Estimate of the Ecosystem Services of Existing Conservation Collier Lands in Collier County Florida

James Beever III, Planner IV
Southwest Florida Regional Planning Council
239-338-2550, ext. 224
jbeever@swfrpc.org

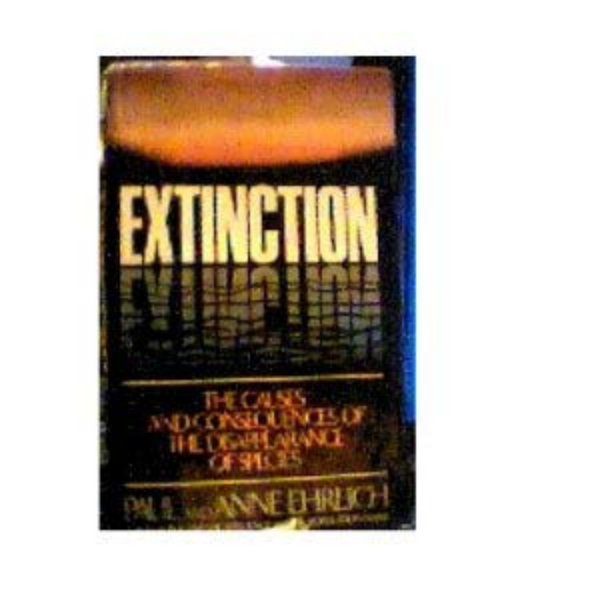
Ecosystems Provide Complex Services

Documented recognition of how ecosystems provide complex services to mankind date back in Western culture to at least Plato (c. 400 BC). (Marsh, G.P. 1864 (1965). Man and Nature. Charles Scribner, New York. 472pp).

Environmental Services

The term 'environmental services' was finally introduced 1970 in a report of the Study of Critical Environmental Problems, (SCEP. 1970. Man's Impact on the Global Environment. MIT Press, Cambridge. 319pp.) which listed services including insect pollination, fisheries, climate regulation and flood control.

Ecosystem Services



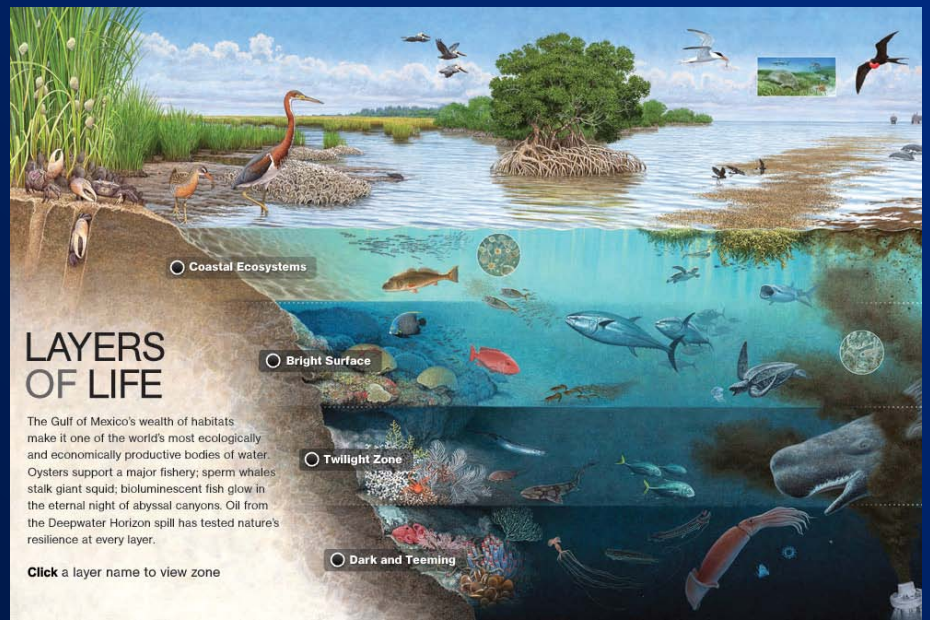
In following years, variations of the term were used, but eventually 'ecosystem services' became the standard in scientific literature. (Ehrlich, P.R. and A. Ehrlich. 1981. Extinction: The Causes and Consequences of the Disappearance of Species. Random House, New York. 305pp.)

