

Observations on Spotted and Diffuse Knapweed Invasion into Ungrazed Bunchgrass Communities in Western Montana

John Lacey, Peter Husby and Gene Handl

Spotted knapweed (*Centaurea maculosa*) and diffuse knapweed (*C. diffusa*) were introduced into the Pacific Northwest from Eurasia around 1900 (Roché and Talbott 1986). They vigorously compete with native vegetation. Whereas spotted knapweed has invaded about 4.7 million acres of Montana's range and pastureland, diffuse knapweed infests less than 15,000 acres (Lacey 1987). Most of the infestations occur in the foothills and mountains of western Montana.

The knapweeds are competitively superior to native plants on many sites. Their competitiveness is attributed to prolific seed production, high seed viability, ability of seeds to germinate during fall and over-winter as rosettes, the absence of natural enemies, and the selective grazing of desirable forage plants. Knapweed invasion is most common on sites disturbed by excessive grazing, logging, rodents, or off-road vehicles. However, disturbance may not be a necessary condition for knapweed to invade some grass communities (Myers and Berube 1983, Morris and Bedunah 1984, Tyser and Key 1988).

The rapid invasion of weeds into rangeland is often blamed on man's management. But a question which is rarely asked is whether the knapweeds are able to invade climax bunchgrass communities. This report provides an evaluation of spotted and diffuse knapweed invasion into climax bunchgrass communities in western Montana.

The Study

The study was done at two locations on the Blackfoot-Clearwater Game Range near Ovando, Montana, and a third location near Helena, Montana (Fig. 1).

Ovando Observations

Spotted knapweed invasion into rough fescue communities was measured on a silty range site. Although the fescue communities were surrounded by a grass hay meadow, a few patches of spotted knapweed occurred between the meadow and the rough fescue (Fig. 2). Spotted knapweed infestations were about 200 × 30 ft and 50 × 10 ft at Sites 1 and 2, respectively. The knapweed infestations were a potential seed source for the rough fescue. Seed dispersal was suspected to be aided by prevailing westerly winds. Although the meadow was cut annually, the knapweed was not mowed. The area was lightly grazed by deer and elk. Livestock grazing had been excluded for 30-40 years.

A permanent stake was placed within the knapweed infestation, approximately 3 ft from the rough fescue at each site. A steel tape was fastened to the stake and

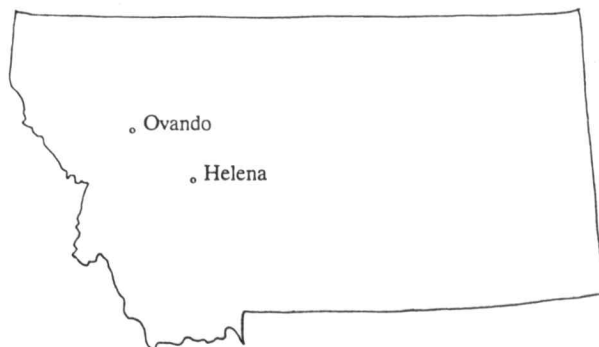


Fig. 1. Location of study sites for observation of spotted and diffuse knapweed invasion into climax bunchgrass communities.

stretched 300 ft into the rough fescue (Fig. 3). One permanent 8 × 20-in plot was located 7 ft from the stake and 20 additional plots were located at 14-ft intervals along each transect. Spotted knapweed plants in each plot were counted annually from 1984 through 1987. The relative importance of other species was determined using the canopy-coverage method (Daubenmire 1959). Thus, the rate at which spotted knapweed moved into the grass community was recorded.

On August 14, 1986, two seed traps were located parallel to the transects at each study site. They were 11 ft by 0.5 ft, constructed from discarded aluminum printing plates (Fig. 4). Petroleum jelly was smeared onto the plates to ensure that the seeds would "stick" to the surface. The collection plates were fastened to the soil surface with spikes. Seeds were collected twice, on September 3 and October 12. Although some seeds remained in the seed heads, the seed traps were removed on the 12th. Nighttime temperatures were dropping to 15° F, which caused the petroleum jelly to lose its effectiveness.

Helena Observations

Diffuse knapweed invasion was measured on a shallow range site at 4,100 ft elevation (Fig. 5). Annual precipita-



Fig. 2. Patches of spotted knapweed were located between the grass meadow and rough fescue communities near Ovando, Mont. (Photo taken from the edge of the meadow).

Authors are extension range management specialist, Montana State University; District Conservationist, Soil Conservation Service, Baker, Montana; and Range Conservationist, Soil Conservation Service, Bozeman, Montana, respectively.



Fig. 3. A metal stake near the edge of the spotted knapweed infestations marked the location of the permanent transect which extended into the rough fescue community near Ovando, Mont.



Fig. 4. Seed traps, constructed from aluminum printing plates, were used to trap seeds.



Fig. 5. Bluebunch wheatgrass dominated the shallow range site near Helena, Mont.

tion averages 10 in. at this site. The site was dominated by bluebunch wheatgrass and was used by Soil Conservation Service personnel as a relict area to evaluate ecological succession. It had not been grazed by livestock for at least 20 years. Diffuse knapweed was established along the banks of an irrigation canal that formed the south edge of the site. Herbage production was clipped and weighted from 1979 through 1987.

