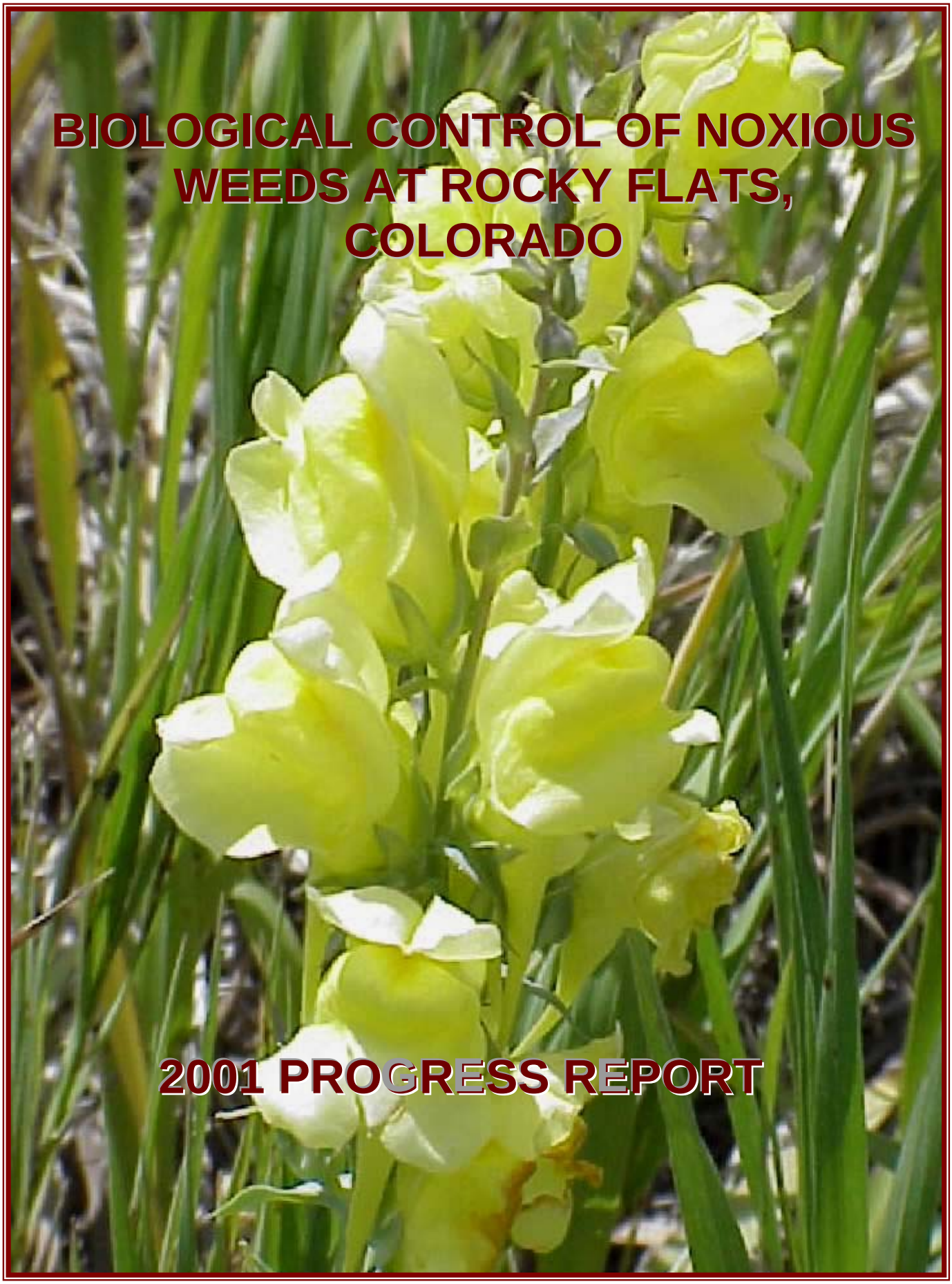
BIOLOGICAL CONTROL OF NOXIOUS WEEDS AT ROCKY FLATS, COLORADO



2001 PROGRESS REPORT

Biological Control of Noxious Weeds at Rocky Flats, Colorado.

