Using Aerial Photography and Satellite Imagery to Monitor Changes in Cheyenne Bottoms Wildlife Area

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Acknowledgements

Bureau of Reclamation:
Mike Irlbeck, Environmental Protection Specialist
Jan Oliver, RSGIG Project Leader
Jim Von Loh, RSGIG Biologist

Kansas Department of Wildlife and Parks:
Keith Sexton, Secretary of Operations
Karl Grover, Field Supervisor

Kansas Applied Remote Sensing Program
Kansas Biological Survey
Cheyenne Bottoms

Total area = 41,000 acres, KDWP maintains 19,857 acres

Natural wetland situated on a Precambrian rock basin that is approximately 100,000 years old.

Basin historically filling at a rate of 12 inches every 800 years
Wetland of International Importance

19,857 acre wetland is a critical stopover point in the central fly-way for approximately half of the migrating waterfowl and shorebirds of North America.

Over 100 bird species nest in the area. 63 are full time residents.
Cheyenne Bottoms

• 241 square mile watershed (mostly agriculture)

• Inflow from Blood and deception Creeks, and canals from the Arkansas River and Dry Walnut Creek

• Inflow is decreasing due to increased irrigation and changes in land use

• Recently, narrow leaf cattail have been extremely successful in encroaching into the shallow waters and moist soils thereby decreasing the area available to wading birds and waterfowl.

*Increased rate of marshland succession?*
Levees were installed in the 1950’s to create four pools to better manage the water supply. Additional dikes and pump stations were built in early 1990’s to subdivide the pools.
In 1998, The Kansas Department of Wildlife and Parks (KDWP) and the Bureau of Reclamation (BOR) started a five year project designed to assess management options of the Cheyenne Bottoms Wildlife Area (CHBWA).

Project Objectives:

- Obtain annual near infra-red photo mosaics of CHBWA
- Develop spatial database for tracking LU/LC changes using remote sensing, field validation, and GIS technology
- Create annual vegetation map and project report
Land Cover Mapping

Annual near infra-red aerial photographs were interpreted and vegetation communities were identified and delineated into 1 of 28 land cover/land use classes:

- Cattail and cattail management
- Undifferentiated emergent wetland
- Spikerush
- Cordgrass
- Saltgrass and wheatgrass
- Native grasses
- Riparian woodland
- Individual tree
- Indian hemp shrubland
- Introduced annual vegetation
- Bluestem grassland
- Historic agricultural land
- Food plots
- Leased agriculture
- Floating aquatic vegetation
- Pools/open water
- Ditches
- Canals
- Ponds
- Bare soil
- Facility/infrastructure
Classification Keys

- Western Wheatgrass and saltgrass are everywhere could be 95% accurate by calling all uplands class 20 need to classify based on key species presence

- Spikerush: Very important for duck food if present at all...its spikerush

- Undifferentiated emergent wetland “dry marsh”: catch all class for very mixed seasonally wet areas. Presence of salt marsh aster and/or smartweed are key also contains saltgrass, spikerush, cordgrass, dock
From Field to Photograph

- The trick was identifying these landscapes on NIR photography and delineating a boundary along what was often a gradient between two classes.
Sept 1, 1999
Changing Landscape

1999  2000  2001
Mapping Land Cover and Land Use

• Use field notes to help interpret NIR aerial photography.

• Digitize vegetation communities based on what was there at time of photo.
  – May be different from what is there now
2001 Land Cover Map
2002 Mapping

• Returned To CHBWA in August 2002 to check accuracy of 2001 map and collect ground truth

• Very different from previous years
  – Very dry
  – Burned and disked large areas
Field sites sampled
August 2002
Overall Changes

• Total area of cattail decreased
• Upland changes difficult to assess…
  – Inter annual changes due to wet/dry years
  – Intra-annual changes due to plant phenology
  – Changes due to management (burning)
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Table 1. A comparison of cattail area by pool through four decades of observations. Modified from the 1998 annual report.
Future Directions

• Continue with NIR aerial photos

• Satellite data
  Landsat 7
  Aster

• Multispectral aerial photos
Multi-date Landsat 7 data allows researchers to identify vegetation communities based on phenological differences in plant development.
Classified image from Landsat 7
• There are problems with using multi-temporal photos to classify landcover in dynamic systems

• Fluxes in water level change the image
  – Bare soil/water
  – Sparse plants and soil/sparse plants and water

Maybe single date, higher spatial resolution imagery …
ASTER satellite data
From May 16, 2001
Landsat 7 data
30 meter resolution

Aster data
15 meter resolution
• ASTER classification didn’t work either

• Higher resolution, but not good enough for such a heterogeneous landscape

• Obtaining data is difficult
  – not always recording, only task specific areas
• DuncanTech MS3100 digital multispectral camera
  – blue, red and NIR bands
  – mounted in Cessna 182 airplane
Managing Cheyenne Bottoms
Seems to be Up-Hill Battle

Fighting aggressive invader (cattail) under ideal cattail conditions
shallow waters and saturated soils are abundant

Increased sedimentation from agricultural run-off is filling
the pools and making more cattail habitat
• Cattail can be successfully stressed (and killed) if emerged in at least 2 feet of water for 2-3 successive years

• From 1992-2001, pool 2 had between 6-40 inches present. Water was held there not to stress cattail, but to prevent new germination by seed...only vegetative reproduction.
Possible ways to decrease sedimentation

– More agricultural grass water ways

– Promote no-till and low-till farming

– Monitor drainage from feedlots
Insights into the Management of CHBWA

- Burning
- Mowing
- Disking
- Herbicide
- Grazing
- White vein dagger moth caterpillars
Mowing and burning alone do not kill the plants (cattail).
  – In 2002, park managers burned, mowed, and burned again...then later, when disking began, the cattail were already sending up green shoots.
  – Need a slow hot burn to kill subsurface roots to be effective

Disking works best when the upturned earth and roots are left very hot and dry for an extended period of time.

Disking costs about $8.00 per acre, but having to mow between the burn and disking times adds to this cost.
“Herbicides are effective on a limited basis”
-the cattail need to be in water and remain in the water for several years following treatment.

Good for areas that can not be accessed or dried out for burning and diskimg.

Cost is about $65.00 per acre when applied aerially
• Grazing
  – Not effective, cows mainly damage cattail through trampling.
  – Hassle of running cattle (fencing and water system) not worth results.

• White Vein Dagger Moth Caterpillars
  – Do a decent amount of damage to cattail
  – No cost, no hassle, but not enough of them
“Long term control, I believe, is accomplished through silt removal (scraping the roots out of the marsh leading to deeper water where it is more difficult for the plants to become established). This is costly and slow, but it is treating the disease (marsh succession) not the symptom (cattail expansion)”

Karl Grover, Field Supervisor CHBWA