HABITAT EXCHANGE
A Market-based Conservation Program for Greater Sage-grouse

TED TOOMBS
Environmental Defense Fund
Habitat Exchange:
Habitat Quantification Tool Overview
Scientists

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- **Amy Pocewicz** - Ph.D., Landscape Ecologist, The Nature Conservancy, Wyoming Chapter
- **Tony Apa** - Ph.D., Avian Research Biologist, Colorado Parks & Wildlife
- **Danielle Bilyeu** - Ph.D., Habitat Researcher, Colorado Parks & Wildlife
- **Dave Anderson** - Director and Chief Scientist, Colorado Natural Heritage Program

* Industry advisor – Hayden-Wing Associates
Process

- Independent Science Team
- Vetted with Stakeholder input
- EDF coordinated process
- Peer and Performance Review
- Adaptive Management
Outline

• Purpose of the Habitat Quantification Tool
• Description of habitat exchanges
• How it works
  – Components
  – Functional acre approach
  – Equation
  – Modifiers
  – Definitions
Need

- Improved quantification
- Consistent, standardized approach
- Science-based accounting
Role of HQT

- measures quantity and quality of habitat
- establishes a common “currency”
- accounts for direct and indirect impacts/benefits
- measures and verifies outcomes, not practices
- incorporates adaptive management
Purpose of the HQT

• To quantify the value of sage-grouse habitat in any particular location
• To quantify the change in habitat condition resulting from management activities
• To enable apples to apples comparisons of impacts to offsets
• To provide the basis for calculating credits and debits
Habitat Exchanges

DEVELOPER

$\rightarrow$ CREDITS

LANDOWNER

$\rightarrow$ 

Butterfly, Tree, Bird, Deer, Fish
Core Principles of Habitat Exchange

• Net Benefit
• Consistent, standardized approach
• Rewards quantifiable outcomes
• Involves Stakeholders
• Adaptively Managed
Exchange is One Part of the Mitigation Hierarchy

The mitigation hierarchy:

Avoid

Reduce, moderate, minimize

Rescue (relocation, translocation)

Repair, reinstate, restore

Compensate/offset

Positive contributions (Net biodiversity benefit)

Thanks to Martin Hollands and Josh Bishop for slide
Exchanges in Development

**Central Valley Habitat Exchange**

**Mokelumne Environmental Benefits Program**

**Nevada Conservation Credit System**

**Wyoming Conservation Exchange**

**Montana Habitat Exchange**

**Lesser Prairie Chicken Habitat Exchange**

**Colorado Habitat Exchange**

**NC Ecosystem Enhancement Program**

**LEGEND**

- **Compliance**
- **Pre-Compliance**
- **Non-regulatory**

**Birds** (Greater sage-grouse, Lesser prairie chicken, Swainson’s Hawk, Riparian songbirds)

**Water** (water quality, increased flood capacity, stream mitigation)

**Fish** (salmon, steelhead)
Partners of Greater Sage-Grouse Exchanges

Colorado Habitat Exchange

Wyoming Conservation Exchange
Wyoming Conservation Exchange
Exchange Manual

Version 1.0  Updated: December 2014

Greater Sage-Grouse Habitat Quantification Tool: A Multi-Scaled Approach for Assessing Impacts and Benefits to Greater Sage-Grouse Habitat
Scientific Methods Document, Version 3

COLORADO HABITAT EXCHANGE AGREEMENT

This Exchange Agreement is made and entered into by and between the United States of America and the U.S. Fish and Wildlife Service (the "Service") and the State of Colorado (the "State") for the purpose of facilitating the exchange of habitat for the conservation of the Covered Species, as defined in the Service's Management Framework for the Greater Sage-Grouse.

