Idaho's 10 Year Strategic Plan for Biological Control of Noxious and Invasive Weeds 2008-2018

Root boring beetle (*Oberea erythrocephala*) on Leafy Spurge (*Euphorbia esula*)

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US Forest Service Forest Health Protection

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MISSION STATEMENT

"To facilitate the meaningful incorporation of biological control into long term integrated weed management throughout the State of Idaho."

EXECUTIVE SUMMARY

Biological control, or the use of an introduced organism to control another introduced organism, is one component of an Integrated Weed Management strategy commonly employed to mitigate the impact of invasive species throughout the country. Idaho's 10 Year Strategic Plan for Biological Control of Noxious and Invasive Weeds provides a unifying vision for weed biological control efforts in the State of Idaho. This document was developed by the leading stakeholders in weed biological control implementation throughout the state. Prior to the development of this strategic plan, a directed approach to guide weed biological control as a management practice was not in existence. This document articulates a vision for achieving Idaho's biological control of noxious and invasive weeds program's mission by identifying 5 program goals.

Through the formation of Cooperative Weed Management Areas (CWMA), the creation of the Idaho Weed Coordinating Committee (IWCC), Idaho Weed Control Association (IWCA), and the Idaho Association of Weed Control Superintendents (IAWCS), Idaho has been a consistent leader nationally in the realm of weed management. This document continues Idaho's leadership in weed management by establishing a blueprint for the improvement of weed biological control efforts of land managers and the public stakeholders.

In Idaho's Strategic Plan for Managing Noxious and Invasive Weeds, drafted in 2005, weed biological control was recognized as a critical area for continuing education, gaining further expertise, and securing personnel to manage and evaluate weed biological control efforts throughout the state. Despite weed biological control's record of success, it remains a minor component of most weed management plans. This strategic plan outlines five goals to further the inclusion of weed biological control as a component of an Integrated Weed Management approach to control noxious and invasive weeds in Idaho: 1) Coordination, 2) Technology Development, 3) Education and Outreach, 4) Capacity Building, and 5) Evaluation and Assessment. Each of these goals is followed by clearly stated objectives and sample work activities which would help achieve the stated objectives. The goals and objectives are meant to provide a programmatic framework for weed biological control efforts in Idaho while facilitating interagency cooperation.

INTRODUCTION

Context and Need

The invasion of non-indigenous plant species throughout North America has been widely recognized as a serious threat to ecosystem integrity and the agricultural and natural resource bases. In the U.S. an estimated 700,000 hectares of wildlife habitat and natural ecosystems are invaded by more than 5,000 non-native plant species per year (Morse *et al.* 1995; Babbit 1998) with an annual loss of productivity estimated at $7.4 billion in the U.S. and $300 million in Idaho alone (ISDA 2005). Non-native invasive plants threaten the ecological integrity and biological diversity across Idaho's landscape by displacing native vegetation and forming monocultures, commonly referred to as "ecological deserts". One reason exotic invasive species can gain a competitive advantage in their new environment is because of the absence of their specialist natural enemies (Elton 1958). Biological control has the potential to be an effective tool in an integrated, long-term approach to managing noxious and invasive weeds in Idaho by bringing the weed's specialist natural enemies into the invaded ecosystem. Historically, weed biological control agents have been released by many land owners, county weed personnel, and state and federal land managers, but weed biological control activities are often not monitored or coordinated between land management entities and little data is available on biological control's weed control potential.

This strategic plan provides a unifying vision for weed biological control efforts in Idaho by identifying issues and concerns and developing procedural approaches to facilitate proper implementation of biological control in integrated weed management programs. In Idaho's 2005 Strategic Plan for Managing Noxious and Invasive Weeds, biological control was recognized as a critical area for continuing education, gaining further expertise, and securing personnel to manage weed biological control agents throughout the state (ISDA 2005). This document has been developed with the input of federal, state, and private land managers as well as biological control of noxious and invasive weed researchers and the four statewide Noxious Weed groups (Idaho Weed Control Association, Idaho Association of Weed Control Superintendents, Idaho Weed Coordinating Committee, and the Idaho Weed Awareness Committee).

