Overview of SAC B&E Guidance

5/11/2010 BBEST Meeting

Environmental Flow Regime

- “a schedule of flow quantities that reflects seasonal and yearly fluctuations that typically would vary geographically, by specific location in a watershed, and that are shown to support a <u>sound ecological environment</u>…

Sound Ecological Environment

- Sustains the full complement of native species in perpetuity
- Sustains key habitat features by these species
- Retains key features of the natural flow regime required by these species to complete life cycles
- Sustains key ecosystem processes and services, such as elemental cycling and the productivity of important and animal populations

Methodologies for Developing Bay and Estuary Inflow Requirements

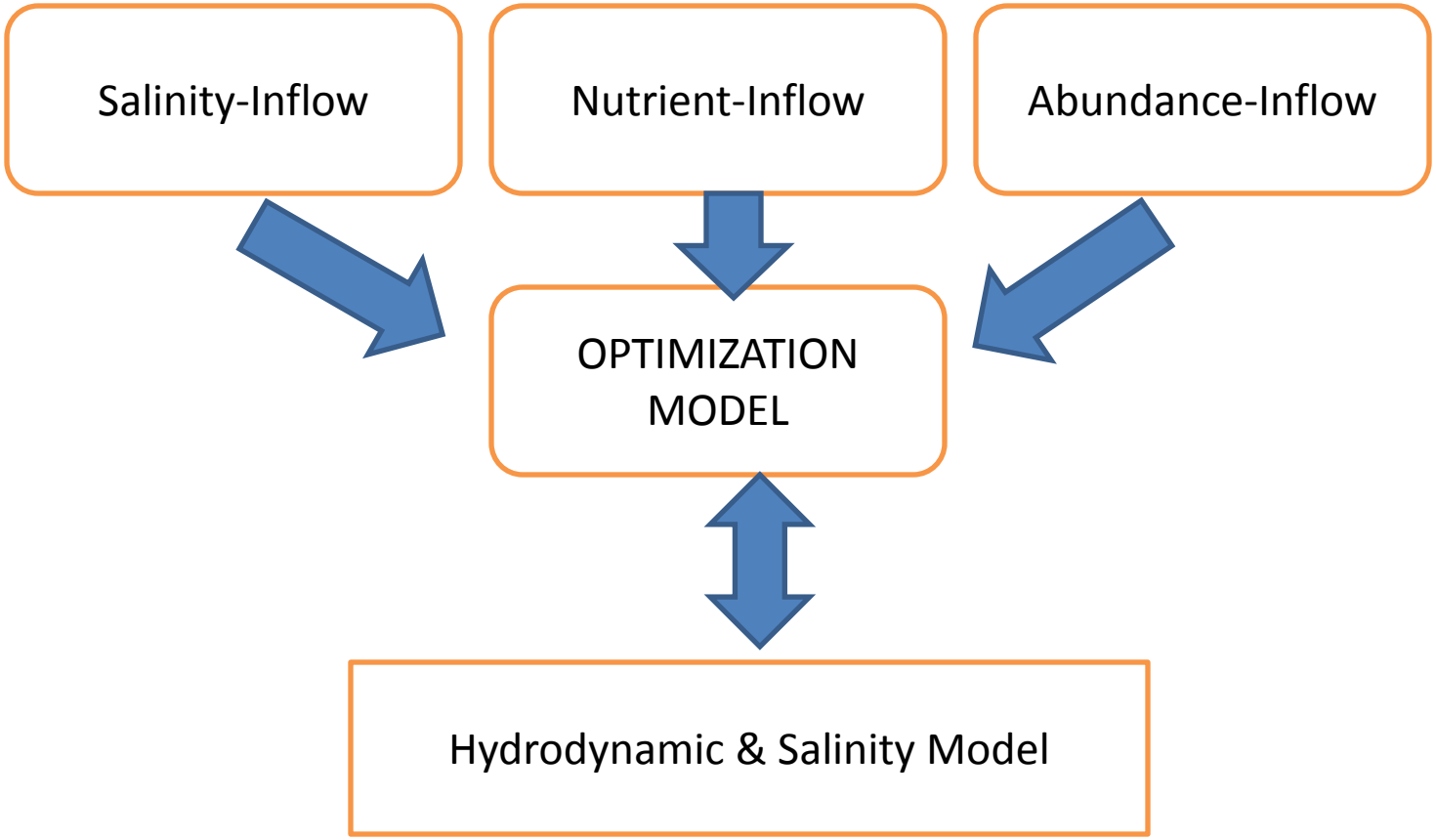
- State Methodology
- Salinity Zone Approach
- Hydrology Based Approach
  - HEFR, NWF Inflow Pattern, % Flow Approach
- Matagorda Bay Health Evaluation method

State Method

- Approach attempts to optimize productivity
  - Hydrology: monthly inflow
  - Salinity: inflow-salinity relationship
  - Biology: inflow-salinity relationship
  - Each variable is constrained
- Various Management Goals
  - Max H- maximized system productiviy
  - Min Q- minimum flow to sustain estuary

