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Program for Biological Control of Saltcedar (*Tamarix* spp.) in Thirteen States

Environmental Assessment
June 2005

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1. Purpose and Need for Proposed Action

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) is proposing a program to expand the release of a biological control agent of saltcedar (*Tamarix* spp.) into 13 States. The USDA, Agricultural Research Service has researched and developed a biological control (biocontrol) agent, *Diorhabda elongata deserticola* (*D. e. deserticola*), a leaf beetle, which has the potential to reduce the area and intensity of infestations of the invasive weed saltcedar in the United States. There is a need to control saltcedar in the western United States because it greatly alters the habitats which it has invaded, limiting land use. The biocontrol agent, *D. e. deserticola,* is self-replicating and host-specific so will not negatively impact non-target plant species (DeLoach *et al.,* 2003a; Lewis *et al.,* 2003a), and may permanently reduce saltcedar populations. The purpose of this program is for APHIS to release *D. e. deserticola* at certain locations that will serve as "nursery" sites or insectaries. Once sufficient populations of beetles build up at those locations, APHIS will distribute beetlesto interested land managers within the 13 States, thus providing another tool to assist with reduction of saltcedar infestations.

This environmental assessment has been prepared, consistent with the APHIS National Environmental Policy Act implementing procedures (Title 7 of the Code of Federal Regulations, Part 372), for the purpose of evaluating the extent of the impact the proposed action described below, as well as any alternatives, if implemented, may have on the quality of the human environment. This environmental assessment will be used to help determine whether or not to prepare an environmental impact statement, which is a more comprehensive study of the proposed action and alternatives considered in this document. An environmental impact statement must be prepared if implementation of the proposed action may significantly affect the quality of the human environment.

2. Background

2.1 Saltcedar

Saltcedar is a long-lived (50 to 100 years), dense, deciduous shrub or small tree that can grow to 30 feet tall. Approximately 10 species of *Tamarix* are established in the United States. *T. ramosissima*, *T. chinenesis*, and their hybrids, are the most widespread and damaging. The most common plant in the U.S. invasion is the *T. ramosissima* × *T. chinenesis* hybrid (Gaskin and Schaal, 2002). *T. parviflora* is sometimes weedy in

California and a *T. ramosissima* × *T. canariensis* hybrid is sometimes weedy in Texas. *T. aphylla*, known as athel, is a low quality ornamental and has become invasive in only a few areas under special conditions, although its weediness appears to be increasing. The remaining species are minor ornamentals, mostly occurring in the eastern United States. In this environmental assessment, all of these species (except athel) are referred to collectively as saltcedar.

Saltcedar (also known as tamarisk) was introduced to North America from Asia in the early to mid 1800s. The plant has been used for windbreaks, ornamentals, and erosion control. By 1890, saltcedar had infested river systems and drainages in the Southwest, often displacing native vegetation. By the 1950s saltcedar occupied most western riparian areas along major streams from the central Great Plains to the Pacific and from northern Mexico to southern Montana. Saltcedar continues to spread rapidly and currently infests water drainages and areas throughout the western United States. Major infestations have replaced at least 50%, and often approach 100%, of the native vegetation in large areas of nearly all the major streams within its distribution (Horton and Campbell, 1974). Saltcedar occupied 900,000 acres by the mid 1960s (Robinson, 1965) and today probably occupies 1.5 million acres (Brotherson and Field, 1987). Invasion is estimated to be expanding by 18,000 hectares (44,479 acres) per year (Di Tomaso, 1998). It is spreading rapidly into previously uninfested areas such as in Montana and North Dakota. Saltcedar is less desirable than native vegetation for the following reasons: high water use; increased soil salinity; provides poor habitat for many species of native wildlife and reduces the abundance and diversity of plants and animals that occur in riparian habitats; increases the incidence of fire from accumulation of heavy litter fall, saltcedar leaves, and dead wood material; reduces recreational usage of infested areas for camping, hunting and fishing, boating, birdwatching, and wildlife photography; adversely affects certain listed threatened and endangered species; and causes alteration of streams (see section 4 for further discussion of saltcedar impacts).

Interior Secretary Norton and then-Agriculture Secretary Veneman, through the National Invasive Species Council, National Association of Counties, the Tamarisk Coalition, Sandia National Laboratories, Los Alamos National Laboratory, National Fish and Wildlife Foundation, Center for Invasive Plant Management, and the U.S. Geological Survey, Western Ecological Research Center, sponsored a saltcedar conference in March 2004 to develop a strategic regional approach to saltcedar in order to help organize all levels of government, academia, non-government organizations, and the private sector under a coordinated, partnership-based, outcome-oriented framework. Outcome from the

conference included: (1) a set of guiding principles that will lead to a more coordinated regional approach to achieve effective control of saltcedar and long-term management of these areas; (2) a strategic regional framework that will highlight areas of project emphasis, project selection criteria, roles of partners, critical research needs, and focus of federal assistance; and, (3) a mapping tool for priority setting and measuring performance that might have applications in other regions for other species.

In February 2004, both the House of Representatives and Senate passed versions of the Salt Cedar and Russian Olive Control Demonstration Act (H.R. 2707 and S.1516), which aims to preserve in-stream water resources by establishing a research and demonstration program to accelerate the eradication of the non-native species thriving along rivers in the western United States. The bill directs the Secretary of the Interior, working with other Federal agencies, to complete an assessment of the extent of the infestations of saltcedar and Russian olive (another non-native, invasive weed, in the western United States) undertake eradication demonstration projects, and analyze possible beneficial uses of the resulting bio-mass.

2.2 The biological control agent *Diorhabda elongata deserticola*

Diorhabda elongata Brullé subspecies *deserticola* Chen, a leaf beetle from central Asia, is a potential biological control agent for saltcedar. This insect has been found to completely defoliate large areas of saltcedar. The eggs of *D. e. deserticola* are small, spherical, and laid in masses on saltcedar plants. After the eggs hatch, the insect completes three larval instars. All larval stages feed on saltcedar foliage. When the larva is fully grown, it drops from the plant and forms a pupal cell using leaf litter or loose soil. Pupation lasts for approximately 7 days. Adult beetles are 6 millimeters in length and also feed on saltcedar foliage. There may be 2 or 3 generations of adults per year, depending on daily average temperatures (Lewis *et al.,* 2003). In field cages in Pueblo, Colorado; Delta, Utah; Lovell, Wyoming; Lovelock and Schurz, Nevada; and Bishop, California, only 2 generations occurred (Lewis, *et al.,* 2003). Release of this insect into the environment is expected to produce a gradual reduction in the size of saltcedar plants and in foliage cover and density of saltcedar stands (DeLoach and Tracy, 1997; DeLoach *et al.,* 2000).

In July 1999, APHIS prepared an environmental assessment: Field Release of a Nonindigenous Leaf Beetle, *Diorhabda elongata* (Coleoptera: Chrysomelidae), for Biological Control of Deciduous Saltcedar, *Tamarix* ?*ramosissima* and *T. parviflora* (Tamaraceae) (USDA, APHIS, 1999). The APHIS environmental assessment and the associated finding of no

significant impact are being incorporated into this environmental assessment by reference. The APHIS environmental assessment and the associated finding of no significant impact were prepared to assess the possible environmental impacts of the release of *D. e. deserticola* in the United States.

Although *D. e. deserticola* was found to be host specific to saltcedar, it was discovered that the southwestern willow flycatcher (*Empidonax traillii extimus*) (SWWF), a bird listed as endangered under the Endangered Species Act of 1973, was nesting in saltcedar near the Rio Grande in New Mexico. The U.S. Fish and Wildlife Service raised concerns that if the beetle were generally released and rapidly killed all saltcedar, native vegetation would not return or would not return rapidly enough, leaving the SWWF without nesting substrate and causing further decline of the species. However, Farley *et al.* (1994) found that willows can regrow rapidly after saltcedar control to provide nesting habitat within 3 years and habitat equal to mature stands within 5 years. The U.S. Fish and Wildlife Service agreed that (1) releases of the beetle could be made at 10 sites in Texas, New Mexico, Colorado, Wyoming, Utah, Nevada, and California, (2) all sites would be located more than 200 miles from where the SWWF nested in saltcedar, (3) the beetles would be confined in field cages for 1 year then released into the open field for 2 years before further releases or purposeful redistribution would be made, and (4) monitoring of the insects and their effect on saltcedar, rate of dispersal, and effects on and recovery of native vegetation after control would be carried out. APHIS issued permits in 1999 for release of *D. e. deserticola* into field cages at specific locations approved by the U.S. Fish and Wildlife Service. Field cages were located in Seymour, Texas; Pueblo, Colorado; Lovell, Wyoming; Delta, Utah; Schurz, Nevada; Lovelock, Nevada; Stillwater National Wildlife Refuge, Nevada; Bishop, California; Cache Creek, California; and Fort Hunter Liggett, California. All of the beetles released into the field cages were originally collected from a single site near Fukang, China, except for the Delta, Utah site which originated from a collection site in Chilik, Kazakhstan. Researchers conducted 2 years of observation in the field cages, prepared a detailed monitoring plan and report, and sent the reports to the U.S. Fish and Wildlife Service. APHIS then issued permits in 2001 to release insects outside of the cages at or near the cage sites. The researchers have continued to monitor and collect data from all of the original experimental release sites.

Since then, additional experimental sites have been approved by the U.S. Fish and Wildlife Service for release. Sites currently approved for experimental releases of beetles include Pollard, New Mexico; Huey, New Mexico; Carlsbad, New Mexico; Kingsville, Texas; Big Spring, Texas;

Lake Thomas, Texas; Lake Meredith, Texas; Candelaria, Texas; Zapata, Texas; Kingsville, Texas; San Jacinto State Park, Texas; Malheur County, Oregon; and Charles M. Russell National Wildlife Refuge, Montana. In those locations south of 38° north latitude, strains of the beetle that originate in Crete rather than Fukang or Chilik are being tested.

The Fukang strain of *D. e. deserticola* proposed for release exhibits a particular life history trait that will enable its safe release in the 13 States and will prevent it from establishing in areas where the southwestern willow flycatcher is nesting in saltcedar. Many insects enter a diapause in response to daylength and temperature. Diapause is a state of suppressed development and reproduction caused by genetically programmed internal mechanisms but which may be activated in response to environmental cues. Diapause is induced prior to the deterioration of environmental conditions. Diapause-associated behaviors include absence of mating, decreased dispersal behavior, decreased rate of feeding, and a movement off of the host plant and into the leaf litter where diapausing adults spend the winter. For *D. e. deserticola* originating from Fukang, China, most individuals will be reproductive only when daylengths are above 15 hours, which is optimal for rapid population expansion. However, when daylengths fall below 14.5 hours of light most individuals originating from these locations will enter diapause, including adults that have been reproductive. The critical photoperiod for diapause induction in this population ranges from over 14.5 hours when the temperature is high to a little over 15 hours when the temperature is moderate. These critical daylengths correspond to day lengths for latitudes above 38° north latitude, where the longest days of the year are at least 14 hours and 45 minutes. In regions south of 38° north latitude, *D. e. deserticola* originating from Fukang, China does not successfully overwinter due to the induction of diapause in response to short daylength during the summer. At latitudes south of 38° north latitude, insects enter diapause prematurely before laying eggs. In addition, mortality of these insects would be high because they would be "overwintering" during the summer months (Lewis *et al.,* 2003a). For saltcedar control in areas south of 38° north latitude, other strains of *D. elongata* adapted to those daylengths and temperatures are being investigated (Milbraith *et al.*, manuscript in preparation) but are not proposed for release by this program. Although the Fukang strain of *D. e. deserticola* may eventually adapt to conditions south of 38° north latitude, the beetle produces only 2 to 3 generations per year, dispersal has been measured as approximately a 100 meter radius from the initial release point in two years and 2.5 kilometers in 3 years (DeLoach *et al.,* 2003b), adaptation to areas south of 38° north latitude will not be rapid.