2001 Progress Report

by
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Introduction

Our project's goal is to reduce existing populations and control the spread of selected state- and federal-listed noxious weeds. The objectives of the research are to 1. Develop and implement procedures and sampling methods to assess the present state of any existing noxious weed biological control on the selected species at Rocky Flats; 2. Monitor abiotic and biotic factors which may be peculiar to Rocky Flats through field data collection and assess the impact of these factors on establishment of natural enemies; 3. Release several species of natural enemies using open field releases; 4. Use GPS to map establishment and spread of natural enemies as well as the weed infestation; 5. Monitor and redistribute established biocontrol agents.

Phase I of this three-phase project will consist of surveying for noxious weeds, collecting and releasing biocontrol agents, and sampling for establishment. To carry out this project, Rocky Flats Fish and Wildlife Service will team up with biological control experts from the Texas Agricultural Experiment Station. The Texas Agricultural Experiment Station will provide expertise, supplies, and biocontrol agents. In addition, they will conduct the surveys, release the biocontrol agents, and monitor for establishment.

In any biological control program, there is a three-phase approach to ensure a sound program that achieves the desired reduction in the pest species targeted for control:

1. Phase One consists of collection and release of biocontrol agents and sampling for establishment.
2. Phase Two takes biocontrol agents that are established in Phase One, and redistributes them into areas where they are not yet established in order to engender high populations of the agents.
3. Phase Three consists of an ecological and economic analysis of the program in terms of how the biocontrol program impacted the pest and the benefits accruing to their establishment in light of standard control practices. In general, each phase covers three years.

Effects of the control program are expected in the third year, however, all results are very dependent on climatic conditions, especially temperature and rainfall.

Severity of winter conditions will also influence establishment of the insects. It cannot be said that control of a given weed species will take place on a particular date, however, we expect a gradual weakening of weed infestations followed by recovery of the affected areas over the next five years.

Knapweed, *Centaurea* spp., is an aggressive perennial weed, has little nutritive value and is an invasive competitor, decreasing forage production as much as 60 to 90 percent. Diffuse knapweed, *C. diffusa*, is one of the most important rangeland weeds in western North America with approximately 129 million ha infested.

Canada thistle, *Cirsium arvense*, is an aggressive dioecious perennial, which grows in patches and has a diverse habitat. Because of its random distribution, it is difficult to determine complete losses, but is considered to be a noxious weed in at least 34 states in the United States.

Leafy spurge, *Euphorbia esula*, is an aggressive long-lived and deep-rooted perennial. It infests over three million acres in 29 states and has cost millions of dollars in control efforts and loss of forage productivity. Leafy spurge degrades wildlife habitat, decreases plant diversity, competes with native plant species, and reduces land values.

Dalmation toadflax, *Linaria genistifolia* spp. *dalmatica*, are perennial noxious weeds that reproduce by seeds and creeping roots. They have the ability to produce large numbers of seed that can remain dormant in the soil for many years. They are found throughout North America in fields, roadsides, waste areas, and overgrazed pastures and rangelands.

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 Bozeman, MT, and U.S. Fish and Wildlife.

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).

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 (U.S. Fish & Wildlife), and is included in this

report. It is our opinion that none of the native thistles found at Rocky Flats are at risk from the biocontrol agents we have released.

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.

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 one insect established at Rocky Flats, *Rhinocyllus conicus* on musk thistle, has 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 Rocky Flats 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 at Rocky Flats. In the future we will monitor native thistle populations as well as the noxious thistle species we are attempting to control.

Chronology

June

In cooperation with Marsha Murdoch, Jody Nelson, and Robin Romero several potential release sites were located (Fig. 2). A large area of diffuse knapweed was located along waterways in the northwest corner of the buffer zone. Six releases of *Larinus minutus*, the lesser knapweed flower weevil, were made (approximately 1500 total) (Fig. 2).

