THE LIFEBLOOD OF LAGUNA MADRE IS WIND-DRIVEN WATER THROUGH THE INTRACOASTAL CANAL

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Convergence of Longshore Sediment Transport

Modified after E.A. Lohse by R.L. Watson, 1967

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Wind-tidal flats, GIWW, Hole
Quammen and Onuf find that GIWW reduced salinity in Northern Laguna Madre

- Before channel dredging
  - Salinity over 60 ppt in 37 of 112 samples

- After channel dredging
  - Salinity over 60 ppt in 17 of 632 samples
  - 37% of samples to less than 3% of samples
Salinity History, S. Laguna Madre from Quammen and Onuf, 1993
Quammen and Onuf find that GIWW reduced salinity in Southern Laguna Madre

- **Before channel dredging**
  - Salinity over 50 ppt in 29 of 76 samples

- **After channel dredging**
  - Salinity over 50 ppt in 19 of 684 samples
  - 38% of samples to less than 3% of samples
Additional factors reducing salinity in southern Laguna Madre

• Mansfield Pass opened in 1962
• Increased flow from N. Floodway
• Increased sewage outfalls
• Agricultural subsurface drainage
LAND CUT CURRENT VELOCITY, (+ TO NORTH)
FEBRUARY, 1991

Average speed 0.66 ft/sec without regard to direction. Average velocity 0.41 ft/sec to the South for the month.
Average speed 0.54 ft/sec without regard to direction. Average velocity 0.48 ft/sec to the North for the month.
LAND CUT 1991
CURRENT VELOCITY AND WIND VECTOR SQUARED

FLOW VELOCITY ft/sec + to north
CURRENT AND WIND TO NORTH
CURRENT AND WIND TO SOUTH

DATE
30-Jun 15-Jul 30-Jul 14-Aug 29-Aug
<table>
<thead>
<tr>
<th>Month</th>
<th>Avg speed ft/sec</th>
<th>Volume billion cuft/mo</th>
<th>Avg velocity ft/sec</th>
<th>Net vol billion cuft/mo</th>
<th>Net direction</th>
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<tbody>
<tr>
<td>Feb</td>
<td>0.64</td>
<td>2.79</td>
<td>-0.40</td>
<td>-1.92</td>
<td>To south</td>
</tr>
<tr>
<td>May</td>
<td>0.58</td>
<td>2.76</td>
<td>-0.03</td>
<td>-0.16</td>
<td>Spring Transition</td>
</tr>
<tr>
<td>July</td>
<td>0.59</td>
<td>2.8</td>
<td>0.44</td>
<td>2.11</td>
<td>To north</td>
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<tr>
<td>Aug</td>
<td>0.53</td>
<td>2.55</td>
<td>0.47</td>
<td>2.25</td>
<td>To north</td>
</tr>
<tr>
<td>Oct</td>
<td>0.58</td>
<td>2.77</td>
<td>-0.05</td>
<td>-0.23</td>
<td>Fall Transition</td>
</tr>
<tr>
<td>Annual Mo. Avg.</td>
<td>0.60</td>
<td>2.77</td>
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<td></td>
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MONTHLY MEAN SEA LEVEL
TOPO 1948-49, RINCON 1992-93

MONTHLY MEAN WATER LEVEL (NGVD)

RINCON 1992

TOPO 1949

South End of Land Cut
The GIWW improved Laguna Madre

- There had been no connection between northern and southern Laguna Madre
- New dredged channel opened in 1949 was 125 ft wide and 12 ft. deep
- Water can now flow from one end of Laguna Madre to the other
- Salinity can no longer build up to the old killing levels
- Sea grasses can now grow in northern Laguna Madre
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Salinity History, N. Laguna Madre from Quammen and Onuf, 1993

% Deviation from 44 Year Mean Annual Precipitation (+ = Drier, - = Wetter than Mean)

GIWW  *  PMC  *  BEULAH  *  FERN  *  ALLEN

LAND CUT 1991
CURRENT VELOCITY AND WIND VECTOR Squared

FLOW VELOCITY ft/sec + to north

DATE
1-Jan  20-Feb  11-Apr  31-May  20-Jul  8-Sep  28-Oct  17-Dec

CURRENT AND WIND TO NORTH
CURRENT AND WIND TO SOUTH

wind vector, vel squared
-1200 -1000 -800 -600 -400 -200  0  200  400  600
-2.5 -2.0 -1.5 -1.0 -0.5  0.0  0.5  1.0  1.5  2.0

-1 -0.5  0.0  0.5  1.0  1.5  2.0  2.5

-1 -0.5  0.0  0.5  1.0  1.5  2.0  2.5

-1 -0.5  0.0  0.5  1.0  1.5  2.0  2.5

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HOURLY WATER LEVELS
CHANGE FROM 1940’s TO 1990’s
RINCON MINUS TOPO

MORE FREQUENT
Elevations above 1.5 ft.
NGVD less frequently flooded

LESS FREQUENT

CHANGE IN PERCENT AFTER CHANNELIZATION

TOP OF EACH 0.25 FT HEIGHT CLASS

South End of Land Cut
HOURLY WATER LEVELS
PERCENT OF LEVEL IN EACH HEIGHT CLASS

PERCENT OF HOURLY OBSERVATIONS

RINCON 1990'S

TOPO 1940'S

TOP OF EACH 0.25 FT HEIGHT CLASS

South End of Land Cut
Manning Equation for open channel flow

\[ V = \frac{k}{n} R_{h}^{2/3} S^{1/2} \]

Hydraulic radius

\[ R_{h} = \frac{A}{P} \]

- V is the cross-sectional average velocity (ft/sec)
- K is a constant equal to 1.49 for US units
- n is the Manning friction coefficient
- S is the slope
- A is the cross-sectional area of the channel
- P is the wetted perimeter of the channel (the length of the bottom and sides)
- \( R_{h} \) is the hydraulic radius (ft) = 1788/179 = 9.99
MONTHLY MEAN SEA LEVEL
TOPO-COYOTE 48-49, RINC.-YARB. 92-93

MONTHLY MEAN WATER LEVEL (NGVD)

ICWW OPENS JUNE 1949

MONTH OF THE YEAR

TOPO COYOTE RINCON YARB
Flats vehicle
Figure 21. Principal elements within the South Texas eolian system, Kingsville and Brownsville-Harlingen areas.
1991 Land Cut Current

Average speed 0.60 ft/sec without regard to direction. Average velocity 0.03 ft/sec to the south for the year.

To North

To South
LAND CUT CURRENT VELOCITY (+ TO NORTH)
Oct, 1991

Average speed 0.59 ft/sec without regard to direction. Average velocity 0.04 ft/sec to the South for the month.

To north
To South
Water level gauge and PBS&J Data Locations