For each new experimental release site, the USDA, Agricultural Research Service consults with the U.S. Fish and Wildlife Service to ensure the protection of SWWF nesting habitat and this will continue whether or not the APHIS program is implemented. APHIS is now proposing that the insect (Fukang strain) be generally released in 13 western and midwestern States to control saltcedar, in areas north of 38° north latitude, where the SWWF does not nest in saltcedar and where the Fukang strain of beetles is adapted for establishment.

3. Alternatives Including the Proposed Action

This environmental assessment analyzes potential environmental consequences of a proposal to implement a program to establish insectaries and distribute *D.e. deserticola* to land managers as a tool for control of saltcedar in 13 States. These States include Colorado, Idaho, Iowa, Kansas, Missouri, Montana, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Washington, and Wyoming. Although APHIS does not plan to establish insectaries or provide *D.e. deserticola* to land managers in California, environmental impacts are considered since beetles released in the 13 Program States could eventually spread to saltcedar in California. Persons in Utah have already distributed *D.e. deserticola* throughout Utah, removing beetles from an experimental release site approved in 2001; thus, APHIS does not plan to establish an insectary or provide beetles to land managers in Utah.

The two alternatives considered are no action (APHIS will not establish insectaries or distribute *D. e. deserticola* to land managers) and implementation of the APHIS biological control rearing and distribution program in the 13 States (preferred alternative). An integrated pest management (IPM) program implemented by APHIS was considered as an alternative but eliminated because APHIS lacks the resources to implement such a program. In addition, APHIS lacks authority to require an IPM program to be used on private lands or public lands managed by other agencies. However, establishment of local populations of the biological control agent is the first step that will allow for land managers and researchers to utilize IPM strategies that include biological control, along with other control techniques.

3.1 No Action

Under this alternative, APHIS would not create insectaries or provide *D. e. deserticola* to land managers. Currently, the agent is released on a site by

site basis as approved by the U.S. Fish and Wildlife Service and permitted by the APHIS permitting staff. Under the no action alternative, APHIS would not be involved in any aspect of saltcedar control efforts other than issuing permits for release sites approved by the U.S. Fish and Wildlife Service. State and local authorities and other Federal agencies, such as the Bureau of Reclamation and the U.S. Fish and Wildlife Service, would likely continue to pursue control of saltcedar in infested areas under their purview using available funds, personnel, and control methods. In addition, private landowners could take action using physical, mechanical, or chemical methods to remove saltcedar. Various methods that are used to control saltcedar are outlined below. These methods of control will likely continue by various land managers whether or not the APHIS biocontrol program is implemented. These methods are described below.

3.1.1 Herbicides

Various herbicidal controls have been used since the 1940's to control saltcedar. The herbicides used for control of saltcedar are listed in table 1. Herbicide treatment recommendations on larger infestations of saltcedar are 3 pints of imazapyr plus 1 quart of glyphosate per acre, with fall applications most effective. Many larger infestations can be controlled with an aerial application. Hand cutting and stump treatment with the herbicide triclopyr or broadcast treatments with the herbicide imazapyr have resulted in the best control of saltcedar (Sisneros, 1990). With all herbicide treatments, saltcedar control is not complete, reinfestation may be rapid, and retreatment every few years is necessary, with continuously increasing damage to native plants in the treatment area (DeLoach *et al.*, 2000). In Big Horn County, Wyoming, herbicide control of saltcedar is estimated to cost $1,000 per acre, with a total cost to the county of $22.5 million (comment received from Alan Pomeroy, Big Horn County Weed and Pest Control District, January 15, 2004).

Table 1. Herbicides Used for Saltcedar Control.

Chemical name	Trade name(s)
imazapyr	Arsenal®
metsulfuron methyl	Escort®XP
Ammonium salt of fosamine	Krenite®S
triclopyr	Garlon* 4, Remedy*
glyphosate	Rodeo®, Roundup Original™

(1) Imazapyr (Arsenal®)

Imazapyr is used to control grasses and broadleaved weeds, brush, vines, and many deciduous trees. It is absorbed by the leaves and roots, and moves rapidly through the plant. Imazapyr and its formulations are low in toxicity to invertebrates and practically nontoxic to fish. Imazapyr is practically nontoxic to mammals and birds. The acute oral median lethal dose (LD_{50}) in birds was greater than 2,150 mg/kg and 4,800 to greater than 5,000 mg/kg for mammals. In tests in rats, the acute oral LD_{50} was greater than 5,000 mg/kg. Imazapyr can remain active in the soil for 6 months to 2 years. Imazapyr may be broken down by exposure to sunlight and soil microorganisms.

(2) Metsulfuron methyl (Escort®XP)

Metsulfuron methyl is a selective herbicide used to control broadleaf weeds and some grasses. The acute oral LD_{50} for metsulfuron methyl was greater than 5,000 mg/kg in male and female rats. It is practically nontoxic to fish, aquatic invertebrates, birds, and mammals. Metsulfuron methyl is not classified as a carcinogen, mutagen, teratogen, or reproductive inhibitor. The half-life of metsulfuron methyl can range from 120 to 180 days (in silt loam soil). It has the potential to contaminate groundwater at very low concentrations. Metsulfuron methyl leaches through silt loam and sand soils. Because it is soluble in water, there is a potential for surface waters to be contaminated if it is applied directly to water or wetlands.

(3) Fosamine ammonium (Krenite®S)

Fosamine ammonium is an herbicide/plant growth regulator. The oral LD_{50} is 24,400 mg/kg in non-fasted male rats and greater than 7,380 mg/kg in guinea pigs. In test dogs fed 10,000 ppm, there was no nutritional, clinical hematological, biochemical, urinary, or gross pathological evidence of toxicity. No reproductive effects were seen at 5,000 ppm, the highest level fed. Fosamine ammonium is not teratogenic or embryotoxic in rats at 10,000 ppm, the highest level fed. It is generally considered to be safe to fish and wildlife when used according to label directions. It is rapidly decomposed by soil microorganisms with a soil half-life of about 7 to 10 days.

(4) Triclopyr (Garlon* 4, Remedy*)

Triclopyr is a selective systemic herbicide used for control of woody and broadleaf plants. The oral LD_{50} ranges from 2,000 to 3,000 mg/kg for various formulated triclopyr products. Triclopyr is slightly toxic to birds and practically nontoxic to fish. It has the potential to be mobile in soil and is degraded rapidly by soil microorganisms. Triclopyr is degraded mainly by sunlight when in water.

(5) Glyphosate (Rodeo®, Roundup Original™)

Glyphosate is a broad-spectrum, systemic, general use herbicide. It is practically nontoxic by ingestion with a reported acute oral LD_{50} of 5,600 mg/kg in rats. It is practically nontoxic by skin exposure with dermal values of greater than 5,000 mg/kg. No chronic toxicity, reproductive, teratogenic, mutagenic, or carcinogenic effects have been observed from glyphosate. It is only slightly toxic to wild birds and aquatic invertebrates and practically nontoxic to fish.

Glyphosate is moderately persistent in soil with an estimated half-life of 47 days. Although it is highly soluble in water, it does not leach appreciably and has low potential for runoff. Microbes are primarily responsible for breakdown of glyphosate; volatilization or photodegradation losses are negligible.

3.1.2 Mechanical/Physical Removal

Mechanical controls result in cutting down or uprooting entire stands of saltcedar plants. These include mowing, sawing, chaining or ripping, hand pulling, and bulldozing. Uprooting methods are effective in the short-term because uprooted trees do not resprout. For sawing and mowing, chemical treatment may be necessary to prevent resprouting. Immature plants may often be physically removed by hand with care given to complete removal of the root structure and disposal of the plant by burning or deep burial. Hand removal is useful for small-scale (less than 1 acre) infestations, but is generally impractical for larger plots.

3.1.3 Flooding

Managed flooding can effectively kill saltcedar on a long-term basis. Repeated flooding is necessary to kill saltcedar seedlings that are rapidly established from windborne seeds. Established saltcedar plants can tolerate flooding for up to 3 months. Conditions suitable for controlled

flooding exist in relatively few areas such as highly managed wildlife refuges. Older saltcedar plants are more tolerant and survive inundation more readily than many native plant species, though first-year plants are easily killed by flooding.

3.1.4 Burning

Prescribed burning alone is not an effective control method for saltcedar because it generally promotes sprouting and flowering. Fire does prevent most saltcedar stands from either reaching maturity or persisting as mature communities. Burning followed by herbicide application has been shown to be effective. In Bosque del Apache National Wildlife Refuge near Socorro, New Mexico, saltcedar is cleared by using a combination of herbicide, burning, and mechanical control techniques costing from $750 to $1,300 per hectare (Taylor and McDaniel, 1998).

3.2 Implement Program to Provide Biological Control Agent to Land Managers (Preferred alternative)

Under this alternative, APHIS is proposing initiation of the implementation phase of saltcedar biological control for 2005. The implementation phase involves the collection of the Fukang strain of *D. e. deserticola* from established U.S. populations and the release of these insects at selected field 'insectary' or 'nursery' sites in up to 13 western and midwestern states, north of 38° north latitude. The States include Colorado, Idaho, Iowa, Kansas, Missouri, Montana, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Washington, and Wyoming. These insectary sites will provide established, locally-adapted *D. e. deserticola* populations that can be harvested and distributed to saltcedar-infested areas throughout each State. Although APHIS does not plan to initiate an integrated pest management (IPM) program for saltcedar, APHIS may provide the agent to land managers for their use as a component of an IPM strategy for saltcedar. See appendix 1 for a description of the proposed program and proposed insectary locations.

Under this alternative, the program does not expect to eradicate saltcedar in any area, but rather to reduce the density of saltcedar by 75 to 85% (DeLoach and Tracy, 1997). Saltcedar is expected to be maintained as an uncommon or less common component of riparian plant communities. No weed biological control agent has ever completely eradicated a target weed.

4. Affected Environment

4.1 In the arid and semi-arid West, riparian corridors are areas of unusually high biodiversity that are of critical importance in the overall ecosystem as habitats for wildlife, especially threatened and endangered species (Decamps and Tabacchi, 1993; Naiman *et al.*, 1993; Johnson, 1989). However, the entire riparian ecosystem in the arid and semi-arid western United States has been in a process of serious degradation since European settlers and their livestock and agriculture arrived. Conflicts in usage of riparian areas arise because these areas are prized agricultural and livestock grazing lands, are valued for parks and recreation and for residential and industrial development, the surface and underground water is of great value for agricultural irrigation, for municipal and industrial use, and for hydroelectric production (DeLoach and Tracy, 1997).