State Method: Matagorda-Lavaca

Process for Determining Target Inflow Needs

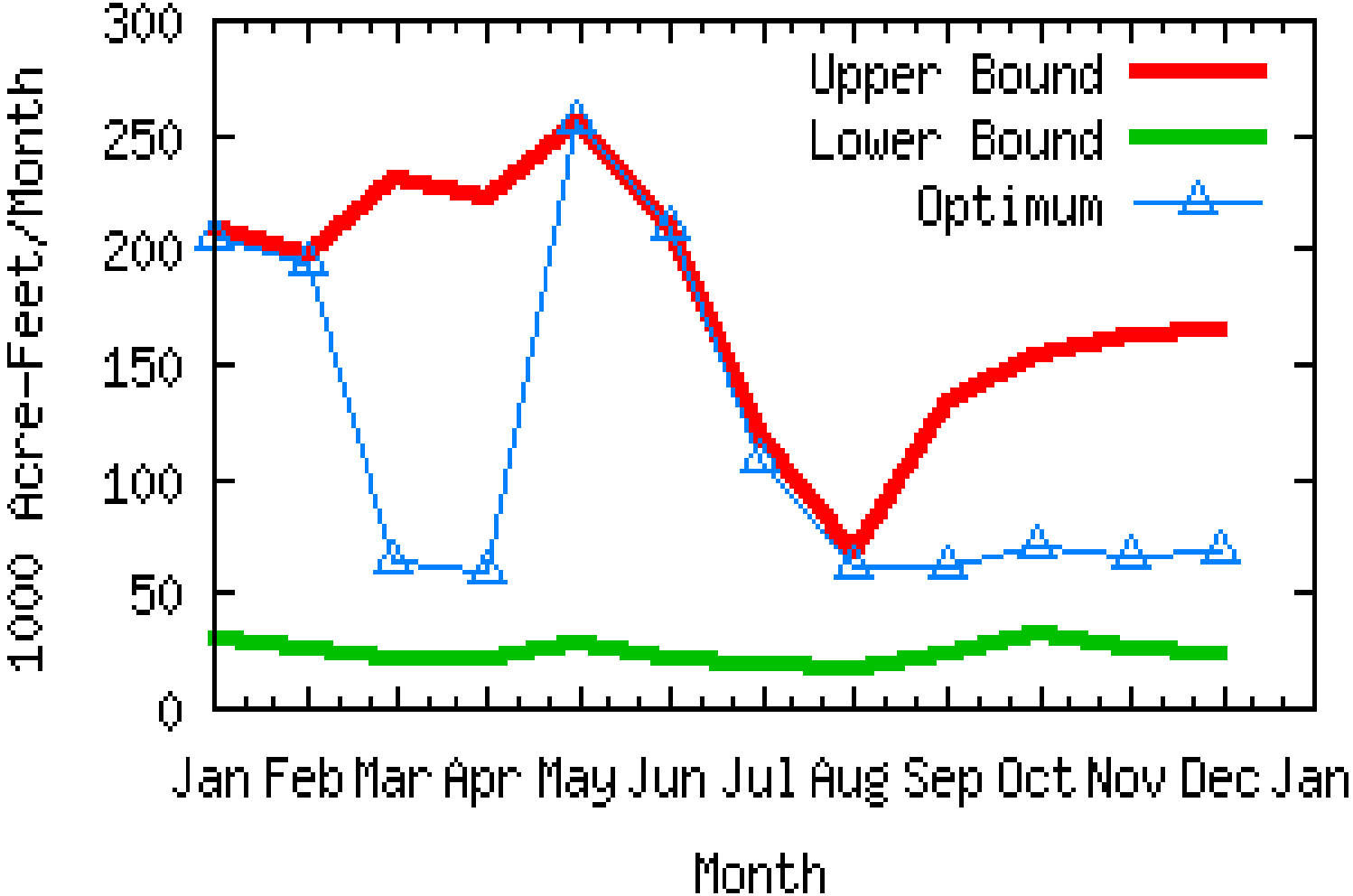


Inflow-Abundance Relationships

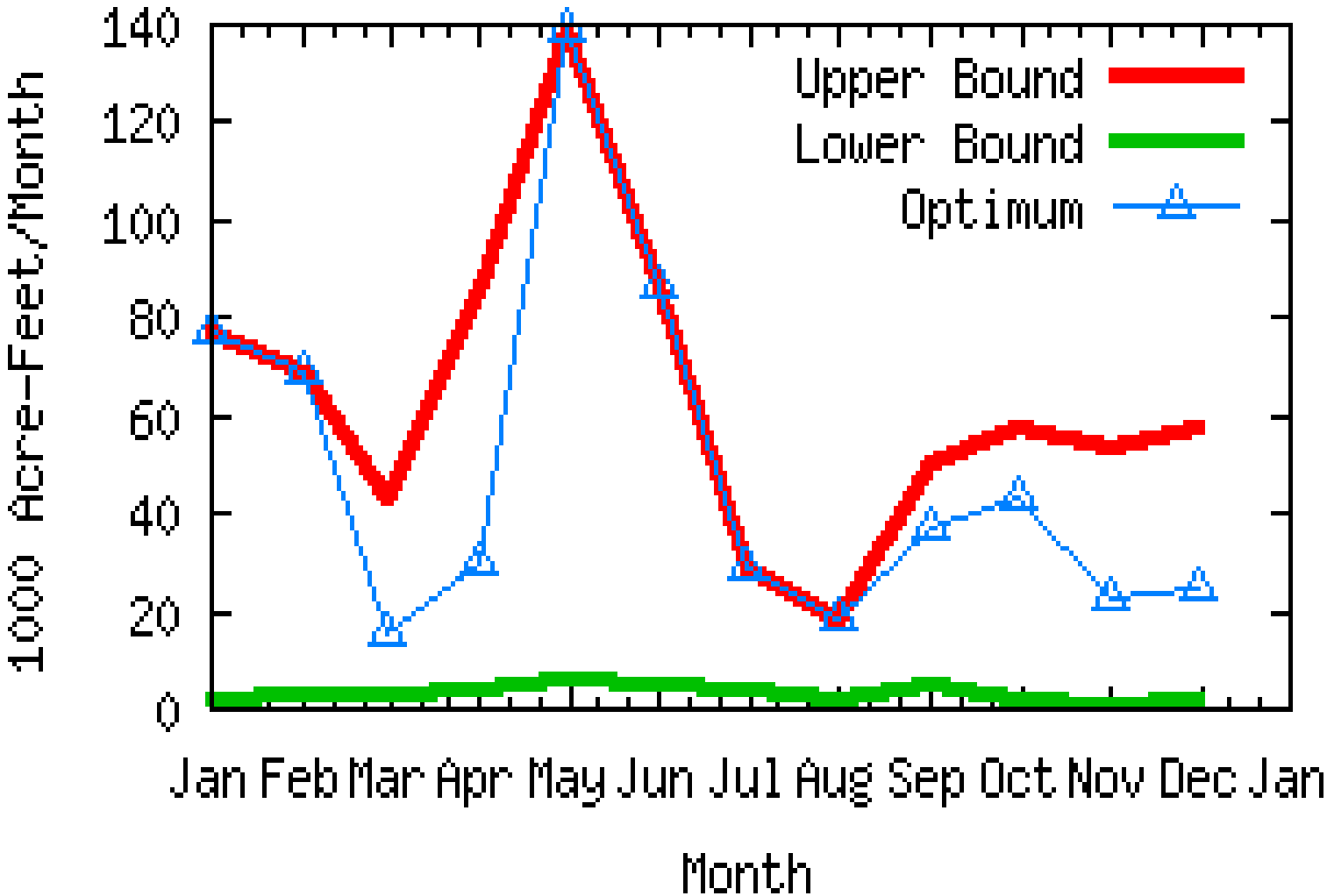
Goal for seven species:

- Develop inflow-abundance equations for use in TXEMP optimization procedure
- White Shrimp
- Brown Shrimp
- Blue Crab
- Striped Mullet
- Red Drum
- Gulf Menhaden
- Eastern Oyster