Definition

Biological control, or biocontrol, was defined by DeBach (1964) as:

> "The actions of parasites, predators, and pathogens in maintaining another organism's density at a lower average than would occur in their absence." This definition contains three different techniques for applied biocontrol: (*a*) "conservation"—protection or maintenance of existing populations of biocontrol agents; (*b*) "augmentation"— regular action to

increase populations of biocontrol agents, either by periodic releases or by environmental manipulation; and (*c*) "classical biocontrol"—the importation and release of exotic biocontrol agents, with the expectation that the agents will become established and further releases will not be necessary"

Biological control is one component of an Integrated Weed Management (IWM) strategy to manage noxious and invasive weeds (Briese 1990; Baskin 2002). An IWM approach includes the use of multiple weed control methods such as cultural control, mechanical control, and chemical control. Classical biological control of weeds attempts to identify natural enemies with the most potential to reduce the competitive advantage of the target weed while posing the least environmental threat to the invaded ecosystem and introduce these biological control agents into the weeds' invaded range with the goal of reducing target weed populations to non-damaging levels. There are advantages and disadvantages to this weed control approach:

Advantages:

- Target specificity
- Continuous action
- Long – term cost effective
- Gradual in effect
- Generally environmentally benign
- Self dispersing, even into difficult terrain

Disadvantages:

- Protracted time until impact is likely or visible
- Uncertainty over ultimate scale of impact
- Uncertain "non-target" effects in the ecosystem
- Irreversible
- Not all exotic weeds are appropriate targets
- Will not work on every weed in every setting

The decision to use weed biological control should be made on a case-by-case basis. The potential impact, alternative control measures available, potential risks to the environment, and the consequences of doing nothing should be considered. The scientific information available for the potential agents should be reviewed prior to initiating a biological control program. Once the organism is released it is irreversible so this decision should be taken seriously. This is further complicated by the fact that social values change through time and that the scientific information available will also change as new data becomes available.

History of Weed Biological Control Efforts in Idaho

In contrast to other western states and Canadian provinces, biological weed control was not a significant component of noxious weed management efforts in Idaho until the mid 1990s. While the University of Idaho has had a moderate

sized weed biological control research program since the mid 1980s, biological weed control efforts were usually spearheaded only in partnership with federal agency personnel, focusing on successful efforts in neighboring states. As a result of Idaho's 1995 Strategic Plan for Managing Noxious and Invasive Weeds, the Idaho Weed Coordinating Committee (IWCC) was created, including a Biocontrol Task Force (BTF), which was composed of University of Idaho personnel, state and federal agency representatives and County Weed Superintendents that met regularly. The BTF was charged with the development of biological control priorities and guidelines for Idaho and providing recommendations to IWCC. Comprehensive recommendations were summarized and ranked according to a point system in a BTF report presented to IWCC in April 2001, but recommendations in the report were not implemented, and the BTF was not asked to provide any further information or charged with additional tasks.

In Idaho's renewed 2005 Strategic Plan for Managing Noxious and Invasive Weeds, biological control was again recognized as a critical area for continuing education and gaining further expertise (ISDA 2005). Biocontrol practitioners continued to meet in irregular intervals between 2003 and 2006. From 2006 to present, regular biannual meetings have occurred. The present version of the Strategic Plan for Biological Control of Noxious and Invasive Weeds in Idaho is in large part the result of an effort spearheaded by Idaho's Biological Weed Control state Coordinator, Joseph Milan (USDI Bureau of Land Management/Idaho State Department of Agriculture) with input from the BTF members. It represents the combined suggestions of the BTF members representing federal and state agencies, non-profit organizations as well as stakeholder and client needs.

GOALS AND OBJECTIVES

Idaho's Strategic Plan for Biological Control of Noxious and Invasive Weeds (2008-2018) identifies five program goals developed by Idaho Bureau of Land Management (BLM), Idaho State Department of Agriculture (ISDA), United States Forest Service (USFS), The Nez Perce Bio-control Center (NPBC), Cooperative Weed Management Areas (CWMA), county weed superintendents, and the University of Idaho (U of I). By working to reach these goals we hope to achieve our mission:

> "To facilitate the meaningful incorporation of biological control into long term integrated weed management throughout the State of Idaho."

Goal 1: Coordination – Improve coordination and collaboration between all involved stakeholders and the public in Idaho and adjacent states to facilitate development, implementation, and evaluation of weed biological control programs.

