

Biological Control of Noxious Weeds at the U.S. Air Force Academy and Monument Fire Center, Colorado.

2001 Progress Report

by

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Introduction

The program goal is to reduce the existing populations and control the spread of selected state- and federal-listed noxious weeds. We will continue the release, colonization, and redistribution of biocontrol agents to reduce or eliminate noxious weeds infestations at Air Force Academy and Monument Fire Center. According to the original and subsequent plans of work, some Phase I release and colonization efforts continue on Canada thistle, musk thistle, field bindweed, leafy spurge, diffuse knapweed, and spotted knapweed. These release efforts focus on the establishment of biocontrol agents that were released in 2000, but are not yet established at our release sites. Phase II redistributions of established biocontrol agents are forthcoming for leafy spurge and musk thistle. In addition, we continue to map noxious weed infestations and record plant parameters at each site. These data will be invaluable to Phase III economic and environmental analyses which will take place in the future.

This report describes the progress during 2001. Several organizations have cooperated with this program, including the Colorado Department of Agriculture, Pennsylvania Department of Agriculture, USDA-APHIS Spokane WA, Montana State University, and U.S. Fish and Wildlife.

On the Cover

Apthona nigriscutis, the black dot leafy spurge flea beetle, was released at three sites, Ferl, Douglas school, and Dead Man's Trail, in 2000 and was recovered at all locations in 2001.

PROGRAMATIC ENHANCEMENTS AND INITIATIVES

In order to facilitate the intensive data collection planned at our Colorado biocontrol sites in 2001 we hired two student aides to work full time in the program. The students, Abigail Appleton and Claire Zimmerman, recent graduates of Colorado College, assisted us in georeferencing and mapping weed infestations, collecting plant data (density, height, numbers of seed heads, etc.),

collecting biocontrol agents for new releases and redistributing insects from previously-established sites (Fig. 1).



Fig. 1. Training summer employees, Abby Appleton (on right) and Claire Zimmerman (middle), for research conducted at Fort Carson, Air Force Academy, Rocky Flats, and Monument Fire Center.

Some aspects of biological control of noxious weeds have been questioned in regard to the potential impact biocontrol agents may have on native plants, primarily native thistle species. In order to address these concerns, and continue with a program that blends noxious weed control with good environmental stewardship, a risk assessment was developed in cooperation with Robin Romero (DECAM), and is included in this report. It is our opinion that none of the native thistles found at Air Force Academy or Monument Fire Center are at risk from the biocontrol agents we have released. In addition, any impact on native thistle species by biological control agents must be assessed in light of what would happen to native thistles if noxious thistles, which often occupy the same habitat, were not controlled, and what impact other forms of control, such as chemical and mechanical, would have on native species. Although two insects established at Air Force Academy, Rhinocyllus conicus on musk thistle and Larinus planus on Canada thistle, have been found to infest native thistles, to date it has not been shown that biological control agents released for Canada and musk thistle control reduce the density of native thistles. In fact, Rhinocyllus conicus was established at Air Force Academy long before the current biocontrol program began, perhaps for as long as 10-15 years, however there are still healthy stands of native thistles found on the Academy. In the future we will monitor native thistle populations as well as the noxious thistle species we are attempting to control.

PROGRAM ACCOMPLISHMENTS BY WEED SPECIES

CANADA THISTLE

Canada thistle is in Colorado's top ten state-listed noxious weeds. In February 2001, *Urophora cardui* galls were collected from an established site known as Duck Pond located at Fort Carson, CO (Fig. 2). The galls were released on Canada thistle at Ice Lake Road 2 site (Table 1, Fig. 3). According to Dr. George Markin, Forestry Sciences Laboratory, Montana State University, the galls are rated on a scale of 1 – 5 according to the size of the gall; with a 1 rating approximately walnut-size and a 5 rating approximately pea-size. It takes 80 Class 1 galls to release about 1000 live larvae and 200 Class 4 galls for 1000 live larvae (Table 2). We released approximately 5 Class 1 galls, 5 Class 2 galls, and 40 Class 1 galls for a total of 50 galls (about 550 live larvae).



Fig. 2. One of several *Urophora cardui* galls collected from a Canada thistle site at Fort Carson, CO and released at Ice Lake Road 2, a Canada thistle site at Air Force Academy, CO in 2001.

Table 1. Summary of Insects Released for Biological Control of Weeds at the United States Air Force Academy and Monument Fire Center, 2000 - 2001.

				R	elease	
2001 Releases in RED	BOLD	Target ¹	Date	Site ²	Number	Total
					Cage / Open	
AGENCY						
Colo.Dept. Of Agric	Lesser knapweed flower weevil- L. minutus	SK	07/15/00	1	0 /150	150
		DK,SK	06/19/01	7	0 /100	100
USDA/APHIS, WA	Spotted knapweed seed head moth- M. paucipunctella	SK	04/20/00	1	0 /2	7200^{3}
Penn.Dept.of Agric.	Thistle-feeding shield beetle- C. rubiginosa	CT	07/15/00	3	0 /1	75
	Canada thistle bud weevil - L. planus	CT	07/15/00	3	0 /1	150
Fort Carson, CO	Thistle stem gall fly - U. cardui	CT	02/21/01	3	0 /50	550 ⁵
Colo.Dept.of Agric.	Rosette weevil- T. horridus	MT	06/21/00	2	0 /75	75
Tx Agric. Exp. Sta.,TX	Bindweed gall mite- A. malherbae	BW	06/28/00	5	0 /1	1 ³
Colo.Dept. Of Agric	Black dot leafy spurge flea beetle- A. nigriscutis	LS	06/28/00	4,5,6	0 /2	2000 ⁴
		LS	06/21/00	7	0 /2	2000 ⁴
	Brown-legged leafy spurge flea beetle- A. lacertosa	LS	06/28/00	4,5,6	0 /2	2000 ⁴
		LS	06/21/00	7	0 /1	1000 ⁴
	Black leafy spurge flea beetle- A. czwalinae	LS	06/28/00	4,5,6	0 /2	2000 ⁴
		LS	06/21/00	7	0 /1	1000 ⁴
Biol.Control of Weeds,M	T. Toadflax flower-feeding beetle- <i>B. pulicarius</i>	TF	07/18/01	7	1 <i> </i> 75	75

¹Target: CT = Canada thistle; SK = Spotted knapweed; DK = Diffuse knapweed; MT = Musk thistle; BW = Bindweed; LS = Leafy spurge; TF = Toadflax

²Sites: 1-Monument Creek; 2-Ice lake Road; 3-Ice Lake Road 2; 4-Dead Man's Trail; 5-Ferl; 6-Douglas School; 7-Monument Fire Center.