The Knapweed Invasion

Ovando Sites

Spotted knapweed moved 14 ft into the rough fescue community at Site 1 during the 4-year study (Table 1). Density of spotted knapweed increased 6-fold (at the 7-ft mark). The conditions responsible for the increase are not known. Spotted knapweed invaded 7 ft at Site 2. Difference in rates of invasion between the study sites may be related to the size of the respective knapweed infestations. The infestation at Site 1 was about 7 times greater than the one at Site 2.

Results from the seed trap indicated that knapweed seed dispersal was concentrated near the infestations. About 50% of the total seed was disseminated within 2 ft

Table 1. Invasion of spotted knapweed into rough fescue communities during a 4-year study at Ovando, Mont.

Year	Distance from the knapweed (ft) ¹	Number of knapweed plants per plot (8 × 20 in)	
		Site 1	Site 2
1984	7	7	0
	21	0	0
	35-287	0	0
1985	7	11	1
	21	0	0
	35-287	0	0
1986	7	10	1
	21	0	0
	35-287	0	0
1987	7	42	1
	21	2	0
	35-287	0	0

¹The first plot at each site was located 7 ft from the stake marking the transition between the knapweed and grass communities. Subsequent plots were located at 14-ft intervals.

Table 2. Number of spotted knapweed seeds trapped at two sites in 1986, Ovando, Mont.

Distance from knapweed front (feet)	Site #1				Site # 2			
	September 3		October 12		September 3		October 12	
	Trap 1	Trap 2	Trap 1	Trap 2	Trap 1	Trap 2	Trap 1	Trap 2
0-1	26	39	6	12	3	7	2	3
1-2	18	31	6	10	2	3	0	2
2-3	9	35	3	16	0	1	0	0
3-4	5	26	2	10	0	2	1	0
4-5	5	9	0	2	0	1	0	0
5-6	1	3	0	1	0	0	0	0
6-7	5	4	0	3	1	0	0	0
7-8	5	1	3	1	0	0	0	0
8-9	0	2	0	4	0	0	0	0
9-11	0	3	0	3	0	0	0	0
	74	153	20	62	6	14	3	5

of the knapweed infestation (Table 2). Only 12% of the seed was recovered more than 5 ft from the edge of the infestation. Average number of seeds recovered ranged from 43 seeds/ft² adjacent to the infestation to less than 1 seed/ft² at a distance of 10 ft. Greater seed fall at Site 1 than Site 2 was attributed to the larger knapweed infestation. Seed dispersal would be affected by wind and animals. It is not known if 1986 was a "typical" year.

The knapweed seeds trapped in the grass community (Table 2) indicate that the seed bank was capable of supporting a faster rate of invasion than what was observed. The relatively slow rate of knapweed encroachment may be related to the status of the climax plant community. Annual herbage production approached 2,000 lbs/ac at the Ovando sites. Canopy cover averaged 90% for litter and 66% for rough fescue. Bare ground averaged 2.7%. Thus, exposed soil was minimal. Under these conditions, the rough fescue climax community was fairly resistant to knapweed invasion.

Helena Site

Total herbage production ranged from 215 lbs in 1985 to 885 lbs in 1986 (Table 3). In 1982, a severe hail storm knocked down the grass, and made it impossible to clip. The hail also physically "impacted" the soil surface.

Diffuse knapweed was not present on the site prior to 1982. However, it invaded the bluebunch wheatgrass after the hail storm. From 1983 through 1987, it contributed from 7 to 49% of the annual herbage production. Once established, it has persisted in the bunchgrass community.

Table 3. Production of bluebunch wheatgrass, diffuse knapweed, and other species of the Helena, Mont. site from 1979-1987.

Year	Bluebunch wheatgrass	Diffuse knapweed	Other species	Total
	-----lbs/ac-----			
1979	400	0	140	540
1980	445	0	120	565
1981	570	0	155	725
1982	Hailed Out	—	—	—
1983	245	125	245	615
1984	240	95	65	400
1985	135	15	65	215
1986	320	430	135	885
1987	225	235	130	620

Management Implications

Our study indicates that the invasion of climax bunchgrass communities by knapweed invasion may be insidious or rapid. A rough fescue climax community—in the absence of disturbance—appeared to be fairly resistant to spotted knapweed invasion. However, even in the absence of grazing, diffuse knapweed rapidly invaded a bluebunch wheatgrass community. Therefore long-term protection from grazing is not recommended as a deterrent to weed invasion.

The knapweed threat emphasizes the need for ranchers to practice good range management. Spotted and diffuse knapweed invasion onto range is favored by soil disturbance, bare ground, and lower succession stages. Until the ecology of the knapweeds is understood, the following grazing management practices are recommended: 1) alter the season of use, 2) do not overstock, 3) rotate livestock and allow plants to recover vigor before regrazing, 4) leave adequate leaf area (stubble height) following grazing, and 5) allow litter accumulation. Herbicide treatments should be applied as soon as the initial knapweed plants are detected.

Implications from our study clearly support the need for additional research to quantify the relationship between ecological class, rangeland use and invasion of noxious weeds. Cause-and-effect relationships need to be better understood. Our range resource deserves an answer.

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