Probabilistic Simulation Of Vegetation Dynamics In The Everglades Vegetation Succession Model (ELVeS)

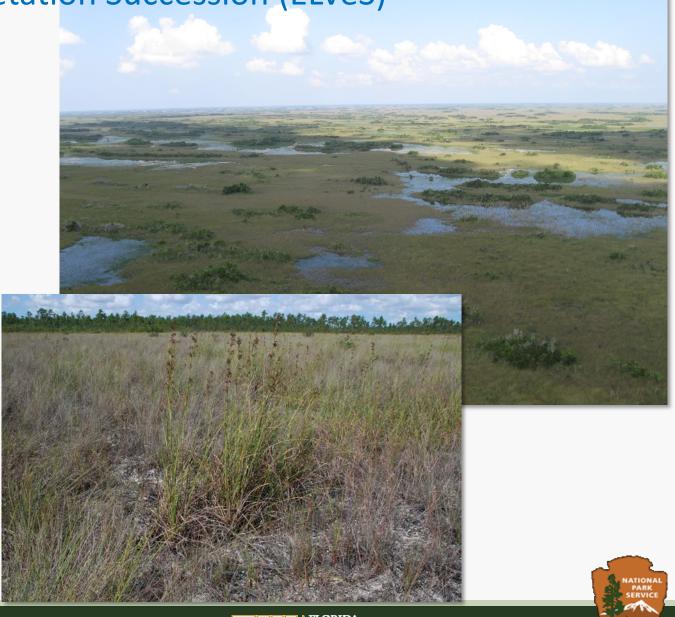
> Leonard Pearlstine¹, Lu Zhai², Jay Sah² and Mike Ross²

National Park Service, Homestead, FL
 Florida International University, Miami, FL



Everglades Landscape Vegetation Succession (ELVeS)

- A spatially explicit cell-based probability model to predict the likelihood of specific vegetation communities given a set of specific environmental conditions
- Links response of vegetation to underlying hydrologic models
- Evaluation of alternatives based on projected ecological outcomes and tradeoffs between restoration goals and targets.

