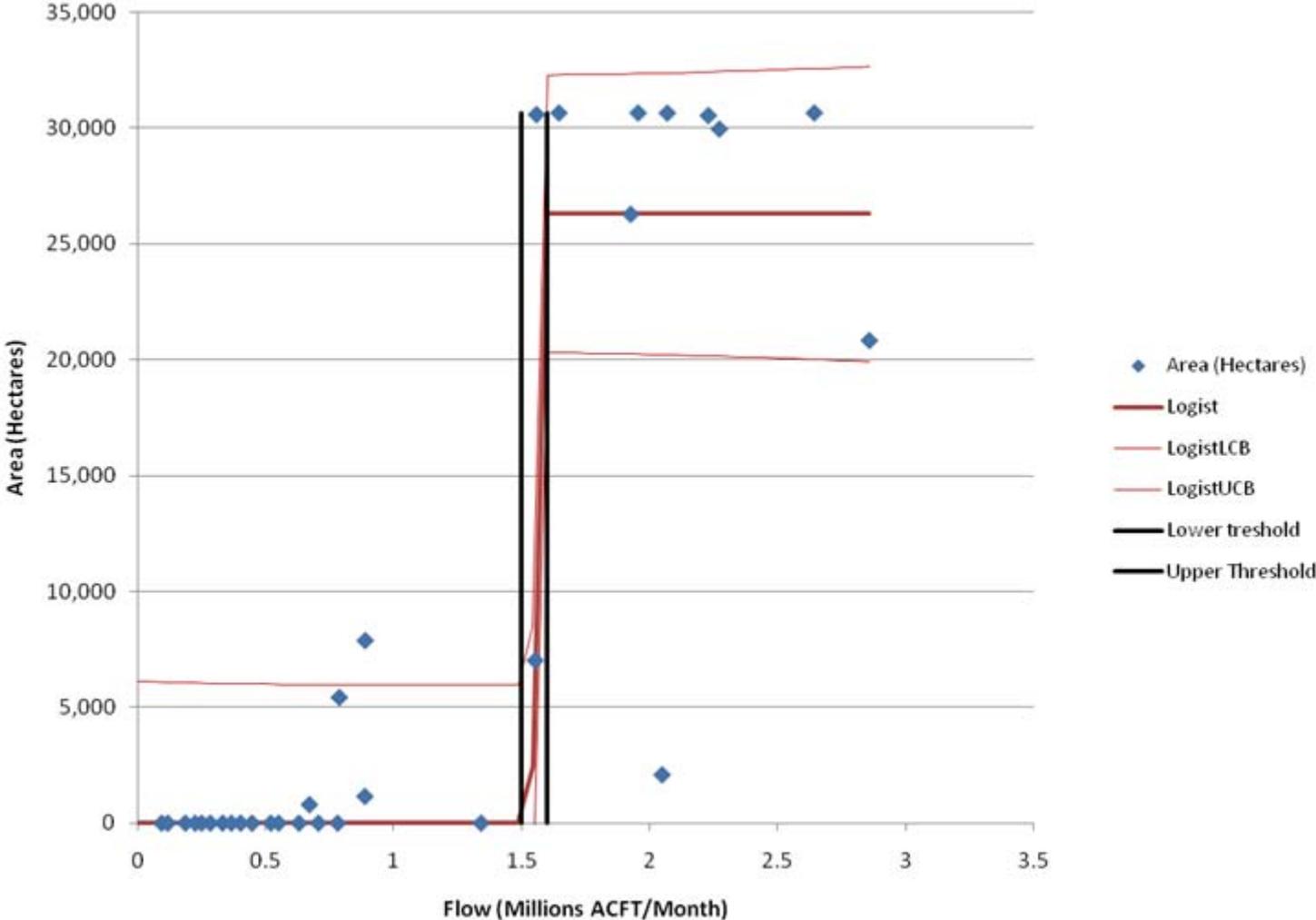
- Support a sound ecological environment? Yes, in the judgments of majority of BBEST. We used the period of record in TPWD monitoring database as baseline and indicators dependent on low to mid salinity in upper and middle bay where salinity variation is relevant.

# Conclusion

- Recommendation is a reasonable product of regulatory science and an improvement on previous efforts. Adaptive management and revision will be essential.

