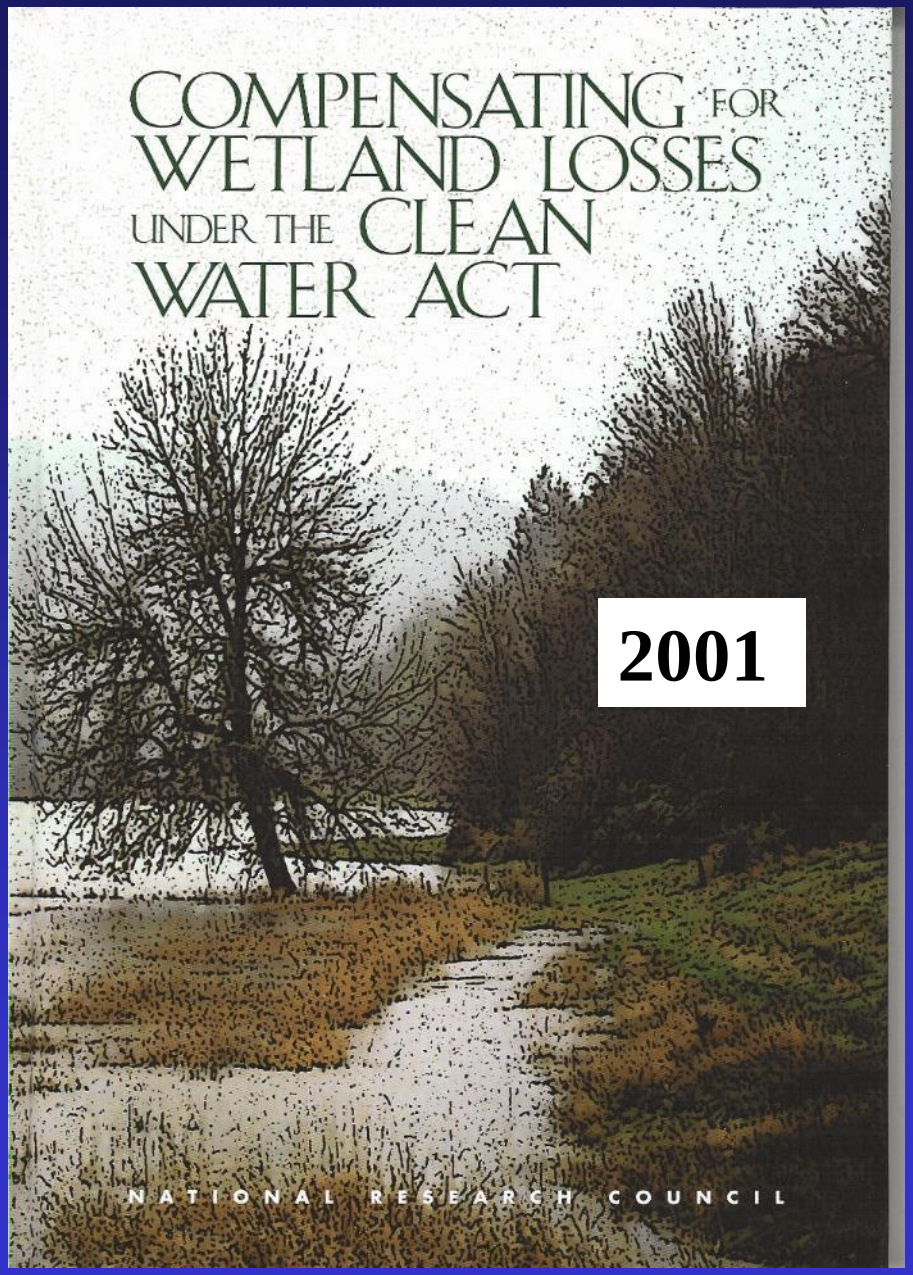
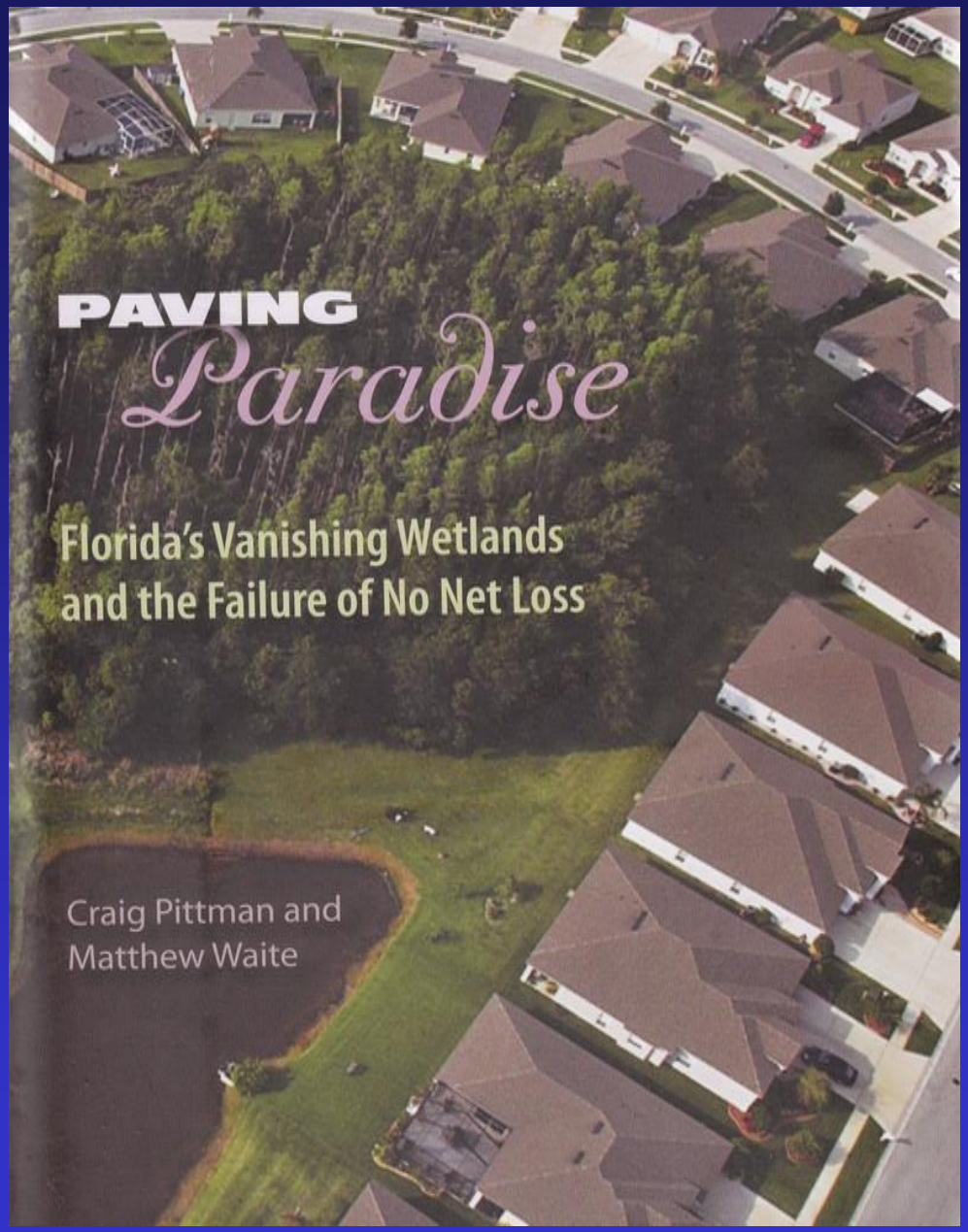
Mangrove and Seagrass Restoration/Mitigation: Success and Failure and the Cost of Both

