Working together to sustain a viable future for California's grasslands

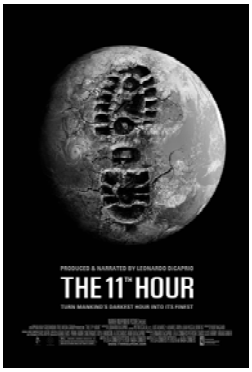
Grey Hayes, PhD
Elkhorn Slough
Coastal Training Program

Outline of Talk

- Threats
- What are we doing?
- How are we doing?
- How do California's grasslands fare?
- How could we do better?
- What can you do?

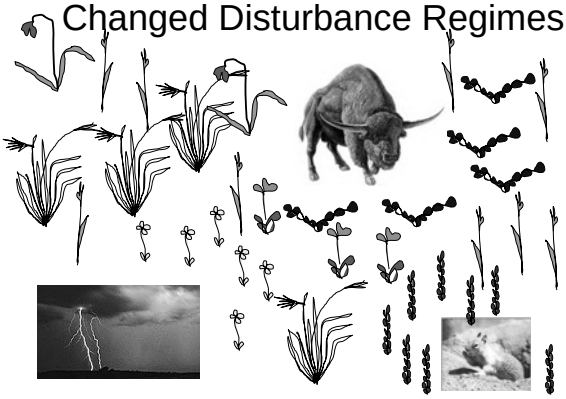
Threats

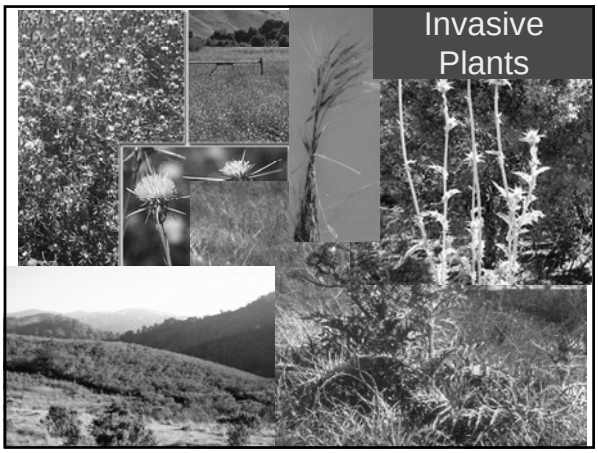
Global Warming

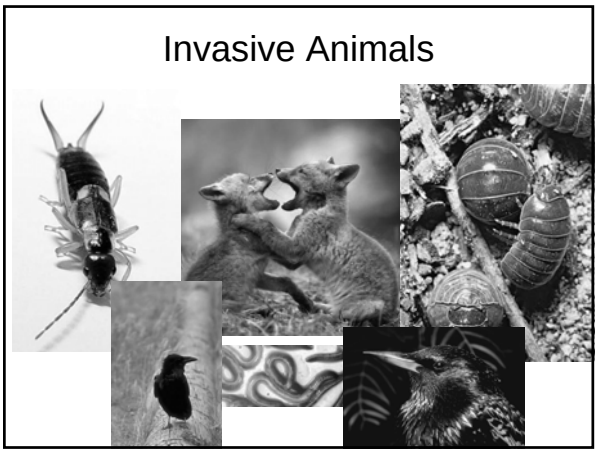


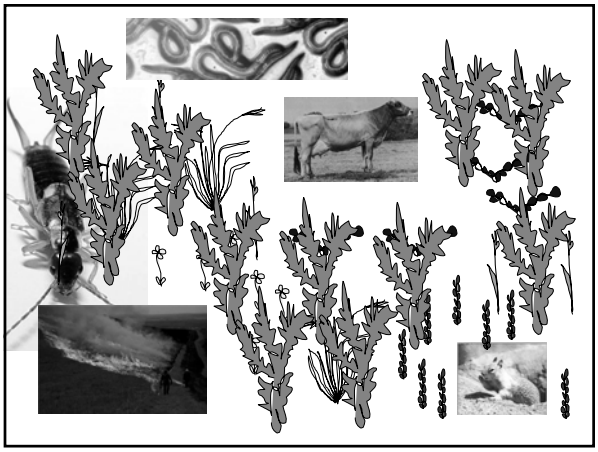
Genetically Modified Organisms

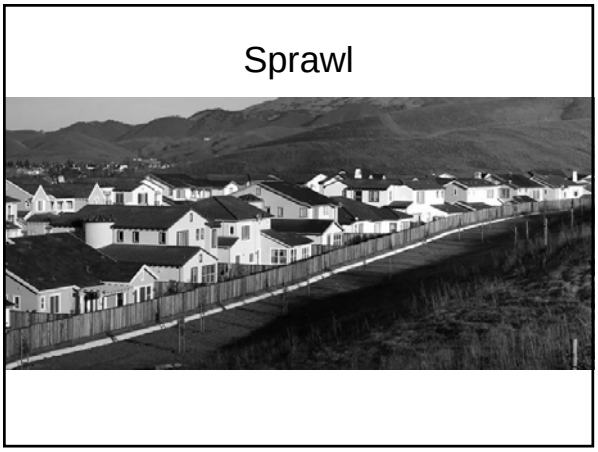
Changed Disturbance Regimes

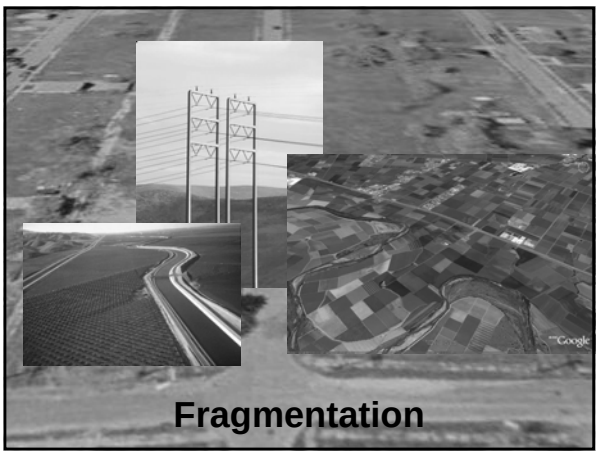



Invasive
Plants

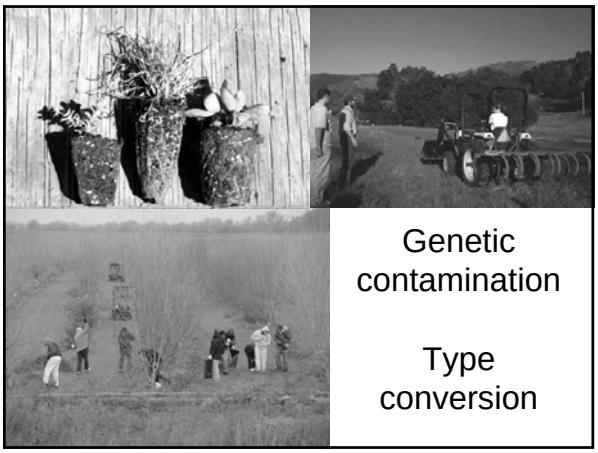

Invasive Animals




Sprawl


Fragmentation


4HorseProperty.Com



Genetic contamination

Type conversion

What are we doing?

And who's doing it?

The Who

- Scientists
- Land managers
- Policy makers
- Land use planners
- Regulators
- Conservation lands acquisition agents

The Scientist

Centaurea solstitialis Invasion Success Is Influenced by *Nassella pulchra* Size

Kimberly J. Reever Morghan[1,2] and Kevin J. Rice[1]

Abstract

Replacement of perennial grasses with non-native annual grasses in California's Central Valley grasslands and foothills has increased drop soil water availability. Yellow starthistle (*Centaurea solstitialis*), a deep-rooted invasive forb, can use this water to invade annual grasslands. Native perennial bunchgrasses, such as Purple needlegrass (*Nassella pulchra*), also use deep soil water, so there is an overlap in resource use between *N. pulchra* and *C. solstitialis*. Restoration of *N. pulchra* to annual grasslands could result in strong competitive interactions between *N. pulchra* and *C. solstitialis*, which may reduce survival, growth, and reproduction of the invader. The strength of this competitive interaction can increase as *N. pulchra* plants mature, increase in size, and develop more extensive root systems. We studied how the size of *N. pulchra* affected the success of *C. solstitialis* invasion over 2 years.

We allowed *C. solstitialis* seed to fall naturally into plots containing *N. pulchra* plants. For each plot, we measured the number of *C. solstitialis* seedlings and mature plants, as well as *C. solstitialis* biomass and seed production. In both years of the study, *C. solstitialis* number, biomass, and seed production declined significantly as *N. pulchra* plant size increased. However, even *C. solstitialis* grown with the largest *N. pulchra* plants produced some seed, especially during the higher rainfall year. We conclude that restoration plantings with larger, established *N. pulchra* plants will be more resistant to invasion by *C. solstitialis* than young *N. pulchra* plantings, but the managers must continue as long as a *C. solstitialis* seed source is present.

Key words: *Centaurea solstitialis*, grassland restoration, invasion, *Nassella pulchra*.

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Introduction

Perennial bunchgrasses were once an important component of the native vegetation of California's Central Valley, and Purple needlegrass (*Nassella pulchra*) was considered one of the dominant grasses (Clements 1934; Hartnolos et al. 1986; Heady 1988, though different arguments are offered by Hamilton 1997; Hobstein 2001). However, the combined effects of invasion by exotic species, drought, overgrazing, and agriculture resulted in replacement of most of the perennial grasses with non-native annual grasses (Dyerman 1975; Heady 1988; Menke 1989; Seefeldt et al. 1995).