Goal 2: Technology Development – Develop weed biological control programs for appropriate new target plants, identify new weed biological control agents for target weeds for which existing weed biological control agents are not capable of obtaining desired control objectives, develop technologies for effective integration of multiple weed control strategies.

Goal 3: Education and Outreach – Intensify efforts to publicize existing and develop needed educational products and effectively use all media forms to disseminate information regarding all aspects of weed biological control programs to stakeholders and the public.

Goal 4: Capacity Building – Expand weed biological control capacity in Idaho to make weed biological control technology readily available to interested land managers.

Goal 5: Evaluation and Assessment – Evaluate the ability of weed biological control to help land managers meet weed management objectives by documenting weed biological control agent releases, monitoring past weed biological control release sites, monitoring vegetation across invaded landscapes to assess impacts, and assessing agent and program efficacy.

Objectives

For each goal a number of objectives were identified. The objectives address key issues and suggest work activities which will help achieve the goal. Focusing limited weed biological control resources on accomplishing identified objectives will enhance our understanding of weed biological control and its appropriate role in integrated weed management efforts.

Objectives and Suggested Actions for the 5 Strategic Goals for Biological Control of Noxious and Invasive Weeds in Idaho

GOAL 1: COORDINATION

Objective I.A. Facilitate communication between land managers and weed biological control specialists (Appendix A).

Issue*: Weed biological control efforts are frequently duplicated or undermined by activities on adjacent lands because communication between land managers and within agencies and other entities is lacking.*

Suggested Actions:

- Create and maintain a comprehensive list of cooperators to include universities, Cooperative Weed Management Areas (CWMAs), Idaho Weed Coordinating Committee (IWCC), Idaho Weed Control Association

(IWCA), and Idaho Association of Weed Control Superintendents (IAWCS).
- Conduct biannual meetings to discuss issues of concern and program direction.

OBJECTIVE I.B. Communicate weed biological control successes and failures with other land managers, land management agencies, and states.

Issue*: Several neighboring states and land management agencies and entities have successful weed biological control programs. Communicating successes and failures between biological practitioners in adjacent states will allow for more rapid implementation of successful weed biological control programs.*

Suggested Actions:
- Establish and maintain points of contact for land management agencies and entities practicing weed biological control in neighboring states.
- Adopt successful components of weed biological control program(s) developed elsewhere and share practical field knowledge gained with others.
- Communicate failure as well as success with weed biological control communities.

OBJECTIVE I.C. Coordinate with existing agencies/entities to develop a centralized, standardized database structure for biological control releases and monitoring.

Issue*: Several land management agencies and landowners are collecting data, but basic, required elements are not being entered into a database that can be easily accessed by biological control practitioners.*

Suggested Actions:
- Develop a list of data elements essential for evaluating biological control of weed activities with other land managers/ interested parties.
- Solicit GIS specialist input so map products can be developed to help with strategic weed biological control implementation across ownership boundaries.
- Coordinate with other weed biological control practitioners as needed.

OBJECTIVE I.D. Identify weed biological control program priorities (target weeds and agents for those weeds).

Issue*: Different agencies and landowners often have different priorities for weed biological control programs.*

Suggested Actions:

- Identify weed biological control priorities for areas, agencies, and landowners.
- Have points of contact for priority areas and priority weeds.
- Act on those priorities according to available personnel, expertise, land use compatibility, and history.
- Use the priority list as a way to provide direction to foreign exploration programs and research projects.
- Share weed biological control priority lists (target weeds and weed biological control agents) among states, agencies, and land managers to identify common needs and opportunities to collaborate.

GOAL 2: TECHNOLOGY DEVELOPMENT

OBJECTIVE II.A. Develop a standard weed biological control agent and vegetation monitoring protocol.

Issue*: Monitoring of weed biological control agents and associated vegetative communities is commonly not conducted making it difficult to assess biological control efficacy.*

Suggested Actions:

- Develop a standard monitoring protocol specific to each weed biological control agent and target weed that can be completed within a reasonable amount of time as defined by land managers.
- Identify data elements that must be recorded by every person conducting monitoring.
- Develop analyses that allow for real time evaluation of biocontrol impact for aforementioned monitoring data.

OBJECTIVE II.B. Develop or adopt procedures to identify preferred weed biological control agent release site characteristics.