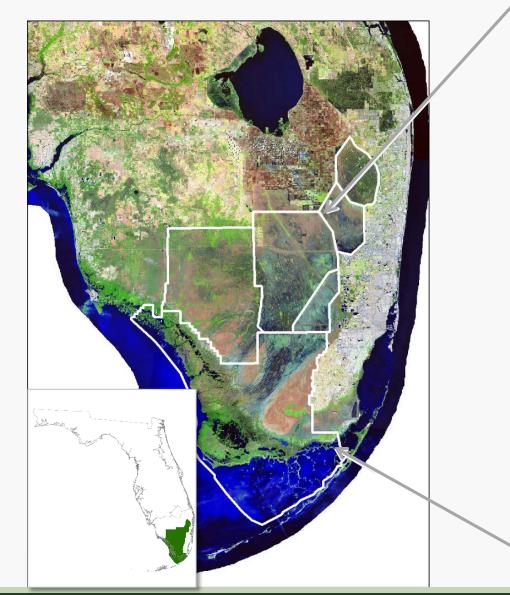


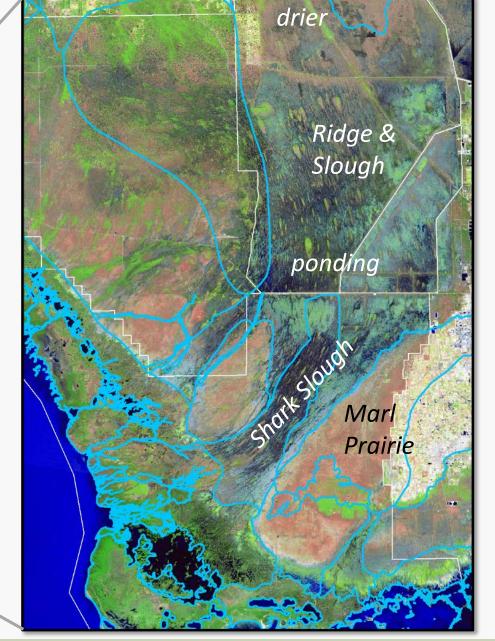


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Model Domain











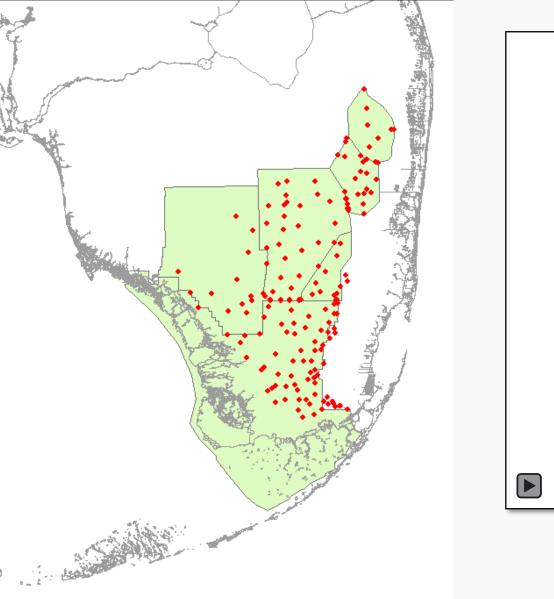


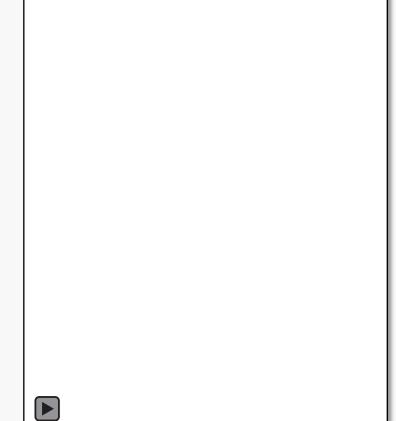


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Daily Water Depth 1991 to present

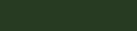




FLORIDA INTERNATIONAL UNIVERSITY







Vegetation Community Observations

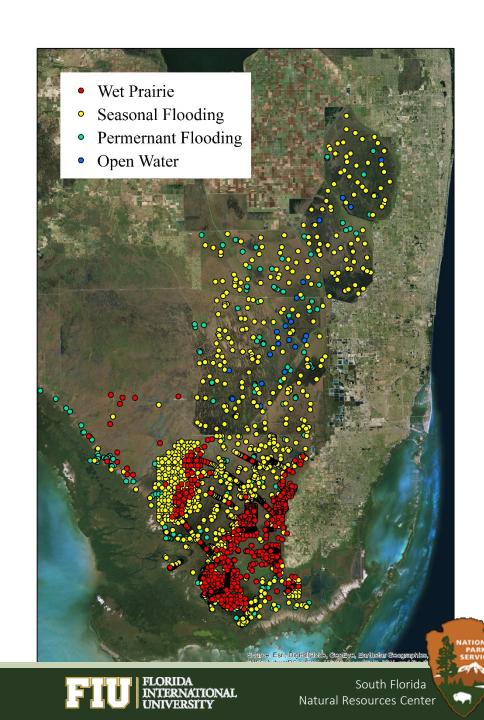
Sah et al., Richards et al. and others:

- 1. 17 vegetation survey projects from 1996
- 2.3601 observations
- 3.40 communities