Monthly flows for Colorado River Basin

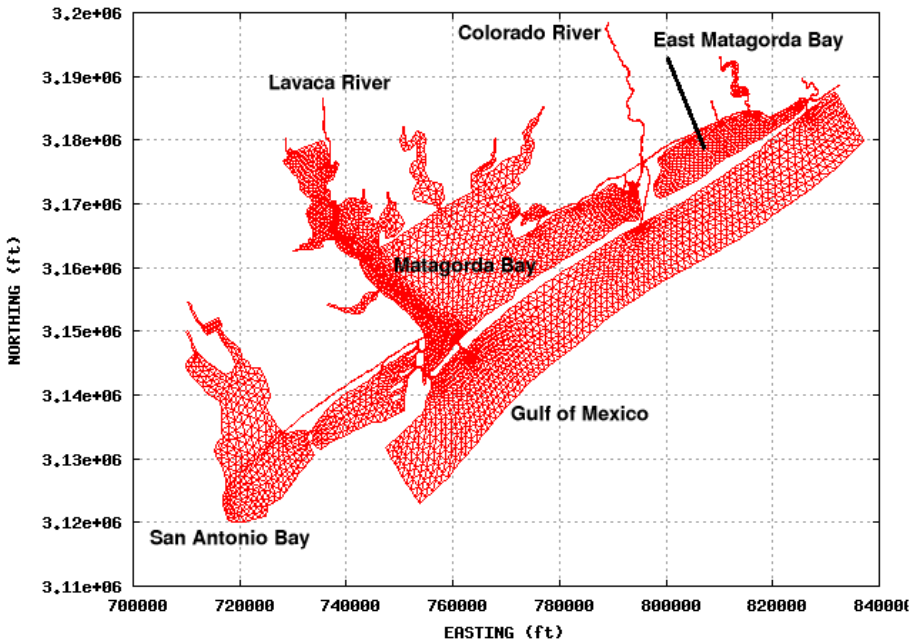


Monthly flows for Lavaca-Navidad River Basin

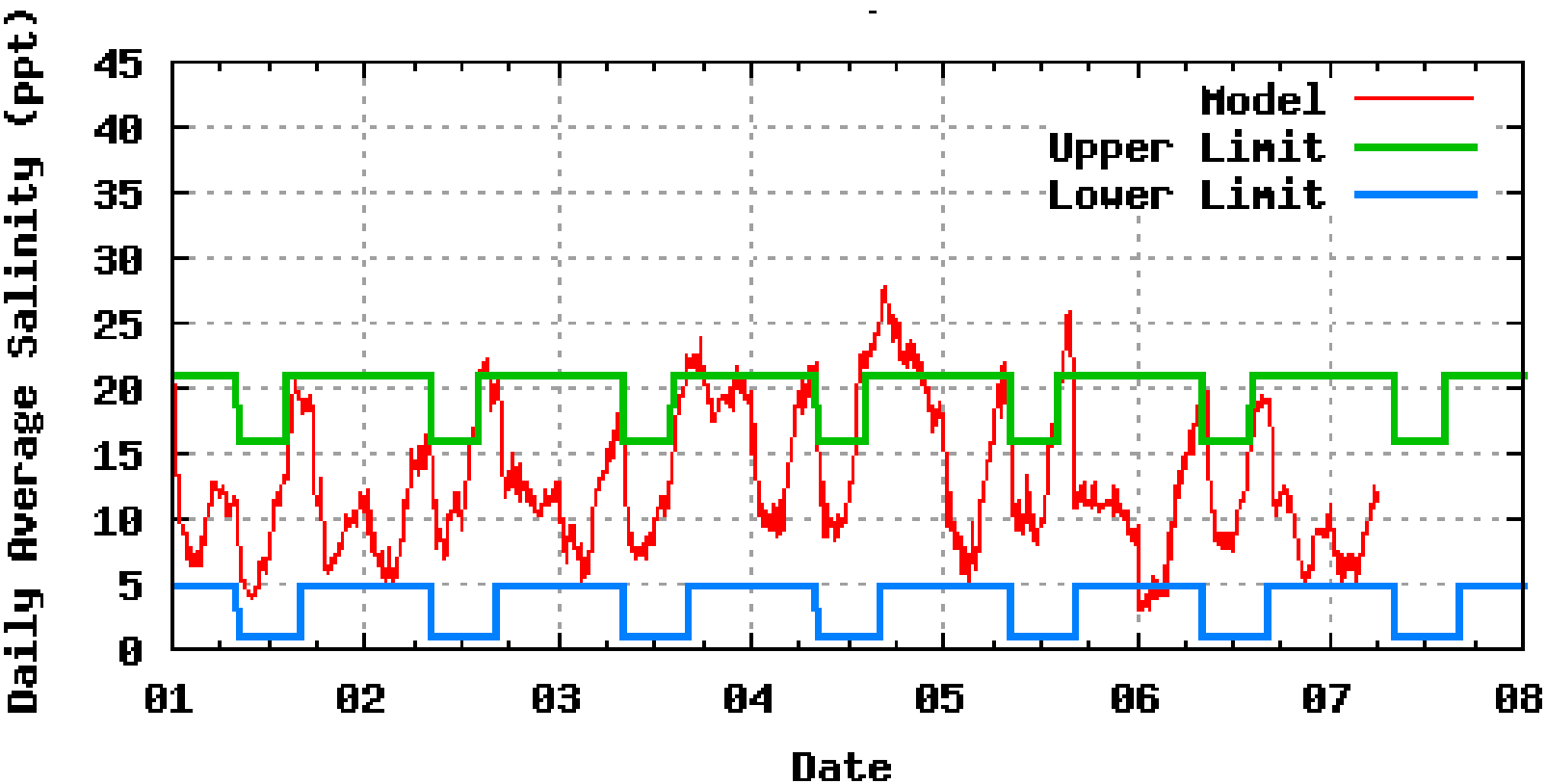


Check of Results with TXBLEND

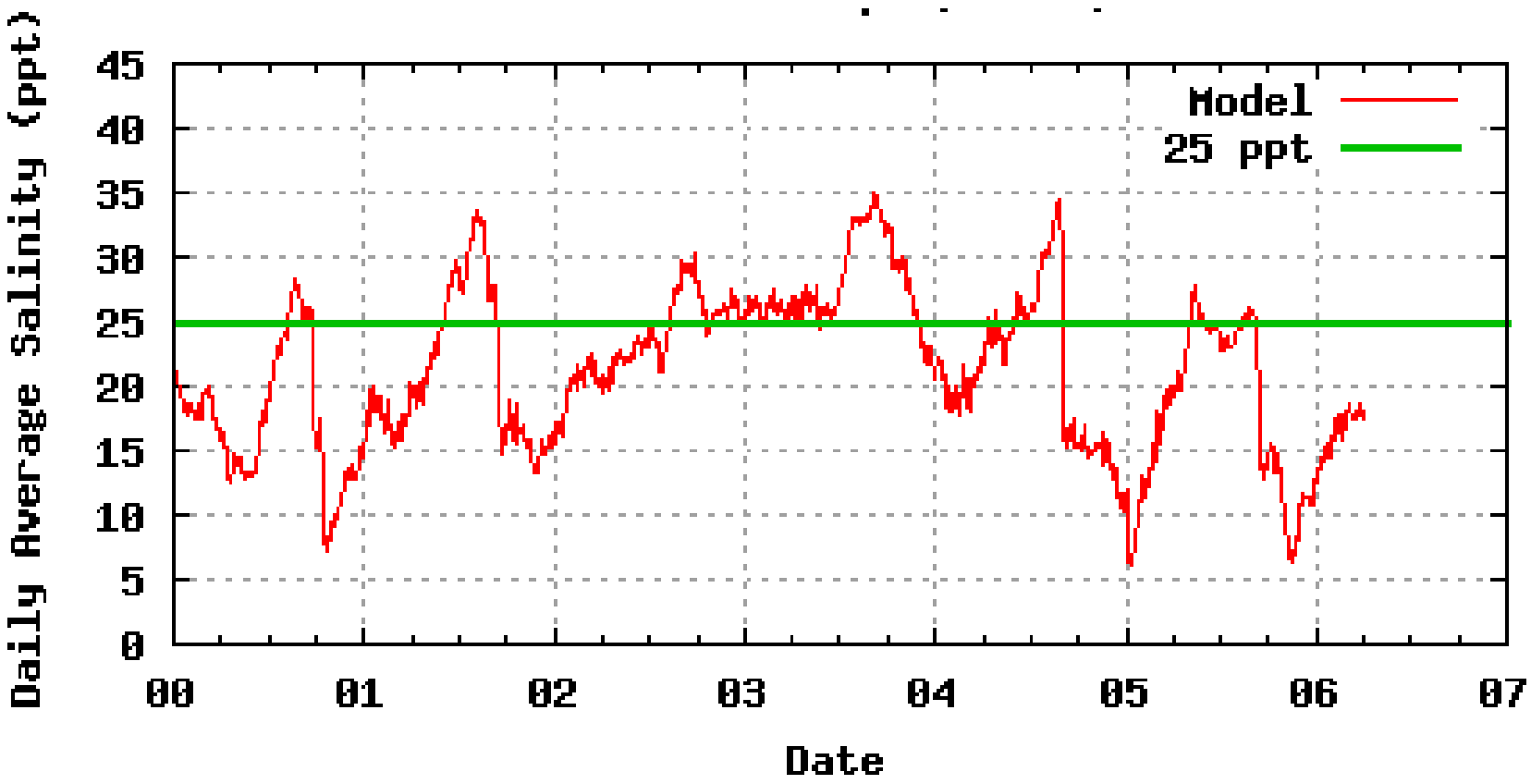
- Hydrodynamic and salinity transport model
- Physically based – requires hydrological and meteorological inputs



Target Inflows- Colorado River



Critical Flow- Colorado River



2006 FINS Target Results	Target Results						
	Colorado River	Lavaca River	Coastal Contribution	Totals		Critical Need	Intermediate Needs
January	205,600	77,000	37,200	319,800		36,000	54,000
February	194,500	68,900	44,500	307,900		36,000	54,000
March	63,200	15,600	42,300	121,100		36,000	54,000
April	60,400	30,300	51,100	141,800		36,000	54,000
May	255,400	139,400	85,300	480,100		36,000	54,000
June	210,500	86,000	80,200	376,700		36,000	54,000
July	108,400	29,200	66,400	204,000		36,000	54,000