Presented by Laura L. Flynn

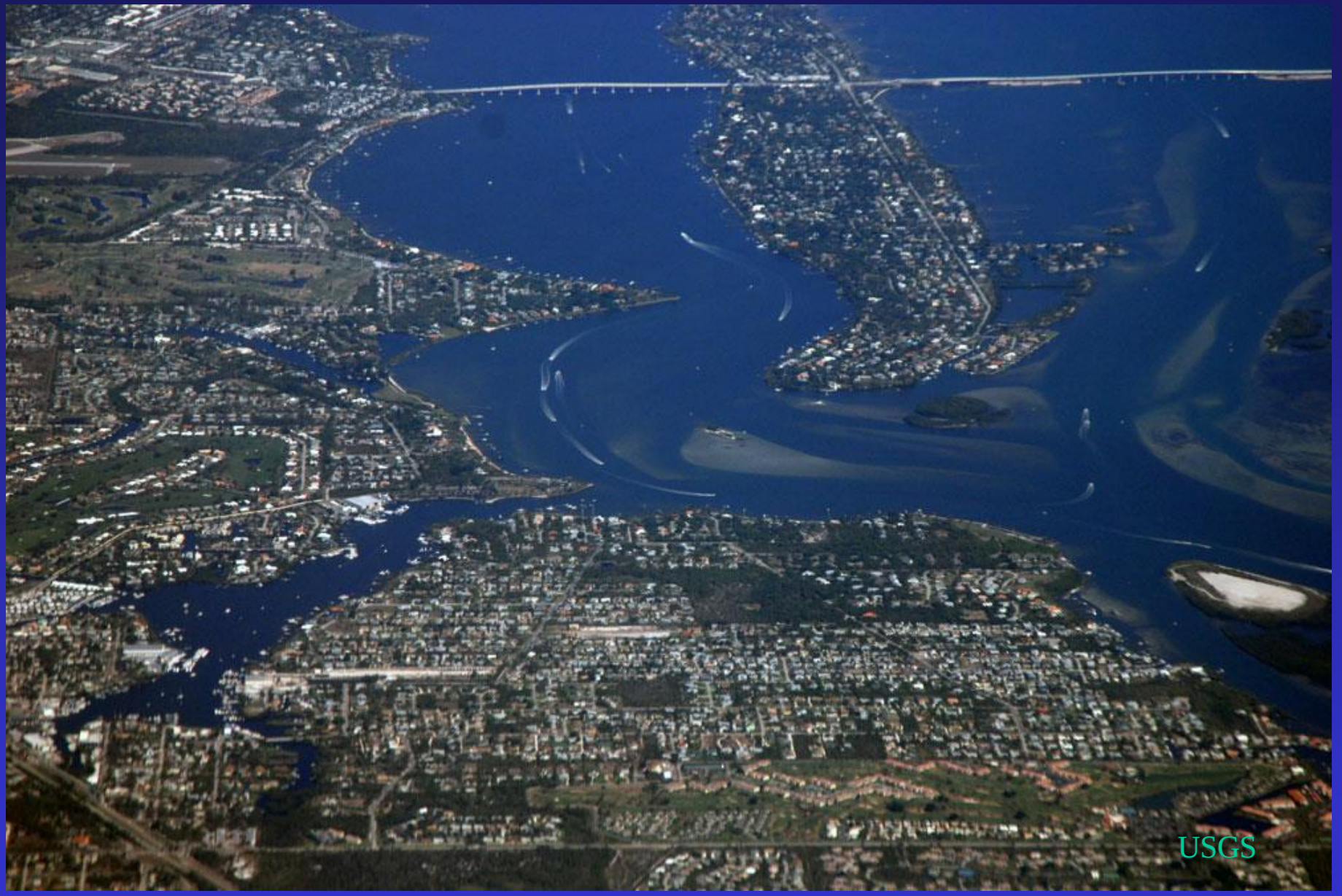
Lewis Environmental



"The goal of no net loss of wetlands is not being met for wetland functions by the mitigation program, despite progress in the last 20 years"



Between 1990 and 2003, there was a net loss of 84,000 acres of wetlands in Florida due to urbanization


USGS

WETLAND CREATION AND RESTORATION

THE STATUS OF THE SCIENCE

Edited by
Jon A. Kusler
Mary E. Kentula

Foreword by
Senator
George J. Mitchell

How Successful Mangrove Forest Restoration Informs the Process of Successful General Wetlands Restoration (2011)

Roy R. Lewis III

National Wetlands Newsletter July-August 2011 pages 23-25.