RECITALS

WHEREAS, the State and the Service recognize the importance of habitat conservation for the conservation of the Covered Species;

WHEREAS, the State and the Service shall cooperate in the development of a Habitat Exchange Program to facilitate the exchange of habitat for the conservation of the Covered Species;

WHEREAS, the State and the Service shall establish and maintain a Habitat Exchange Program to facilitate the exchange of habitat for the conservation of the Covered Species;

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Executive Order: D- 2015- 004

Directive D:
• Exchange Operational by end of 2015
• “this voluntary, market-driven program shall be made available to mitigate residual impacts of development on greater sage-grouse habitat after avoidance and minimization has occurred.”
How it works
Components of HQT

- Method’s Document
  - Explanation and justification of metrics used
- User’s Guide
  - GIS instructions
- Calculator
  - Spreadsheet where data is entered that calculates credits and debits
  - Incorporates GIS data and site vegetation data
- Field Guide (to be completed at later date)
  - Instructions for field data collection
The Functional Acre Approach

• A measure of Quantity AND Quality

• Functional Acres = Acres x Functionality

• Function represents quality relative to optimal conditions on a scale of 0-1

• Example:
  100 acres x 20% function = 20 functional acres
Calculating Functional Acres

\[
\text{Functional Acres} = \text{Acres} \times \text{Function}
\]

\[
\text{Functional Acres} = \text{Acres} \times \text{Site Score} \times \text{Modifiers}
\]

\[
\text{Functional Acres} = \text{Acres} \times \text{Site Score} \times \text{Site Modifiers} \times \text{Local Modifiers} \times \text{Landscape Modifiers}
\]

<table>
<thead>
<tr>
<th>Site Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Score</td>
</tr>
<tr>
<td>Vegetation Condition</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site Modifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>4(^{\text{th}}) Order Modifiers</td>
</tr>
<tr>
<td>Cheatgrass</td>
</tr>
<tr>
<td>Conifer Cover</td>
</tr>
<tr>
<td>Anthro. Dist.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Local Modifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>3(^{\text{rd}}) Order Modifiers</td>
</tr>
<tr>
<td>Distance to Lek</td>
</tr>
<tr>
<td>Presence of Sagebrush</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Landscape Modifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2(^{\text{nd}}) Order</td>
</tr>
<tr>
<td>Landscape Disturbance Index</td>
</tr>
</tbody>
</table>
Multiple Scales Meaningful to Grouse

1st Order
Occupied range for the species in WY

2nd Order
Habitats required by subpopulations

3rd Order
Habitats used by individuals in the subpopulation

4th Order
Habitat conditions at the site of proposed activities
# Vegetation Attribute Weighting

## BREEDING

<table>
<thead>
<tr>
<th>Cover / Refugia (50%)</th>
<th>Forage (50%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagebrush Height 10%</td>
<td></td>
</tr>
<tr>
<td>Sagebrush Canopy Cover 15%</td>
<td>Grass Canopy Cover 12.5%</td>
</tr>
</tbody>
</table>

## SUMMER

<table>
<thead>
<tr>
<th>Cover / Refugia (30%)</th>
<th>Forage (70%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass Canopy Cover 15%</td>
<td></td>
</tr>
<tr>
<td>Grass Height 15%</td>
<td>Forb Cover 23.3%</td>
</tr>
</tbody>
</table>

## WINTER

| Sagebrush Height 50% | Sagebrush Canopy Cover 50% |
Calculating Functional Acres
Example: Seasonal Functional Acre Accounting (Summer)

**Summer**

- **Functional Acres**
- **Map Unit Area**
- **Site Score**
- **Cheatgrass**
- **Conifer Cover**
- **Anthro. Disturbance**
- **Presence of Sagebrush**
- **Landscape Disturbance**

**Calculations:**

- Functional Acres = 100
- Map Unit Area
- Site Score = 0.9
- Cheatgrass = 0.6
- Conifer Cover = 0.8
- Anthro. Disturbance = 0.6
- Presence of Sagebrush = 0.8
- Landscape Disturbance = 0.8

**Result:**

- Functional Acres = 16.6
Calculating Change in Functional Acres
Change in Functional Acres (Pre- vs. Post-Project)

The 2nd and 3rd order modifiers do not change from pre-project to post-project condition.

