

Does horse manure harbor invasive plants?

Lauren Quinn
Bonnie Davis
Mietek Kolipinski
Sibdas Ghosh



Weeds and Land Use

- Trails are positively correlated with invasive cover and decreased native spp richness (Baret & Strasberg 2005)
- Potential vectors include hikers...



Weeds and Land Use

- Equestrian trails in IL had more weeds than trails that didn't allow horses (Campbell & Gibson 2001)
- In one MT study, horse camps had greater invasive cover than backpacker camps (Cole & Hall, 1992), but another showed no difference (Marcus, Milner & Maxwell, 1998)



Horses May Promote Invasion Indirectly...



- Soil compaction
 - Soil crusts and mycorrhizae
- Erosion
 - Greater % bare soil (Phillips & Newsome 2001)
- Shifts in plant community (Phillips and Newsome 2001)
- Fertilization
 - N deposition promotes exotics (Fenn et al 2003)

And Directly: Weeds in Horse Manure

- Diet manipulation study:
 - 23-45% of weed seeds germinated after digestion (Harmon & Keim, 1934)
- Manure collection studies (non-“sterile”):
 - 23 non-native species in IL (Campbell & Gibson, 2001)
 - 29 non-native species in Australia (Weaver & Adams, 1996)
 - 10 non-native species in CO (Wells & Lauenroth, in review)

DU of C Experiment



- Study sampled horse manure from locations in the SF Bay Area (trial 1)
- Sampled only central portion of manure piles
 - “sterile” design removed external surfaces
- Planted 90 samples in sterile soil under netting
- Identified germinating plants

DU of C experiment

- Low germination rate in trial 1
 - 23% of samples
- But germinants included invasives on Cal-IPC's list!



Cal-IPC Status

- Cal-IPC's moderate list:
 - Italian wild rye (*Lolium multiflorum*)
 - Mediterranean mustard (*Hirschfeldia incana*)
- Cal-IPC's limited list:
 - Burr-clover (*Medicago polymorpha*)
- Native:
 - Toad rush (*Juncus bufonius*)
- Unlisted:
 - Jersey cudweed (*Gnaphalium luteoalbum*)
 - common purslane (*Portulaca oleracea*)

Cal-IPC Designations



■ Moderate:

- Substantial (\neq severe) ecological impacts
- Moderate to high dispersal rates
- Disturbance-dependent establishment
- Distribution: limited to widespread

- Familiar examples: wild oat (*Avena fatua*) and black mustard (*Brassica nigra*)



Cal-IPC Designations



■ Limited:

- Minor ecological impacts, except in some specific regions/habitats
- Low to moderate dispersal rates
- Distribution is generally limited

- Familiar examples: Russian thistle (*Salsola tragus*) and soft brome (*Bromus hordeaceus*)

DU of C Experiment Trial 2

- Samples from northern CA NPSU's
 - Lassen Volcanic National Park
 - Whiskeytown National Recreation Area (NRA)
 - Point Reyes National Seashore
 - Golden Gate NRA
 - Juan Bautista National Historic Trail
- This will be repeated once more from samples from soCal NPSU's

Trial 2 Results

- Greater germination rate:
 - 72% of samples

- Cal-IPC listed species:

- Rose clover (*Trifolium hirtum*)
- Italian wild rye (*Lolium multiflorum*)
- Sheep sorrel (*Rumex acetosella*)
- Pennyroyal (*Mentha pulegium*)
- Mediterranean barley (*Hordeum marinum*)
- Rat-tail fescue (*Vulpia myuros*)
- Smooth cat's ear (*Hypochaeris glabra*)
- Kentucky bluegrass (*Poa pratensis*)
- Hyssop loosestrife (*Lythrum hyssopifolia*)
- Burr clover (*Medicago polymorpha*)

6 on moderate list

4 on limited list

We've Learned...



- YES, invasive plants *can* germinate after passing through the horse gut
 - Sterile technique increases confidence
- Should we make management decisions based on this and similar studies?

Invasive, but...?

- In our studies, **none** were highly invasive according to Cal-IPC
 - None were listed by CDFA
- In other studies, germinating species were **not** on official lists in IL & Australia, but 2 were on state lists in CO (*B. tectorum* & *Capsella bursa-pastoris*)
- Future range/impact of these species?

Where are the HIGH species?

- Do horses avoid grazing on the nastier species?
 - Maybe
- Are they killed in the digestive tract, while other species are not?
 - Unlikely (CO study)
- Are these species not invading growers' fields?
 - Unlikely, but growers may be more vigilant



Promise of CWFF?



- If invasive species at all Cal-IPC levels can be prevented from invading fields...
- And parks prohibit grazing within parks...
- And parks require weed-free feed...
- And weed-free feed can be easily obtained...
- This may just do the trick!

Road Blocks

- CWFF is NOT easily obtained:
 - Survey of CA ag commissioners in June '06
 - 61% of counties have never certified a field
- Each CA park has different CWFF requirements
 - Most have none for now
- CA parks and parks in neighboring states use different invasive species lists

36 CFR §2.16 – HORSES and PACK ANIMALS

(a) The following animals are designated as pack animals for purposes of transporting equipment:

- Horses and Mules

(b) The use of horses or pack animals is allowed on the following trails, routes or areas:

- Campers with pack animals are permitted only in the portions of Ryan Campground and Black Rock Campground that are designated for their use.
- All Pack animals must travel single file and may only use designated trails and corridors. See Appendix 5 "Pack Animal Trail and Corridor Map."

(d) Free-trailing or loose-herding is allowed on the following trails/routes, subject to the conditions noted:

- Not allowed

(g) Other conditions concerning the use of horses or pack animals:

- Resting or tethering of pack animals is not allowed within 200 feet of any water source including springs, seeps, dams, and tanks.
- Pack animals fed within the park are restricted to feed in pellet form.
- Pack animal manure must be removed from campground areas by the owner/user of the animals.

What Can Be Done?

- Memorandum of Understanding between Federal and State agencies to require use of Certified Weed Free Feed
 - NPS, FS, BLM, CA Ag Commissioners, and CDFA
- With this requirement MUST come adequate local CWFF supplies and enforcement
 - It must be worthwhile for farmer to comply with CWFF standards
 - In many cases, ag commissioners must develop certification procedures and standards

Conclusions and Remaining Questions

- Invasive seeds can pass through horse gut
 - But does this represent a major vector?
 - How worthwhile is a prevention program targeting equestrians?
 - Have not demonstrated subsequent spread
 - Also, have not seen the most aggressive invaders in manure samples (yet?)
 - Why not?
- How can we facilitate interagency adoption of CWFF standards? Should we?

Thank you!

- Many undergraduate researchers at DU of C
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 - National Park Service
 - EnviroHorse