Probability of Success

…high

Estuarine marshes

Coastal marshes

Mangrove forests

Freshwater marshes

Freshwater forests

Groundwater/Seepage Slope Wetlands

Seagrass Meadows (SAV)

…low

Probability of Success

…high

Estuarine marshes

ALL THESE WETLAND TYPES AND MANY OTHERS HAVE BEEN SUCCESSFULLY RESTORED OR CREATED WHICH CONFIRMS THAT THE TECHNOLOGY IS THERE TO DO THE JOB RIGHT, BUT THERE IS STILL A PROBLEM

Seagrass Meadows

…low

Probability of Success

…high

Estuarine marshes

Coastal marshes

Mangrove forests

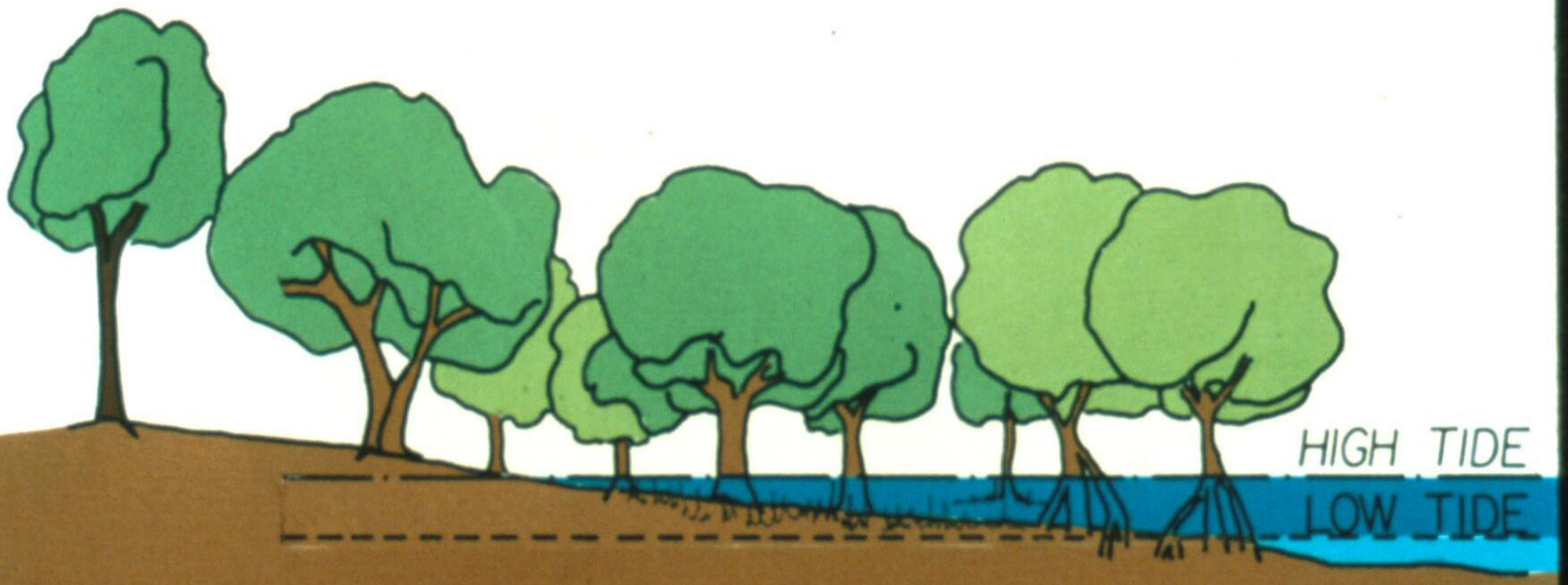
Freshwater marshes

Freshwater forests

Groundwater/Seepage Slope Wetlands

Seagrass Meadows (SAV)

…low



PLANT ZONATION – LOW ENERGY BAY SHORELINE

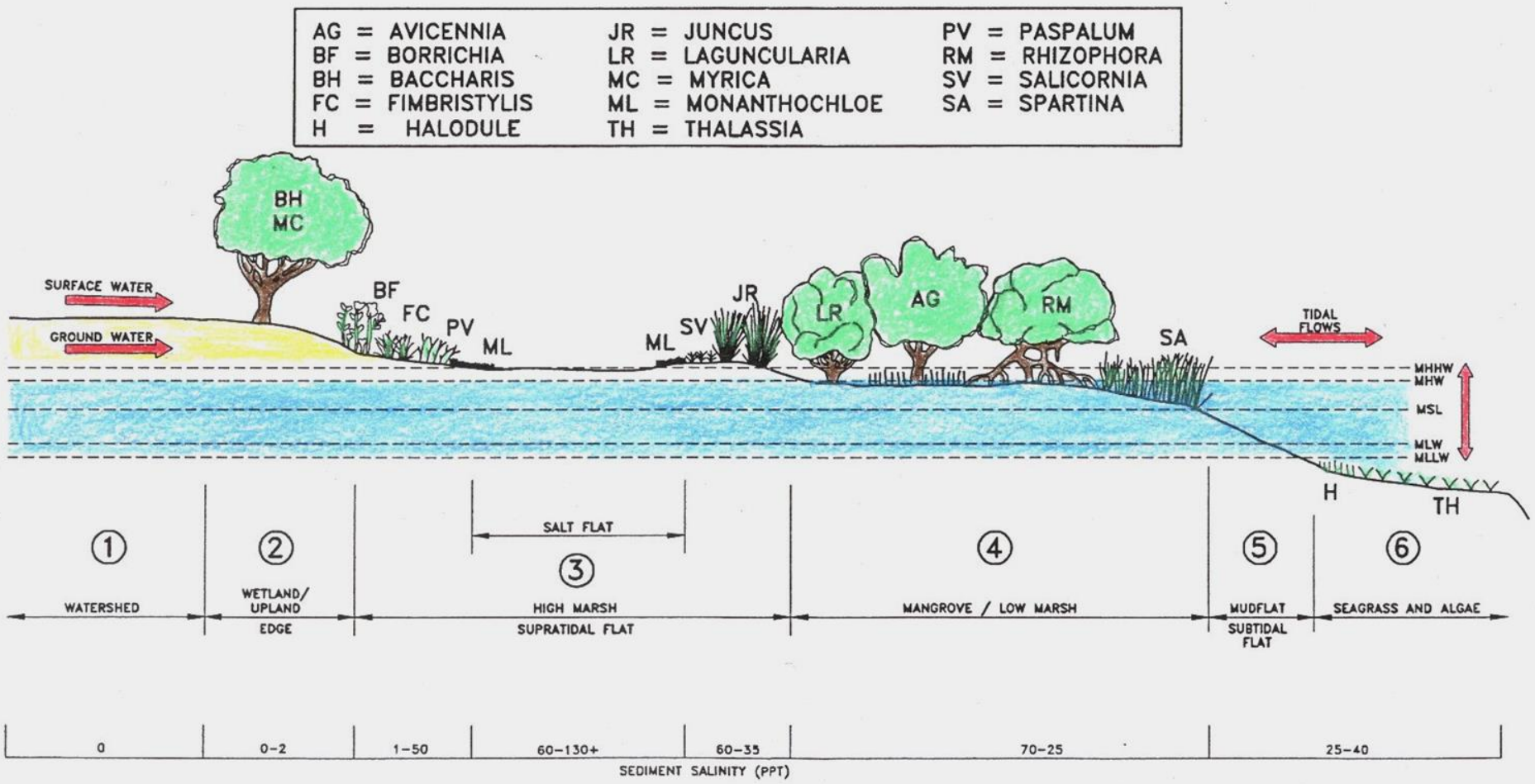
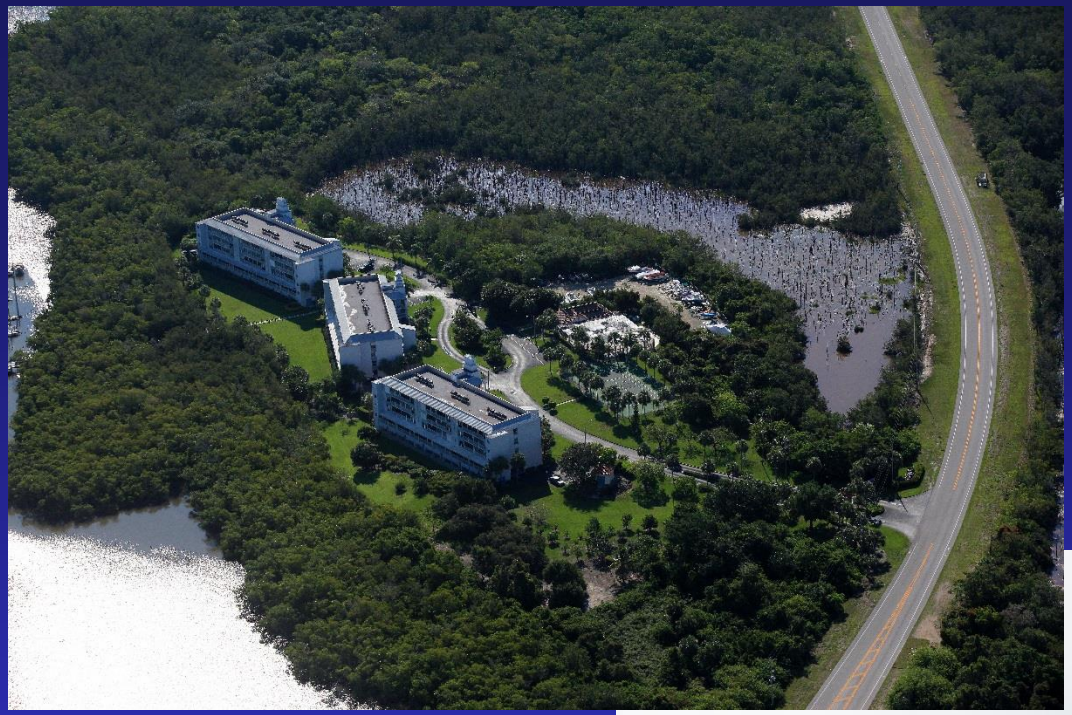