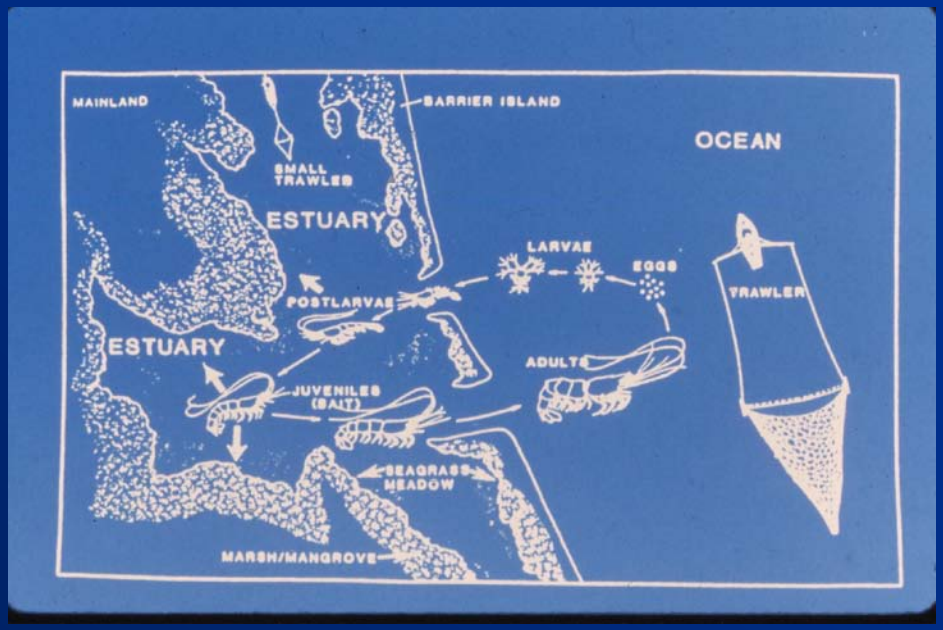
Modern expansions of the ecosystem services concept include socio-economic and conservation objectives

Ecosystem Services

The multitude of resources and processes that are supplied by natural ecosystems

- The United Nations 2004 Millennium Ecosystem Assessment grouped ecosystem services into four broad categories
  - Provisioning, such as the production of food and water;
  - Regulating, such as the control of climate and disease;
  - Supporting (Habitat), such as nutrient cycles and crop pollination;
  - Cultural (Socio-economic), such as spiritual and recreational benefits.





- In southwest Florida, **80% of commercial and recreational harvested marine species depend on mangrove estuaries** for at least a portion of their lifecycles.
- The First Evaluation of mangroves values in a Federal enforcement action in Lee County (in 1986), utilizing conservative estimators, found that a mature 6 meter (20 ft.) tall canopy of red mangrove forest contributed $2,040.54 per year in commercial fisheries landings in 1970 dollars, not adjusted for inflation. This translates into **$12,169.98** per acre per year in 2012 dollars.

$776+ Million

per Year in 2012 dollars for GUNFR

Smaller and shorter mangrove canopies, including trimmed canopies, contribute less to fishery values than taller, natural canopies because there is less NPP available as export from shorter canopies. The difference is non-linear

A 1.5 m (5 ft.) height contributes $143.70 per acre/yr and a 10.7 m (35 ft.) tall canopy contributes $6,514.40 per acre/yr. in 1975 dollars, unadjusted for inflation.