9 major communities

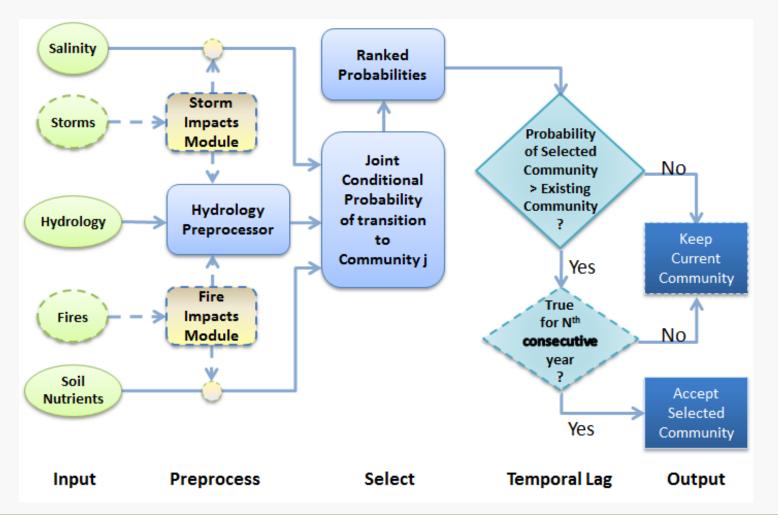
in our current modeling work

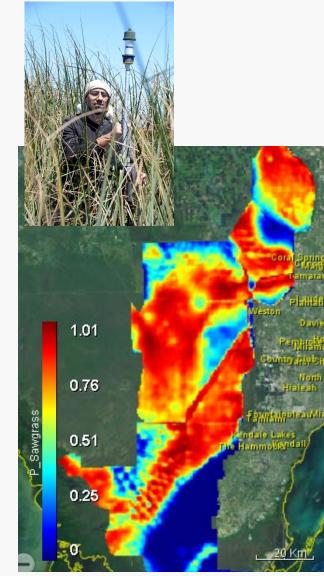
- 1. Beakrush
- 2. Blackrush-Bluestem
- 3. Cattail
- 4. Muhly
- 5. OpenMarsh-Waterlily
- 6. Sawgrass, Sparse
- 7. Sawgrass, Tall
- 8. Sawgrass, Marl Prairie
- 9. Spikerush-Sawgrass



Vegetation Succession

Everglades Landscape Vegetation Succession (ELVeS)





Sawgrass probability



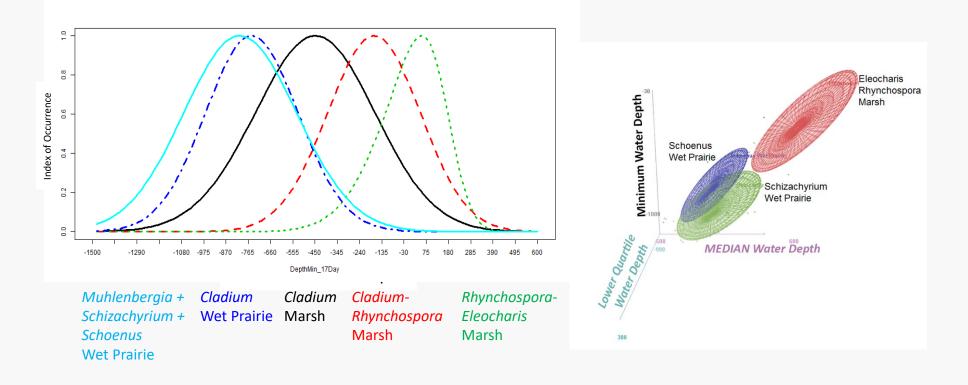




Vegetation Community Succession

Explore models that discriminate vegetation assemblages

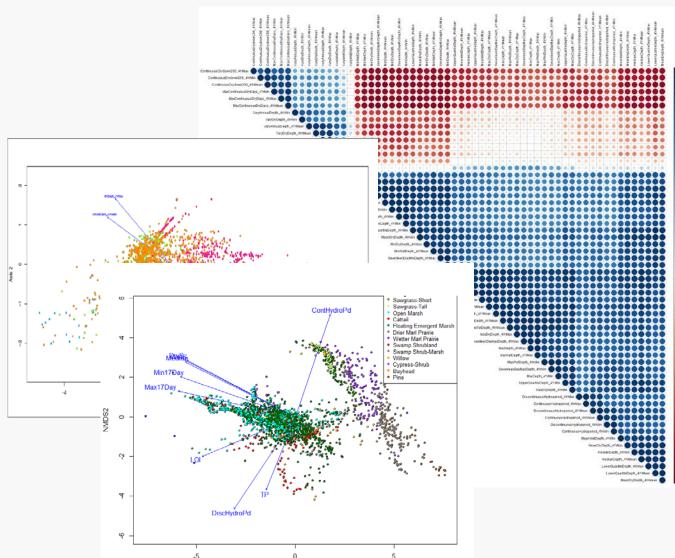
- along hydrologic gradient,
- soil characteristics,
- fire occurrences and fire history