²Released in screened cages containing 3600 seedheads/cage (approx. 2808 larvae/cage; 78% infestation).

³Release consisted of twenty mite-infested bindweed sprigs placed at the field bindweed site. Each sprig housed approximately 100 mites for a sum of approximately 2000 mites.

⁴All three *Apthona* spp. were collected and bagged together in groups of approximately 1000 mixed adults

⁵Galls rated on a scale of 1-4; approximate number of live larvae/50 galls released.

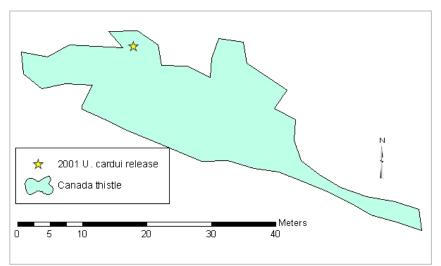


Fig. 2. *Urophora cardui* galls were released at Ice Lake Road 2 Canada thistle site in February 2001.

Table 2. Scale to determine the approximate number of live *Urophora cardui* larvae per gall. Scale derived by Dr. George Markin, Forestry Sciences Laboratory, MSU, Bozeman, MT.

Class # Live Larvae/		Class (Gall volume ²	Class	# galls /
	gall ¹		(cm ³)		1000 live larvae
1	12	1	7.55	1	80
2	10	2	6.10	2	100
3	8	3	4.30	3	125
4	5	4	2.40	4	200
5	4	5	1.30		

¹Approximate number of live larvae per gall

At Ice Lake Road 2 site, Larinus planus and Cassida rubiginosa were recovered on Canada thistle in 2001 (Fig 3). Trichosirocalus horridus was found on Canada thistle at this site but was not released there. It was released at Ice Lake Road 1 on musk thistle, which is located near Ice Lake Road 2 (Fig. 4). This is a distance of approximately 815 meters. Apparently, the weevil moved from Ice Lake Road 1 to Ice Lake Road 2 either by flight or carried by some other form of transportation (i.e. wind, animal, etc).

SPOTTED KNAPWEED

Larinus minutus was recovered from Monument Creek spotted knapweed site in June 2001 (Fig. 5). Monument Creek site was mapped and plant data taken allowing for comparisons to be made over time. Spotted knapweed infestation, densities and heights from 2000 and 2001 were compared (Figs. 6 – 8). Infestation, density and height have all increased, however this is the first year for biological control and the bioagents to establish at this site.

²Gall size ranges from Class 1(walnut size) to Class 5 (pea size) respectively.

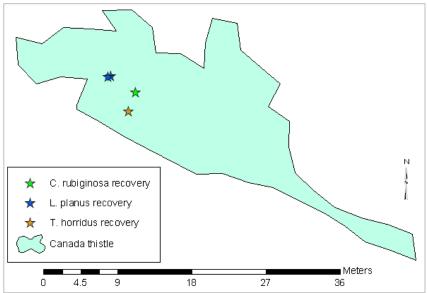


Fig. 3. Map of three recoveries made at Ice Lake Road 2 in 2001.

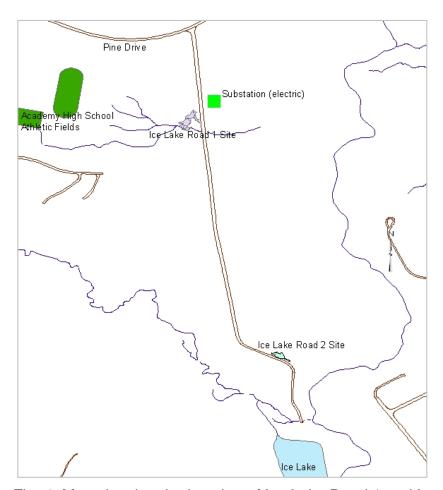


Fig. 4. Map showing the location of Ice Lake Road 1 and Ice Lake Road 2 sites.

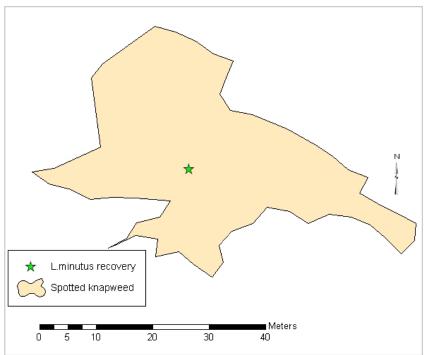


Fig. 5. L. minutus recovery made at Monument Creek site 2001.

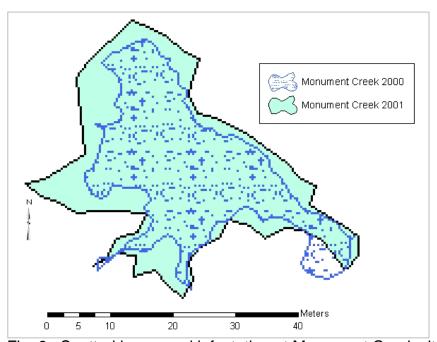


Fig. 6. Spotted knapweed infestation at Monument Creek site in 2000 and 2001.

