Use of Habitat Suitability Index Modeling for Both Roseate Spoonbills (*Platalea ajaia*) and American Crocodiles (*Crocodylus acutus*) in South Florida

Photo: Belinda Serata

Photo: University of Florida

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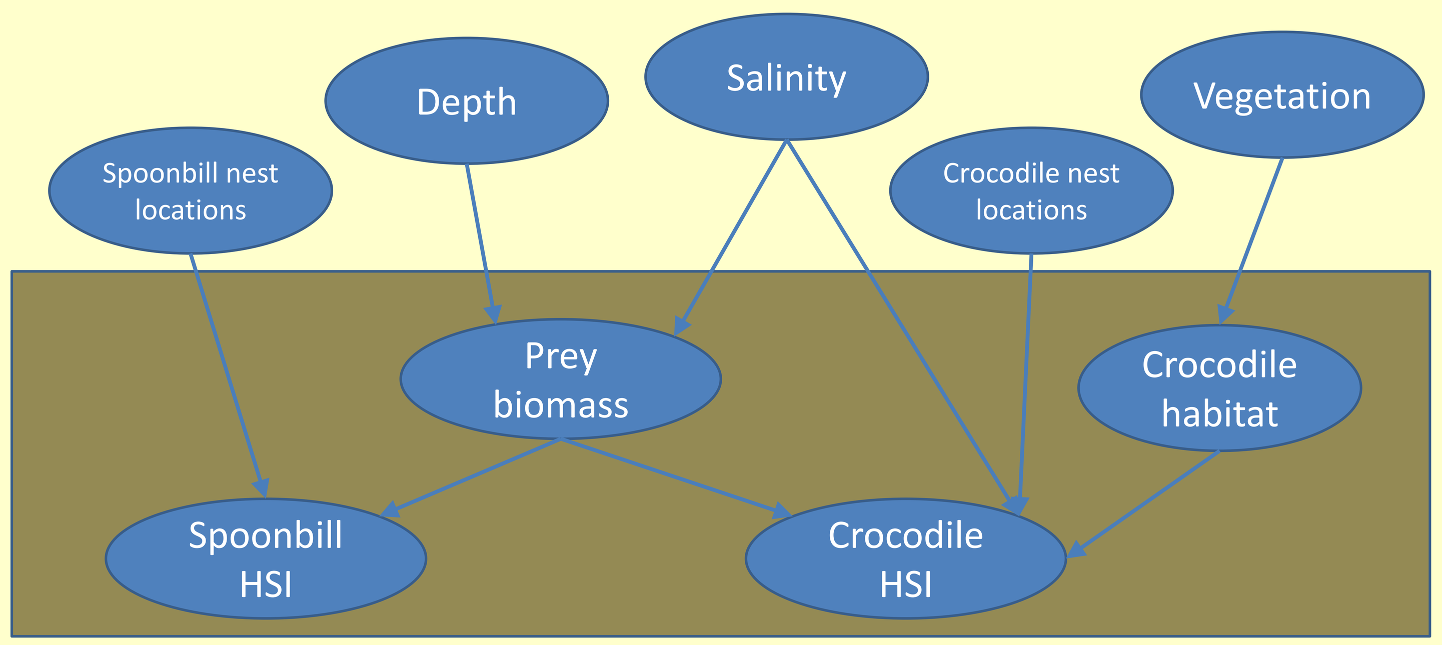
Integrated model

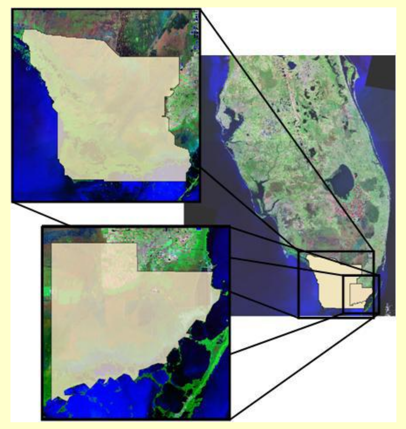
Roseate spoonbills (*Platalea ajaia*) and American crocodiles (*Crocodylus acutus*) are indicator species of estuarine health and productivity in south Florida. Planned Comprehensive Everglades Restoration Plan (CERP) projects will affect salinity and water depth both spatially and temporally. Habitat Suitability Index (HSI) models are used to examine the extent and quality of suitable habitat for spoonbills and crocodiles relative to changes in salinity and water depth.