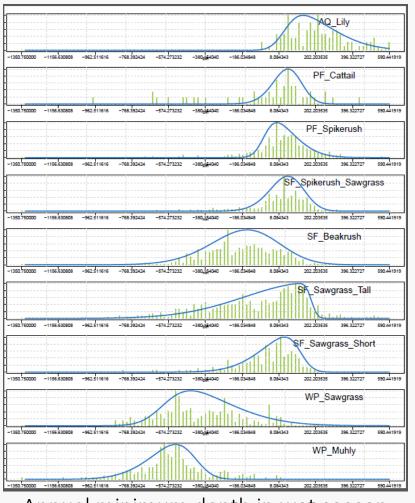




Metric Evaluations



NMDS1



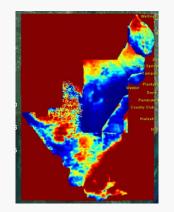
Annual minimum depth in wet season Four-year mean



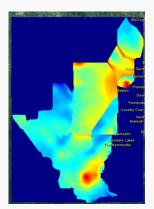




Selected Variables

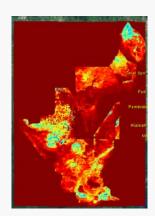


MaxContDays > 200cm

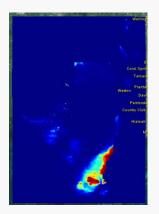


Depth Std Dev

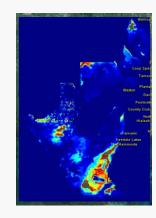
All layers are from 1995



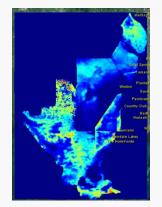
MaxContDays 0 - 5cm



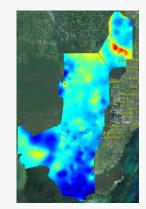
Days < -20cm



Days -20 - -10cm



Days 10 - 25cm

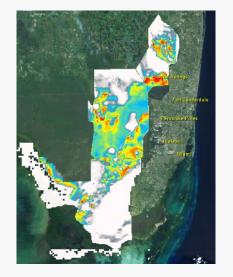








Joint Instantaneous Probability Index



Joint probability index for Spikerush-Sawgrass

P(Spiker-Sawgr | Days -20 to- 10cm)

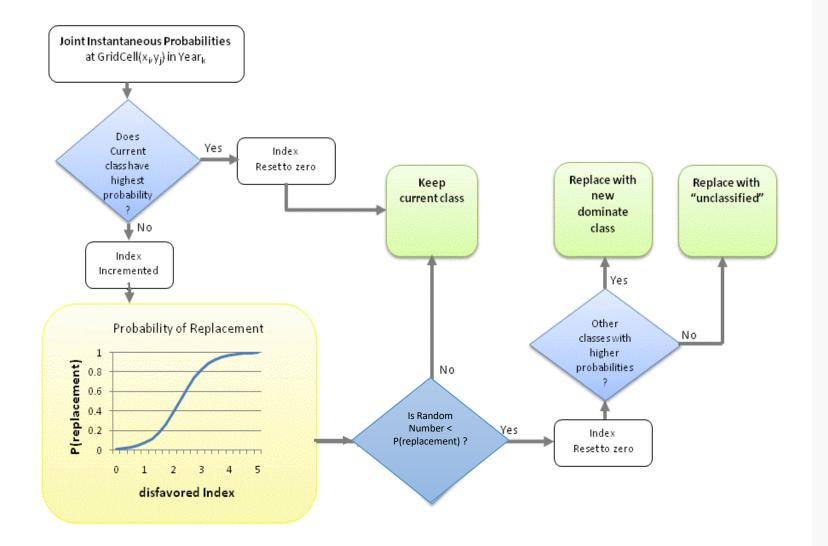
P(Spiker-Sawgr | TP)

P(Spiker-Sawgr | Days 0 to 50cm)





