Background

- Reproductive success and survivorship limited by:
  - Time of arrival onto breeding grounds
  - Body condition upon arrival
  - Mortality during migration

- Factors effecting migration
  - Weather patterns
  - Habitat suitability at stopover sites
  - Predation
  - Competition

- All of which influence energy reserves and water balance
Is Water Important During Migration?

- Past research on water balance focus on the extremes (i.e. Sahara desert, ocean)
  - Lean birds were more dehydrated than fat birds (Bairlein and Totzke 1992)
  - Flight duration is restricted by dehydration (Carmi et al. 1992)
- Few studies have focused on the role of surface water
- Anecdotal evidence suggests that desert water developments attract large numbers of birds
Water Developments

- Water defined as apron-catchments or wind-powered wells
- Self-contained
- Provide year round water
- Water is accessible to birds by ramps
- Do not provide water to the surrounding plant community
Hypothesis:

Wildlife waters provide more suitable stopover habitat for migrants in need of water

- Bird abundance and species richness will be higher at watered sites
- Birds at watered sites will have lower fat reserves
- Males will have higher fat content than females, thus more females will be found at the watered sites
- Bird migration will correlate with flower phenology
Objectives:

1. Quantify use of wildlife waters during spring and fall migrations
   - Direct Observations
   - Video Cameras

2. Compare use of sites with water versus those without water by migratory birds
   - Line Transects

3. Compare mean differences in body condition and sex between sites
   - Mist Netting
Study Area
Southwestern Arizona

Objective #1:
Observations
1. Kofa National Wildlife Refuge
2. BLM lands
Cameras
1. Yuma Proving Grounds

Objective #2:
Line Transects
1. Kofa National Wildlife Refuge
2. BLM lands

Objective #3:
Mist Nets
1. Kofa National Wildlife Refuge
Methods and Results
#1: Quantify Water Use

## Methods

1. **Direct Observations**
   - Three Sites: Kofa N.W.R and adjacent BLM
   - Spring: 6 April – 11 May
   - Conducted between 0530 – 1030

2. **Video Cameras**
   - Two Sites: YPG
   - Spring: April – May
   - Fall: August – November
   - Operate 14 hrs/day for 5 days/week
## Results: Migrant Water Use

<table>
<thead>
<tr>
<th>Method</th>
<th>Days</th>
<th>Hours</th>
<th>Species Richness</th>
<th>Species</th>
<th>Richness</th>
<th>Visits</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Observation</td>
<td>17</td>
<td>40</td>
<td>21</td>
<td>Resident</td>
<td>15</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Migrant</td>
<td>6</td>
<td>18</td>
<td>n/a</td>
</tr>
<tr>
<td>Video</td>
<td>28</td>
<td>400</td>
<td>24</td>
<td>Resident</td>
<td>19</td>
<td>8881</td>
<td>99.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Migrant</td>
<td>5</td>
<td>46</td>
<td>0.6</td>
</tr>
</tbody>
</table>

*a* data pooled from three sites  
*b* data from one site only
# Results: Migrant Water Use

<table>
<thead>
<tr>
<th>Video</th>
<th>Direct Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lazuli Bunting</td>
<td>Lazuli Bunting</td>
</tr>
<tr>
<td>Yellow-rumped Warbler</td>
<td>Yellow-rumped Warbler</td>
</tr>
<tr>
<td>Western Tanager</td>
<td>Western Tanager</td>
</tr>
<tr>
<td>Bullock’s Oriole</td>
<td>MacGillivary’s Warbler</td>
</tr>
<tr>
<td>Black-headed Grosbeak</td>
<td>Orange-crowned Warbler</td>
</tr>
<tr>
<td></td>
<td>Western Flycatcher</td>
</tr>
</tbody>
</table>
#2: Compare Use Between Sites

Methods: Line Transect Surveys

- Three sites
  1. New Water Well (KNWR)
  2. Scott’s Well (KNWR)
  3. Well # 967 (BLM)

- 9 April – 18 May

- 6 surveys conducted between 0530-0930

- Used distance sampling
#2: Compare Use Between Sites

- Paired design – no water versus water
- Water located within 50 m of dry wash
- Transects run perpendicular to wash
- Control site a minimum of 1 km from treatment
- Pairs surveyed simultaneously

![Diagram showing comparison between watered and unwatered sites.](image)
Results: Relative Abundance

All Migrants

Did not detect differences in relative abundance between sites
Results: Species Richness

Did not detect differences in species richness between sites
#3: Compare sex differences and fat reserves between sites

**Methods: Mist nets**

- Two stations at one paired site
  - Kofa N.W.R.

- 2 days / week between 27 March to 15 May

- 10 standard 12 m mist nets / station

- Located within 250 m of water
#3: Compare sex differences and fat reserves between sites

- Subcutaneous fat in the furculum scored using a scale from 0-6 (Helms and Drury 1960).

<table>
<thead>
<tr>
<th>Fat Scores</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>No fat</td>
</tr>
<tr>
<td>1</td>
<td>Trace</td>
</tr>
<tr>
<td>2</td>
<td>1/3 full</td>
</tr>
<tr>
<td>3</td>
<td>Half full</td>
</tr>
<tr>
<td>4</td>
<td>2/3 full</td>
</tr>
<tr>
<td>5</td>
<td>Full</td>
</tr>
<tr>
<td>6</td>
<td>Bulging</td>
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</tbody>
</table>
## Results:

**Mist Net Summary**

<table>
<thead>
<tr>
<th></th>
<th>Wet</th>
<th>Dry</th>
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</thead>
<tbody>
<tr>
<td>Days</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Net Hours</td>
<td>69.3</td>
<td>70.4</td>
</tr>
<tr>
<td>Total Captures</td>
<td>296</td>
<td>360</td>
</tr>
<tr>
<td>Migrants</td>
<td>74%</td>
<td>81%</td>
</tr>
<tr>
<td>Richness</td>
<td>18</td>
<td>21</td>
</tr>
</tbody>
</table>
Results: Sex Differences

Did not detect differences in numbers of males and females between sites
Results: Fat Reserves

No Significant Differences
Chi-Square = 0.51
P-value 0.05

![Bar chart showing percentage of all captures for wet and dry conditions across different fat scores.](Image)
Conclusion:

- Few migrants observed drinking water
- No significant differences in relative abundance
- No significant differences in species richness
- No significant differences between sex or fat scores
Resident Species Using Water

Data does suggest heavy use by resident birds

- Mourning Dove
- White-winged Dove
- Gambel’s Quail
- Red-tailed Hawk
- Turkey Vulture
- Elf Owl
- Common Raven
- Gila Woodpecker
- Great-Horned Owl
- Cactus Wren
- Loggerheaded Shrike
- Phainopepla
- Ash-throated Flycatcher
- Great-tailed Grackle
- Hummingbird species
- Scott’s Oriole
- Say’s Phoebe
- Black-tailed Gnatcatcher
Conclusion:

Scale Dependent?

Vegetation Cues?
Acknowledgements

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