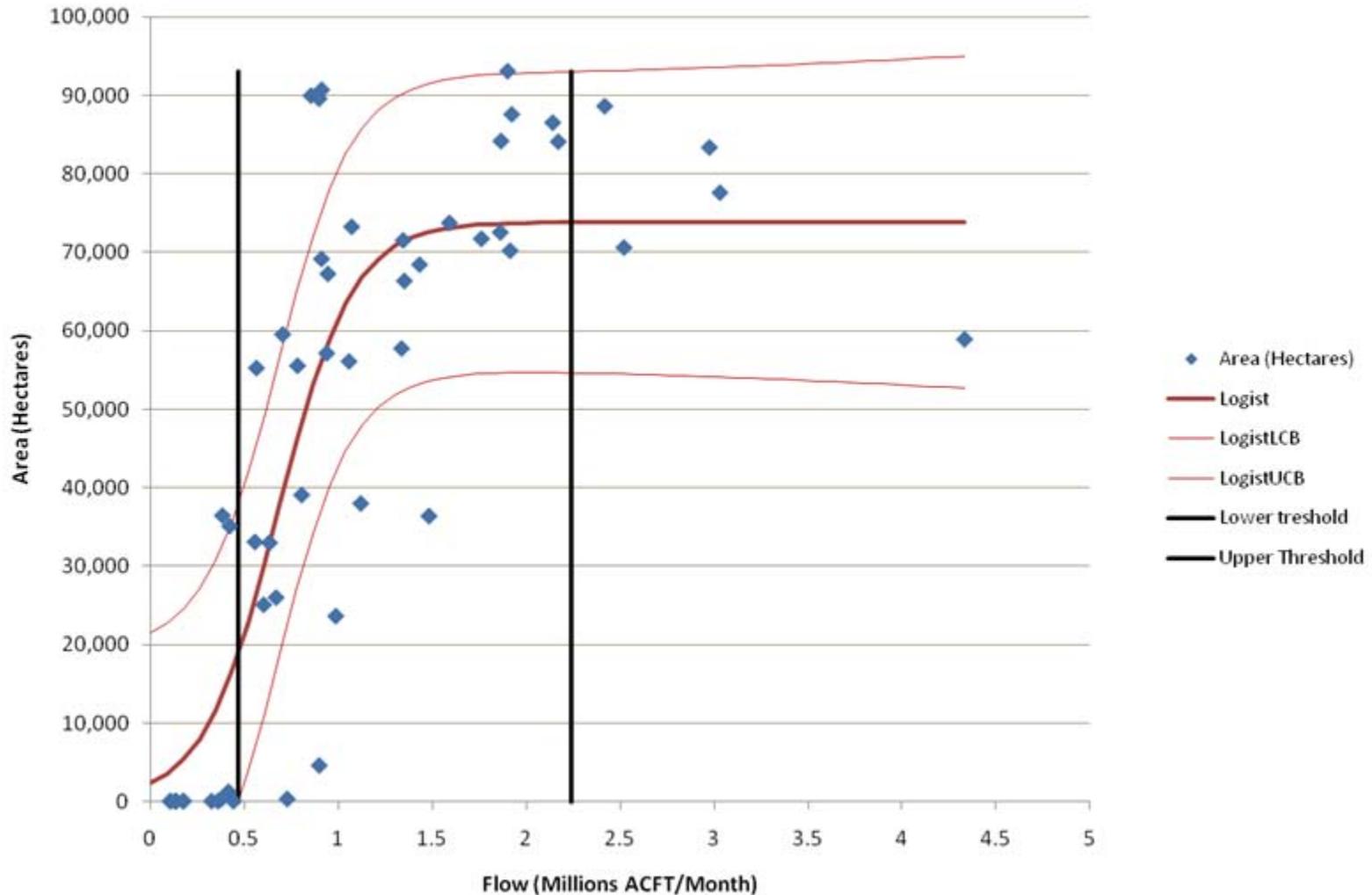
The following are optional slides  
for dealing with questions  
should they arise.