In fact, the grasslands of California's Central Valley may be experiencing an "invasional meltdown" where the initial invasion by one group of non-native species increases the likelihood that other non-native species will invade. When describing the concept of invasion meltdown, Simberloff and Von Holle (1999) give as an example the modification of habitat by a non-native plant that facilitates establishment by another non-native plant. We propose that this is happening in California's Central Valley, where changing soil moisture levels resulting from the invasion of annual grasses appears to have facilitated invasion by the deep-rooted annual thistle, Yellow starthistle (*Centaurea solstitialis*).

Non-native annual grasses that dominate grasslands in California only reduce soil moisture to a depth of about 30 cm and leave deep soil water relatively untouched (Holmes & Rice 1996). *Centaurea solstitialis* is a new and recent invader and uses the deep soil moisture that is left by annual grasses to invade many California grasslands (Hoffman et al. 1992). Studies have shown a positive correlation between *C. solstitialis* invasion success and deep soil water availability during late spring and summer (Dukes 2001). Unfortunately, *C. solstitialis* is one of the most serious exotic invasive weeds in the western United States and occupies an estimated 10–22 million acres in California (Pitcairn 1993; Dukes 1999; DiTomaso 2000; DiTomaso et al. 2000). Thus, the success of exotic species in habitats where they were not previously found (Rejmánek and Richardson 1996) has increased deep soil moisture availability and facilitated invasion by an even more problematic invader.

Restoring native perennial grasses to California grasslands may slow down this invasional meltdown, especially if native perennial grasses may create an effective barrier to invasion if the grasses compete with *C. solstitialis* for below- and belowground resources, especially deep soil moisture. *Centaurea solstitialis* allocates much of its resources to root growth and increasing the probability of extraction. In contrast, coexistence models from community ecology suggest that for species with dormancy, environmental fluctuations may be essential for persistence in competitive communities. We used models based on California grasslands to examine the influence of interannual fluctuations in the environment on the persistence of rare forbs competing with exotic grasses. Despite grasses and forbs independently possessing high fecundity in the same types of years, interspecific differences in germination biology and dormancy caused the rare forb to benefit from variation in the environment. Owing to the buildup of grass competitors, consecutive favorable years proved highly detrimental to forb persistence. Consequently, negative temporal autocorrelation, a low probability of a favorable year, and high variation in year quality all benefited the forb. In addition, the litter produced by grasses in a previously favorable year benefited forb persistence by inhibiting its germination into highly competitive grass environments. We conclude that contrary to conventional predictions of conservation and population biology, yearly fluctuations in climate may be essential for the persistence of rare species in invaded habitats.

