FIELD RELEASE OF THE EXOTIC WEEVIL, *MECINUS JANTHINUS* (COLEOPTERA: CURCULIONIDAE), FOR BIOLOGICAL CONTROL OF THE WEEDS DALMATIAN TOADFLAX, *LINARIA DALMATICA*, AND YELLOW TOADFLAX, *LINARIA VULGARIS* (SCROPHULARIACEAE)

ENVIRONMENTAL ASSESSMENT

FEBRUARY 1996

Agency contact:
Ronald D. Hennessey, Ph.D.
USDA--Animal and Plant Health Inspection Service
4700 River Road, Unit 133
Riverdale, MD 20737-1236
Phone: (301) 734-7839
Fax: (301) 734-8700

I. Proposed Action--Description and Statement of Need

The Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) has received an application (Appendix 1) from Montana State University (MSU) for a permit to release a nonindigenous weevil, *Mecinus janthinus* Germar (Coleoptera: Curculionidae), in Montana. This insect is a biological control agent of Dalmatian toadflax, *Linaria dalmatica* (L.), and yellow toadflax, *Linaria vulgaris* Mill., two weeds in the family Scrophulariaceae.

The applicant proposes to collect *M. janthinus* adults in southwestern Yugoslavia (Macedonia) and import them to the Insect Quarantine Laboratory at MSU in Bozeman, MT, where their species identity will be confirmed and where they will be checked for diseases, parasitoids, and other contaminants. After having been screened, adult weevils will be allowed to oviposit on caged toadflax plants in the laboratory and an outdoor garden. Weevils taken from the cages will be released in infestations of Dalmatian toadflax at Lodge grass and Townsend, MT, and yellow toadflax at Boulder and West Yellowstone, MT. After weevil populations build up, the insects will be collected and distributed to other release sites in Montana and other states.

Voucher specimens will be deposited in the Department of Entomology Museum, Montana State University, Bozeman, MT. Specimens have already been deposited in the collection of the International Institute of Biological Control (IIBC), European Station, Delemont, Switzerland. Identification of *M. janthinus* was confirmed by Dr. L. Dieckmann, Ebaerswalde, DDR, a taxonomist specializing in beetles.

If a permit to release *M. janthinus* is issued, this weevil will be the second exotic biological control agent approved for release against the two toadflax species in the United States.

The pending application was submitted in accordance with the Federal Plant pest Act (7 U.S.C. 150aa *et seq*.) and the Plant Quarantine Act (7 U.S.C. 151aa *et seq*.). This EA was prepared in compliance with the National Environmental Policy Act (NEPA)(42 U.S.C. 4321 *et seq*.) as described in implementing regulations adopted by the Council on Environmental Quality (40CFR 1500-1509), by USDA (7CFR 1b), and by APHIS (60 CFR 6000-6005).

II. Purpose and Need for the Proposed Action

The purpose of the proposed releases of *M. janthinus* is to reduce the severity of infestations of Dalmatian toadflax and yellow toadflax.

Dalmatian toadflax has become an important weed of pastures, cultivated fields, and disturbed rangelands throughout the northern and western United States, mainly because of its adaptiveness and ability to spread (Montgomery 1964, Reed and Hughes 1970). It is listed as a noxious weed in Montana, Oregon, and Washington. Increasingly severe infestations are displacing forage plants to the detriment of the cattle industry. The native flora is suffering as well.

Yellow toadflax occurs throughout the United States (USDA 1970). It colonizes disturbed habitats rapidly by seed and creeping roots and does particularly well on fallow land. It is causing increasing economic losses in perennial crops such as mint (H. J. Hopen, pers. comm.)

III. Alternative to the proposed action.

The "no-action" alternative to issuing a permit for the release of *M. janthinus* is to deny the permit. If the permit is denied, chemicals will be used to control Dalmatian toadflax and yellow toadflax in croplands. Chemicals are not a practical means of control in rangelands.

