Multifunctional Shelterbelts: Considerations and designs for ecobuffers & ecologically-based farming

Gary Bank
AAFC Science and Technology Branch
Calgary, AB
Ecobuffers an ecologically-based approach

- Why consider an ecologically-based approach
- Benefits and functions of ecobuffers
- Design considerations for ecobuffers
- Examples of ecobuffers
Why Ecobuffers

- Increase biodiversity and ecological function in agricultural landscapes
- Reduce dependency on commercial inputs
- Increase agricultural system resiliency
Objective

Develop tree based practices that take advantage of (leverage) ecosystem services for agricultural production.
Ecobuffer “Definition”

Self-sustaining groups of trees, shrubs (and herbaceous plants), in a variety of shapes, that are designed and planted to provide ecosystem services.
Shelterbelts provide microclimate changes that increase yield; but what else is possible?

[Graph showing wheat yield as a percent of field normal vs. distance (h)]
Ecobuffers: designed to go beyond shelterbelts

• Improved pollination
• Improved natural pest suppression
• Increased nutrient cycling
• Provide refuge for beneficials organisms
• Provide timber/fuel/edibles (provisioning services)
• Carbon sequestration
- Multirow/multispecies wide spacing
- 2 row/2 species wide spacing
- Multirow/multispecies narrow spacing
- Ecobuffer multirow/multispecies narrow spacing
- Natural hedgerow multispecies
First Order Eco-Buffer Design Considerations

- Diverse tree- and shrub-dominated plantings (species and characteristics (suckering, nitrogen fixing, thorns, fruiting/flowering, fast and slow growing, deciduous/coniferous, shade/drought/salt tolerance, rooting depth)
- Plants native to the region
- Planted to mimic natural patterns (linear or clustered, vertically complex)
- The goal is to create a concentrated group of plants that will establish quickly
- Consider landscape context and opportunities for connectedness, stepping stones, movement corridors, other core habitat
Establish Design Objectives, Then Associated Structural and Composition Elements

- Pollination
- Pest suppression
- Snow Trapping
- Wind Erosion Protection
- Winter Shelter for Livestock
- Summer Shelter for Livestock
- Carbon Sequestration
- Wildlife Movement Corridor
- Water Quality Protection
- Fibre and florals
- Edible forest, essential oils, etc.

- Look for overlap
Basic Eco-Buffer Design

Trees
Nurse Trees
Shrubs
Herbaceous

7m
Eco-Buffer

Tree layer
(Tall & short)

Tall Shrub layer

short shrub/Herbaceous layer

5-14 meters
General Classification of Trees & Shrubs for Eco-Buffers

- **Tall Long lived Trees**
  - 5-7m spacing
  - >15 meters tall
  - 10% of plants
  - Long-lived climax species
  - eg. green ash, white spruce, Manitoba maple, bur oak, basswood

- **Nurse Trees**
  - 3-4 m spacing
  - 20% of plants
  - Short-lived pioneer species
  - eg. pin cherry, balsam poplar, trembling aspen, plains cottonwood, white birch, peach-leaf willow, speckled alder, showy mountain ash
Classification of Trees & Shrubs for Eco-Buffers

• **Big Shrubs**
  – 2m spacing
  – **40% of plants**
  – Form future understory
  – eg. choke cherry, buffaloberry, dogwood, hawthorn, highbush cranberry, Canada plum, American plum, red elderberry, gooseberry, golden currant, basket willow, pussy willow, heartleaf willow, bebb’s willow, nannyberry, beaked hazelnut

• **Small Shrubs and Herbaceous**
  – 1m and less spacing
  – **30% of plants**
  – eg. snowberry, woods rose, prickly rose, wolf willow, potentilla, Spiraea, strawberry, wild rose, aster, golden bean, goldenrod, harebell
Wildlife Corridor Eco-Buffer

Travel Corridor

Food and Cover Source

- Trees
- Nurse Trees
- Tall Shrubs
- Small Shrubs
Forest belt
(ecobuffers or multifunctional shelterbelt?)
• Early Ecobuffers

3-row Buffer (5m)  
Francis, SK  
16 years old

5-row Ecobuffer (8m)  
Indian Head, SK  
6 years old

13 ecobuffer planted across Canada so far; Mostly for demonstration (2011)
- 3-row ecobuffer
- Francis, SK
  - Est. 1994

- 5-row ecobuffer
- Indian Head, SK
  - Est. 2004
100 m section of a 5 row ecobuffer
Asparagus beds - Consideration must be given as to permanent location. Rotation of all other crops necessary. Light feeders followed by heavy feeders followed by nitrogen fixers. Garlic and onions as well as Predator attracting flowers should be interplanted in most beds, can still be in blocks or rows. Polyculture - Try to avoid large blocks of only one species, interplant where practical. Integrate - Chickens can be moved over beds in sections, in the fall after harvest to clean up slugs, tractor and add manure to beds.
Killam, AB
Ecobuffer Research Project
Ecobuffer Research
Treatment A – 2-row Choke Cherry
Low Complexity
Treatment B - 3 row eco-belt (med complexity)

- Tree layer (long lived trees)
- Nurse tree plus shrubs
- Suckering Tree/shrubs
Treatment C – 7-row Maximum Complexity Belt
As-planted June 20 2011

Species Legend
## Cost Estimates

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost 100m</th>
<th>Cost 150m</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>site prep &amp; mulch app</td>
<td>100</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>fencing</td>
<td>150</td>
<td>150</td>
<td>single wire &amp; 12 posts</td>
</tr>
<tr>
<td>mulch</td>
<td>200</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>plant materials</td>
<td>1386</td>
<td>1386</td>
<td>at $3.50 per tree/shrub</td>
</tr>
<tr>
<td>planting</td>
<td>120</td>
<td>320</td>
<td>2-4 hr for 4 people at $20/hr</td>
</tr>
<tr>
<td>Maintenance/yr</td>
<td>60</td>
<td>120</td>
<td>at $20/hr</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2016</strong></td>
<td><strong>2326</strong></td>
<td></td>
</tr>
</tbody>
</table>

Up to $18K/ half mile of 5 row ecobuffer
Knowledge gaps

- Where do they fit/who can best use them
- How complex is complex enough (structure/composition/function)
- Best planting densities and weed control
- Most suitable flowering plants
- Most suitable host plants for beneficials
- Nesting/Over-wintering habitat needs
- Importance of landscape context
- Will pest insects & birds also be attracted
Barriers

- No off-the-shelf designs
- Wildlife damage during establishment
- Limited sources of native plant materials
- High cost of establishment (plant material)
- Lack of cost/benefit evaluation
- Don’t fit “typical” farm
Questions?

Gary Bank, Agroforestry Research
Science and Technology Branch,
Agriculture and Agri-food Canada
Calgary, AB
Gary.Bank@agr.gc.ca