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Automated Online Ecological Modeling and Evaluation for Everglades Management and Restoration

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Effective resource management and restoration of the Everglades relies on a continuous process of field monitoring, ecological modeling, data and model result evaluation, and planning meetings. To support Everglades restoration and ecosystem management, there are weekly and monthly multi-agency meetings regarding the effects of water-management operations on a species of concern. Often there are time delays in providing the most recent data and model-result evaluation to decision makers due to time required for data acquisition, data processing, model execution, and model post-processing. The integration of real-time hydrologic data with ecological models provides a platform for automating the delivery of the most current information to decision makers for effective resource management and restoration.

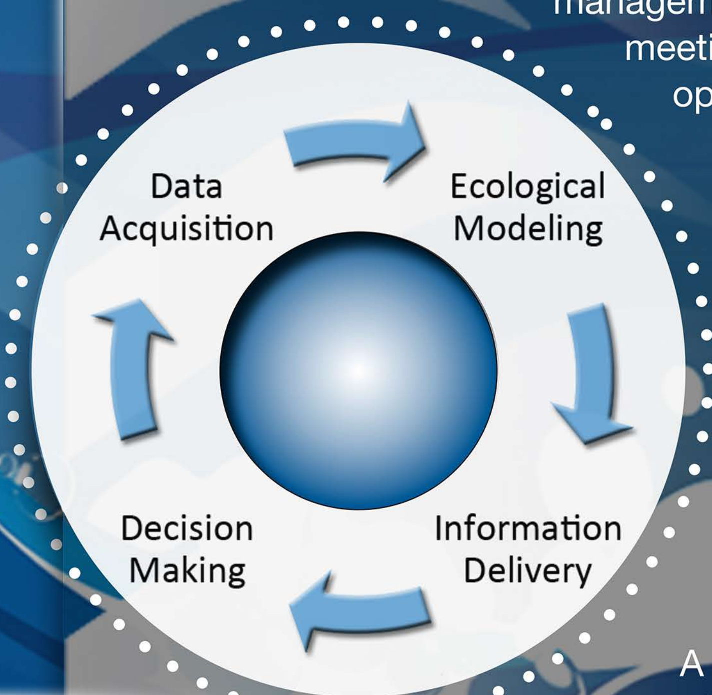

Figure 1. Schematic of the principal data flow steps for the online real-time ecological decision support system. The web-based tool is designed with flexibility that encourages its use as a standard framework for future addition of evaluation models for other species.

An automated online ecological decision support system (DSS) has been developed for data acquisition from external sources, evaluation modeling, and display of spatio-temporal ecological model results, summary evaluation graphics and reports (http://www.cloudacus.com/simglades/woodstork_gallery.php). The pilot application integrates a wood stork (Mycteria americana) foraging model into the DSS. Wading birds are a high priority indicator with a well-established and analyzed dataset that is highly linked to surface-water hydrology.

Photo showing wood storks in the Everglades Agricultural Area, Palm Beach County, Florida. Photograph courtesy of Elise Pearlstine.

The online ecological DSS acquires and preprocesses monitoring data from multiple external sources to perform weekly ecological model simulations and evaluations. The principal data flow and model execution steps of the DSS are shown on fig. 1. The initial step of daily data acquisition from various sources is accomplished using a daemon process (fig. 2). The next step of the automated process is pre-processing the data and execution of the wood stork model (fig. 3). The model predicts the relative suitability of foraging conditions for wood storks within the Everglades freshwater marshes during the breeding season. The final step of the process is the synthesis of model evaluations of spatial trends for wading birds and other indicators of ecological health in easily accessible and understandable information products (fig. 4). The DSS produces weekly wading bird reports that provide valuable information for multi-agency meetings and completes the monitoring-management-action feedback loop. Reducing the time to produce ecological model evaluations to a near real-time (weekly) basis increases the likelihood that the information from the DSS reports will be used in water-management operations and planning decision making in the Everglades.

