Birds, water, and saltcedar: strategies for riparian restoration in the Colorado River Delta
Riparian Restoration in Western NA

• Loss of riparian and wetland areas

• More critical in the Sonoran Desert

• Population declines in at least 30 riparian dependant birds
Riparian Restoration in Western NA

• How do bird populations respond to pulse floods and regeneration events?

• Which strategies are best to enhance bird habitats in riparian areas?
Habitat Changes in the Colorado River Delta

- Dams and Water Diversions: Reduction of flows
- Agricultural Expansion
- 80% reduction in wetland area
Colorado River Flows to the Delta (Mx)

Glenn Canyon Dam

17 years of no flows
Recognition of the Colorado River Delta

- Ramsar Site
- Biosphere Reserve
  - Federal Recognition in Mexico
  - UN Man and the Biosphere Program
- Western Hemisphere Shorebirds Reserve Network
- AICA / Important Bird Area
- CONABIO Priority Conservation Site
- Conservation Priority in the Gulf of California
The Birds of the Colorado River Delta

A total of 368 species have been documented in the Colorado River Delta region (19 new records in the last 6 years)

350,000 wintering shorebirds

+50,000 wintering waterfowl
The Birds of the Colorado River Delta

Two Endangered Species: California Black Rail, Bald Eagle, and Southwestern Willow Flycatcher (Ex)

Six Threatened Species: Yuma Clapper Rail, Snowy Plover, Black Storm-Petrel

Sixteen species Under Special Protection: Least Tern, Large-billed Savannah Sparrow, Virginia Rail, Peregrine Falcon
Changes in the Avifauna

Most changes on riparian dependant species, including those that require mature cottonwood-willow forest or mature mesquite forest

Extirpations of breeding species, but also of wintering species

Reduction on the abundance of wintering waterfowl
Changes in the Avifauna

8 Extirpated species:

Former Breeders
• Willow Flycatcher
• Summer Tanager
• Lucy’s Warbler
• Yellow Warbler
• Gilded Flicker
• Fulvous-whistling Duck

Wintering Species
• Sandhill Crane
• Roseate Spoonbill
Different Projects

• Status of riparian birds and relationship with habitat features

• Landbird migration through the Colorado River Delta (El Doctor)

• Winter ecology of migrant landbirds

• Status and trends of marshbirds

• Status and trends of shorebirds
Landbird Migration: Objectives

Assess the use of El Doctor by migratory landbirds

• Long-term monitoring site of bird migration

• Habitat conservation and restoration

• Summary of results and conservation implications
El Doctor Wetlands

- Maintained by freshwater springs along the Gran Desierto escarpment
- 350 ha of marshlands, mesquite and saltcedar areas
- Core zone of the Upper Gulf of California and Colorado River Delta Biosphere Reserve
Methods

Mist-netting

• 6 standard nets (12 m X 3.6 m, 36 mm mesh size)
• Operated 3 days in every 10-d period, 5 hours
• 30 net –hours per day, 90 net-hours per period
• From March 10 to June 10 (9 periods – 810 net hours per year)
• 4 years: 2002-2005
Methods

Bird Processing
• Banded with USGS aluminum bands
• Determine sex, age, fat levels, weight, molts, feather condition, breeding condition, skull ossification, and wing chord
• Wing morphology, tail length and bill measurements for *Empidonax* flycatchers
Results

• Data to understand patterns of migration through the Sonoran coast

• Document the importance of stopover sites along the Colorado River delta

• Contribute to the understanding of migratory routes on western NA
Results

• 4,704 birds captured and processed during all years

• 73 species

• Average capture rate: 1.74 birds per net-hour

• Maximum number of birds per day: 284 birds on May 8, 2003
## Results

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Captures</th>
<th>Net hours</th>
<th>Birds PNH</th>
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<tbody>
<tr>
<td>2002</td>
<td>597</td>
<td>456.45</td>
<td>1.31</td>
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<tr>
<td>2003</td>
<td>1601</td>
<td>735.00</td>
<td>2.18</td>
</tr>
<tr>
<td>2004</td>
<td>1265</td>
<td>804.67</td>
<td>1.57</td>
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<tr>
<td>2005</td>
<td>1241</td>
<td>648.00</td>
<td>1.92</td>
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</table>
Common migrants through El Doctor

