Context Document: Mangrove Restoration Ecosystem Service Conceptual Model for Southwest Florida

http://bit.ly/NI-ESCM

Ecosystem Service Conceptual Models (ESCMs) are conceptual models that summarize the effects of an intervention, such as a habitat restoration project, on ecological and social systems. Each model links changes in biophysical systems caused by an intervention to measurable socioeconomic, human well-being, and ecological outcomes. ESCMs assume that the restoration is successful and include all potentially significant outcomes for the intervention; not all outcomes will be relevant to each individual project, depending on location and environmental conditions.

The direction of an outcome (whether the restoration will have a positive or negative influence) often depends on the specific situation—or remains unclear due to multiple links (arrows) that may have opposite effects leading into the same outcome. Thus, language like "increased" or "decreased" is not included in the models. These models are often used to consider management with or without an intervention or to compare different interventions.

This context document includes additional information about the restoration approach and details about some of the relationships in the mangrove restoration ESCM created for Southwest Florida. The model was built at a series of workshops held at the Rookery Bay National Estuarine Research Reserve in November of 2018 and January of 2019. This document also includes a list of the references used to develop the ESCM and names of experts with whom we spoke to refine the model.

Mangrove Restoration Description and Use in Florida

Specific techniques for mangrove restoration in Florida vary in terms of the process used, but primarily consist of restoring site conditions to those that are conducive to mangrove growth and waiting for mangrove propagules to colonize the site. These restoration activities include: hydrological restoration (to restore proper tidal flow, freshwater inputs, and salinity levels) and restoring sediment elevation. Restoration in Florida very rarely involves planting seedlings.

External Factors That Influence Restoration Success

A number of factors, including environmental factors (salinity, sedimentation) and social factors (institutional constraints), can affect the success of a mangrove restoration project but are outside of the project's control. During a workshop held to improve and expand this mangrove restoration ESCM the following external factors affecting project success were identified by participants: storms and hurricane damage to mangroves, human development direct and indirect effects, water pollution (e.g., agricultural runoff, stormwater being directed into mangrove areas), sea level rise, invasive species, and ocean acidification.

Model Notes and Clarifications

Water quality outcomes: There was significant debate at the workshop as to the effect of a single restoration site on water quality, specifically algae bloom frequency and associated downstream effects. The nutrient filtration capacity of mangroves is seen as significant, but participants noted

uncertainty about the potential influence of a single restoration site on localized or regional algae blooms due to the multitude of factors that determine when and where algae blooms occur. Therefore, we have not included effects on algae bloom frequency or intensity in the generalized mangrove model. If someone using the generalized model is examining restoration on a large scale or for multiple sites in a single estuary, they may want to consider adding these effects back into the model.

Beekeepers and mangroves: There was a mention at the workshop concerning commercial beekeepers using Florida's mangrove forests as a resting place for bees during part of the year. It is unlikely that a single mangrove restoration site would alter the delivery of this service. This service was not considered significant enough to include in the model at this time, but further investigation (or future changes in demand for commercial bee colonies) might indicate that this service should be incorporated into the model.

Odor: Dead or dying mangroves can release a unique (and unpleasant) odor, therefore mangrove restoration has the potential to remove or lessen this smell. Workshop participants emphasized that this was a significant linkage to include, especially if the dead or dying mangroves are nearby residential or commercial properties. However, this outcome will not be relevant everywhere and should be removed from the model if there is no one close to the site who is bothered by the odor.

Nutrient retention and nutrient credits: Mangroves do retain nutrients and restoration sites could potentially generate nutrient credits, but due to a lack of current nutrient credit programs and markets, this was removed from the model.

Adjacent habitats: Mangrove restoration can have effects on other types of habitat close to the project site. Changes to these habitats will have their own suite of ecological and socioeconomic effects. In the ESCM, these are referred to under the heading, "Outcomes related to adjacent habitat." If a project is expected to have substantial effects on other habitat types, we recommend referring to the separate ESCM for that habitat type.

Education and science opportunities feedback loops: Education and science opportunities provided by restoration sites will link back to increased restoration elsewhere. With increased awareness about the need for and benefit of habitat restoration, there will (hopefully) be increased demand for healthy habitats by the public and policy makers. This important linkage is not shown in the current model because it is such a long-term outcome.

Context is essential: In southwestern Florida mangroves are still relatively abundant (though there is concern about loss of this habitat). The current ESCM framing is based on the assumption of expected benefits (or changes) resulting from restoration of a particular mangrove site. In some parts of Florida, a model framed around avoided loss might be more relevant. The model could be reframed to show what expected losses (changes) might occur if large tracts of mangrove die off or are removed for development. The model content and structure would not change with this reframing, but the intervention at the model's start could be replaced.

Experts Consulted

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