Temporal Lag Routine







ELVeS GUI

A ELVeS 1.0.0a							- x	
File Edit	🛓 ELVeS 1.0).0a					_	
Setup	File Edit	🛃 ELVeS 1.0.0a					-	×
Commu	Setup	File Edit Help						
	Commu	Setup Runtime						
Communit	File: Variable:	Communities Data Layers Evaluation Output						
		Normal Skewed	Normal Logistic	Categorical Simul	ation			
Commur		Community: Spiker	ush	▼	Data Layer: loi			
Spikerus Cattail	Layer Na Ioi	Location: 0	Scale 0	Shape: 0	Max: 0			Add
OpenMar	tp_krig		Scale	Shape. U	Max. 0			Add
FloatingE Muhlenbe		Community	DataLayer	Location	Scale	Shape	Max Us	
MixedMar		MixedMarlWetPrai	meanAnnualDepth	27.46	100	10.17		
Sawgras OpenWa		Sawgrass	meanAnnualDepth	150	300	3		
oponind	Sevenice	Openwater	meanAnnualDepth	187.46	200	10.17		
		Spikerush Cattail	seventeenDayWat seventeenDayWat	120 -120	200 250	-3		
?		OpenMarsh	seventeenDayWat	20.07	400	7.2		V
	?	FloatingEmergent		-59.93	400	7.2	0.75	
		MuhlapharaiaMat	aguantaan Doulliot	050.00	400	7.0	0.75	
		?						Remove
								Run

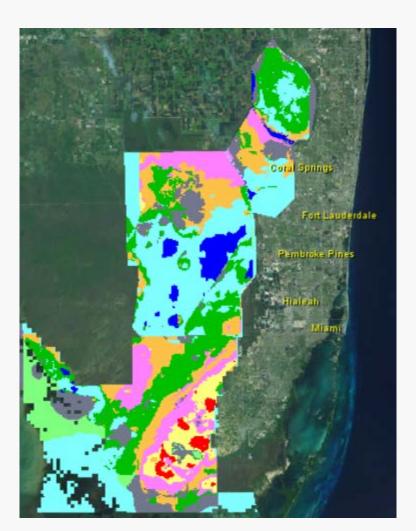




Dominate Vegetation Community







2011

Muhly Grass
BlackSedge-BlueStem
Sawgrass Marl Prairie
Beakrush
Sawgrass, Tall
Sawgrass, Sparse
Spikerush-Sawgrass
Cattail
Open Marsh-Lily



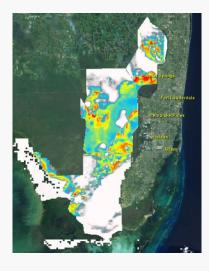
Individual Community Probability Indices

