BEACH NOURISHMENT AND SEA TURTLES: A CASE STUDY ON HUTCHINSON ISLAND, FLORIDA

Ecological Associates, Inc.

Thanks to:
FDEP
Martin County, Florida
Applied Technology & Management
Erosion is a Matter of Perspective

Beaches Are Dynamic – They Change Seasonally
Loggerhead Turtles Do Quite Well on Narrow Beaches
Wider is Better?
Beachfront Residents Have a Right to Protect Their Properties

Shoreline Protection is a Matter of Alternatives
EVALUATING BEACH NOURISHMENT PROJECTS

- Coastal Processes (Currents, Tides, Waves)
- Habitat Quality of Pre-Existing Beaches
- Characteristics of Borrow Sediments
- Beach Design (Length, Width, Interval)
- Construction Methods (Pumping, Tilling)
- Prevailing Weather
POTENTIAL EFFECTS OF BEACH NOURISHMENT

- Nesting Habitat (Quantity and Quality)
  - Nest Densities and Nesting Success
  - Energy Expenditures During Nesting
  - Spatial Distribution of Nests

- Incubation Environment
  - Reproductive Success
  - Hatchling Fitness and Emergence Patterns
NESTING HABITAT (QUANTITY AND QUALITY)

- Beach Profile (Width, Height and Slope)
- Sediment Compaction
- Sediment Grain Size and Color
- Temperature
- Moisture Content
- Gas Exchange
Beach Widths at Crawls

Beach Width (m)

1995
(N=213)

1996
(N=251)

1997
(N=159)

Control North South Control North South Control North South

1995
(N=203)

1996
(N=279)

1997
(N=205)

(N=181)

NS
Sediments - Control

Cumulative % By Weight

Grain Size (Phi)

1995 (N = 11)
1996 (N = 18)
1997 (N = 18)
Sediments – North Treatment

Cumulative % By Weight

Grain Size (Phi)

- 1995 (N = 11)
- 1996 (N = 18)
- 1997 (N = 18)
Compaction Seaward of Dune

1995

NS

1996

(N=336) (N=300) (N=180)

1997

(N=552) (N=420)

Control North South Control North South Control North South

Compaion (psi)
COMPACTION ADJACENT TO NESTS AND ABANDONED DIGS (0-30 cm)

1995
- (132)
- (146)
- (114)

1996
- (181)
- (169)
- (246)

1997
- (224)
- (177)
- (151)

NS
SEDIMENT MOISTURE CONTENT

Percentage By Weight

1995

1996

1997

NS

(11)

(12)

(10)

(14)

(16)

(15)

(15)

(15)
CALCULATION CARBONATE CONTENT
OF SEDIMENTS

Percentage By Weight

1.0
0.8
0.6
0.4
0.2


C N S C N S C N S

(9) (10) (8) (12) (12) (12) (12) (12)

NS
POTENTIAL EFFECTS OF BEACH NOURISHMENT

• Nesting Habitat (Quantity and Quality)
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  – Energy Expenditures During Nesting
  – Spatial Distribution of Nests

• Incubation Environment
  – Reproductive Success
  – Hatchling Fitness and Emergence Patterns
Number of Emergences by Treatment

- Control
- North Treatment
- South Treatment
Treatment Comparison of Emergences

- North Treatment
- South Treatment

Proportion of Emergences

Treatments > Control
Control > Treatments
Number of Nests by Treatment

- Control
- North Treatment
- South Treatment

Number of Nests
Treatment Comparison of Nesting

Proportion of Nests

- North Treatment
- South Treatment

Treatments > Control
Control > Treatments
Nesting Success by Treatment

- Control
- North Treatment
- South Treatment

Nesting Success (Percent) for the years 1981 to 2000.
Treatment Comparison of Nesting Success

Difference in Nesting Success (Percent)

North Treatment
South Treatment

Treatments > Control
Control > Treatments
DISTRIBUTION OF NESTS AMONG SURVEY SECTIONS - 1996

Number of Nests

Beach Width (m)

North Treatment
Control
South Treatment

Beach Width
POTENTIAL EFFECTS OF BEACH NOURISHMENT

- Nesting Habitat (Quantity and Quality)
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- Incubation Environment
  - Reproductive Success
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ENERGY EXPENDITURES DURING NESTING

- Crawl Length
- Scarp Encounters
- Time Required to Excavate Egg Chamber
- Number of Attempts to Construct Nest
- Egg Chamber Construction
Crawl Length