<table>
<thead>
<tr>
<th>Site Score</th>
<th>Site Modifiers</th>
<th>Local Modifiers</th>
<th>Landscape Modifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Score</td>
<td>4th Order Modifiers</td>
<td>3rd Order Modifiers</td>
<td>2nd Order Landscape Disturbance Index</td>
</tr>
<tr>
<td>Vegetation Condition</td>
<td>Cheatgrass, Conifer Cover, Anthro. Dist.</td>
<td>Distance to Lek, Presence of Sagebrush</td>
<td></td>
</tr>
</tbody>
</table>

Only site score and site modifiers adjust with changes in habitat quality, such as impacts or improvements.
Changes in Habitat Quality (Site Scale Only)

Impacts/Anthropogenic Dist.  
- Oil & gas wells
- Towers (cell / met / etc.)
- Transmission lines
- Mines
- Agriculture
- Development
- Roads
- Reservoirs

Improvements
- Removing cheatgrass
- Removing conifer
- Adding forbs cover
- Adding vegetation (sagebrush)
- Converting roads to vegetation
Calculating Change in Functional Acres

Change in Functional Acres =
Post-project functional acres – Pre-project functional acres

<table>
<thead>
<tr>
<th>Seasonal Habitat</th>
<th>Post-Project</th>
<th>Pre-Project</th>
<th>Functional Acre Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeding</td>
<td>575.54 functional acres</td>
<td>755.11 functional acres</td>
<td>- 179.58 functional acres</td>
</tr>
<tr>
<td>Summer</td>
<td>830.65 functional acres</td>
<td>1042.66 functional acres</td>
<td>- 212.02 functional acres</td>
</tr>
<tr>
<td>Winter</td>
<td>537.68 functional acres</td>
<td>673.4 functional acres</td>
<td>- 135.73 functional acres</td>
</tr>
</tbody>
</table>
Scoring Curves and Decision Triggers
## Decision Triggers

<table>
<thead>
<tr>
<th>Local Climatic Conditions</th>
<th>Determine whether site is either mesic conditions or arid/xeric conditions for breeding, summer, and winter habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topography and Aspect</td>
<td>Determine the topography and aspect curves (slope &lt;5% or &gt;5%) for winter habitat</td>
</tr>
<tr>
<td>Sagebrush Canopy Cover</td>
<td>≥5% required for breeding and winter habitat</td>
</tr>
<tr>
<td>Facultative Forb Presence</td>
<td>Presence of facultative forb species required for summer habitat, see Appendix D for species list</td>
</tr>
</tbody>
</table>
### Breeding Habitat

**Sagebrush Height, Arid condition in the Upper Green River Basin**

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>&lt;10</th>
<th>10-15</th>
<th>15-20</th>
<th>20-25</th>
<th>25-30</th>
<th>30-35</th>
<th>35-40</th>
<th>40-45</th>
<th>45-50</th>
<th>50-55</th>
<th>55-60</th>
<th>65-70</th>
<th>&gt;70</th>
</tr>
</thead>
<tbody>
<tr>
<td>% perf</td>
<td>0</td>
<td>0.2</td>
<td>0.7</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.8</td>
<td>0.4</td>
<td>0.2</td>
<td>0.15</td>
<td>0.15</td>
<td>0.1</td>
<td>0</td>
</tr>
</tbody>
</table>


**Field data**  
Sagebrush height = 25cm  
**HQT Calculator**  
1.0

---

**Sagebrush Cover, Arid condition in the Upper Green River Basin**

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>&lt;5</th>
<th>5-10</th>
<th>10-15</th>
<th>15-20</th>
<th>20-25</th>
<th>25-30</th>
<th>30-35</th>
<th>35-40</th>
<th>40-45</th>
<th>45-50</th>
<th>50-55</th>
<th>55-60</th>
<th>60-65</th>
<th>&gt;65</th>
</tr>
</thead>
<tbody>
<tr>
<td>% perf</td>
<td>0</td>
<td>0.2</td>
<td>0.5</td>
<td>0.8</td>
<td>1.0</td>
<td>0.9</td>
<td>0.7</td>
<td>0.5</td>
<td>0.3</td>
<td>0.2</td>
<td>0.15</td>
<td>0.1</td>
<td>0.1</td>
<td>0</td>
</tr>
</tbody>
</table>


**Field data**  
Sagebrush cover = 20%  
**HQT Calculator**  
1.0
Site Scale Modifiers
Site Scale Modifiers by Season

Site modifiers:

4th Order Modifiers
- Cheatgrass
- Conifer Cover
- Anthro. Dist.