Keywords: environmental fluctuations, rarity, exotic invasion, grasslands.

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COMPETITION BETWEEN NATIVE PERENNIAL AND EXOTIC ANNUAL GRASSES: IMPLICATIONS FOR AN HISTORICAL INVASION

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Abstract. Though established populations of invasive species can exert substantial competitive effects on native populations, exotic propagules may require disturbances that decrease competitive interference by resident species in order to become established. We compared the relative competitive responses of native perennial and exotic annual grasses in a California coastal prairie grassland to test whether the effects of exotic propagules on native seedlings would be greater than the effects of native propagules on community composition from native perennial to exotic annual grasses. Under experimental field conditions, we compared the aboveground productivity of native species alone to native species competing with exotics, and exotic species alone to exotic species competing with natives. Over the course of the four-year experiment, native grasses became increasingly dominant in the mixed-assemblage plots containing natives and exotics. Although the competitive interactions in the first growing season favored the exotics, over time the native grasses significantly reduced the productivity of exotic grasses. The number of exotic seedlings emerging and the biomass of their seedlings removed during weeding were also significantly lower in plots containing natives as compared to plots that did not contain natives. We found evidence that the ability of established native perennial species to limit space available for exotic seedlings was the primary mechanism by which they reduced exotic success, reduced exotic productivity and shifted competitive interactions in favor of the natives. If interactions between native perennial and exotic annual grasses follow a similar pattern in other coastal grassland habitats, then the introduction of exotic grass propagules alone without changes in land use or climate, or both, was likely insufficient to convert the region's grasslands.

Key words: California grassland; coastal prairie grassland; exotic annual grasses; grass competition; invasive species; native perennial grasses; priority effects.

Introduction

Biotic invasions have been recognized as a major component of human-caused global change (Wilcove et al. 1998, Vitousek et al. 1997a), particularly in cases where invasions have resulted in the disruption of native ecosystems by altering community composition without changing in land use or climate, or both, was likely insufficient to convert the region's grasslands.

MECHANISM OF INVASION AND DOMINANCE OF COASTAL GRASSLAND BY *MESEMBRYANTHEMUM CRYSTALLINUM*

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Department of Botany, University of California, Berkeley, California 94720 USA

and

Cornelius H. Muller

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Abstract. The invasion of *Mesembryanthemum crystallinum* into coastal grassland was observed at Swirl on the central coast of California, USA. The species became established in areas unoccupied or sparsely occupied by other plants, and then grew into surrounding areas. The following season, less grassland seedlings established beneath dried *Mesembryanthemum* as compared to adjacent grassland. The reduction in members of grassland seedlings did not appear to be the result of limiting levels of moisture, light or macronutrients which were found in lower levels in the grassland, nor to be due to grazing by small mammals, since the pattern persisted in the absence of grazing. The differential pattern of seedling establishment was correlated with high levels of salt found in the soil beneath dried *Mesembryanthemum*. The salt accumulated in the soil from the leaves of *Mesembryanthemum* as they decomposed in Allogus. After the plant dies, this salt is released with leaching by fog and rain. The salt produces a detrimental osmotic environment preventing growth of nonsalicant species. The salt does not appear to have a direct toxic influence on grassland species. Osmotic interference resulting from accumulation and release of salt appears to be the means by which *Mesembryanthemum crystallinum* dominates areas previously occupied by grassland.

Key words: California; dominance; grassland; interference; invasion; Mesembryanthemum crystallinum; salt.

Introduction

Numerous authors have described invasion by a species and the resulting change in the composition of the vegetation. Although sometimes are usually made as to why the invasion occurred, little experimental work has been done to investigate the mechanisms of invasion by plants. Cowles (1899) described the invasion and establishment of dune species of Lake Michigan. He described in his discussion and again in later papers (Cowles 1911) the possible factors influencing the change in species composition. These factors included topography, climate, and biotic influences. Clements (1916) described many successional series and suggested several causal factors. He also performed some preliminary experiments attempting to identify causal factors, especially competition. Keever (1950) performed experiments investigating the invasion and establishment of plants in old fields. She concluded that life cycle was an important factor in invasion as well as the factors suggested by Cowles (1911) and Clements (1916). Bois (1958) described the invasion of a number of

[1] Manuscript received 26 January 1976; accepted 22 December 1976.

EFFECTS OF SOIL RESOURCES ON PLANT INVASION AND COMMUNITY STRUCTURE IN CALIFORNIAN SERPENTINE GRASSLAND

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Biological Sciences, Stanford University, Stanford, California 94305 USA

Abstract. Non-native annual grasses dominate most Californian mediterranean-climate grasslands today. However, native Californian grassland flora persists in grasslands on serpentine-derived soils. We manipulated soil nutrient resources to explore the links between nutrient availability, plant productivity, and the relative abundances of native and non-native species in serpentine grassland. Factorial combinations of nitrogen, phosphorus, and other components of a nutritionally complete formula were added to field plots over two growing seasons.

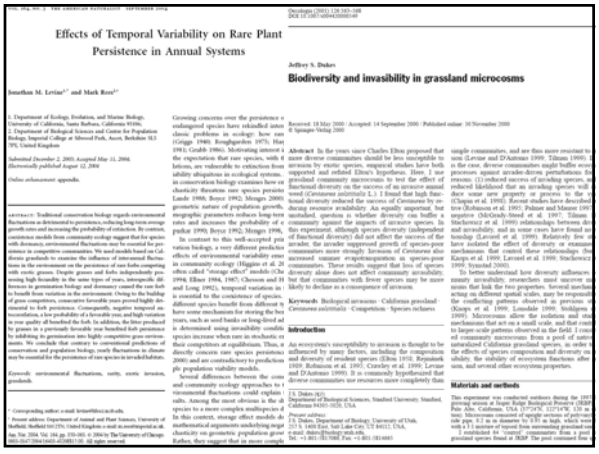
Fertilization with nitrogen and phosphorus increased biomass of the resident vegetation substantially in the first season, and within two years allowed the invasion and dominance of non-native annual grasses in patches originally dominated by native annual forbs. Species of native annual forbs, which had been the most responsive to added soil resources, suppressed some native forbs. Increased macronutrient availability can increase production on serpentine-derived soil, even when other serpentine characteristics (such as low Ca:Mg ratios and high heavy-metal concentrations) have not been mitigated. Observed changes in community structure and composition demonstrate that the invasibility of plant communities may be directly influenced by nutrient availability, independent of physical disturbance.

