Integrated Management of Invasive Cattails as Biofuel and as a Wetland Management Strategy in the Northern Great Plains of the United States and Canada.

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Overview

- Background – past work.
- Recent studies – how much, where, and harvest.
- What next? Issues to address.
Early use in Minnesota

- Holt, MN operation used cattail fluff for life vests and insulation during WW II. (Typha, Inc.)
- Harvested seed heads during the winter.
Planting cattails
Constructed wetland
(Crystal Sugar Company, Crookston)
Conventional farm equipment harvest
Glacial Ridge National Wildlife Refuge.
Brushy fringe of shallow wetlands at Glacial Ridge
Fig. 1. Design of cover-removal plots. Stippled and clear areas represent cattail and open water, respectively.
The Goal: Hemi-marsh
Open marshes, less blackbird depredation on sunflowers
Research at Northwest Research and Outreach Center, U of MN, Crookston

- Estimate coverage of cattail in patches over 20 acres.

- Evaluate the logistical feasibility and sustainability of harvesting cattails to achieve a 50:50 ratio of open water to emergents.

- Preliminarily assess the market feasibility of cattails as a bioenergy source.
  - Economics of harvesting, densification, transportation, and storage of the feedstock. (David Ripplinger-NDSU)
Methods

- Developed GIS maps for all semi-permanent and seasonally flooded wetlands greater than 20 acres in the 10 northwest counties.

- Used National Wetland Inventory (NWI) and aerial photography to identify cattail extent.

- Interviewed land managers to understand history of larger wetlands and attitudes towards harvesting cattails.
Collaboration

“Cattail Summit”

Watershed District

Int. Inst. for Sus. Dev.
Winnipeg, MA

MN DNR
Findings

- Most of the cattail stands are on public lands (NWR, WMA, WPA and flood-control impoundments managed by watershed districts)

- Most managers perceive dense cattail stands as a problem and favor “liberal” harvest (control?)
Cattail cover in northwest Minnesota

Total units: 903
Total area: 95,500 acres

Area of cattails in patches of 20+ acres

- Public Ownership
- Private Ownership

Counts by County:
- Marshall: 27
- Becker: 49
- Roseau: 118
- Pennington: 26
- Red Lake: 17
- Polk: 132
- Norman: 44
- Mahnomen: 133
- Clay: 94
- Becker: 263

Acres
0 5000 10000 15000 20000 25000 30000 35000
Richard Grosshans hand harvesting in Manitoba in the pilot phase.
The Lake Winnipeg Watershed: a large and complicated ecosystem.
What is the Bioeconomy?

A sustainable economy that uses biological renewable resources (e.g. plants, algae, fish) as input to bioproducts: bioenergy, liquid fuels, plastics, textiles, chemicals and pharmaceuticals.
Argo used in Netley-Libau Marsh, Manitoba
Manitoba cattail harvest by MacDon units. Sept-Oct, 2012
Cattail Harvesting for Nutrient Removal and Bioenergy Production

Cattail Biomass Harvest
Yield: 10 to 20 T/ha
Phosphorus captured: 20 to 60 kg / hectare

Biomass Transport
(Baled)

Biomass Densification
(cubes, pellets)

Cattail Biomass IN
Cattail P IN

Biomass Burner

Bioenergy

Emissions out

Phosphorus captured: 20 to 60 kg / hectare

Nutrient Capture and Removal

Heat Energy

P Recovery

Ash OUT

88% Phosphorous Recovery
The general idea:

1. **Harvest**

2. **Storage**

3. **Pelletizing**

4. **Burning pellets**
Mattracks from MN

LeveTracks
“Ratrak” from Poland
Kassbohrer “Piston Bully” from Germany

Manitoba Opportunities
Piston Bully - Baling technology for Phargmites harvesting. Germany.
Logic softrack cut and collect system from the U.K.
Pilot scale processing at Northwest Research and Outreach Center
Northwest Manufacturing, maker of Woodmaster stoves. Red Lake Falls, MN
What next?
Issues to address