1995

1996

1997

Control North South Control North South Control North South

1995 (N=213)
1996 (N=262)
1997 (N=181)

1996 (N=202)
1996 (N=277)
1997 (N=205)

1997 (N=160)
1997 (N=160)

Crawl Length (m)

NS

NS
Percentage of Treatment Scarped

1995

1996

1997

Control | North | South

Control | North | South

Control | North | South

(N=21)   (N=21)   (N=21)

(N=21)   (N=21)   (N=21)

(N=21)   (N=21)   (N=21)

NS
Scarp Encounters

![Graph showing scarp encounters with data points and error bars for 1995, 1996, and 1997.](image)

Proportion of Crawls vs. Year and Location

<table>
<thead>
<tr>
<th>Year</th>
<th>Control (N=15)</th>
<th>North (N=15)</th>
<th>South (N=13)</th>
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<tbody>
<tr>
<td>1995</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>(N=15)</td>
<td>(N=15)</td>
<td>(N=15)</td>
</tr>
<tr>
<td>1997</td>
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</tbody>
</table>
Time to Dig Egg Chamber

1995

(N=46) Control
(N=48) North
(N=37) South

NS

1996

(N=53) Control
(N=51) North
(N=49) South

1997

(N=62) Control
(N=50) North
(N=42) South

NS
Frequency of Abandoned Digs

1995

NS

1996

NS

1997

(N=15)

(N=13)

(N=15)

(N=13)
Compaction at Nest Sites vs ADA

Compaction (psi)

<table>
<thead>
<tr>
<th>Year</th>
<th>ADA</th>
<th>Nest</th>
</tr>
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<tbody>
<tr>
<td>1995</td>
<td></td>
<td></td>
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<tr>
<td>1996</td>
<td></td>
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<tr>
<td>1997</td>
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- Incubation Environment
  - Reproductive Success
  - Hatchling Fitness and Emergence Patterns
Distance to Dune
Nests vs False Crawls

- False Crawls
- Nests

Distance to Dune (m)

DISTRIBUTION OF NESTS ACROSS BEACH

Distance from Toe of Dune (ft)

Percentage

Control (N=166)
North Treatment (N=117)
South Treatment (N=116)
Old Dune Toe

New Vegetation Line

Nourished Beach

Tide Line
POTENTIAL EFFECTS OF BEACH NOURISHMENT

- Nesting Habitat (Quantity and Quality)
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  - Energy Expenditures During Nesting
  - Spatial Distribution of Nests

- Incubation Environment (Quality)
  - Clutch Depth
  - Nest Fate (Exposure to Disturbance)
  - Reproductive Success
HATCHING SUCCESS INCLUDING WASHED OUT NESTS

Hatching Success (Percent)

1995 NS (78) (96) (76)
1996 NS (150) (118) (103)
1997 NS (163) (117) (106)

C N S C N S C N S
Summary

- Emergence Patterns and Nest Densities
  - No Change in Emergence Patterns
  - No Increase in Nesting
  - Reduction in Nesting Success
- Increase in Beach Width
  - Significantly Longer Crawls
  - Broader Distribution of Nests
  - Habitat Suitability Determined Early in Crawl
Summary (Continued)

- **Compaction**
  - Increased Digging Times
  - Digging Times Reduced by Tilling
  - Increased Number of Abandoned Digs
  - No Effect on Clutch Depth

- **Change in Beach Profile**
  - Altered Dune Horizon
  - Nest Loss and Scarping During Equilibration
Incubation Environment Changed

- Sediments More Compact
- Sediments Coarser With More Shell
- Sediments Darker and Warmer
- Sediments More Moist

Incubation Period Shortened
Summary (Continued)

- **Nest Fate**
  - Fewer Nests Overwashed During Year 1
  - Larger Percentage of Nests Washed Out

- **Reproductive Success**
  - Nourished Beach Did Not Reduce Reproductive Success
RECOMMENDATIONS

- Carefully Evaluate Fill Material for Beach Compatibility
- Assess Feasibility of More Natural Fill Template
- Ensure Adequate Tilling
- Protect Nests On Seaward Portion of Beach
- Identify and Evaluate Feasibility of Alternative Construction Methods (Stockpiling)
- Implement Monitoring Programs That Isolate Effects of Nourishment (Baseline & Control)