$618.09 and $28,020.03

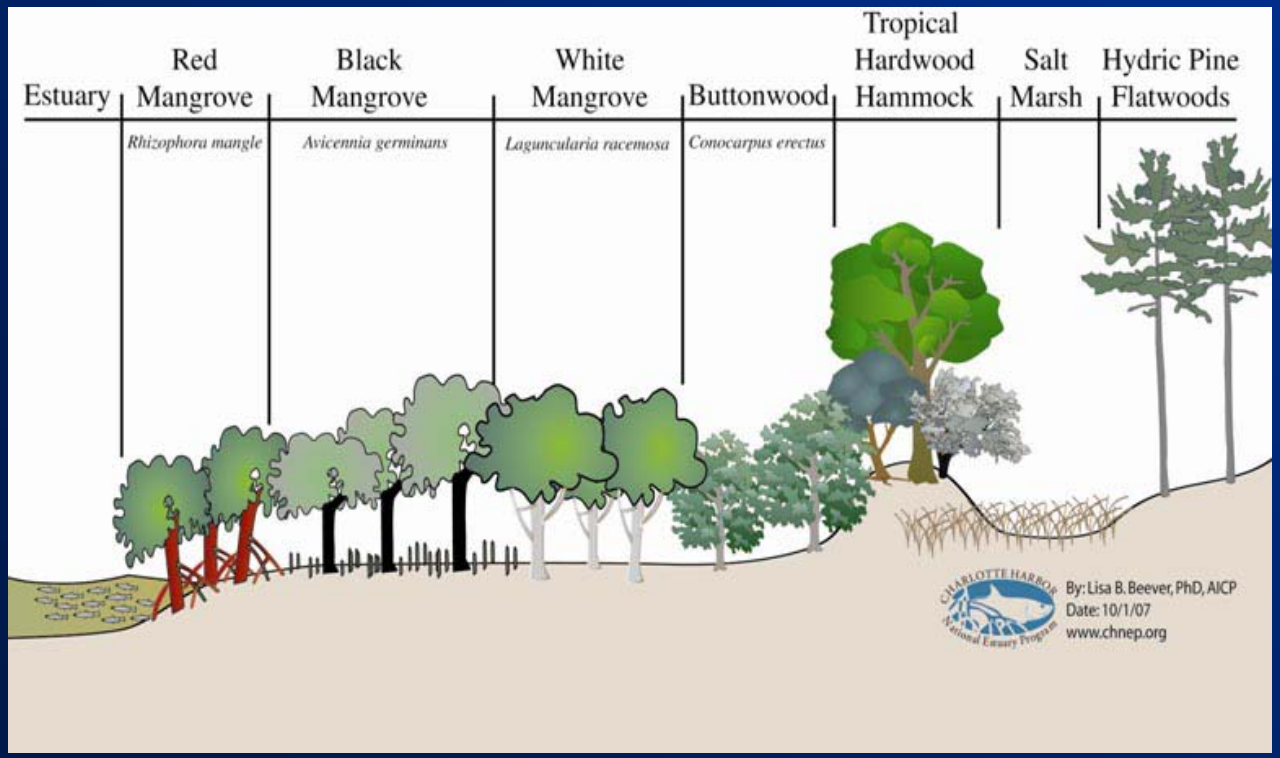
per acre/yr in 2012 dollars.

These values do not reflect recreational fisheries values, including prey base, which are from 5.6 to 6.5 times the primary sales of commercial fisheries (Lewis *et al.* 1982). This would range from

$146 Thousand to $169+ Thousand

per acre per year in 2012.

…Nor do they include the erosion protection value, the tourist income generated from tours, bird watching, canoeing and recreational non-fishing boating in mangrove estuaries, the water quality enhancement of point and non-point sources of water pollution, the privacy screen value and habitat value of these mangroves to endangered and threatened species.



Carbon Sequestration Credits

Low trace gas emissions and high soil carbon sequestration from mangroves and salt marshes make a robust case for carbon credit projects. Coastal habitats mangroves and salt marsh store up to 50 times more carbon in their soils by area than tropical forests, and ten more than temperate forests.

Peak mangrove carbon fixation is 16 tons per acre per year (Hicks and Burns 1975) in brackish water conditions.
Peak southern slash pine carbon fixation is 14 tons per acre per year in a 50 year old stand.
For the CHNEP just these two habitats could provide 3 Million tons of carbon fixation per year.

