ATLSS SESI Model Number and Name

AT.ASI.v0. Apple Snail Spatially-Explicit Species Index Model

Justification

The apple snail (*Pomacea paludusa*) is an air-breathing snail found throughout fresh-water areas of the Everglades. It feeds on algae and decaying organic matter. and in turn provides food for many wetland creatures. Apple snails are only food source for the endangered Snail Kite, and provide 75% of the diet of the limpkin. Many other species of wildlife, including wading birds, turtles, and young alligators, consume apple snails. Because of their key role in the food chain and their sensitivity to hydrologic conditions, apple snails are considered be an indicator for a healthy wetland system, and can serve as a barometer for success of the planned Everglades restoration. Hydrologic conditions that are adverse for apple snails will likely also be unfavorable for crayfish and other species that form the base of the Everglades food chain.

Water levels play an important role in apple snail survival and productivity. The snail lays clusters of eggs on plant stems about 20-cm above the water's surface during the period from March to May. A rise in water depth above the level of the eggs during the period of maturation will drown the covered eggs, while a drydown to levels below 10-cm during this period will interrupt egg production and cause mortality of newly-hatched snails.

The ATLSS Apple Snail Index (ASI) Model was developed as an indicator of relative habitat quality for the Apple Snail under the proposed Everglades hydrologic restoration scenarios. The ASI measures potential production of apple snail recruits through a year. The model makes the assumption mature apple snails are present in a particular year and projects the fraction of potential recruits from those adults by calculating (1) interruptions in oviposition due to drydowns, (2) losses of recent hatchlings due to drydowns and (3) losses of eggs due to submersion by high water.

The time scales at which alternative scenarios are evaluated are likely too short to encompass some long-term changes in habitat quality. Particularly, stabilized hydrologic regimes may result in a slow degradation of habitat that may not be apparent at the time scales evaluated with this model.

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

Several types of habitat have been identified as suitable habitat for apple snails. These are, with their FGAP numbers: Freshwater marsh (29,30), *Typha* (34), *Spartina* (35), *Muhlenbergia* (33, 39), *Eleocharis* (31), Open water (0).

- Habitat types other than those listed are excluded (the HSI index is set to zero).

Uninterrupted oviposition and complete survival of all apple snail eggs produced in a given year would lead to an index value of 1.0. Interruption of oviposition by drydowns, as well as losses of eggs and hatchlings, leads to a lower index value. The index considers only the effects within the given year on production of apple snail recruits during that year, all of which will be negative. We then adjust the index values downward to reflect the occurrence of drydowns (defined as water depths less than 10 cm). Egg production will stop when water depths fall to that level

- If there is a drydown of some duration, for example 1/2- month, the basic effect is assumed to be the elimination of egg production during that period. We assume that this reduction in reproduction is not compensated for by a greater rate of production following the drydown.

A drydown may also cause mortality of recently hatched snails.

- Mortality is applied to recently hatched snails at a rate that depends on the length of a drydown. If the duration of a drydown exceeds one month, it is assumed to kill all snails that were less than a month old during that period.

An increase in water level after eggs are laid but before they hatch may cause mortality of eggs.

- If the water level increases by more than 20 cm, eggs produced during the preceding 20 days are destroyed.

Details of the Apple Snail SESI are available at: http://www.atlss.org/d_applesnail.html. We express the effects of proposed scenarios as changes in the spatial pattern of breeding 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).

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 Don DeAngelis, Jane Comiskey, and Louis Gross.

Selected References:

Darby, P.C., PL. Valentine Darby, R.F. Bennetts, J.D. Croop, H.F. Percival, and W.M. Kitchens. 1997. Ecological studies of apple snails (*Pomacea paludosa*, Say). Final Report prepared for South Florida Water Management District and St. Johns River Water Management District. Contract # E-6609, Florida Cooperative Fish and Wildlife Research Unit, Gainesville, Florida.

Hanning, G.W. 1978. Aspects of reproduction in *Pomacea paludosa* (Mesogastropoda: Pilidae). M.S. Thesis. Florida State Univ., Tallahassee 119 pp.

Little, C. 1968. Aestivation and ionic regulation of two species of *Pomacea* (Gastropoda, Prociobranchia). Journal of Experimental Biology. 48: 569-585.

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

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