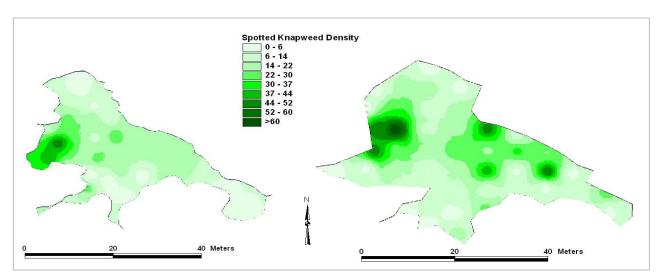


Fig. 7. Spotted knapweed densities per m² in 2000 and 2001 at Monument Creek site.

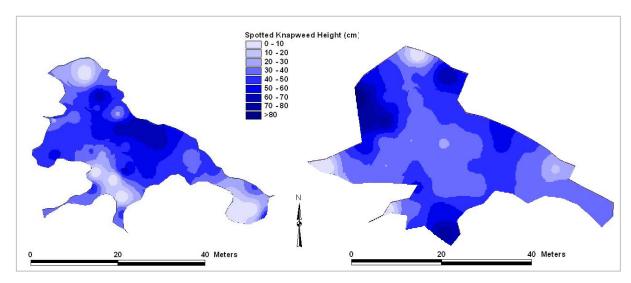


Fig. 8. Spotted knapweed height (cm) at Monument Creek site in 2000 and 2001.

Cyphocleonus achates, the root knapweed weevil, will be released at this site in July 2002. Due to increased security, it was difficult to return to the release site in the Fall of 2001. Spotted knapweed seed heads from Monument Creek were collected by Dr. Brian Mihlbachler and sent to the Texas Agricultural Experiment Station lab for dissection (Table 3). Larval recovery and emergence data for 2000 and 2001 were compared (Table 4).

Table 3. Summary of Larvae Recovered from Spotted Knapweed Seed Heads, Monument Creek Site, 2001.

Species	Status	Larva	al density ¹		Emergi	ng adults	L	arval	fre	qu	end	су	dis	trib	out	ion	2
		total/50	average/	std.	total	percent											
		seed heads	seed head	error			0	1	2	3	4	5	6	7	8	9	10
			4.40				- 4		_	_	_	_		_	_	_	_
Urophora quadrifasciata	Live	59	1.18	0.19	55	88.7	21	17	7	_	2	0	-	0	0	0	0
	Dead	3	0.06	0.03			44	3	1	2	0	0	0	0	0	0	0
	Total	62	1.24	0.20			65	20	8	4	2	0	1	0	0	0	0
Urophora affinis	Live	5	0.10	0.04	5	100.0	45	5	0	0	0	0	0	0	0	0	0
,	Dead	0	0.00	0.00			50	0	0	0	0	0	0	0	0	0	0
	Total	5	0.10	0.04			95	5	0	0	0	0	0	0	0	0	0
Larinus minutus*	Live	1	0.02	0.02	1	100.0	42	8	0	0	0	0	0	0	0	0	0
	Dead	0	0.00	0.00			50	0	0	0	0	0	0	0	0	0	0
	Total	1	0.02	0.02			92	8	0	0	0	0	0	0	0	0	0

¹ Number of larvae in dissected seed heads.

² Seed heads containing the specified number of larvae in fifty seed head sample.

^{*} Larvae will not develop after being removed from the dissected seed head.

Table 4. Summary of Larvae Recovered from Spotted Knapweed Seed heads 2000 - 2001.

Year	Species	Status	Lar	al density ¹		Emergi	ng adults
			total/50 seed heads	average/ seed head	std. error	total ²	percent
			Site: Monum	ent Creek			
	U. quadrifasciata	Live					
2000			74	1.50	0.20	15	20.27
2001			62	1.24	0.20	55	88.71
	L. minutus*	Live					
2000			8	0.16	0.05	8	100.00
2001			1	0.02	0.02	1	100.00
	U. affinis	Live					
2000			5	0.10	0.07	1	20.00
2001			5	0.10	0.04	5	100.00

¹ Number of larvae in dissected seed heads.

The total number of *U. quadrifasciata* and *L. minutus* in 2001 in fifty seed heads was lower than in 2000. However, the percent emergence for *U. quadrifasciata* increased, possibly due to the decline of the *L. minutus*. As *L. minutus* increases, the numbers of *U. quadrifasciata* are expected to decline. Fifty diffuse and/or spotted knapweed seed heads were randomly collected from Monument Fire Center and dissected. The summary of larvae recovered is shown in Table 5.

Table 5. Summary of Larvae Recovered from Spotted Knapweed Seed heads, 2001.

Species	Status	Lan	al density ¹		Emer	ging adults		La	rval	frec	quer	су с	distr	ibuti	ion ²		_
·		total/50 seed heads	average/ seed head	std. error	total	percent	0	1	2	3	4	5	6	7	8	9	10
1			Mo	numen	t Fire C	Center_											_
U. quadrifasciata	Live	5	0.10	0.07	4	80.0	47	3	0	0	0	0	0	0	0	0	0
•	Dead	7	0.14	0.06			47	2	1	0	0	0	0	0	0	0	0
	Total	12	0.24	0.09			94	5	1	0	0	0	0	0	0	0	0
U. affinis	Live	10	0.20	0.08	1	10.0	42	6	2	0	0	0	0	0	0	0	0
	Dead	0	0.00	0.00			50	0	0	0	0	0	0	0	0	0	0
	Total	10	0.20	0.08			92	6	2	0	0	0	0	0	0	0	0
L. minutus	Live	0	0.00	0.00	0	0.0	50	0	0	0	0	0	0	0	0	0	0
	Dead	0	0.00	0.00			50	0	0	0	0	0	0	0	0	0	0
	Total	0	0.00	0.00			100	0	0	0	0	0	0	0	0	0	0

¹ Number of larvae in dissected seed heads.