Figure 2. The automated data acquisition step for the online ecological decision support system. One critical dataset is the daily Everglades Depth Estimation Network (EDEN, Telis and others, 2014) hydrologic data for the entire freshwater portion of the Greater Everglades from 1991 to present (2015) (Conrads and others, 2014). These data are updated daily and are readily available using the EDEN Thematic Real-time Environmental Distributed Data Services (THREDDS) server. The automated system will be collecting data from additional sources including the National Oceanic and Atmospheric Administration (NOAA) to meet other modeling requirements for Everglades species.

Figure 3. Elements of the automated ecological model execution. The model, Everglades Wood Stork Foraging Probability Index (STORKI v. 2.4.2; LoGalbo and others, 2012), calculates wood stork foraging probabilities in the Everglades freshwater marshes based on estimated water depth and recession rates.

Open web assess, near real-time model results

A

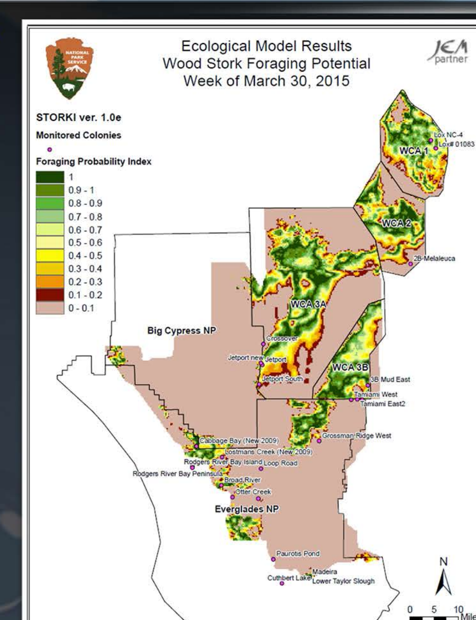

Figure 4. Examples of information provided by the ecological DSS including A) map showing wood stork foraging areas by probability, B) tabular output listing acreage by habitat suitability index (HSI) for each wood stork colony, and C) acreage by HSI category for whole area.

B

Colony	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Lox NC-4	140,868	10,319	11,268	8,856	9,924	14,075	13,680	15,142	13,996	20,440
Lox# 01083	255,445	0	0	0	0	0	0	0	0	0
Jetport	321,708	20,875	13,284	10,793	8,619	7,828	6,168	7,077	8,382	19,926
3B Mud East	424,661	0	0	0	0	0	0	0	0	0
Jetport South	326,136	19,096	12,019	9,647	7,986	7,156	6,168	5,614	8,303	22,536
Jetport new	323,724	20,796	13,245	10,596	8,579	7,551	6,049	7,117	8,184	18,819
Crossover	298,856	22,536	14,589	11,821	10,556	9,212	7,631	9,568	12,770	27,122
2B Melaleuca	354,444	0	0	0	0	0	0	0	0	0
Tamiami West	305,735	13,719	7,789	6,049	6,721	8,382	12,770	13,877	16,170	33,448
Cabbage Bay (New 2009)	424,661	0	0	0	0	0	0	0	0	0
Paurotis Pond	278,771	0	0	0	0	0	0	0	0	0
Lostmans Creek (New 2009)	424,661	0	0	0	0	0	0	0	0	0
Rookery Branch	424,661	0	0	0	0	0	0	0	0	0
Rodgers River Bay Peninsula	424,661	0	0	0	0	0	0	0	0	0
Broad River	424,661	0	0	0	0	0	0	0	0	0
Cuthbert Lake	0	0	0	0	0	0	0	0	0	0
Grossman Ridge West	356,777	7,512	4,586	3,005	3,440	3,637	4,784	5,258	9,845	25,817
Tamiami East1	424,661	0	0	0	0	0	0	0	0	0
Lower Taylor Slough	214,643	0	0	0	0	0	0	0	0	0
Tamiami East2	424,661	0	0	0	0	0	0	0	0	0
Rodgers River Bay Island	424,661	0	0	0	0	0	0	0	0	0
Loop Road	350,609	7,631	6,326	5,100	5,970	6,286	6,800	6,682	9,805	19,452
Madeira	214,643	0	0	0	0	0	0	0	0	0
Otter Creek	424,661	0	0	0	0	0	0	0	0	0

C

Area	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Whole area	1,201,156	71,007	55,153	48,867	51,872	57,526	61,321	68,121	79,112	156,881

References

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