

***Lower Rio Grande and Lower Laguna Madre
Basin and Bay Expert Science Team
(LRG/LLM BBEST)***

Freshwater Inflows Recommendations Study



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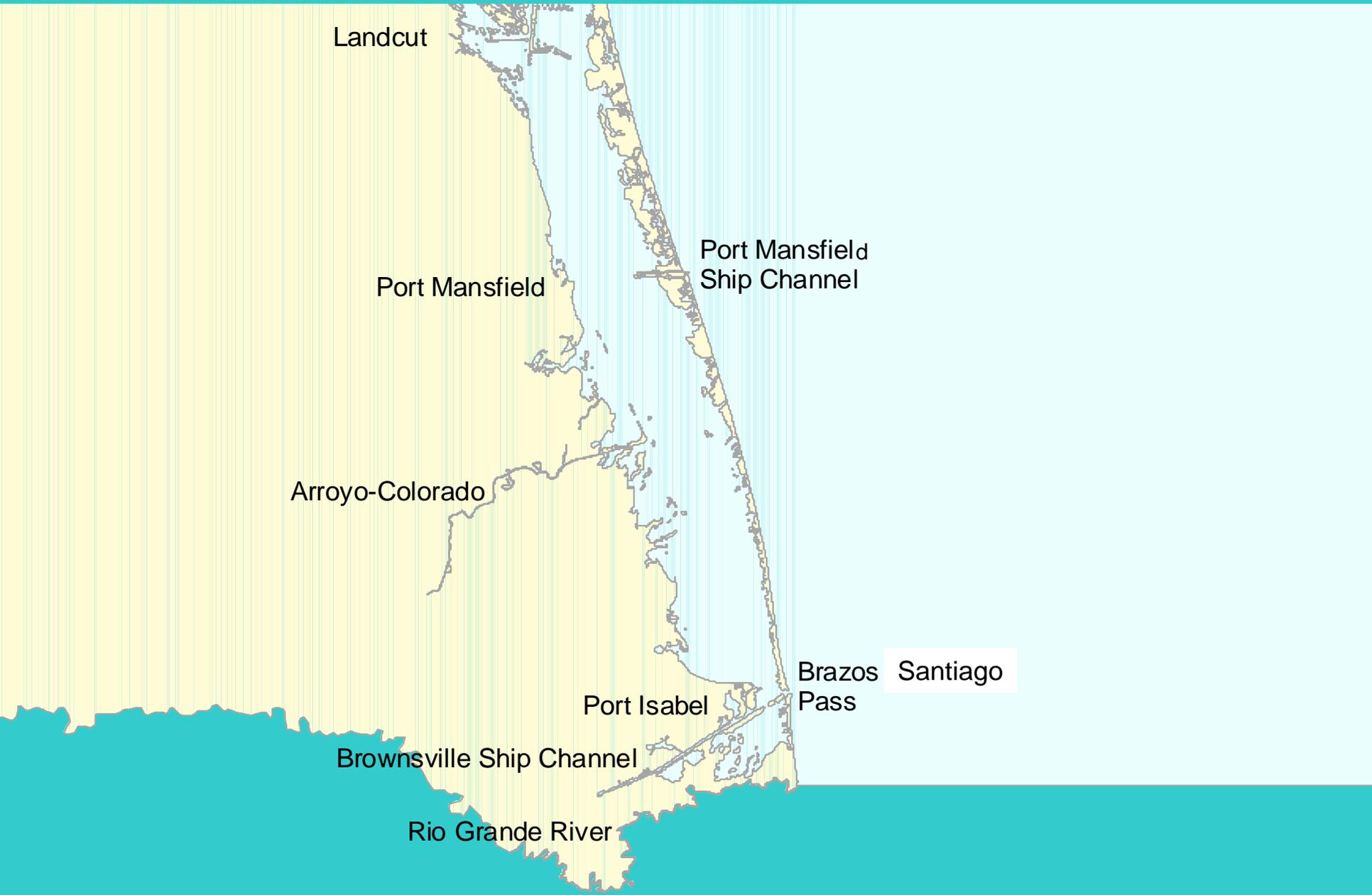
July 18, 2012

Basin & Bay Expert Science Team (BBEST)

- 1) Comprised of technical experts with knowledge of the river basin and bay system and of methods for developing environmental flow regimes.
- 2) **LRG-LLM BBEST performs freshwater inflow analyses based on best available science/data and recommends environmental flow regimes through a consensus process.**
- 3) Provide environmental flows recommendations by June, 2012.
- 4) Provide technical support to the LRG BBASC in its development of recommendations on environmental flow standards & strategies, and their work plan.

LRG/LLM BBEST Analyses & Recommendations

- 1) Overview of Lower Laguna Madre**
- 2) Sound Ecological Environment ?**
- 3) Hydrology Analyses**
- 4) Inflow Regime Analyses of Focal Species/Habitats**
- 5) Environmental Flow Regime Recommendations**
- 6) Adaptive Management Plan**



