Impacts of *Cyphocleonus achates* in Natural Systems
Center for Invasive Plant Management
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Final Report

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The root weevil *Cyphocleonus achates* shows potential as an important biological control agent against spotted knapweed (*Centaurea maculosa*), but field releases have not previously been monitored with before-and-after data or controls for effects of other factors. These problems are being addressed in the study 'Impacts of *Cyphocleonus achates* in Natural Systems.' In 2002, four sites were chosen in the Bitterroot River Valley bottomland of western Montana for experimental field releases of *C. achates*. Prior to release, baseline data on knapweed infestations, plant community characteristics, and occurrence of other biological control agents on spotted knapweed were collected. Three hundred adult weevils were released in the center of each of the four release sites. Twenty fenced control plots were built to account for natural variation in knapweed density and vigor by comparison. In 2003, we began monitoring impacts of *C. achates* on knapweed density and vigor, and on plant community characteristics with funding from the above-referenced grant. This report summarizes project activities and findings from our work in 2003.

See Table 1 of the Progress Report (March 26, 2004) for a summary of field work conducted in 2003. We sampled knapweed, plant community, and biocontrol agent assemblages at each of the four release sites as indicated.

Major findings

1. Releases of *C. achates* in 2002 were successful in establishing populations on all four sites in 2003, based on larval counts of the species from a sample of knapweed plants (Table 1).Other species of biocontrol agents against knapweed also occur on our release sites: *Agapeta zoegana*, a root moth, and *Larinus* spp., seedhead weevil species. Based on larval counts and sweepnet survey, numbers of both species were reduced significantly in 2003 in comparison to 2002 (Tables 1 and 2).

2. Knapweed density was lower in 2003 than 2002, but not due to weevil presence, because knapweed density declined in control plots as well as in areas exposed to weevils (Figure 1). Biomass and live vegetative cover declined from 2002 to 2003, as well.

3. Seventy-five species or genera of plants were identified on release sites. From the list, 2 groups of species were identified for follow-up. The first group contains desirable species that may increase as knapweed dominance declines on the area. These plants, although non-native species, are desirable range plants for forage. The second group are noxious weeds

with potential for increase as knapweed dies back. Dynamics of plant community recovery and the rise of different noxious weeds will be important for quantifying the benefits of biocontrol of knapweed, and identifying potential problems from other noxious weeds. These species will be tracked on the 124 permanent knapweed density plots, where we will collect absence/presence data for the remainder of the study.

4. Weather (flooding, drought) appeared to have strong effects on knapweed growth in 2003. The growing season of 2003 was unusual along western Montana river bottomlands. The early season was very wet; soils were saturated for up to 72 hours in late May. Subsequently, relatively hot, dry weather prevailed, especially in comparison to the first year of the study when baseline vegetation data were collected.

We hypothesize that flooding and/or drought affected both spotted knapweed and biocontrol agent populations in 2003. Nonetheless *C. achates* became established on all release sites, and their effects on spotted knapweed should be detectable within a few years.

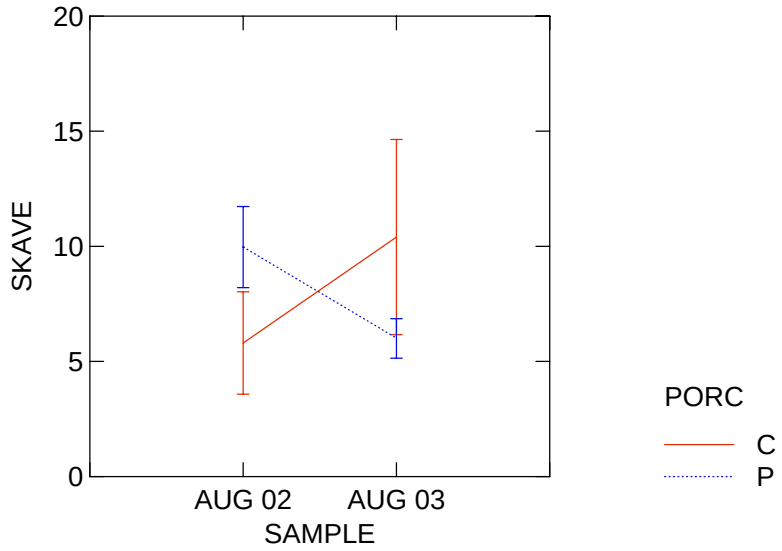
Table 1. Larval counts of biocontrol agents in roots of spotted knapweed.					
Site no.	**Species**	**Year**	**n**	**Number of larvae/plant**	
				mean	**se**
1	*Agapeta*	2002	27	1.1	0.48
		2003	30	0.3	0.16
	Cyphocleonus	2002	27	0.0	0.0
		2003	30	0.3	0.13
2	*Agapeta*	2002	27	1.5	0.51
		2003	30	0.7	0.21
	Cyphocleonus	2002	27	0.0	0.0
		2003	30	0.57	0.2
3	*Agapeta*	2002	27	1.9	0.52
		2003	30	0.5	0.15
	Cyphocleonus	2002	27	0.0	0.0
		2003	30	0.03	0.03
4	*Agapeta*	2002	27	2.1	0.43
		2003	29	0.5	0.18
	Cyphocleonus	2002	27	0.1	0.09
		2003	29	0.17	0.07

