“Insidious and Stealthy Water Thieves of Texas: Factors Affecting Water Supply, Environmental Flows and Ecosystem Services”

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Texas Watershed Coordinators January 2016
Insidious

• a : awaiting a chance to entrap : treacherous
• b : harmful but enticing : seductive

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• a : having a gradual and cumulative effect :
• b of a disease : developing so gradually as to be well established before becoming apparent

Stealthy

• behaving, done, or made in a cautious and surreptitious manner, so as not to be seen or heard.
• synonyms: furtive, secretive, secret, surreptitious, sneaking, sly, clandestine, covert
"It doesn't seem to be covered in our invasive species management plan."
Impacts on Humans:

- Economic Impacts
- Agricultural impacts
- Community diversity
- Capacity to readjust will be limited
- Degrade essential resources
Impacts on Ecology:

1. Extinctions
2. Synergistic effects
3. Homogenization of world’s biota, loss of diversity
4. Disruption of food web, predator–prey interactions
5. Disease transmission (small pox, rinderpest)
6. Plant pathogens (chestnut blight)
7. Disruption of original ecosystem
8. Direct predation (Domestic cat, brown tree snake)
9. Out-competition
10. Hybridization
## Ecosystems products and services

<table>
<thead>
<tr>
<th>Products</th>
<th>Functions/Services</th>
</tr>
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<tbody>
<tr>
<td>Food</td>
<td>Hydrological services</td>
</tr>
<tr>
<td>Fuel wood</td>
<td>- Purification of water</td>
</tr>
<tr>
<td>Non-timber forest products</td>
<td>- Capture, storage and release of surface and groundwater</td>
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<tr>
<td>Fisheries products</td>
<td>- Mitigation of floods and droughts</td>
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<tr>
<td>Marine products</td>
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<tr>
<td>Wetlands products</td>
<td></td>
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<tr>
<td>Medicinal and biomedical</td>
<td>Biodiversity</td>
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<tr>
<td>products</td>
<td>- Maintenance of biodiversity (plants and animals)</td>
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<tr>
<td>Forage and agricultural</td>
<td></td>
</tr>
<tr>
<td>products</td>
<td>Climate</td>
</tr>
<tr>
<td>Water</td>
<td>- Partial stabilization of climate through carbon sequestration</td>
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<tr>
<td>Reeds</td>
<td>- Moderation of temperature extremes and the force of winds and waves</td>
</tr>
<tr>
<td>Building material</td>
<td></td>
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</tbody>
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Source: Adapted from Simpson (2001)
Ecological damage & control costs: $120 billion annually
(Pimentel, 2005)

- Fish
- Zebra/Quagga Mussels
- Plants
- Insects
- Invertebrates
- Parasites
Effects of Invasives on Water Quantity/Quality

- Water Loss/Consumption
- Instream Flow
- Regulation
Lower Rio Grande Conditions

- Low flows
  - recent drought
  - increased agricultural and municipal use
- Weed infestation
- Cessation of flow in summer 2001
Non-native Vegetation

- *Hydrilla verticillata* and *Eichornia crassipies* have infested large portions of the Lower Rio Grande.
  - further increasing evapotranspiration
  - Restriction of canals and rivers
  - Water loss through bank absorption
  - Reduce water quality
  - Stunt fish growth
Water Supply Costs
Grass Carp

$15/fish @ 20,000 fish

= $300,000
1998  $104,000 (TPWD)
1999  $ 62,000 (USBR)
2000  $ 32,000 (USBR)
2001  $ 50,000 (TCEQ)
2003  $ 149,995 (LRGVDC, NFWF)
      $ 62,300 (Mexico, USACOE)
      $ 53,190 (TPWD)
      $ 50,000 (USDA)
2004  $ 14,000 (USBR)
      $ 12,687 (Mexico)
2006  $ 85,000 (Mexico, LRVDC)
      $ 65,000 (TPWD, USBR)
Some Common Characteristics of Aquatic Weeds:

- Prolific growth rates
- High seed-output
- Multiple modes of propagation (clonal and sexual)
- Clonal: vegetative fragmentation, tubers, turions, rhizomes
- High vegetative and physiological plasticity
- Intense competitiveness
- Environmental fitness
Some Other Problems Caused by Aquatic Weeds:

- Recurrent cost and difficulty in management
- Flooding
- Habitat for mosquito and other human parasites
- Habitat for snakes and other harmful creatures
- Water loss through evaporation and transpiration
Economic Damage:

Cost of control (annual, US $):

*E. crassipes, P. stratiotes, and H. verticillata*
- In the USA: $100 million
- In Florida: $15 million

Cost of attempted eradication of *H. verticillata*:
- 192 km of irrigation canals in the Imperial Valley, CA: $5.3 million
A Wise Investment for Our Nation’s Future

The Healthy Watersheds Initiative encourages states, local governments, watershed organizations and others to take a strategic, systems approach to conserve healthy watersheds with a goal to protect high quality waters and prevent future water quality impairments.

Benefits of Healthy Watersheds

- Clean, Healthy Water
- Fish and Wildlife Habitat
- Flood Minimization
- Climate Adaptation
  - Carbon Sequestration (reduced greenhouse gases)
  - Resistant and Resilient Ecosystems (habitat complexity and corridors)
- Recreation Opportunities
- Drinking Water Protection
- Billions in Cost Savings

EPA’s Healthy Watersheds Initiative

Despite billions of dollars spent in the last three decades to address impairments to water resources, aquatic ecosystems are still in decline. A recent EPA survey of the nation’s wadeable streams found 42 percent in poor biological condition and 25 percent in fair condition. Nearly 40 percent of North America’s freshwater fish, 700 species in total, are imperiled. We face a serious conservation crisis.

