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

Presented by Laura L. Flynn
“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.
How Successful Mangrove Forest Restoration Informs the Process of Successful General Wetlands Restoration (2011)

Roy R. Lewis III

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
estatts@napplesnews.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 LDJ 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 if they want 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.
Figure 2. Some examples of the less successful mangrove enhancement initiatives in the Philippines, mainly planting *Rhizophora* at the seafront: (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.
20 Year Failed Effort To Restore Mangroves In The Philippines, USD$ 17.6 Million Spent for 44,000 Ha of Plantings

From Sampson and Rollon 2008
Probability of Success

...high

- Estuarine marshes
- Coastal marshes
- Mangrove forests
- Freshwater marshes
- Freshwater forests
- Groundwater/Seepage Slope Wetlands
- Seagrass Meadows (SAV)

...low

> $10X-100X$
Figure 3a: Economies of Scale—Primary Data

- 10% increase in size = - 3.5% decrease in cost
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, Insein Road, Yangon, Myanmar. Email: FAO-MMR@fao.org, Phone: 95-1-641172, 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.

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Restoring Coastal Livelihoods Program (www.rc.lit.id)

&
USAID - CADRE Program

Lutheran World Relief

USAID
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 or Reduce Stress
6. Plant Mangroves Only As Needed

SUCCESS!

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

FAILURE**#!**!
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 + 27 Months
Time Zero + 78 months - January 1996
KERF/KRF = A MANGROVE/SEAGRASS ILF PROGRAM FOR FEDERAL PERMITTING IN EXISTENCE FOR 17 YEARS IN MONROE COUNTY

<table>
<thead>
<tr>
<th>SITE</th>
<th>YEAR COMPLETED</th>
<th>METHODS</th>
<th>2013 TOTAL COST</th>
<th>2013 COST PER FT²</th>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Port Bougainville Phases I and III</td>
<td>1994-2008</td>
<td>Fill removal and placement in basins with minor planting</td>
<td>$530,975**</td>
<td>$1.26</td>
<td>Hobbs et al. 2006, KERF 2013</td>
</tr>
<tr>
<td>3. Crocodile Lake Road Removal</td>
<td>2000</td>
<td>Road removal</td>
<td>$142,515**</td>
<td>$2.34</td>
<td>Hobbs et al. 2006, KERF 2013</td>
</tr>
<tr>
<td>4. Cudjoe Plantation Road Removal</td>
<td>1991</td>
<td>Road removal</td>
<td>$20,536**</td>
<td>$0.76</td>
<td>Hobbs et al. 2006, KERF 2013</td>
</tr>
<tr>
<td>5. Dispatch Slough</td>
<td>1999</td>
<td>Road removal</td>
<td>$89,410*</td>
<td>$1.55</td>
<td>McNeese 1999a, b, Hobbs et al. 2006, KERF 2013</td>
</tr>
<tr>
<td>6. Trevor Berm</td>
<td>1982</td>
<td>Berm removal</td>
<td>$1,596**</td>
<td>$0.33</td>
<td>Hobbs et al. 2006, KERF 2013</td>
</tr>
<tr>
<td>7. Upper Sugarloaf Refuge Road</td>
<td>1983</td>
<td>Road Removal</td>
<td>$127,211**</td>
<td>$1.02</td>
<td>Hobbs et al. 2006, KERF 2013</td>
</tr>
<tr>
<td>8. Cactus Hammock Road</td>
<td>1982</td>
<td>Road removal</td>
<td>$17,956**</td>
<td>$1.79</td>
<td>Hobbs et al., 2006, KERF 2013</td>
</tr>
</tbody>
</table>

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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Estuarine marshes
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Seagrass Meadows (SAV)

...low
Why is Seagrass Meadow Restoration so Difficult and Expensive?
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<tr>
<td>2. Heidi Baby</td>
<td>2005</td>
<td>Fill, Stakes and Transplant</td>
<td>$89,704**</td>
<td>$16.03</td>
<td>NOAA 2009</td>
</tr>
<tr>
<td>3 Julia Reanne</td>
<td>2006</td>
<td>Fill, Stakes and Transplant</td>
<td>$73,933**</td>
<td>$35.18</td>
<td>NOAA 2007A</td>
</tr>
<tr>
<td>6. True Justice</td>
<td>2002</td>
<td>Stakes and Transplant</td>
<td>$46,092**</td>
<td>$35.18</td>
<td>Anderson and Farrer 2011, NOAA and FDEP 2002</td>
</tr>
<tr>
<td>7. Egret Island Phase 2</td>
<td>2004</td>
<td>Road Removal Only</td>
<td>$127,211</td>
<td>$5.85</td>
<td>Hobbs et al.2006, KERF 2013</td>
</tr>
<tr>
<td>9. Lignumvitae Phase I Stake Array</td>
<td>1999</td>
<td>Stakes only</td>
<td>$9,818</td>
<td>$0.53</td>
<td>Kruer 2001, Hobbs et al. 2006, KERF 2013</td>
</tr>
<tr>
<td>13. Hypothetical FKNMS PEIS Seagrass</td>
<td>2004</td>
<td>Fill, Stakes and Transplant</td>
<td>$28,741</td>
<td>$27.94</td>
<td>NOAA and FDEP 2004</td>
</tr>
</tbody>
</table>

| 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!