Issue*: Weed biological control agents are often released in areas that do not give the agent the best chance for establishment (wrong host, wrong weed biological control agent species, wrong environment, wrong time, etc.). Developing guidelines which identify site and land use characteristics best suited for weed biological control agent establishment will improve the likelihood of biological control efforts achieving their weed control potential.*

Suggested Actions:

- Develop a list of preferred habitat and land use practices for Idaho-specific weed biological control agents.
- Discuss ongoing weed biological control programs with practitioners to learn from their experiences.
- Consult with other specialists and identify exceptions to the general guidelines that may exist.

OBJECTIVE II.C. Work with the University of Idaho and other research institutions to identify needs for additional research in weed biological control in the state of Idaho.

Issue*: There is a continued need for technology development pertinent to the advancement of biological control and weed biological control's compatibility with other weed management techniques.*

Suggested Actions:

- Identify technology development needs.
- Relay weed biological control technology development needs to University of Idaho and other research institutions and coordinate potential research.

OBJECTIVE II.D. Develop tools for measuring the ecological success of weed biological control.

Issue*: Weed biological control monitoring should focus on the changes to the vegetative community, not only reduction of the target weed, to insure that an area is no longer susceptible to future weed infestations.*

Suggested Actions:

- Utilize the expertise of specialists (resource managers, range conservationists, wildlife biologists, ecologists, etc.) to assess the susceptibility of the vegetative community to weed infestation.
- Summarize ecological information in a format that is easy to understand and provides information needed to make management decisions.

OBJECTIVE II.E. Assist overseas collaborators with foreign exploration needs.

Issue*: Foreign colleagues require native seed material to evaluate the host specificity of potential biological control agents from the area the agent is intended to be released.*

Suggested Actions:

- Coordinate with foreign colleagues working with biological control to identify needs.
- Coordinate with area botanists to fulfill those needs.

OBJECTIVE II.F. Develop simplified, efficient monitoring protocols and data sheets.

Issue*: The time and expertise required to conduct existing weed biological control and vegetation monitoring protocols and fill out standard forms is often cited as the main reason monitoring is not done.*

Suggested Actions:

- Create a monitoring form that can be completed in a short amount of time by virtually any land manager.
- Distribute monitoring forms to county weed superintendents and other interested land managers.
- Create a monitoring data dictionary which can be easily incorporated into GPS units most frequently used by land managers to digitize data collection as an alternative to paper copies.

GOAL 3: EDUCATION AND OUTREACH

OBJECTIVE III.A. Increase public awareness of weed biological control.

Issue*: While the impacts resulting from weed invasions are gaining attention across the state, weed biological control as an IWM practice is not typically addressed.*

Suggested Actions:

- Get more people involved in weed biological control.
- Utilize the Idaho Weed Awareness Campaign (IWAC), University of Idaho Extension, and the Idaho Weed Control Association (IWCA) for outreach regarding weed biological control issues.
- Be actively engaged and available to schools and other educational opportunities.
- Involve teachers and students where feasible.
- Share success stories and lessons learned with the public, land managers, and legislators so that decisions regarding weed biological control as a restoration tool can be made with current information.

OBJECTIVE III.B. Sponsor workshops and scientific meetings.

Issue*: Workshops and scientific meetings are essential to obtain and transmit current knowledge regarding pertinent weed biological control agents, their availability, and their effectiveness for specific ecological habitats.*

Suggested Actions:

- Conduct monitoring-specific workshops (Northern Idaho, Eastern Idaho, and Western Idaho) on an annual basis to familiarize participants with the weed biological control monitoring protocol and agents available for release in Idaho.
- Attend and conduct weed biological control-specific workshops to obtain and transmit current weed biological control knowledge.
- Communicate with colleagues and cooperators about observations and new findings in the field of weed biological control.

- Standardize information presented in statewide workshops conducted by weed biological control specialists to insure it is current and accurate.

OBJECTIVE III.C. Identify and disseminate educational materials dealing with proper use and implementation of weed biological control.

Issue*: Educational weed biological control materials are requested by and need to be made available to weed control practitioners and the interested public.*

Suggested Actions:

- Maintain an open dialogue with weed control personnel and provide them with weed biological control information.
- Educate land managers and the public regarding the International Code of Best Practices for Classical Biological Control of Weeds (Appendix B).
- Identify existing and develop new weed biological control educational materials that may be of use to weed control practitioners.