Figure 1. Schematic diagram of the six components of the tropical coastal shelf ecosystem (modified from Crewz and Lewis 1991).



Rookery Bay,
Naples, FL
2012

Probability of Success

…high

ALL THESE WETLAND TYPES AND MANY OTHERS HAVE BEEN SUCCESSFULLY RESTORED OR CREATED WHICH CONFIRMS THAT THE TECHNOLOGY IS THERE TO DO THE JOB RIGHT – BUT THE CORRECT APPLICATION OF THAT TECHNOLOGY OFTEN DOES NOT TAKE PLACE AND MONITORING, COMPLIANCE AND ENFORCEMENT ARE WEAK

…low

Mangrove replanting project a bust

Only 9 percent of seedlings placed around Naples Bay since 2000 have survived

By ERIC STAATS
emstaats@naplesnews.com

A pilot project to replant mangroves along Naples Bay has not had much more success than Mother Nature.

Crews from the Conservancy of Southwest Florida planted 1,114 red and white mangrove seedlings at various spots around Naples Bay in two planting cycles between 2000 and 2002.

Of those, only 95 red mangrove seedlings have survived, or about 9 percent, according to monitoring results reported in a December 2005 report to the U.S. Fish and Wildlife Service.

The Fish and Wildlife Service awarded the Conservancy a $25,000 grant in 2000 to conduct the pilot project.

The results illustrate the high hurdles scientists will have to jump to regrow mangroves as part of a larger effort to restore Naples Bay.

It will take more than a green thumb.

Conservancy researchers have estimated that Naples Bay has lost some 70 percent of its mangrove forest to development. Mangrove loss has dealt a significant blow to the bay's ecosystem.

Fish find meals and hide from predators among mangrove roots. The roots keep water clean by holding sediment. Migratory birds roost in mangrove branches. When mangrove leaves fall and rot, they become food for organisms at the base of the food chain.

A healthy mangrove forest can produce millions of floating seeds each year, and a small percentage of them find a place where they can grow on their own, said wetlands scientist and mangrove expert Roy "Robin" Lewis III, president of Lewis Environmental Services in Salt Springs, Fla.

If mangroves have not moved into an area, the problem could be with the site, not necessarily the planter, he said.

On Naples Bay, water along most seawalls is too deep for mangroves to grow, and riprap is placed at too steep an angle in many places.

The solution: Either don't plant mangroves where they won't grow or find ways to revamp the shoreline, Lewis said.

"It doesn't mean you can't correct it," Lewis said.

Restoration also will depend on quelling homeowners' fears that water views and mangroves are not mutually exclusive.

Homeowners volunteered to allow mangroves to be planted on the edge of their lots as part of the pilot project.

Besides inhospitable shoreline structure, boat wakes slamming the shoreline also contributed to mangrove seedlings' failure, according to the Conservancy report.

An unexpected freeze in late December 2000 took a toll on the first planting cycle, according to the report.

Vandalism or honest mistakes by ill-informed gardeners were other problems, according to the report. The report theorizes that misguided shoreline fishermen pulled out seedlings at Bayview Park.

"It's not an easy thing," said Brad Rieck, a Fish and Wildlife Service biologist in the agency's project planning division in Vero Beach.

"You just don't walk up and down the shoreline, plant propagules at the mean high water line, walk away and a couple years later have a nice stand of mangroves."

Although most of the seedlings didn't make it, crews did what they could to give them a leg up when they were planted.

Workers collected about 2,750 mangrove seeds and propagules and cultivated them in a nursery the Conservancy set up.

About 18 percent of the white mangrove seeds and 72 percent of the red mangrove propagules germinated and grew roots for replanting, according to the report.

Monitoring after the planting showed a survival rate of 19 percent for the first cycle and 71 percent in the second cycle, according to the report.