² Seed heads containing the specified number of larvae in fifty seed head sample.

^{*} Larvae will not develop after being removed from the dissected seed head.

² Seed heads containing the specified number of larvae in fifty seed head sample.

^{*} Adults had already emerged. Count determined by the emergence hole.

LEAFY SPURGE

We recovered three species of *Apthona* (*A. nigriscutis, A. lacertosa*, and *A. czwalinae*) at Ferl site, Douglas School site, and Dead Man's Trail site. The recoveries at Dead Man's Trail site were georeferenced (Fig. 9). Due to heightened security, not all recovery sites were georeferenced, but voucher specimens were collected. Leafy spurge infestation, densities, and heights from 2000 (prior to *Apthona* spp. releases) and 2001 (after establishment of *Apthona* spp.) were compared (Figs. 10 - 18).

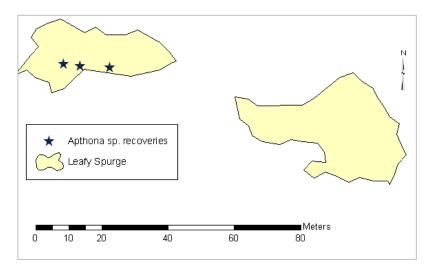


Fig. 9. Recoveries of *Apthona* spp. on leafy spurge at Dead Man's Trail site 2001.

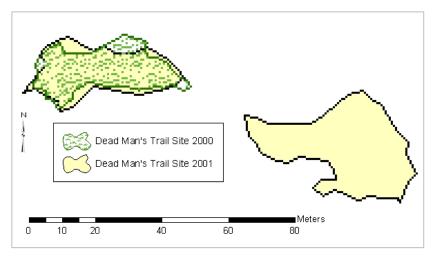


Fig. 10. Dead Man's Trail site leafy spurge infestation in 2000 and 2001.

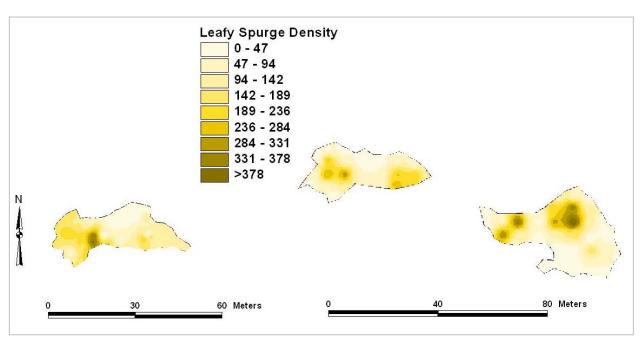


Fig. 11. Leafy spurge density per m² at Dead Man's Trail site in 2000 and 2001.

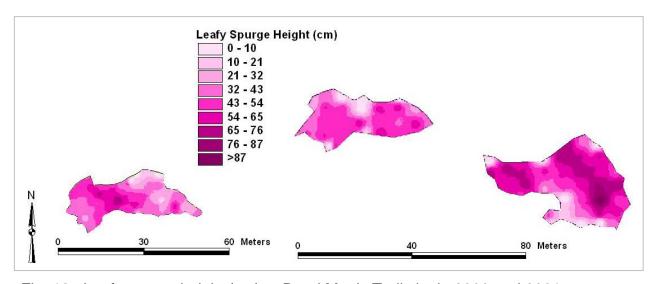


Fig. 12. Leafy spurge height (cm) at Dead Man's Trail site in 2000 and 2001.

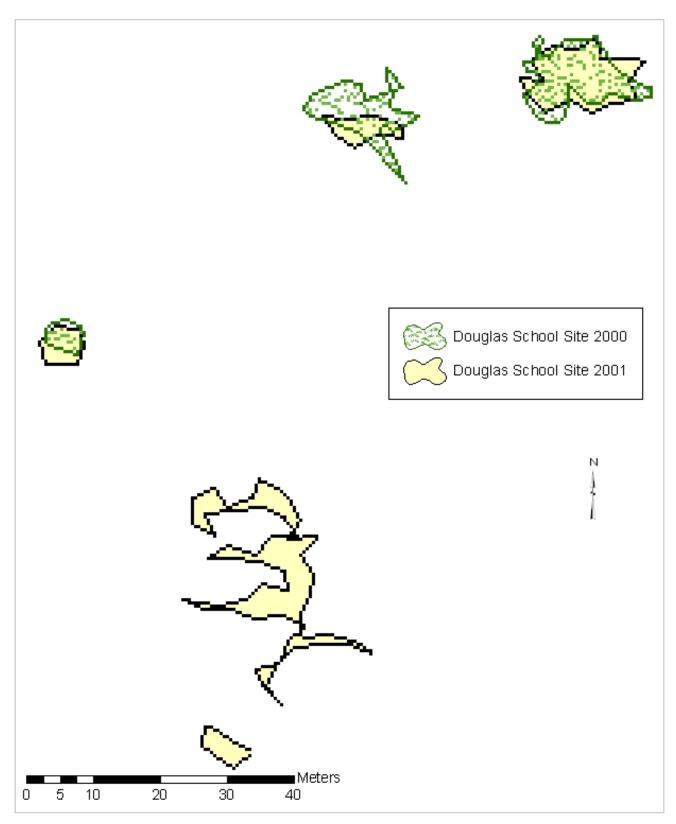


Fig. 13. Douglas School site leafy spurge infestation in 2000 and 2001.