Key words: California; community structure; grassland community; invasion; native vs. non-native species; nutrient additions; serpentine grassland; serpentine soils; soil nutrients.

Introduction

The mediterranean-climate annual grassland of California is ideal for investigations of the relationship between soil resources, plant community structure, and ecosystem processes (Huenneke and Mooney 1989). Native grassland vegetation in California's Central Valley and coastal regions consists of perennial bunchgrasses with diverse annual and perennial forbs (Heady 1977, Bartolome et al. 1986), with annual grasses apparently common in at least the drier portions of the Central Valley (Wester 1981). Today, although much of the Central Valley grassland has been displaced by intensive agriculture, annual grassland has been displaced by intensive agriculture, annual grassland has become common in the coast ranges (Huenneke 1989).

Although grasslands persist, the native flora of California's grasslands has experienced one of the world's most dramatic episodes of ecological invasions (Mooney et al. 1986a). After settlement by the Spanish, many annual grasses and forbs native to Eurasia and the Mediterranean basin spread rapidly through California, and quickly became dominant in most California grasslands (Burcham 1957, Baker 1989). Today California annual grassland is overwhelmingly dominated by these invaders (such as members of the genera *Avena*, *Bromus*, *Erodium*, and *Hordeum*). These species constitute a stable, permanent annual vegetation in California (Heady 1977), in contrast to the successional or ruderal nature of the same species assemblages in their native Mediterranean ranges (Jackson 1985).



Effects of Temporal Variability on Rare Plant Persistence in Annual Systems

Jonathan M. Levine[1,2] and Mark Rees[2,*]

[1] Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, California 93106;

[2] Department of Biological Sciences and Centre for Population Biology, Imperial College at Silwood Park, Ascot, Berkshire SL5 7PY, United Kingdom

Submitted December 2, 2003; Accepted May 11, 2004; Electronically published August 12, 2004

Online enhancement: appendix.

ABSTRACT: Traditional conservation biology regards environmental fluctuations as detrimental to persistence, reducing long-term average growth rates and increasing the probability of extinction. In contrast, coexistence models from community ecology suggest that for species with dormancy, environmental fluctuations may be essential for persistence in competitive communities. We used models based on California grasslands to examine the influence of interannual fluctuations in the environment on the persistence of rare forbs competing with exotic grasses. Despite grasses and forbs independently possessing high fecundity in the same types of years, interspecific differences in germination biology and dormancy caused the rare forb to benefit from variation in the environment. Owing to the buildup of grass competitors, consecutive favorable years proved highly detrimental to forb persistence. Consequently, negative temporal autocorrelation, a low probability of a favorable year, and high variation in year quality all benefited the forb. In addition, the litter produced by grasses in a previously favorable year benefited forb persistence by inhibiting its germination into highly competitive grass environments. We conclude that contrary to conventional predictions of conservation and population biology, yearly fluctuations in climate may be essential for the persistence of rare species in invaded habitats.

Keywords: environmental fluctuations, rarity, exotic invasion, grasslands.

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Biodiversity and invasibility in grassland microcosms

Jeffrey S. Dukes

Received 18 May 2000; Accepted 14 September 2000; Published online 30 November 2000

Abstract In the years since Charles Elton proposed that communities should be less susceptible to invasion by exotic species, empirical studies have both supported and refuted Elton's hypothesis. Here, I use grassland community microcosms to test the effect of functional diversity on the success of an invasive annual weed (*Centaurea solstitialis* L.). I found that high functional diversity reduced the success of *Centaurea* by reducing resource availability. An equally important but unstudied, question is whether diversity can buffer a community against the impacts of invasive species. In this experiment, although species diversity (independent of functional diversity) did not affect the success of the invader, the invader suppressed growth of species-poor communities more strongly. Invasion of *Centaurea* also increased consumer exploitation in species-poor communities. These results suggest that loss of species diversity alone does not affect community invasibility, but that communities with fewer species may be more likely to decline as a consequence of invasion.

Keywords: Biological invasions · California grassland · *Centaurea solstitialis* · Competition · Species richness

Introduction

An ecosystem's susceptibility to invasion is thought to be influenced by many factors, including the composition and diversity of resident species (Elton 1958; Remanek 1989; Robinson et al. 1995; Crawley et al. 1999; Levine and D'Antonio 1999). It is commonly hypothesized that diverse communities use resources more completely than

Patterns of invasion within a grassland community

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Summary

1 Relatively few studies have looked for patterns of invasion by non-native species within communities. We tested the hypotheses that (i) some types of microhabitats within a community are more invasible than others; (ii) microhabitat types that differ in invasion also differ in resource availability; and (iii) invasibility is mediated by effects of these resources on competition between native and non-native species.

2 To test the first two hypotheses, we measured plant cover and soils in a coastal grassland in northern California. Consistent with these hypotheses, cover of non-native plants was consistently high where nitrogen-fixing shrubs had recently grown, in the bottoms and sides of gullies and on deep soils, and these microhabitats tended to have relatively high nitrogen or water availability.

3 Cover and number of native species tended to be lower where cover of non-native species was higher, indicating that non-native species are a major negatively affected native species. However, the number of non-native species also tended to be lower where the total cover of these species was higher. This suggests that a few non-native species excluded natives and other non-natives alike.

4 To test the third hypothesis, we grew a common non-native, the annual grass *Lolium multiflorum*, and a common native, the perennial grass *Hordeum brachyantherum*, at different levels of water and nitrogen. The relative competitive ability of the native was higher at lower nitrogen availability but not at lower water availability. When both invaded native plants were grown with non-native seedlings and nitrogen was relatively low, the native out-competed the non-native. However, the non-native out-competed the native at all resource levels when species were both grown as seedlings. Competition between native and non-native grasses in this system may thus help prevent invasion by non-natives in microhabitats where nitrogen availability is low, but invasion may be relatively irreversible.