Summer
- Cheatgrass
- Conifer Cover
- Anthro. Dist.

Breeding
- Cheatgrass
- Conifer Cover
- Anthro. Dist.

Winter
- Conifer Cover
- Anthro. Dist.
Cheatgrass Modifier

<table>
<thead>
<tr>
<th>% BRTE</th>
<th>0</th>
<th>1-10</th>
<th>10-20</th>
<th>20-30</th>
<th>30-40</th>
<th>40-50</th>
<th>&gt;50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionality</td>
<td>1</td>
<td>1</td>
<td>0.8</td>
<td>0.6</td>
<td>0.4</td>
<td>0.2</td>
<td>0</td>
</tr>
</tbody>
</table>

Functionality decreases as BRTE increases.
Conifer Cover Modifier

Encroachment of conifers into upland sagebrush habitats has the potential to transform sagebrush communities once suitable for GRSG into a less suitable state.

<table>
<thead>
<tr>
<th>Conifer Cover within 1km Radius of Map Unit</th>
<th>Percent Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1%</td>
<td>100%</td>
</tr>
<tr>
<td>&gt;1 – 2%</td>
<td>85%</td>
</tr>
<tr>
<td>&gt;2 – 3%</td>
<td>75%</td>
</tr>
<tr>
<td>&gt;3 – 4%</td>
<td>65%</td>
</tr>
<tr>
<td>&gt;4 – 7%</td>
<td>40%</td>
</tr>
<tr>
<td>&gt;7 – 10%</td>
<td>20%</td>
</tr>
<tr>
<td>&gt;10%</td>
<td>0%</td>
</tr>
</tbody>
</table>
## Conifer Cover Modifier

### Graph:

The graph illustrates the relationship between conifer cover percentage and functionality. The x-axis represents the percentage of conifer cover, while the y-axis shows the functionality. The line on the graph decreases as the conifer cover percentage increases, indicating a decline in functionality.

### Table:

<table>
<thead>
<tr>
<th>% cover</th>
<th>0-1%</th>
<th>1-2%</th>
<th>2-3%</th>
<th>3-4%</th>
<th>4-7%</th>
<th>7-10%</th>
<th>&gt;10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionality</td>
<td>1.0</td>
<td>0.85</td>
<td>0.75</td>
<td>0.65</td>
<td>0.4</td>
<td>0.2</td>
<td>0</td>
</tr>
</tbody>
</table>

This table shows the functionality values corresponding to different % cover intervals.
Anthropogenic features are defined as human-built features on the landscape that have influence on grouse.
<table>
<thead>
<tr>
<th>Disturbance</th>
<th>Subtype</th>
<th>Weight</th>
<th>Distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil &amp; gas wells</td>
<td>Active</td>
<td>100</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Inactive</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Towers (Met.)</td>
<td></td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Towers (Com.)</td>
<td></td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Transmission lines</td>
<td></td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>Wind Turbines</td>
<td></td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>Mines</td>
<td>Active – large</td>
<td>100</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Active – med or small</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Inactive – large</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Inactive – med or small</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Tilled</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Untilled</td>
<td>85*</td>
<td>0</td>
</tr>
<tr>
<td>Development</td>
<td>Med – High</td>
<td>100</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>75</td>
<td>1.5</td>
</tr>
<tr>
<td>Roads</td>
<td>Major</td>
<td>100</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>50</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Local Context
Modifiers
Local Context Modifiers by Season

Local modifiers:

3rd Order Modifiers
- Distance to Lek
- Presence of Sagebrush

Summer
- Presence of Sagebrush

Breeding
- Distance to Lek
Distance to known lek applies only to breeding habitat. GRSG breeding habitat is spatially tied to lek locations; the majority of females breeding on a given lek nest within 6-km of that lek.

