



A Conceptual Model to predict coastal wetland vegetation composition and production under different management scenarios

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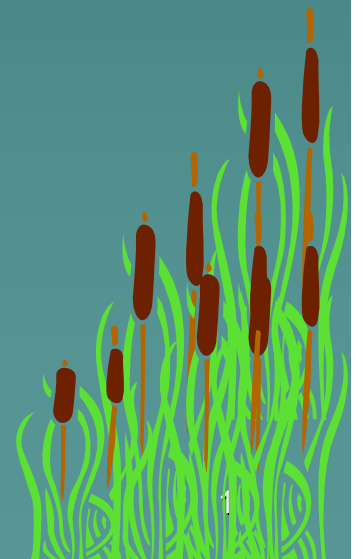
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Louisiana Department of Natural Resources Conceptual Model Teams

Habitat Switching

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Uncertainty Analysis

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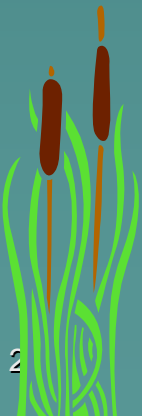
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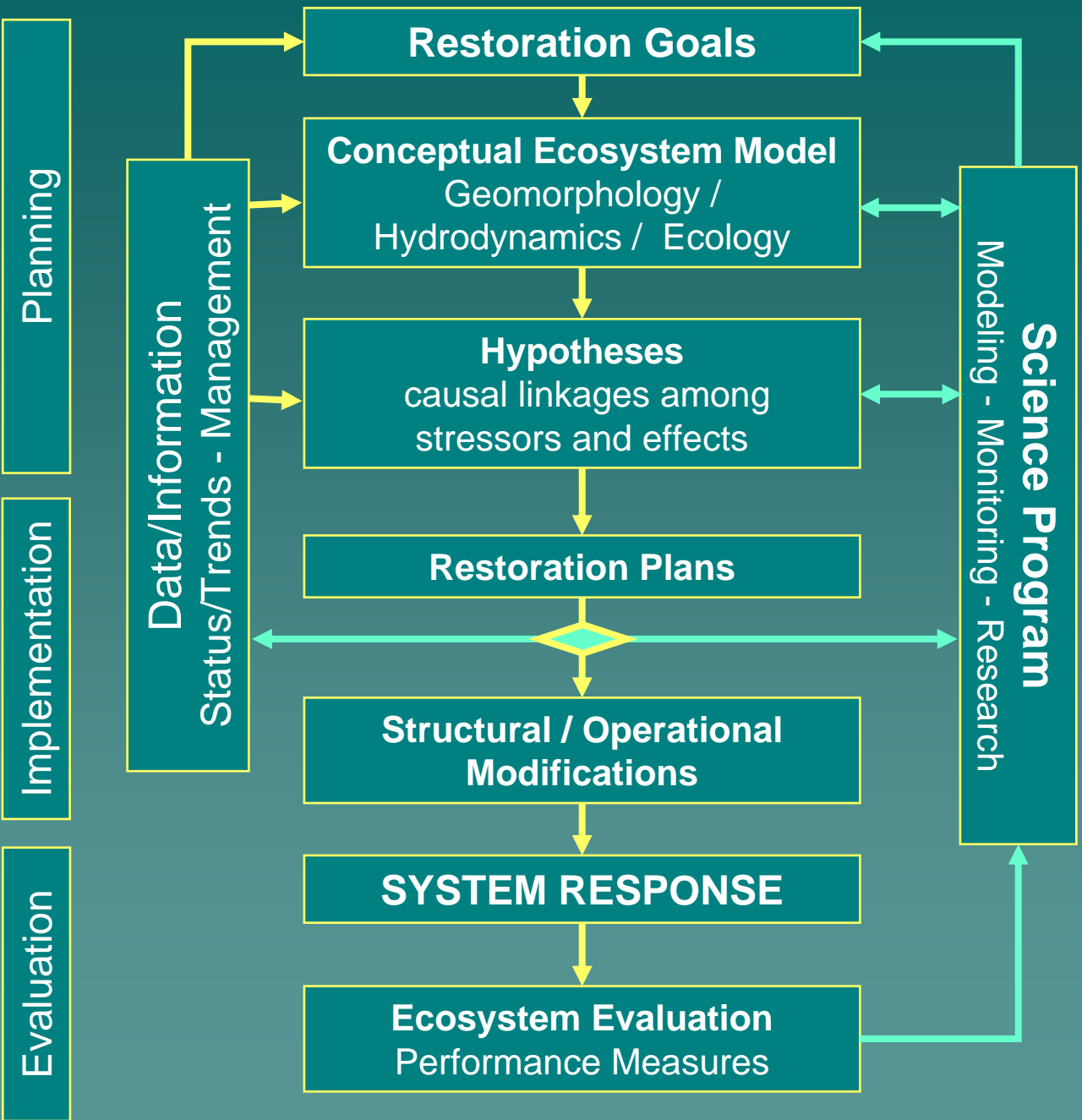
Erick Swenson

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ADAPTIVE MANAGEMENT & ASSESSMENT

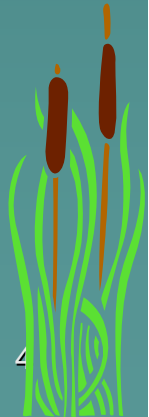
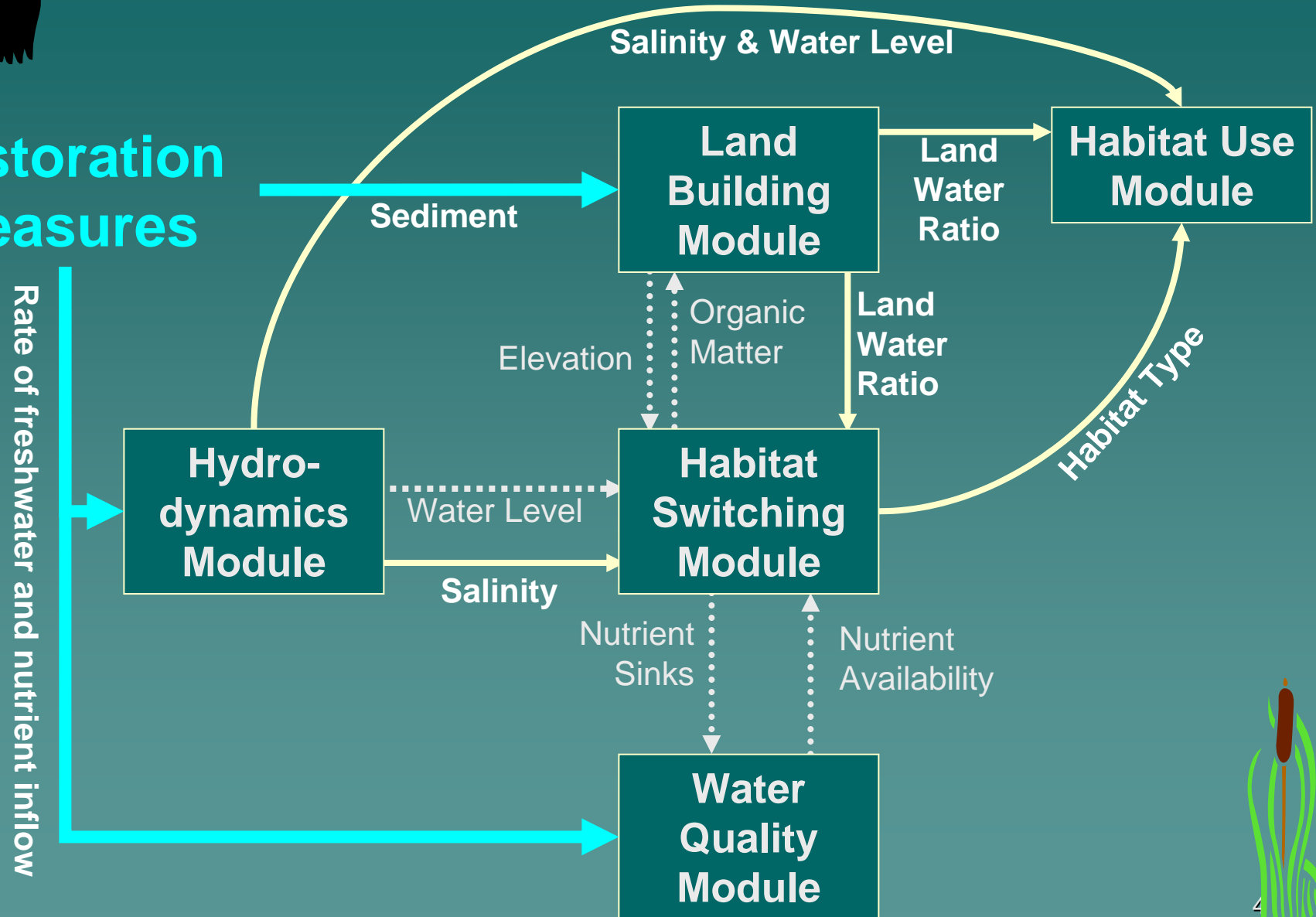
Reducing Scientific Uncertainty