Key-words: invasive plant species, northern California coast, plant competition, soil characteristics, water and nitrogen availability

Journal of Ecology (2002) **90**, 871–881

Introduction

The invasibility of natural communities, i.e. the likelihood that additional species will become established among the existing species in a habitat, has long been a central issue in ecology (e.g. Elton 1958). The accelerating spread of non-native species (Mooney & Hobbs 2000), defined as those carried by humans into

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a region (Randall 1997), offers an opportunity, as a practical reason to study the factors that [illegible] invasibility.

Comparisons of the degree to which non-native species have spread into different communities suggest that types of communities or habitats are more invasible than others (e.g. Lonsdale 1999; Rodrigues et al. 1998). A range of factors may underlie these differences (e.g. D'Antonio et al. 1999; Alpert et al. 2000; Richardson et al. 2000b), including disturbance, resource availability, habitat fragmentation and accessibility, evolutionary history, propagule pressure, predation, mutualism, and competition. These factors interact with one another and with the characteristics of individual species (Richardson et al. 2000b), making it difficult to identify the causes of invasibility in individual cases

The Land Manager

Public Grassland Manager

- >250 land managers in Central California
- > 50% of publically owned grasslands in the SF Bay area actively managed

Elkhorn Slough Coastal Training Program 2005 Grassland Manager Survey Results

Public Grassland Manager Priorities

- Reduce all non-native species
- Increase targeted sensitive species
- Increase native grasses

Elkhorn Slough Coastal Training Program 2005 Grassland Manager Survey Results

The Policymaker

Statewide/Regional Conservation Initiatives

The California Land Conservation (Williamson) Act

2006 Status Report

Natural Resources Conservation Service — California

Features | News | Programs | Technical Resources | MLRA Office 2 | Partnerships | Contact Us

Grassland Reserve Program (GRP)

The Grassland Reserve Program (GRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. Section 2401 of the Farm Security and Rural Investment Act of 2002 (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize this program. The Natural Resources Conservation Service (NRCS), Farm Service Agency and Forest Service are coordinating implementation of GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.

Grasslands make up the largest land cover on America's private lands. Privately-owned grasslands and shrublands cover more than 525 million acres in the United States. For the first time, the U.S. Department of Agriculture will direct financial resources and technical expertise to help landowners protect and restore these lands.

- National GRP Information

California NRCS GRP Information

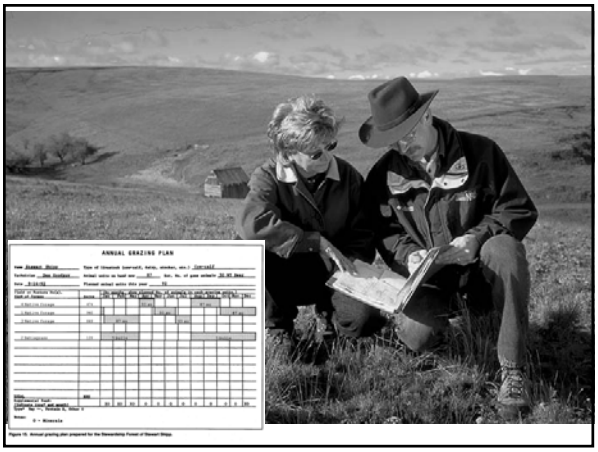
Note: There is no funding allocation for the GRP program for Fiscal Year 2006. Therefore there is no FY06 application period or instructions.

How to Apply for GRP in California

Not Applicable for Fiscal Year 2006.

Prior Applicants

Applications received in a previous year for GRP will continue to be considered for funding unless the application is withdrawn at the written request of the applicant. Applicants who want to change what is included in a previous GRP offering can cancel the previous application and reapply. Such changes that might affect an application this way would include modification of location or acreage within

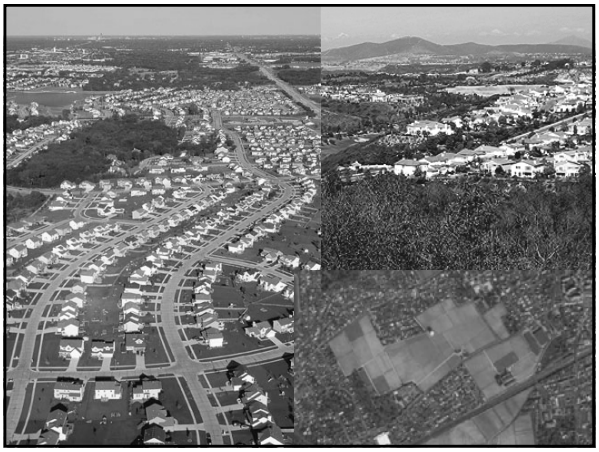


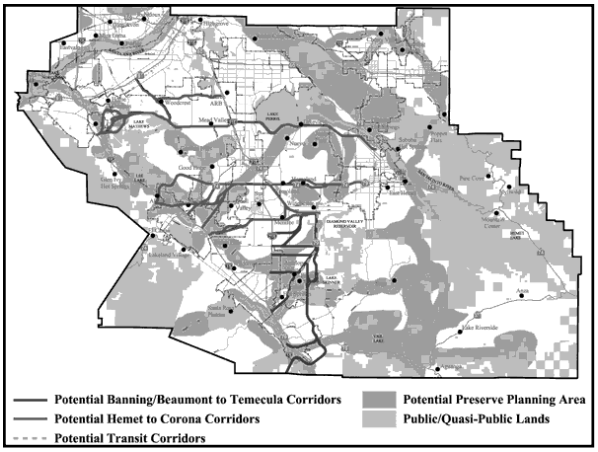
The Land Use Planner

Planner's Code of Ethics

- We shall have special concern for the long-range consequences of present actions.
- We shall promote excellence of design and endeavor to conserve and preserve the integrity and heritage of the natural environment.
- We shall not direct or coerce other professionals to make analyses or reach findings not supported by available evidence.