GOAL 4: CAPACITY BUILDING

OBJECTIVE IV.A. Develop a network of weed biological control practitioners throughout the state.

Issue*: An expansion of the weed biological control program would require an increase in adequately trained personnel to assist in the continuing development and implementation of the weed biological control program.*

Suggested Actions:

- Identify potential weed biological control cooperators and notify them about weed biological control activities, workshops, and other educational opportunities.
- Develop a distribution network of engaged practitioners for weed biological control related information and a communication platform (e.g. website, listserve) to keep everyone informed of ongoing weed biological control activities in Idaho and adjacent states.

OBJECTIVE IV.B. Increase Geographical Information System (GIS) / Global Positioning System (GPS) integration with weed biological control activities.

Issue*: Spatial data management and analysis should be a major component in improving the science of weed biological control.*

Suggested Actions:

- Analyze weed biological control release data and annual monitoring data to assist in determining potential reasons for success or failure of agent establishment.

- Analyze target weed distribution data to determine potential sites for future weed biological control agent releases.
- Utilize GIS target weed location information and historic weed biological control agent release data to identify potential weed biological control agent insectaries, weed biological control success stories, ownership (potential cooperators), and to develop strategic weed biological control programs of work.

OBJECTIVE IV.C. Develop and maintain a list of effective, available, and recommended weed biological control agents and insectaries to facilitate approved and recommended agent collection and redistribution

Issue*: Not all established weed biological control agent insectaries are being utilized because their existence is guarded or unknown. Many entities are purchasing weed biological control agents that are readily established throughout the state. Some land managers are purchasing and releasing weed biological control agents that are not currently permitted and/or recommended for release.*

Suggested Actions:

- Identify approved and desirable weed biological control agent insectaries and coordinate collections.
- Identify weed biological control user needs (federal, state, and private) and attempt to fill those needs by identifying local insectaries.
- Coordinate with private weed biological control agent providers to obtain agents not currently available from public insectaries within the state.
- Develop management plans for weed biological control agent insectaries.
- Identify unapproved or not recommended weed biological control agent releases/insectaries and caution against their inclusion in weed biological control programs, as per the International Code of Best Practices for Classical Biological Control of Weeds (Appendix B).

OBJECTIVE IV.D. Integrate weed biological control into all appropriate weed management programs across the state.

Issue*: Many land managers are not utilizing weed biological control where there is a high likelihood of success.*

Suggested Actions:

- Utilize the Annual Operating Plans (AOP) and End of Year Reports (EYR) submitted to ISDA's CWMA costshare program to determine the extent of weed biological control use throughout the CWMAs in Idaho.
- In areas where weed biological control is not currently being utilized, but has a high probability of helping managers reach weed control objectives, approach managers to discuss incorporating biological control.

- Discuss weed management plans with land management entities and identify areas where weed biological control can be implemented into current programs.

OBJECTIVE IV.E. Provide baseline data for new weed biological control programs currently in the testing phase.

***Issue**: To accurately measure the impact of a weed biological control agent on its target weed and the invaded ecosystem, it is essential to collect vegetation data prior to the release of a new agent.*

Suggested Actions:

- Use a standard data collection format to gather baseline data for 3-5 field seasons prior to the release of a new biological control agent.
- Permanently mark monitoring sites when established for continued monitoring into the future once the new weed biological control agent has been released.

OBJECTIVE IV.F. Identify and manage current and historical weed biological control projects within the state (Appendix C).

***Issue**: Several weed biological control projects exist in Idaho, but are not known to potential cooperators.*

Suggested Actions:

- Draft a list of current and past weed biological control projects for area specialists.
- Establish points of contact for those projects.

GOAL 5: EVALUATION AND ASSESSMENT

OBJECTIVE V.A. Develop a comprehensive monitoring program to be used to evaluate weed biological control program impacts and assess vegetative response throughout the state.

***Issue**: There are several different weed biological control monitoring programs among the FS, BLM, University of Idaho, Nez Perce, NGO, and county personnel.*

Suggested Actions:

- Collaboratively develop a weed biological control and vegetation monitoring protocol that can be used to evaluate the effectiveness of weed biological control agents and changes to the vegetative community.
- Emphasize the importance of consistent monitoring in weed biological control programs.

- Monitor weed biological control releases on federal, state, and private lands.

OBJECTIVE V.B. Evaluate weed biological control agent performance.