Landcut

Port Mansfield

Arroyo-Colorado

Brownsville Ship Channel

Rio Grande River

Port Isabel

Port Mansfield
Ship Channel

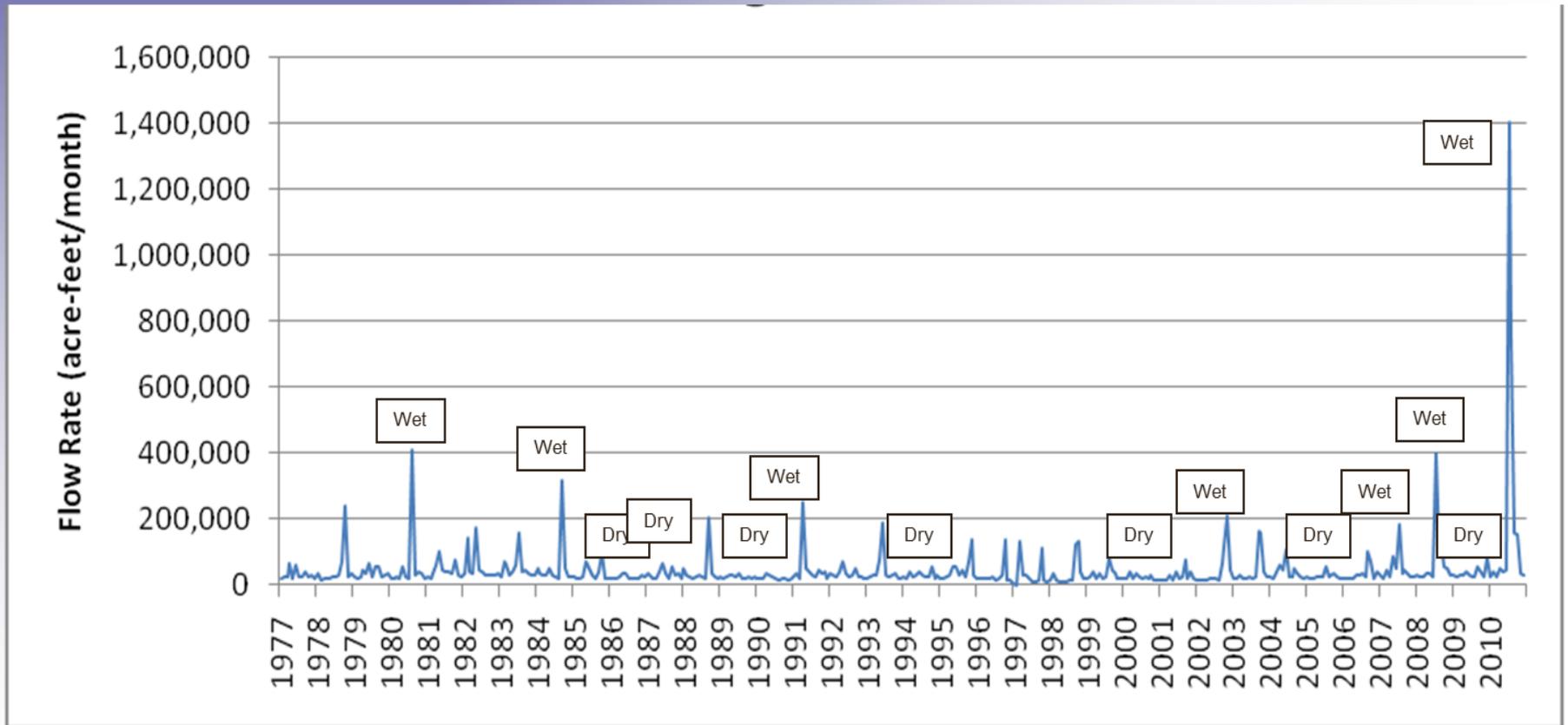
Brazos
Pass

Santiago

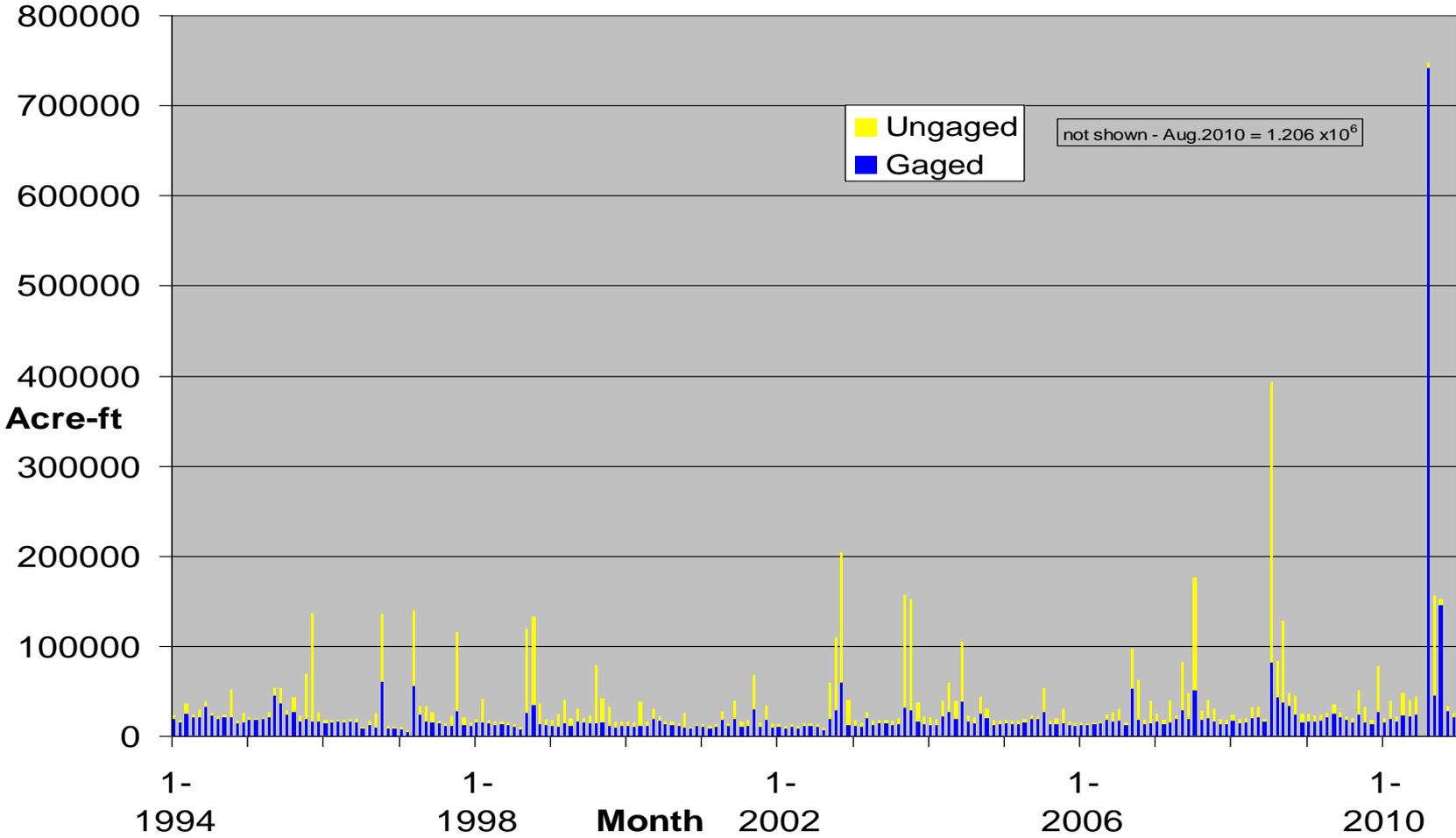
Hydrology Analyses

- 1) Geographic Scope (Lower Laguna Madre and its watershed)**
- 2) Gage Selection (Arroyo Colorado @ Harlingen)**
- 3) Ungaged Watersheds for LRGV**
- 4) Historical Flow Regimes Analyses (1977 - 2010)**
- 5) Total Freshwater Inflow to LLM**