August	62,000	18,300	31,400	111,700		36,000	54,000
September	61,900	37,300	107,200	206,400		36,000	54,000
October	71,300	42,900	100,700	214,900		36,000	54,000
November	66,500	23,000	47,400	136,900		36,000	54,000
December	68,000	24,900	35,700	128,600		36,000	54,000
	1,427,700	592,800	729,400	2,749,900		432,000	648,000

State Method

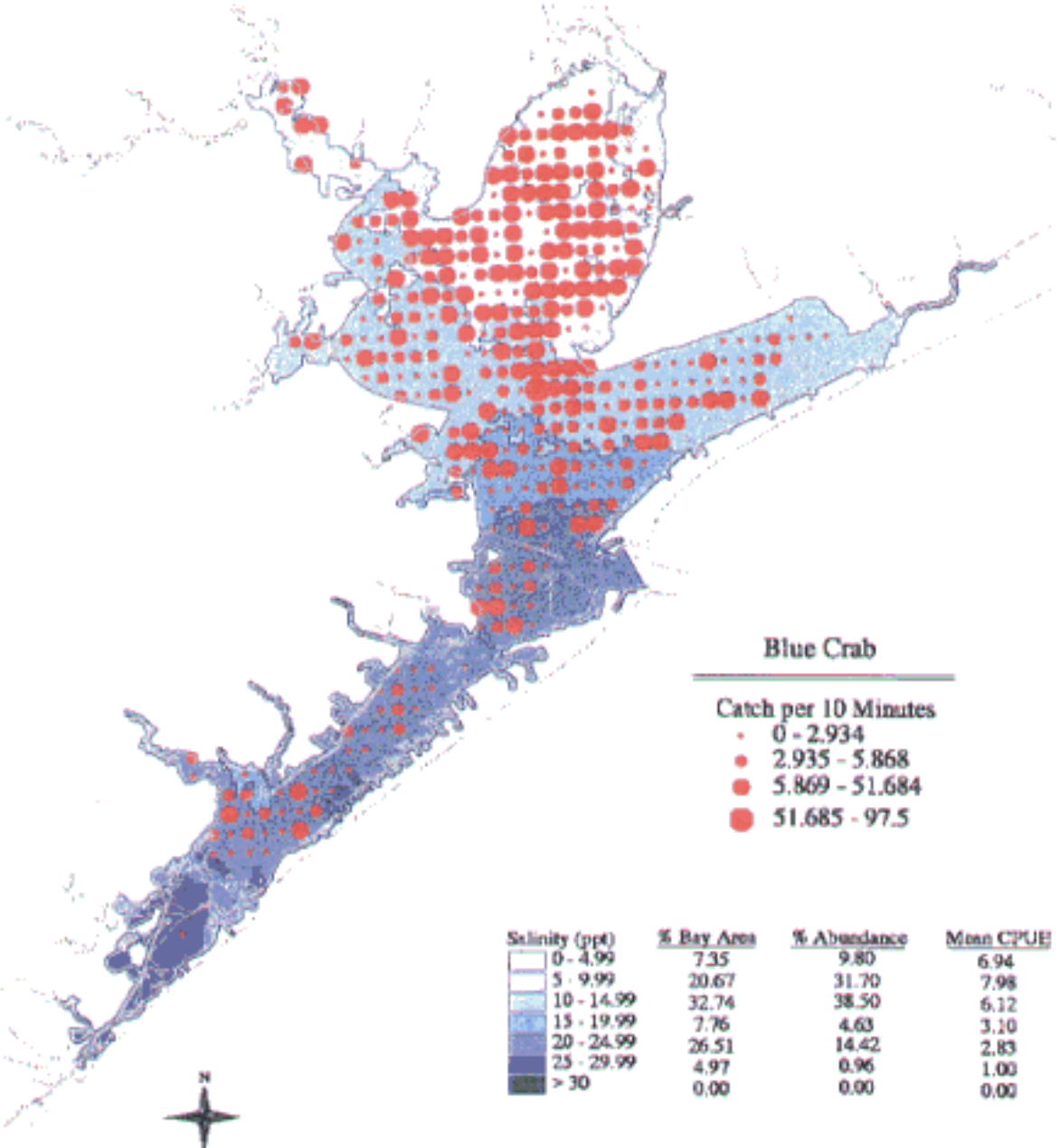
- Strengths
  - Easy to understand objectives
  - Sensible way to integrate disparate information
  - Constraints keep solution ‘reasonable’
  - Optimization model is objective
- Weaknesses
  - Low predictive ability of harvest/abundance equations
  - Species may not represent estuarine ecology
  - Solution implies that flows must always be met
  - Does not address low flow needs explicitly
  - Does not provide a regime consistent with the requirements of SB3
  - Optimized solution is dominated by constraints

