

Prescribed Herbivory for Vegetation Management: An Emerging IPM Technology

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Background

- IPM seeks to optimize management of weeds by (a) optimally combining tools, (b) optimally timing application, and (c) optimally choosing application intensity
- Prescribed herbivory may assume an important role in the IPM toolbox
- There are specific advantages and problems that are the topic of this talk

Traditional Bio-Control

- Bio-control agents are selected on the basis of effectiveness and host specificity
- In general, invasive weeds are viewed as single species problem, rather than an ecosystem problem
- Bio-Control is perhaps the most 'pure' expression of the single-species approach to weed management

Problem View

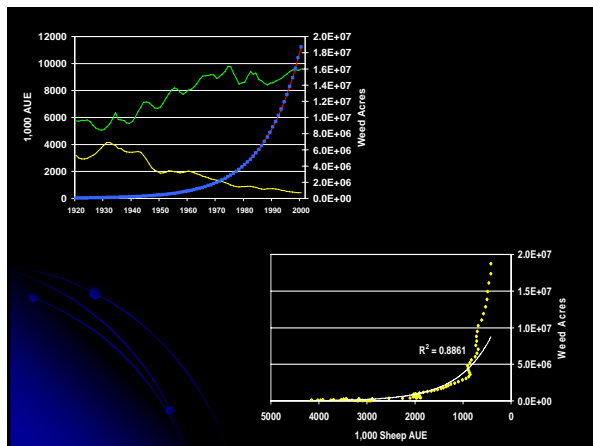
- Weed infestations continue to grow and restoration (or rather: restoration management) is moving to the forefront; hence research on invasibility and re-invasibility should be given high priority
- This aspect is clearly the domain of community ecology

Problem View

- This situation has a parallel in current research priorities in rangeland ecology:
 - A major research focus is on prediction models for succession in plant communities under disturbance regimes (fire and grazing)
 - Progress in this research field should clearly benefit weed ecology

Problem View

- While interest in applications of prescribed herbivory is exploding, cautionary voices are plenty: grazing is widely assumed to be responsible for the spread of weeds in western rangelands
- Evidence for this is rather controversial:



Problem View

- There are virtually no systematic, replicated studies on factors driving weed infestations on rangelands
- The role of disturbance in establishment of weeds is not well understood at all – example *Lepidium latifolium*
- What we do know however is that world-wide, removal of domestic herbivores leads to explosion of weed infestations



Photo credit: Jack Alexander, Synergy Inc.



Strategic Perspective

- Individual tools have increasing problems
- New tools are used but research is lagging
- Research on effective integration of weed control methods with grazing management is lagging

Strategic Perspective

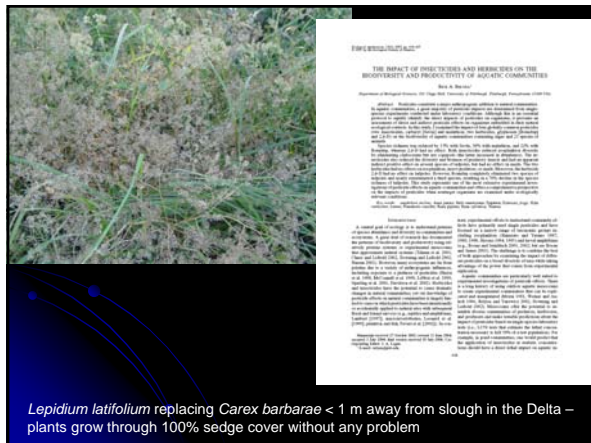
- Understanding invasibility requires a plant community ecology perspective
- Successional models for the prediction of change in plant communities are at the center of interest in rangeland ecology research
- The two major disturbances considered are fire and grazing

Strategic Perspective

- Thus, there are overlapping research interests
- Prescribed herbivory is the application of domestic herbivory to methodically influence the composition of plant communities over time in a desired direction