Specifically, degradation of native riparian plant communities in the western United States has been caused by three human-produced changes: (1) the construction of dams that eliminated overbank flooding and changed the seasonal flood cycle; (2) the lowering of the watertable by channelization of rivers and by diversion of water and the pumping of groundwater for agricultural and municipal use; and (3) the slow increase in soil salinity caused by the natural salinity of the areas, the evapotranspiration of vegetation which leaves salts behind, and the lack of floods which prevents the leaching out of the accumulating salts. In many areas, these changes have occurred simultaneously with the invasion of saltcedar which, without the natural enemies that regulate its populations in the Old World, appears more aggressive and better adapted to these altered conditions than native vegetation. While these changes have been well documented (Hastings and Turner, 1965; Turner, 1974; Ohmart *et al.*, 1988, reviewed by DeLoach 1991), they cannot account for the changes in riparian plant communities where saltcedar has invaded and heavily dominated many unregulated springs, small streams and rivers of the west that are not or only minimally affected by dams or lowered water tables (DeLoach and Tracy, 1997; DeLoach and Tracy, 2000, Dudley *et al.,* 2000).

Saltcedar is a deep-rooted plant that obtains water from the water table or the layer of soil just above it. Its roots may penetrate soil 30 feet or more, but the plant cannot survive if moisture is suddenly removed from the taproot zone. It generally grows where the depth of the water table does not exceed 25 feet and normally where it is less than 15 feet. Dense stands will only grow where the water table is between 5 and 20 feet below the soil surface. If the water table is less than 5 feet from the surface, plants

branch profusely and do not form a dense stand. Established plants can tolerate drought, fire, and intermittent flooding. By shedding leaves and halting growth, saltcedar plants can withstand lengthy drought periods. Additionally, established saltcedar plants can tolerate water innundation for up to 3 months (Warren and Turner, 1975).

Saltcedar commonly occurs along floodplains, riverbanks, stream courses, salt flats, marshes, reservoirs, and irrigation ditches in arid regions. It often forms pure thickets that extend for miles. It can inhabit the following types of ecosystems: oak and hickory, elm-ash-cottonwood, Ponderosa pine, sagebrush, desert shrub, chaparral-mountain shrub, mountain grasslands, Plains grasslands, and prairie, desert grasslands. The reduction in flooding and the shift in the seasonality of flooding downstream from dams and reservoirs, built on many rivers for irrigation and flood control, gives saltcedar a strong competitive advantage over cottonwood and willow. Cottonwood blooms only early in spring and its seeds germinate on new sediment after spring floods; by the time the modified flood flows subside in summer, seed production has ended and the seeds already produced are no longer viable. However, saltcedar blooms from spring into fall, and its seeds are abundant during that time. In addition, the seeds of saltcedar germinate very quickly after becoming wet, enabling it to establish rapidly after floodwaters recede. Once wetted, fresh seeds usually germinate within 24 hours (Kerpez and Smith, 1987).

Saltcedar grows well in moist, sandy, sandy loam, loamy, and clayey soil textures. It has a wide range of tolerance to saline and alkaline soil and water. It has been found growing in Death Valley, California, where the ground water contains as much as 5% (50,000 ppm) dissolved solids. It tolerates high concentrations of dissolved solids by absorbing them through its roots and excreting the excess salts through glands in its stems and leaves. Eventually these salts end up on the ground beneath the plant, forming a saline crust.

Saltcedar is highly susceptible to shading. Shaded plants have altered leaf morphology and reduced reproduction. Saltcedar grows from below sea level to more than 7,000 feet elevation. Saltcedar is a colonizing species that establishes on fresh, exposed alluvium (clay, silt, or gravel carried by rushing streams and deposited where the stream slows down), sand and gravel bars, and stream banks or other flood plains after disturbance. A decrease in river fluctuations can rapidly shift sites from habitats dominated by native vegetation to pure stands of saltcedar.

In the proposed program area, saltcedar is found in the Columbia Plateau, Upper and Lower Columbia Basin, Middle Rocky Mountains, Wyoming

Basin, Southern Rocky Mountains, Great Plains, Black Hills Uplift, and Upper Missouri Basin and Broken Lands. In Montana, saltcedar is located from the North Dakota line west to the central part of Montana and south into Wyoming. It is found along the major river drainages of the Yellowstone, Missouri, Tongue, Powder, Musselshell, and Bighorn Rivers. Infestations have also been found around Fort Peck Reservoir and in Dead Man's Basin. It is also found in major creek drainages into these rivers in Montana and Wyoming. In Wyoming, the Bighorn River drainage is infested all the way to the Montana border. The Powder River drainage has large infestations in its southerly extent in Johnson and Natrona Counties and its northerly extent in Campbell County. The North Platte and Green River are known to have significant saltcedar infestations. In Idaho, saltcedar is found on the Green and Snake Rivers. In Nevada, saltcedar occupies areas along the Walker River, saltgrass communities or former croplands at Stillwater National Wildlife Refuge and the Humboldt Sink, and arroyos of the Stillwater Range at Fence Marker Pass. The Colorado, Muddy, and Virgin Rivers are also heavily infested. In Colorado, infestations occur on every major river drainage except the North Platte. In North Dakota, saltcedar is widespread across the western part of the State with new infestations discovered in 2003 along the Little Missouri River in Billings and Dunn Counties, Lake Tschida in Grant County, two islands in the Missouri River between Washburn and Bismarck, the Indian Creek Wildlife Management Area, Lake Oahe and Rice Lake in Emmons County, and the Bowman-Haley reservoir in Bowman County (North Dakota Noxious Weed Quarterly, 2003). In the Great Plains, saltcedar is common along streams, in low undrained areas, and around lakeshores. Current distribution of saltcedar in the United States and Mexico has been reviewed by Zouhar (2003).

4.2.1 Negative attributes of saltcedar

(1) High use of water

Water use by saltcedar is among the highest of all stream bank species (Johns, 1989). Saltcedar can lower water tables, reduce stream flow, dry up desert springs, and reduce availability of water for agriculture, municipalities, native plants, and wildlife. The cost of water lost to saltcedar is estimated at $133 to 285 million annually (Zavaleta, 2000a). Some studies have indicated that water use by saltcedar and native riparian trees are similar (Dahm *et al.,* 2002; Glenn and Nagler, 2005). However, because of its deep root system, saltcedar can grow over a much broader area of floodplains than can the shallow rooted willows and cottonwoods (which can grow only near the stream) and thus use much more water on a floodplain scale (Smith *et al.,* 1998).

(2) Increased soil salinity

Increased salinization of waterways resulting from human activities is a source of salt that saltcedar brings to the surface. Saltcedar is capable of utilizing saline groundwater by excreting excess salts through leaf glands (Hem, 1967). The brine drips to the soil surface or falls with leaves in autumn, forming a layer of salt. This prevents other plants from germinating or growing among saltcedar stands (Shafroth *et al.*, 1995). Cottonwoods and willows can tolerate salinity levels of only 1,500-2,000 parts per million (ppm) but saltcedar can grow at levels up to 18,000-36,000 ppm (Jackson *et al.,* 1995) or more.

(3) Low biodiversity

Saltcedar provides poor habitat for many species of native wildlife and reduces the abundance and diversity of plants and animals that occur in riparian habitats (DeLoach, 1997). Riparian zones are long strips of vegetation adjoining streams, rivers, reservoirs, lakes, and other inland aquatic systems that affect or are affected by the presence of water. In arid and semi-arid regions, there typically is a strong visual contrast between riparian and upland vegetation communities. Riparian vegetation often consists of a lush mixture of trees, shrubs, and other vegetation, while adjacent upland areas generally consist of sparse stands of desert shrubs, forbs, and grasses. Other western riparian zones, such as those in the Rocky Mountains and Pacific Northwest, typically occur along fast-moving streams in deeply incised valleys (Fischer *et al.*, 2001). As saltcedar begins to dominate riparian areas, the diversity of native vegetation begins to decline, as does the diversity of the native fauna of the area.

(4) Increased fire hazard

Saltcedar is a fire-adapted species with more efficient fire recovery mechanisms than nearly all other native riparian species (Anderson *et al.*, 1977; Busch and Smith, 1993). In native riparian plant communities dominated by native vegetation, wildfires appear to be infrequent (Busch and Smith, 1993). In contrast, intervals between fires are considerably shorter in saltcedar-infested areas (Di Tomaso, 1982). The accumulation of heavy litter fall from the leaves of saltcedar as well as dead wood material has been attributed to the increased incidence of fire (Busch, 1995; Busch and Smith, 1993; Kerpez and Smith, 1987). Fire readily kills cottonwoods and several other native plants but kills only the above-ground parts of saltcedar. Saltcedar rapidly resprouts and may regrow up

to 10 feet in the first year after burning. Saltcedar quickly gains dominance over many other species after fires.

(5) Reduced recreational usage

Saltcedar substantially reduces recreational usage of parks, national wildlife refuges and other riparian areas for camping, hunting and fishing, boating, birdwatching, and wildlife photography (Kunzmann *et al.,*1989; DeLoach, 1991). This occurs not only because saltcedar causes declines in many desirable species but also because saltcedar creates nearly impenetrable stands that block access to other habitats, it drips brine in humid mornings, and it accumulates dust (DeLoach *et al.*, 2000).

(6) Impacts on threatened and endangered species

The southwestern subspecies of the willow flycatcher (SWWF) is the only endangered species known to actively utilize saltcedar to any important degree, but this use by the SWWF may have a negative effect on its reproductive rate. The willow flycatcher, *Empidonax traillii,* is a small, neotropical migrant, mid-summer breeding, riparian-obligate bird. The southwestern subspecies, *Empidonax traillii extimus*, was federally listed as endangered on March 25, 1995; the other four subspecies are not threatened or endangered. The breeding range of the SWWF extends from southern California, through Arizona, to central New Mexico, to the southwestern third of Colorado, to southern Utah, and Nevada. Negative impacts to this species have occurred as a result of riparian habitat loss due to urban and agricultural development, hydrologic modifications, fires, invasive plants, and overgrazing by domestic livestock.

Common tree and shrub species comprising the nesting habitat of the SWWF include willows, saltcedar, boxelder maple, and a few other plants, although historically, it nested primarily in willows, with an overstory of cottonwood and in boxelder maple. It now nests extensively in saltcedar but only in mid-elevational areas of central Arizona and occasionally in a few locations on the Rio Grande in New Mexico, on the Santa Margarita River in southern California, and on the Virgin River in southern Nevada. Sometimes it nests preferentially in saltcedar even though suitable willows are present. When it nests in nearly monotypic saltcedar stands, willows often grow nearby that may provide some additional resource. In all other areas, it nests only in native vegetation.

Saltcedar indirectly increases the negative impacts on the SWWF by replacing its native willow breeding habitat, by increasing cowbird nest parasitism, by increasing wildfires that burn the nests, by reducing free

water that is highly attractive in nest territory selection, and by increasing ambient temperature and probably predation within the nesting habitat. Some reports indicate that overall, SWWF reproductive rate in near monotypic saltcedar stands is only half that in native or mixed native/saltcedar stands (DeLoach *et al.*, 2000). However, the Final Recovery Plan for the SWWF cites data that indicates that nest productivity in saltcedar-dominated sites is 23-54% which is similar to native willow-dominated sites (FWS, 2002). Most of the recent increased SWWF populations have occurred in areas of substantial willow increase, such as at Roosevelt Lake in Arizona and at Elephant Butte Reservoir on the Rio Grande of central New Mexico.

