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Estero Bay Tributaries Riparian Vegetation Analysis

Inland Ecology Research Group

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ABSTRACT

We examined the riparian vegetation along the five main tributaries to Estero Bay. Riparian vegetation serves as a non-motile integrator of salinity conditions over time, and can prove useful for detecting shifting salinity gradients associated with altered freshwater flow. The objective of this project is to refine our understanding of the freshwater/estuarine interface in the Estero Bay tributaries, utilizing riparian vegetation as ecosystem indicators, toward more ecologically sound definitions of minimum flows. We analyzed historical aerial photography for trends in land use change over the last 40 year, and we established three, long-term vegetation transects along each tributary across the gradient of tidal influence. Historical patterns of land use show a loss of agricultural land followed by impacts on upland communities. Earlier development showed a loss of riparian buffers, but later development, under new rules, appears to maintain riparian buffers. Measures of biodiversity were not significantly different among position along the tributary (upstream, middle, or downstream) or among the five estuaries. The proportion of exotics was surprisingly consistent across several measures: percent of species richness (22.1%), percent of vegetative cover (22.5%), or percent of woody stem richness (21.4%). To investigate influence of altered freshwater flow, we focused on specific indicator species and the percent coverage of these species by transect along each tributary, and documented the decreasing cover of freshwater indicators and the corresponding increase in saltwater species for downstream transects.

This study: 1) documents the changing dynamics of land use conversion in the western Everglades; 2) quantifies the extent of exotic infestation in riparian buffer of tributaries to Estero Bay; 3) demonstrates the potential of riparian vegetation as an indicator of hydrologic change in tidally influenced streams; and 4) establishes transects for monitoring of long-term trends in vegetation, particularly shifts in indicator species resulting from altered freshwater flow and changes in competitive advantage of invasive exotic species.

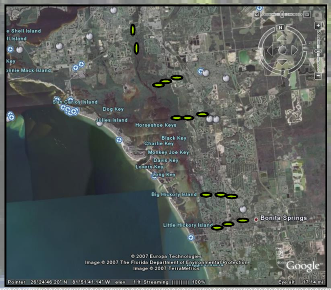

Figure 1 – Estero Bay Tributaries and Transect Locations. Transect locations indicated by green ovals -

METHODS

We examined historical changes in riparian vegetation through interpretation of aerial photography from: 1966, 1981, and 2002. We established a 100 m buffer around the entire section of each tributary from upstream to downstream transect and categorized riparian vegetation into five broad classes: mangrove, mixed riparian, mixed upland, human landscaped, and agriculture. To establish a baseline for more resolved vegetation community data, we established three transects in each tributary to Estero Bay. The middle transect was placed at the estimated transition point between freshwater and estuarine systems, the upstream extent of tidal influence. The two additional transects were placed 0.5 – 1.0 km above and below this point. Each transect is 50 meters long, and 5 m wide to include emergent vegetation. The transects were sub-divided into 5m quadrates, providing a 5 m by 5 m sampling unit. Within each 25 m^2 unit, we: 1) created a species list, 2) estimated percent cover for each species, 3) measured and mapped all woody stems 10 cm or larger in diameter at breast height (dbh), 4) recorded canopy density, and 5) measured the vertical structure of the vegetation. We then: 1) calculated biodiversity indices (Richness, Simpson, and Shannon) for each transect, 2) summarized the vertical structural data for each tributary, 3) examined patterns of exotic species abundance, and 4) examined patterns in distribution of selected freshwater or salt-tolerant plant species. For measures of biodiversity, we averaged samples from all transects at each position in the tributaries and tested for significant differences among means (ANOVA), and averaged values for all transects along each tributary and tested for significant differences among means of the tributary (ANOVA). For the vertical structural data we averaged all subplots within each transect and compared differences between tributaries and transect position. Patterns of exotic species distribution were summarized for each transect based on plant species richness, proportion of large woody vegetation (>10cm dbh) and percent of total plant cover due to exotic species. For the freshwater indicators we used *Crinum americanum, Salix caroliniana, Typha spp.*, and *Hydrocoytle spp.* For saltwater indicators we used mangrove species: *Rhizophora mangle, Avicennia germinans, Laguncularia racemosa* , and *Conocarpus erectus.*

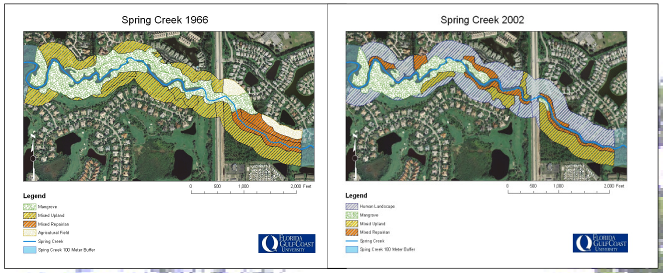

Figure 2 – Changes in riparian vegetation from 1966 to 2002 for an example tributary – Spring Creek. For this tributary, the largest percent change occurred from mixed upland habitat (43.9% to 15.8 %) to human landscaped habitat (0.0% to 47.1%).