IV. Environmental Impacts of the Proposed Action and Alternatives

The intended environmental impact of the proposed action is a reduction in severity of infestations of Dalmatian toadflax and yellow toadflax with consequent improvement in range conditions and the return of a mixed community of native herbaceous plants. Sales of ornamental toadflax are expected to decrease.

If successful biological control agents are not released, Dalmatian toadflax and yellow toadflax will invade new areas, and infestations will increase in severity.

More herbicides will be required for weed control in certain areas, especially in croplands and in sandy-gravelly soils. Groundwater may become contaminated to the extent that it is no longer safe to drink. Where toadflax is controlled by herbicides, native plants and associated fauna will suffer from chemical treatments. In areas where herbicides are not a practical means of control, native plants and the associated fauna will suffer from competition with toadflax.

Test plant list.

Thirty-nine plant species were tested by IIBC, following the test plant list proposed by the Canadian Review Committee and the United States Technical Advisory Group. These can be found in Table 1 below and Table 1 in the original petition for release that went to TAG; they also are listed in Jeanneret and D. Schroeder (1991). These included 12 Scrophulariaceae species in the tribe Antirrhineae; 12 other plant species in the family Scrophulariaceae, a number of which are native and/introduced ornamentals; and 15 plant species from other plant families, most of which are economically important plants.

Genera of plants serving as hosts for *M. janthinus* and other *Mecinus* species are presented in Table 2. Host records indicate that *M. janthinus* is only associated with plants in the genus *Linaria*. Concerning the native species of *Linaria*. There are only three native species in North America: *Linaria canadensis* (L.) Dum, *Linaria texana* Scheele (a variety of *L. canadensis* according to Gleason 1952; see ref. below), and *Linaria floridana* Chapm. All three of these native *Linaria* species are annuals and would not have stem diameters sufficient in size to support development of *Mecinus janthinus*. None of these species are listed as rare or endangered.

Field observations of *Mecinus janthinus* were made by IIBC and in 1988, 1989, and 1990 in Yugoslavia in the area around Belgrade and Macedonia, in Italy in the area around Rome, and in the Upper Rhine Valley between Basle and Strasbourg. The aim was to collect information on the occurrence and abundance of the weevil, its life-history, and the field host plants.

Multiple choice tests and host acceptance tests were initially carried out on 38 plant species. The numbers of test plants used in single choice tests (23 plant species) were chosen based on the results obtained in the 1989 and 1990 multiple choice tests (Jeanneret and Schroeder (1992), while the number of plant species used in the larval feeding and development tests (5 plant species) was based on the plant species in which *M. janthinus* had fed and oviposited on in multiple choice tests. Except for the larval feeding and development tests, which were carried out on potted plants, tests were generally carried out on cut shoots (12 cm in length) inserted into a wet sponge immersed into a

water-filled vial and placed in 2.5 l plastic cylinders in the laboratory at IIBC, Delemont, Switzerland. From three to five pairs of beetles per plastic cylinder were used for the multiple-choice tests, the host acceptance tests, and the single-choice tests. Experiments were replicated four to 10 times for each plant species tested (Jeanneret and Schroeder 1991, Jeanneret and Schroeder 1992).

Adult Feeding and Oviposition:

After it had been demonstrated that cut shoots (12 cm in length) were as well accepted as shoots of potted plants, cut shoots were used in most of the tests to economize on space and plant material.

Multiple choice tests were carried out in 2.5 l plastic cylinders. In the laboratory, shoots of three randomly chosen test plant species were placed at equal distance from each other with *Linaria vulgaris* (yellow toadflax from Delemont, Switzerland) as a control plant in the center. The shoots were inserted into a wet sponge immersed into a water-filled vial. Three pairs of beetles were put into each plastic cylinder. The test was replicated nine or 10 times with each of the thirty eight plant species.

Host acceptance tests were made in the same way with *Linaria dalmatica* (from Canada), and *L. vulgaris* (from Delemont). Cut shoots were presented to five pairs of beetles and replicated 13 times. The amount of feeding and the number of eggs laid were compared.