In the central Great Plains, saltcedar has overgrown the gravel bars along streams, preempting this essential nesting habitat of the endangered interior population of the least tern (*Sterna antillarum*) (Koenen *et al.*, 1996). The endangered Yuma clapper rail (*Rallus longirostris yumanensis*) along the lower Colorado River Valley is harmed because saltcedar has replaced its necessary cattail/bulrush habitat and reduced its crayfish food supply (DeLoach *et al.,* 2000). Other federally listed species suffer clear quantifiable negative impacts from saltcedar invasion, including the bald eagle (*Haliaeetus leucocephalus*), the whooping crane (*Grus americana*) and the peninsular bighorn sheep (*Ovis canadensis*) (Zavaleta, 2000b).

Many species of threatened and endangered fish are found in saltcedar-infested areas and their habitat is seriously degraded by reduced water levels, modified channel morphology, silted backwaters, altered water temperature, and probably by reduced and modified food resources (DeLoach *et al.*, 2000).

(7) Sedimentation, flooding, and erosion

The extensive root system of saltcedar is more stable and resistant to erosion than most native riparian trees and shrubs (Di Tomaso, 1998). However, heavy infestations can significantly alter stream structure in an area. When stream channels are stabilized, they become more immobile and inflexible (Graf, 1978) which progressively restricts channel width by increasing sediment deposition (Di Tomaso, 1998). Narrowing of the water channel increases the rate of water flow and the potential and severity of subsequent floods (Egan *et al.,* 1993; Frasier and Johnsen, 1991; Friederici, 1995; Kerpez and Smith, 1987; Blackburn *et al.*, 1982). Along streams where flooding occurs, a dense growth of saltcedar slows the floodflow and eventually blocks the channel with debris or causes loss of channel identity with the water being dispersed into many small,

meandering streams, as along the Pecos River below Artesia, New Mexico and along the Rio Grande between El Paso and Ojinaga.

4.2.2 Positive attributes of saltcedar

Saltcedar does have some positive value. It is used as nesting habitat for certain bird species, as a source of firewood, provides shade for domesticated animals, provides fair to good cover for wildlife species such as elk, deer, small mammals, upland game birds, and waterfowl, can be used as an ornamental plant, provides pollen for honeybees, controls streambank erosion, and has been used as a windbreak (reviewed by DeLoach, 1991, DeLoach *et al.*, 2000). Black-tailed jackrabbits use saltcedar as a food source. Beaver will eat young saltcedar shoots.

Saltcedar can serve as an ecologically important functional analog to displaced native species that are no longer able to survive on these altered sites (Stromberg, 1998). In certain locations, saltcedar may actually be a key element of the flora, standing in for natives and providing habitat for at least some native plants and animals (Anderson, 1998). A potential method for managing saltcedar involves the use of pulse floods rather than physical or chemical removal methods to create a sustainable, mixed community of saltcedar and native trees, functionally equivalent to the original native plant community (Stromberg, 2001; Stromberg and Chew, 2002; Glenn and Nagler, 2005).

5. Environmental effects of the proposed action and the alternative

Regulations implementing the National Environmental Policy Act require that several types of impacts or effects to the human environment be considered. Direct effects, which are caused by the action and occur at the same time and place, must be considered. Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable, must also be considered. Finally, cumulative impacts, which are impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions, must be considered.

5.1 Effects associated with the proposed action and alternatives capable of affecting the quality of the human environment.

Direct feeding by *D.e. deserticola* on non-target plants and indirect impacts to wildlife and plants as a result of saltcedar removal represent the principal threats to environmental quality associated with implementation of the proposed action.

5.2 Aspects of environmental quality affected by the phenomena identified.

In determining whether or not an environmental impact statement has to be prepared for the proposed action, the decisionmaker must evaluate certain intensity factors regarding environmental quality issues. This subsection of the environmental assessment will be developed in the context of those factors and issues, which are enumerated in regulations implementing the National Environmental Policy Act. Only those factors and issues that apply in this case will be discussed below.

To better understand the action's magnitude of impact on the quality of the human environment, the "no action" alternative establishes an environmental risk baseline. For purposes of this environmental assessment, "no action" means that APHIS would not establish insectaries and provide the Fukang strain of *D. e. deserticola* to land managers in the 13 State area. The environmental risk baseline, therefore, would be zero. However, release of the biocontrol agent will likely continue with approval of new experimental release sites by the U.S. Fish and Wildlife Service and as permitted by the APHIS permitting staff. The eventual result of the no action alternative may be the same as if the proposed APHIS program were implemented since *D. e. deserticola* has already been released at several sites and is able to spread without the assistance of man. If releases are unassisted, it will take considerably longer for the beetles to spread throughout their potential range. The rate that *D. e. deserticola* can disperse varies, but dispersal has been measured as approximately a 100 meter radius from the initial release point in two years and 2.5 kilometers in 3 years (DeLoach *et al.,* 2003b). Within 4 years, at the Lovelock, Nevada site, saltcedar has been defoliated within a 10 mile radius of the initial release site and beetles have dispersed 50 miles from the initial release site (R. Carruthers, personal communication). At Schurz, Nevada, defoliation of saltcedar has occurred within a 1 mile radius of the initial release site and beetles have dispersed a distance of 5 miles within 4 years (R. Carruthers, personal communication). All other research sites exhibit reduced defoliation and dispersal compared to the Lovelock and Schurz

sites. There is also concern that because there is strong interest in the biocontrol program in western states, beetles may be "poached" from current research sites and illegally redistributed to new locations. In Utah, beetles have been removed from a permitted site in Delta and distributed throughout the State.

If the APHIS program were not implemented, State and local authorities, other Federal agencies, and private landowners would likely continue to pursue control of saltcedar in infested areas under their purview using physical, mechanical, chemical, or other methods as previously described. APHIS has no authority over the measures that others may use to control saltcedar. These methods will likely continue whether or not the proposed biocontrol program is implemented.

The environmental impacts discussed below contemplate potential effects on non-target species by direct feeding by *D.e. deserticola*, or indirectly, by saltcedar removal, particularly to those species that may occur in riparian habitats or otherwise use saltcedar. According to the NEPA implementing regulations, criteria set forth to determine significance or lack of significance should be considered in this environmental assessment. Not all criteria are applicable; those that are applicable will be considered below, principally for the proposed action. The degree to which the no action alternative potentially could adversely affect all aspects of environmental quality being considered is similar to that associated with the proposed action. The main difference between the two alternatives is the rate of assisted spread of the biocontrol agent.

5.2.1 Uncertainties and unknowns

Data collected from host specificity tests, and field cage and open release sites is summarized below.

(1) Impact on saltcedar from field cage and open field studies

Although saltcedar recovers well from defoliation, intensive feeding by the beetles in field cages has resulted in substantial dieback of stems, death of small plants, or in limited plant regrowth in the following spring after the defoliation occurred (Lewis *et al.,* 2003a). At sites in Pueblo, Colorado and Bishop, California, two years of severe defoliation in the field cages completely killed some large plants (DeLoach *et al.,* 2003c).

In May 2001, adults of *D. e. deserticola* were released from field cages at 7 locations approved by the U.S. Fish and Wildlife Service and APHIS

(Seymour, Texas; Pueblo, Colorado; Lovell, Wyoming; Delta, Utah, Schurz and Lovelock, Nevada; and Bishop, California). Saltcedar defoliation by the beetles was variable from little or none to spectacular and almost complete. At Lovelock, Nevada, the beetles almost defoliated all plants in a 2-acre stand of dense saltcedar plants during the second summer after release. At other sites, beetle populations were reduced by predators, mostly by ants, predaceous bugs, rufous sided towhees (*Pipilo erythrophthalamus*), or at one site by the landowners (DeLoach *et al.,* 2003b). Dispersal in the open field at these sites was within approximately a 100 meter radius from the initial release point during the two years (DeLoach *et al.,* 2003b).

Within 4 years, at the Lovelock, Nevada site, saltcedar has been defoliated within a 10 mile radius of the initial release site and beetles have dispersed 50 miles from the initial release site (R. Carruthers, personal communication). At Schurz, Nevada, defoliation of saltcedar has occurred within a 1 mile radius of the initial release site and beetles have dispersed a distance of 5 miles within 4 years (R. Carruthers, personal communication). All other research sites exhibit reduced defoliation and dispersal compared to the Lovelock and Schurz sites. After, 4 years, no mortality of saltcedar outside of field cages has been observed at any research site; however, repeated defoliation (once or twice per season) is taking its toll and saltcedar mortality is expected in the 2005 season (R. Carruthers, personal communication). Defoliated saltcedar plants produce no flowers or seeds (R. Carruthers, personal communication).

Observations of a severely defoliated saltcedar site in Kazakhstan indicated that extensive dieback of most branches occurred, but that most plants resprouted from the base late in the season. Beetles pupated beneath the defoliated trees. When adults emerged, they spent a few days on the defoliated plants then flew *en masse* to an undamaged part of the stand and began reproducing there (DeLoach *et al.,* 2003c; Jashenko and Mityaev, 2002).

The effects of a late-season defoliation of saltcedar, the dispersal behavior of the beetles after defoliation of a saltcedar stand, and the long-term effect of the beetles on saltcedar are unknown (DeLoach *et al.,* 2003c).

(2) Impact on nontarget plant species

Host specificity data was reviewed by the Technical Advisory Group for Biological Control Agents of Weeds (TAG). The TAG is an independent, voluntary, committee that reviews petitions for biological control of weeds and provides an exchange of views, information and advice to researchers and those in APHIS responsible for issuing permits for importation, testing, and field release of biological control agents of weeds. Members are representatives from many Federal agencies including the U.S. Department of Interior's Fish and Wildlife Service, National Park Service, Bureau of Reclamation, Bureau of Indian Affairs, U.S. Geological Survey, and Bureau of Land Management; the Environmental Protection Agency; USDA's Agricultural Research Service, Animal and Plant Health Inspection Service, and Cooperative State Research, Education, and Extension Service, and Forest Service; Army Corps of Engineers; as well as representatives from the National Plant Board, Mexico, and Canada. Researchers wishing to release new biological control agents of weeds submit petitions to the TAG. TAG members review petitions and provide recommendations from each of their Agency perspectives. Petitions submitted by researchers contain information regarding plant lists intended for host specificity testing, the target plant, the proposed biological control organism, host specificity data, and other relevant information. Visit the TAG website for detailed information about TAG petitions and information researchers are required to submit <http://www.aphis.usda.gov/ppq/permits/tag/index.html>. Two petitions were submitted to the TAG by the researcher for *D. e. deserticola.* The first petition was submitted in 1994 and the TAG recommended environmental release of the agent. Due to concerns regarding *Frankenia* spp., the researcher conducted additional host specificity tests for *Frankenia* spp. and submitted another petition to the TAG in 2000 with the additional information. The TAG again recommended release of the agent.

Literature review and surveys have indicated that, in its native range in the Old World, this insect is only associated with *Tamarix* species and occasionally with another related plant genus, *Myricaria*, but not with two other closely related genera, *Reumaria* or *Frankenia.* Six species of *Frankenia* (family Frankeniaceae) are native in southwestern Texas and northern Mexico. These are *Frankenia jamesii* in scattered locations in western Texas, New Mexico, and Colorado; *F. johnstonii* in southern Texas; *F. salina* throughout most of California and Baja California Norte; *F. palmeri* in southernmost California and in Baja California and Sonora, Mexico; and *F. gypsophila* and *F. margaritae*, both of limited distribution in southern Nuevo Leon, Mexico.