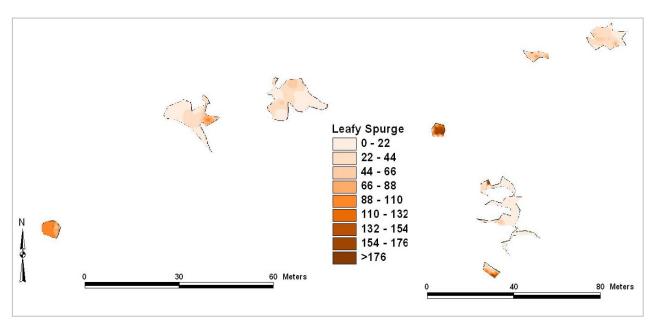


Fig. 14. Leafy spurge density per m² at Douglas School site in 2000 and 2001.

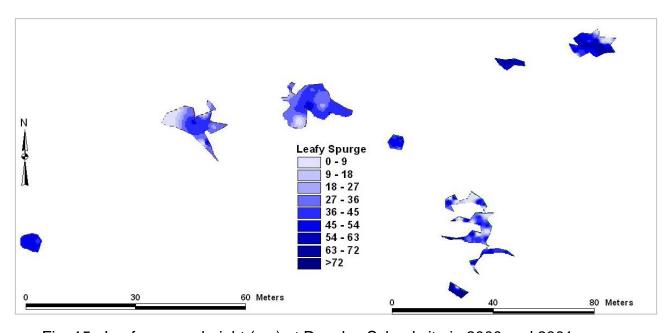


Fig. 15. Leafy spurge height (cm) at Douglas School site in 2000 and 2001.

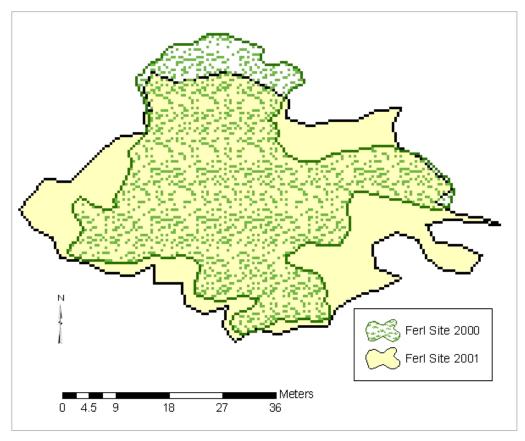


Fig. 16. Ferl site leafy spurge infestation in 2000 and 2001

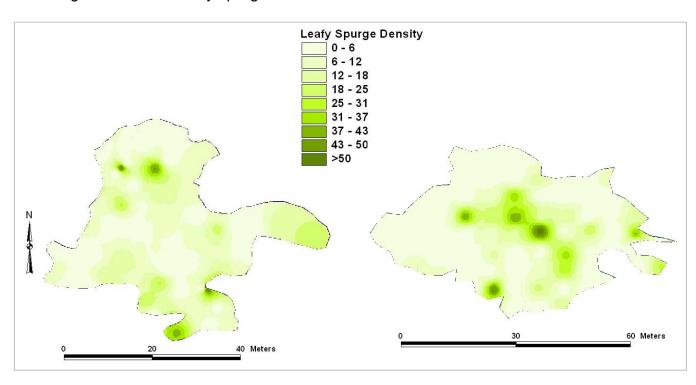


Fig. 17. Leafy spurge density per m² at Ferl site in 2000 and 2001.

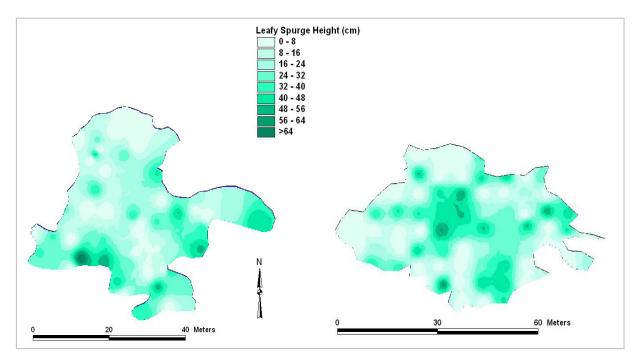


Fig. 18. Leafy spurge height (cm) at Ferl site in 2000 and 2001.

In cooperation with Steve Tapia, U.S. Forest Service, several sites were located at Monument Fire Center including toadflax, spotted and diffuse knapweed, and leafy spurge (Fig. 19). Seventy-five *Brachypterolus pulicarius* were released on the toadflax, 100 *L. minutus* on diffuse and spotted knapweed, and approximately 4000 *Apthona* spp. on leafy spurge (Table 1, Fig. 20). The leafy spurge site was mapped and data collected (Tables 6a & b., Fig. 20). The other weed infestations were to be mapped by the U.S. Forest Service. Leafy spurge infestation, density and height were mapped for future comparisons (Figs. 21 & 22).

ADDITIONAL PROGRAM COMPONENTS, CONCERNS AND RESULTS

In July 2001, we noticed chemical burn on many of the plants in the area of our release sites. Upon further investigation, it was determined that most of our biological control release sites had been sprayed with herbicides (Fig. 23).

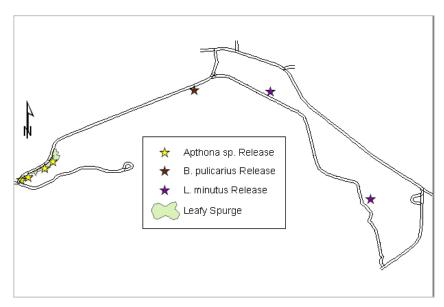


Fig. 19. Monument Fire Center leafy spurge infestation site and releases made on leafy spurge, toadflax, and spotted and diffuse knapweed in 2001.

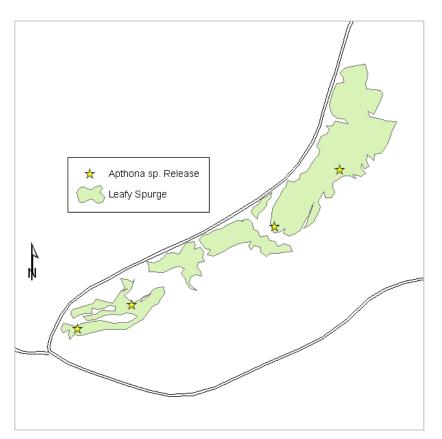


Fig. 20. Leafy spurge infestation site and *Apthona* spp. releases made in 2001 at Monument Fire Center.