American Institute of Certified Planners Code of Ethics and Professional Conduct
Adopted March 19, 2005; Effective June 1, 2005




Potential Banning/Beaumont to Temecula Corridors
Potential Hemet to Corona Corridors
Potential Transit Corridors
Potential Preserve Planning Area
Public/Quasi-Public Lands

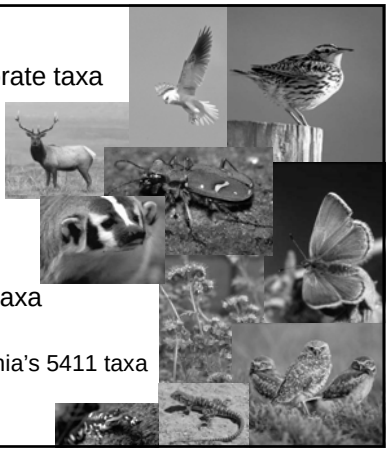
The Regulator

282 native vertebrate taxa

- 101 mammals
- 130 birds
- 14 amphibians
- 38 reptiles

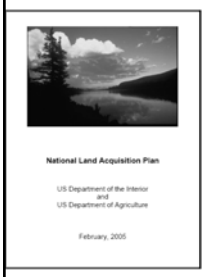
996 native plant taxa

- 18% of California's 5411 taxa

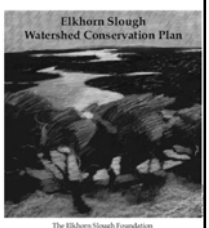


# sensitive taxa in CA grasslands	% of total sensitive taxa in CA	Taxonomic Group
54	12%	Vertebrates
46	13%	Invertebrates
479	31%	Plants

Conservation Lands Acquisition Agents



Conceptual Area Preservation Plan Plan



Work on "pocket park" completed

Forever green

First part of Resica Falls Boy Scout Reservation conserved as open space

How're we doing?

The Scientist

Almost no reserve design studies

A few species-specific studies
(mostly dominant grasses)

Many studies on invasives, with little application

27 fire studies; 19 useful for meta-analysis

25 grazing studies; 6 useful for meta-analysis

The Public Lands Manager

- Parcels are not visited yearly
- <1 staff person for 16,000 acres
- Loss of endangered species = greater burden on private property owners

Holloran, P., and D. Press. 2005. Obstacles to Land Stewardship in California. Draft Report

The Public Lands Manager

- 1/3 of properties have no management plans
- Outdated management plans on many properties
- Insufficiently document management efforts

California State Auditor, "California's Wildlife Habitat and Ecosystem: The State Needs to Improve Its Land Acquisition Planning and Oversight," Report No. 2000-101, June 2000

The Policy Maker

The Land Use Planner

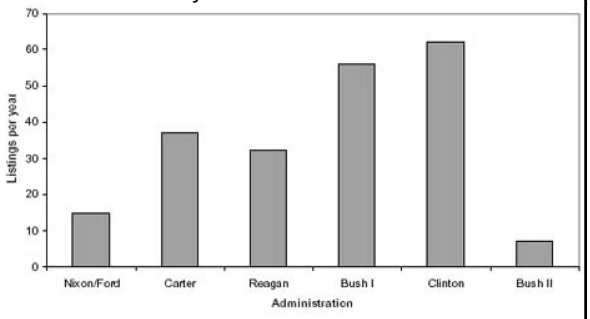
- Municipalities: mixed success
  - Monterey County: 5 years, 3 versions, $5,000,000 General Plan Update
  - Ventura: uses science, progressive policies
  - Very few have grassland ordinances
- Coastal Commission
  - Local Coastal Program violations rampant
  - Total of $2,000,000 of fines revenue year

The Regulator

Would the proposal result in impacts to:	Potentially Significant	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Endangered, threatened or rare species or their habitats (including but not limited to plants, fish, insects, animals, and birds)?	☐	☒	☐	☐
b) Locally designated species (e.g., heritage trees)?	☐	☒	☐	☐
c) Locally designated natural communities (e.g., oak forest, coastal habitat, etc.)?	☐	☐	☐	☒
d) Wetland habitat (e.g., marsh, riparian, and vernal pool)?	☐	☐	☐	☒
e) Wildlife dispersal or migration corridors?	☐	☐	☐	☒

Few T&E listed species
No clear nexus for community protection
Cumulative impacts rarely analyzed

Number of Endangered Species Listed Each Year by the Federal Gov't

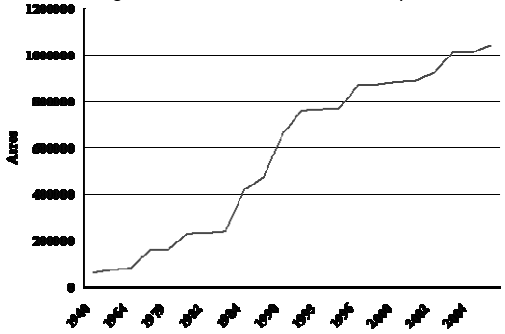


Center for Biological Diversity

Conservation Banks

The Conservation Land Acquisition Agent

Acres of grassland-oriented conservation purchases



The Acquisition Agent

Habitat type	Private	Public	Total	% Private
Conifer woodland	434	1,166	`1,599	27
Desert shrub	3,804	10,500	14,304	27
Desert woodland	25	9	34	73
Hardwood woodland	4,036	634	4,669	86
Hardwood forest	85	43	128	66
Grassland	8,273	889	9,163	90
Shrub	5,135	6,504	11,638	44
Wetland	129	60	189	68

Figures in thousands of acres

California Department of Forestry 2003

How do California's grasslands fare?

Most invaded system in world

One of the top ten most endangered ecoystems in U.S.

Coastal prairie is the most urbanized habitat type in U.S. (and the most diverse in No.Am.)

99%

Loss of native grassland

(Kreissman 1991)

26%

Loss of native annual and perennial grasslands between 1945 and 1980

(Mayer and Laudenslayer 1988)

8,653%

Increase in non-native annual grassland

(Barbour et al. 1991)

99.9%

Loss of needlegrass steppe

(Barbour et al. 1991)

90%

Loss of northern coastal bunchgrass

(Barbour et al. 1991)

68.3%

Loss of alpine meadows

(Barbour et al. 1991)

All Grassland Endangered Species Continue to Decline

How could we do better?