Salinity Zone Approach

- Assesses suitability of salinity distribution for specific organism
- Combination of organism salinity preference and salinity mapping
- Identify optimal salinity range; overlay species data
- Salinity distribution is linked to inflow

Spatial Distribution of Blue Crab in the Galveston Bay System

March - August
1982 - 1993



Salinity (ppt)	% Bay Area	% Abundance	Mean CPUE
0 - 4.99	7.35	9.80	6.94
5 - 9.99	20.67	31.70	7.98
10 - 14.99	32.74	38.50	6.12
15 - 19.99	7.76	4.63	3.10
20 - 24.99	26.51	14.42	2.83
25 - 29.99	4.97	0.96	1.00
> 30	0.00	0.00	0.00

Salinity Zone Approach

- Strengths
  - Quantitative measure of desired salinity range
  - Capability to combine with other geographical features- e.g. marshes, reefs
  - Affords graphic display capability
- Weaknesses
  - Extremes of flow may not be well represented in data or model results to supply meaningful statistical evaluations
  - Depends on accuracy of isohaline delineated
  - TPWD verification analysis not well validated approach using TxBlend model

HEFR

- Designed to identify reasonable schedule of flow components that are adequate to protect a sound ecological environment
- Limited application- exploratory analysis for San Antonio Bay
- No estuary specific components were idenitied

HEFR

- Strengths
  - Hydrologic data are robust and consistent at multiple locations
  - Hydrology is considered master variable for instream flows and may also be very important variable for estuaries
  - Significant flexibility in setting parameters to parse the hydrograph as well as summary statistics of the flow regime components
  - HEFR outputs have same formats as expected results from the TIFP studies
  - Initial set of recommendations reflect key aspects of natural flow regime