	Agapeta	***Cyphocleonus***
	(ave. no./plant)	
2002 grand mean	1.64	0.04
se	0.24	0.02
n	108	108
2003 grand mean	0.48	0.27
se	0.09	0.06
n	119	119
F	4.67	3.29
p	<0.005	<0.005
	2002>2003	2003>2002

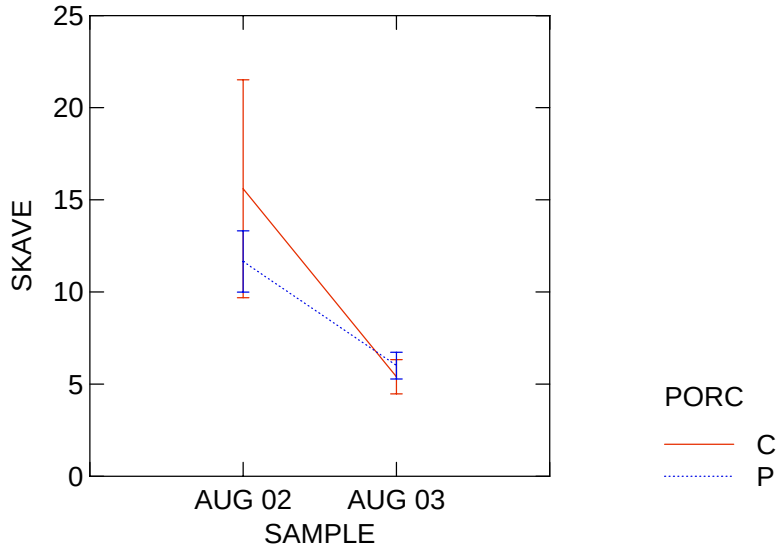
Table 2. Sweepnet catches of *Larinus* spp., seedhead weevils against spotted knapweed.					
relative abundance 7/24/2002			relative abundance 7/22/2003		
Release plot	**Plot average count**	**se**	**Release plot**	**Plot average count**	**se**
1	39.8	11.04	**1**	25.2	11.67
2	41.0	9.08	**2**	14.6	3.37
3	32.6	11.24	**3**	9.6	3.72
4	58.8	20.13	**4**	6.6	3.53
Grand mean	**43.05**	**6.44**		**14.00**	**3.65**
	contrast between years	**F**	**3.82**		
		p	**<0.005**		

Figure 1. Spotted knapweed density (SKAVE) on Bitterroot River bottomland sites in western Montana where *C. achates* were released in 2002. ('PORC': P = permanent plots, C = control plots protected from *C. achates* attack.)

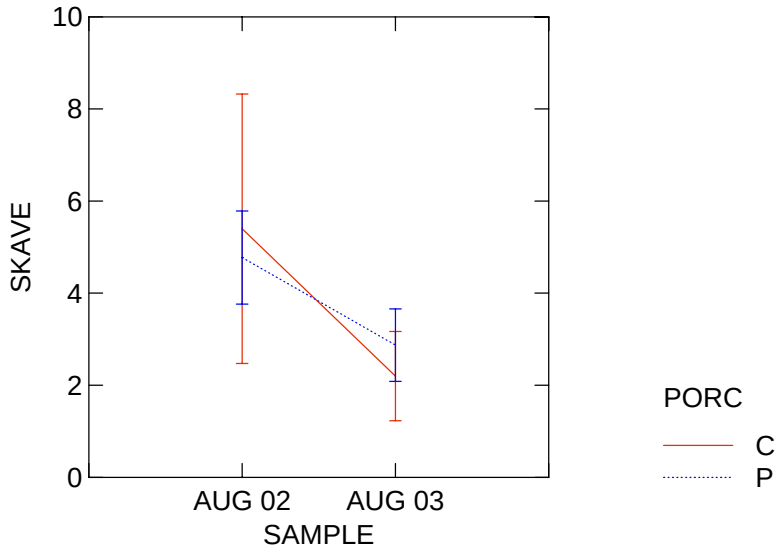
A. Release Plot 1



B. Release Plot 2



C. Release Plot 3



D. Release Plot 4