The diagram below shows the inputs into and overlaps between the spoonbill and crocodile HSI models.



Our HSI models currently use the fixed-grid TIME (Tides and Inflows in the Mangrove Ecotone) hydrology for salinity and water depth input. However, the models have been developed to allow input from disparate hydrologies. When data become available, we plan to use TIME only for salinity and the variable-mesh RSM (Regional Simulation Model) hydrology for water depth.

TIME

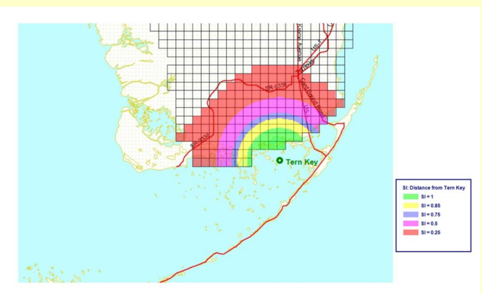


RSM

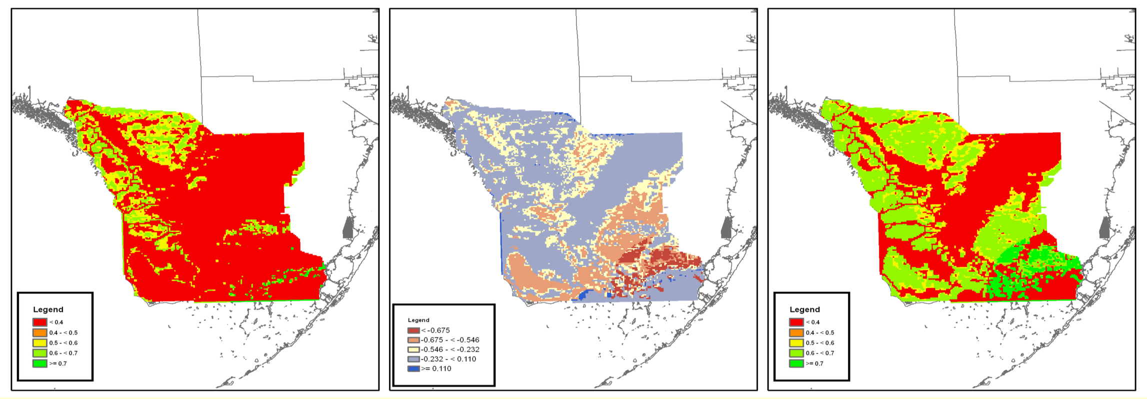
Roseate spoonbills

The HSI model for this species of special concern is built upon the biomass production and availability index (described in far right column of this poster), with a proximity index that considers distance to a known roseate spoonbill nesting colony on Tern Key (see map below). These two indices are combined in a weighted geometric mean:

$$HSI = (\text{biomass production \& availability index})^{5/6} * (\text{proximity index})^{1/6}$$



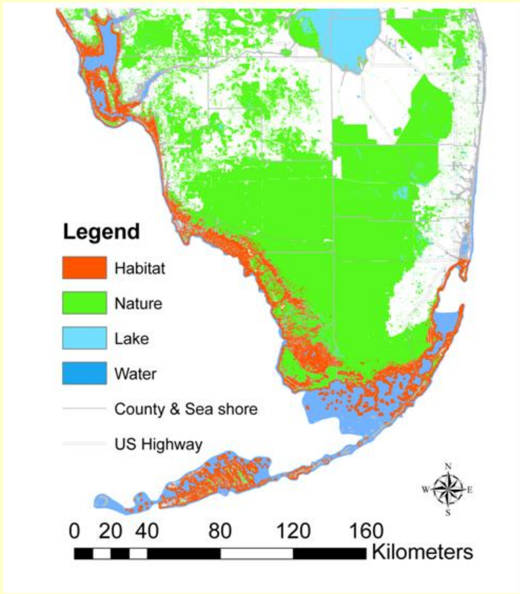
Below we present HSI output from a TIME calibration run for an example date of June 12, in both 1997 and 2001, as well as the difference between the HSI values for these dates.



June 12, 1997 Spoonbill HSI | difference (1997 – 2001) | June 12, 2001 Spoonbill HSI

American crocodiles

To produce a HSI model for American crocodiles we first create a map of their potential habitat. American crocodile habitat is defined as mangrove-lined ponds, creeks, coves, shorelines, and human-made ponds and canals. Crocodiles are found in coastal areas in fresh to hypersaline water although most are found in lower salinity waters.