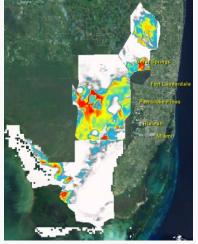




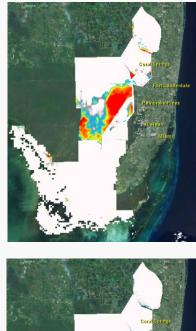


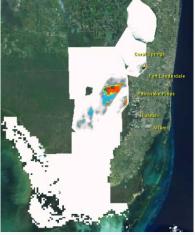
Muhly Grass

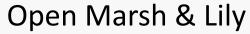




Spikerush - Sawgrass









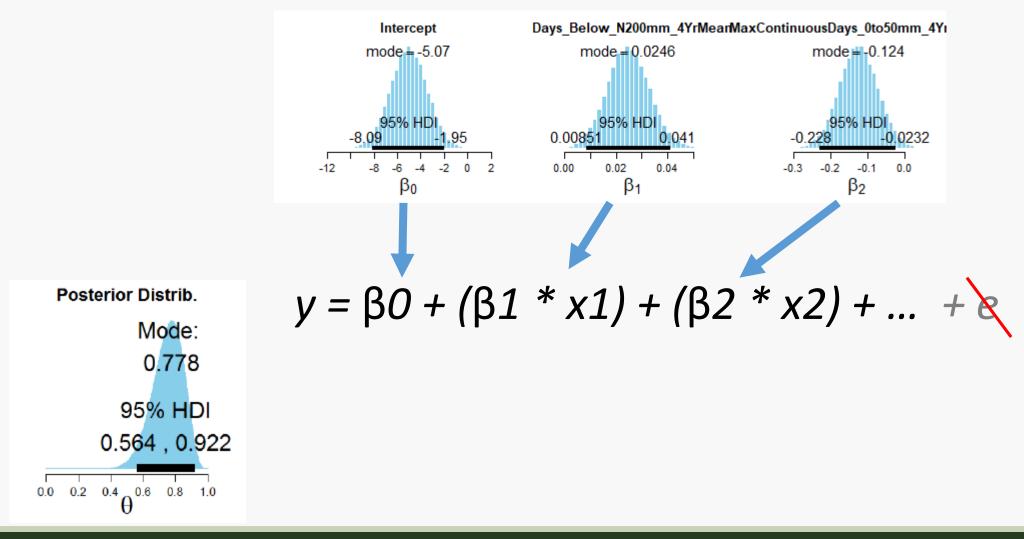




2011



Bayesian Regression

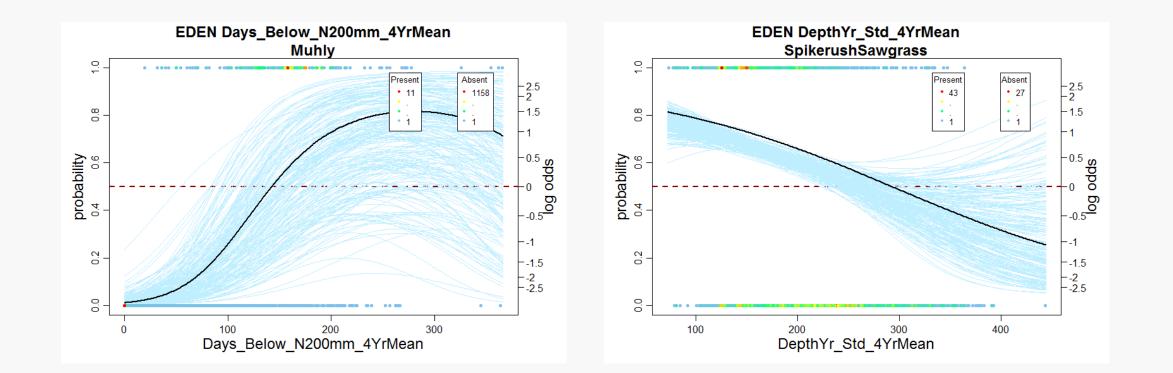




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Bayesian Multiple Logistic Regression

Applied to the same vegetation community data and variables



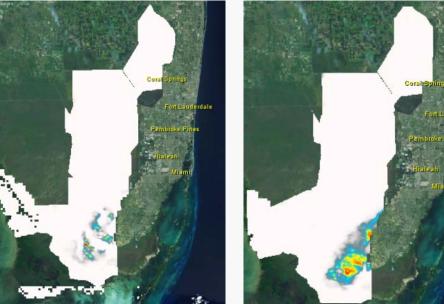




ELVeS and Bayesian Comparison

First DRAFT!

Muhly Grass

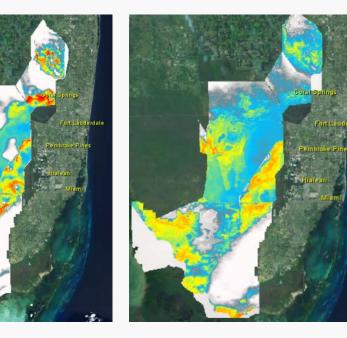


Current ELVeS



Bayesian Multi-Logistic

Spikerush & Sawgrass



Bayesian Multi-Logistic



1995



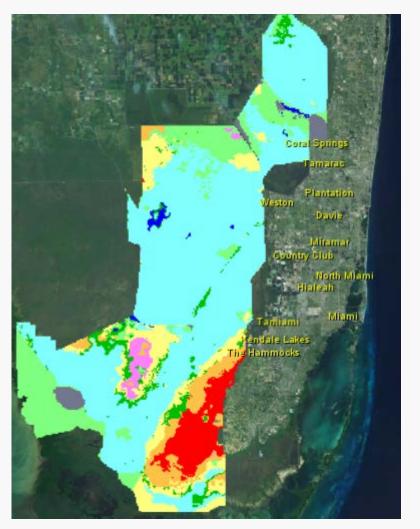


Current ELVeS

ELVeS and Bayesian Comparison

Fort Lauderdale

Current ELVeS 2011



Bayesian Multi-Logistic 2011

Muhly Grass BlackSedge-BlueStem Sawgrass Marl Prairie Beakrush Sawgrass, Tall Sawgrass, Sparse Spikerush-Sawgrass Cattail Open Marsh-Lily