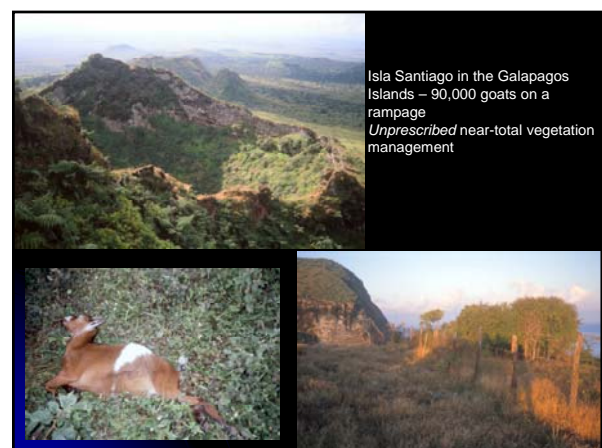
Herbicides

- Herbicides have come under increased scrutiny in regards to environmental impact
- Especially water quality concerns increasingly limit applications
- Many ranchers cannot bear the cost of herbicide applications anymore
- The BLM Great Basin herbicide initiative is meeting with fierce resistance



Biocontrol

- Conventional biocontrol agents have a mixed success record: the mega-problems continue to expand
- No quantitative impact assessment available – only experiment-wise efficiency data
- Cost-benefit analysis would be useful



Can we already 'prescribe' herbivory?

- Prescription entails: understand the problem, know the most effective solution (therapy – treatment/dose/duration), understand and mitigate the side effects, know when to repeat
- We may understand individual *elements* of the prescription, but usually not at all scales and for all dimensions involved

Example 1

- Sheep and goat grazing has been shown highly effective in the control of *C. solstitialis*
- Many *Centaurea* species contain sesquiterpene lactones that are putative causative agents involved in Negropallidal Encephalomalacia (chewing disease)
- Are you sure that e.g. repin does not enter animal product?



Example 2

- *Lepidium latifolium*, one of the most significant threats to California plant communities, can be effectively eliminated by sheep grazing
- This plant contains glucosinolates whose rumen metabolites may exert subclinical effects on energy metabolism via the thyroid gland (reproduction, growth) – how would that affect the pricing of potential ecological services?



L. latifolium reaching 100% dominance on CA grassland site in the Sacramento river delta in < 4 years

Research Issues

- *Effects of plants on animals:*
 - plant secondary compounds affect intake, health and performance
 - Reduced animal performance is a cost factor – specific information usually lacking
 - Weeds are not a free lunch!

Research Issues

- *Effects of animals on plant communities:*
 - differential effects of selective grazing on target and non-target species
 - Seasonal dynamics of nutrient and plant secondary compound levels in target and non-target species
 - Optimized match between target species and domestic herbivore species (secondary considerations such as behavior in riparian habitat)

Research Issues

- *Secondary effects on the landscape level:*
 - Soil compaction and drainage
 - Emission of pollutants and pathogens
 - Increased mobilization of sediment
 - Effects on plant community structure affecting wildlife habitat properties

Research Issues

- *Direct effects on wildlife:*
 - Disease transmission
 - Disturbance
 - Hybridization

Research Issues

- *Food security concerns:*
 - Plant secondary compounds or toxins may accumulate in meat or milk
 - No relevant information available for most weed species

Multidisciplinary Work

- Pricing the cost of prescribed herbivory in vegetation management requires to:
 - Understand expected intake
 - Predict performance effects
 - Predict latent and possible acute health effects
 - Budget available nutrition in a given area
 - Relate to intervention priorities – where will it burn next? Where is weed eradication most critical?

Work Needed

- Vegetation management effects on soil and hydrology properties
- Economics: huge problem because markets for small ruminants in the US are becoming increasingly intransparent, especially for goats – zero government support
- Efficiency and impact assessment – possibly labor-intensive monitoring

Current Work

- Method for rapid assessment of nutritional quality and application to seasonal nutrition dynamics: Hohenheim Gas Production Test
- Create model for research on plant effects on animals: *C. solstitialis*
- Create model bioassay for secondary compounds affecting ruminal transactions: Hohenheim GPT
- Develop methods for reliable field assessment of dietary profiles of different domestic herbivores (alkane marker based)