Issue*: Many weed biological control agents have been released, but their weed control performance has not been evaluated. Such evaluations will provide data that will enable land managers to concentrate limited resources on effective weed biological control agents.*

Suggested Actions:

- Create a weed biological control agent focus list pertinent to Idaho with established weed biological control agents that can be further developed and weed biological control agents which Idaho does not currently have, but may be capable of supporting.
- Create a list of weed biological control agents which are not currently approved or recommended for release/redistribution within Idaho.
- Monitor biological control agent populations within Idaho and maintain an open dialogue with collaborators in adjacent states regarding the status of the agents in their area as well as any concerns about agents requested, but not currently established, in Idaho.
- Continue to update the Pacific Northwest Weed Management Handbook regarding weed biological control agent distribution, attack rate, control efficacy, and availability.
- Create a weed biological control practitioner flow chart for the scenarios listed above regarding insect establishment: If one management practice or release site is unsuccessful after many years and several different methods, move in an alternate direction (different agents, augmentative releases, new site, conservation methods, etc.).

OBJECTIVE V.C. Evaluate weed biological control program effectiveness and areas for potential improvement.

Issue*: In the absence of constant evaluation, the effectiveness of an established weed biological control program will not improve.*

Suggested Actions:

- Convene the Biocontrol Task Force (BTF) biannually to evaluate the weed biological control program.
- Identify areas that need to be improved.
- Maintain an open, objective dialogue with cooperators and practitioners to ensure that the weed biological control program continues to improve.

LITERATURE CITED

Babbitt, B. (1998) Statement by Secretary of the Interior on invasive alien species. National Weed Symposium, Bureau of Land Management Weed pp. 8-10 Denver, CO.

Balciunus, J. K. (2000) *Proceedings of the X International Symposium on Biological Control of Weeds* 435, 4-14 July 1999, Montana State University, Bozeman, Montana, USA. Neal R. Spencer [ed.]. p. 435.

Baskin, Y. (2002) A plague of rats and rubber vines: the growing threat of species invasion. Island Press, Washington D.C.

Briese, D.T. (1990) A new biological control programme against thistles of the genus *Onopordum* in Australia. Proceedings of the VII International Symposium on Biological Control of Weeds (Delfosse, E.S., Ed.), pp. 155-163.

Coombs, E.M., Piper, G.L., Schwarzlaender, M., Andreas, J. and Milan, J.D. (2007) Biological Control. In 2008 Pacific Weed Management Handbook (Peachey, E., Ball, D., Parker, R., Yenish, J., Morishita, D., and Hutchinson, P. Eds.). Oregon State University, Corvallis, Oregon, pp. 3-6.

Debach, P. (1964) Biological control of insect pests and weeds. Chapman and Hall, London.

Elton, C.S. (1958) The ecology of invasions by animals and plants. Chapman and Hall, London.

Idaho State Department of Agriculture (2005) Idaho's Strategic Plan for Managing Noxious and Invasive Weeds, 36 pp.

Morse, L.E., Kartesz, J.E., and Kutner, L.S. (1995) Native vascular plants. In Our living resources: a report to the nation on the distribution, abundance and health of U.S. plants, animals and ecosystems (LaRoe, E.T., Farris, G.S., Puckett, C.E., Doran, P.D., and Mac, M.J. Eds.). Washington (DC): US Department of the Interior, National Biological Service, pp. 205-209.

APPENDIX A

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APPENDIX B
(Adapted from Balciunus 2000)

International Code of Best Practices for Classical Biological Control of Weeds:

1. Ensure target weed's potential impact justifies release of non-endemic agents
2. Obtain multi-agency approval for target
3. Select agents with potential to control target
4. Release safe and approved agents
5. Ensure only the intended agent is released
6. Use appropriate protocols for release and documentation
7. Monitor impact on target
8. Stop releases of ineffective agents, or when control is achieved
9. Monitor impacts on potential non-targets
10. Encourage assessment of changes in plant and animal communities
11. Monitor interaction among agents
12. Communicate results to public

Delegates and participants to the X International Symposium for Biological Control of Weeds, recognizing the need for professional standards in the subdiscipline of classical biological control of weeds, urge practitioners of the to voluntarily adopt the CODE OF BEST PRACTICES FOR CLASSICAL BIOLOGICAL CONTROL OF WEEDS, as published in the proceedings of the Symposium, and to adhere to the principals outlined in the Code.