- *Fixation of 1 ton of Carbon was worth $7 per ton in 2008 in the United States ($21 Million)*
- *$10 to $25 in 2011 in the world markets including California ($30 to $75 Million)*

A Quilt of Habitats Drawn Together by Threads of Water

Habitats Depend On Each Other For Full Ecosystem Service Value

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Funded by Collier County

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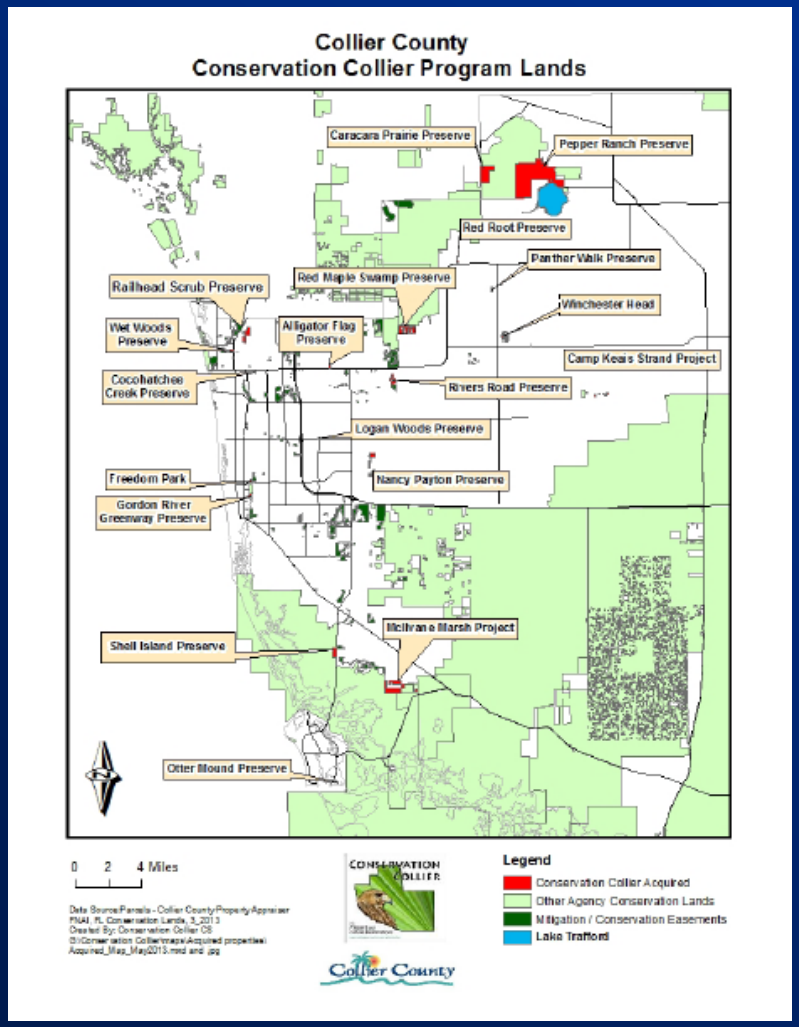
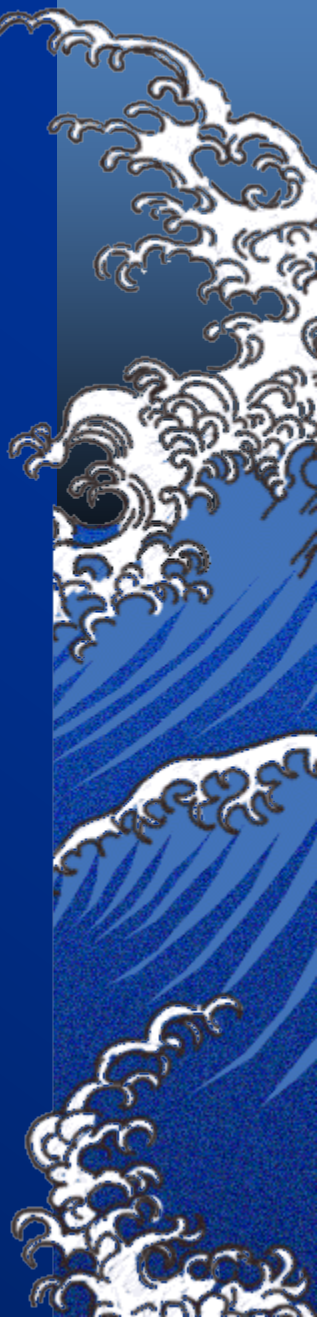
Conservation Collier Map as of May 2014



Conservation Collier as of May 2014

- Number of Preserves: 19
- Total Acres: 4,054.7
- Total Ecosystem Services Value (TEV)