![Bar chart showing bird migration data]

- WWA: 1200
- SWTH: 800

Images of birds: Yellow warbler and Ovenbird.
Common migrants through El Doctor

- WIWA
- SWTH
- WEFL
- YWAR
- WAM
- WETA
- WFL
Common migrants through El Doctor
Recaptures

- Only 13% of recaptures

Of those:

<table>
<thead>
<tr>
<th>Recapture Period</th>
<th>Percent of Recaptures</th>
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<tr>
<td>0 d</td>
<td>65%</td>
</tr>
<tr>
<td>1 d</td>
<td>16%</td>
</tr>
<tr>
<td>2 d</td>
<td>4%</td>
</tr>
<tr>
<td>3 d</td>
<td>5%</td>
</tr>
<tr>
<td>&gt; 3 d</td>
<td>10%</td>
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</table>
## Fat levels

<table>
<thead>
<tr>
<th>Fat Level</th>
<th>Fat % in Furculum</th>
<th>% of Birds</th>
<th>Accumulative Percentile</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>16.10</td>
<td>16.10</td>
</tr>
<tr>
<td>1</td>
<td>1% - 5%</td>
<td>38.53</td>
<td>54.62</td>
</tr>
<tr>
<td>2</td>
<td>5% - 30%</td>
<td>24.83</td>
<td>79.45</td>
</tr>
<tr>
<td>3</td>
<td>30% - 60%</td>
<td>14.21</td>
<td>93.66</td>
</tr>
<tr>
<td>4</td>
<td>60% - 100%</td>
<td>5.82</td>
<td>99.49</td>
</tr>
<tr>
<td>5</td>
<td>&gt;100%</td>
<td>0.51</td>
<td>100.00</td>
</tr>
<tr>
<td>6</td>
<td>&gt;&gt;100%</td>
<td>0.00</td>
<td>100.00</td>
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## Fat levels

<table>
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<tr>
<th>Species</th>
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<th>Fat &lt; 30%</th>
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<tr>
<td>SWTH</td>
<td>8.21</td>
<td>42.31</td>
<td>81.34</td>
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<tr>
<td>WEFL</td>
<td>23.89</td>
<td>60.32</td>
<td>79.14</td>
</tr>
<tr>
<td>WIWA</td>
<td>16.25</td>
<td>56.45</td>
<td>75.00</td>
</tr>
<tr>
<td>WIFL</td>
<td>25.34</td>
<td>81.81</td>
<td>95.45</td>
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<tr>
<td>WETA</td>
<td>5.87</td>
<td>38.23</td>
<td>76.47</td>
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<tr>
<td>YWAR</td>
<td>20.68</td>
<td>63.11</td>
<td>79.56</td>
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<tr>
<td>WAVI</td>
<td>12.44</td>
<td>40.12</td>
<td>69.23</td>
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<tr>
<td>All</td>
<td>16.10</td>
<td>54.62</td>
<td>79.46</td>
</tr>
</tbody>
</table>
El Doctor: stopover site

- Birds arrive with low reserves: probably after a long night flight

- Birds stay at El Doctor for a short period of time, and keep migrating north

- El Doctor might play a critical role as a stopover site, providing resting sites, fresh water, and food

- Further research is required to determine patterns of migration along the coast of Sonora and the activities of migrant birds at El Doctor
El Doctor: threats and conservation opportunities
El Doctor: conservation

• Biosphere Reserve: but impact of cattle grazing
• Depletion of groundwater table by pumping in the region
• Low recruitment of native trees

Conservation measures in the area include:
• Exclusion of cattle by fencing
• Reforestation: mesquite
• Establishment of Conservation Easements with landowners to secure the long-term conservation of the area
Next steps…

• Long-term banding at El Doctor: use captures per year as an abundance index to monitor population trends

• Monitor migration across habitat types in the Colorado River delta region: saltcedar/mesquite/cottonwood-willow

• Establish migration monitoring sites along the Sonoran coast

• Conservation and restoration activities at El Doctor

• Develop and implement conservation strategies for key stopover sites across the Sonoran Desert
Winter Ecology: Objectives

• Evaluate habitat relationships and monitor trends of wintering songbirds in the Colorado River delta, Mexico, conducting variable distance point counts.