Modular Approach

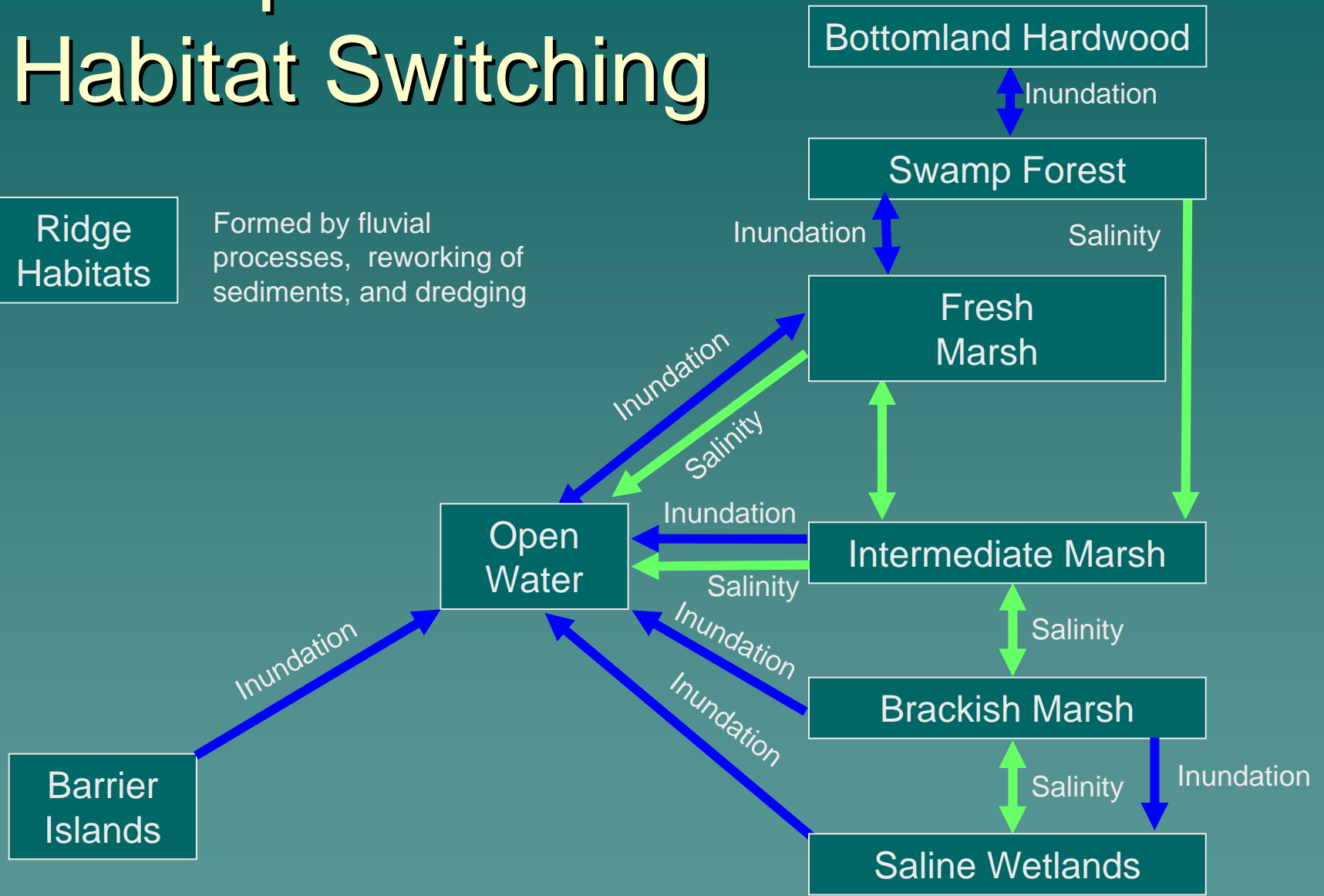
Restoration Measures



Conceptual Model Habitat Switching

Ridge Habitats

Formed by fluvial
processes, reworking of
sediments, and dredging



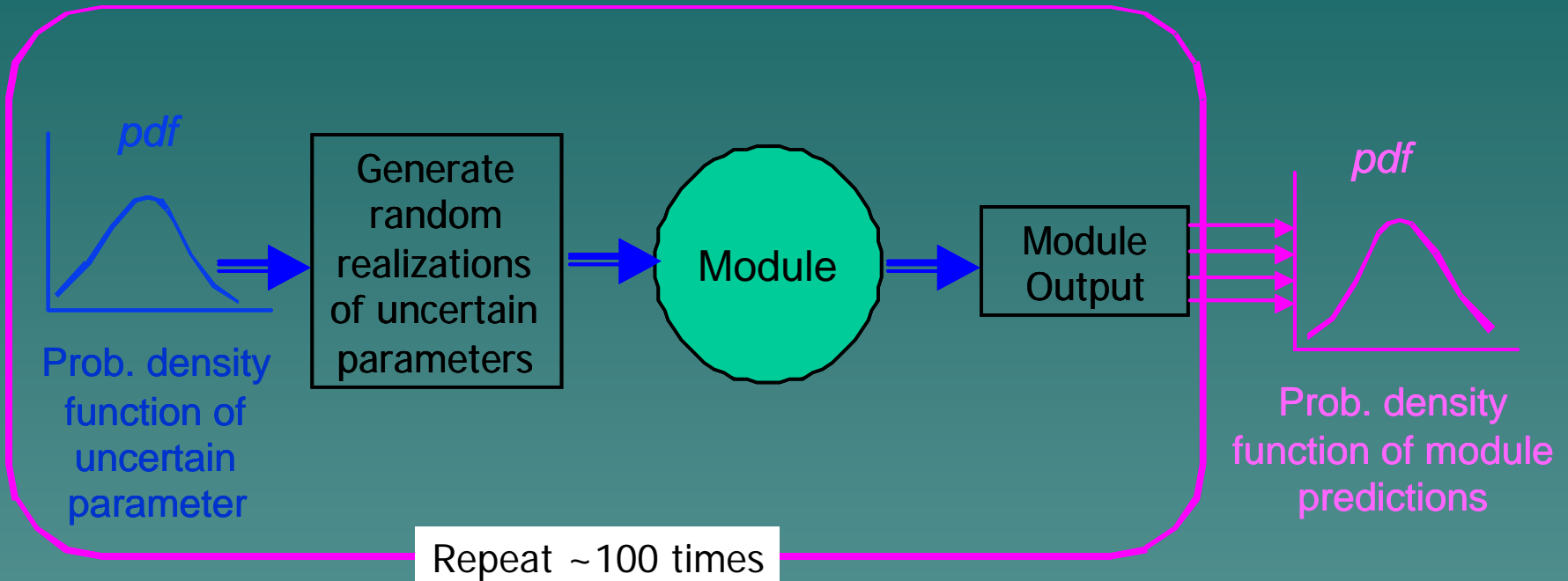
Switcher Salinity Thresholds

	Time 1 Habitat						
Time 0 habitat	Upland	Swamp forest	Fresh marsh	Intermediate Marsh	Brackish marsh	Saline marsh	Water
Upland	Always						
Swamp forest		Always					
Fresh marsh			<2.5 ppt	2.5-9 ppt			> 9 ppt
Intermediate Marsh			< 1 ppt	1-6 ppt	6-15 ppt	>15 ppt	
Brackish marsh				< 6 ppt	6-15 ppt	>15 ppt	
Saline marsh					<15 ppt	>15 ppt	

Based on average annual salinities of each habitat. Note that little to no information exist where sites were monitored through a switch in habitat type.

