ATLSS SESI Model Number and Name

AT.WBI.v0. Wading Bird Spatially-Explicit Species Index Model

Justification

Changing water management strategies for South Florida have been implicated in dramatic declines in colonial wading bird populations. The ATLSS Wading Bird Foraging Conditions Index Model uses knowledge of how hydrologic factors affect the concentration and availability of food resources during the breeding season to compute a Foraging Conditions Index (FCI) for wading birds. The FCI is a composite index of spatial and temporal patterns. We express the effects of proposed hydrologic modification scenarios as changes in the spatial pattern of foraging potential over the model area for the 31-year simulation period.

For most wading bird species, small freshwater fish and invertebrates are the primary food brought back to rookeries to feed young birds. Both the amount and timing of prey availability are critical to breeding success during any specific nesting season. SFWMM restoration scenario hydrology output is used to make spatially explicit estimates of surface area with water in the depth range needed for successful feeding for group-foraging species in two categories: short-legged feeders such as white ibis and small herons and long-legged feeders such as wood storks and snowy egrets.

CERP Target

Rather than specifying a single "performance measure" for each model, it is the objective of ATLSS to provide a rational basis for different stakeholders to determine their own criteria for comparing different hydrologic plans based upon their own choices of trade-offs between species, spatial regions and time horizons.

Evaluation Protocol

The wading birds in a breeding colony exploit an area of many square kilometers around the colony site. To be successful, a site should be surrounded by sufficient foraging habitat.

- To construct the FPI, all spatial cells within a 1.5 km radius (short-legged wading birds) and 3.0 km radius of the colony site (cell or pixel) are considered to be in the primary "foraging areas" and are evaluated. Only cells that have sufficient surrounding cells that qualify as habitat (> 50%) and less than 25% urban area are considered potential colony sites. Others are excluded (index set to zero).

Wading birds can exploit fish from an area only when water depths are within certain ranges.

- In the FPI, long-legged wading birds are assumed to require water levels in the range 5 to 35 cm, and short-legged wading birds are assumed to require water levels in the range 0 to 20 cm.

Wading bird breeding occurs between December and July. Wading birds need a continuous supply of available food for the entire period they are caring for eggs and young, requiring receding water levels in suitable depth ranges in a high fraction of their foraging area so that fish become concentrated.

In the FPI, the breeding period for short-legged wading birds was chosen to be January 1 to May 15, while the breeding period for long-legged wading birds was chosen to be January 1 to July 15. The FPI for the region around a particular colony site or cell is calculated to reflect the fraction of the cells in the primary foraging areas that have decreasing water levels in suitable depth ranges. "Foraging cycles" of 54 and 21 days are assumed for long- and short-legged wading birds, respectively. The index tracks the number of cycles of these lengths for which at least 20% of the cells in the primary foraging area are in appropriate depth regimes. These "foraging cycles" do not correspond to the actual breeding cycles, which are much longer. However, they are assumed to be reasonable surrogate measures of the relative goodness of conditions. If the mean suitable area surrounding a colony decreases below 20% of the total area, the current wading bird breeding cycle for that pixel is terminated and calculations for a new cycle are not initiated until the area mean increases above 20%. If a reversal of water depth takes place over a sufficiently large fraction of the foraging area (> 80%), the cycle is terminated.

Details of the Wading Bird SESI are available at: http://www.atlss.org/d_wb.html . We express the effects of proposed scenarios as changes in the spatial pattern of foraging potential over the model area at a 500-m scale of resolution. Our sub-area reporting units are based on a combination of public area, drainage basin, and management unit subregion maps, shown in http://www.atlss.org/repunits.pdf. Interpretation is focused on the central and southern rookery areas, shown at: http://www.atlss.org/rookeryregions.pdf.

Model output includes three-panel maps displaying landscape results for (a) proposed hydrologic modification scenario on the left, (b) base scenario on the right, and (c) a cell-by-cell difference between index values for the two compared scenarios in the center panel, enabling the reader to make comparisons between alternatives.

Source and History of Evaluation Protocol

The ATLSS modeling group has worked with field biologists to explore conceptual models and develop spatially-explicit species index models that reflect relationships between hydrologic factors and breeding/foraging potentials for key Everglades species. This SESI was one of 8 identified for development and was developed by John Curnutt, Jane Comiskey, Lou Gross, and Michael Huston, with advice from Marty Fleming.

Selected References:

Bancroft, G.T., A.M. Strong, R.J. Sawicki, W. Hoffman, and S.D. Jewell. 1994. Relationships among wading bird foraging patterns, colony locations, and hydrology in the Everglades. In Everglades: The Ecosystem and Its Restoration, S.M. Davis and J.C. Ogden (Eds.), St. Lucie Press, Delray Beach, Fla., chap. 25.

Cramer, P., K.M. Portier and D.M. Fleming, D.M. 1997. Systematic Reconnaissance Flights, Wading Bird Study, ENP. www.stat.ufl.edu/~arcs/enp/.

Fleming, D.M., W.F. Wolff, and D.L. DeAngelis. 1994. Importance of Landscape Heterogeneity to Wood Storks in Florida Everglades. Environmental Management 18(5):743-757.

Frederick, P.C. and G.V.N. Powell. 1994. Nutrient transport by wading birds in the Everglades. In Everglades: The Ecosystem and Its Restoration, S.M. Davis and J.C. Ogden (Eds.), St. Lucie Press, Delray Beach, Fla., chap. 23.

Ogden, J.C. 1994. A comparison of wading bird nesting colony dynamics (1931-1946 and 1974-1989) as an indication of ecosystem conditions in the southern Everglades. In Everglades: The Ecosystem and Its Restoration, S.M. Davis and J.C. Ogden (Eds.), St. Lucie Press, Delray Beach, Fla., chap. 22.

http://www.atlss.org/d_overview.html

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