EXOTIC PLANTS OF NORTHERN ROCKY MOUNTAIN ENVIRONMENTAL ZONES

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Introduction

The Rocky Mountain exotic plant project is designed to determine (1) what exotics are capable of invading disturbed sites in major vegetational (environmental) zones of the Northern Rocky Mountains and (2) whether they are capable of invading near-climax closed vegetation in those zones. As an accessory activity we are determining (3) what natives are invading the same disturbed zones since we hope to find, among them, species likely to be successful on these sites and therefore species that might competitively exclude exotic invaders. A second accessory project of interest to managers, but with less immediate scientific value, was designed to (4) record the present distribution of major weeds along roadsides of Grand Teton National Park as they were recorded in Glacier during 1983-84.

Methods

To determine the invasion capacities of exotic plants we have sampled major vegetation zones for exotics (and invading natives) (1) in constantly disturbed zones between highways and adjacent ditches, (2) in heavily disturbed, but presently succeeding, sites across the ditch, (3) in deforested, but otherwise little disturbed, sites between the road cut and adjacent near-climax vegetation, and (4) in the adjacent near-climax vegetation itself. These zones represent the range of disturbance types found in most habitats. We have studied zone (habitat series and type) invasion-susceptibility at roadsite sites because disturbed microsites suitable for establishment of invading species are available. We are studying invasion of native vegetation at adjacent sites because competitive effects there will be exhibited on a background of similar environmental conditions and seed availability, i.e. the background conditions are well controlled.

To record the present distribution of weed species in Grand Teton National Park we listed those exotics present at points located at one-mile intervals along all major roads in the park. A comparable project conducted by C. Key and D. Lang in Glacier involved making species lists at points spaced at 1/3 mile intervals along major roads of that park.

Results

We now have data on exotic invasion of disturbed and undisturbed sites in four of the six major environmental zones (including eleven habitat types) listed in Table 1 and need more data from three regionally important types indicated there. The 57 sites sampled in 1984 and the 50 sites sampled in 1985 represent the Abies, Thuja - Tsuga, and Festuca zones well. In 1986 we hope to sample fifty or more additional stands representing the Tundra, Pseudotsuga forests, and Agropyron grasslands needed to support statements about exotic invasion in the region. To that end we have taken reconaissance trips along roads of Teton, Yellowstone, Glacier and intervening areas.

Preliminary data suggest that our study will finally recognize the four groups of exotic species (Table 2). The first group occupies relatively warm-dry Festuca-Populus sites and further study is needed to determine its adaption to Agropyron grasslands of the foothills as well. The second appears in warm sites, wet or dry, and it seems likely that sampling to date may have adequately outlined its distribution. The distribution of species of the third moist forest zone is probably well deliniated. A fourth group appears to be localized in the Abies zone but further sampling is required to determine its capacity to invade lower Pseudotsuga and higher Tundra zones.

The capacity of the species which enter a zone to invade undisturbed vegetation is indicated by the presence of the plant in undisturbed sites adjacent to infested roadside sites. Aggressiveness maps for 36 species appearing in Weaver and Woods (1985) include most but not all species we expect to identify in the Northern Rockies. Study of these tables suggest that, at least in Glacier, introduced pasture grasses, Chrysanthemum leucanthemum, Euphorbia escula, and Centaurea maculosa are invaders deserving tight management. At the other extreme, species like Hordeum jubatum, Plantago lanceolata, Pantago major and Veronica officinale are of little concern since they are apparently restricted to constantly disturbed sites. Incorporation of data from other areas and vegetation zones will permit us to appropriately magnify or temper our initial impressions of the aggressiveness of individual species. It will also help us to identify invaders not yet in a region (e.g. Teton or Glacier), but likely to invade a zone there when they arrive.

Exotic species might be controlled by quarantine; by continual elimination via cultivation, grazing or herbicide spraying; or by competition. If we assume that the native invaders are also entering disturbed sites a list of major invaders may indicate species which might be seeded as exotic-excluding competitors. Table 3 provides a preliminary list of the most aggressive native invaders corresponding to each of the four exotic groups listed above.

Conclusions

Sampling conducted during the summer of 1984 in Glacier National Park showed that a sampling of "natural experiments" can tell us in what environmental zones major exotics can survive and whether they can invade native vegetation there.

Table 1. Progress in a sampling of major vegetation zones needed to forcast the exotic invasion of site appearing in major environments of the Northern Rocky Mountains.