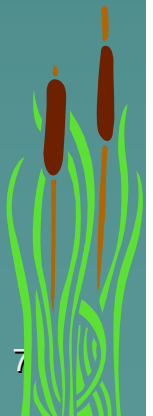


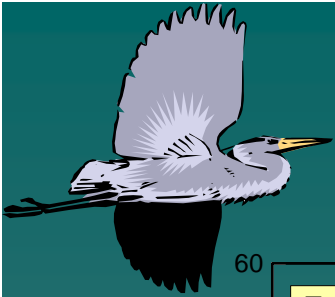
Uncertainty Analysis



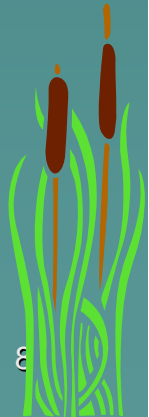
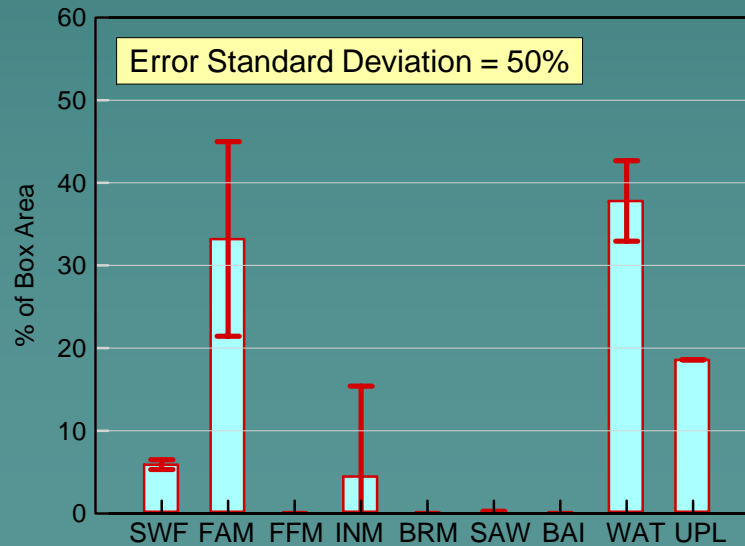
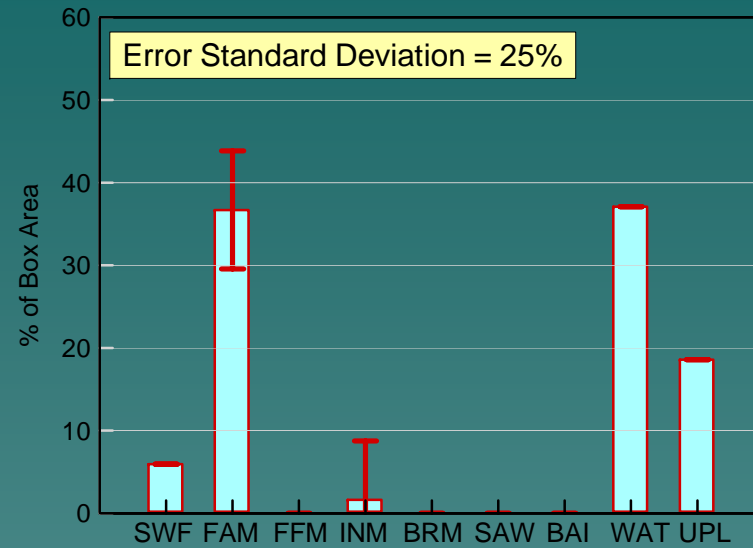
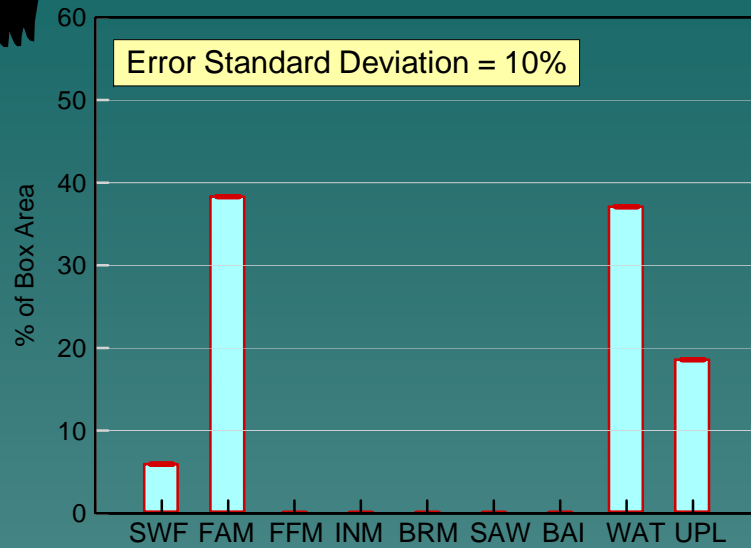
Monte Carlo Simulation Method

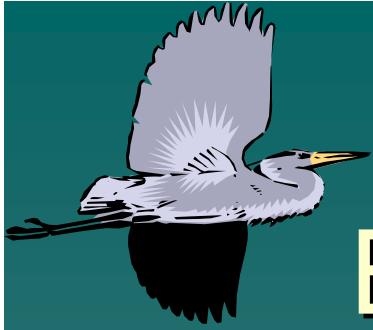
- used to test uncertainty of switching thresholds





Threshold Uncertainty Effect





Forcing Functions of Emergent Marsh Productivity

Affected by Restoration

- Salinity
- Inundation
- Dominant Plant Species /Habitat Type
- Nutrient levels
- Wetland area

Unaffected by Restoration

- Grazing
- Fire
- Acidity
- Climate

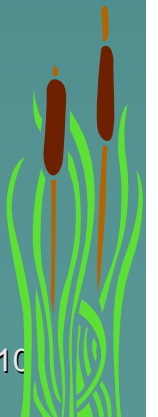
Selected functions are those most affected by ecosystem restoration measures

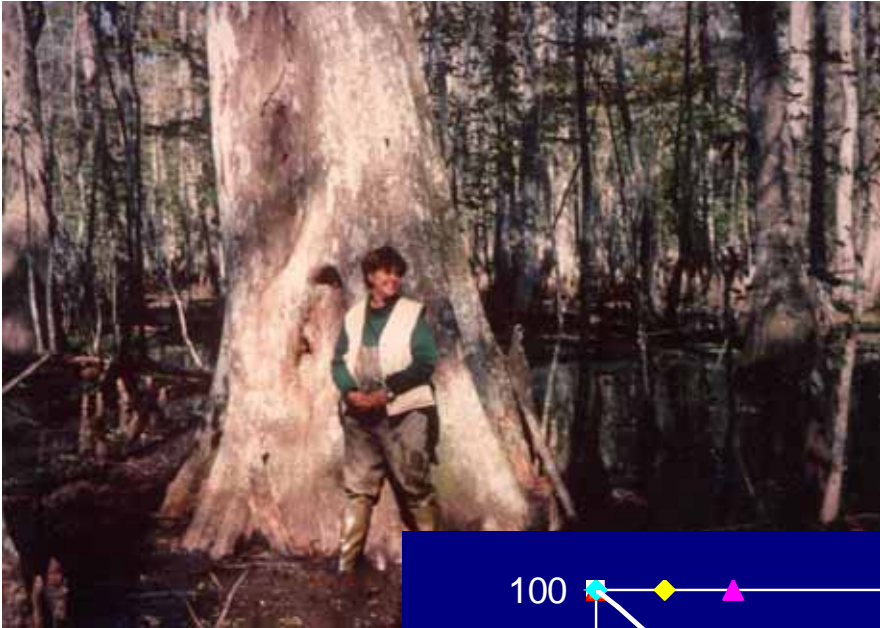
The timing of changes in forcing functions was considered