Single choice tests: A total of 23 plant species were chosen based on results of the 1989 and 1990 multiple choice tests. For 15 plant species (on which *M. janthinus* had fed but not oviposited during the 1989 experiments) three cut shoots of each were presented in a 2.5 l plastic cylinder to three pairs of beetles. The tests were replicated twice. Potted plants of another eight test plant species, on which *M. janthinus* had fed and oviposited during the 1989 tests, were offered to each of five pairs of beetles. The tests were replicated four to 10 times. Potted plants of these eight test plant species had to be used to find out if they actually allowed complete development form egg to adult, which is not possible on cut shoots. Because of the prolonged developmental period of *M. janthinus*, the plants were kept in a greenhouse to allow termination of larval development in case of host acceptance, and dissected in November.

Larval Feeding and Development:

Larval feeding and development was tested with plant species on which *M. janthinus* had fed and oviposited in multiple choice tests. In order to obtain larvae for transfers, stems of yellow toadflax were offered for oviposition in 2.5 l plastic cylinders. After oviposition, the shoot parts with eggs were removed and kept in small plastic cups on wet filter paper at 20 C and 80% relative humidity. The newly hatched larvae were transferred into small holes drilled into the stems of potted plants, and the holes were covered with a small piece of tissue fixed around the stems to prevent the larvae from leaving the artificial mines. The stems were dissected in November.

Investigations by IIBC showed that *M. janthinus* has a host range limited to plants in the genus *Linaria* with a stem diameter over 0.9 mm (see Table 3 for a summary of the host specificity information and Appendix 1 for more detailed information on host specificity tests), which excludes all the annual species. Although 31% of the larvae of *M. janthinus* transferred to *Antirrhinum*

orontium were able to complete development, no oviposition and only minimal feeding was observed for adult weevils on this introduced weedy species. Adult feeding and oviposition also occurred on *Linaria alpina* (an ornamental from Europe), *Linaria repens* (an introduced weedy species), and *Linaria canadensis* (an annual native species that is not rare or endangered and is widely distributed in North America). Some adult feeding (but no oviposition), also was observed on *Linaria maroccana*, which is a widely grown introduced ornamental species, that is also listed as a weedy species in Budd's Flora (Looman and Best 1979). Minimal feeding and some oviposition also occurred on the common European ornamental snapdragon species, *Antirrhinum majus*, however, larval development was unsuccessful.

It has been demonstrated that *M. janthinus* accepts and normally develops on the North American biotypes of both target weeds, *L. dalmatica* (broad-leaved and narrow-leaved) and *L. vulgaris*.

The biology of *M. janthinus* precludes any direct impact on humans.

Two of the accidentally introduced species, *Gymnetron antirrhini* and *Brachypterolus pulicarius*, have proven highly effective in reducing seed production in yellow toadflax, but additional insect species must be introduced to obtain satisfactory control of both toadflax species.

In summary, extensive data collected by the International Institute of Biological Control indicate that *M. janthinus* is safe to introduce as a biological control agent of Dalmatian toadflax and yellow toadflax in the U.S.

V. References

Coupland, R. T. 1954. The Saskatchewan weed survey. Dept. Plant Ecol. Coll. Agric. Univ. Saskatchewan. Circ. 34.

Germar, E. F. 1821. Genera Curculionitum. Magazin der Entomologie, Vierter Bd.: 314-321.

Gleason, H. A. 1952. The new Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada, Vol. 3. The New York Botanical Garden, 228-229.

Hoffmann, A. 1958. Tribu des Mecinini. Faune de France, Coleopteres Curculionidae, Lechevalier.

Jeanneret, P., and D. Schroeder. 1991. *Mecinus janthinus* Germar (Coleoptera: Curculionidae): a candidate for the biological control of Dalmatian and yellow toadflax in North America. Final Report. International Institute of Biological Control, CAB International, European Station, Delemont, Switzerland.