Vegetation zone	Habitat types studied and location[1,2,3]
Tundra	none, planned for Glacier and The Beartooth Plateau[3]
Abies lasiocarpa	Arnica cordifolia[2] yaccinium scopariu[2] Xerophyllum tenax, [1] Clintonia uniflora[1]
Tsuga heterophylla and Thuja plicata	Clintonia uniflora[1] and Oplopanax horridum[1]
Pseudotsuga menziesii	none, planned for Yellowstone[3], Glacier[3], and intervening areas
Festuca grasslands	Festuca idahoensis-Agropyron canium[2] Festuca scabrella-Festuca idahoensis[1]
Artemisia tridentata	Festuca idahoensis[2]
Artemisia arbuscula	Agropyron spicatum[2]
Agropyron spicatum[3]	

[1]Vegetation of Glacier National Park sampled in 1984.

[2]Vegetation of Grand Teton National Park sampled in 1985.

[3]Vegetation of Glacier National Park, Yellowstone National Park and intervening areas to be sampled in 1986.

Table 2. Location and agressiveness of major exotic plants in Glacier National Park. The plant list runs from general invaders, to those most common in grasslands, grasslands and dry forests, warm grasslands and forests, cool-dry forests only, and warm moist forests only. The environments were indicated by climax communities; additional data on plant relationships to degree of disturbance appear in Appendix Tables 1-37. Tabular records give the highest recorded values of constancy (P) and cover (C) for each species in each environmental type.

Species	Environmental type Festuca		Populus		Abies-Xero		Abies-Clin		Tsuga-Clin		Thuha-Oplo	
	P	C	P	C	P	C	P	C	P	C	P	C
Agrostis alba	3	3	9	9	5	0	7	1	9	5	6	3
Bromus inermis	6	2	4	0	8	8	10	6	6	7	5	10
Centaurea macu	9	17	8	5	3	0	3	0	2	0	6	4
Cerastium vulgar	4	0	0	0	2	0	0	0	4	0	0	0
Dactylis glomer	4	1	1	0	3	0	4	0	8	4	4	0
Melilotus alba	1	0	0	0	1	0	0	0	0	0	2	0
Phleum pratense	9	2	10	7	9	10	10	9	7	2	9	7
Plantago major	4	0	5	1	2	0	7	2	8	15	7	3
Poa compressa	8	2	10	6	8	0	7	0	1	0	8	2
Poa pratensis	8	4	9	5	7	4	7	3	9	13	9	4
Taraxacum offic	8	1	10	12	9	8	10	4	1	12	9	5
Tragopogon dubi	4	0	1	0	4	0	2	0	0	0	4	9
Trifolium hybr	2	0	6	1	8	4	9	8	1	1	9	3
Trifolium prat	1	0	3	0	6	6	2	0	7	5	9	3
Trifolium proc	7	2	10	3	8	2	8	3	7	1	7	5
Agropyron repen	1	0	0	0	0	0	0	0	0	0	0	0
Melilotus offi	9	1	10	4	2	0	1	0	0	0	3	0
Al yssum alyss	5	0	1	0	0	0	0	0	0	0	0	0
Medicago sativ	0	0	1	0	0	0	0	0	0	0	0	0
Arabis glabra	1	0	0	0	2	0	1	0	0	0	0	0
Cirsium arve	3	1	9	2	0	0	0	0	4	0	1	0
Hordeum jubatum	1	0	1	0	0	0	0	0	0	0	1	0
Linaria vulgaris	2	1	0	0	0	0	0	0	1	0	1	0
Verbascum thap	2	0	1	0	0	0	0	0	1	0	6	2
Cirsium canaden	0	0	0	0	1	0	1	0	0	0	0	0
Linaria dalmat	0	0	0	0	0	0	1	0	0	0	0	0
Phalaris arund	0	0	0	0	0	0	1	0	0	0	0	0
Rumex acetosa	0	0	0	0	1	0	0	0	0	0	0	0
Artemisia absi	0	0	0	0	0	0	1	0	0	0	3	0
Chrysanthemum leu	0	0	0	0	0	0	2	1	7	5	9	6
Cirsium vulgaris	0	0	0	0	0	0	2	0	2	0	7	0
Plantago lanc	0	0	0	0	0	0	1	0	4	1	1	0
Silene cucubalis	0	0	0	0	0	0	3	0	0	0	3	0
Trifolium agra	0	0	0	0	0	0	2	0	4	0	3	0
Trifolium repens	1	0	3	0	8	2	8	2	10	13	9	5
Hypericum perfor	0	0	0	0	0	0	0	0	0	0	4	0
Verbascum offici	0	0	0	0	0	0	0	0	2	1	1	0

1
Environmental zones are indicated by climax communities (Pfister et al 1977 and Muggler and Stewart 1980) occupying them. Festuca scabrella-Festuca idahoensis, Populus tremuloides, Abies lasiocarpa-Xerophyllum tenax, Abies lasiocarpa-Clintonia uniflora, Tsuga heterophylla-Clintonia uniflora, and Thuja plicata-Oplopanax horridum. Alpine and drier grassland zones are to be added.