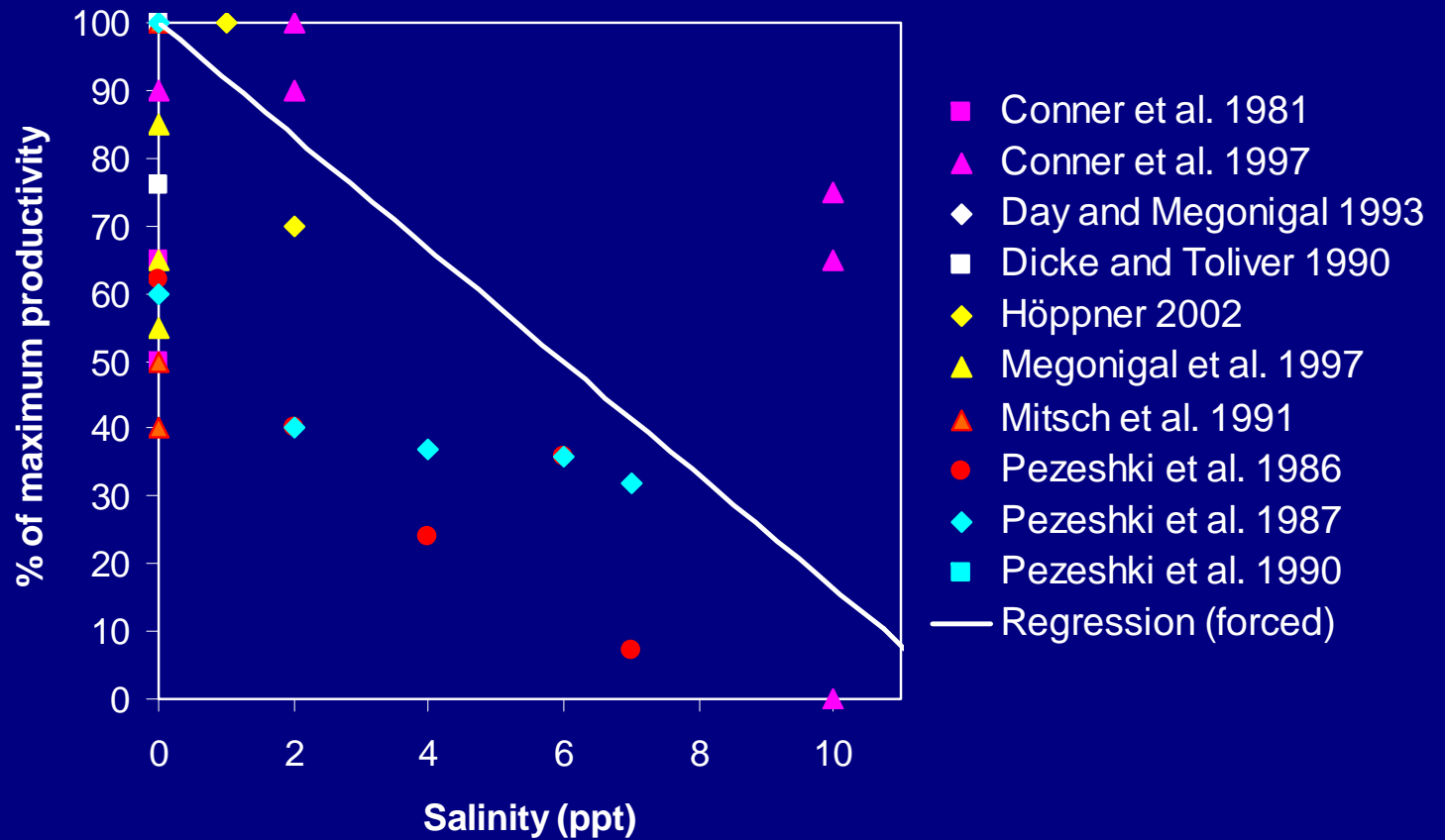
Salinity vs. Productivity

- ◆ Extensive Literature
 - Interaction with other factors (primarily flooding)
 - Many ways to measure productivity
 - ◆ Stem / Leaf length
 - ◆ Biomass
 - ◆ Photosynthesis
- ◆ Normalized by taking percentage of maximum measurement in moist soil