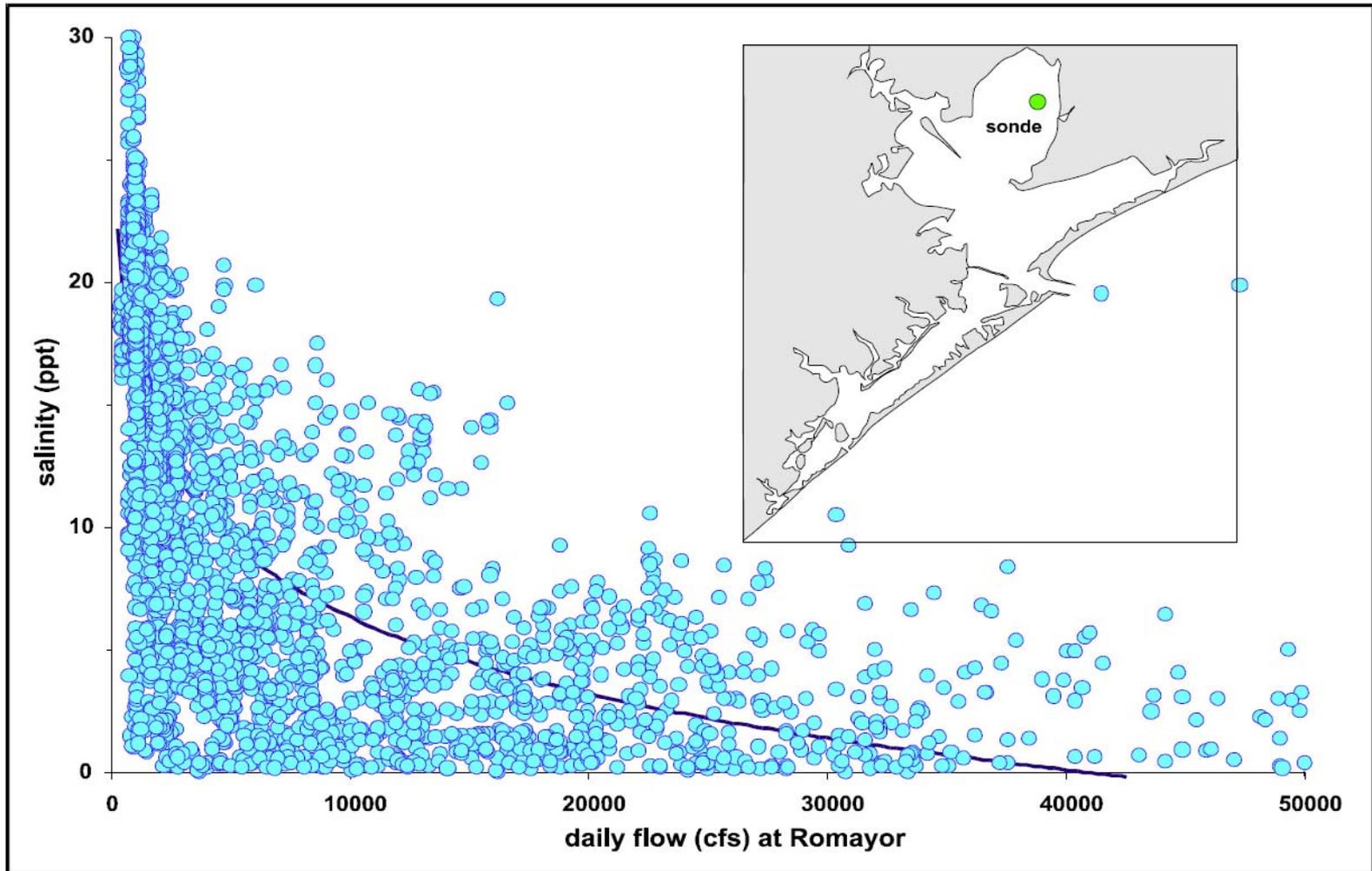
Plot of logistic regression of Rangia habitat meeting salinity criterion with spring flows for the entire bay when the preceding salinity has been high (recommended flow = 1,500,000 ac-ft).



Regression analysis of winter flows following high salinity conditions and the area of Gulf menhaden habitat in suitable salinity conditions (5 - 15 psu).