Scientists

- Study questions with clear *application* for grassland management, and propose solutions to decision makers
- Inventory species distributions to prioritize conservation activities
- Help develop nomenclature for grassland communities
- Clarify the importance of genetic vs. more easily obtained demographic data for species recovery
- Increase genetic sampling to assess not just listed species, but also other species of concern
- Inform agencies with data: petition to protect vertebrate populations under the federal ESA and create lists of regionally significant populations for protection under CEQA
- Describe grassland species response.
- Explore potential grassland indicator species including ones that could be planted in grasslands to facilitate monitoring

The Land Manager

- Create adaptive management regimes
- Assess management outcomes
- Communicate with other grassland managers
- Demonstrate management practices
- Be familiar with landscape-scale issues: species need varying frequencies, intensities, and types of disturbance
- Work with others in designing and acquiring effective reserves and corridors.
- Protect grassland corridors while restoring and managing seed dispersal agents – e.g., California quail and ungulates

The Policy Maker

- Create a regulatory nexus for large-scale grassland reserves
- Create more regional governance, like the Coastal Commission
- Give grasslands legal protection
- Legally reinforce the centrality of avoidance with CEQA; clarify the meaning of 'mitigation'

The Land Use Planner

- Integrate genetic considerations in mitigation
- Put conservation priorities in open space protection, especially in general plans.
- Provide mechanisms for long term stewardship, connectivity to larger scale conservation efforts (corridors), and mitigation for ongoing impacts of development.
- Better estimate funding needed to implement mitigation and monitoring,
- Funding and other uncertainties should be reviewed by third party scientists
- Use CEQA rules to protect species *and* habitats, including newly recognized grassland types.
- Incorporate regional landscape planning with local/regional plans

Regulators

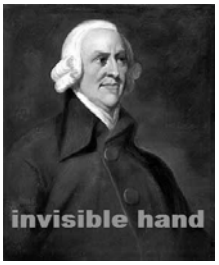
- Protect invertebrate and plant species *and* populations
- Use genetic studies to inform listing decisions
- Prioritize genetic research in species recovery plans
- Partner with research institutions
- Create lists of regionally significant populations for protection under CEQA
- Speed recovery plan production and frequently revision.
- Define corridors as part of critical habitat designations
- Reinvigorate biodiversity councils and other groups for regional landscape conservation

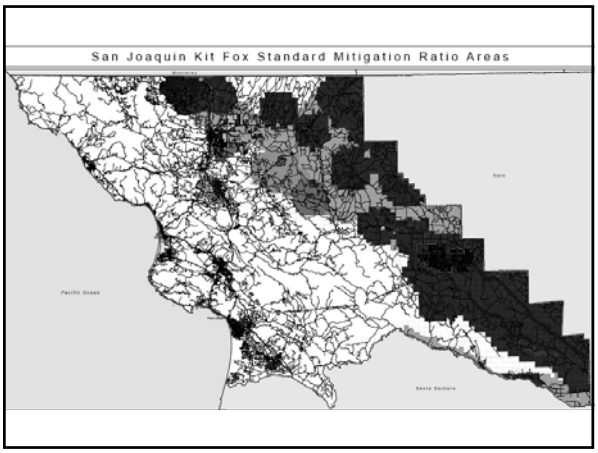
Conservation Lands Acquisitions Agents

- Reference genetic conservation efforts suggested in recovery plans.
- Resolve issues with data sharing. Releasing reserve design maps increases land prices, but withholding data hinders cooperation among diverse interests.
- Learn from other countries' to incorporate 'working landscapes' with conservation, especially Mediterranean areas like South Africa and France.
- For better information, ask scientists and use GIS *analyses* not just maps.
- Improve mechanisms other than fee title ownership. With systems for grasslands parallel to sustainable forestry certification, conservation easements might include better conditions and monitoring.
- Create performance measures for success in grassland conservation programs

Not enough $

Its this guy's fault

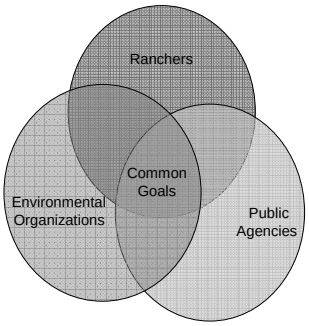


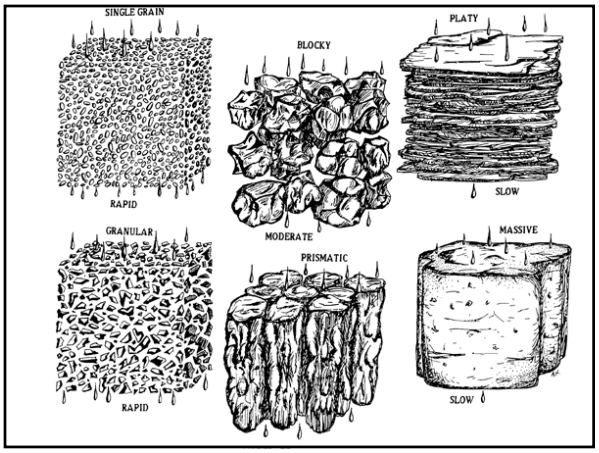


The Central Coast Rangelands Coalition

A Case Study in
Collaborative Research
And Ecosystem-Based Management

Collaborative Research




SINGLE GRAIN
RAPID
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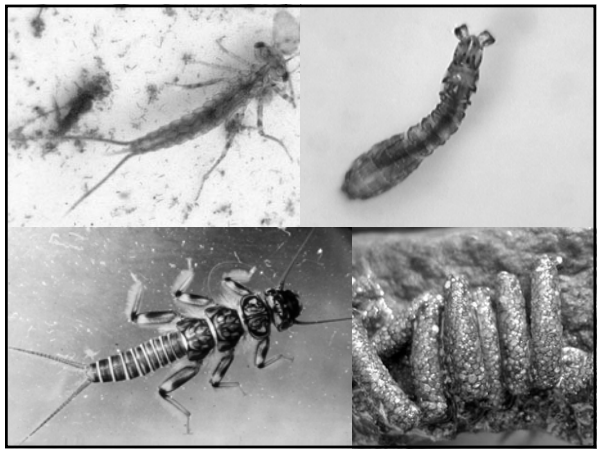
SLOW