Monthly Combined Freshwater Inflow to the Lower Laguna Madre



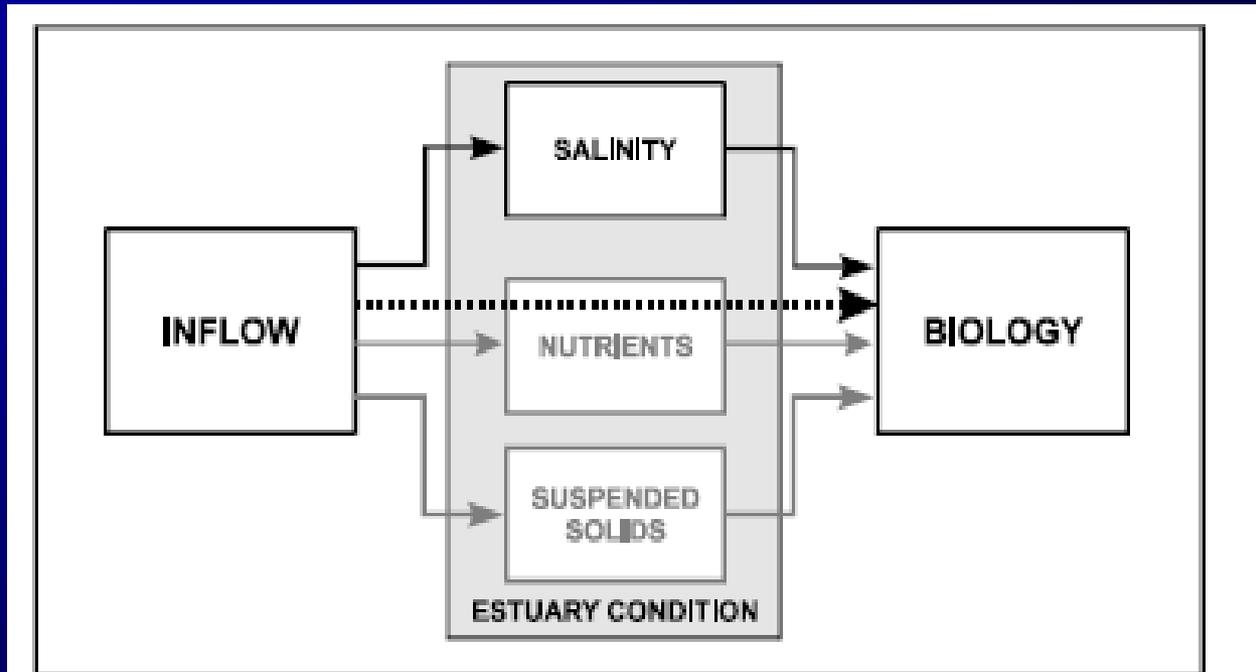
Monthly Inflow to Lower Laguna Madre, 1994 - 2010





Ungaged discharge to Arroyo Colorado after local rainfall event

Freshwater Inflow Effects



SAC

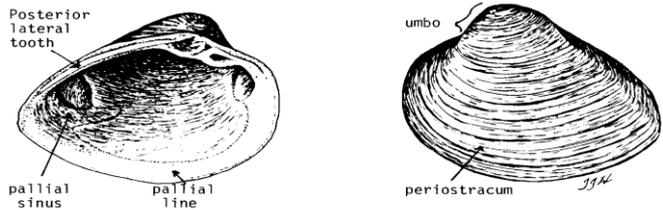
Figure 2.1-2 – Schematic of Relation of “Biology” to “Inflow”
(Compressed from Figure 2.2-1)

