Ecology on the Move
Using Wood Stork Movement to Enhance Conservation Efforts

Mathieu Basille, University of Florida
Wood Storks
Wood Stork in the Southeastern US
Wood Stork in the Southeastern US
Wood Stork in the Southeastern US
Wood Stork Project

Fort Lauderdale
Research & Education Center

James Watling
Allison Benscoter
David Bucklin
Frank Mazzotti
Carolina Speroterra

Rena Borkhataria

Threatened & endangered (T&E) species

Laura Brandt
Stephanie Romañach

UF
USGS
Wood Stork Monitoring

- 115 individuals
- Argos/GPS tags: one location every 1 or 2 hours
- ~1 million locations
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling
Spatio-temporal Scaling

Movement step
Spatio-temporal Scaling

Movement step

[Diagram showing a timeline with points at 2PM, 3PM, 4PM, 5PM, 6PM, 7PM, and 8PM with an arrow indicating movement from 4PM to 5PM.]
Spatio-temporal Scaling

Movement step
Spatio-temporal Scaling

Movement step

[Diagram showing time points from 2 PM to 8 PM with 'traveling' marked between 3 PM and 5 PM]
Spatio-temporal Scaling

Movement step
Spatio-temporal Scaling

Movement step

traveling

foraging
Spatio-temporal Scaling

Movement step

Movement modes

traveling
foraging
Spatio-temporal Scaling

Movement step

Movement modes

2PM 3PM 4PM 5PM 6PM 7PM 8PM

traveling
foraging

birth
dead
Spatio-temporal Scaling

Movement step:
- 2PM
- 3PM
- 4PM
- 5PM
- 6PM
- 7PM
- 8PM

Movement modes:
- Traveling
- Foraging

Lifetime track:
- Birth
- Death
Spatio-temporal Scaling

Movement step

Movement modes

Lifetime track

Mechanisms of geographical distribution
Movement Ecology Framework
Movement Ecology Framework

HOW
Movement Ecology Framework

WHY

HOW
Movement Ecology Framework

WHY

HOW

WHEN & WHERE
Movement Ecology Framework

- Why
- Consequences
- When & Where
- How
Movement Ecology Framework

WHY

CONSEQUENCES

WHEN & WHERE
Behavioral movement modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes

[Map of Florida with routes marked]

[Graph with labeled points for Foraging and Commuting]

1 km
Stork Movement Modes

[Diagram showing movement patterns of storks with annotations for foraging and commuting]
Stork Movement Modes

[Diagram showing movement patterns of storks with labels for 'Foraging' and 'Commuting']
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes

[Diagram showing movement patterns of storks with labels for foraging and commuting.]
Stork Movement Modes

1 km

Foraging

Commuting

Commuting

Foraging
Stork Movement Modes

[Map depicting Stork movement modes with labeled areas for 'Foraging' and 'Commuting']
Stork Movement Modes
Stork Movement Modes

10 km

Foraging

Commuting
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes
Stork Movement Modes

- Migrating
- Traveling
- Foraging
- Commuting
Identifying the Modes
Identifying the Modes

- Foraging
- Commuting
- Traveling
- Migrating
Identifying the Modes

- Foraging
- Commuting
- Traveling
- Migrating
Identifying the Modes

- Foraging
- Commuting
- Traveling
- Migrating
Characterizing the Modes

![Graph showing density of speeds for different modes]

**Modes**
- Foraging
- Commuting
- Traveling
- Migrating

**Speed (m/h, log scale)**
Characterizing the Modes

Density

Latitudinal displacement (km, log scale)

Modes
- Foraging
- Commuting
- Traveling
- Migrating
Characterizing the Modes

Modes:
- Foraging
- Commuting
- Traveling
- Migrating

Density vs. Linearity (ratio)
**Predicting the Modes**

<table>
<thead>
<tr>
<th>Pred \ Obs (%)</th>
<th>Foraging</th>
<th>Commuting</th>
<th>Traveling</th>
<th>Migrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foraging</td>
<td>98</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Commuting</td>
<td>8</td>
<td>90</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Traveling</td>
<td>0</td>
<td>8</td>
<td>90</td>
<td>2</td>
</tr>
<tr>
<td>Migrating</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>91</td>
</tr>
</tbody>
</table>
## Predicting the Modes

<table>
<thead>
<tr>
<th>Pred \ Obs (%)</th>
<th>Foraging</th>
<th>Commuting</th>
<th>Traveling</th>
<th>Migrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foraging</td>
<td>98</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Commuting</td>
<td>8</td>
<td>90</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Traveling</td>
<td>0</td>
<td>8</td>
<td>90</td>
<td>2</td>
</tr>
<tr>
<td>Migrating</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>91</td>
</tr>
</tbody>
</table>

The pie chart shows the distribution of modes: Foraging, Commuting, Traveling, and Migrating. The percentages are as follows:
- Foraging: 98%
- Commuting: 90%
- Traveling: 90%
- Migrating: 91%

These percentages indicate that the primary mode is Commuting, followed closely by Traveling, with Foraging and Migrating having slightly lower but significant percentages.
Migration
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Habitat Selection along the Path

Land-cover type
- Wetland
- Agriculture
- Shrub
- Developed
Northward and Southward Migrations

Spring migration

Fall migration
Northward and Southward Migrations

Spring migration

Fall migration
Northward and Southward Migrations

Emergent wetlands
Woody wetlands
Agriculture
Grass
Shrub
Developed

Relative preference

Emergent wetlands
Agriculture
Woody wetlands
Shrub
Grass
Developed

Relative preference

Precipitation
Temperature

Avoidance

Spring migration

Precipitation
Temperature

Avoidance

Fall migration
Northward and Southward Migrations

Spring migration

Fall migration
Northward and Southward Migrations

- Spring migration
- Fall migration

Relative preference

Avoidance

Precipitation
Temperature
Northward and Southward Migrations

- Spring migration
- Fall migration

Relative preference

Avoidance

Precipitation

Temperature

Emergent wetlands
Woody wetlands
Agriculture
Grass
Shrub
Developed

Relative preference

Avoidance

Preference

Precipitation

Temperature
Migration Corridors

Spring
Summary

- Why
- Consequences
- When & Where
Summary

Suitable conditions for nesting

WHY

CONSEQUENCES

WHEN & WHERE
Summary

**WHY**

- Suitable conditions for nesting

**CONSEQUENCES**

- Migration corridors + developed areas

**WHEN & WHERE**

- Selection for temperature and wetlands
Thank you!