Jeanneret, P., and D. Schroeder. 1992. Biology and host specificity of *Mecinus janthinus* Germar (Col.: Curculionidae), a candidate for the biological control of yellow and Dalmatian toadflax, *Linaria vulgaris* (L.) Mill. and *Linaria dalmatica* (L.) Mill. (Scrophulariaceae) in North America. Biocontrol Sci. Technol. 2: 25-34.

Lajeunesse, S.E., P.K. Fay, J.R. Lacey, R.M. Nowierski, D. Zamora, and D. Cooksey. 1993. Dalmatian toadflax - a weed of pasture and rangeland: Identification, biology, and management. Montana State Univ. Ext. Bull. 115, pp 1-13.

Lange, A. W. 1958. Dalmatian toadflax - a possible rival of goatweed as a serious range weed. Weeds 6: 68-70.

Looman, J. and K. F. Best. 1979. Budd's Flora of the Canadian Prairie Provinces. Res. Branch, Agric. Canada Publ. No. 1662.

McClay, A. S. 1987. Proposal to screen further agents for biological control of common toadflax, *Linaria vulgaris* (L.) Mill.. Alberta Environmental Centre, Vegreville, Report, 18 pp.

McClay, A. S. 1989. Selection of suitable target weeds for classical biological control in Alberta. Alberta Environmental Centre, Vegreville, Report, 97 pp.

Montgomery, F. H. 1964. Weeds of the northern United States and Canada. Frederick Ware and Co., Inc., New York. 226 pp.
Polunin, O. 1969. Flowers of Europe. Oxford University Press, p. 662.
Reed, C. F., and R. O. Hughes. 1970. Selected weeds of the United States. U.S.D.A Handbk. 366. pp. 326-329.
Scherf, H. 1964. Die Entwicklungsstadien der mitteleuropaischen Curculionidae (Morphologie, Bionomie, Oekologie). Abh. Senckenb. Ges. 506: 1-335.
Sticher, O. 1971. Isolation of Antirrhinoside from *Linaria vulgaris*. Phytochem. 10: 1974-1975.
USDA-FWS 1985. Federal Register. 50 CFR Part 17. Vol. 50 No. 188, pp. 39528-39584.

VI. List of Preparators, Consultants, and Reviewers

This report was prepared by **Robert M. Nowierski**, Department of Entomology, Montana State University, Bozeman, MT, and by **Ronald Hennessey**, USDA--APHIS, Riverdale, MD.

This EA is based largely on a petition submitted by **Robert M. Nowierski** to the Technical Advisory Group (TAG) on the Biological Control of Weeds. The following TAG members approved the petition: **Alfred F. Cofrancesco**, U.S. Army Corps of Engineers, Vicksburg, MS; **Jack R. Coulson**, USDA--ARS, Beltsville, MD; **James Kryson**, USDA--APHIS, Riverdale, MD; **Dale Meyerdirk**, USDA--APHIS, Riverdale, MD; **Janine E. Powell**, USDA--Forest Service, Washington, DC.; **James G. Saulmon**, U.S. Environmental Protection Agency, Washington, DC.; **David Sisneros**, U.S. Bureau of Reclamation, Denver, CO; **Charles Turner**, USDA--ARS, Albany, CA; **B.D. Wright**, Oregon Department of Agriculture, Salem, OR.

This environmental assessment was reviewed by **Robert Flanders**, Ph.D., USDA--APHIS, Riverdale, MD; **Kenneth Lakin**, Ph.D., USDA--APHIS, Riverdale, MD; **Charles Turner**, Ph.D., USDA--ARS, Albany, CA.

VII. Appendices

Appendix 1. Application for a permit to release *Mecinus janthinus* in Montana. The petition for release, which includes the results of host specificity studies of *M. janthinus*, was submitted to APHIS-PPQ by Robert M. Nowierski in June 1994.

Appendix 2. Import permit from Montana Department of Agriculture, #952535, for *Mecinus janthinus*. **Another permit requesting release of *M. janthinus* from quarantine was submitted in 1995**.