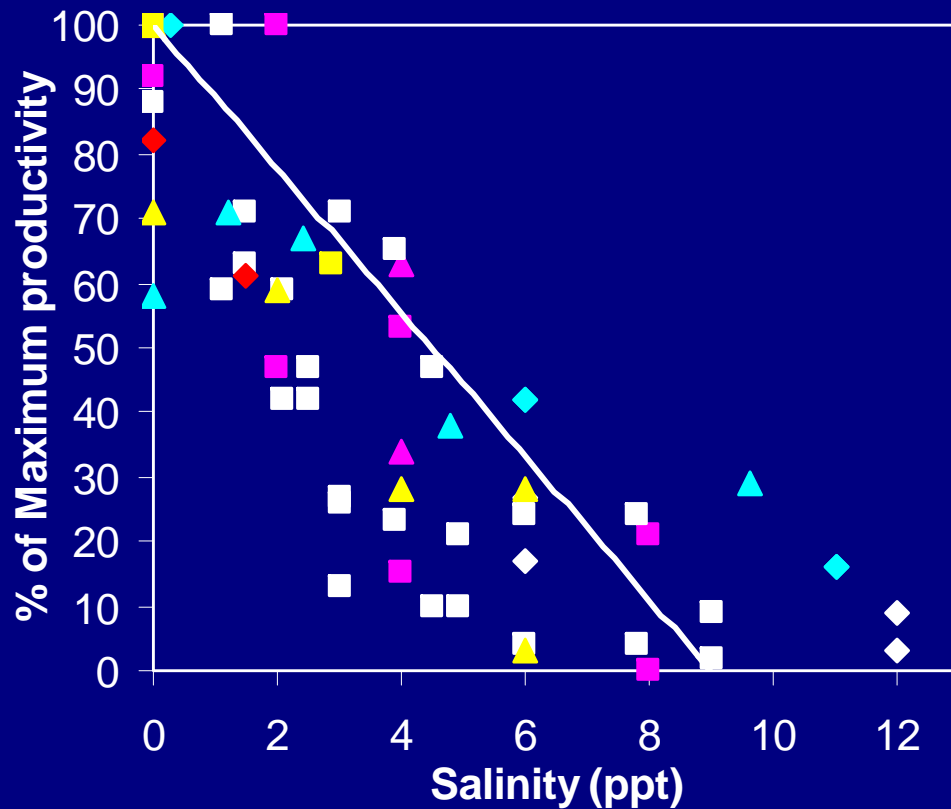




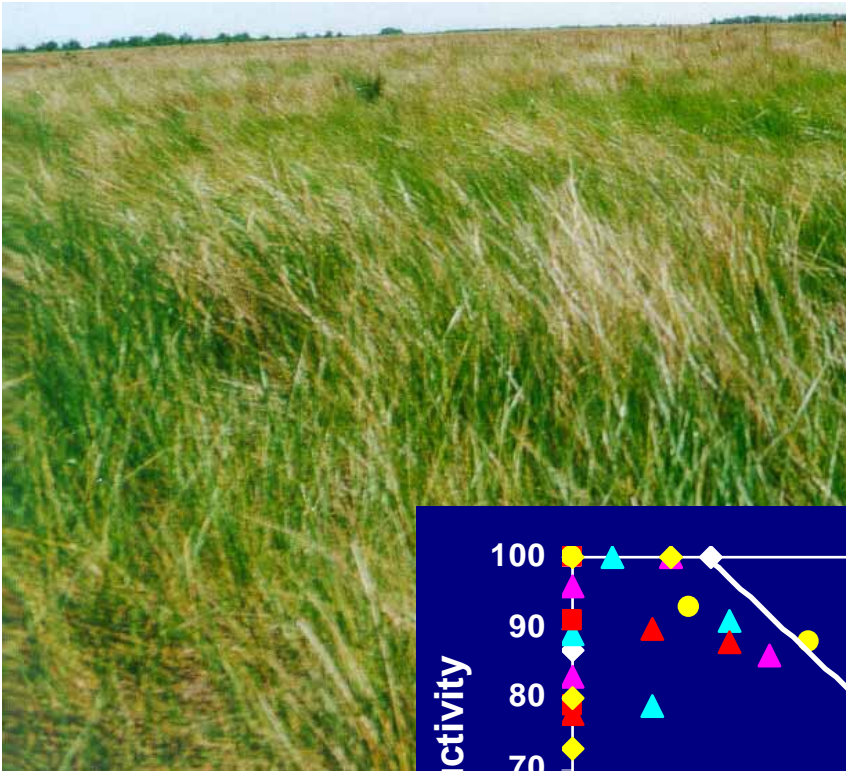
Swamp Forest



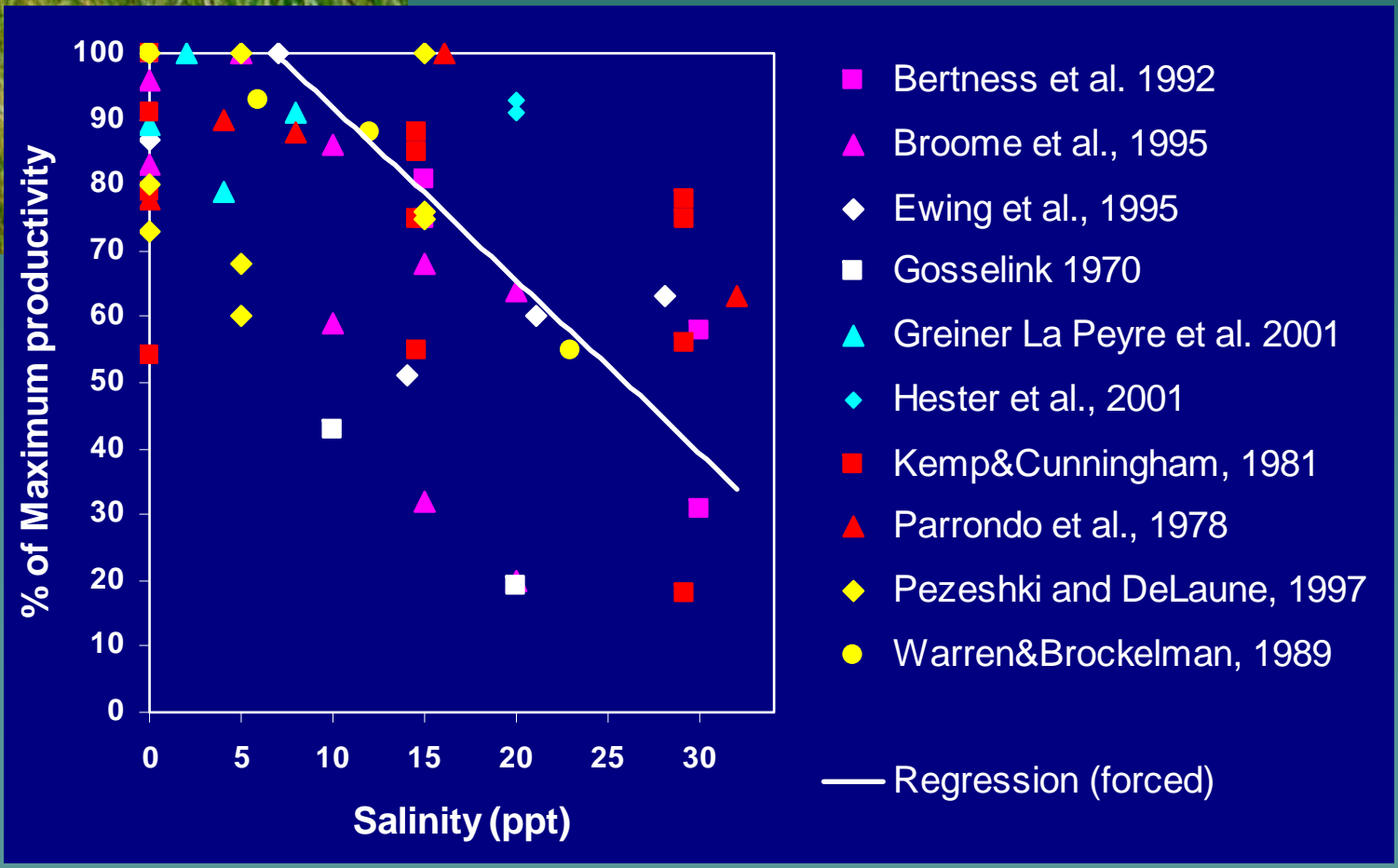
Fresh Marsh

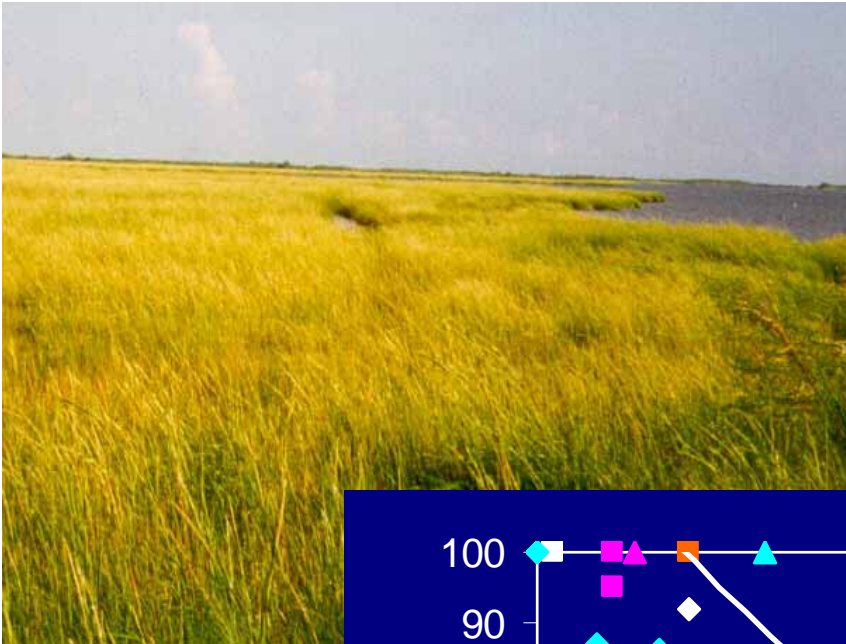


- Greiner La Peyre et al. 2001
 - ▲ Hester et al. 2001
 - ◆ Howard&Mendelssohn 1999a
 - Howard&Mendelssohn 1999b
 - ▲ McKee&Mendelssohn, 1989
 - ◆ Pezeshki et al. 1987a
 - Pezeshki et al. 1987b
 - ▲ Spalding and Hester (in prep)
 - ◆ Willis and Hester (accepted)
- Regression (forced)