The HSI model for this federally threatened species was developed using a hatchling growth & survival index and a biomass production & availability index.

$$\text{Hatchling growth and survival} = (\text{hatchling growth \& survival salinity index} + \text{hatchling growth \& survival proximity index}) / 2$$

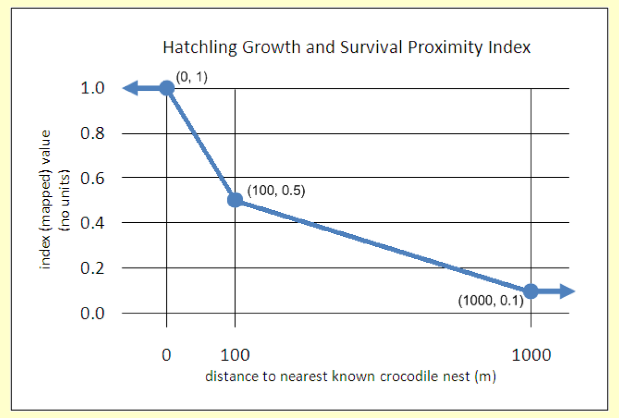
During fall (August – December), the above index and the biomass production & availability index are combined in a geometric mean to create the crocodile HSI:

$$HSI = (\text{hatchling growth \& survival index})^{1/2} * (\text{biomass production \& availability index})^{1/2}$$

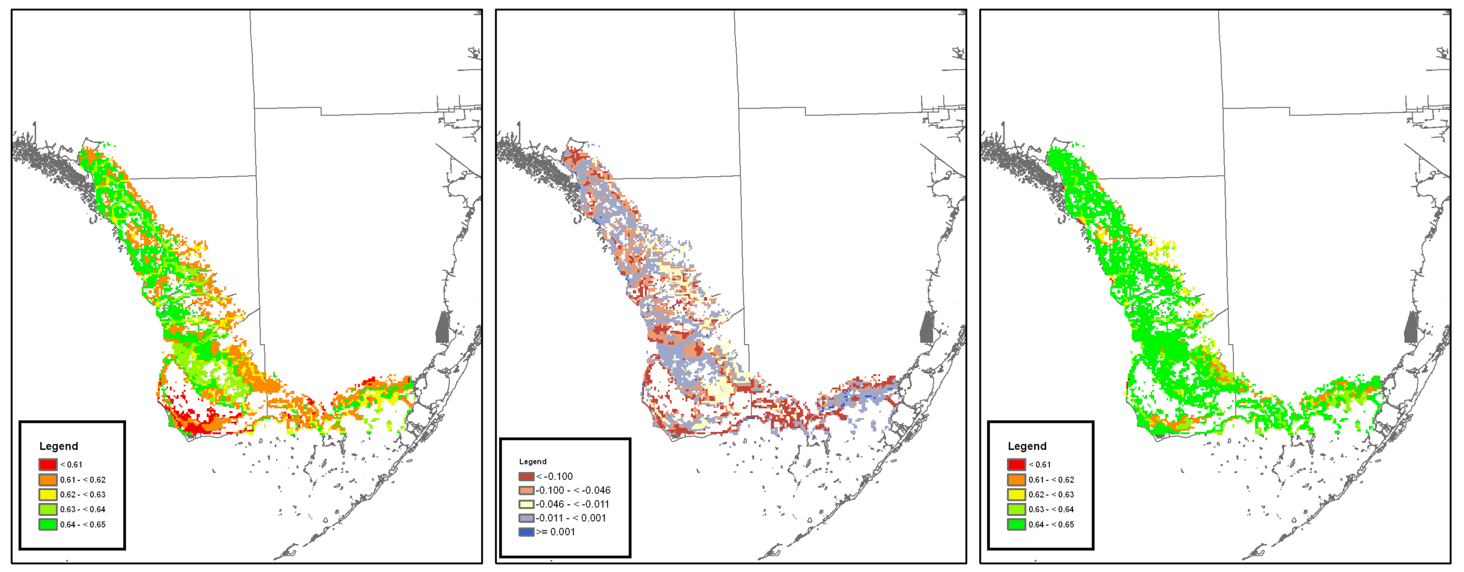
During the rest of the year, the crocodile HSI is equal to the biomass production & availability index (described in the right column of this poster).