  $144,988,312.22 in 2013 dollars

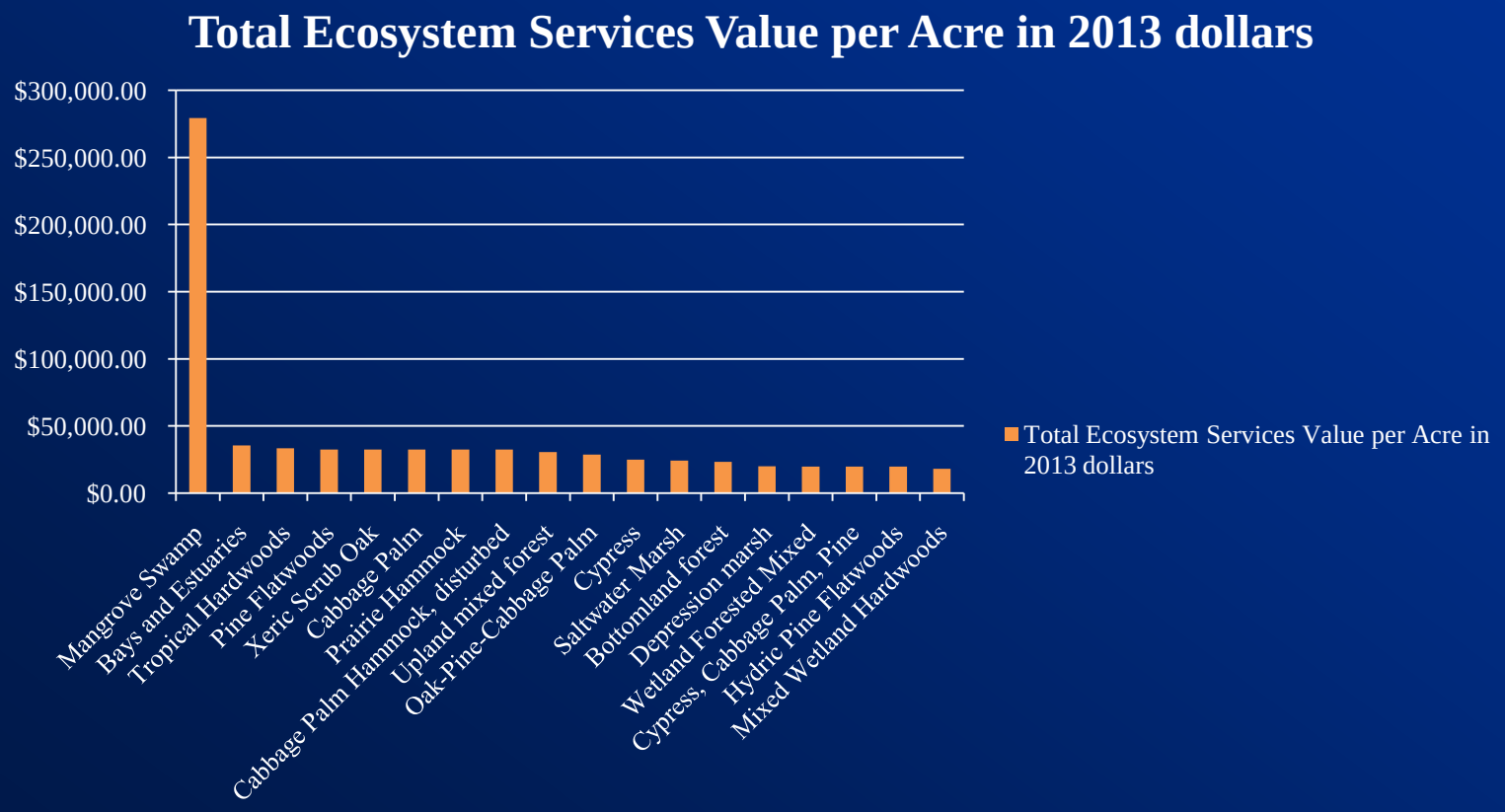


To determine the Total Ecosystems Services Value, 32 ecosystem services were reviewed on a per acre basis:

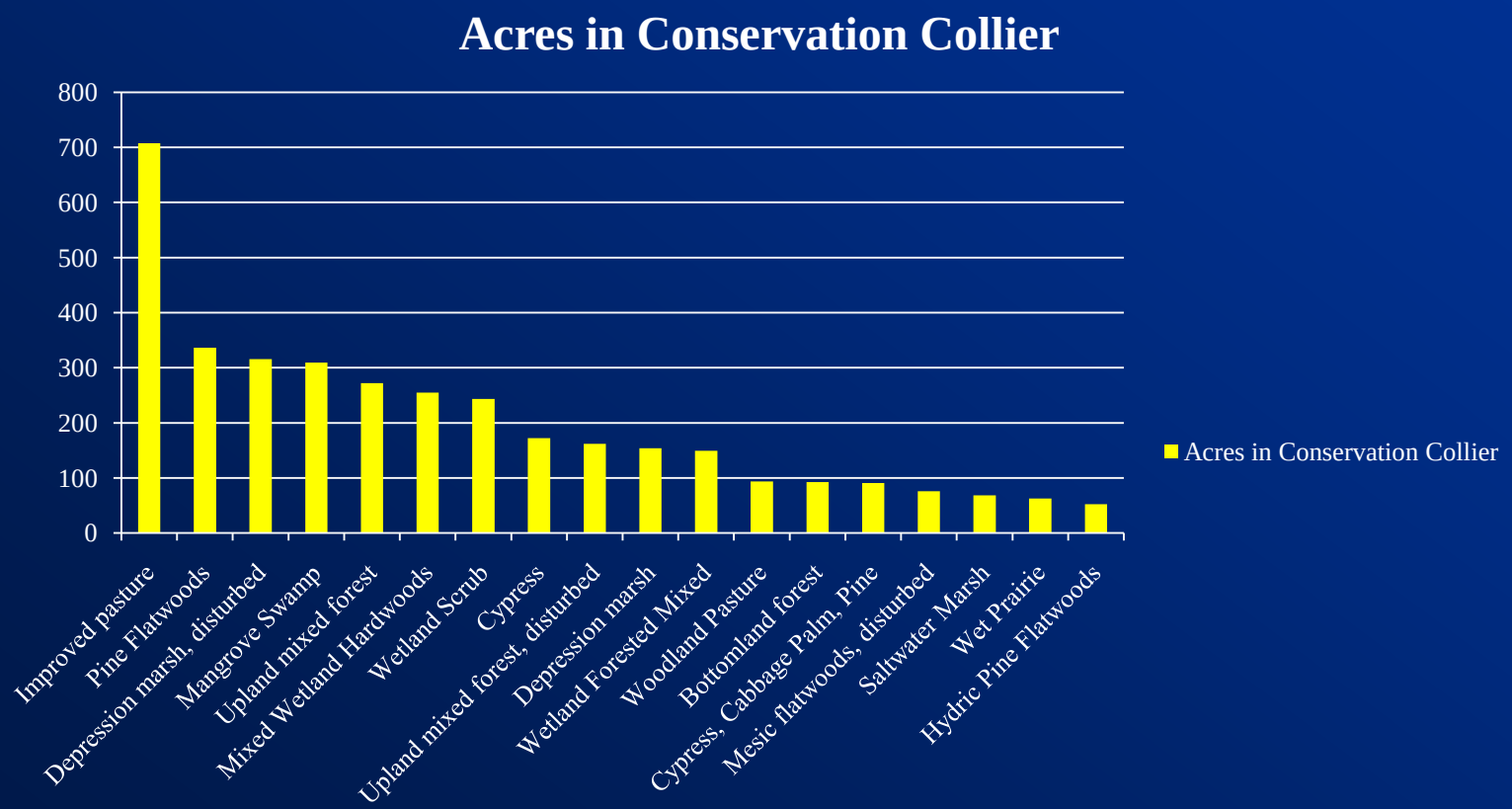
1. Production of Oxygen, 2. Other Gas Regulation, 3. Net Primary Productivity, 4. Carbon Sequestration 5. Local and Global Climate Regulation, 6. Disturbance Regulation, 7. Water Regulation, 8. Potable Water Supply, 9. Erosion Control and Sediment Retention, 10. Protection against Floods, Hurricanes and Tidal Waves, 11. Soil Formation, 12. Storage and recycling of complex organic matter and trace nutrients like metals, 13. Waste Treatment and Nutrient Removal, 14. Pollination Services, 15. Biological Control, 16. Habitat and Refugia, 17. Biological Maintenance of Resilience, 18. Biophysical support to other coastal ecosystems, 19. Commercial Fishery, 20. Recreational Fisheries, 21. Hunting, 22. Water Production, 23. Raw and Market Materials, 24. Genetic Resources, 25. Control of Disease, 26. Recreational and Tourism Benefits, 27. Cultural and Spiritual Benefits, 28. Privacy Screening, 29. Habitat for Indigenous Cultures, 30. Heritage Values, 31. Artistic Inspiration, and 32. Educational and Scientific Information.