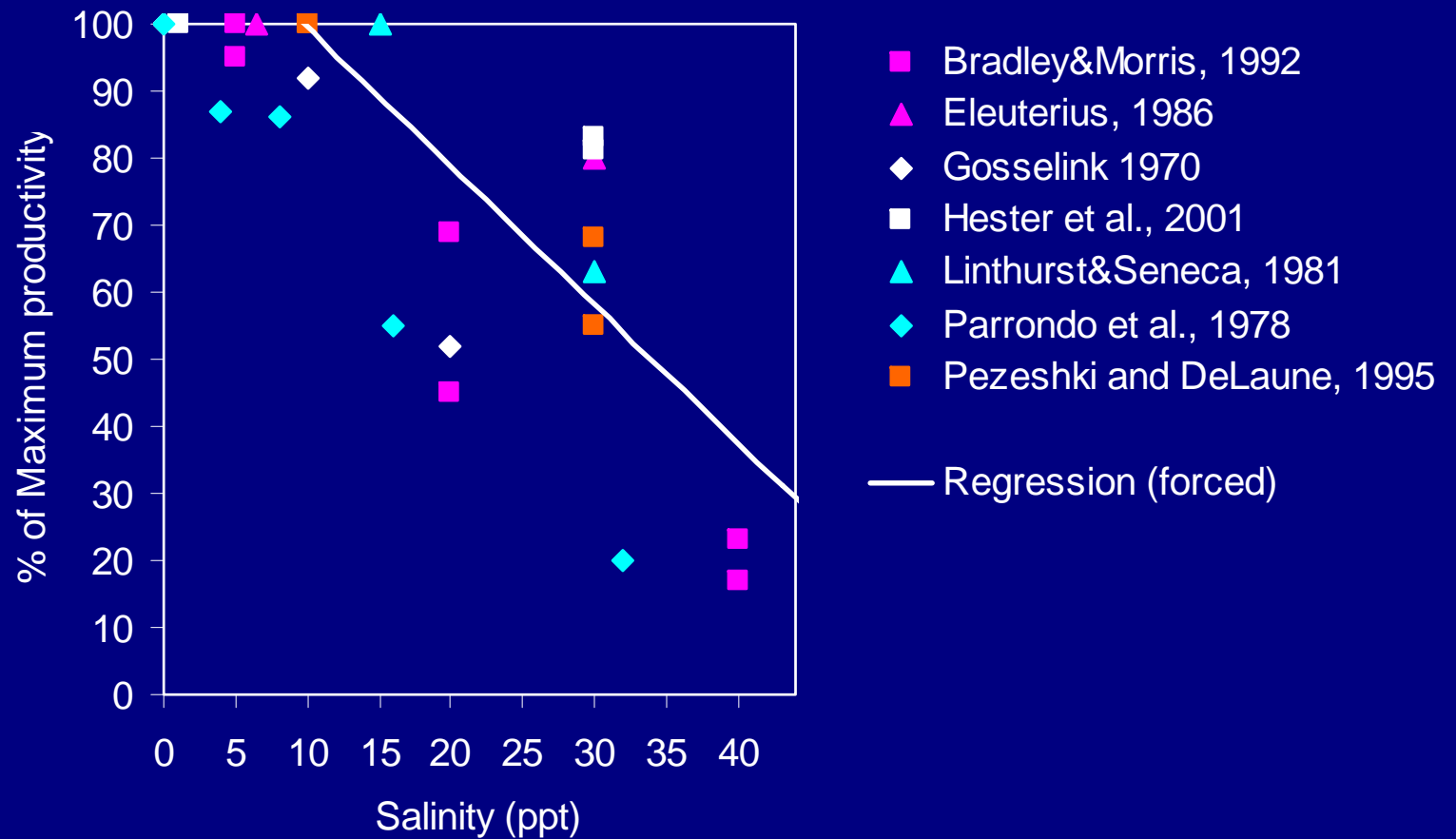


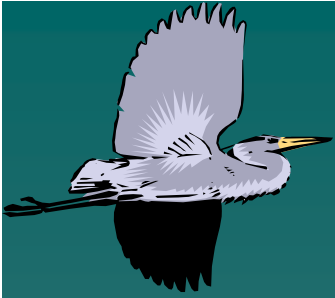
Brackish Marsh





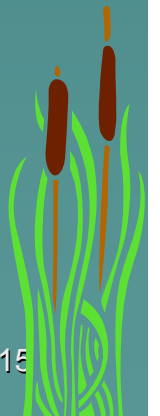
Saline Marsh

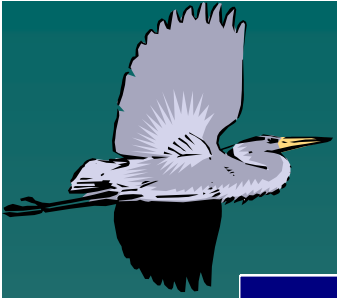




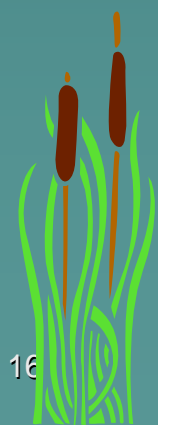
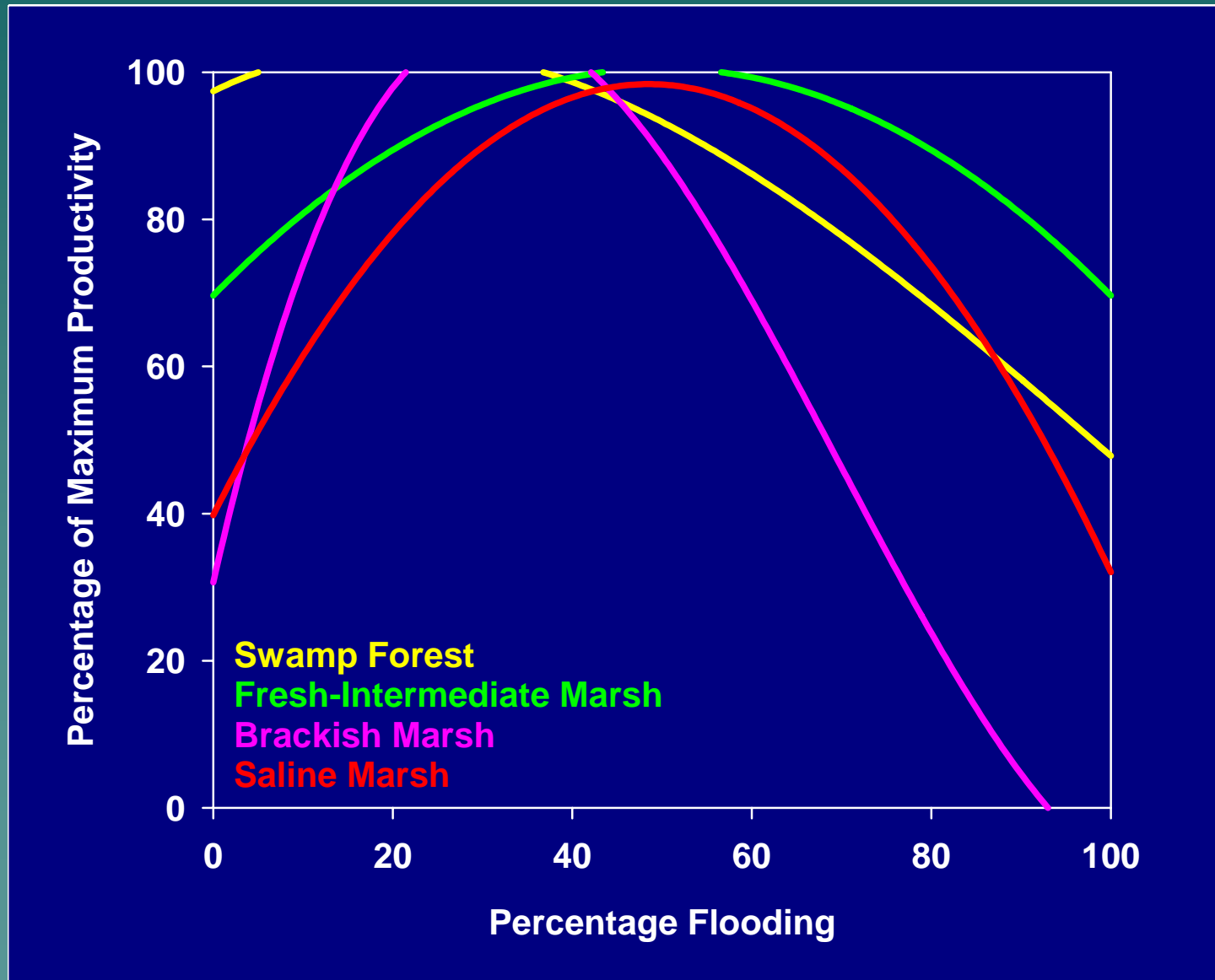
Salinity vs. Flooding