The relative taxonomic isolation of *Tamarix* in North America is an important factor in evaluating the safety of the release of *D. e. elongata.* Taxonomically isolated weeds provide much safer targets for biocontrol than do targets with closely related native plants (Pemberton, 2000). Pemberton (2000) found that only 1 of 117 established biocontrol agents has come to use a native, non-target plant that is unrelated to the target weed species and that virtually all of the non-target, native plant species that have been attacked by biological control insects are closely related to the target weed species. For instance, Louda *et al.* (1997) raised concerns regarding an introduced weevil released for the biological control of exotic thistles. The weevil has been found to attack native thistles as well, causing reduction in seed production and suppression of populations of certain native flies that use the same food resource as the weevil. However, in prerelease host specificity testing of the weevil, it was known that it would attack many related species of thistles; thus expansion to native species was not unexpected. Nonetheless, predicting all of the ecological consequences of the release of any biological control agent is difficult.

Host specificity data for *D. e. deserticola* has been published by DeLoach *et al.* (2003a) and Lewis *et al.* (2003a). In the United States, host-specificity tests were conducted on six species and three hybrids of *Tamarix* and on 58 species of other plants in 15 tests of different types, using 1,852 adults and 3,547 larvae over 10 years (DeLoach *et al.,* 2003a). Survival from larvae to adults averaged 55 to 67% on the *Tamarix* species, 12% on *Myricaria* sp., and only 1.6% on the three *Frankenia* spp. tested (DeLoach *et al.,* 2003a). No larvae completed their development on any of the other remaining plant species. Laboratory and field-cage tests conducted in Temple, Texas, and Albany, California, have demonstrated that *D. e. deserticola* is attracted to and is able to reproduce and complete its lifecycle only on exotic *Tamarix* and to a minimal extent, on native *Frankenia* among plants occurring in North America, and also on *Myricaria* which only occurs in Asia (DeLoach *et al.*, 2003b; Lewis *et al.,* 2003b).

APHIS does not intend to release beetles in areas where any native *Frankenia* spp. occur except for *F. jamesii* which occurs in Colorado. Although, beetles will likely spread naturally to areas where *F. jamesii* occurs, *F. jamesii* is not expected to be attacked or to suffer significant damage (Lewis *et al.,* 2003b).

Once a biological control agent such as *D. e. deserticola* is released into the environment and becomes established, there is a slight possibility it could move from the target plant to non-target plants and itself become a

pest. Host shifts by introduced weed biocontrol agents to unrelated plants are uncommon (Pemberton, 2000). However, if a host shift were to take place, the resulting effects could be environmental impacts that may not be easily reversed. Biological control agents such as *D. e. deserticola* generally spread even without the actions of man. In principle, therefore, release of these insects at even one site must be considered equivalent to release over the entire area in which potential host plants occur and in which the climate is suitable for reproduction and survival. However, post- release evaluations of the beetle populations and their effects on saltcedar will be conducted for several years after release at the insectary sites in the proposed States. The negative effects, if any, on non-target plants also will be monitored during the post-release evaluations of the released biocontrol agent. A monitoring plan has been developed to detect early signs of adverse environmental impacts (appendix 1). Contingency plans to treat release sites with insecticides will be implemented if signs of adverse environmental impacts or non-target effects are detected.

5.2.2 The degree to which the proposed action may be both beneficial and adverse.

(1) Impact on migratory birds

Migratory birds are known to inhabit riparian habitats which contain saltcedar, however there are discrepancies among studies in the extent to which migrant birds use habitats dominated by saltcedar. A list of migratory birds that may occur with saltcedar is included in appendix 2. This list was provided to APHIS from the U.S. Fish and Wildlife Service. Most birds feeding on insects and fruit or cavity dwelling species tend to avoid saltcedar communities. Saltcedar does provide nesting sites for white-winged dove, Bell's vireo, black-throated sparrow, and the endangered southwestern willow flycatcher (SWWF); however, abundance and diversity of birds in pure stands of saltcedar are reduced compared to habitats containing native vegetation (Tennant, 2002; Schroeder, 1994; Anderson and Ohmart, 1984; Hunter, 1984). *D. e. deserticola* may directly contribute to the nutritional resources of passerine foraging birds such as warblers, flycatchers, and vireos (DeLoach and Tracy, 1997). Non-native leaf hoppers specific to saltcedar are fed upon by insectivorous birds and have been found to substantially augment the diet of Lucy's warbler (*Vermivora luciae*) (Yard *et al.,* 2004). Rufous-sided towhees have reduced populations of *D.e. deserticola* at research site locations (DeLoach, *et al.,* 2003). Since saltcedar offers some abundant prey sources and cover for nesting birds, saltcedar eradication projects in the Southwest may have negative impacts on some neotropical migrant birds unless

replacement by native woody vegetation occurs quickly (Yard *et al.,* 2004).

The native vegetation of western riparian areas is of greater value than that of saltcedar that has replaced it, with possible exception that saltcedar may be of equal value to the white-winged dove (*Zenaida asiatica*) as nesting habitat (DeLoach and Tracy, 1997). Saltcedar provides habitat for other bird species including the mourning dove, Mississippi kite, black-throated sparrow, summer tanager, yellow-billed cuckoo, yellow-breasted chat, and the rufous-sided towhee. The decline of many species has been linked with the saltcedar invasion (Anderson and Ohmart, 1984, Anderson, *et al.* 1977; Hunter, 1984; Hunter *et al.,* 1985). However, the number and type of bird species supported by saltcedar depends, in part, on density of saltcedar and composition and structure of the community. Mixed communities may support more bird species than monocultures of saltcedar. Release of *D.e. deserticola* is not expected to eradicate saltcedar in any area, but rather to reduce the density of saltcedar by 75 to 85% (DeLoach and Tracy, 1997). Saltcedar is expected to be maintained as an uncommon or less common component of riparian plant communities.

(2) Impact on wildlife and livestock

Cattle and sheep browse heavily on saltcedar seedlings but prefer to browse native plants, giving saltcedar the competitive advantage in areas grazed by livestock (Dick-Peddie, 1993; Stromberg, 1997). In Arizona, saltcedar is used by cattle for cover in river bottoms (Kearney *et al.,* 1960). Some loss of cover to livestock may occur after saltcedar is defoliated or killed by *D.e. deserticola* in certain locations if no other vegetation is present. Exclusion of livestock grazing may be necessary for native plants to return to some locations after saltcedar has been removed by *D. e. deserticola.* When livestock are kept out of riparian areas during the growing seasons on a systematic basis, native species can return and establish (Hughes, 2000).

Although saltcedar may provide habitat for some species of wildlife, in general, it has little value to most native amphibians, reptiles, birds, and mammals (Lovich and De Gouvenain, 1998). Faster decomposition of saltcedar leaf litter compared to that of native Fremont cottonwood was found to reduce richness and abundance of aquatic macroinvertebrate communites (Bailey *et al.*, 2001). Saltcedar communities support extremely low numbers of immature insects (such as caterpillars, that are a favored food of many insectivorous birds) indicating that most native insects cannot reproduce on saltcedar. The plant is relatively unpalatable to most classes of livestock and wildlife, and it has been rated as poor in

energy and protein value. In some locations, saltcedar has reduced or eliminated water supplies for bighorn sheep, pupfish, and salamanders (Stephenson and Calcarone, 1999). Ellis *et al.* (1997) found species richness of rodent communities to be greater in saltcedar compared to cottonwood riparian forests in central New Mexico. However, other reports indicated little difference between saltcedar habitats and other habitats or that preferences varied between rodent species (Anderson and Ohmart, 1984), and saltcedar had a negative effect on several species. Saltcedar generally ranked low in habitat quality for reptiles and amphibians (Jakle and Gatz, 1985).

Reduction of saltcedar by *D. e. deserticola* will likely result in increased wildlife diversity, as native vegetation is reestablished. However, loss of cover to wildlife species may occur as saltcedar declines and native vegetation reestablishes. If native vegetation does not reestablish and the area where saltcedar has been removed remains bare or the area is invaded by other weedy species, increases in wildlife diversity may not occur.

(3) Revegetation

A major question in regards to biological control of saltcedar is the extent to which areas presently occupied by saltcedar would be replaced by native vegetation of good ecosystem and wildlife value, either naturally or by human-assisted revegetation. A sub-question is how rapidly control of saltcedar would occur and whether native vegetation will return as quickly as saltcedar decreases.

Four major factors influencing these responses are (1) alteration of the seasonal cycle and level of annual floods caused by the construction of dams and the channelization of rivers, (2) the salinity level of the surface soil, the deeper soil, and groundwater, (3) the depth to and fluctuation of the water table and/or soil moisture levels above the water table, and (4) the competitive relationships between saltcedar and the native vegetation (DeLoach and Tracy, 1997). The effectiveness of past and current revegetation efforts, and the influence of salinity, depth to water table, biotic factors, and competitive interactions on the probabilities and rate of revegetation were reviewed by DeLoach (1991), DeLoach and Tracy (1997) and DeLoach *et al.* (2000). The effects of saltcedar on the ecosystem and the interaction of the saltcedar invasion with human-produced negative environmental impacts (dam construction, channelization, etc.) are issues greater and more complex than with many other biocontrol projects (DeLoach *et al.,* 2000; DeLoach and Tracy, 1997; DeLoach, 1991).

Natural revegetation is much more vigorous along rivers that are unregulated or minimally regulated. Along the Rio Grande, New Mexico, the lower Colorado River, and other rivers, extensive areas of willows and cottonwoods revegetated naturally after the floods of 1983-84 (Swett *et al.* 1997; Stromberg, 1997). In California and Nevada, many areas around springs and small streams that were cleared of saltcedar revegetated naturally with cottonwoods, willows, and other plants (Barrows, 1993; Inglis *et al.* 1996; Egan, 1997). Along the Middle Rio Grande, NM, sites revegetated with willow provided good bird habitat after only 3 years, and 5-year old sites were used by as many birds as 30-year old sites (Farley *et al.*, 1994).

Native vegetation may not return in some areas if saltcedar is controlled, but in other areas, clumps of cottonwoods and willows have responded with vigorous growth and seedling establishment after saltcedar was removed (Thomas *et al.*, 1989). The response of native vegetation in areas where saltcedar is controlled can vary widely with site conditions such as salinity levels, the species and number of native plants present, whether or not natural processes such as flooding are still functioning, and water availability (USDI, Bureau of Reclamation, 1995; Barrows, 1993). Glenn and Nagler (2005) indicate that "under a natural flow regime, native trees are competitive with saltcedar in germination and establishment during a flood year and they have equal or faster growth rates."

Although there are many examples of natural revegetation of areas where saltcedar has been removed, it is possible that in certain areas, due to the factors described above, revegetation may not occur naturally after *D. e. deserticola* has suppressed saltcedar. It is also possible that in the short term, saltcedar may be killed but native vegetation will not reestablish rapidly, leaving areas temporarily with no vegetation, which may lead to soil erosion. In addition, there may be an increased short term fire hazard if the majority of saltcedar is killed in an area and dense stands of dead stems remain.

The likelihood of these outcomes occurring is not known. However, it is expected that death of saltcedar will occur gradually, likely in 3 to 10 years. For its insectaries, APHIS will choose release locations with at least remnant populations of native plant communities, including woody species such as willows and poplars, that were likely dominant prior to saltcedar invasion. These populations will assist in revegetation and restoration efforts should *D. e. deserticola* significantly suppress saltcedar populations.