<table>
<thead>
<tr>
<th>Distance to Known Lek (km)</th>
<th>Percent Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 6</td>
<td>100%A</td>
</tr>
<tr>
<td>&gt;6 – 7</td>
<td>50%</td>
</tr>
<tr>
<td>&gt;7 – 8</td>
<td>40%</td>
</tr>
<tr>
<td>&gt;8 – 9</td>
<td>30%</td>
</tr>
<tr>
<td>&gt;9 – 10</td>
<td>20%</td>
</tr>
<tr>
<td>&gt;10</td>
<td>10%</td>
</tr>
</tbody>
</table>
Distance to Lek Modifier (Breeding Season)

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th>0-6</th>
<th>6-7</th>
<th>7-8</th>
<th>8-9</th>
<th>9-10</th>
<th>&gt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functionality</strong></td>
<td>1.0</td>
<td>0.5</td>
<td>0.4</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Presence of sagebrush cover applies only to summer habitat. During this season, GRSG use habitat that does not have sagebrush directly present, but it is in close proximity. As long as at least 15% sagebrush canopy cover, 20cm sagebrush height is located with 300-m of each sample point, the map unit is considered summer habitat.

<table>
<thead>
<tr>
<th>Presence of Sagebrush Cover (m)</th>
<th>Percent Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 300</td>
<td>100%&lt;sup&gt;A&lt;/sup&gt;</td>
</tr>
<tr>
<td>&gt;300</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>A</sup>Presence of Sagebrush Cover (m)
Landscape Modifiers
Landscape modifiers:

Summer
- Landscape Disturbance Index

Breeding
- Landscape Disturbance Index

Winter
- Landscape Disturbance Index

2nd Order
- Landscape Disturbance Index
The Landscape Disturbance Index represents the density of anthropogenic disturbance at a landscape scale. It is calculated by:

- Mapping the cumulative distance footprint associated with anthropogenic features
- Calculating the disturbance density from the cumulative disturbance footprint for a 3.2-km radius surrounding each raster cell
### Landscape Disturbance Index

<table>
<thead>
<tr>
<th></th>
<th>Lower density threshold</th>
<th>Upper density threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Median well density</strong>&lt;sup&gt;A&lt;/sup&gt;</td>
<td>0.39 wells/km&lt;sup&gt;2&lt;/sup&gt;</td>
<td>2.54 wells/km&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(1.01 wells/mi&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>(6.58 wells/mi&lt;sup&gt;2&lt;/sup&gt;)</td>
</tr>
<tr>
<td><strong>Median road density</strong>&lt;sup&gt;B&lt;/sup&gt;</td>
<td>0.94 km road/km&lt;sup&gt;2&lt;/sup&gt;</td>
<td>3.73 km road/km&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Combined road and well density</strong></td>
<td>0.03 km&lt;sup&gt;2&lt;/sup&gt;/ km&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.10 km&lt;sup&gt;2&lt;/sup&gt;/km&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Density threshold applied to 3.2 km radius</strong></td>
<td>0.82 km&lt;sup&gt;2&lt;/sup&gt;/ 32.2 km&lt;sup&gt;2&lt;/sup&gt;</td>
<td>3.07 km&lt;sup&gt;2&lt;/sup&gt;/ 32.2 km&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(203 acres/12.4 mi&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>(759 acres/12.4 mi&lt;sup&gt;2&lt;/sup&gt;)</td>
</tr>
<tr>
<td><strong>Area associated with density threshold at 3.2-km radius</strong></td>
<td>203 acres; equivalent to 2.5% disturbance</td>
<td>759 acres; equivalent to 9.5% disturbance</td>
</tr>
</tbody>
</table>
Next Steps for HQT

• Complete External Peer Review by end 2016
• Develop Monitoring and Adaptive Management Plan by end of 2016
• Draft Field Guide by end of 2016
• Adapt model to other States
Questions?