Modeling Manatee Response to Restoration in the Ten Thousand Islands and Everglades National Park

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We are developing a spatially explicit, individual-based model of the Florida manatee *(Trichechus manatus latirostris*) in southwestern Florida. This model is being used to project the potential effects of altered hydrologic regimes on manatees in southwest Florida. This model is parameterized with telemetry data for 30 manatees tracked between June 2000 and Dec 2003 in the Ten Thousand Islands area. These manatees showed a consistent pattern of feeding on marine seagrass beds in offshore zones for 1 to 7 days, followed by large movements of 5 to 30 km or more up rivers and canals to assess fresh water. A network data structure is used to model manatee movement between nodes representing destination sites for feeding, drinking, and thermal sheltering, all connected by arcs representing travel corridors. The travel corridors were developed from GPS telemetry points fixed at 15-30 minute intervals. The movement of manatees between different zones is simulated using a Markov Chain approach to transition manatees into different behavioral states that drive the movement patterns of individuals. Transition probabilities are derived using a mark-recapture (program MARK) Multi-State model. Virtual manatees are allocated home ranges comprising different portions of the total network that includes one or more freshwater sites, thermal refugia, and offshore seagrass beds. Salinities, water temperature, and water depth also are modeled along this network to reflect natural environmental variation and changes due to restoration. Manatees can shift their home range to different parts of the network if freshwater, thermal refugia, or seagrass become unavailable within their home range. These shifts are modeled using a reinforcement model which controls how manatees respond to changes in the availability of critical resources. Sensitivity analyses are used to evaluate the importance of different assumptions and uncertainty associated with poorly understood model parameters. As additional telemetry data are collected, the model will be refined to incorporate new insights from these data. Radiotracking and aerial surveys will provide an important means of monitoring manatee response to natural environmental fluctuations and human-induced alterations associated with restoration activities.