FINDING OF NO SIGNIFICANT IMPACT

USDA--APHIS--PPQ is reviewing an application for a permit to release *Mecinus janthinus* (Coleoptera: Curculionidae) in Montana and other states in the U.S. This nonindigenous weevil is potentially useful for the biological control of Dalmatian toadflax, *Linaria dalmatica*, and yellow toadflax, *Linaria vulgaris* (Scrophulariaceae). Dalmatian toadflax and yellow toadflax cause economic damage in rangeland and cropland in the U.S. and Canada.

Releases of *Mecinus janthinus* are expected to have no significant impacts on the quality of the human environment. This finding in based on the following considerations:

- Extensive tests by IIBC showed that *M. janthinus* has a host range limited to plants in the genus *Linaria* with a stem diameter over 0.9 mm, which excludes all annual species. Some adult feeding and oviposition occurred on *Linaria alpina* (an ornamental from Europe), *Linaria repens* (an introduced weedy species), and *Linaria canadensis* (an annual native species which is not rare or endangered and is widely distributed in North America). Some adult feeding (but no oviposition), was also observed on *Linaria maroccana*, which is widely grown and according to Budd's Flora an introduced weedy species (Looman and Best 1979). Minimal feeding and some oviposition also occurred on the common European ornamental snapdragon species, *Antirrhinum majus*, however no larvae were able to complete development on this plant species. It is important to note that there are no records of *M. janthinus* attacking *A. majus* under field conditions in Europe. Hence, one can conclude that *A. majus* is not a suitable host for the weevil, and would likely not be attacked in North America.

- No species of *Linaria* (or species in the tribe Antirrhineae) are listed by the Federal Government or any State Government as threatened or endangered (USDA-FWS 1985; see Table 4).

- Control of Dalmatian toadflax and yellow toadflax is expected to have no negative impacts on threatened or endangered species. Neither weed species is utilized as a food source by a threatened or endangered species.

- The weevil will have no direct impacts on humans nor any negative impacts on the human environment.

- Overall impacts on wildlife and native vegetation should be highly beneficial.

_____ _____

Charles P. Schwalbe, Ph.D. Date
Director, Operational Support
Plant Protection Quarantine
Animal and Plant Health Inspection Service
United States Department of Agriculture

Table 1. Test plant list for *Mecinus janthinus*.

Plant species	Status
Tribe: Antirrhineae	
Linaria dalmatica (L.) Mill.	Ornamental and weed
L. vulgaris (L.) Mill.	Ornamental and weed
L. alpina Mill.	Ornamental
L. maroccana Hook. F.	Ornamental
L. canadensis (L.) Mill.	Native
L. repens (L.) Mill.	Introduced into North America
Anarrhinum bellidifolium (L.) Mill	Weed
Antirrhinum majus L.	Ornamental (introduced)
Antirrhinum orantium L.	Ornamental
Chaenorrhinum minus (L.) Lange	Introduced into North America
Cymbalaria muralis Baumg.	Ornamental
Kickxia elatine (L.) Dumont	Introduced into North America
Family: Scrophulariaceae	
Calceolaria crenatiflora Cav.*	Ornamental
Castilleja miniata Dougl. ex Grah.	Native
Chelone obliqua L.	Native and ornamental
Collinsia parviflora Lindl.*	Native
Digitalis purpurea L.	Ornamental and medical
Gratiola neglecta Torr*	Native
Mimulus lewisii Pursh.	Native and ornamental
Pedicularis groenlandica Ratz.	Native
Penstemon procerus Dougl. ex Grah*	Native
Scrophularia nodosa L.	Introduced into North America
Verbascum thapsus L.	Weed
Veronica spicata L.	Ornamental and naturalized in North America
Plant Species from other families:	
Beta vulgaris L.	Economic (beet)
Cucumis sativa L.	Economic (cucumber)
Ipomoea batatas L.	Economic (sweet potato)
Lycopersicon esculentum L.	Economic (tomato)
Medicago sativa	Economic (alfalfa)
Persea americana Mill.	Economic (avocado)
Petunia grandiflora L.	Ornamental
Plantago major L.	Common alternate host of *Linaria* insects
Raphanus sativus L.	Economic (radish)
Rheum rhaponticum L.	Economic (rhubarb)
Salvia coccinea L.*	Ornamental and alternate host of some *Linaria* insects
Sesamum indicum L.	Economic (sesame)
Solanum tuberosum L.	Economic (potato)
Solidago canadensis L.	Weed
Zea mays L.	Economic (corn)

