Mycorrhizal Associations of Coastal Sage Scrub: Implications for Restoration

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Coastal Sage Scrub (CSS)

- A natural habitat of southern CA
- high levels of biodiversity and endemism
- An endangered ecosystem
- Threatened by non-native species, pollution, and fragmentation
2 Contrasting Sites in Newport Backbay Ecological Reserve

- **BVS (Bayview Slope) Site (232,165 m^2):**
  - Eroded; degraded from previous farming and grazing
  - Sparsely fragmented with CSS
  - Invaded by non-native plants

- **CSS Site (149,737 m^2):**
  - Relatively unaltered and undisturbed
  - Densely populated CSS
  - Habitat for threatened CA Gnatcatcher
- 4 fragments on BVS; CSS site = 5th fragment.
- Biodiversity as an indicator of health of habitat
- Data compiled from both sites
Restoration

• Necessary for degraded, eroded, invaded and fragmented areas

• But how can restoration be most successful and efficient?
  – First, we must understand the ecology of the system: Mycorrhizal fungi
Mycorrhizal Fungi

• Two types: Ectomycorrhizal fungi (ECM) and Arbuscular mycorrhizal fungi (AMF)
  – So.Cal Chaparral plants (elevation 300-500m) known to have ECM and AMF
  – The extent of ECM vs. AMF in Coastal Sage Scrub unknown!

• AMF recur in succession quicker than ECM, which can take 15 years (Treseder, 2004).
Hypotheses

1) Greater percent ECM colonization of roots in the CSS site expected; greater AMF colonization of roots in the BVS site expected

2) *Encelia californica* expected to grow better in the site with more AMF; *Eriogonum fasciculatum* expected to grow better in the site with more ECM.
Experimental Design

• To test hypothesis 1:
  – Percent colonization of roots from soil cores of both sites were measured for ECM and AMF.

• To test hypothesis 2:
  – In the greenhouse, 2 plants were grown in the soil from both sites. Plant height was measured once every 5 days for 1 month.
2 CSS Plants

- *Encelia californica* - family Asteraceae known to form AMF associations
- *Eriogonum fasciculatum* - known to form ECM associations
Greenhouse Experiment

• Which plant species grows better in which soil?

- Eriogonum fasciculatum
- Encelia californica

• 6 replicates of each species in BVS and CSS soil

• Plant height recorded once every 5 days for 1 month.
Plant Growth

- P = 0.10

Note: p-value refers to plant growth within each soil type
ECM and AMF colonization of roots

- % colonization of ECM measured by examination of extracted roots under 30x magnification (Brundrett 1991).

- % colonization of AMF measured by Trypan blue staining of extracted fine roots (Koske and Gemma 1989, McGonigle et al. 1990).
AMF Colonization

P = 0.132

Ave. % Root Colonization

CSS site

BVS site
Results

ECM Colonization

P = 0.016
Hypothesis 1 supported: CSS site has significantly more ECM, while the BVS site has more AMF, although not significant.

- Likely explanation: ECM has not recovered from land degradation in BVS yet.
Conclusion

• Hypothesis 2 partially supported: Both plant species grew better in the CSS site soil, although not significant.

  – Likely explanation: other soil characteristics also involved (i.e. pH, salinity, amount of K, P, and N in soil)
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