(3) Post-release restoration and revegetation strategy

Vegetation monitoring will occur at each initial release location (insectaries) (see appendix 1 for monitoring protocols and for initial insectary sites). Saltcedar mortality due to beetle impacts will be a slow and gradual process, expected to occur over 3 to 10 years. By selecting release locations that have remnant populations of native plant species, the program expects that colonization of previously-infested areas will occur naturally after suppression of saltcedar. Vegetation monitoring will document whether this is, in fact, the case. If examination of monitoring data and visual assessment of site conditions suggests that revegetation by native species is not taking place, program personnel will develop and implement a restoration plan. Such a plan could include more intensive vegetation monitoring, amelioration of site conditions (*e.g.* flushing of soils with increased salinity), and planting of salinity or drought tolerant native species. Extensive research is underway by the Bureau of Reclamation, Denver, Colorado, and by USDA, Natural Resources Conservation Service, Los Lunas, New Mexico, to develop revegetation technology. However, once *D. e. deserticola* is distributed to private, State, and Federal land managers, APHIS will have no control over vegetation monitoring or revegetation and cannot require that land managers participate in such activities. However, saltcedar removal should be followed with the development of a plant community that is weed resistant and meets other land-use objectives such as wildlife habitat or recreation (Anderson, 1998). APHIS will work with land managers to assist in the development of monitoring and revegetation plans to ensure that revegetation occurs, either naturally or by planting, where saltcedar has been eliminated by the beetle.

In the unlikely event that released *D. e. deserticola* populations present a real or potential hazard to human health or to nontarget plants and animal species, program personnel will make an immediate site visit to assess the situation, in conjunction with local cooperators and land managers. If reduction or removal of the beetle population is warranted, a mitigation plan will be developed. Possible strategies to be incorporated in such a plan may include: (1) use of appropriate, approved insecticides; (2) destruction of host plants or plant material; (3) caging or other confinement of *D. e. deserticola* or threatened organism(s); and (4) other tactics as needed.

5.2.3 Cumulative impacts

Under NEPA, one must analyze whether the action is related to other actions with individually insignificant but cumulatively significant impacts (Title 40 of the Code of Federal Regulations, section 1508.27(b)(7)). The regulations require that the analysis of the cumulative effects include "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (Title 40 of the Code of Federal Regulations, section 1508.7)." Each individual action may not have a significant effect; however, "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (Title 40 of the Code of Federal Regulations, section 1508.7)."

(1) Gradual reduction in saltcedar

The most important cumulative impact would be the gradual decrease of saltcedar in the United States. Although individual releases at insectary sites in seven States will have little impact on saltcedar, the eventual distribution of *D. e. deserticola* throughout areas where saltcedar occurs above 38° north latitude, whether by human assistance or natural redistribution, will have major impacts on saltcedar. However, the eventual establishment of *D. e. deserticola* throughout its potential range in the United States will likely result in the reduction of other methods, such as herbicide use and physical removal, to manage saltcedar in the United States. To date, saltcedar has not been controlled on a large scale along any major western rivers using current methods of control (Zouhar, 2003). Biological control using *D. e. deserticola* could potentially allow saltcedar to be controlled on large areas of river (Glenn and Nagler, 2005).

The USDA, Agricultural Research Service (ARS) is pursuing experimental releases of other strains of *Diorhabda deserticola* appropriate to areas south of 38° north parallel and will also continue experimental releases of *D. e. deserticola* in the States where APHIS will conduct its release program. The ARS has requested permission for experimental release of the beetle at locations within the vicinity of several of the planned APHIS insectary locations. Although separate actions, these experimental releases will contribute to the impact that the APHIS biocontrol program will have on saltcedar.

(2) Approval of other biological control agents

At some locations, different species of biological control agents may be required if *D. e. deserticola* fails to establish or provide adequate control

of saltcedar. For example, predation by native ants or birds has been observed at some sites and different species of insects may be required that can escape such predation. Several different insect species are being tested overseas and in quarantine in the United States including the mealybug *Trabutina mannipara* from Israel, the leaf feeding beetle *Coniatus tamarisci* from France, some gall producing insects, and a psyllid, among others. Of these insects, only *D. e. deserticola* has preliminary approval for release. Once *D. e. deserticola* is approved for general release, these other biological agents may be pursued for approval for environmental release, adding to the impact on saltcedar.

5.2.4 Impacts on endangered or threatened species or their habitats.

Section 7 of the Endangered Species Act (ESA) and ESA's implementing regulations require Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat.

APHIS has prepared a biological assessment and submitted it to the U.S. Fish and Wildlife Service (FWS) on March 30, 2005 for their review and concurrence. In the biological assessment, 201 federally listed species or species proposed for listing in fifteen states were considered. APHIS concluded that no threatened or endangered species will be adversely affected or critical habitat adversely modified by the release of *D. e. deserticola* in the 13 States. Based on the information provided by APHIS, FWS concurred with the APHIS determination stating that "release of *D.e. deserticola* for control of saltcedar may affect, but is not likely to adversely affect, any threatened or endangered species. It is also not likely to destroy or adversely modify any critical habitat of such species and is not likely to jeopardize any species proposed to be listed as endangered or threatened or result in destruction or adverse modification of any area proposed to be designated as critical habitat."

Certain species included in the biological assessment are discussed below.

Southwestern willow flycatcher

The southwestern willow flycatcher (SWWF), *Empidonax traillii extimus*, was federally listed as endangered on March 25, 1995 (USFWS, 1995). In a letter from FWS to APHIS regarding release of agents for the biological control of saltcedar, dated June 3, 1999, FWS indicated that the SWWF was nesting in saltcedar near the Rio Grande in New Mexico and was

concerned that the nests of flycatchers may be affected by saltcedar control as a result of temperature increases and parasitism by the brown-headed cowbird.

The SWWF is not known to nest in saltcedar in the areas included in the proposed program. The SWWF is nesting in saltcedar frequently in Arizona and occasionally along the middle Rio Grande in New Mexico, the Virgin River of southernmost Nevada, and the Santa Margarita of coastal California. In addition, releases in the States included in the proposed program will be north of 38° north latitude. In regions south of 38° north latitude where daylength and temperature induce premature diapause, *D. e. deserticola* originating from Fukang, China fails to overwinter (Lewis *et al.,* 2003a). The areas where southwestern willow flycatchers are nesting in saltcedar are south of 38° north latitude. Even if *D. e. deserticola* were to reach these areas in Arizona and New Mexico, beetles would enter premature diapause and fail to establish populations. Therefore, there will be no effect on the southwestern willow flycatcher by the implementation of the proposed program in Colorado, North Dakota, South Dakota, Iowa, Nebraska, Nevada, Kansas, Missouri, Montana, Idaho, Oregon, Washington, and Wyoming.

Johnston's frankenia

Johnston's frankenia (*Frankenia johnstonii*) is a plant that was listed as endangered on August 7, 1984 (49 Federal Register (FR) 31418–31421). This species, once thought to be quite limited in distribution, has now been found at more than 40 sites in southern Texas. A proposed rule to delist this species was published in the Federal Register by the U.S. Fish and Wildlife Service on May 22, 2003 (68 FR 27961). Based on host specificity testing, *D. e. deserticola* is not expected to adversely affect this plant (Lewis *et al.,* 2003b). The U.S. Fish and Wildlife Service has concurred with this finding in a previous consultation (letter of concurrence from U.S. Fish and Wildlife Service, signed June 3, 1999). In releases into field cages at Pueblo, Colorado and Bishop, California, adults or larvae only slightly or never damaged *Frankenia* plants inside the cages, even when *D. e. deserticola* populations increased greatly and defoliated the saltcedar plants, leaving hundreds of starving adults and larvae crawling inside the cage searching for food (DeLoach *et al.*, 2003b). In addition, the program does not intend to release *D. e. deserticola* in Texas where this plant occurs, and the insect would not establish in Texas since it is not adapted to the daylength/temperature of that State.

Yellow-billed cuckoo

The western United States distinct population unit of the yellow-billed cuckoo (*Coccyzus americanus*) was designated as a candidate for Federal listing. This cuckoo is relatively common east of the crest of the Rocky Mountains, but more than 90% of the bird's riparian habitat in the West has been lost or degraded (USDOI, FWS, 2004). Competition from non-native plants such as saltcedar is considered as one of the reasons for the decline in distribution and abundance of this species in the West (USDOI, FWS, 2004). Reduction of saltcedar in the western States by *D. e. deserticola* may benefit the recovery of the yellow-billed cuckoo.

Western boreal toad (southern Rocky Mountain Distinct Population Unit (DPU))

The boreal toad, southern Rocky Mountain DPU, is a candidate for listing under the Endangered Species Act. The boreal toad can be found throughout most of the mountainous regions of the western United States and was considered common throughout the southern Rocky Mountains but has declined in the past several decades (USDOI, FWS, 2005). The boreal toad occurs at altitudes between 8,000-11,500 feet with occurrences at 11,860 feet in the San Juan Mountains and 11,940 feet in Clear Creek County, Colorado (FWS, 2004). Saltcedar grows from below sea level to more than 7,000 feet elevation. Saltcedar may overlap to some extent with the habitat of this species, but it does not grow well at altitudes above 8,000 feet. Therefore, release of *D. e. deserticola* and removal of saltcedar will have no effect on the boreal toad.

5.2.5 Other Environmental Statutes

Some executive orders, such as Executive Order No. 13045, Protection of Children From Environmental Health Risks and Safety Risks, as well as departmental or agency directives, call for special environmental reviews in certain circumstances. No circumstance that would trigger the need for special environmental reviews is involved in implementing the proposed action considered in this document.

6. Listing of Agencies and Persons Consulted

Environmental Services
Policy and Program Development
Animal and Plant Health Inspection Service

U.S. Department of Agriculture
4700 River Road, Unit 149
Riverdale, MD 20737

Animal and Plant Health Inspection Service
U.S. Department of Agriculture, Western Region
2150 Centre Ave., Bldg. B, MS 3E10
Fort Collins, CO 80526–8117

Grassland/Soil/Water Research Laboratory
Agricultural Research Service
U.S. Department of Agriculture
808 E. Blackland Rd.
Temple, TX 76502

United States Department of Interior
Bureau of Land Management
Dillon Field Office
1005 Selway Drive
Dillon, Montana 59725

U.S. Fish and Wildlife Service
Ecological Services
Arlington, VA

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Appendix 1. USDA-APHIS-PPQ Management plan for implementation of classical biological control of exotic saltcedars (*Tamarix* spp.), using the leaf beetle *Diorhabda elongata deserticola* (Coleoptera: Chrysomelidae)

Introduction

The saltcedar leaf beetle, *Diorhabda elongata deserticola* (Coleoptera: Chrysomelidae) is an insect native to Europe and Asia that has been permitted for release as a classical biological control agent of exotic saltcedars (*Tamarix* spp.) in the United States. To date, beetles have been released in field cages and in open field locations in several western states; these 'research sites' were established to study the biology and life history of *D. e. deserticola* under U.S. conditions and to quantify the beetle's impact on saltcedars and nontarget plants and animals. Based on information obtained from these research sites, USDA-APHIS-Plant Protection and Quarantine (PPQ) has proposed initiation of the implementation phase of saltcedar biological control in 2005. This phase involves the collection of *D. e. deserticola* from established U.S. populations and the release of these insects at selected field 'insectary' or 'nursery' sites in up to 13 western and midwestern States. These States are Colorado, Idaho, Iowa, Kansas, Missouri, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Montana, Washington, and Wyoming. APHIS does not plan to release *D.e. deserticola* in California or Utah. These insectary sites will provide established, locally-adapted *D. e. deserticola* populations that can be harvested and distributed to saltcedar-infested areas throughout each State. In this way, classical biological control will be implemented by land managers as a component of integrated pest management (IPM) strategies for exotic saltcedar.