Table 2. Genera of plants serving as hosts for *Mecinus* species.[1]

Mecinus species	Host Plant Genus	Host plant family	No. host species
Mecinus circulatus	*Plantago*	Plantaginaceae	4
Mecinus collaris	*Plantago*	Plantaginaceae	5
Mecinus dorsalis	*Anarrhinum*	Scrophulariaceae	1
	Antirrhinum	Scrophulariaceae	2
	Linaria	Scrophulariaceae	1
Mecinus janthinus	*Linaria*	Scrophulariaceae	4
Mecinus heydeni	*Linaria*	Scrophulariaceae	1
Mecinus pyraster	*Plantago*	Plantaginaceae	1
Mecinus sicardi	*Antirrhinum*	Scrophulariaceae	1
Mecinus suturalis	*Plantago*	Plantaginaceae	1

[1]Data in Table 2 comes from Jeanneret and Schroeder (1991).

Table 3. Host-specificity of *Mecinus janthinus* within the family Scrophulariaceae and Tribe Antirrhineae.

Plant species	Egg deposition	Larval feeding	Complete larval development	Adult feeding
Antirrhinum majus[1] (introduced snapdragon)	+	+	-	+
Antirrhinum orontium[1] (introduced weedy sp.)		+	+	+
Linaria alpina[1] (introduced ornamental)	+	+	+	+
Linaria canadensis[1] (common native sp.)	+	+	-	+
Linaria dalmatica[1] (dalmatian toadflax)	+	+	+	+
Linaria genistifolia[1] (narrow-leaved Dalmatian toadflax)	+	+	+	+
Linaria minor[2] (European sp.)				+?
Linaria maroccana[1] (introduced ornamental)				+
Linaria repens[1] (introduced weedy sp.)	+	+	+	+
Linaria vulgaris[1] (yellow toadflax)	+	+	+	+

[1]Laboratory studies.
[2]Recorded from this host plant in the field (life stage of beetle unknown).
[3]Data in Table 3 comes from Pennell, 1935; Britton and Brown, 1970; and Jeanneret and Schroeder, 1991).

Table 4. Threatened (T) and endangered (E) species in the family Scrophulariaceae. Species not followed by a letter have been proposed for listing as endangered or threatened. Field observations and laboratory studies show that *Mecinus janthinus* is restricted to plants in the Tribe Antirrhineae (Family Scrophulariaceae). No plant species in this tribe are listed as threatened or endangered in the U.S., nor are any plant species in this tribe proposed for such status.

Buchnereae	
Agalinis acuta (E)	Eastern U.S.
Cheloneae	
Penstemon discolor	AZ
Penstemon grahamii	CO, UT
Penstemon haydenii (E)	NE
Penstemon penlandii (E)	CO
Penstemon scariosus	CO, UT
Euphrasieae	
Castilleja aquariensis	UT
Castilleja christii	ID
Castilleja elongata	TX
Castelleja grisea (E)	San Clemente Is.
Castilleja levisecta	OR, WA
Castilleja mollis	CA
Castilleja salsuginosa	NV
Cordylanthus maritimus (E)	CA
Cordylanthus mollis	CA
Cordylanthus nidularius	CA
Cordylanthus rigidus	CA
Pedicularis furbishiae (E)	ME
Schwalbea americana (E)	Eastern and Southern U.S.
Gratioleae	
Amphianthus pusillus (T)	AL, GA, SC
Mimuleae	
Mimulus glabratus (E)	MI
Mimulus mohavensis	CA
Mimulus shevockii	CA
Veroniceae	
Synthyris ranunculina	NV