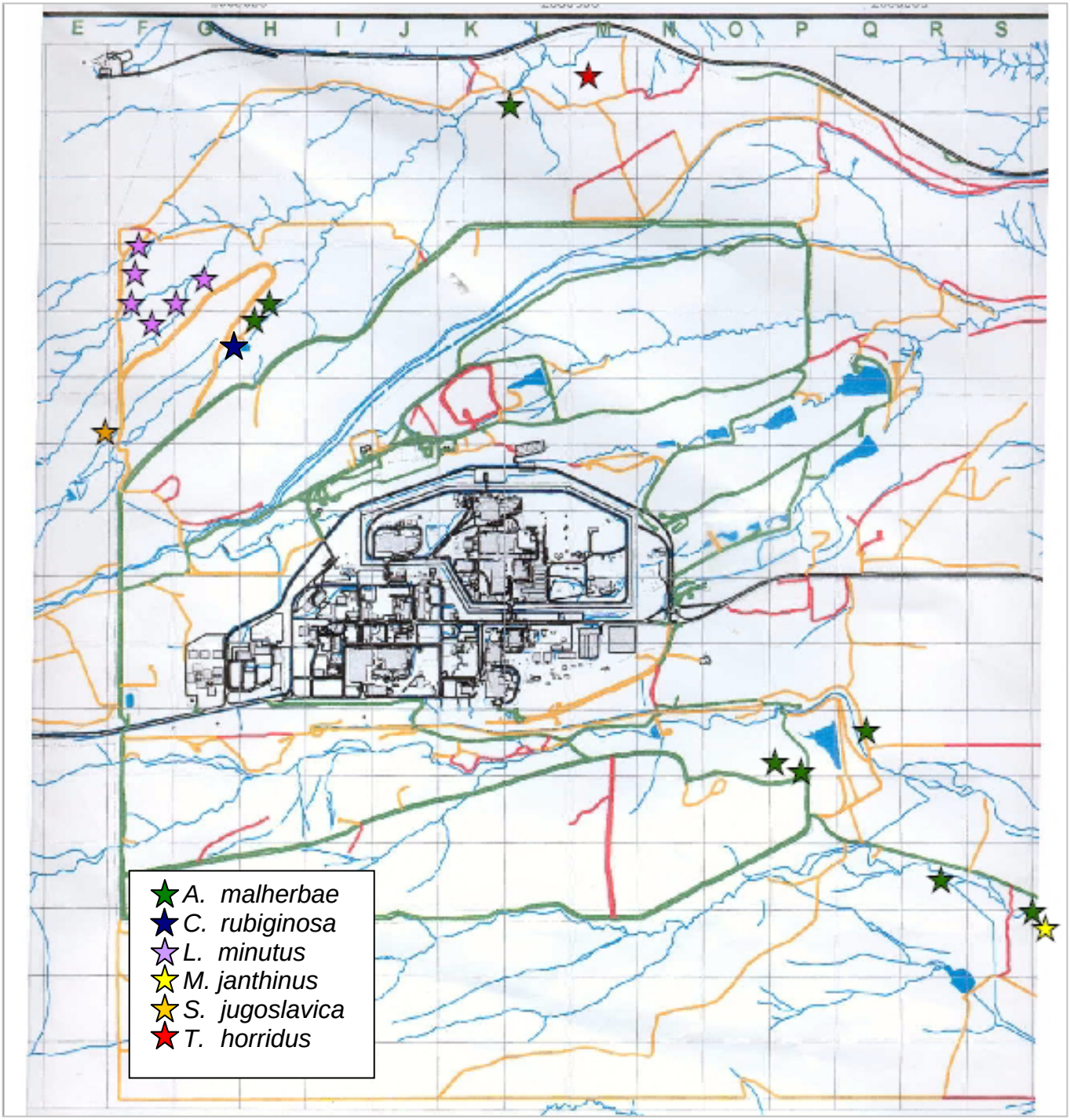

Fig. 2. Approximate locations of release sites and the bioagents released at these sites in 2001 at Rocky Flats, CO.

L. minutus were provided by Fred Stahl (Colorado Dept. of Agric.) (Table 1). A Canada thistle site was located, referred to as the Lindsey Ranch site. Approximately 450 *Cassida rubiginosa* were released at this site (Table 1, Fig.

2). Field bindweed is located in many areas throughout the buffer zone. Releases of *Aceria malherbae* were made in five different areas (Table 1, Fig. 2). A musk thistle site was located and approximately 100 *Trichosirocalus horridus* were released (Table 1, Fig. 2). A large area of Dalmation toadflax was located in the southeast corner of the buffer zone. About 400 *Mecinus janthinus* were released (Table 1, Figs. 2 - 4). The toadflax infestation site was mapped and data collected (Fig. 3). Dalmation toadflax density, height, %coverage per m2, % grass per m2, and % other weeds or forbs, were recorded (Table 2). Dalmation toadflax height (cm) and density per m^2 were mapped using an inverse distance weighting method in ArcView Spatial Analyst for future comparisons (Figs. 5 & 6).