Effects of Freshwater Inflow on Estuarine Ecosystems

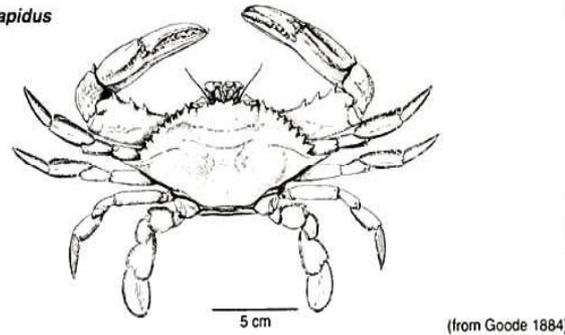
Estuarine Focal Species

Sessile vs. Motile Species and Responses to Salinity or Nutrients

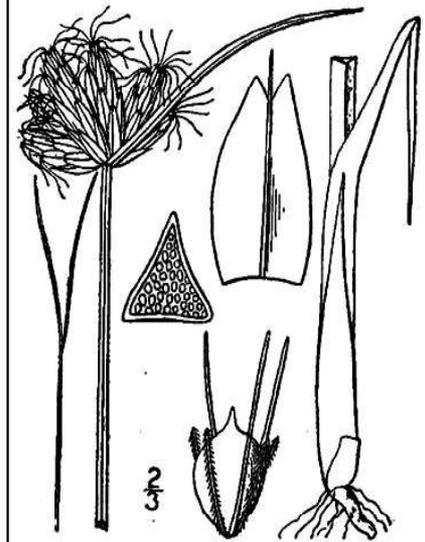
Rangia cuneata



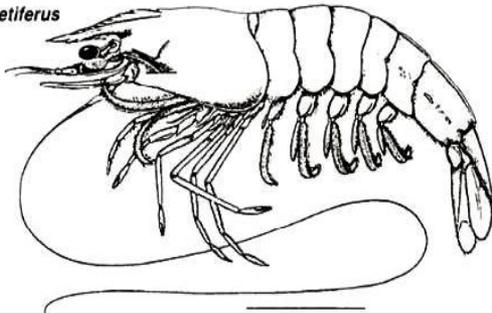
Callinectes sapidus
Adult



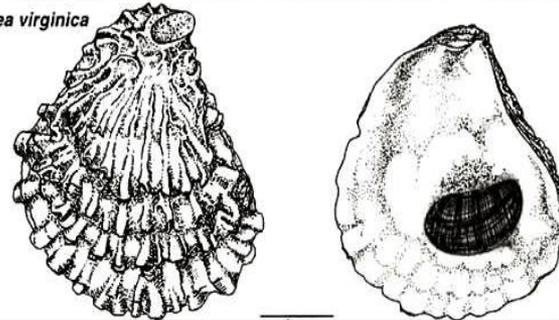
Bulrush



Penaeus setiferus
Adult



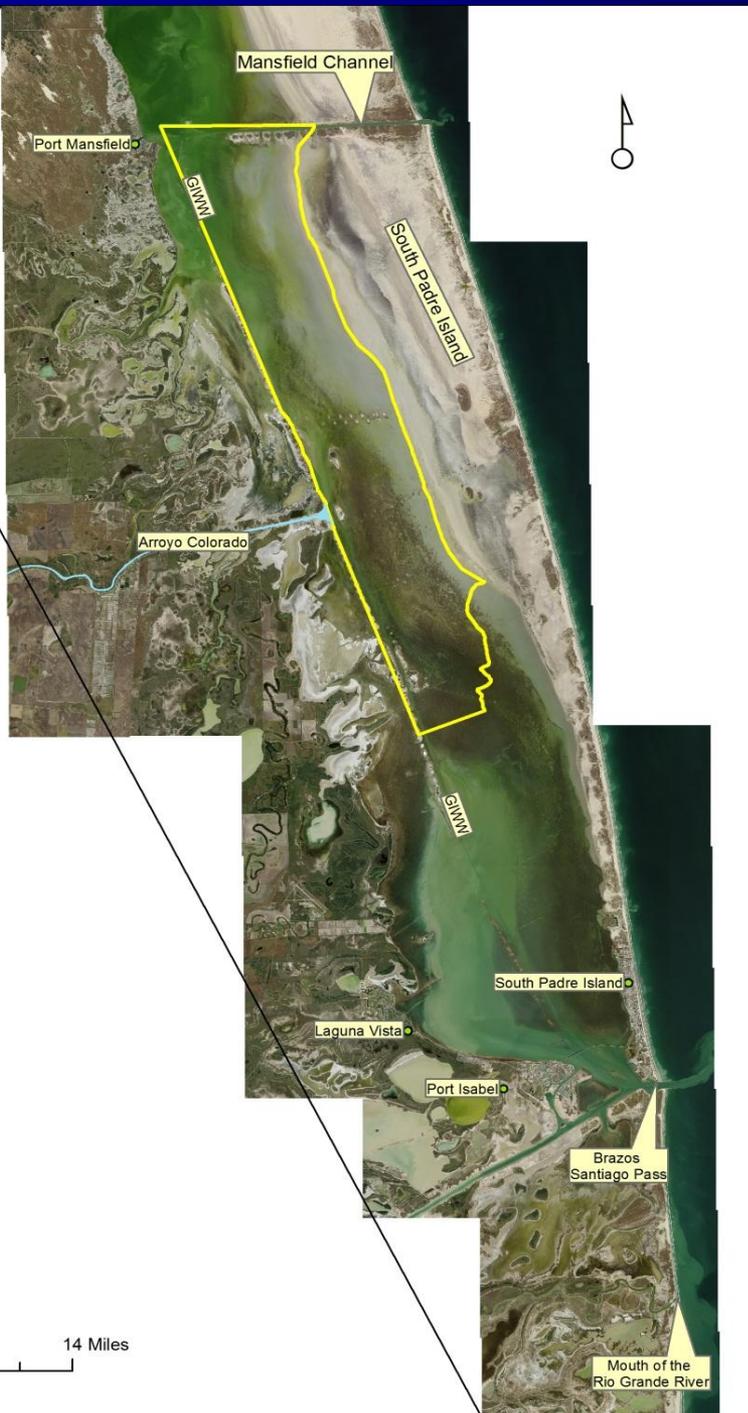
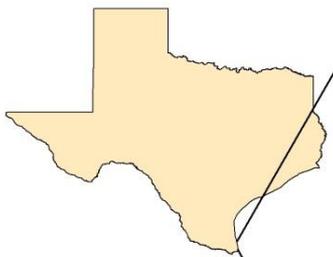
Crassostrea virginica
Adult



LLM Seagrass Communities

Seagrass Responses to Salinity and/or Nutrients





2009 NAIP Imagery of Lower Laguna Madre and Seagrass Distribution

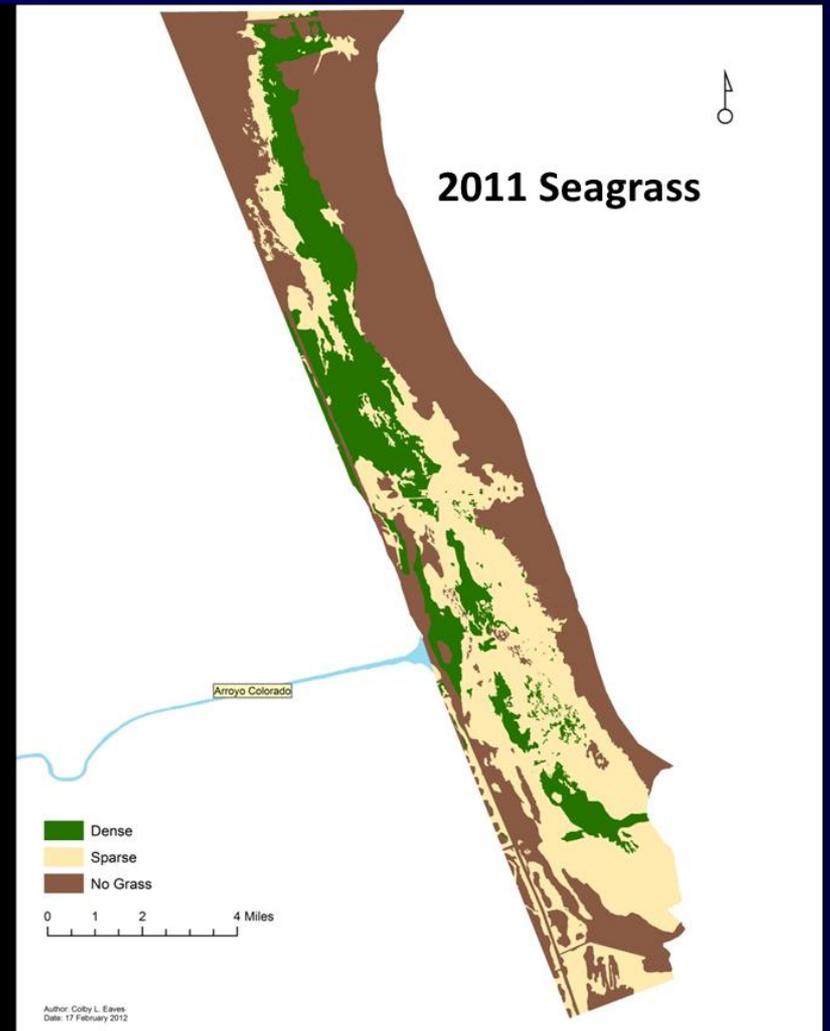
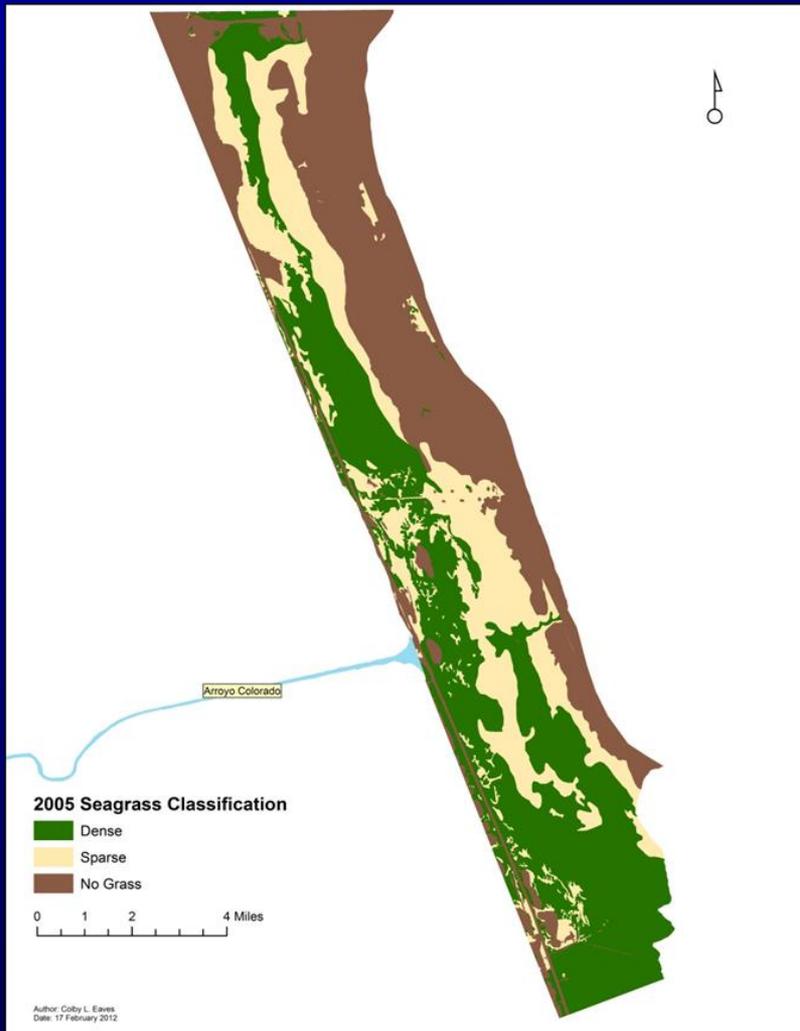
 Final Study Area Boundary