2
Tabled constancy values (P) give the number of sites (out of ten) in the type in which the plant was found and cover values give the highest percent cover recorded in any disturbance zone. Less condensed summaries useful for examining the capacity of the exotics to compete with natives in open or closed stands appear in appendix tables.

Table 3. Native species most aggressively invading Glacier National Park roadsides [1] in six environmental zones. [2] Species with broad altitudinal ranges are listed first and followed by those only found in grasslands and moister conifer forests. The presence of each species is dictated both by a percent constancy figure (P) and a percent cover (C) figure[3].

Species	environmental type Festuca		Populus		Abies-Xero		Abies-Clin		Tsuga-Clin		Thuja-Oplo	
	P	C	P	C	P	C	P	C	P	C	P	C
Achillea millef	9	1	10	2	10	4	9	3	7	1	6	1
Agropyron can m.	2	0	9	1	6	3	2	1	0	0	1	0
Agropyron spic	5	2	1	0	1	0	1	0	0	0	1	0
Anaphalis marg	1	0	0	0	4	0	9	2	7	1	8	0
Antennaria rose	4	0	0	0	5	1	1	0	0	0	2	0
Aster laevis	1	0	0	0	7	3	6	5	5	2	2	1
Carex spp	3	0	3	2	6	2	3	1	4	1	4	1
Epilobium angust	1	0	0	0	4	0	1	0	0	0	3	0
Epilobium pani	0	0	1	0	0	0	6	0	0	0	1	0
Festuca idaho	9	3	0	0	2	0	4	1	0	0	1	0
Festuca scab	6	0	1	0	2	0	3	1	0	0	5	4
Fragaria virg	6	1	6	0	5	1	9	4	10	5	7	3
Rosa spp	8	3	4	1	1	0	0	0	1	0	1	0
Agropyron can a.	5	1	3	0	3	0	0	0	0	0	0	0
Aster spp	6	1	8	4	2	0	0	0	0	0	0	0
Geranium visc	4	1	4	1	1	0	0	0	0	0	0	0
Lupinus arge	1	0	5	3	0	0	0	0	0	0	0	0
Lupinus seri	6	6	4	1	5	2	0	0	0	0	0	0
Penstemon conf	6	0	3	0	5	4	0	0	0	0	0	0
Potentilla grac	6	1	5	1	4	0	0	0	0	0	0	0
Potentilla fruti	5	1	1	0	1	0	1	0	0	0	0	0
Equisetum arve	1	1	5	4	0	0	0	0	5	1	2	1
Arnica latifol	0	0	0	0	1	0	1	1	0	0	0	0
Pinus contorta	0	0	0	0	2	6	1	2	0	0	2	1
Circaea alpina	0	0	0	0	2	0	1	0	8	1	0	0
Alnus sinu	0	0	0	0	4	0	0	0	1	1	2	9
Geum macr	0	0	0	0	0	0	0	0	7	9	0	0
Rubus parvi	0	0	0	0	0	0	2	1	4	2	3	2
Salix spp	0	0	1	0	3	0	3	0	1	0	6	1

[1] The roadside zone described here included the shoulder and both ditch slopes. These descriptions are supported by tables similar to the exotic species tables appearing in appendix tables, but which are not presented here.

[2] Environmental zones are indicated by climax communities Pfister et al. 1977 and Mueggler and Stewart 1980), occupying them: Festuca scabrella-Festuca idahoensis, Populus tremuloides, Abies lasiocarpa-Xerophyllum tenax, Abies lasiocarpa-Clintonia uniflora, Tsuga heterophylla-Clintonia uniflora and Thuja plicata-Oplopanax horridum.

[3] Constancy is the number of sites studied (out of 10) at which the species was found. Cover tells the average percent of the ground covered by that species in that site type; it may appear low if a species has high cover at a site familiar to the reader but absent from other sites in the type.

Sampling during 1985 in Grand Teton National Park was concentrated in similar environmental zones since the most used (best roaded) parts of both Teton and Glacier National Parks are in the Abies-Festuca zone. Wintertime analysis of the resultant data will better demonstrate (1) the variety of invading exotics, (2) their performance in a greater variety of related habitat types, and (3) the degree to which plants present in one part of the region haven't yet reached another.

Sampling planned for the summer of 1986 will extend our conclusions to vegetation important in Teton, Glacier, and Yellowstone, but inaccessible to our sampling design. To find road sites suitable for the estimation of exotic plant effects in the extensive areas of the Tundra, Pseudotsuga, and Agropyron zones of the parks and the region they represent, we need additional samples both from the alpine of Glacier and the Beartooth Plateau and the upper foothills of Yellowstone and similar areas between Yellowstone and Glacier.

Literature Cited

Weaver, T. and B. Woods. 1985. The exotic flora of Glacier National Park: a preliminary atlas. MSU Biology Report #37. MT State Univ., Bozeman, 597171. 66 pp.