Klamath weed beetles, *Chrysolina hyperici*, were collected from a St. Johns Wort site and were redistributed to a site located near Fort Carson.

July

Approximately 250 *Sphenoptera jugoslavica* were collected from an area near Chatfield Reservoir in Denver, CO., and released on diffuse knapweed in the northwest corner of Rocky Flats (Table 1, Fig. 2).

September

Due to increased security,diffuse knapweed seed heads were collected by Robin Romero and sent to us for dissection. Fifty seedheads were dissected (Table 3). The *Urophora* galls were retained in individual containers for species confirmation and emergence (Table 3).

Table 1. Summary of Insects Released for Biological Control of Weeds at Rocky Flats, CO, 2001.

Agency	Bioagent	Target[1]	Release		
			Date	Number Released	Total
Colo.Dept. Of Agric	Lesser knapweed flower weevil - *L. minutus*	DK	06/20/01	250	1500
	Root boring buprestid - *S. jugoslavica*	DK	07/10/01	250	250
Penn.Dept.of Agric.	Thistle-feeding shield beetle- *C. rubiginosa*	CT	06/29/01	450	450
Colo.Dept.of Agric.	Rosette weevil - *T. horridus*	MT	06/21/00	100	100
Tx Agric. Exp. Sta.,TX	Bindweed gall mite - *A. malherbae*	BW	06/20/01	5	6[2]
USDA-APHIS, MT	Stem boring weevil - *M. janthinus*	DTF	06/20/01	200	400

[1]Target: CT = Canada thistle; DK = Diffuse knapweed; MT = Musk thistle; BW = Bindweed; DTF = Dalmation Toadflax

[2]Release 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.

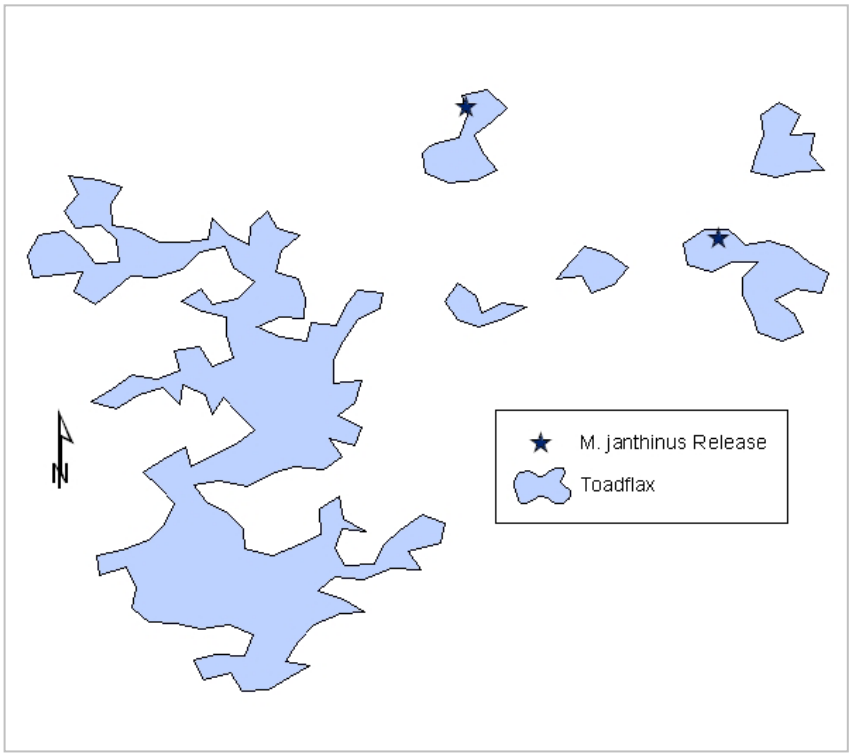

Fig. 3. Toadflax infestation site located in the southwest corner of Rocky Flats, CO.


Fig. 4. Dalmation Toadflax site at Rocky Flats, CO. The orange flag marks the release of *M. janthinus* made in June, 2001.

Table 2. Data collected from Dalmation Toadflax site in 2001 at Rocky Flats, CO.