APPENDIX C

Current status of biological weed control agents in Idaho (Coombs et. al 2007):

Weed	Agent	Distribution[1]	Attack Rate[2]	Control[3]	Availability[4]
Field Bindweed	*Aceria malherbae*	L	L	F	L
Scotch Broom	*Bruchidius villosus*	U	U	U	U
	Exapion fuscirostre	U	U	U	U
	Leucoptera spartifoliella	-	-	-	-
Diffuse Knapweed	*Bangasternus fausti*	L	U	U	L
	Cyphocleonus achates	L	M	F	L
	Larinus minutus	W	H	E	W
	Pterolonche inspersa	-	-	-	F
	Sphenoptera jugoslavica	H	H	G	M
	Urophora affinis	W	H	G	M
	Urophora quardifasciata	W	H	G	M
Meadow Knapweed	*Larinus minutus*	-	-	-	-
	Larinus obtusus	-	-	-	-
	Urophora quardifasciata	-	-	-	-
Russian Knapweed	*Subanguina picridis*	U	U	U	U
Spotted Knapweed	*Agapeta zoegana*	W	L	U	L
	Bangasternus fausti	L	U	U	L
	Chaetorellia acrolophi	L	L	U	L
	Cyphocleonus achates	L	M	G	M
	Larinus minutus	W	H	E	M
	Larinus obtusus	L	M	F	L
	Metzneria paucipunctella	W	H	G	M
	Sphenoptera jugoslavica	-	-	-	-
	Terellia virens	-	-	-	-
	Urophora affinis	W	H	G	M
	Urophora quadrifasciata	W	H	G	M
Purple Loosestrife	*Galerucella calmariensis*	W	H	E	M
	Galerucella pusilla	W	H	E	M
	Hylobius transversovittatus	L	L	F	L
	Nanophyes marmoratus	L	L	F	L
Tansy Ragwort	*Botanophila seneciella*	L	L	F	U
	Longitarsus jacobaeae	U	U	U	U
	Tyria jacobaeae	-	-	-	-
Mediterranean Sage	*Phrydiuchus tau*	W	H	G	M
Saltcedar	*Diorhabda elongata*	L	S	U	U
Rush Skeletonweed	*Aceria chondrillae*	W	H	G	M
	Bradyrrhoa gilveolella	U	U	U	U
	Cystiphora schmidti	W	H	G	M
	Puccinia chondrillina	W	H	G	M
Leafy Spurge	*Aphthona cyparissiae*	L	L	G	M
	Aphthona czwalinae	L	L	G	M

	Aphthona flava	L	L	G	M
	Aphthona lacertosa	W	M	G	M
	Aphthona nigriscutis	W	M	G	M
	Oberea erythrocephala	W	M	G	M
	Spurgia esulae	L	U	U	U
Yellow Starthistle	*Bangasternus orientalis*	W	H	G	M
	Chaetorellia australis	W	H	G	M
	Eustenopus villosus	W	H	G	M
	Larinus curtus	W	M	G	M
	Urophora sirunaseva	L	L	U	L
Canada Thistle	*Ceutorhynchus litura*	L	L	U	L
	Urophora cardui	L	M	G	M
Musk Thistle	*Trichosirocalus horridus*	L	M	G	L
Dalmatian Toadflax	*Brachypterolus pulicarius*	W	M	P	L
	Calophasia lunula	W	L	U	L
	Gymnetron linariae	U	U	U	U
	Mecinus janthinus	W	H	E	M
Yellow Toadflax	*Brachypterolus pulicarius*	L	M	P	L
	Calophasia lunula	L	M	F	L
	Gymnetron antirrhini	L	M	U	L

[1]Distribution within host range: W = widespread; L = limited sites; F = failed to establish; U = unknown status; - = not released

[2]Attack rate host: H = (> 70%); M = medium (>30%); L = light (>1 0%); S = slight (< 1%); U=unknown status; - = not released

[3]Control ability on seeds and/or plant density: E = excellent; G = good; F = fair; P = poor; U = undetermined; - = not released

[4]Availability for redistribution: M = mass collections; L = limited; U = unavailable; - = not released (Limited availability indicated agent populations are slow in building or are recently introduced. Work on these species should be coordinated through biological control specialists.)