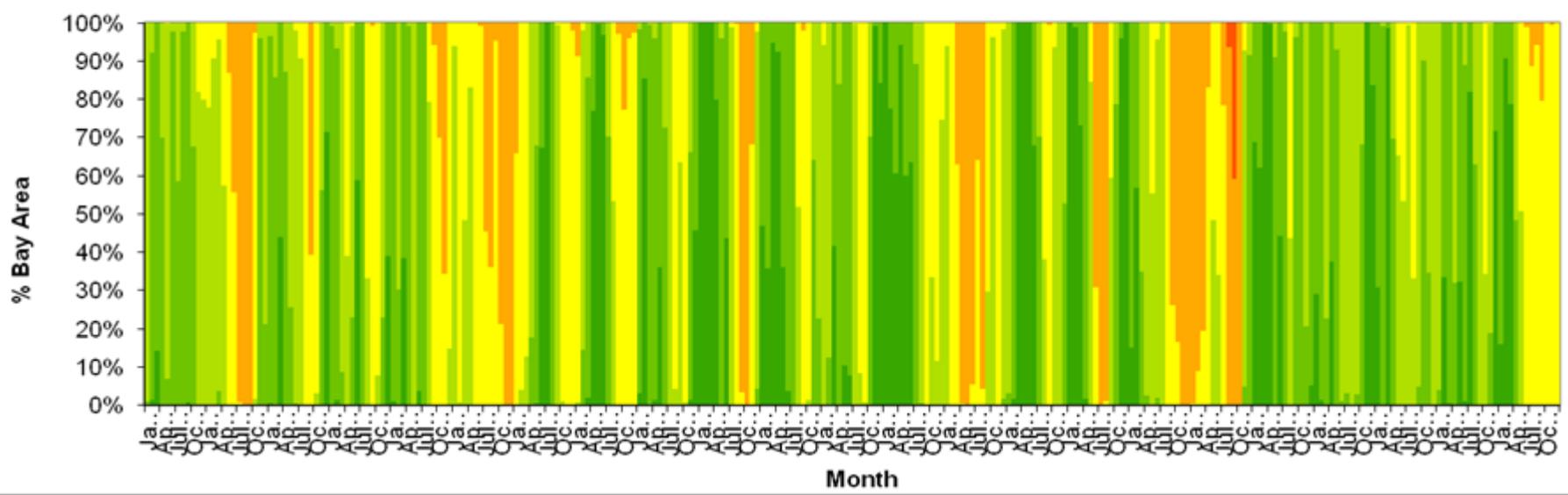
Recommended flow from all sources is 469,000 ac-ft in one winter month.



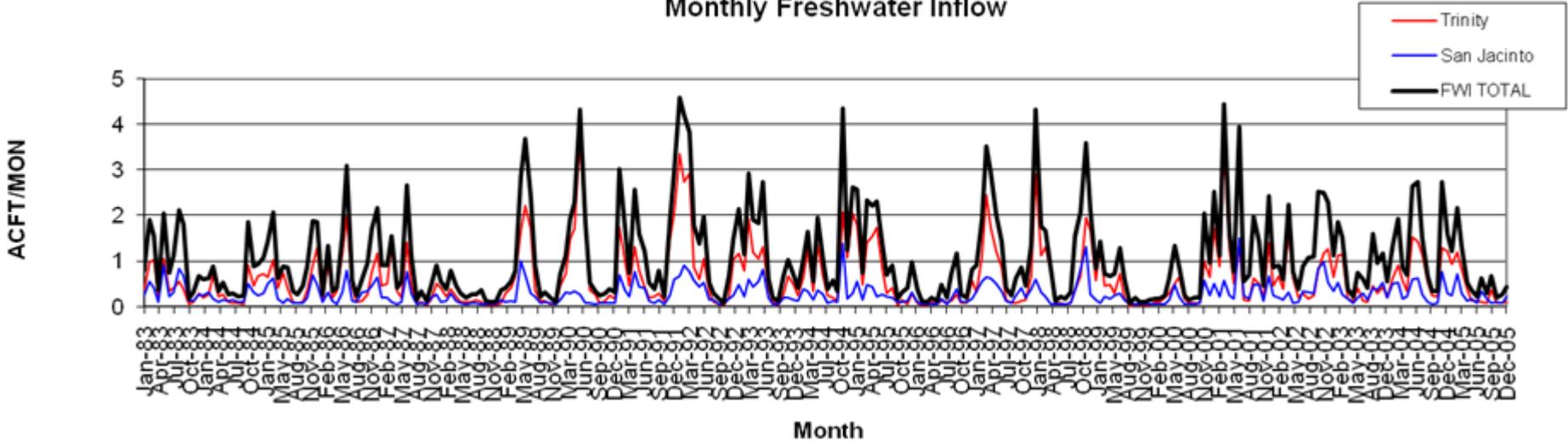


**Figure 2.3-2 Surface Daily-Mean Salinity at Trinity Bay Sonde Versus Trinity River Flow at Romayor with 30-Day Lag of Salinity Behind Flow for 1986-2007**  
(from data files of Texas Water Development Board)

### Percent of Rangia Sub-Bay Area Within Salinity Ranges



### Monthly Freshwater Inflow



# Comparison of GBFIG Recommendation with BBEST Recommendation (combining Salinity Zone and HEFR analyses)