• Estimate winter survival and population demographics following the MoSI protocol.
Bird banding


• 5 monthly pulses, November trough March

• 4 sites, 2 on mesquite/marsh habitat, 2 on riparian habitat (cottonwood - willow).

• 16 (12m) nets (36 mm mesh) on 20 ha plot

• Operated 15 min before sunrise until 17:00 hr.

• Conducted searches for color-banded individuals
Banded Birds

- 21 species of wintering landbirds have been banded in the Colorado River delta

<table>
<thead>
<tr>
<th>Especies</th>
<th>% capturas</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Regulus calendula</em> - RCKI</td>
<td>14.9</td>
</tr>
<tr>
<td><em>Vermivora celata</em> - OCWA</td>
<td>13.9</td>
</tr>
<tr>
<td><em>Dendroica coronata</em> - YRWA</td>
<td>13.2</td>
</tr>
<tr>
<td><em>Melospiza lincolnii</em> - LISP</td>
<td>7.7</td>
</tr>
</tbody>
</table>
Wintering Landbirds

Based on the results:

At least 21 riparian songbirds are winter residents in the Colorado River Delta region.

However, birds are not ‘residents’ and do not establish territories in a particular riparian patch (10-20 ha), and move through the region during winter.

• Low recapture estimates/low p of recap history
• High estimates of proportion of transients
Riparian Birds: Objectives

• Patterns of bird densities and species richness

• Relationships with habitat and land cover features
Objectives

• Habitat value of cottonwood-willow versus saltcedar sites

• Identify restoration guidelines
Patterns of Richness and Densities

• 30 transects along the Colorado River floodplain, 240 variable distance point counts (5 min)

• Measurement of habitat features

• Monthly surveys, May 2002 – July 2003
Second phase: Habitat value of Native vs Saltcedar sites

- Bird and habitat surveys at 175 randomly selected plots

- Visited 3 times during the breeding season (May-July), 2003 and 2004
Value of Native vs Saltcedar

• All sites with >50% vegetation cover
• Wet sites with >5% surface water (<30%)
• Dry sites >400 m away from surface water
• Native sites with >15% cover of cottonwoods and/or willows
• Saltcedar sites with >30% cover of saltcedar and no willows, cottonwoods, and/or mesquite
Habitat Features in the Floodplain of the Colorado River in Mexico
Percent cover by species within the Tree stratum in the Floodplain of the Colorado River in Mexico

- Willow: 20%
- Cottonwood: 6%
- Honey Mesquite: 1%
- Screwbean Mesquite: 3%
- Saltcedar: 70%
Floodplain of the Colorado River

A total of 109,287 bird records; 186 species

<table>
<thead>
<tr>
<th>Summary of Bird Data</th>
<th>Per Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Records</td>
<td>29.21 (± 1.20)</td>
</tr>
<tr>
<td>Number of Species</td>
<td>8.58 (± 0.16)</td>
</tr>
<tr>
<td>Density per Ha</td>
<td>47.67 (± 7.01)</td>
</tr>
</tbody>
</table>
The Floodplain of the Colorado River

Most common birds

- Mourning Dove
- Brown-headed Cowbird
- Red-winged Blackbird

41% of all records
Current Status of Birds in the Delta

64 species were common in the floodplain (>10 records per visit):

• Abert’s Towhee
• Song Sparrow
• Blue Grosbeak
• Crissal Thrasher
• Verdin
• Black-tailed Gnatcatcher
• Gila Woodpecker
• Ladder-backed Woodpecker
• Ash-throated Flycatcher
• Common Yellowthroat
Species that declined, but are now common:

- Vermillion Flycatcher
- Clapper Rail
- Least Bittern
- Cinnamon Teal
- Yellow Breasted Chat
Current Status of Birds in the Delta

Species that declined (extirpated), but are recuperating:

- Yellow-billed Cuckoo
- Lesser Goldfinch
- Bell’s Vireo
- Osprey
Which habitat features explain avian richness?