RESULTS

Our analysis of historical patterns of vegetation change showed four clear trends: 1) a loss of agricultural activity near the tributaries, 2) a lack of upstream movement of the mangrove forest, 3) maintenance of the riparian buffer, and 4) a conversion of mixed upland habitat to human landscapes (Figure 2).

We identified a total of 122 species in the riparian zone of these five tributaries. Mean Richness, Simpson Index and Shannon Index were not significantly different among positions along the tributary (upstream, middle, or downstream) or among the five estuaries.

We considered patterns of exotic species in several ways. For the entire study area, the proportion of exotics was surprisingly consistent across several measures: percent of species richness (22.1%), percent of vegetative cover (22.5%), or percent of woody stem richness (21.4%). Percent exotic vegetation coverage (Figure 3) indicates a pattern of decreasing exotic cover from upstream to downstream with the highest levels of exotic infestation in the upstream transects of the Estero River and Mullock Creek (61.2% and 65.0%, respectively).

Vegetative structure in the lower 3.0 meters of each transect showed no clear patterns among tributaries, with relatively unique patterns in each. For example, Estero River had consistently lower coverage in the middle transect relative to upstream and downstream (Figure 4).

Figure 5. illustrates the decreasing cover of freshwater indicators (A) and the corresponding increase in saltwater species for downstream transects (B). Changes in the relative proportions of these species will be the most sensitive indicator of freshwater flow alteration.

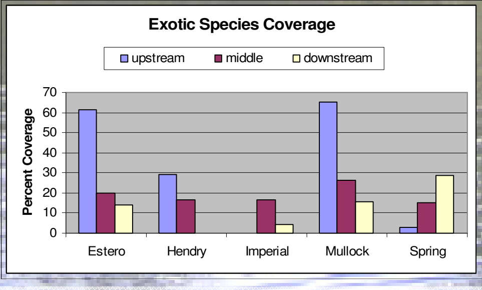

Figure 3 – Exotic species cover as percent of total plant cover in the transect.

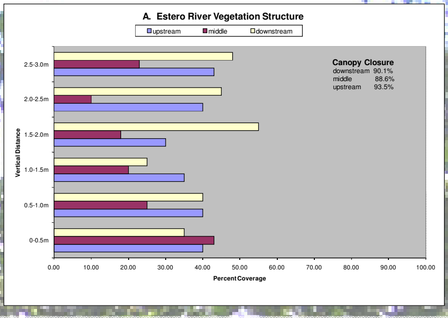

Figure 4 – Vertical structure for the three transects in an example tributary – Estero River. Data represent the percent of points with vegetation within O.5 m intervals above ground. For the Estero River, vegetation structure was consistently lower along the middle transect compared to the upstream or downstream transect.

DISCUSSION

Based on the historical analysis of aerial photographs, mixed riparian buffers, typically up to 5 – 10 meters from the stream edge, were surprisingly consistent through time. In only a few places did early development result in modification of the stream edge that eliminated riparian vegetation. Modern permitting requirements seem to have maintained, and along some streams resulted in recovery of, riparian buffer zones.

The most consistent trend across all tributaries is the loss of mixed upland habitat to human landscaped habitats. Typically the loss of upland habitat was greater than 50% (Hendry Creek was the only exception with a loss of 33%), and the increase in human landscaped habitat was greater than 50% (again, only Hendry Creek was less with a 24%), with several more than doubling the cover of human landscapes.

Finally, most tributaries showed little change in mangrove cover (Spring Creek was the exception with 46% loss since 1966). Sea level rise associated with global climate change might be expected to drive mangrove monoculture communities inland and upriver. Altered freshwater flows might counteract this change. A new project intended to map mangrove community change through time in the entire watershed might be warranted. If sea level changes are causing a reduction in mangrove cover downstream, without a corresponding increase in mangrove cover inland, long-term we are reducing the total acreage of mangrove habitat and losing some of its ecological function.

Long-term patterns in exotic coverage may help us determine the direct impacts of human activity – altering native plant communities and introducing exotic species – and the indirect impacts of altered freshwater flows on the competitive advantages of invasive exotics.

This study provides detailed vegetative community data along the tributaries to Estero Bay. These transects will allow monitoring of long-term trends in vegetation, particularly shifts in indicator species resulting from altered freshwater flow and changes in competitive advantage of invasive exotic species.

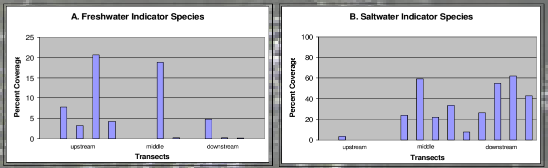

Figure 5 – Percent coverage by transect for selected species. A. Freshwater indicator species: *Crinum americanum, Salix caroliniana, Typha sp.*, and *Hydrocoytle sp.* B. Saltwater indicator species: *Rhizophora mangle, Avicennia germinans, Laguncularia racemosa* , and *Conocarpus erectus.* For these two figures, the transects were grouped by position along the tributary (upstream, middle, or downstream) rather than by tributary. Note the difference in scale between A and B.