

Roseate Spoonbill Model Requirements Document

Inputs

A number of input files are needed to generate the model results. These inputs are listed in and generically described by the following table:

Input	Time Resolution	Units	Type
Water Depth	Time Step	Centimeters	Map
Biomass Index	Time Step	None (Index)	Map
Nest Location	Static	Coordinates	Table

The **Input** column contains the name of the input to be used. **The Time Resolution** column describes the generalized time resolution of the input: Time Step denotes that the input has values which change along some regular time interval (e. g. daily, weekly, monthly, etc.), and Static means that the input has a single set value which does not change. The **Units** column describes the meaning of the values in the input (e. g. a Water Depth value of 3 would mean that the water was 3 centimeters deep in that location). The **Type** column denotes the nature of the input: Map means that the input is a map or series of maps, and Table means that the input is tabular data.

Note that all inputs of the Map type must have the exact same shape, scale, geographical location, and coordinate system for the model to work as formulated in this document. In addition, all inputs with a value of Time Step in the Time Resolution column must cover exactly the same time steps. All inputs must have data whose values are in the units denoted in the Units column for the formulation of the model containing in this document to be directly implementable as it exists. Finally, any input that has Coordinates in the Units column must contain values whose coordinate system is the same as the coordinate system of inputs with a value of Map in the Type column. If any of the above is not true, this document must be reformulated to take the differences into account before the model can be adapted.

Outputs

A number of outputs will be produced by the model. Some of these outputs are model results, while other outputs exist to verify both the model results and examine the causes and factors which led to the results. The outputs to be produced by the model are listed in and generally described by the following table:

Output	Inputs	Time Resolution	Type
Foraging Proximity Index	Nest Location	Static	Map
Prey Availability Index	Water Depth	Time Step	Map
Prey Abundance & Availability Index	Prey Availability Index, Biomass Index	Time Step	Map
Habitat Suitability Index [HSI]	Prey Abundance & Availability Index, Foraging Proximity Index	Time Step	Map
Landscape HSI	Habitat Suitability Index	Static	Table

The **Output** column contains the name of the output to be produced. The method by which each of these was produced is described in the Process section. The **Inputs** column lists the items which comprise the output (e. g. the Prey Abundance & Availability Index is a function of the Prey Availability Index and Biomass Index data, and whenever the Prey Availability Index or Biomass Index change, the Prey Abundance & Availability Index will also change). The **Time Resolution** column describes the time resolution upon which the results are generated: Time Step denotes that the output will be generated with the same time resolution as the input files which go into producing it (e. g. if Water Depth data was daily, then the Prey Availability Index would also be daily, since the Prey Availability Index is a function of the Water Depth data), and Static denotes that the output will be generated exactly once for each run of the model. The **Type** column denotes the nature of the output: Map means that the output is a map or series of maps, and Table means that the output is tabular data.

Note that all of these outputs with Map in the **Type** column will have the same exact shape, scale, geographical location, and coordinate system as the input layers with Map in the **Type** column.

Foraging Proximity Index

The Foraging Proximity Index is a map which is a function of the Nest Location input. A single Foraging Proximity Index map will be generated for each run of the model. This map is generated by applying the function $f_{Foraging Proximity}$ to the minimum distance from the centroid of each cell in the Foraging Proximity Index output map to any nest location contained in the Nest Location input map. This function is defined as:

$$f_{Foraging Proximity}(d) = \begin{cases} 1 & d < 12400 \\ 0.85 & 12400 \leq d < 16000 \\ 0.75 & 16000 \leq d < 18200 \\ 0.50 & 18200 \leq d < 24000 \\ 0.25 & 24000 \leq d \end{cases}$$

where d is in meters.

Prey Availability Index

The Prey Availability Index is a map which is a function of the Water Depth input. A Prey Availability Index time step will be generated for each Water Depth input time step by applying the function $f_{Availability}$ to each cell of the Water Depth input map and placing the result in the corresponding cell of the Prey Availability Index output map for the time step. This function is defined as:

$$f_{Availability}(w) = \begin{cases} 0 & w < -20 \\ 0.75 & -20 \leq w < -10 \\ 1 & -10 \leq w < 6 \\ 0.75 & 6 \leq w < 13.1 \\ 0.25 & 13.1 \leq w < 20 \\ 0 & 20 \leq w \end{cases}$$

where w is in centimeters.

Prey Abundance & Availability Index

The Prey Abundance & Availability Index is a map which is a function of the Prey Availability Index and Biomass Index. A Prey Abundance & Availability Index time step will be generated for each time step of the Prey Availability Index and Biomass Index. The Prey Abundance & Availability Index for a given time step is defined to be:

$$Biomass^{\frac{2}{5}} \cdot Availability^{\frac{3}{5}}$$

where $Biomass$ is the Biomass Index input for the time step, $Availability$ is the Prey Availability Index for the time step, and all exponentiations and multiplications are performed cell-wise.

Habitat Suitability Index

The Habitat Suitability Index is a map which is a function of the Prey Abundance & Availability Index and Foraging Proximity Index. A Habitat Suitability Index time step will be generated for each time step of the Prey Abundance & Availability Index and Foraging Proximity Index. The Habitat Suitability Index for a given time step is defined to be:

$$Abundance^{\frac{5}{6}} \cdot Proximity^{\frac{1}{6}}$$

where $Abundance$ is the Prey Abundance & Availability Index for the time step, $Proximity$ is the Foraging Proximity Index for the time step, and all exponentiations and multiplications are performed cell-wise.

Landscape HSI

The Landscape HSI is a table which is a function of the Habitat Suitability Index. A single Landscape HSI table will be generated for each run of the model. This table contains two columns and a single row for each time step of the Habitat Suitability Index. The first column contains the date of a Habitat Suitability Index time step, and the second column contains the arithmetic mean of the 23% (rounded up) of real-valued cells (by cell count, not cell area) with the highest values contained within that time step of the Habitat Suitability Index map.