The solution demands a more integrated approach that looks broadly to maintain water quality and ecological integrity on a geographic – or watershed basis. Thanks to today’s highly advanced assessment, planning and data analysis tools, we now can achieve the vision for holistic water resource management embraced by EPA and others in the early 1990’s. Under the new Healthy Watersheds Initiative, EPA is proposing:

- **A Strategic Framework** that outlines a systems-based approach to integrated watershed assessment, protection and conservation programs.

- **A New Policy Direction** that focuses on maintaining healthy waters and meeting Clean Water Act (CWA) goals of fishable and swimmable.

- **A Collaborative Approach** that integrates CWA programs and other aquatic resource programs across agencies and the private sector.

- **Technical Assistance and Funding** to states and watershed organizations to support healthy watershed assessment and conservation.
Development of the Upper Llano River Watershed Protection Plan

- 1) empowering local stakeholders,
- 2) characterizing current water quantity & quality conditions
- 3) analyzing watershed data using models, and
- 4) increasing education among the targeted audience
Example Workgroup: Aquatic Invasives

1. Identify concern
   - Invasive, non-native elephant ear located within Upper Llano watershed

2. Identify region(s) of concern
   - Elephant ear has been documented along South and North Llano rivers
     - Found mostly on the SLR above 1st crossing to CR150
     - Patches found along NLR near Roosevelt

3. Methods of management
   - Manual removal; herbicide (glyphosate); mechanical cutting; combination

4. Informed decision making
   - Through experiences and previous studies: hand-painting herbicide with multiple treatments best

5. Implementation
   - Technical and financial assistance through TPWD
   - Education and outreach through SLWA

6. Make set of recommendations to Coordination Committee
Arundo donax along the Rio Grande
Arundo donax
Giant reed
Evapotranspiration by *Arundo Donax* versus Native vegetation

70 K af/yr @ $500/af = $35 Million/yr
Headwaters San Marcos River
• Control of non-native vegetation to improve habitat and enhance recreation
Water Supply Costs
Elephant Ear

Evapotranspiration
17,500 af/yr 10 river miles

= $1.75 million/yr at $100/af
Project Tasks: Plant Invasives on the Llano River

- Distribution and Map
- Management Plan
- Education & Outreach
Riparian Management

Funding ($20,000): Hal & Charlie Peterson Foundation, Partner’s for Fish & Wildlife
Additional Partners: NRCS, Schreiner University Internship Program
Riparian Restoration

Unique Exclosure
Research Opportunity and Conservation Demonstration Area
A TEXAS SIZE PROBLEM:
“Evapotranspiration”
Ashe juniper (*Juniperus ashei*)
Brush Control Morocco
Advantages of Watershed Restoration and Brush Control

- Conserves water lost to evapotranspiration
- Recharges and slows groundwater depletion
- Enhances spring and/or stream flows
- Enhances and restores native habitat; rangeland improved with native grasses and other beneficial land cover
- Positive environmental and ecosystem benefits
- Landowner approved brush sculpting improves grazing, wildlife, hunting and recreation income
- Increased land value
Surface Water Reservoirs in Texas

- 196 major reservoirs in Texas (> 5,000 acre-feet)
- 175 have water supply function
  - 15 major river basins
  - 8 coastal basins
- Total conservation storage capacity of all major reservoirs is 39,729,230 acre-feet, but ranges from 5,200 acre-feet for Upper Neches Lake to 4,472,900 acre-feet for Toledo Bend Reservoir
- Combined yield of all major reservoirs under 2010 conditions is 8,994,580 acre-feet/year
- Firm yield is the maximum amount of water that can be withdrawn from a reservoir without shortages during the worst drought of record
Water hyacinth
St. Johns River, FL
1898
Water Hyacinth, *Eichhornia crassipes*:

- World’s worst aquatic weed
- Costs billions in control costs and economic losses throughout the world
- Disrupts the lives of millions of people (especially in the third world)
- Contributes to losses in water (evaporation-transpiration), water quality, and water use
- Negatively affects biodiversity, fishing, aquaculture, and others
- By harboring disease vectors, poses a threat to human health
THE CASE FOR EXOTICS TO > H₂O
LOSS IN TEXAS

- EVAPORATION: 9K gallons/day/acre
- WATER HYACINTH: 3 times above
  - = 30 acre ft/acre/year
  - Texas Major Lakes: 1 million acres surface area
  - Thus: Water Hyacinth loss potential @ 5% surface area:
  - = 1.5 million acre ft
- IMPACT: $500/acre ft = $750 million/year
INCREASING WATER FOR TEXAS

- **Demand-based Strategies**
  - Water conservation
  - *Waste prevention*
  - Cancellation of water rights
  - Water transactions and banking

- **Nontraditional Supply Strategies**
  - Conjunctive use of groundwater and surface water
  - Brush Control
  - Interbasin transfer
  - Desalination
  - Weather modification
  - Rainwater Catchment and Graywater Systems

- *Invasive Species???????
Up & Down Connections

- Aquatic Invasive Species
- Brush Control and Land Stewardship
- Drought and Land Stewardship
- Engagement, Outreach and Natural Resource Literacy
What can we do about it?

• Improve policy, planning, and management
  • Integrate decision-making between different state and federal agencies and sectors to ensure that water planning accounts for invasive species in water supply, availability and loss

• Invasive species management is a water conservation strategy

• Education, Citizen Science, Us