Author: Colby L. Eaves
Date: 17 February 2012
Source: National Agriculture Imagery Program, 2009



Seagrasses Mapped in 2005 and 2009



Seagrasses Mapped in 2005 and 2011

Change in Seagrass Acreage between 2005 – 2009 and 2005 - 2011

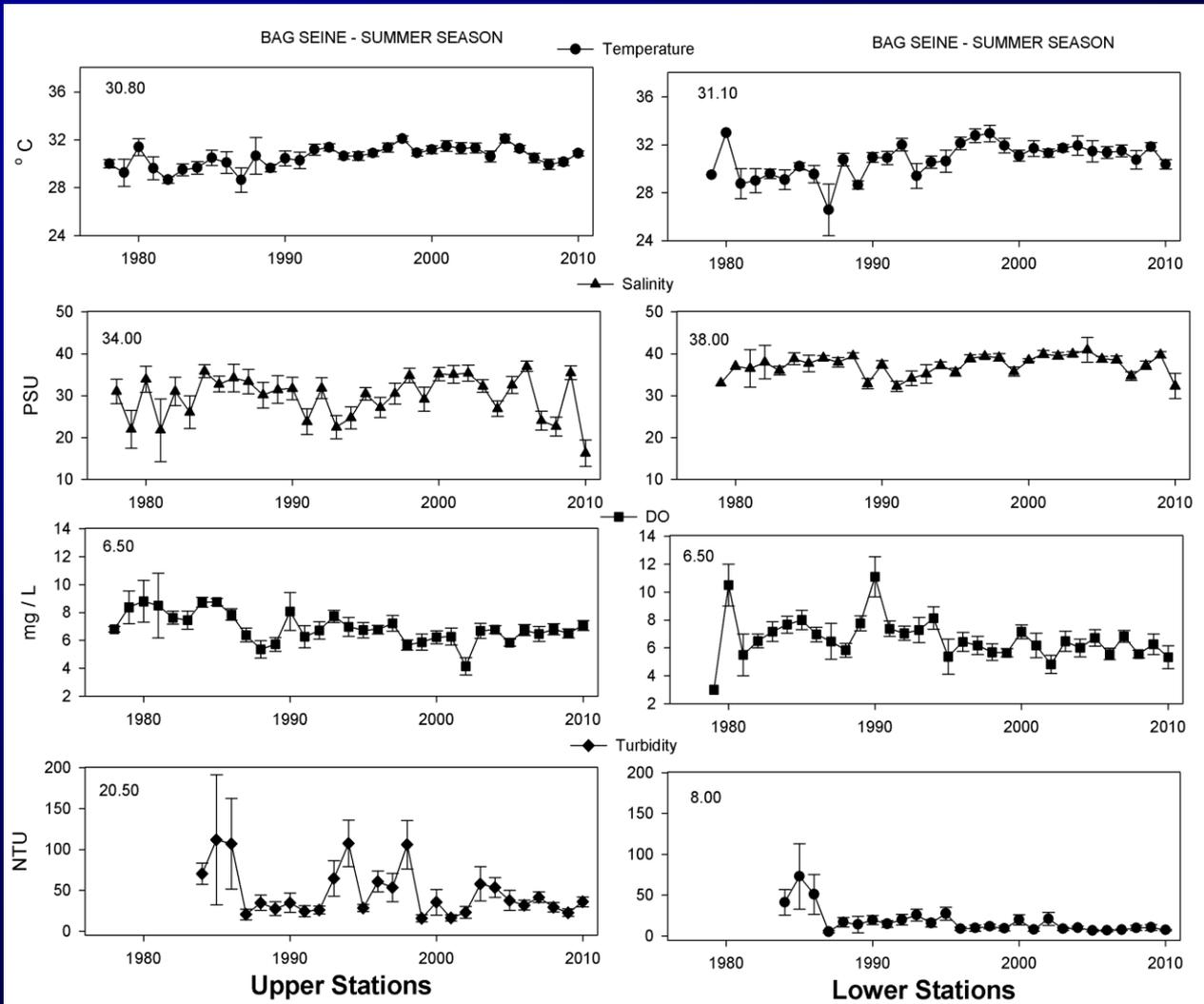
	Nov. 2005 USACE		Jan. 2009 NAIP	
	Acres	% area	Acres	% area
Dense Grass	39,134	40.6	24,067	25.0
Sparse Grass	21,532	22.3	29,784	30.9
Bare Area	35,782	37.1	42,605	44.2
TOTAL	96,448	100	96,456	100

	Nov. 2005		Oct. 2011	
	Acres	% area	Acres	% area
Dense Grass	18,453	37.9	9,324	18.3
Sparse Grass	11,946	24.5	16,748	35.1
Bare Area	18,289	27.6	22,614	46.6
TOTAL	48,689	100	48,689	100

Freshwater Inflow Analyses

- 1) Effects of Freshwater Inflow on Lower Laguna Madre or Rio Grande Estuary Ecosystems**
- 2) Hydrology and Salinity Relationships in tidal Rio Grande**