The report attributes the difference to more mature seedlings planted in the second cycle.

In both planting cycles, some of the mangroves were planted inside plastic tubes and the rest were planted directly into riprap.

In the second planting cycle, the root systems of half of the mangroves seedlings were wrapped in cheesecloth filled with soil and then wedged into riprap, packed with more soil and supported with bamboo stakes.

Unwrapped seedlings had a survival rate of 69 percent compared with an 81 percent survival rate of wrapped seedlings, according to the report.

Seedlings planted in riprap had a 56 percent survival rate compared with 36 percent surviving in plastic tubes along seawalls, according to the report.

By the end of the monitoring period in November 2005, though, the overall survival rate had dropped to 9 percent.

Conservancy biologist Kathy Worley said the results should not discourage future plantings, but the problems that kept mangroves from growing should be fixed first.

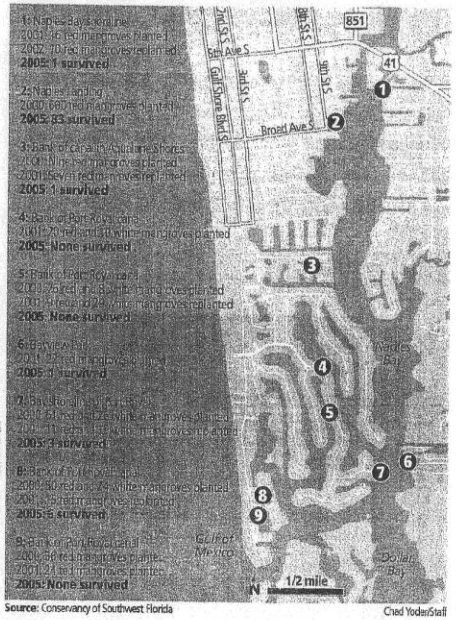
"We're not saying it can't be done; it can," she said.

■ Conservancy of Southwest Florida biologist Kathy Worley said the results should not discourage future plantings, but the problems that kept mangroves from growing should be fixed first.

NAPLES DAILY NEWS
NAPLES
DAILY - 63,000
Jan 20, 2006

Trouble with mangroves

Less than 10 percent of the mangrove seedlings the Conservancy of Southwest Florida planted along Naples Bay have survived, according to a Conservancy report. The report cites problems with vandalism, water depths and boat wakes. Some 70 percent of the bay's original mangroves have been destroyed by development.



Source: Conservancy of Southwest Florida — Chad Yoder/Staff

Figure 2. Some examples of the less successful mangrove enhancement initiatives in the Philippines, mainly planting *Rhizophora* at the seafronts: (a) under a prolonged period of immersion, *Rhizophora* seedlings planted at the lower intertidal zone may "drown," causing massive mortalities in Tayabas Bay (16, pers. obs.); (b and e) macroalgae and other debris may cause defoliation of the broad-leafed *Rhizophora*; (c and g) planting between pneumatophores (c) of *Sonneratia* and aided by bamboo stakes (g) did not prevent many *Rhizophora* seedlings from dying (g; i.e., <50 of the ~1000 seedlings planted survived; Agdangan, Quezon); (d and h) part of 10-ha mangrove plantation (carbon-sink) effort in which *Rhizophora* seedlings mostly (i.e., >95% of the seedlings within sampling plots) died after only about 9 months, apparently because of the mechanical stress of wave action and substrate erosion; and (f) seedling stems serving as substrates for oyster colonization.

From Sampson and Rollon 2008

20 Year Failed Effort To Restore Mangroves In The Philippines, USD$ 17.6 Million Spent for 44,000 Ha of Plantings

Figure 2. Some examples o ing *Rhizophora* at the seafronts: (a) under a prolo nay "drown," causing massive mortalities in Taya n of the broad-leafed *Rhizophora*; (c and g) planti ent many *Rhizophora* seedlings from dying (g; i.e., mangrove plantation (carbon-sink) effort in which *Rhizophora* seedlings mostly (i.e., >95% of the seedlings within sampling plots) died after only about 9 months, apparently because of the mechanical stress of wave action and substrate erosion; and (f) seedling stems serving as substrates for oyster colonization.

From Sampson and Rollon 2008


3 3 2007


THE UNITED STATES OF AMERICA
B57066618A
B57066619A
B57066605A
B57066615A
B57066614A
B57066620A
B57066613A
B57066616A
B57066611A
ONE DOLLAR