Hatchling Growth and Survival Salinity Index

salinity (ppt)	index (mapped) value (no units)
>=0 and <20	1
>=20 and <30	0.75
>=30 and <40	0.5
>=40	0



Below we present sample HSI output from a TIME calibration run for the same example dates of June 12, in both 1997 and 2001, for comparison spoonbill HSI output for these dates.



June 12, 1997 Crocodile HSI | difference (1997 – 2001) | June 12, 2001 Crocodile HSI

Prey biomass

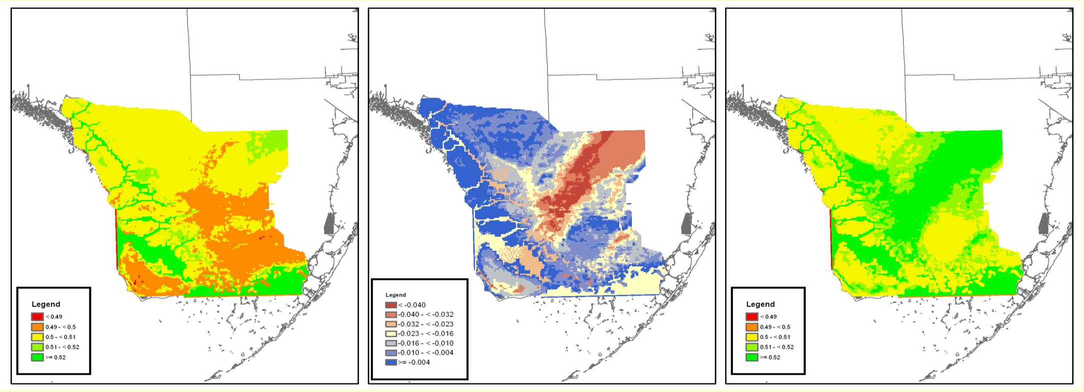
The prey biomass model uses depth and salinity inputs to model total biomass and availability of biomass of fish that are prey for spoonbills and crocodiles.

Total prey biomass is modeled with the following equation:

1.01 +
0.0013 * (number of days of last 90 that salinity was less than 5 ppt) +
0.037 * (mean depth of last 300 days, in cm) +
(-0.041) * (standard deviation of depth for past 90 days, in cm) +
(-0.02) * (current day depth, in cm) +
(-0.01) * (number of days of last 60 that depth was less than 5 cm) +
0.0013 * (number of continuous days with depth greater than 12.5 cm)

To allow for comparison among maps from a single model run and across a set of model runs, biomass is scaled according to the maximum biomass value across the set of model runs. The resulting scaled biomass has a range of 0 to 1, and the scaled biomass value of a given cell represents the ratio of that cell's total biomass value to the maximum total biomass cell value for the set of model runs.

Below we present sample prey biomass output from a TIME calibration run for the example dates of June 12 1997 and 2001, for comparison to the spoonbill and crocodile HSI outputs.



June 12, 1997 scaled biomass | difference (1997 – 2001) | June 12, 2001 scaled biomass

Biomass availabilities for spoonbills and crocodiles are determined from water depth as shown in the following tables:

Biomass Availability Index, Spoonbill

water depth (cm)	index (mapped) value (no units)
<6	1
>=6 and <12.5	0.75
>=12.5 and <20	0.25
>=20	0

Biomass Availability Index, Crocodile

water depth (cm)	index (mapped) value (no units)
<0	1
>=0 and <6	0.9
>=6 and <12.5	0.8
>=12.5	0.7

The biomass production & availability index is then calculated as a weighted geometric mean of production and availability:

$$\text{biomass production \& availability index} = (\text{scaled biomass})^{2/5} * (\text{biomass availability})^{3/5}$$

Conclusions

The next phase of modeling will be to produce HSI output using RSM hydrology for more accurate water depth input. We will also refine the geographic extent of the prey biomass model to include only estuarine fish populations.

HSI models can be used to select among alternative restoration plans for the most suitable conditions for spoonbills and crocodiles. For roseate spoonbills, prey availability, prey abundance, and distance from a breeding colony were chosen as metrics to evaluate alternative restoration plans. For American crocodiles, growth and survival were chosen as metrics. Assessment of these metrics provides a means to forecast the effects of restoration projects on these species.

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