- 3) Seagrass Habitat Response to FWI in Lower Laguna**
- 4) Salinity vs. Nutrient Effects on Seagrasses**
- 5) Freshwater Inflow Plumes as Proxy for Nutrient Impacts**
- 6) Identify Inflow Regime Thresholds for Seagrass**
- 7) Develop Environmental Flow Recommendations**



Lower Laguna Madre Hydrographic Conditions

Salinity Tolerance Ranges of LLM Seagrasses

Seagrass Species	Optimal Growth Salinity Range (psu)	Lethal Salinity Range (psu)
Shoal grass (<i>Halodule wrightii</i>)	20 – 44	6 or <; 70 or >
Clover or star grass (<i>Halophila engelmannii</i>)	23 – 40	13 or <; 50 or >
Turtle grass (<i>Thalassia testudinum</i>)	24 – 38	10 or <; 48 or >
Manatee grass (<i>Syringodium filiforme</i>)	24 – 38	10 or <; 44 or >

Laguna Madre
TxBLEND
Hydrodynamic &
Salinity Transport
Model

TxBLEND Model Grid

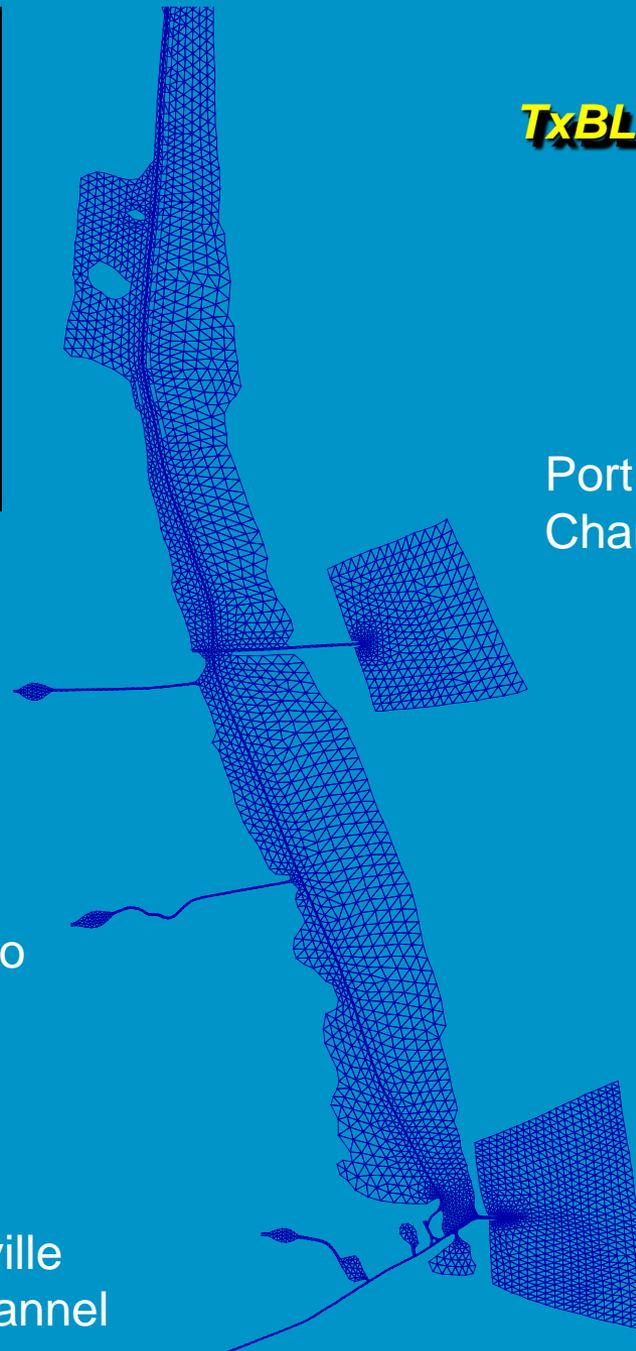
Main Floodway

Arroyo Colorado

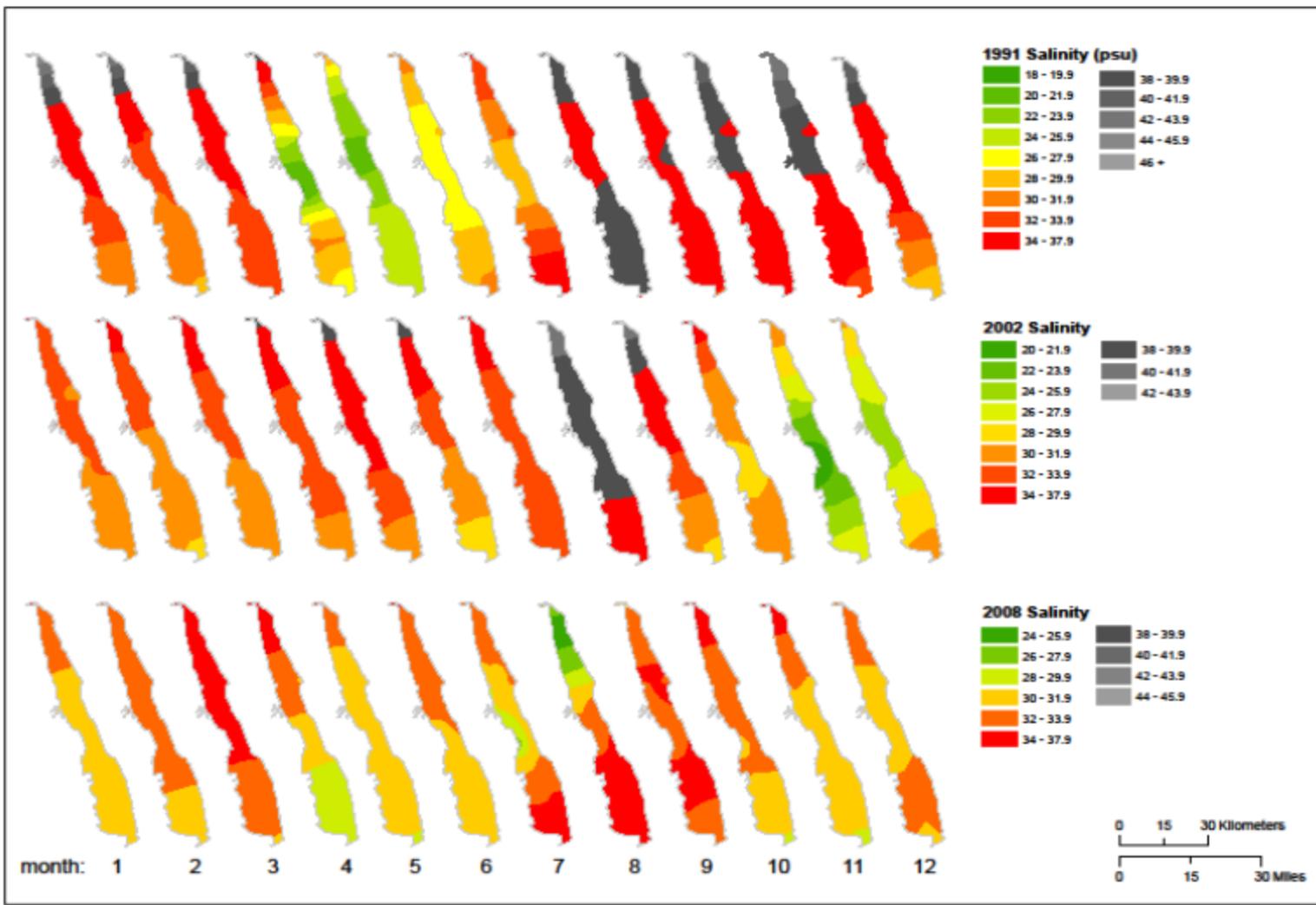
Brownsville
Ship Channel

Port Mansfield
Channel

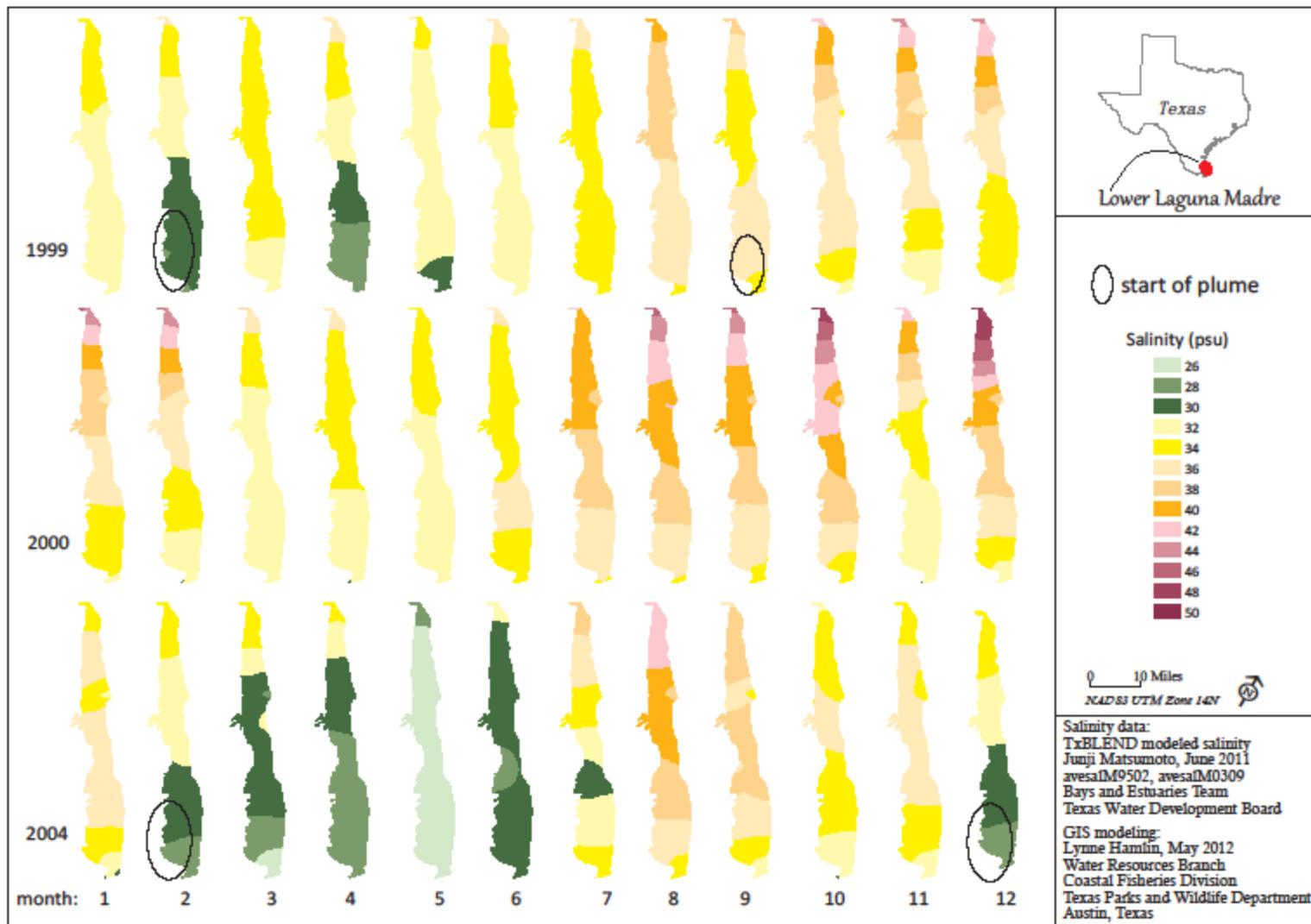
Brazos-
Santiago Pass

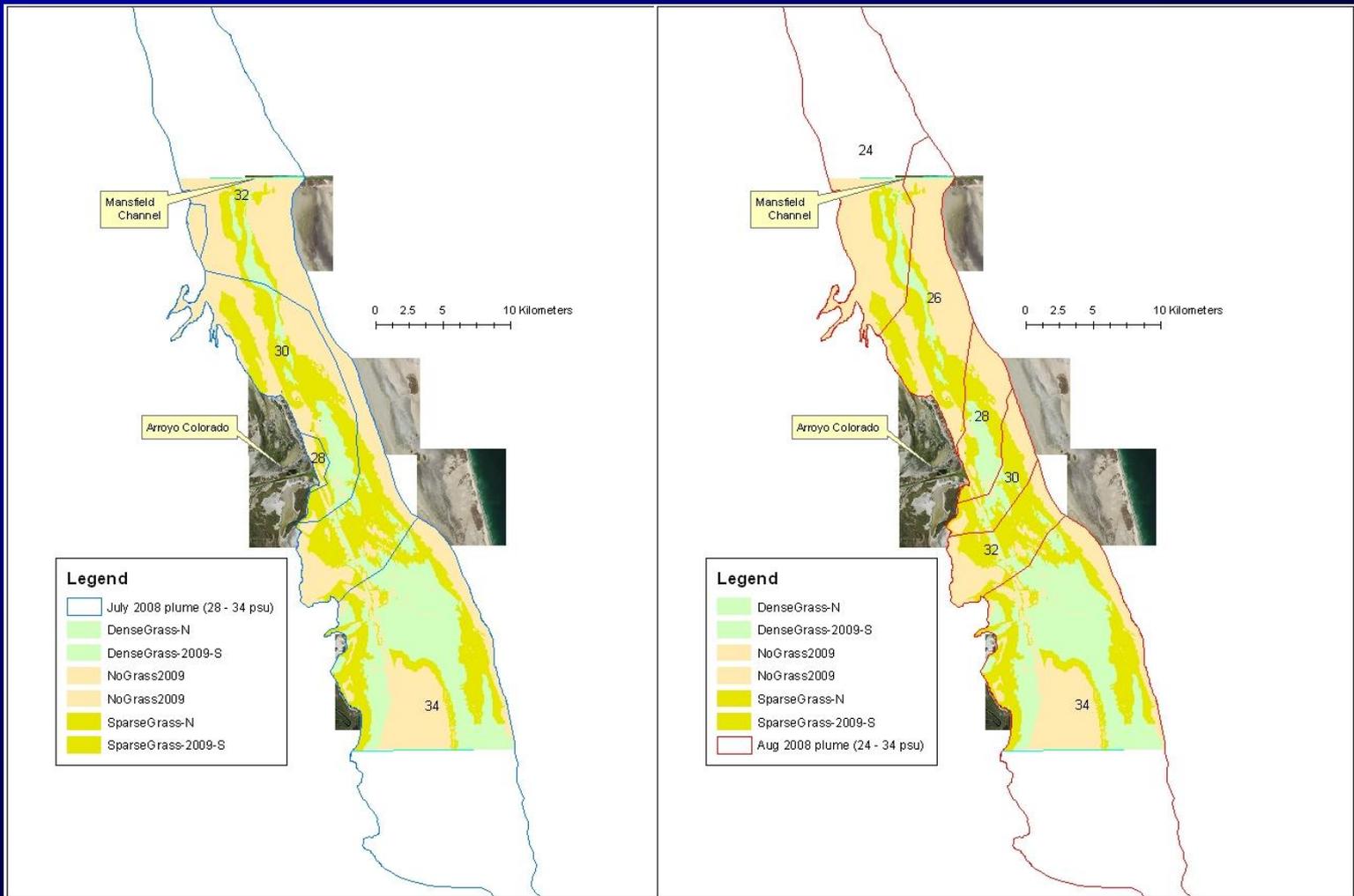


TxBLEND Model Monthly Salinity Contours of Lower Laguna Madre

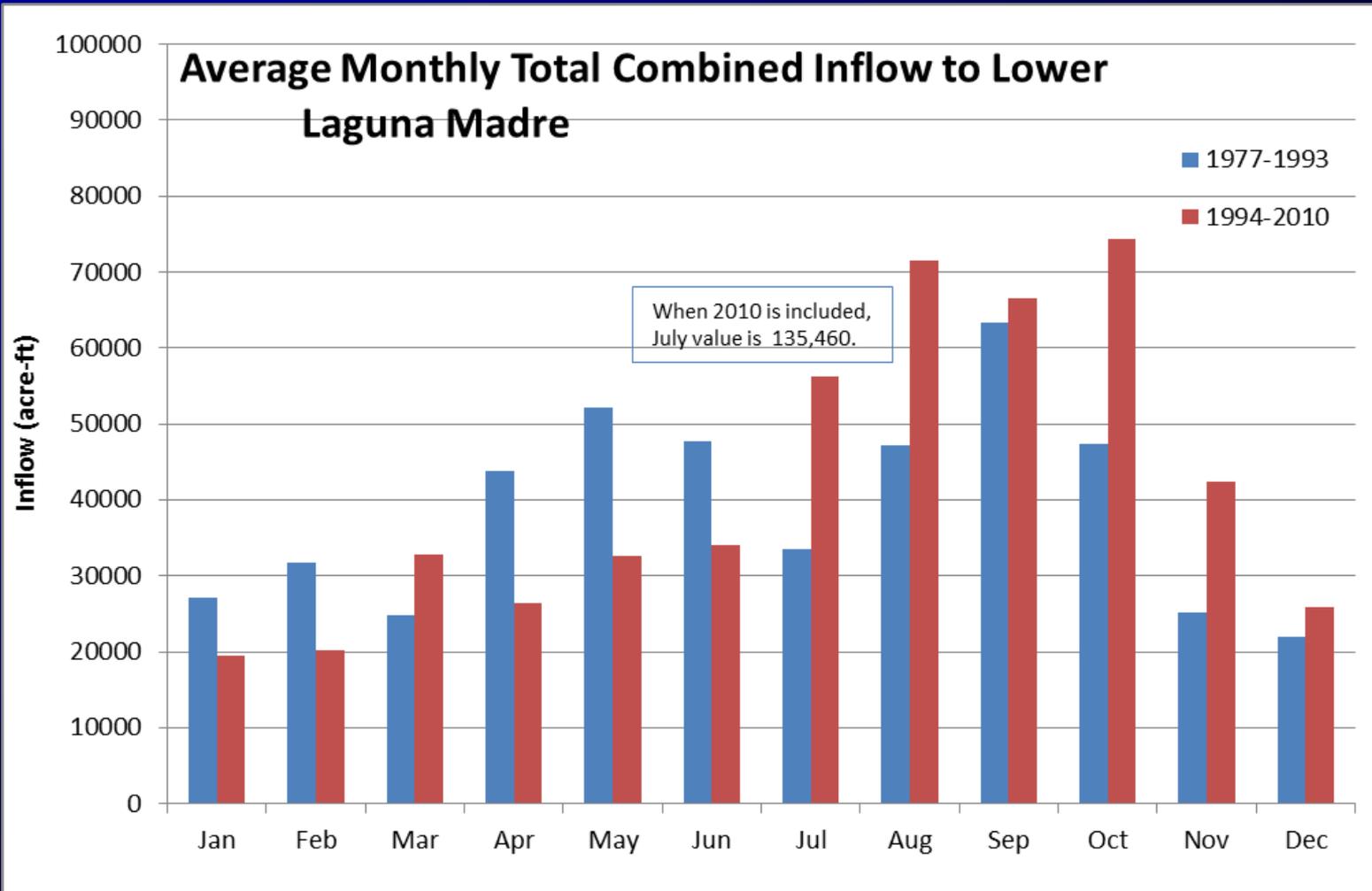


TxBLEND Model Monthly Salinity Contours of Lower Laguna Madre





Salinity plumes from July - Aug 2008 inflows overlaid onto 2009 seagrass



Flow Regimes	Years of Occurrence	Monthly Pulses (acre-ft)	Ga/Ung Ratio
LOW	(8) 1986 – 87, 1989 – 90, 1994, 2000, 2005, 2009	< 40,000	3 or more to 1
HIGH	(12) 1984, 1988, 1991, 1993, 1997-98, 2002 – 2004, 2007 – 08, 2010	>100,000 (generally 2 months consecutively)	mostly 0.4 to 1
INTERMEDIATE	(9) 1982-83, 1985, 1992, 1995 – 96, 1999, 2001, 2006	50,000 – 85,000 (often 2 + months consecutively)	1.2 – 2 to 1

Categories of Inflow Regimes affecting Seagrasses