- Cover (ha) of surface water, regardless of vegetation type

Adjusted $r^2 = 0.45$, $p < 0.001$, $F_{1,28} = 24.83$

<table>
<thead>
<tr>
<th>Effect</th>
<th>Coeff</th>
<th>SE</th>
<th>Std C</th>
<th>Tol</th>
<th>t</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>Constant</td>
<td>20.74</td>
<td>1.34</td>
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<td>.</td>
<td>15.49</td>
<td>&lt; 0.001</td>
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<tr>
<td>Water</td>
<td>0.84</td>
<td>0.17</td>
<td>0.67</td>
<td>1.00</td>
<td>4.98</td>
<td>&lt; 0.001</td>
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</table>
Which habitat features explain avian richness during the breeding season?

- Surface water
- Cottonwoods

Adjusted $r^2 = 0.53$, $p < 0.001$, $F_{2,27} = 17.40$

<table>
<thead>
<tr>
<th>Effect</th>
<th>Coeff</th>
<th>SE</th>
<th>Std C</th>
<th>Tol</th>
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<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>19.89</td>
<td>1.07</td>
<td>0</td>
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<td>18.55</td>
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<tr>
<td>Water</td>
<td>0.63</td>
<td>0.12</td>
<td>0.65</td>
<td>0.99</td>
<td>5.09</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Cottonwoods</td>
<td>0.32</td>
<td>0.13</td>
<td>0.32</td>
<td>0.99</td>
<td>2.49</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Which habitat features explain avian densities?

- Surface water
- Screwbean mesquites

Adjusted $r^2 = 0.28$, $p = 0.005$, $F_{2,27} = 6.63$

<table>
<thead>
<tr>
<th>Effect</th>
<th>Coeff</th>
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<th>Std C</th>
<th>Tol</th>
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<th>P</th>
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<tbody>
<tr>
<td>Constant</td>
<td>22.50</td>
<td>9.38</td>
<td>0</td>
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<td>2.40</td>
<td>0.02</td>
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<td>Water</td>
<td>2.74</td>
<td>1.07</td>
<td>0.41</td>
<td>0.98</td>
<td>2.57</td>
<td>0.02</td>
</tr>
<tr>
<td>Sc. Mesquite</td>
<td>4.21</td>
<td>1.45</td>
<td>0.46</td>
<td>0.98</td>
<td>2.90</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Which habitat features explain avian densities during the breeding season?

- Surface water
- Willows

Adjusted $r^2 = 0.31$, $p = 0.003$, $F_{2,27} = 7.49$

<table>
<thead>
<tr>
<th>Effect</th>
<th>Coeff</th>
<th>SE</th>
<th>Std C</th>
<th>Tol</th>
<th>t</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>Constant</td>
<td>9.75</td>
<td>7.50</td>
<td>0</td>
<td>.</td>
<td>1.30</td>
<td>0.2</td>
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<tr>
<td>Water</td>
<td>1.84</td>
<td>0.73</td>
<td>0.39</td>
<td>1.00</td>
<td>2.54</td>
<td>0.02</td>
</tr>
<tr>
<td>Willows</td>
<td>1.83</td>
<td>0.61</td>
<td>0.47</td>
<td>1.00</td>
<td>3.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Corroboration of habitat characteristics in the 4 habitat groups: NW, ND, SW, SD

No difference in vegetation cover
74% (± 1.03); $F_{3,171} = 0.27, P = 0.88$

No difference in cover by trees
32% (± 1.32); $F_{3,171} = 1.65, P = 0.18$

No difference in water cover at the wet sites
10% (± 0.72); Turkey-Kramer $P = 0.36$
$F_{3,171} = 18.97, P < 0.001$
$F_{3,171} = 22.86, P < 0.001$
$F_{3,171} = 23.89, P < 0.001$
Birds of the Colorado River in Mexico

• The presence of water determines ecological value

• Diversity: more influenced by surface water

• Abundance:
  • Wet sites > Dry sites
  • Saltcedar Wet ≈ Native Dry
Birds of the Colorado River in Mexico

- Restoration ≠ eradication of saltcedar
- Enhance riparian bird habitats: increase surface water
- Additional effects: regeneration of native trees, even in the presence of saltcedar
Initiative for the Restoration of the Colorado River Delta

- Legal Protection of Natural Areas
- Participative Management Plan
- WATER
Conservation Measures

- Secure water sources for the Colorado River: voluntary, market-based process

- Establish legal strategies and community-based initiatives for the protection of the floodplain

- Restore cottonwood-willow and mesquite areas in the floodplain