Portions of the monitoring protocols described here have been adapted from guidelines developed by the Saltcedar Research Consortium.

Selection of *D. e. deserticola* insectary locations

I. Selection criteria for insectary locations

We are proposing *D. e. deserticola* releases in up to 13 U.S. States with established saltcedar infestations. Site location will be selected independently by stakeholders in each State, including personnel from USDA-APHIS-PPQ, other Federal agencies, State agencies, and local weed management groups, as well as landowners and other interested

parties. The following general guidelines have been developed to assist in site selection:

1. Each state should identify at least four, and up to ten, potential release sites, prioritized according to their relative suitability (see following).

2. Release locations will be situated north of 38° north latitude.

3. Release sites will preferably, but not exclusively, be located on federally-owned property.

4. Release locations should be situated some distance away from casual human traffic or have some mechanism to limit unwanted access, so as to minimize the risk of vandalism or disturbance.

5. Release sites will be situated at least 32 kilometers (20 miles) from known saltcedar research locations.

6. Release sites should provide a minimum of about 1-2 hectares (2-5 acres) infested with saltcedar, representing a variety of age classes.

7. Release locations should possess at least remnant populations of native plant communities, including woody species like willows and poplars, that were likely dominant prior to saltcedar invasion. These populations will assist in revegetation and restoration efforts should *D. e. deserticola* significantly suppress saltcedar populations.

8. Release sites should be at least 0.4 kilometers (0.25 miles) from known populations of federally- or state-listed or other protected plant and animal species, for purposes of protecting species from human activities that might occur at the insectary site.

9. Other management tactics, including herbicides, fire, and various cultural techniques, should not be applied at release locations during the year of initial release and for five (or more) years after initial release.

In 2005, *D. e. deserticola* releases will occur at certain locations in 7 States: Colorado, Idaho, Kansas, Montana, Oregon, South Dakota, and Wyoming (table 1). At each insectary location, beetles will be allowed to reproduce for a year or two (depending on how rapidly populations grow) and then will be redistributed throughout the 13 States to land managers. Land managers may be required to conduct their own environmental analyses prior to releasing beetles on public land.

Table 1. USDA-APHIS *D.e. deserticola* insectary sites for 2005

State	Location Name	County	Longitude/Longitude
CO	Echo Park		N 40 31/-109
CO	Horse Thief		N 39 09 55/-1085033
CO	Bonney Reservoir		N 39 37 24/-1021026
CO	Adams Co. Open Space	Adams	N 39 56/-10452
KS	Keith Sebelius Reservoir/ Norton Wildlife Area	Norton	N 39.7982/-99.93699
KS	Kirwin Reservoir/Kirwin National Wildlife Refuge	Phillips	N 39.66031/-99.18817
KS	Webster Reservoir/Webster State Wildlife Area	Rooks	N 39.39081/-99.4661
OR	Owyhee Reservoir, south end	Haystack	N 43.32924/-117.46019
OR	Huffman Island	Farewell Bend	N 44.26535/-117.18637
OR	Acton Gulch, Owyhee Reservoir	Haystack	N 43.46418/-117.35158
SD	Edgemont	Fall River	N 43.3055489/ -103.8192861 N 43.3091874/ -103.828265
SD	Sandhill Reservoir	Perkins	N 45.354938/-102.28922
SD	Bear Butte State Park	Meade	44.135567/-103.202171
ID	Brunneau Dunes	Owyhee	N 42 53' 41.0"/W115 41' 52.6" N 42 53' 32.3"/W115 41' 58.6" N 42 53' 33.8"/W115 42' 16.7"
ID	Deer Flat National Wildlife Refuge	Owyhee	
MT	Mussellshell River Drainage		N 46' 39.148"/W 107' 49.088"
MT	Big Horn River Drainage		N 45' 31.622"/W 107' 43.323"

MT	Yellowstone River		N 45' 59.918"/W 108' 00.579"
MT	Powder River Drainage		N 45' 24.372"/W 105' 27.197"
MT	Miles City, on Yellowstone		N 45' 24.372"/W 105' 27.197"
MT	Powder River, near Wyoming		
WY	Boysen-Muddy Creek Delta	Freemont	N 43.28343/-108.22185
WY	Flaming Gorge-Upper Marsh Creek	Sweetwater	N 41.152878/ -109.540531
WY	Powder River-Wagner	Johnson	N 44.29444/-106.51111
WY	Platte River-Morrison	Goshen	N 42.1206/ ?
WY	Boysen West	Fremont	N 43.343667/-108.44639
WY	Flaming Gorge North	Sweetwater	N 41.327608/ -109.473228
WY	Salt River	Natrona	N 43.25463/-106.17269

II. General insectary site description

For each potential release location identified in each state, Global Positioning System (GPS)-derived latitude and longitude coordinates should be provided. If this is not possible, U.S. Geological Survey (USGS) coordinates and/or the marked location on a topographic map should be provided for each potential *D. e. deserticola* release site.

The general physical and biological characteristics of the site should be described at least once, preferably during the year of initial *D. e. deserticola* release. Please record:

A. Physical site characteristics

1. General topography
2. Aspect
3. Elevation
4. Latitude and longitude of release point
5. USGS coordinates for site

B. General soil type

C. Biological site characteristics

1. Native vegetation classification at site, if known
2. Human manipulation history at site, if known
3. Saltcedar distribution at site (provide a map or aerial photo, if possible)

Diorhabda elongata deserticola release protocols

I. Number of insectary locations

The number of prospective release sites at which *D. e. deserticola* is ultimately released will depend on the number of insects collected for distribution and the quality of potential sites. However, we anticipate that approximately two to five releases will be made in each State.

II. Source of insects

We propose to collect adult *D. e. deserticola* from an established research site in northwestern Nevada. The 'Fukang strain' of *D. e. deserticola* is established at the Nevada site; this strain originated in northern China, and is well-adapted to climatic conditions in the northern United States.

III. Collection of *D. e. deserticola* (Fukang strain)

We collected adult *D. e. deserticola* beetles from the Nevada site in September 2004 for overwinter storage in the laboratory. If additional beetles are needed, they will be collected from the Nevada site at some time during the peak abundance of overwintered adults, which will likely occur during May 2005. If this is not possible, collections will be made when adults from the next *D. e. deserticola* generation are most abundant (presumably, during June or July 2005). Alternatively, collections may be made at both times, in order to account for variable saltcedar phenologies among release locations in the States. These dates are only estimates, and may vary considerably depending on local temperature and other weather conditions.

Prior to actual beetle collection(s), adult samples will be collected and submitted to (1) a taxonomic expert to confirm the identification of *D. e. deserticola*; and (2) an insect pathologist to confirm the absence of internal entomopathogens. If pathogens are discovered in the Nevada population, several options are possible. These include proceeding with collection and distribution if the infection is judged to be minor,

developing and applying an antimicrobial treatment prior to release, or canceling distribution altogether if the infestation is severe.

IV. Shipment and release of *D. e. deserticola* adults

The actual number of beetles provided for each field insectary release will be determined once we know the total number of insects collected for distribution. However, we anticipate that cohorts of approximately 500-2,500 *D. e. deserticola* adults will be provided for each release. Collected beetles will be hand-sorted and counted to ensure that extraneous insects and other organisms are not included in each shipment.

Beetles provided for release at each field insectary location will be packaged in unlined paper cartons containing sprigs of saltcedar foliage as a food source. All saltcedar material so provided will not contain flowers or seeds. Cartons will be securely taped to preclude *D. e. deserticola* escape.

D. e. deserticola adults will be shipped directly, via overnight delivery, to cooperators in each state who will be making the field releases. Shipment will be made in insulated containers containing an ice substitute, so that beetles will remain largely inactive and protected from temperature extremes during shipment and in the field prior to release. Ideally, field releases will be made immediately upon receipt, but if this is not possible, beetles will be held in a refrigerator until release.

Monitoring protocols at *D.e. deserticola* field insectary sites

I. Vegetation monitoring

Select and permanently mark 25 saltcedar plants in the following manner. Mark one plant at the insect release point, and then mark six trees along each of four transects radiating from the re-lease point in each cardinal direction. Plants should be selected at 5 m, 35 m, 65 m, 95 m, 125 m, and 155 m from the release point. This arrangement may not be possible at every site, so adjust selection of marked trees as necessary to reflect saltcedar distribution, local topography, and other conditions.

A. Saltcedar data collection

At least once per year, beginning just before or at the time of initial release, and then coincidental with at least one *D. e. deserticola* sampling visit (below) in subsequent years.

1. Whole-tree monitoring: on each of the 25 trees, please record:

a. GPS coordinates (tree location) - only have to do this once, unless a new marked tree must be selected
b. digital photo from a permanent point - optional
c. estimated average height and width of live crown
d. foliage color, by category
e. reproductive status, by category
f. canopy density (densitometer) or light penetration into canopy (light meter) - optional

2. Branch monitoring: on each of the 25 selected saltcedar plants, permanently mark four branches each, 40 centimeters long from the terminal. Branches should be at about mid-crown level, if possible, and one branch should be selected from the north, south, east, and west side of the plant. From each marked branch, please record:

a. branch length (from trunk junction or a permanent marker to branch tip) and estimated average width
b. number of secondary branches - optional
c. number of inflorescences - optional
d. foliage color, by category
e. amount (%) of post-defoliation regrowth, if present - optional

B. Associated woody vegetation data collection

Note the three woody plants with stem diameters > 2.5 cm (1 in) that are closest to each of the 25 marked saltcedar plants. For each of these neighboring plants, please record:

1. identification: common name, genus name (e.g. Salix = willows, Populus = cottonwood), or species name, if known
2. distance to marked saltcedar plant (stem to stem)
3. Height and canopy diameter of each plant

C. Associated understory vegetation data collection

At each marked saltcedar tree, examine two 1 m^2 quadrats (1 m x 1m) for various types of vegetation. One quadrat should be permanently placed under the canopy of the saltcedar plant, if possible, while the second quadrat should be permanently marked 2 or 3 meters away from the saltcedar canopy. From both quadrats, please record:

1. portion of canopy cover (%) attributable to woody plants (trees and shrubs), forbs, grasses, plant litter, or bare ground

2. average depth of plant litter, if present - optional
3. number of juvenile saltcedar stems
4. a list of all plant species present, as much as possible

II. *D. e. deserticola* monitoring

D. e. deserticola should be monitored at least twice per season, though more frequent monitoring can be conducted. Recommended monitoring dates are sometime in late May or early June, when overwintered adults are active, and late July to mid-August, when second-generation beetle life stages should be present (actual dates will have to refined over time to reflect local conditions). For each *D. e. deserticola* monitoring visit, utilize the 25 marked saltcedar trees and their selected, marked branches (described above), and please record:

A. Whole-tree observations data collection

Generally examine the entire tree, noting the presence or absence of each *D. e. deserticola* life stage

B. Branch observation data collection

On the terminal 40 centimeters of each of the four selected branches per tree, please record:

1. numbers of *D. e. deserticola* eggs, larvae, and adults
2. estimated *D. e. deserticola* defoliation, by category
3. generally note the presence of, and damage caused by (if any), other insects observed on each branch (e.g. leafhoppers, aphids, scales)

C. Long-distance dispersal data collection

Begin two years after initial field release. Proceed at 1 km intervals from the release point, in each cardinal direction, if possible, or whatever long-distance directions are possible depending on saltcedar distribution (e.g. one or two cardinal directions, up-stream and downstream); visit eight such points (up to 8 km from release point) if you are able to do so. At each 1 km interval, examine one to five saltcedar plants, and for each plant examined, please record:

1. abundance (absent, few, moderate, heavy) of *D. e. deserticola* life stages
2. foliage color, by category
3. estimated defoliation (%) caused by *D. e. deserticola*

III. Vertebrate monitoring

Consult with U.S. Fish and Wildlife Service staff in your State for assistance in the development and completion of monitoring protocols for selected birds, mammals, reptiles, amphibians, or fish at *each D. e. deserticola* release location.