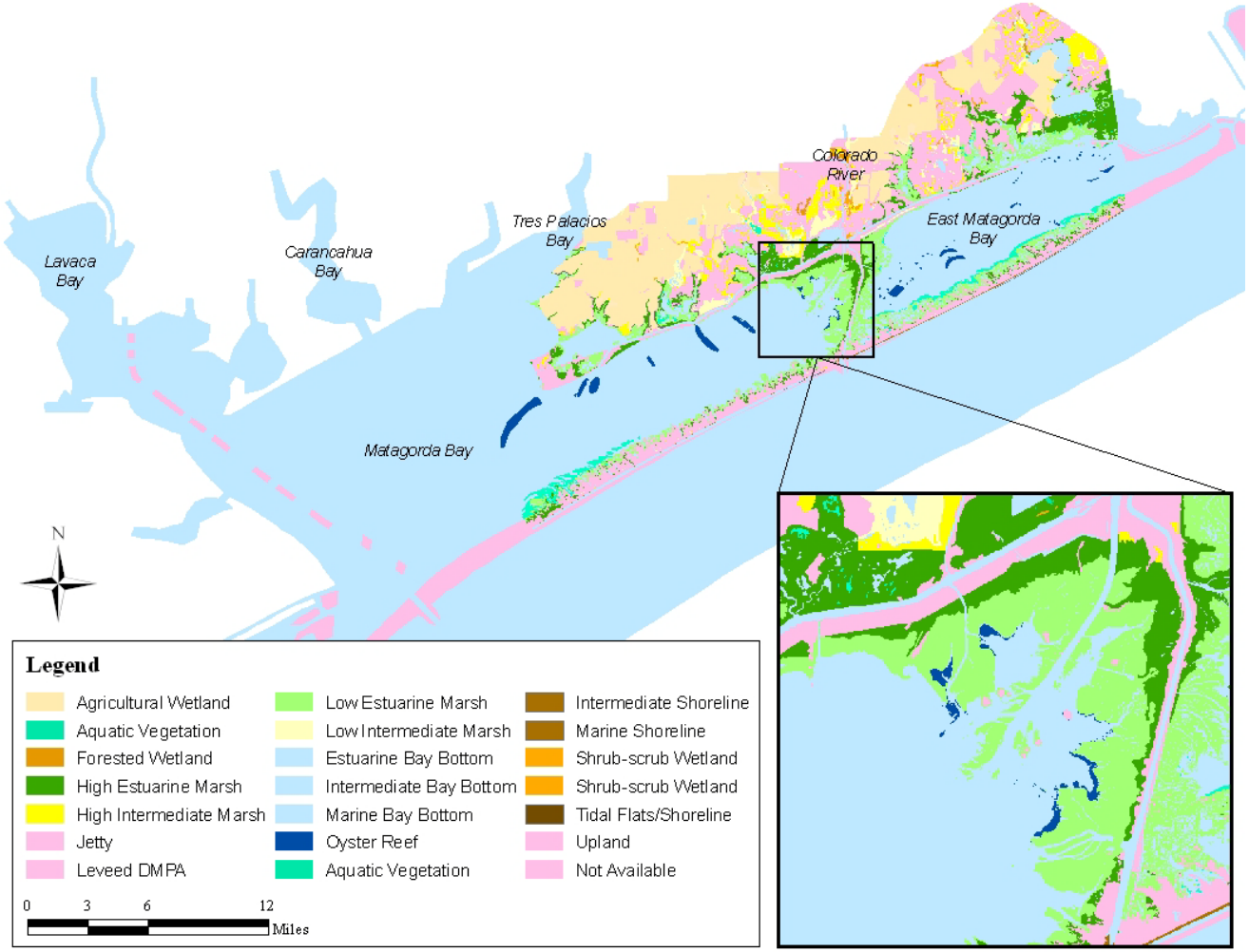
Technical Components

- Habitat
- Salinity-Inflow Relationships
- Freshets

MBHE Habitat Assessment Tools

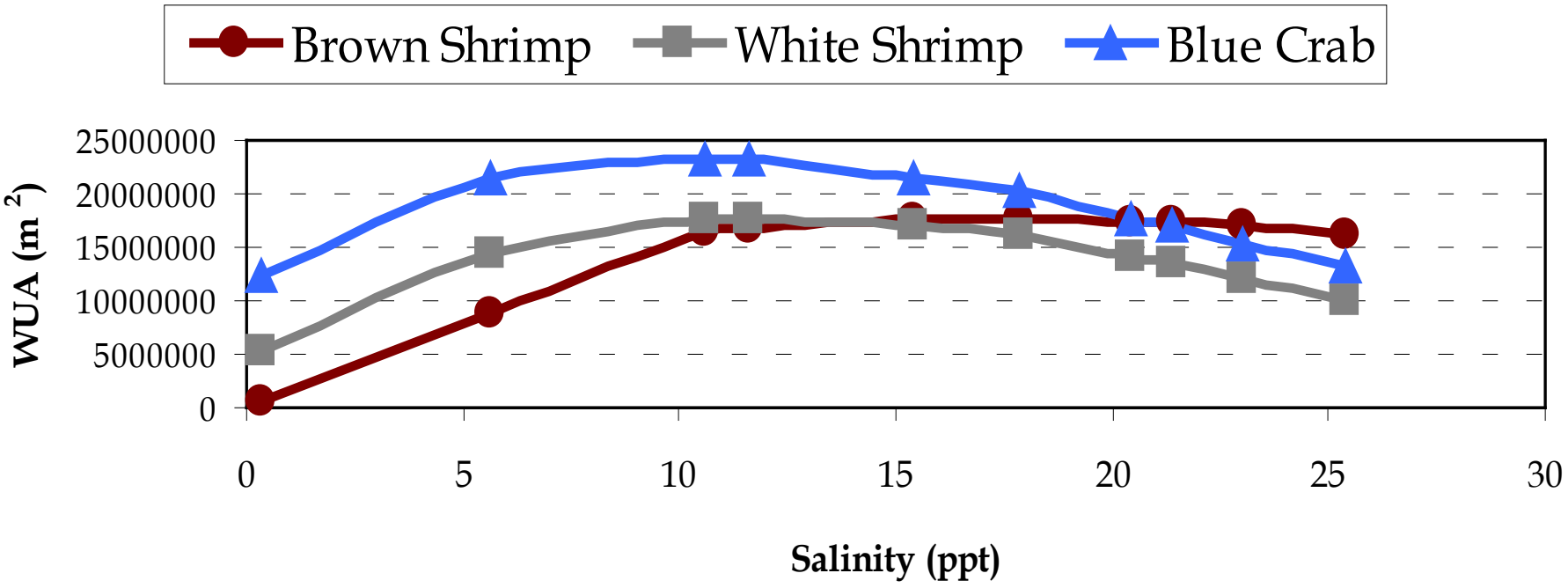
- Trophic level habitat modeling
  - Low estuarine marsh
  - Shellfish (brown shrimp, white shrimp, blue crab)
  - Forage fish (Atlantic croaker, Gulf menhaden)
- Oyster health
  - Dermo Condition Index
- Dr. Paul Montagna's benthic studies