First DRAFT!



National Academy of Sciences, Committee on Independent Scientific Review of Everglades Restoration Progress, 2016.

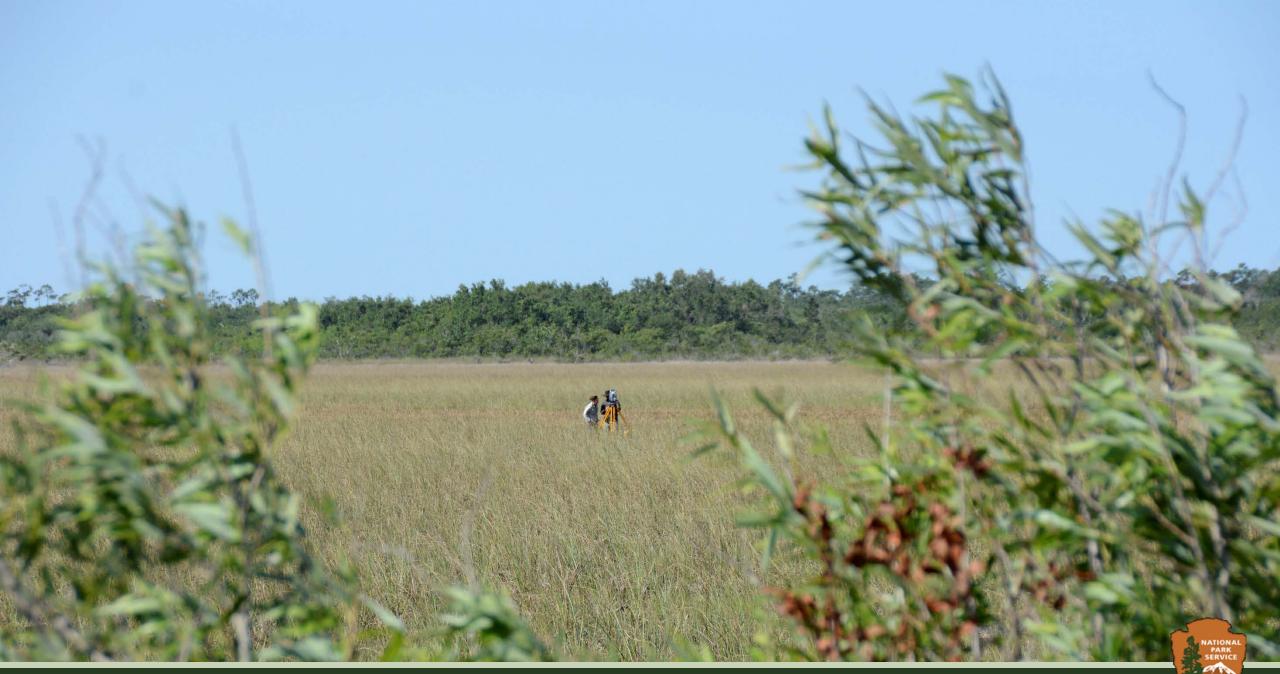
The capacity to identify achievable goals and objectives is much improved since CERP authorization due to advances in modeling, especially in the development of systemwide ecological models.

[Hydrological and ecological modeling provides the capacity to establish] clearly defined goals and quantitative objectives involving evaluation of tradeoffs among various hydrologic and ecological objectives, and perhaps some rethinking of priorities, especially with respect to expectations for particular species.

Ecological models also can be used to explore the implications of climate change and sea level rise, changes in CERP project feasibility, and the improved understanding of the pre-drainage.



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