Cooperative interagency strategy for completion and funding of *D. e. deserticola* release and monitoring

The USDA Agricultural Research Service (ARS) conducts and coordinates foreign selection for, host specificity testing of, and conducts additional pre-release research with potential saltcedar biocontrol agents. Through this process, selected agents are approved for U.S. field release by USDA-APHIS-PPQ. USDA-APHIS-PPQ will facilitate the implementation of saltcedar biological control, both by direct involvement and by coordinating biocontrol agent releases with other federal, tribal, state, and local agencies and other weed management groups.

Responsibility for *D. e. deserticola* release, post-release monitoring, and field insectary management will be collectively determined by partners in each State, and the project cooperators actually doing the work will probably vary among release locations. However, a lead contact will be identified for each state, to facilitate project communication. USDA-APHIS-PPQ will provide *D. e. deserticola* for field release with the implied agreement that site descriptions and post-release monitoring will be conducted as described in this document. Ultimately, USDA-APHIS-PPQ, by collating and managing release and monitoring data, should be able to document compliance in these areas.

We expect that costs associated with establishment and management of *D. e. deserticola* field insectaries will largely consist of personnel and travel expenses, with minimal expenditures for equipment and supplies. We anticipate that these costs will be adequately supported by USDA-APHIS-PPQ and cooperating agencies and groups in each state. If this is not the case, additional funding may be sought from other USDA, USDA-APHIS-PPQ, or other federal sources, as well as state and local funding agencies. Such decisions will be made on a state by state basis, with the full cooperation of all partners involved.

Post-release restoration and revegetation strategy

Based on data collected at *D. e. deserticola* research locations, we anticipate that saltcedar mortality due to beetle impacts will be a slow and gradual process, occurring over a three to ten year (or longer) timeframe. By selecting release locations that have remnant populations of native plant species, we believe that colonization of previously-infested areas will occur naturally in many locations after suppression of saltcedar if soil salinity and depth to water table are not too great. Vegetation monitoring, described previously, will document whether this is, in fact, the case. If examination of monitoring data and visual assessment of site conditions suggests that revegetation by native species is not taking place, we will meet with project cooperators and land managers to develop and implement a restoration plan. Such a plan could include more intensive vegetation monitoring, amelioration of site conditions (e.g. flushing of soils with increased salinity due to saltcedar litter), and planting of saline resistant and drought resistant native species.

Mitigation strategy for D. e. deserticola

In the unlikely event that released *D. e. deserticola* populations present a real or potential hazard to human health or to nontarget plants and animal species, we will make an immediate site visit to assess the situation, in conjunction with local cooperators and land managers. If reduction or removal of the beetle population is warranted, a mitigation plan will be developed. Possible strategies to be incorporated in such a plan include: (1) use of appropriate, approved insecticides; (2) destruction of host plants or plant material; (3) caging or other confinement of *D. e. deserticola* or threatened organism(s); and (4) other tactics as needed. A mitigation plan will be accompanied by augmented *D. e. deserticola* and nontarget monitoring protocols.

Data management

USDA-APHIS-PPQ personnel and/or local collaborators in each state will be responsible for selecting *D. e. deserticola* release locations, implementing beetle releases, and conducting post-release monitoring. The USDA-APHIS-PPQ-Center for Plant Health Science and Technology, National Weed Management Laboratory (NWML) in Fort Collins, Colorado, will assist in developing release and monitoring protocols and will develop field data collection forms; if possible, electronic data collection methods (e.g. PDA-based) will be developed and employed. All collected data will be returned to NWML, where it

will be stored and processed. The NWML database will document locations and characteristics of release locations, the number of *D. e. deserticola* released and initial release dates, establishment successes or failures, growth and spread of *D. e. deserticola* populations, and beetle impacts on the target weeds and on nontarget plant and animal communities. This information will be used to produce annual progress reports, and will also be made available to project cooperators, land managers and landowners, and other stakeholders.

Appendix 2. Migratory birds that may occur with saltcedar in the States where *Diorhabda elongata deserticola* will be released.

A

Abert's towhee
American avocet
American bittern
American coot
American crow
American golden plover
American goldfinch
American kestrel
American redstart
American robin
American tree sparrow
American white pelican
American wigeon

B

Baltimore oriole
bank swallow
Bell's vireo
belted kingfisher
Bewick's wren
black and white warbler
black-billed cuckoo
black-billed magpie
black-capped chickadee
black-chinned hummingbird
black-crowned night-heron
black-headed grosbeak
black swift
black tern
blue grosbeak
blue jay
blue-winged teal
Brewer's blackbird
Brewer's sparrow
broad-tailed hummingbird
brow-headed cowbird
brown creeper
brown thrasher
buff-breasted sandpiper
buffleheasd
Bullock's oriole

C

cackling goose
California gull
Canada goose
canvasback
Cassin's kingbird
cattle egret
cedar waxwing
chipping sparrow
clay-colored sparrow
cliff swallow
common goldeneye
common grackle
common loon
common merganser
common nighthawk
comomon tern
common yellowthroat
common whipporwill
Cooper's hawk
Cordilleran flycatcher
Crissal thrasher

D

dickcissel
double-crested cormorant
downy woodpecker
dusky flycatcher

E

eared grebe
eastern bluebird
eastern kingbird
eastern screech-owl
eastern wood-pewee

F

field sparrow
Forster's tern
fox sparrow
Franklin's gull

G

gadwall
golden eagle
golden-crowned kinglet
gray catbird
great blue heron
great horned owl
greater white-fronted goose
green heron
green-winged teal

H

hairy woodpecker
Harris' sparrow
hooded merganser
horned grebe
house finch
house wren

I

indigo bunting

K

killdeer

L

lark sparrow
Lazuli bunting
least flycatcher
LeConte's sparrow
lesser godfinch
lesser scaup
Lewis' woodpecker
Lincoln's sparrow

loggerhead shrike
long-eared owl
Lucy's warbler

M

MacGillivray's warbler
mallard
marbled godwit
marsh wren
mountain bluebird
mourning dove
mourning warbler

N

Nelson's sharp-tailed sparrow
northern flicker
northern harrier
northern mockingbird
northern pintail
northern saw-whet owl
northern shoveler
northern shrike
northern waterthrush

O

olive-sided flycatcher
orange-crowned warbler
orchard oriole
osprey
ovenbird

P

peregrine falcon
pied-billed grebe
pine siskin
purple finch

R

red-breasted nuthatch
red-eyed vireo
red-headed woodpecker
red-naped sapsucker
red-tailed hawk
red-winged blackbird
redhead
ring-billed gull
ring-necked duck
ring-necked pheasant
rose-breasted grosbeak
ruby-crowned kinglet
ruby-throated hummingbird
ruddy duck
Rudy blackbird
rufous-sided towhee

S

sandhill crane
savannah sparrow
Say's phoebe
sedge wren
sharp-shinned hawk
sharp-tailed grouse
snow goose
snowy plover
solitary sandpiper
song sparrow
sora
spotted sandpiper
spotted towhee
Sprague's pipit
Swainson's hawk
Swainson's thrush

T

Tennessee warbler
Townsend's solitaire
tree swallow
turkey vulture

V

veery
Virginia rail

W

warbling vireo
western grebe
western kingbird
western meadowlark
western screech-owl
western wood-pewee
white-breasted nuthatch
white-crowned sparrow
white-throated sparrow
willet
willow flycatcher
Wilson's phalarope
Wilson's warbler
wood duck

Y

yellow-bellied sapsucker
yellow-billed cuckoo
yellow-breasted chat
yellow-headed meadowlark
yellow rail
yellow rumped warbler
yellow warbler

Decision and Finding of No Significant Impact
for
the APHIS, Western Region Biological Control Program for Saltcedar in 13 States
Environmental Assessment
June 2005

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), is proposing a program to expand the release of a biological control agent of saltcedar (*Tamarix* spp.) into 13 States (Colorado, Idaho, Iowa, Kansas, Missouri, Montana, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Washington, and Wyoming). This agent, *Diorhabda elongata deserticola* (*D. e. deserticola*), a leaf beetle, has the potential to reduce the area and intensity of infestations of the invasive weed saltcedar in the United States. There is a need to control saltcedar in the western United States because it greatly alters the habitats which it has invaded, limiting land use. The APHIS has prepared an environmental assessment (EA) that analyzes the potential environmental consequences of this action. The EA is available from:

U.S. Department of Agriculture
Animal and Plant Health inspection Service, PPQ
Western Region
2150 Centre Ave., Bldg. B, MS 3E10
Fort Collins, CO 80526-8117

The two alternatives considered are no action (APHIS will not establish insectaries or distribute *D. e. deserticola* to land managers) and implementation of the APHIS biological control rearing and distribution program in the 13 States (preferred alternative). An integrated pest management (IPM) program implemented by APHIS was considered as an alternative but eliminated because APHIS lacks the resources to implement such a program. In addition, APHIS lacks authority to require an IPM program to be used on private lands or public lands managed by other agencies. However, establishment of local populations of the biological control agent is the first step that will allow for land managers and researchers to utilize IPM strategies that include biological control, along with other saltcedar control techniques. APHIS has analyzed the potential effects of the APHIS Program.

I have decided that an environmental impact statement need not be prepared for any of the alternatives. I have decided to authorize the APHIS biological program for saltcedar using *D.e. deserticola.* The reasons for my decision are:

o This biological control agent is sufficiently host specific and poses little, if any, threat to the biological resources of the continental United States.

o This biological control program will not disproportionately affect minority or low- income populations, nor will they disproportionately affect children or result in any environmental health risks or safety risks to children.

o *D.e. deserticola* poses no threat to the health of humans or wild or domestic animals.

o *D.e. deserticola* is not likely to adversely affect any endangered or threatened species or their habitats.

While there is not total assurance that the release of *D.e. deserticola* into the environment by APHIS will be reversible, there is no evidence that this organism will cause any adverse environmental effects.

Based on the analysis found in the EA, I find that none of the alternatives will have a significant impact on the quality of the human environment and an environmental impact statement need not be prepared.

/s/

Phillip E. Garcia June 29, 2005
Acting Regional Director, Western Region
Plant Protection and Quarantine
Animal and Plant Health Inspection Service
United States Department of Agriculture