- ◆ Limited Literature
 - Generally three treatments
 - ◆ Moist soil / Drained
 - ◆ Constant flooding with 5 cm of water
 - ◆ Constant flooding with 15-20 cm of water
 - Need experiments with duration of flooding
- ◆ Therefore we used our best professional judgment



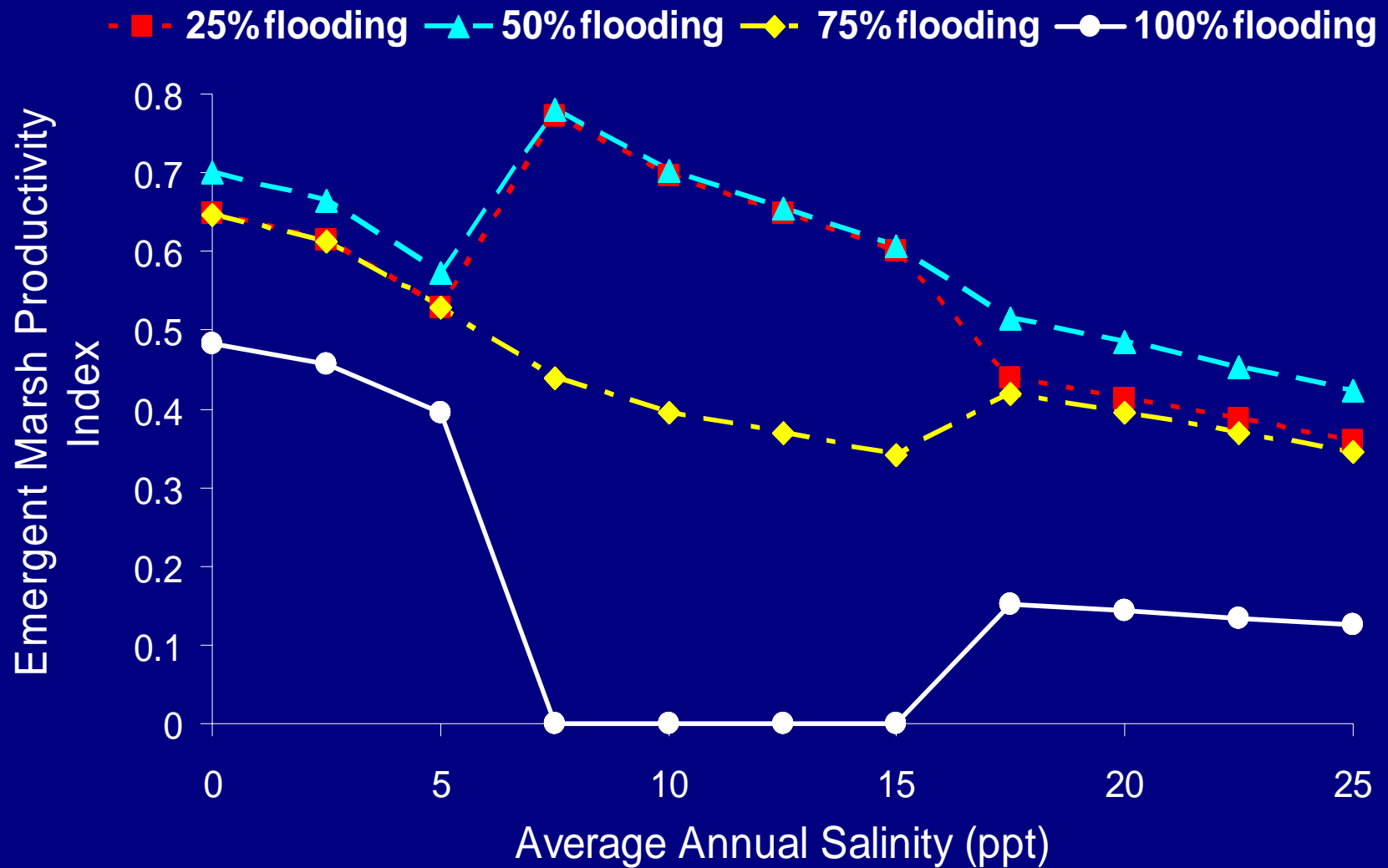


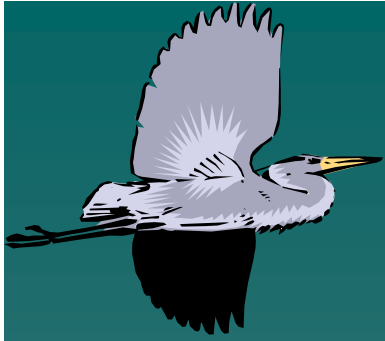
Hypothesized Relationship



Emergent Marsh Productivity

Sensitivity Analysis





Seasonal Distribution of Growth

Months	Swamp Forest	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Saline Marsh
November-February	0%	14%	21%	30%	24%
March – June	75%	38%	40%	35%	29%
July - October	25%	48%	39%	35%	47%

Sources:

Swamp Forest from Keeland and Sharitz, 1995

Fresh Marsh from Sasser and Gosselink, 1984

Intermediate, Brackish, and Saline Marsh from Hopkinson et al., 1978

Maximum Primary Production Estimate

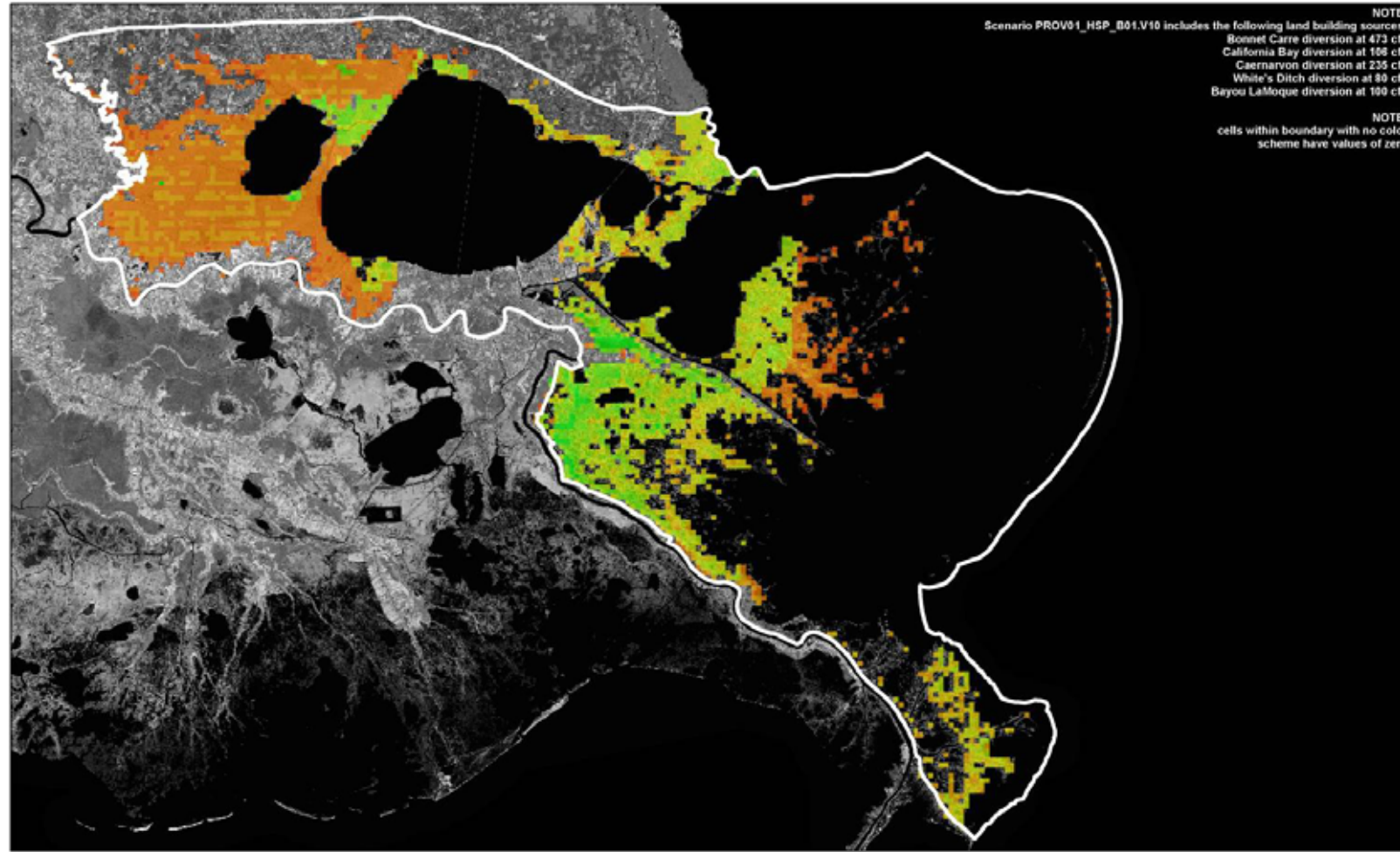
	Swamp Forest	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Saline Marsh
Turnover Rate ^A (crops/year)		9.1	4.2	4.2	2.9
Maximum Aboveground biomass ^B (g/m ²)		635	1499	1781	1750
Root:Shoot Ratio ^C		2.6	0.7	0.7	0.7
Total Production ^D (g/m ² /yr)	1780	7430	7285	8656	6318

^AHopkinson et al. 1980, ^BVisser et al. 1998, ^CGosselink and Sasser 1995,

^DSwamp from Conner et al. 1981 marshes calculated as follows:

$$\text{Total production} = (\text{biomass} * \text{turnover rate}) + (\text{biomass} * \text{root:shoot ratio})$$

Example of Graphical Output



NOTE:
Scenario PROV01_HSP_B01.V10 includes the following land building sources:
Bonnet Carré diversion at 473 cfs
California Bay diversion at 156 cfs
Caernarvon diversion at 235 cfs
White's Ditch diversion at 80 cfs
Bayou LaMoque diversion at 100 cfs

NOTE:
cells within boundary with no color
scheme have values of zero

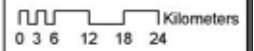


Data Source:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Coastal Restoration Field Station
Baton Rouge, LA
and
Working LCA Simulation
& Desktop Modeling Datasets

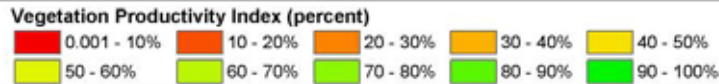
Image Source:
2000 Thematic Mapper Imagery
Map Date: May 19, 2003
Map ID: USGS-NWRC 2003-11-1402



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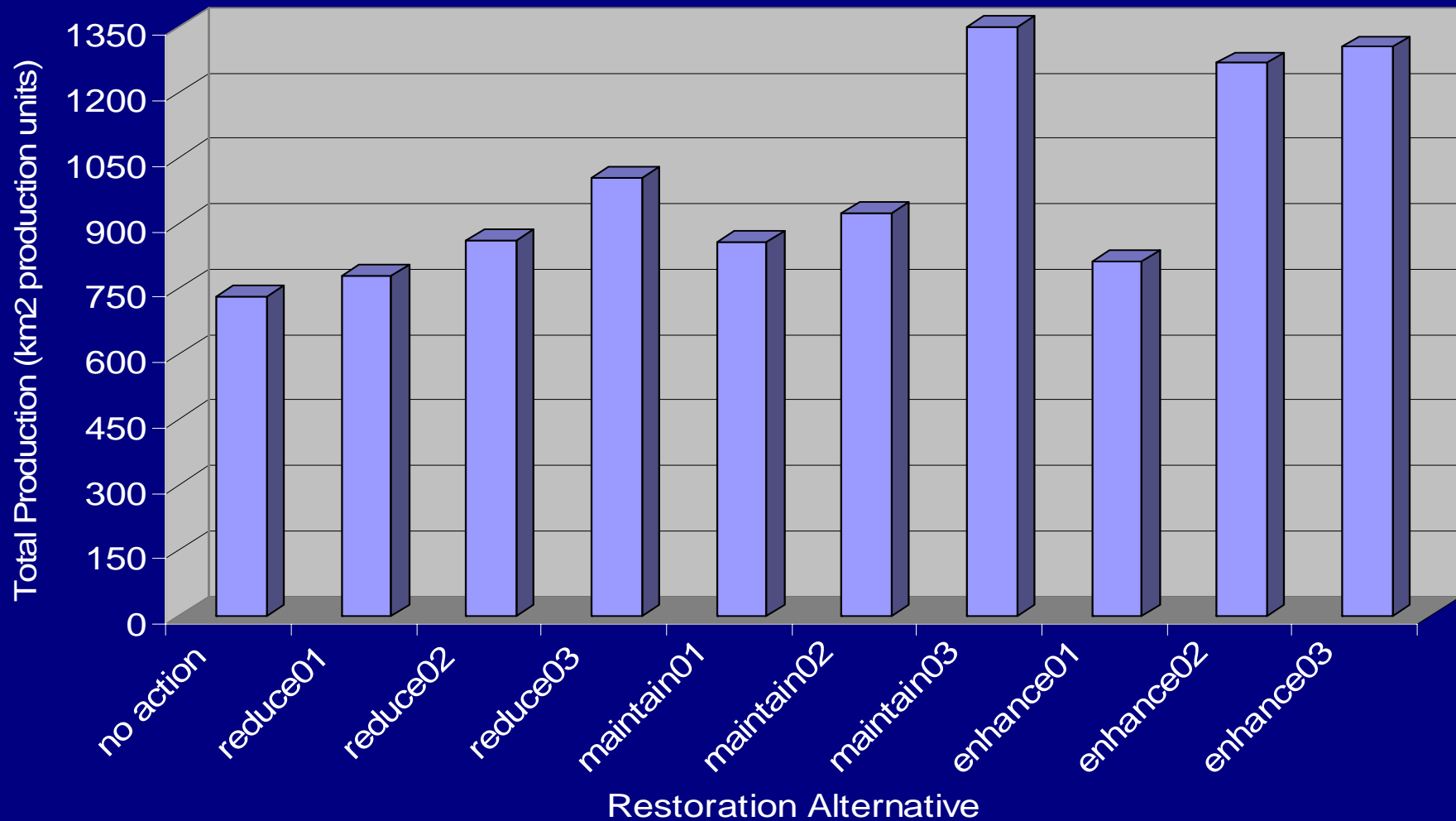
LCA



Vegetation Productivity
Sub-Province 1: No Action Alternative - Year 50

Example of Output Use

Total Production - Vegetation Sub-Province 1 - Year 50





Conclusions

- ◆ The framework for a conceptual model of marsh habitat switching and primary production has been established
- ◆ Results from the model are usable in the early planning phase of a large scale ecosystem restoration project
- ◆ Inundation effect on productivity needs to be strengthened with additional research
- ◆ Additional driving forces need to be added to the model (i.e. nutrient levels)