Study Area Physical Habitats

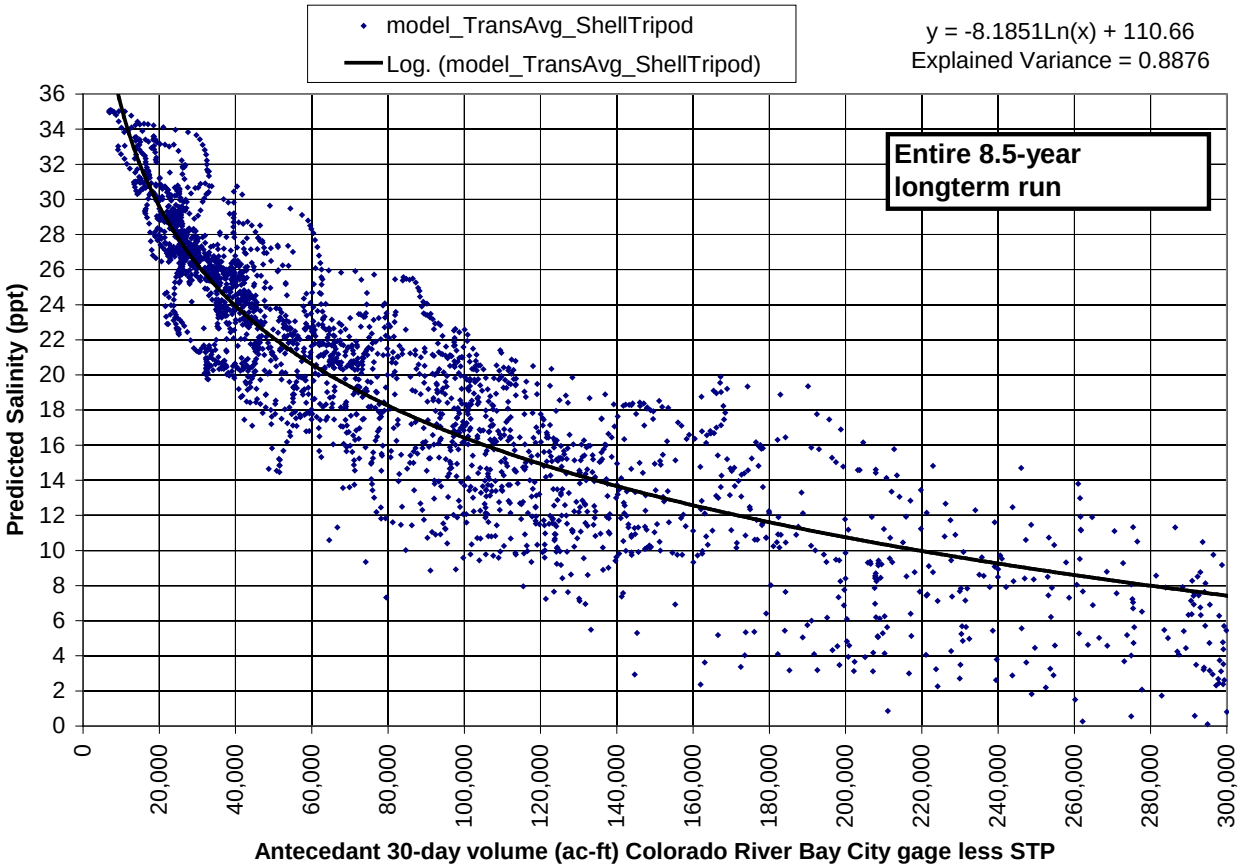


Salinity Preference

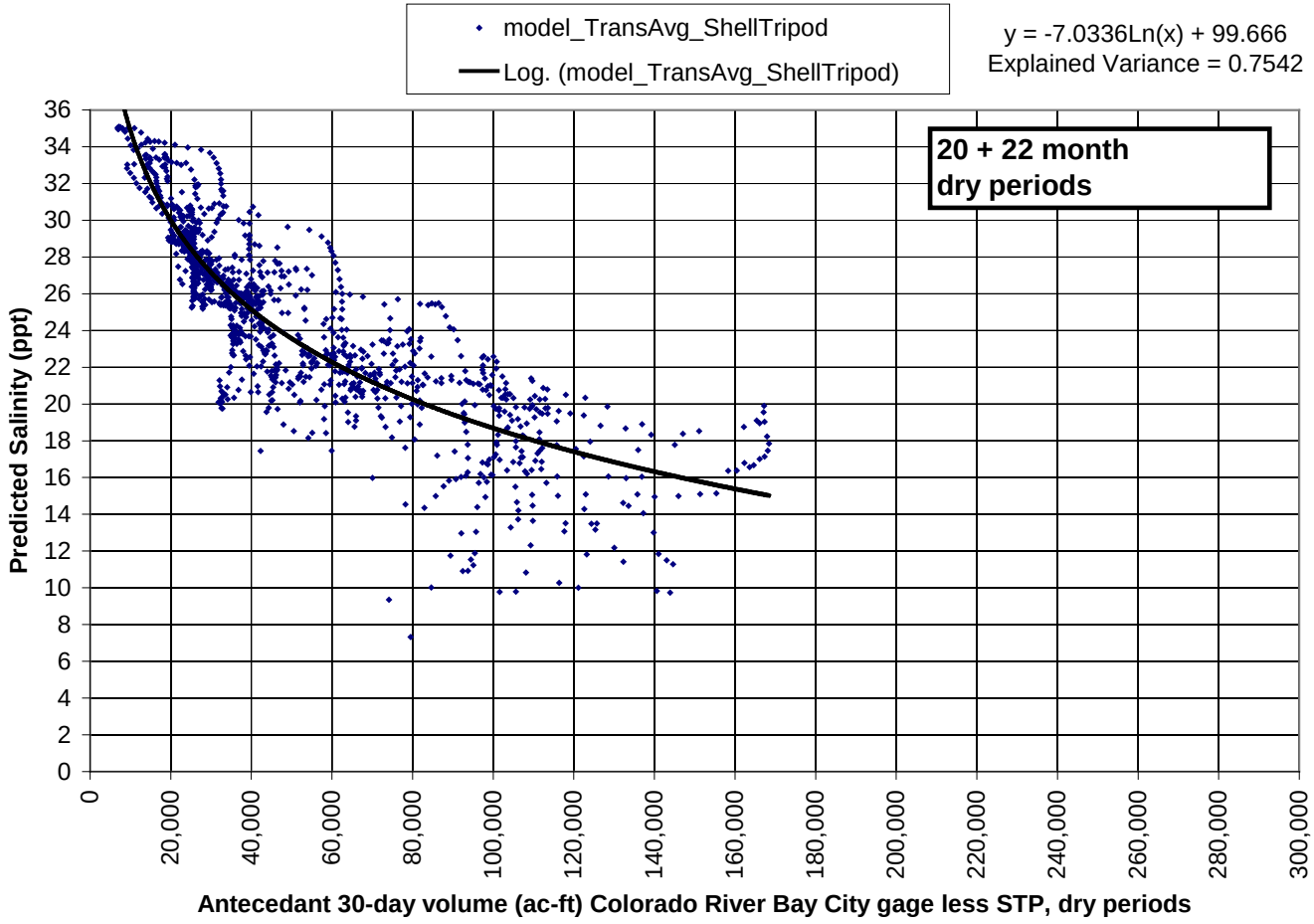
Weighted Useable Area



SMB_Tripod Transect – Linear Regression (8.5 year)