Mangrove Ecosystem Service	TEV Value in 2013 dollars per acre per year
1. Production of Oxygen	$254,809.24
2. Other Gas Regulation	$155.73
3. Net Primary Productivity	$5,134.25
4. Carbon Sequestration	$414.26
5. Local and Global Climate Regulation	$118.72
6. Disturbance Regulation	$1,080.64
7. Water Regulation	$39.48
8. Potable Water Supply	$0.00
9. Erosion Control and Sediment Retention	$111.34
10. Protection against Floods, Hurricanes and Tidal Waves	$3,609.57
11. Soil Formation	$14.17
12. Storage and recycling of complex organic matter and trace nutrients like metals	$219.24
13. Waste Treatment and Nutrient Removal	$3,934.77
14. Pollination Services	$11.96
15. Biological Control	$6.81
16. Habitat and Refugia	$355.71
17. Biological Maintenance of Resilience	$239.79
18. Biophysical support to other coastal ecosystems	Already listed values for net primary production, storage and recycling of complex organic matter and trace nutrients like metals, and disturbance regulation
19. Commercial Fishery	$344.75
20. Recreational Fisheries	$2,085.74
21. Hunting	$0.00
22. Water Production	$0.00
23. Raw and Market Materials	$0.52
24. Genetic Resources	$8.97
25. Control of Disease	Not documentable
26. Recreational and Tourism Benefits	$6,371.46
27. Cultural and Spiritual Benefits	Captured in Recreation and Tourism
28. Privacy Screening	$26,000 for the Gordon River.
29. Habitat for Indigenous Cultures	$0.00
30. Heritage Values	$0.00
31. Artistic Inspiration	In the absence of a reliable empirical method to place a value on artistic inspiration, a TEV has not been generated for this study.
32. Educational and Scientific Information.	$2.30
Total TEV in 2013 dollars per acre per year	$279,307.71