Probability of Success

…high

Estuarine marshes

Coastal marshes

Mangrove forests

Freshwater marshes

Freshwater forests

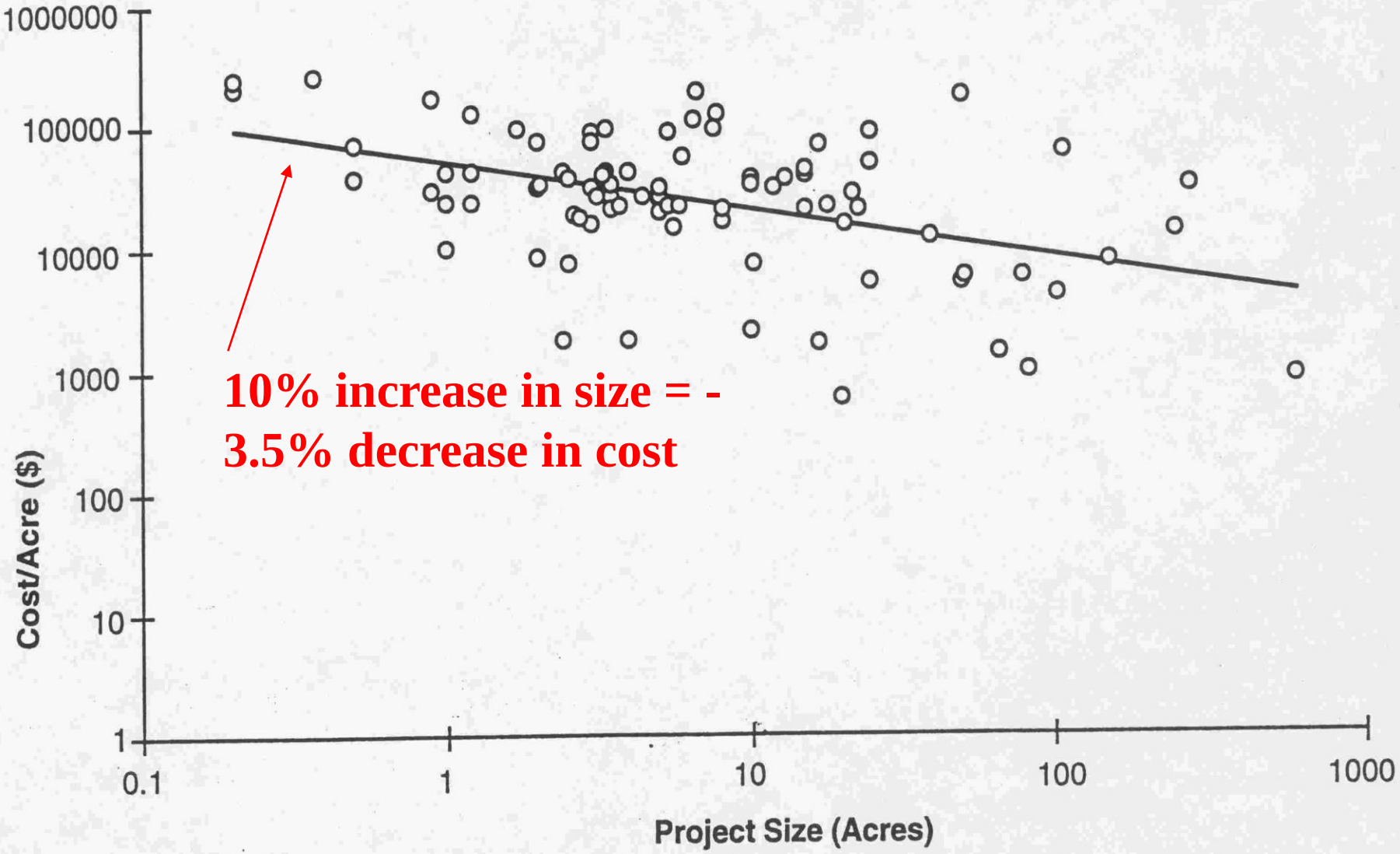
Groundwater/Seepage Slope Wetlands

Seagrass Meadows (SAV)

>$ 10X-100X

…low

Figure 3a: Economies of Scale—Primary Data




CONSTRUCTION OFFICE
Florida
Wetlandsbank
Providing Environmental Solutions
20790 SHERIDAN ST., PEMBROKE PINES

Probability of Success

…high

Estuarine marshes

Coastal marshes

Mangrove forests

Freshwater marshes

Freshwater forests

Groundwater/Seepage Slope Wetlands

Seagrass Meadows (SAV)

…low

Ecological Mangrove Restoration (EMR)

Food and Agriculture Organization of the United Nations (FAO - UN)
&
Forest Department of Myanmar adopts EMR Technique to Restore Degraded Mangroves in Rakhine State, Myanmar

March 2011 - December 2011

In Wunbaik Reserved Mangrove Forest

Hamlet Involved: Hlaing Kaung (23 families)
EMR Pilot Area: 2 acres; Compartments: 41 & 44

Sustainable Community-based Mangrove Management in Wunbaik Forest Reserve, TCP/MYA/3204




For more information please visit: Lewis Environmental Services, Inc.: www.mangroverestoration.com
FAO Representation Office, Seed Division Compound, Inseine Road, Yangon, Myanmar, Email: FAO-MMR@fao.org,Phone: 95-1-641772, 641673,Fax: 95-1- 641561

Ecological Mangrove Rehabilitation
A Field Manual for Practitioners

Over the years, there have been many different attempts to restore mangroves. Some of these efforts have been gargantuan, involving several thousand hectares of coastal lands. Other efforts have been small in comparison, with perhaps less than a hectare of mangroves restored. Yet, in these efforts, both large and small, the lessons learned in this important process are vital in re-establishing otherwise rapidly vanishing mangrove forests. Without taking those necessary steps now to restore mangroves, our planet's coastal regions will be seriously impacted by erosion, declining fisheries, vanishing wildlife, and displaced indigenous coastal peoples.

There are many different techniques and methods utilized in planting mangroves. Because some of these have resulted in identifiable successes or failures, we wish to present herein a detailed process of mangrove rehabilitation which has proven successful in its application in various locations at various scales. Ecological Mangrove Rehabilitation engages communities to consider social, economic and ecological factors before undertaken mangrove restoration, and relies on monitoring to inform corrective actions over time. This EMR manual also presents summary descriptions of particular case studies from around the world, which are representative of both successful and failed attempts at mangrove restoration.

Publication of this manual was made possible by support from:

Restoring Coastal Livelihoods Program (www.rcl.or.id)

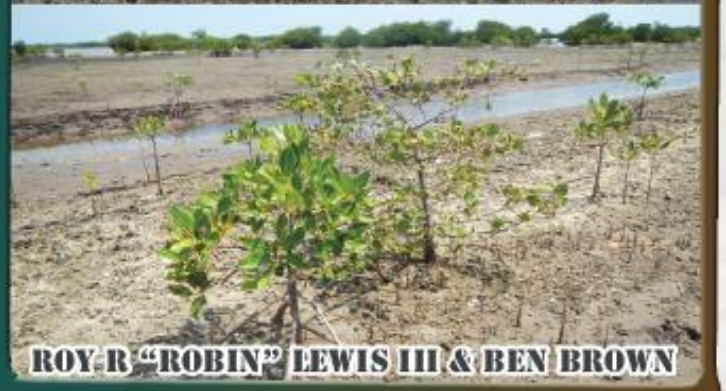
&

USAID - CADRE Program

Ecological Mangrove Rehabilitation
A Field Manual for Practitioners

EMR

ECOLOGICAL MANGROVE REHABILITATION



ROY R "ROBIN" LEWIS III & BEN BROWN

A FIELD MANUAL FOR PRACTITIONERS

ALTERNATIVE APPROACHES TO MANGROVE RESTORATION

Ecological Mangrove Restoration (EMR) versus Planting Only

1. Understand Autecology and Community Ecology
2. Understand Normal Hydrology
3. Assess Modifications to Hydrology or Added Stress?
4. Select the Restoration Site
5. Restore or Create Normal Hydrology, or Remove Reduce Stress
6. Plant Mangroves Only As Needed

SUCCESS !