Table 6a. Leafy spurge data collected from Monument Fire Center site in 2001.

Leafy spurge	Density	Height	P	ercent / m ²	
Sample	(m ²)	(cm)	Cover	Grass	Other ^a
1	8	28	10	15	0
2	8	54	15	50	0
3	12	53	15	70	0
4	90	29	25	60	15
5	14	43	10	70	10
6	24	51	20	5	30
7	12	51	20	10	40
8	44	31	20	45	5
9	0	0	0	70	0
10	0	0	0	50	35
11	0	0	0	45	40
12	12	66	10	10	0
13	36	37	15	25	30
14	2	26	5	30	5
15	0	0	0	30	50
16	18	45	25	25	30
17	18	38	15	0	5
18	50	48	30	30	0
19	20	44	15	20	10
20	16	47	15	40	0
21	26	45	15	70	10
22	382	80	70	20	5
23	152	33	30	20	10
24	224	99	60	5	25
25	148	66	55	10	10
26	186	45	50	10	10
27	240	67	60	30	0
28	26	44	15	60	0
29	76	52	20	15	0
30	54	16	10	0	0
31	2	25	5	5	5
32	162	57	55	5	5
33	18	79	30	15	30
34	72	77	30	70	0
35	64	36	20	70	5
36	264	70	60	40	0
37	118	56	35	40	5
38	4	71	5	35	0
39	14	54	15	10	20
40	8	69	20	60	0
41	10	24	5	40	0
42	76	34	20	15	10
43	146	41	50	15	10
44	132	62	45	15	0
45	2	9	1	30	25
Average	66.44	44.5	23.2	31.22	10.89

^aOther includes all plants that were not leafy spurge and grasses.

Table 6b. Leafy spurge data collected from Monument Fire Center site in 2001.

Leafy spurge	Density	Height		Percent	
Sample	(m ²)	(cm)	Cover	Grass	Other ^a
46	8	61	20	30	5
47	74	56	40	30	10
48	16	41	20	30	45
49	10	39	10	20	30
50	4	85	10	30	5
51	12	23	10	0	25
52	12	41	15	20	45
53	0	0	0	5	15
54	16	62	20	50	0
55	8	63	15	15	50
56	22	43	15	25	30
57	26	57	20	15	35
58	0	0	0	45	30
59	60	47	30	40	10
60	6	59	10	40	25
61	40	50	20	35	45
62	16	46	20	20	25
63	0	0	0	15	80
64	0	0	0	15	70
65	4	82	10	5	45
66	6	71	15	20	25
67	4	17	5	5	15
68	68	47	20	10	40
69	4	22	5	65	10
70	64	60	30	40	30
71	22	61	20	15	45
72	18	50	20	50	30
73	364	57	80	5	15
74	70	56	30	5	25
75	10	48	15	70	10
76	24	61	20	5	55
77	90	69	35	20	40
78	82	42	25	5	20
79	30	61	20	5	40
80	46	26	20	0	15
81	46	53	15	5	25
82	4	20	5	20	15
83	76	68	25	20	30
Average	35.84	45.9	18.2	22.37	29.21

^aOther includes all plants that were not leafy spurge and grasses.

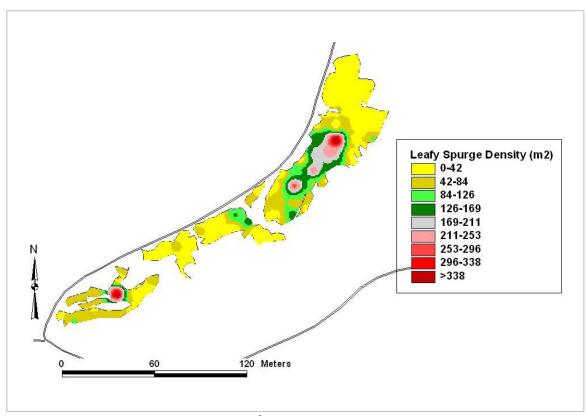
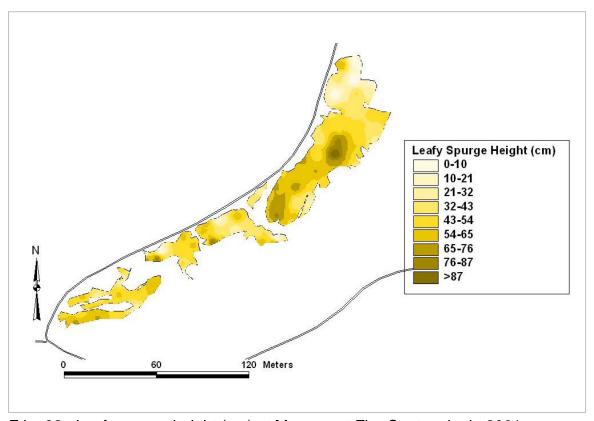


Fig. 21. Leafy spurge density per m² at Monument Fire Center site in 2001.



F ig. 22. Leafy spurge height (cm) at Monument Fire Center site in 2001.



Fig. 23. Douglas School leafy spurge site after being treated with herbicide in July 2001.

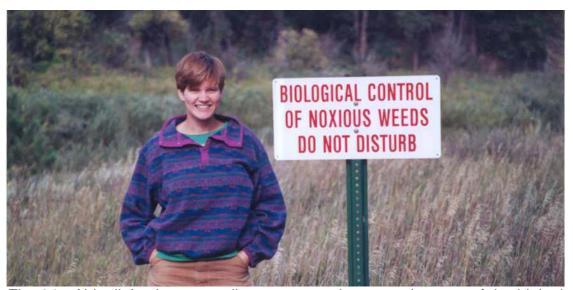


Fig. 24. Abigail Appleton standing next to a sign posted at one of the biological control release sites in 2001.