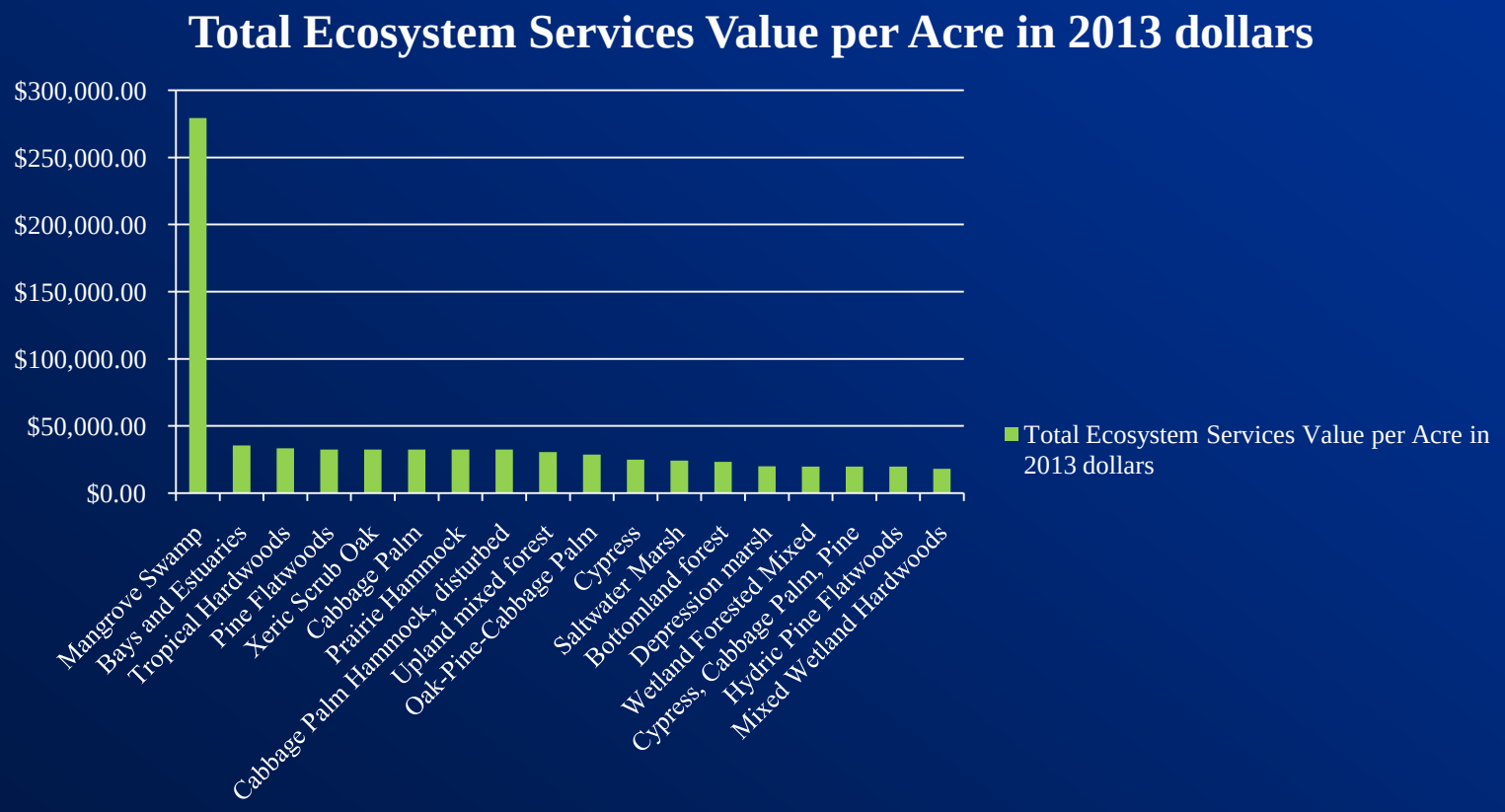
TEV by Habitat per Acre



Areas of Habitat in Conservation Collier



TEV per Acre by Habitat



Mangrove Swamp: 309.49 Acres
$279,307.71 TEV per Acre
for a total of $86,442,943.17 TEV

Pine Flatwoods : 336.41 Acres at
$32,340.94 TEV per acre
for a total of $10,879,815.63.

Upland Mixed Forest: 271.74 Acres at
$30,628.54 TEV per acre
for a total of $8,322,999.46.

Mixed Wetland Hardwoods: 255.08 Acres at
$18,084.14 TEV per acre
for a total of $4,612,902,43.

Cypress Swamp: 172.45 acres
$24,979.39 per acre
TEV $4,307,695.81 TEV

Pasture – Improved: 707.36 Acres
$1,387.62 per Acre TEV
for a total of $981,546.88 TEV

Potential Next Steps

Maps of ecological services topographies (ECOSERVE) in GIS form. Intersect ECOSERVE GIS data layers to generate combined analyses of provided ecosystem services. Generate existing past and alternate future ECOSERVE topographies related to anticipated land use changes, climatic changes, and alternate wetland protection and conservation land acquisition programs. Apply alternate climate change scenarios to the properties ECOSERVE landscape and observe changes in Ecosystem Services with **Sea Level Rise, Altered Hydrology, Climate Instability, Geomorphic Changes, Habitat and Species Changes, Infrastructure, and Land Use Changes.**

Report the results in a format useful to decision makers to inform the outcomes of future land use decisions in regard to wetlands impacts and the gain or loss of ecosystem services and the cost to their jurisdictions and society.

Produce the Ecosystem Services Maps (ECOSERVE layers) for each Services set, Combined Categories and TEV in a landscape, geographical context.

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