1. Build a Nursery, Grow Mangrove Seedlings and Plant Mangroves

(GARDENING)

FAILURE#!!***

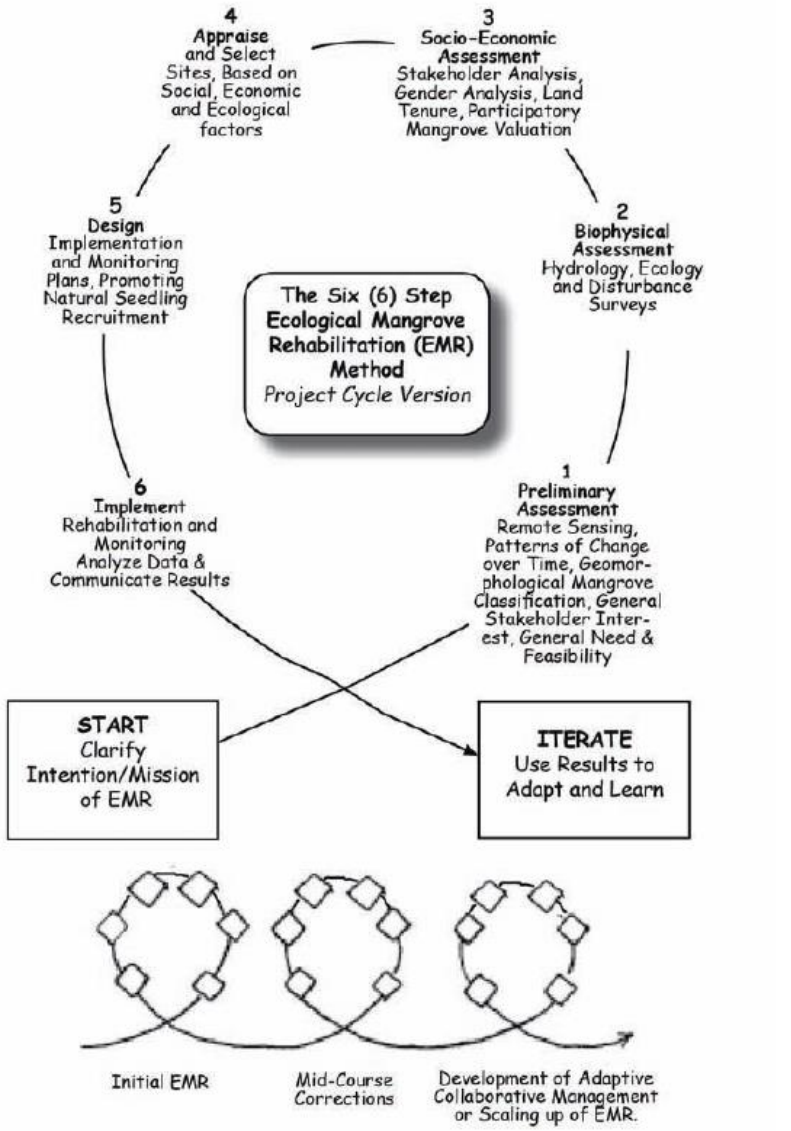


Figure 3.1 - The project cycle. Each step is built upon the previous step, the answers and questions generated by one step, inform and shape the next level. (note – use the EMR specific project cycle).

1. Understand Autecology and Community Ecology
2. Understand Normal Hydrology
3. Assess Modifications to Hydrology or Added Stress?
4. Select the Restoration Site
5. Restore or Create Normal Hydrology, or Remove or Reduce Stress
6. Plant Mangroves Only As Needed

Time Zero – July 1989


Time Zero + 27 Months


Time Zero + 78 months- January 1996


THE UNITED STATES OF AMERICA
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THE UNITED STATES OF AMERICA
B57066620A
B57066613A
B57066616A
B57066611A
B57066618A
57066614A

http://geo.usace.army.mil/ribits/index.html

KERF/KRF = A MANGROVE/SEAGRASS ILF PROGRAM FOR FEDERAL PERMITTING IN EXISTENCE FOR 17 YEARS IN MONROE COUNTY

SITE	YEAR COMPLETED	METHODS	2013 TOTAL COST	2013 COST PER FT^2	REFERENCES
1. Carysfort Phases I-IV	2001-2013	Fill removal and placement in basins with minor planting	$1,858,662*	$1.24	McNeese 2002, Hobbs et al. 2006, Hobbs 2013a,b and KERF 2013
2. Port Bougainville Phases I and III	1994-2008	Fill removal and placement in basins with minor planting	$530,975**	$1.26	Hobbs et al. 2006, KERF 2013
3. Crocodile Lake Road Removal	2000	Road removal	$142,515**	$2.34	Hobbs et al. 2006, KERF 2013
4. Cudjoe Plantation Road Removal	1991	Road removal	$20,536**	$0.76	Hobbs et al. 2006, KERF 2013
5. Dispatch Slough	1999	Road removal	$89,410*	$1.55	McNeese 1999a, b, Hobbs et al. 2006, KERF 2013
6. Trevor Berm	1982	Berm removal	$1,596**	$0.33	Hobbs et al. 2006, KERF 2013
7. Upper Sugarloaf Refuge Road	1983	Road Removal	$127,211**	$1.02	Hobbs et al.2006, KERF 2013
8. Cactus Hammock Road	1982	Road removal	$17,956**	$1.79	Hobbs et al.. 2006, KERF 2013,
9. Harrison Tract	1995	Fill and road removal and placement in excavated basins with some mangrove planting	$7,260,799	$3.99	Lewis Environmental Services, Inc., and Consul-Tech Engineering, Inc.1996, CES 1998, Lewis 2000, FDOT 2001
Mean of all Per Square Foot Estimates				$1.59 sq ft or $69, 260.00 per ac	

* *Land purchase costs and compliance monitoring to the extent needed not included*

** *Limited monitoring*

Probability of Success

…high

Estuarine marshes

Coastal marshes

Mangrove forests

Freshwater marshes

Freshwater forests

Groundwater/Seepage Slope Wetlands

Seagrass Meadows (SAV)