Ice Lake Road 2 and Monument Creek seemed to be the only sites left unsprayed. Signs were posted to deter any future spraying or any other human interference (Fig. 24). However, after the signs were posted, the Ice Lake Road site was sprayed with herbicide as well (Fig. 25). It cannot yet be determined

what effect this will have on the bioagents that were recovered at these locations. The major problem with the chemical applications was that they were not applied only on the target weed, but also on native plants and grasses (Fig. 26), and most of the release sites are near or around waterways. The chemical application was done after seed set thereby eliminating the plant, but not prevention of new plants emerging from seed. Some of the bioagents may have completed their life cycles and were preparing to overwinter and thus, not harmed by the herbicide applications. The *Apthona* spp. however, may not be able to recover as they overwinter in the roots of leafy spurge. It will not be known until the spring how much damage to the populations has occurred.



Fig. 25. Ice Lake Road 2 site was sprayed with herbicide after "Do Not Disturb" signs were posted in 2001.

Greenhouse Studies

To estimate the noxious weed seed bank at our release sites, soil samples were taken in 2000, at 1 inch and 2-3 inch depths from each site. The samples were bagged, labeled, and brought back to Bushland, TX.

Beginning in August 2000, the plants in each flat were counted and recorded monthly. After each count, all vegetation was removed from each flat and the soil was stirred. This process continued until germination of new plants ceased. The flats were then returned to incubators at 0° C to vernalize samples for 90 days. After vernalization, they were returned to the greenhouse. The process will be repeated until no new growth occurs.

Plant emergence including noxious weeds and comparisons of the emergence data from 2000 to 2001 are shown in Table 7 and Figs. 27 & 28. The noxious weed emergence and 2000 to 2001 comparisons are shown in Table 8

and Figs. 29 & 30. Table 9 shows the percentage of the total plants at each site that are noxious weeds.



Fig. 26. A native thistle (flagged for future monitoring) destroyed by herbicides in 2001.

RESULTS AND DISCUSSION

The work conducted by the summer workers was extensive. Each release site was mapped and density, height, bioagents released, and bioagents recovered was done throughout the summer. Two new leafy spurge sites were located near the original Ferl site. The two sites were named Ferl Training and Ferl Ditch. Another leafy spurge site was located and named Thinned Forest. The new sites were mapped and data collected (Fig 31).

Table 7. Total plant emergence from 2000 soil samples.

Sample			Rel	ease Site ²				
Date ¹	DMT	DS	EP	FERL	ILR1	ILR2	MC	WT
				1" Soil De	epth			
1	44	5	35	88	48	46	0	8
2	86	18	58	117	64	40	32	18
3	4	0	0	7	1	0	2	0
4	2	0	0	19	3	1	2	2
5	0	2	10	18	16	11		2
Total	136	25	103	249	132	98	36	30
				2-3" Soil D	epth			
1	12	3	8	68	34	36	0	8
2	25	22	23	78	68	66	15	29
3	0	0	0	26	0	0	0	0
4	3	0	0	3	1	4	2	0
5	1	0	2	4	9	15		10
Total	41	25	33	179	112	121	17	47

¹Sampling dates began in August 2000.

²DMT = Dead Man's Trail, DS = Douglas School, EP = Eagle Peak, ILR1 = Ice Lake Road 1, ILR2 = Ice Lake Road 2, MC = Monument Creek, WT = Water Tank

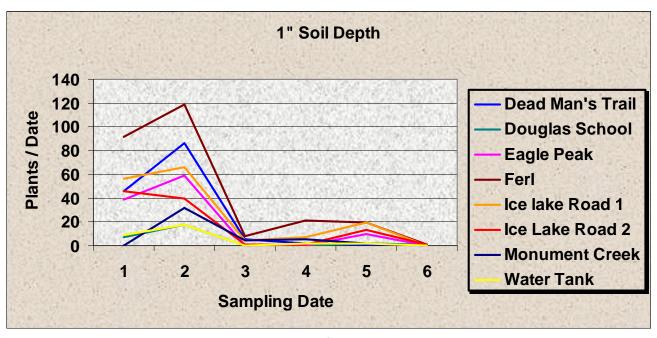


Fig. 27. Plant emergence in soils collected from eight release sites in 2000 at 1" depths. Sampling dates began in August 2000.

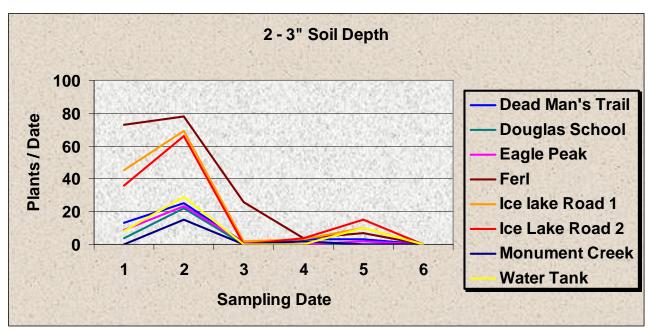


Fig. 28. Plant emergence in soils collected from eight release sites in 2000 at 2-3" depths. Sampling dates began in August 2000.

Table 8. Total noxious weed emergence from 2000 soil samples.

Sample			Rel	ease Site ²				
Date ¹	DMT	DS	EP	FERL	ILR1	ILR2	MC	WT
				1" Soil De	epth			
1	0	0	15	0	0	1	0	1
2	0	3	0	1	1	0	3	0
3	0	0	0	1	0	0	1	0
4	0	0	0	1	1	0	0	0
5	0	0	0	0	0	1		0
Total	0	3	15	3	2	2	4	1
				2-3" Soil D	epth			
1	0	1	4	1	0	0	0	2
2	1	2	0	0	0	0	2	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	1	0
5	0	0	0	0	1	0		0
Total	1	3	4	1	1	0	3	2

¹Sampling dates began in August 2000.

