A Novel, Landscape Approach to Constructing Plant-Pollinator Networks Important for Greater Sage Grouse Conservation and Habitat Restoration

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Chick Survivorship Linked to Vegetation Structure and Food Resource Abundance

Gregg and Crawford 2009 J. Wildlife Man. 73:904-913
Non-Pollinating Insects – GSG Chick Food

*Hemileuca hera* (Lepidoptera)
Strawberry Reservoir, Wasatch County, UT

*Eleodes* (Tenebrionidae)
Florida Canyon, Pima Co., AZ

*Polyphylla* (Scarabaeidae)
Oldtown, Bonner County, ID

*Chrysomela* (Chrysomelidae)
Lyons, Boulder County, CO

*Anabrus simplex* (Orthoptera)
Austin, Lander County, NV

*Hymenoptera*
Big Gypsum Valley nr Utah border, San Miguel Co, CO

*Pogonomyrmex* (Hymenoptera)
Boulder, Boulder County, CO
Native Forbs – Esp. Asteraceae and Fabaceae – GSG Chick Food

Microsteris gracilis (Phacelia gracilis)

Astragalus geyeri

Agoseris heterophylla

Achillea millefolium

Taraxacum officinale

http://www.americansouthwest.net/
Plant-Pollinator Network

Eriogonum  Astragalus  Microsteris  Achillea  Lupinus  Taraxacum

Bee 1  Bee 2  Bee 3  Bee 4  Bee 5  Bee 6

Forb fecundity
Plant-Pollinator Network

Keystone Bee

Specialist Bee

Forb fecundity

Eriogonum
Astragalus
Microsteris
Achillea
Lupinus
Taraxacum
What are the vegetation characteristics associated with forb diversity and abundance in N. Utah?

Shrub/grass dominants – height, cover
GSG forbs – phenoseason variation
Landscape-level variation

What pollinators support GSG forb species critical to brood survivorship?

Apoidea/Diptera/Lepidoptera diversity
Visitation rates to GSG forb species
Landscape-level variation

What are the relationships between non-pollinating insects, forb diversity and vegetation characteristics?

How do pollinator identity and visitation rate affect forb fecundity?
What are the vegetation characteristics associated w/ forb diversity and abundance in N. Utah?

- Shrub/grass dominants – height, cover
- GSG forbs – phenoseason variation
- Landscape-level variation

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What are the relationships between non-pollinating insects, forb diversity and vegetation characteristics?

How do pollinator identity and visitation rate affect forb fecundity?
Take-Homes (in progress)

• 3 distinct *Artemesia* communities w 4/forb assemblages

• *A. tridentata* most homogeneous, low forb diversity, low VR

• *A. nova* most heterogenous, high forb diversity

• Signif. effects of location and phenoseason – short window of pollinator support and pollen movement in early summer

• Across sites, forb species vary greatly in pollinator support, VR

• The same forb species attract different pollinators at different rates across the landscape
Study Sites
Study Sites

BOX1

BOX2

RICH1

RICH2

RICH3 (VEG)
Monitoring Sites

LEK

3 mile nesting zone

Forbs

Pollinators Rana

Vegetation

50m
1. Vegetation Description

- Linear cover (grasses and shrubs), *Artemisia* sp. height, and forb abundance and cover (x3 pheno)

![Achillea millefolium](image1.jpg)  ![Microsteris gracilis (Phacelia gracilis)](image2.jpg)  ![Agoseris heterophylla](image3.jpg)  ![Astragalus geyeri](image4.jpg)
Artemisia height

ANOVA, site, $F = 19.09$, $P < 0.001$

species, $F = 11.40$, $P < 0.001$

Total linear cover (grasses and shrubs)

ANOVA, site, $F = 5.00$, $P < 0.01$
Linear Cover of Grasses and Shrubs

PERMANOVA, site, F = 5.78, R2 = 0.61, P < 0.001
PERMDISP, site, F = 4.40, P < 0.05
Forb Abundance, Cover and Composition

1 = early summer
2 = mid summer
3 = late summer

Diversity

Shannon Diversity

BOX1 BOX2 RICH1 RICH2 RICH3
1 2 3 1 2 3 1 2 3 1 2 3 2 3

1 = early summer
2 = mid summer
3 = late summer
2. Using Rana to Document Plant-Insect Interactions

- Pollination – essential for self-maintaining forb populations
- Herbivory – attracting supporting non-pollinating insects
Rana Pollinator Monitoring

- 4 sites, late May-late July
- 14 forb species
- 75 individuals
- 3047 hrs observation
- 1762 foraging visits
Rana Pollinator Monitoring

https://www.youtube.com/watch?v=anLmhcCvqb8
Visitation Rates ($V_R$)

resource abundance, pollen movement, pollinator abundance

Kruskal-Wallis test, species, P<0.001
Visitation rates:

-species & site-specific

Species*site P<0.01
Why does pollinator $V_R$ vary?

Positive correlation with forb diversity (H), negative with *Artemesia* ht

CAPSCALE – semi-parametric, constrained ordination
3. Forb Seed Collections for Restoration
3. Forb Seed Collections for Restoration
## SOS Collections

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Common Name</th>
<th># Plants Sampled</th>
<th>Seed Estimate</th>
<th>County</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Senecio integerrimus</strong></td>
<td>lamb-tongue ragwort</td>
<td>87</td>
<td>1,150</td>
<td>Rich</td>
</tr>
<tr>
<td><strong>Balsamorhiza sagittata</strong></td>
<td>arrow-leaf balsamroot</td>
<td>110</td>
<td>1,000</td>
<td>Box Elder</td>
</tr>
<tr>
<td><strong>Lupinus argenteus</strong></td>
<td>silver-stem lupine</td>
<td>213</td>
<td>9,500</td>
<td>Rich</td>
</tr>
<tr>
<td><strong>Eriogonum umbellatum</strong></td>
<td>sulphur flower buckwheat</td>
<td>145</td>
<td>4,500</td>
<td>Rich</td>
</tr>
<tr>
<td><strong>Eriogonum umbellatum</strong></td>
<td>sulphur flower buckwheat</td>
<td>160</td>
<td>18,500</td>
<td>Rich</td>
</tr>
<tr>
<td><strong>Eriogonum heracleoides</strong></td>
<td>parsnip-flower buckwheat</td>
<td>50</td>
<td>18,000</td>
<td>Box Elder</td>
</tr>
<tr>
<td><strong>Achillea millefolium</strong></td>
<td>common yarrow</td>
<td>150</td>
<td>1,000,000</td>
<td>Wasatch</td>
</tr>
<tr>
<td><strong>Eriogonum heracleoides</strong></td>
<td>parsnip-flower buckwheat</td>
<td>250</td>
<td>10,000</td>
<td>Wasatch</td>
</tr>
<tr>
<td><strong>Potentilla gracilis</strong></td>
<td>graceful cinquefoil</td>
<td>150</td>
<td>600,000</td>
<td>Wasatch</td>
</tr>
<tr>
<td><strong>Achillea millefolium</strong></td>
<td>common yarrow</td>
<td>71</td>
<td>1,000,000</td>
<td>Wasatch</td>
</tr>
</tbody>
</table>
Take-Homes (in progress)

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Expected Outcomes

• Pollinator Support Evaluation
  – identify keystones, specialists and networks of N. Utah

• Comparison of Pollinator Support Indices
  - between forb species and sites (visitation rates + diversity)

• Native forb seed collections for pollinators

• Site-specific restoration? (target taxa, increase forb and insect diversity, pollinator support, seed zones)
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