A Landscape-Scale Restoration Experiment:
The 2014 spring flood flow release to the Colorado River Delta, Mexico

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Historic Delta

Photo source: IBWC
Colorado River Flow at U.S. - Mexico Border 1878-2009

- Treaty obligation
- Colorado River Compact Signed
- Treaty with Mexico Signed
- Glen Canyon Dam Completion
- Hoover Dam Completion
- Pulse flow
Colorado River Water Use

~75% Agriculture

~25% Cities

“Law of the River” and 1944 international treaty

USA: 15 million acre-feet per year (maf)
Mexico: 1.5 maf per year

A river in deficit:
Total allocated: 16.5 maf per year
1,000 yr average: 14.5 maf per year

Future:
• 10-20% less supply – climate change
• Increased demand – population growth

Environmental impact?
Water for Nature?
Minute 319

- 5-year agreement signed in November 2012 by US and Mexico
- Establishes new guidelines for the management of Colorado River water during times of drought and promotes investments in water conservation projects
- Water dedicated for ecological flows to the Colorado River in Mexico for the 1st time in history
- Total water to be dedicated to Delta: 158,088 acre-feet (af)
- Delta Water Trust to provide 52,700 af for river base flow; 105,400 af provided by US and MX for flood pulse flow
- NGO goal is to restore 2300 acres of habitat by end of 5-year term
- At end of 5-year term, US and MX will determine if/how to expand commitments
Primary Lower Colorado Water Diversions

Minute 319 Pulse Flow
Yuma Mesa Irrigation and Drainage District
Welton-Mohawk Irrigation District
Yuma County Water Users Association
Southern Nevada Water Authority
Coachella Valley Water District
Colorado River Indian Reservation
Palo Verde Irrigation District
Metropolitan Water District
Mexico
Central Arizona Project
Imperial Irrigation District

One-time allocation

Annual allocations

Thousands of acre feet

0  500  1,000  1,500  2,000  2,500  3,000

ag
municipal
environmental
Min. 319, Section 6 (c): “As part of this pilot program, resources for joint investigation of the different aspects of the pilot program should be obtained. The resources for this investigation should be provided by the United States and Mexico. This investigation should:

i. “evaluate the performance of the pilot program, its success in creating water for the environment, the environmental benefits derived therefrom.”

ii. “test the mechanisms for the allotment and delivery of water to the Riparian Corridor in the reach between Morelos Dam and the Hardy River confluence,”

iii. “evaluate the ecosystem response, most importantly the hydrological response and, secondarily, the biological response.”
15 streamflow discharge stations
100 piezometers (groundwater)
29 staff gauges w/ transducers
Geophysical methods
LiDAR data collection
Satellite imagery
Aerial imagery

Topographic surveys
Inundation mapping
Vegetation surveys and mapping
Water quality sampling
Fish and shrimp postlarvae surveys
Avian surveys
Repeat photography
Minute 319 Pulse Flow
130 million cubic meters, March 23-May 18, 2014
A 60 second tour of the pulse flow

Thanks to Dale Turner, The Nature Conservancy
Pulse Flow
March 23 – May 18 2014

Water ordered

Water delivered

Km 27

Km 18 delivery

m³/sec

23-Mar-14 30-Mar-14 6-Apr-14 13-Apr-14 20-Apr-14 27-Apr-14 4-May-14 11-May-14 18-May-14
Percent of pulse flow remaining as surface flow

Morelos Dam
102mcm

River Km below Morelos Dam

Percent volume of original pulse flow

Km 27
21 mcm

DMS-6

Km 18
9 mcm

DMS-11

DMS-7
DMS-8
DMS-10

DMS-12

DMS-15

Jorge Ramirez
UABC
Landsat – based Inundation Maps
Reach 3

Jeff Milliken, USBR
Steve Nelson, M319 Science team

Draft maps and area statistics complete.

Reach 3 - Inundated Area
March 8 - May 27, 2014

Square Meters
Vegetation Monitoring:

21 seedling transects co-located with groundwater wells

- Transects perpendicular to the channel to capture the range of topographic surfaces present
- Seed dispersal timing and abundance
- Pre- and post-pulse vegetation
- Seedling locations and densities
- Pre- and post-pulse topography
- Pre- and post-pulse sediment texture and salinity

Vegetation surveys in restoration sites

- Randomly distributed nested plot sampling design within different restoration treatments
- Assess seedling establishment and growth in different restoration treatments (i.e. nonnative species removal, inundation with the pulse flow, planting, irrigation).
- Measurement of variables that affect seedling recruitment and growth:
  - Groundwater levels, sediment deposition, seed source locations and phenology, soil moisture, salinity, and texture, ground cover, canopy closure
Preliminary Results:

<table>
<thead>
<tr>
<th>Germinant Zone Description</th>
<th>No. of transects</th>
<th>Reaches where present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any type of species germinant present</td>
<td>15</td>
<td>1-4</td>
</tr>
<tr>
<td>Mix of native &amp; tamarisk germinant zones</td>
<td>6</td>
<td>1, 2, 4</td>
</tr>
<tr>
<td>Native species germinant only zones</td>
<td>2</td>
<td>1 &amp; 4</td>
</tr>
<tr>
<td>Tamarisk germinant only zones</td>
<td>13</td>
<td>1-4</td>
</tr>
</tbody>
</table>

Ex. of germinant zone distances along transects:

- Transect 1-3: 11.2m mixed; 13.9m tamarisk
- Transect 1-2: 65.9m mixed; 3.6m native; 3.4m tamarisk
- Transect 4-6: 9.4m mixed; 6.5m native
Social impact: Community Support
The pulse flow successfully reached the entire river downstream of Morelos Dam, including sections of the river that were prepared for restoration. Restoration work in these sites continues under the auspices of the Sonoran Institute and Pronatura Noroeste.

The pulse flow reached the Gulf of California on May 15, 2014.

Groundwater levels rose as a result of the pulse flow.

Both native and non-native vegetation germinated after the pulse flow.

Base flows are being delivered by the Delta Water Trust.

Monitoring of seedlings, groundwater, existing vegetation and wildlife (birds) will continue at regular intervals through 2017. Remote-sensing work also continues.