²DMT = Dead Man's Trail, DS = Douglas School, EP = Eagle Peak, ILR1 = Ice Lake Road 1, ILR2 = Ice Lake Road 2, MC = Monument Creek, WT = Water Tank

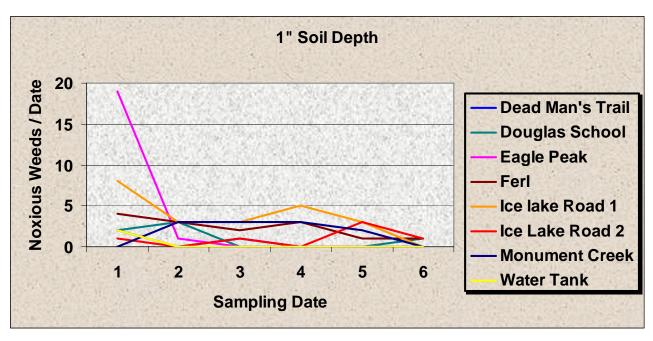


Fig. 29. Noxious weed emergence in soils collected from eight release sites in 2000 at 1" depths. Sampling dates began in August 2000.

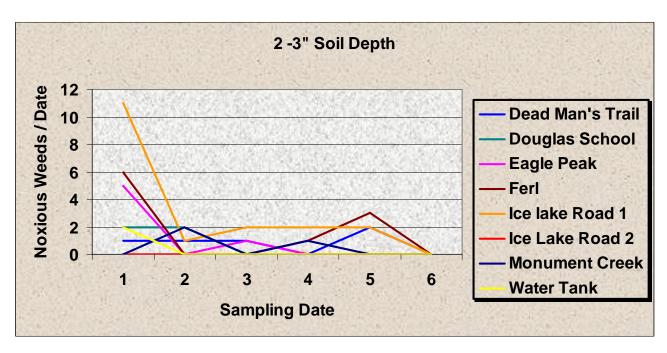


Fig. 30. Noxious weed emergence in soils collected from eight release sites in 2000 at 2-3" depths. Sampling dates began in August 2000.

Table 9. Noxious weeds as a percentage of total plants emerging from 2000 soil samples¹.

Sample			Re	elease Site ³				
Date ²	DMT	DS	EP	FERL	ILR1	ILR2	MC	WT
				1" Soil [Depth			
1	4.35	28.57	48.72	4.35	14.29	2.17	0.00	22.22
2	0.00	16.67	1.69	2.52	4.55	0.00	9.38	0.00
3	20.00	0.00	0.00	25.00	75.00	100.00	75.00	0.00
4	0.00	0.00	0.00	14.29	71.43	0.00	60.00	0.00
5	0.00	0.00	0.00	5.26	15.79	23.08	100.00	0.00
6	0.00	100.00	0.00	100.00	0.00	100.00	0.00	0.00
Total	2.16	21.43	18.52	5.38	14.47	5.88	25.58	6.45
				2-3" Soil	Depth			
1	7.69	50.00	55.56	8.22	24.44	0.00	0.00	25.00
2	4.00	9.09	0.00	0.00	1.45	0.00	13.33	0.00
3	100.00	0.00	100.00	0.00	100.00	0.00	0.00	0.00
4	0.00	0.00	0.00	25.00	66.67	0.00	50.00	0.00
5	66.67	0.00	0.00	42.86	20.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	11.11	15.38	17.14	5.32	13.95	0.00	17.65	4.26

¹Soil samples consisted of 900g of soil from 1 and 2-3" depths per site.

This program is in its initial stages and it is important that further setbacks do not occur. We will continue to release bioagents and monitor their spread and impact upon noxious weeds. We will also monitor these agents for any potential impact they may have on native weeds.

²Sampling dates began in August 2000.

³DMT = Dead Man's Trail, DS = Douglas School, EP = Eagle Peak, ILR1 = Ice Lake Road 1, ILR2 = Ice Lake Road 2, MC = Monument Creek, WT = Water Tank

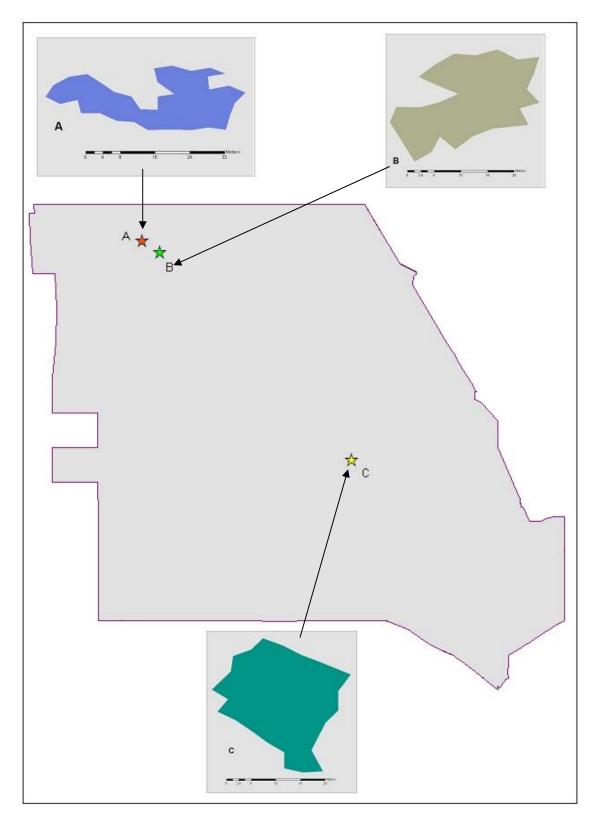


Fig. 31. Location of three new leafy spurge infestation sites known as A) Ferl Training B) Ferl Ditch and C) Thinned Forest.