- Getting material out of the marsh-logistically and economically.
- Cost to transport to processing site. (No pellet plants in northern Minnesota.)
- Cost and logistics to produce a fuel that is usable in existing burners, economically competitive, and has consistent quantity and quality.
Harvesting options

Wet year, dry year, average year?
The general idea

Harvest

Transport

Storage

Pelletizing

Burning pellets
Processing

Tub grinder
End Products

Torrefaction

- Pellets
- Pucks
- Cubes
## Comparative cost of energy sources

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Btu/lb</th>
<th>Cost per ton</th>
<th>Cost per MMBtu</th>
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</thead>
<tbody>
<tr>
<td>UMC Coal (Sub-Bituminous, delivered)</td>
<td>9,500</td>
<td>$70</td>
<td>$3.68</td>
</tr>
<tr>
<td>Wood pellets picked up (Hayward, WI)</td>
<td>8,000 to 9,000</td>
<td>$150</td>
<td>$8.82</td>
</tr>
<tr>
<td>Wood pellets delivered to Red Lake Falls (Ladysmith, WI)</td>
<td>8,000 to 9,000</td>
<td>$175</td>
<td>$10.29</td>
</tr>
<tr>
<td>Cattail pellets</td>
<td>8,551</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>
Biomass supply? No pellet plants in NW MN. This plant is in Ladysmith, WI.
Possible role for Biobaler for Aspen Parkland and brushy fringes of marshes.
Parnell Impoundment Cattail Study

Mow area.
New York trail groomer
Cattail Harvesting for Nutrient Removal and Bioenergy Production

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Biomass Burner
Integrated systems approach needed

**Feedstock** → **Pre-Treatment** → **Densification Technologies** → **Products / End Uses**

- **Plant fibers**
  - Cattail
  - Switchgrass
  - Willow
  - Ag residues

- **Harvest**
  - *Conventional
  - **Non-conventional

- **Transportation**

- **Chop/Grind**

- **Drying**

- **Mechanical**
  - Bales
  - Cubes
  - Pellets
  - Briquettes/Pucks

- **Pyrolysis**
  - Torrefication
    - Torrefied pellets (Bio-coal)
  - Hydrothermal Carbonization (Bio-coal)
  - Gasification

- **Combustion/Heat**
  - Soil Amendment
  - Ash Fertilizer
  - Producer Gas/Heat

* During dry years
** During wet years
Exploration of higher value bioproducts
biofuels, biochar, liquid fertilizer, composites

- Rural storm and ditch wetlands
- City of Winnipeg – urban ditches

- Stoker Boiler
- Shredded loose biomass
- Density: Cubes & pellets
- Livestock bedding

- Harvested and Baled Cattail biomass
- Treated Biomass
- Solid Fuel
- Combustion
- Ash

- Gasification
- Liquid nutrient extract
- Syngas
- Carbon Offset Credits

- Biochar
- High value fertilizer
- Greenhouse fertilizer trials
- Soil amendment
- Crop scale trials

- Diversion From Landfill and methane avoidance
Life Cycle Analysis - Cattail to Endproducts
• energy balance and nutrient flow

- Urban ditches
- Methane avoidance
- Harvested and Baled Cattail biomass

- Stoker Boiler
- Biofibre
- Gasification
- Ethanol
- Biochar

- Rural storm and ditch wetlands
- Densiﬁed: Cubes & pellets
- Treated Biomass
- Liquid nutrient extract
- Syngas

- Shredded loose biomass
- Combustion
- Solid Fuel
- Densify: Cubes & pellets

- Livestock bedding
- Ash
- Carbon Offset Credits

- Soils amendment
- Crop scale trials
- High value fertilizer
- Greenhouse fertilizer trials
“We need to find new ways of doing old things.” (like using renewable energy and maintaining nutrient cycles.)

Steve Allard, UMC Native American student