Toadflax	Density	Height	Percent / m^2		
Sample	(m^2)	(cm)	Cover	Grass	Other[a]
1	8	35	5	50	25
2	42	53	25	45	15
3	28	57	25	45	5
4	30	57	25	30	5
5	30	64	15	45	10
6	22	30	20	50	5
7	32	46	20	50	10
8	6	67	10	40	25
9	18	37	10	40	20
10	2	63	5	30	15
11	12	44	10	25	20
12	24	61	20	50	10
13	22	62	20	35	5
14	14	43	20	50	5
15	44	54	35	25	5
16	52	67	35	35	10
17	14	45	10	55	15
18	44	58	30	20	30
19	16	62	15	50	25
20	14	50	10	45	0
21	16	40	15	35	0
22	4	30	5	45	40
23	4	40	5	40	5
24	22	84	20	25	25
25	12	73	15	15	10
26	8	44	10	55	5
27	24	51	20	30	35
28	18	69	15	45	30
29	42	61	30	45	5
30	32	59	25	15	30
31	18	55	25	45	10
32	12	56	15	40	5
33	64	51	40	35	20
34	18	40	10	20	45
35	28	50	25	45	5
36	8	49	10	20	40
37	16	57	25	30	10
38	22	40	15	40	10
39	32	50	25	50	10
40	12	50	15	25	20
41	12	55	15	45	20
42	28	51	15	35	30
43	22	50	25	25	30
44	48	61	30	40	20
45	20	40	20	60	20
46	2	69	5	55	40
47	36	58	25	40	25
Average	22.43	52.94	18.40	38.62	17.13

[a]Other includes all plants that were not dalmation toadflax and grasses.

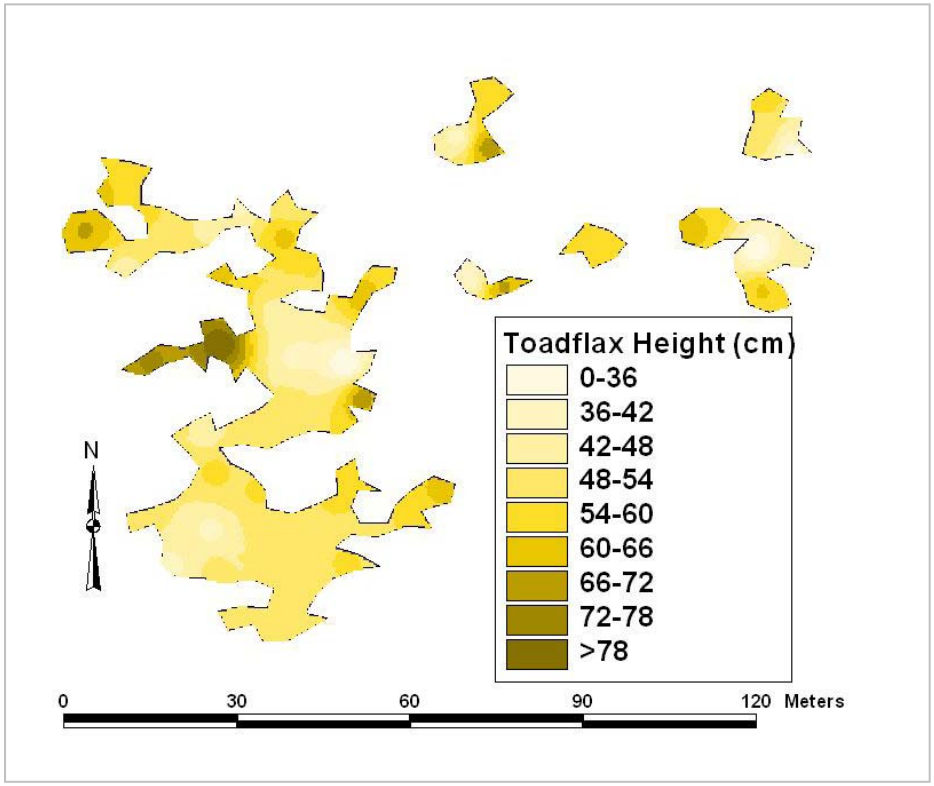

Fig. 5. Dalmation toadflax height (cm) in 2001 at Rocky Flats, CO.