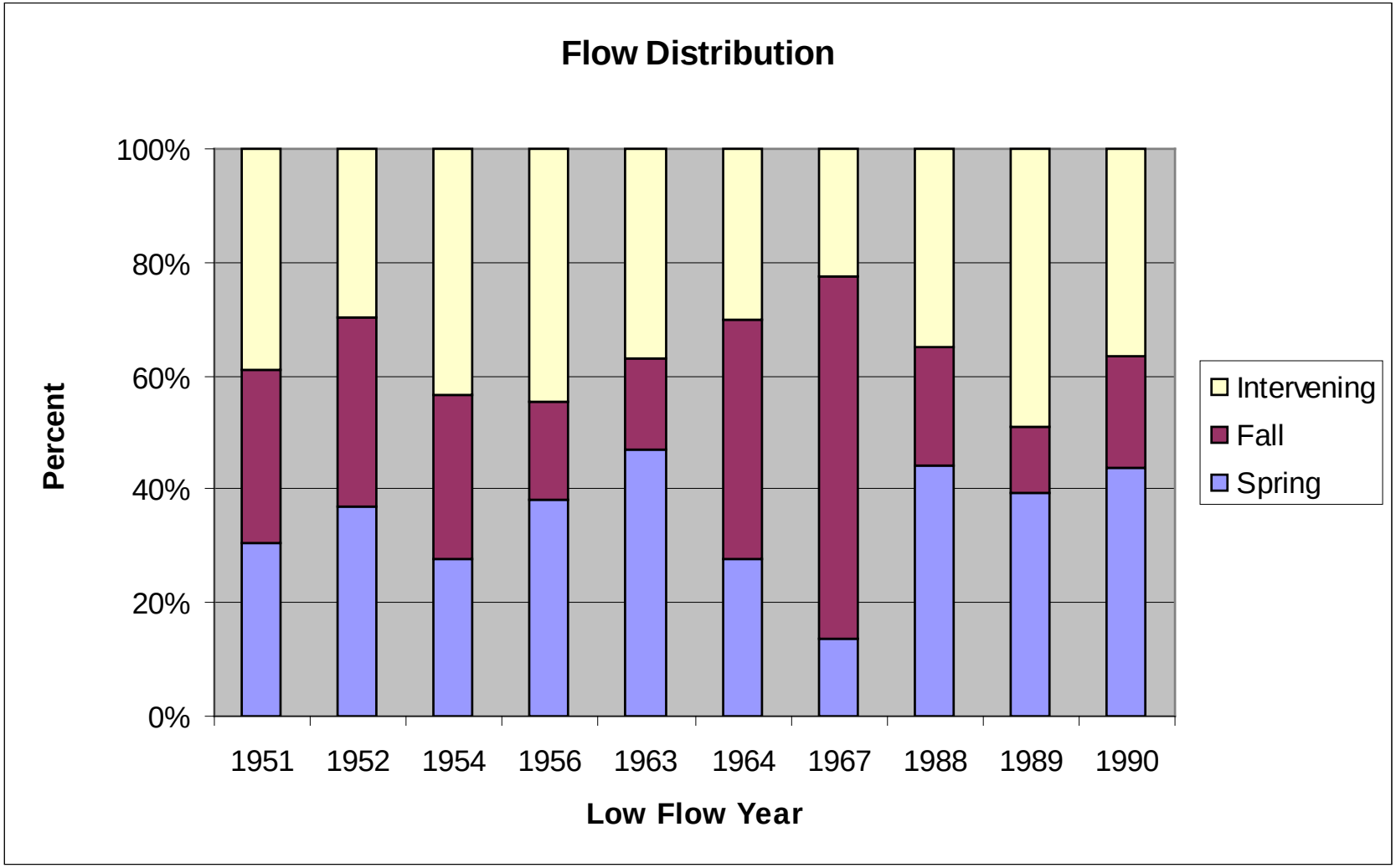
SMB_Tripod Transect – Linear Regression (Low Flow)



Blending 8.5-year and Low Flow Regressions

	Flow (AF)		
Salinity (ppt)	**Low Flow Eq.**	**Normal Eq.**	
15	168,951	119,025	Apply Normal Eq.
16	146,560	105,337	I
17	127,136	93,222	I
18	110,287	82,501	I
19	95,670	73,013	I
20	82,991	64,616	I
21	71,992	57,185	Apply Normal Eq.
22	62,451	50,609	
23	54,175	44,788	
24	46,995	39,638	Linear Interpolation
25	40,767	35,079	
26	35,364	31,045	
27	30,677	27,474	Apply Low Flow Eq.
28	26,611	24,315	I
29	23,085	21,518	I
30	20,025	19,044	I
31	17,371	16,854	I
32	15,069	14,915	Apply Low Flow Eq.

Freshet Distribution – Low Flow



MBHE Inflow Criteria Objectives

Category	Criterion	Condition	Bay Components
Long-Term	Avg Vol & Variability	Existing Essential	Primary productivity & adequate food supply
Inflow Regime	MBHE 4	High Quality	Primary productivity, oyster, habitat, benthic, shellfish, forage fish, marsh
	MBHE 3	Quality	Oyster, habitat, benthic, shellfish, forage fish, marsh
	MBHE 2	Sustain	Oyster, habitat, benthic, shellfish, forage fish, marsh
	MBHE 1	Tolerable	Oyster, habitat, benthic
Minimum	Threshold	Refuge	All species/habitats

Seasonal Components of Inflow Regime

Inflow Criteria	Flow		Seasonal		
	AF / 30 days	Annualized	Spring (38%)	Fall (27%)	Intervening (35%)
MBHE 4	95,000	1,140,000	433,200	307,800	399,000
MBHE 3	54,000	648,000	246,200	175,000	226,800
MBHE 2	37,000	444,000	168,700	119,900	155,400
MBHE 1	25,000	300,000	114,000	81,000	105,000

Summary of Freshwater Inflow Criteria, Design Areas Salinity Ranges

	Threshold	MBHE 1	MBHE 2	MBHE 3	MBHE 4	Long-term Volume and Variability
Design Area	Delta	Delta Edge to Mad Island Transect	Delta Edge to Mad Island Transect	Delta Edge to Mad Island Transect	Delta Edge to Mad Island Transect	EAMB
Salinity range across area (ppt)	< 30[1]	27-29	24-26	20-23	15-18	Average[4]
Trophic Level						
Primary Production	Low	Low	Low	Moderate	High	Normal[5]
Oyster Health	Refuge[2]	Refuge[2]	Poor[2]	Fair	Good	Normal[5]
Benthic Condition	Fair / Poor	Poor	Fair	Good	Peak	Normal[5]
Marsh Productivity	Fair	Fair	Good	Good	Good	Normal[5]
Shellfish Habitat	Good[3] / Poor	Good[3] / Poor	Selected[3] / Fair / Poor	Selected[3] / Fair	Selected[3] / Good	Normal[5]
Forage Fish Habitat	Poor / Refuge	Poor / Refuge	Poor	Fair	Good	Normal[5]

[1] This would be typical when no significant local watershed inflows have occurred.

[2] Potentially detrimental to select reefs based on Dermo Condition Index. However, a condition experienced a similar amount of time historically.

[3] Ranking applies to brown shrimp. Blue crab and white shrimp habitat ranks lower.

[4] The long-term average salinity will be in the mid teens but include very low and high periods.

[5] Indicators of productivity and health will be normal, but will experience variations during dry and wet periods.

Inflow Criteria – Volumes, Variability, and Achievement Guidelines

Criteria	Flow Volumes Acre-Feet (AF)			Achievement Guideline
Long-Term Volume	Average inflow of at least 1.4 to 1.5 MAF per year			100%
	Coefficient of Variation > 0.8			
Regime	**Spring**	**Fall**	**Intervening**	
	(AF/ 3 mo.)	(AF/ 3 mo.)	(AF/ 6 mo.)	
MBHE 4	433,200	307,800	399,000	35%
MBHE 3	246,200	175,000	226,800	60%
MBHE 2	168,700	119,900	155,400	75%
MBHE 1	114,000	81,000	105,000	90%
Threshold	Maintain 15,000 AF per month			100%