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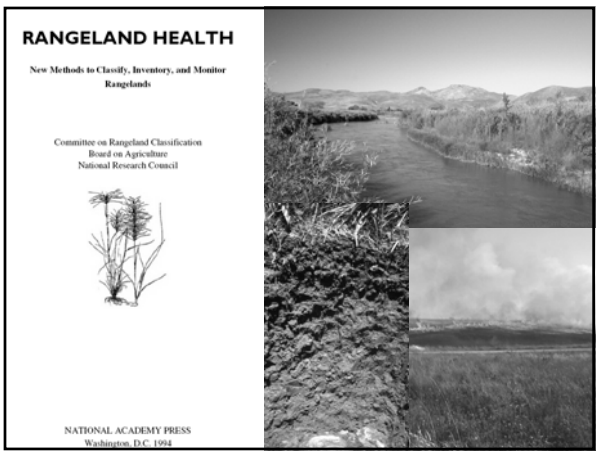
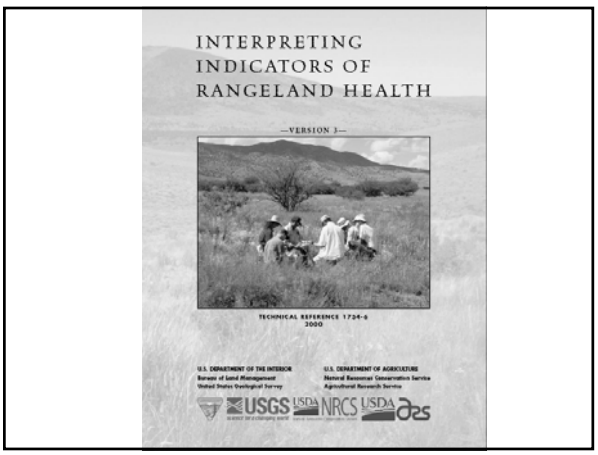
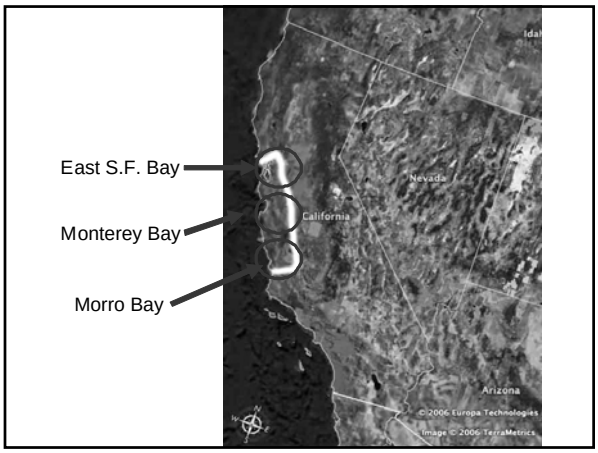
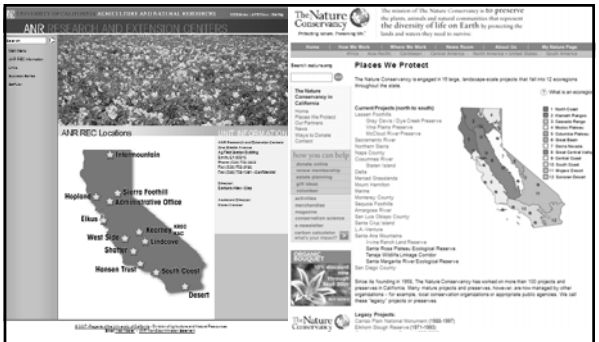

RANGELAND HEALTH
New Methods to Classify, Inventory, and Monitor Rangelands
Committee on Rangeland Classification
Board on Agriculture
National Research Council
NATIONAL ACADEMY PRESS
Washington, D.C. 1994


INTERPRETING
INDICATORS OF
RANGELAND HEALTH
—VERSION 3—
TECHNICAL REFERENCE 1734-6
2000
U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management
United States Geological Survey
U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
Agricultural Research Service
USGS
USDA NRCS
USDA ARS



CCRC 5-Year Goals

- Increase the capacity of land managers to steward central coast rangelands by:
  - Increased capital
  - Increased community and neighbor support
- Build to 1,000,000 acres of cooperating lands
- Continue to monitor participating ranches
- Measurably increase the public's understanding the value of sustainably managed rangelands

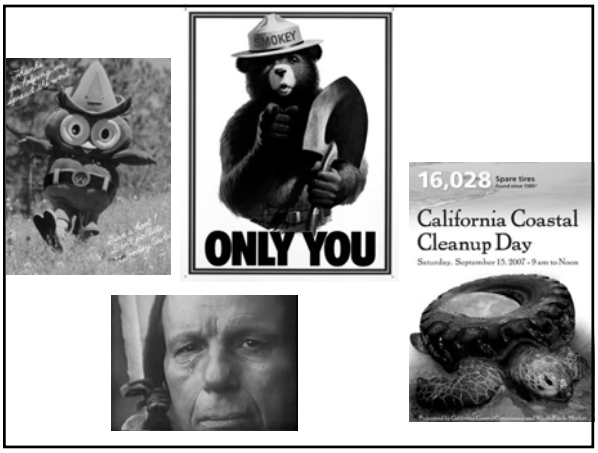


Regional Education and Research Leadership

Community Education

Community Education

- Ecosystem services
  - Management is necessary
  - Management needs funding
- History
  - Grasslands are integral to California's culture
- Land use planning
  - Is good for everyone
- Grassland critters are cute and worth saving



What can you do?

Find Reference Sites

Change your terminology

Change your terminology

- Eliminate “overgrazing”

Change your terminology

- Eliminate “overgrazing”
- Eliminate free-standing term ‘grazing’ and most generalizations thereof

Change your terminology

- Eliminate “overgrazing”
- Eliminate free-standing term ‘grazing’ and most generalizations thereof
- Ditto with ‘fire’ and ‘rest’

Be a scholar:

Read and recall
peer-reviewed literature

Work Across Disciplines

Work Across Disciplines

Work with Others

Work Across Disciplines

Work with Others

More Frequently