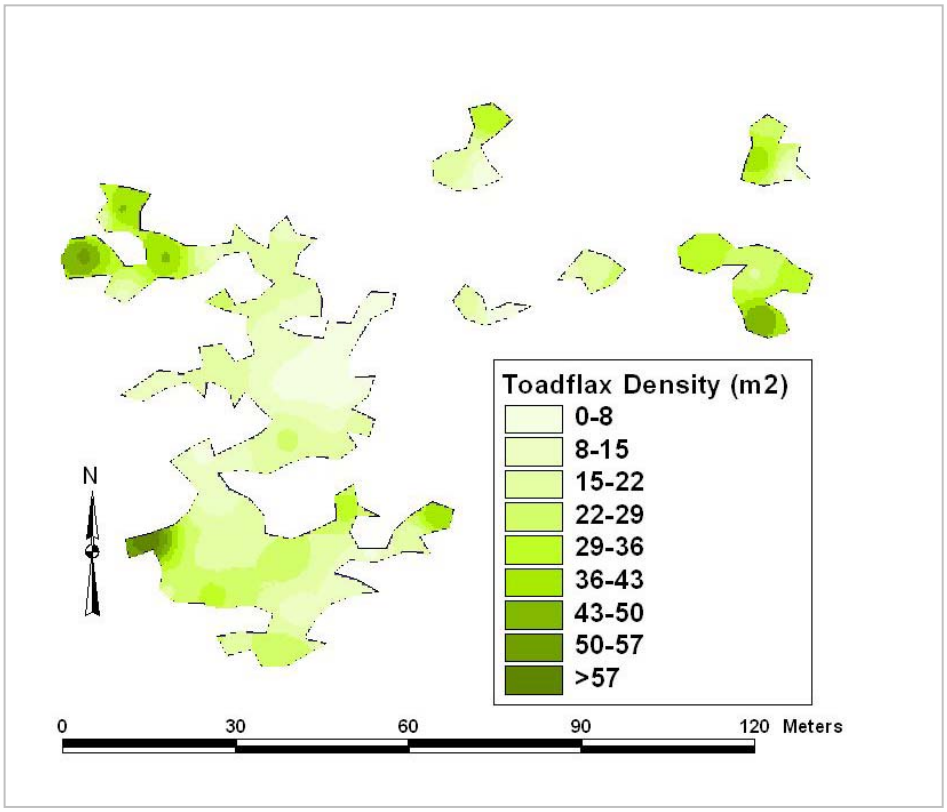

Fig. 6. Dalmation toadflax density per m^2 in 2001 at Rocky Flats, CO.

Table 3. Summary of Larvae Recovered from Spotted Knapweed Seed heads, 2001.

Species	Status	Larval density[1]			Emerging adults		Larval frequency distribution[2]										
		total/50 seed heads	average/ seed head	std. error	total	percent	0	1	2	3	4	5	6	7	8	9	10
				Rocky Flats													
Urophora quadrifasciata	Live	17	0.34	0.14	13	76.5	41	6	0	1	1	1	0	0	0	0	0
	Dead	3	0.08	0.04			48	2	0	0	0	0	0	0	0	0	0
	Total	20	0.42	0.15			89	8	0	1	1	1	0	0	0	0	0
Urophora affinis	Live	19	0.36	0.11	3	15.8	37	9	2	2	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	19	0.38	0.11			87	9	2	2	0	0	0	0	0	0	0
Larinus minutus	Live	0	0.00	0.00	0	0.0	50	0	0	0	0	0	0	0	0	0	0
	Dead	1	0.02	0.02			49	1	0	0	0	0	0	0	0	0	0
	Total	1	0.02	0.02			99	1	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.

Results

In 2001, six biological control agents were released at Rocky Flats, targeting five noxious weed species; musk and Canada thistle, diffuse knapweed, dalmation toadflax, and field bindweed. The data collection and mapping carried out in 2001 established a baseline necessary to track reductions in weed densities and height, the spread of bioagents, possible spread or reduction of weed-infested areas, and the impact of the bioagents on the weed populations in subsequent years.

2002

Field research will continue at Rocky Flats. All sites will be monitored for establishment of bioagents and data recorded regularly for plant density, height, spread and/or reduction, and damage. Additional releases of bioagents will continue. New insects scheduled to be released in 2002 include: the Canada thistle stem weevil, *Ceutorynchus litura*; the thistle stem gall fly, *Urophora cardui*; the knapweed root weevil, *Cyphocleonus achates*; and the sulphur knapweed moth, *Agapeta zoegana*, depending on availability of insects. GPS mapping will be conducted to determine possible spread of established or newly colonized biocontrol agents as well as spread/reduction of the weed infestations.