…low

Probability of Success

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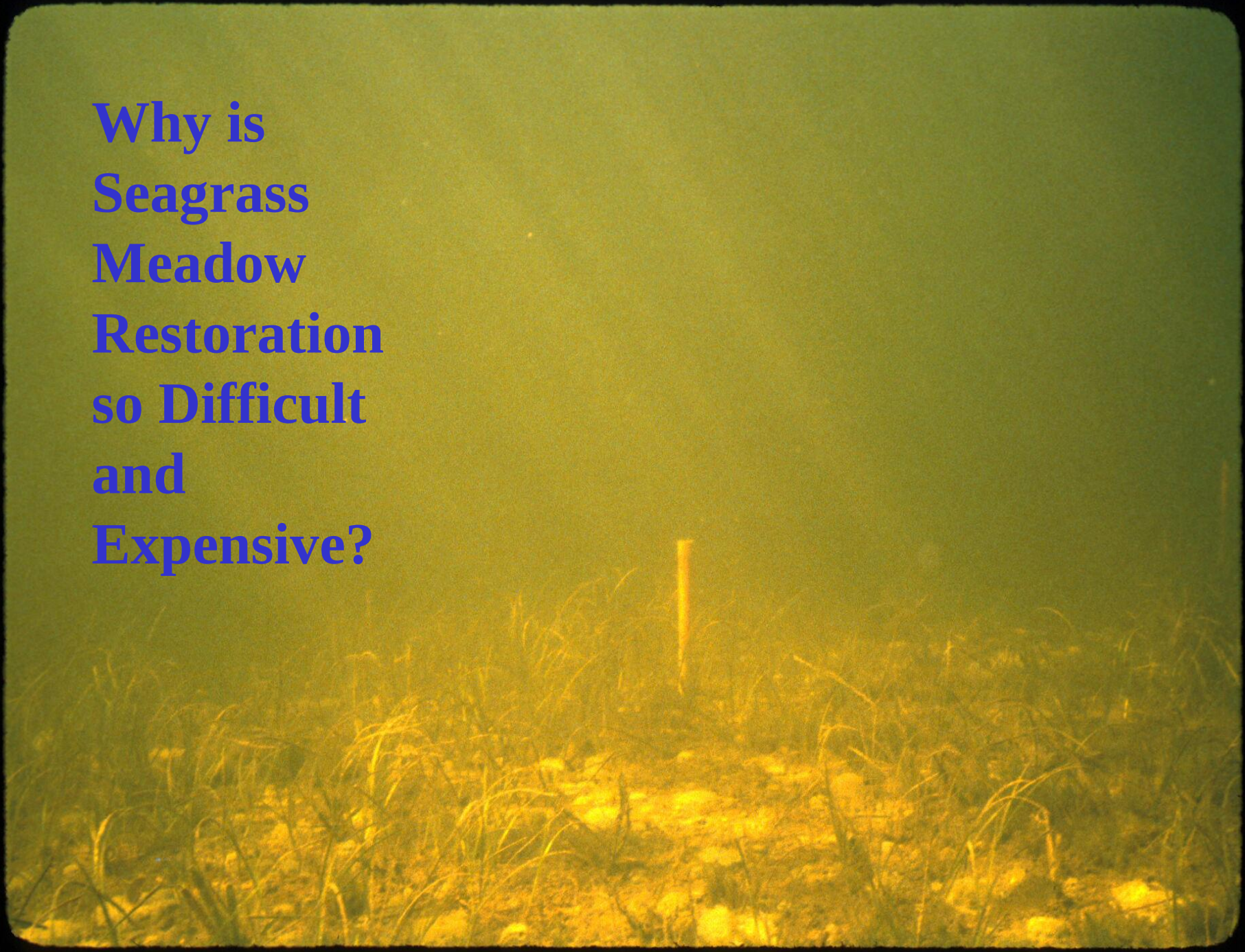
Why is
Seagrass
Meadow
Restoration
so Difficult
and
Expensive?

SITE	YEAR COMPLETED	METHODS	2013 TOTAL COST	2013 COST PER FT^2	REFERENCES
1. House Boat Row	2012	Fill and Transplant	$1,614,471*	$14.26	FDOT and Stantec 2013, Phil Frank (pers. comm).
2. Heidi Baby	2005	Fill, Stakes and Transplant	$89,704**	$16.03	NOAA 2009
3 Julia Reanne	2006	Fill, Stakes and Transplant	$73,933**	$35.18	NOAA 2007A
4. Lucky One	2006	Fill, Stakes and Transplant	$27,513**	$50.30	NOAA and FDEP 2006, 2007
5. Kristal	2008	Sediment tubes, Stakes and Transplant	$41,312**	$46.03	NOAA 2007B, Bailey 2011
6. True Justice	2002	Stakes and Transplant	$46,092**	$6.83	Anderson and Farrer 2011, NOAA and FDEP 2002
7. Egret Island Phase 2	2004	Road Removal Only	$127,211	$5.85	Hobbs et al.2006, KERF 2013
8. Lignumvitae Phase 1 Scar Repair	1999	Fill only followed by sediment tubes and planting in part (2002?)	$41,208***	$14.93	Kruer 2001 Hobbs et al.. 2006, KERF 2013, Hall (pers. comm)
9. Lignumvitae Phase I Stake Array	1999	Stakes only	$9,818	$0.53	Kruer 2001, Hobbs et al. 2006, KERF 2013
10. Lignumvitae Phase 2 (2 projects)	2005	Fill, Stakes and Planting	$124,241	$14.26	Hobbs et al. 2006, KERF 2013
11. Lignumvitae Phase 3	2013	Fill only	$215.947****	$44.99	Hobbs et al. 2006, KERF 2013, Hobbs 2013
12. Middle Torch Key Circulation Cut	1983	Fill Removal	$11,430	$10.15	Hobbs et al. 2006, KERF 2013
13. Hypothetical FKNMS PEIS Seagrass	2004	Fill, Stakes and Transplant	$28,741	$27.94	NOAA and FDEP 2004
14. Potential Restoration for Federal Court Settlement	1996	Planting only	$566,475	$13.00	Fonseca et al. 2002
Mean of all Per Square Foot Estimates				$21.45 sq ft or $934, 362.00 per ac	

* *"Other Costs" estimated as 40% of construction costs*

** *Cost estimates included site restoration and compensatory mitigation offsite*

*** *Cost does not include monitoring or reporting and additional work on site (placement of sediment tubes and planting) are not included in this cost*

**** *Cost does not include any monitoring or reporting*

- Do your homework to make sure your work and hired consultants use the technology and information available to them accurately in order to achieve success cost effectively and efficiently.

- To reduce costs, work with nature by restoring historic hydrologic conditions by eliminating or reducing the stress on the system to facilitate natural recovery.

- Follow up and monitoring are crucial to document success

THE FUTURE?

- **Can We Really Achieve No Net Loss?**
- **The Technology Is There, The Information Transfer is Not**
- **Compliance Monitoring and Enforcement of Permit Conditions Are Not Meeting Minimum Criteria to Ensure "Success" BUT This is Likely to Change in the Future**
- **We Do Not Really Have A Trained and Respected Cadre Of Wetland Professionals That Are Acknowledged And Used in Lieu of Less Knowledgeable Consultants**
- **Don't Get Caught in the Middle and End Up Wasting Money and Time with Failed Expensive Mitigation. Vet Your Consultants VERY CAREFULLY!**

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