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Field Release of *Neomusotima conspurcatalis* (Warren) (Lepidoptera: Crambidae), an Insect for Biological Control of Old World Climbing Fern (*Lygodium microphyllum*), in the Continental United States

Environmental Assessment, June 1, 2007

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I. Purpose and Need for the Proposed Action

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), is proposing to issue a permit to a USDA, Agricultural Research Service (ARS) researcher for release of a nonindigenous defoliating moth, *Neomusotima conspurcatalis* (Warren) (Lepidoptera: Crambidae). The agent would be used by the applicant for the biological control of Old World climbing fern, *Lygodium microphyllum* (Cav.) R. Br. (Lygodiaceae) in Florida. Before a permit is issued for release of *N. conspurcatalis*, APHIS must analyze the potential impacts of the release of this agent into the continental United States.

This environmental assessment[1] (EA) has been prepared, consistent with USDA, APHIS' National Environmental Policy Act (NEPA) implementing procedures (Title 7 of the Code of Federal Regulations (CFR), part 372). It examines the potential effects on the quality of the human environment that may be associated with the release of *N. conspurcatalis* to control infestations of *L. microphyllum* within the continental United States. This EA considers the potential effects of the proposed action and its alternatives, including no action.

The applicant's purpose for releasing *N. conspurcatalis* is to reduce the severity of infestations of *L. microphyllum* in Florida. *L. microphyllum* is a climbing fern that belongs to the plant family Lygodiaceae[2]. It has a large native range, extending through much of the Old World tropics, spanning almost half of the world's circumference from 18°E in Senegal to 150°W in Tahiti between the latitudes of 29°S in Australia and 27°N in northeastern India (Pemberton, 1998). It has been introduced into Jamaica, Guyana, and southern and central Florida. *L. microphyllum* is now well established in central and southern peninsular Florida, where it grows in a number of wetland and mesic (having a moderate supply of moisture) habitats including hammocks, cypress swamps, flatwoods, bayheads, and disturbed sites. The potential distribution in Florida of this climbing fern includes all mesic habitats in southern Florida from Lake Okeechobee south. The weed occurs in central Florida north of Orlando and has become increasingly serious north of Lake Okeechobee. There is a need to release a host-specific biological control agent to reduce

[1] Regulations implementing the National Environmental Policy Act of 1969 (42 United States Code 4321 *et seq.*) provide that an environmental assessment "[shall include brief discussions of the need for the proposal, of alternatives as required by section 102(2)(E), of the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted." 40 CFR § 1508.9.

[2] Other authors consider the plant to belong to the plant family Schizaeceae that includes several additional genera, such as *Achinostachys* and *Anemia*.

infestations of *L. microphyllum* because herbicidal and mechanical controls are expensive, are temporary solutions, and are damaging to non-target plants.

II. Alternatives

This section will explain the two alternatives available to APHIS; no action and to issue a permit for release of *N. conspurcatalis*. Although APHIS' alternatives are limited to a decision on whether to issue a permit for release of *N. conspurcatalis*, other methods available for control of *L. microphyllum* are also described. These control methods are not decisions to be made by APHIS and may continue whether or not a permit is issued for environmental release of *N. conspurcatalis*. These are methods presently being used to control *L. microphyllum* by public and private concerns.

A third alternative was considered, but will not be discussed further. Under this third alternative, APHIS would have issued a permit for the field release of *N. conspurcatalis* but the permit would contain special provisions or requirements concerning release procedures or mitigating measures. No issues have been raised that would indicate that special provisions or requirements are necessary.

A. No Action

Under the no action alternative, APHIS would not issue a permit for the field release of *N. conspurcatalis* for the control of *L. microphyllum*. The release of this biological control agent would not take place. The following methods are presently being used to control *L. microphyllum*. These control methods will continue under the "No Action" alternative and may continue even if a permit is issued for release of *N. conspurcatalis*.

1. Chemical Control

Ferriter (2001) summarizes current control methods and reports that various herbicides have given excellent control of *L. microphyllum* vines but that regrowth and nontarget damage usually occur. The herbicides glyphosate (Rodeo®), triclopyr (Pathfinder ®, Garlon®), 2,4-D (Weedar®, Vanish®), fosamine (Krenite®), and imazapyr (Arsenal ®) are used for control of *L. microphyllum*. These may be applied to foliage aerially, such as when tree islands are covered with the vine, or may be applied as "poodle-cuts" where the vines are cut 4-5 feet up from the ground and herbicide is applied to the rooted portion of the plant.

2. Mechanical Control

Mechanical control includes cutting vines, physical removal (hand-pulling), or burning. Heavy equipment to remove vines can be used but has limited value.

B. Issue the Permit for Environmental Release of *N. conspurcatalis*

Under this alternative, APHIS would issue a permit for the field release of *N. conspurcatalis* for the control of *L. microphyllum*. This permit would contain no special provisions or requirements concerning release procedures or mitigating measures.

1. Biological control agent information

The moth *N. conspurcatalis* (Lepidoptera: Crambidae) was first observed to defoliate *L. microphyllum* vines in Hong Kong by Robert Pemberton (Pemberton and Goolsby, 2005). During field surveys it was found to occur widely from Southeast Asia to Australia (Goolsby et al., 2003). Specifically, it occurs in northeastern India in Assam and Sikkim; in Indonesia on the islands of Java, Sulawesi, Sumatra; in East Timor; and in north Queensland and the Northern Territory of Australia. In China it is known from Hong Kong, Guandong, and Hainan Provinces.

Neomusotima conspurcatalis is a brown moth with two distinctive white boomerang shaped marks near the margin of the top surface of the forewing. The eggs are very flat, pale yellow and usually laid in clusters on the leaflets. The larvae are yellow to green with dark brown heads and prothoracic shields. Older larvae may have black spots on the under surface. Young larvae feed together in groups, often under webbing, on the undersides of the leaves which they skeletonize (scrape leaf surface). Older larvae are more spaced and eat whole leaflets. Pupae are dark brown.

The lifecycle of *N. conspurcatalis* is as follows: moths mate after emergence, and females lay eggs in small clusters on both sides of the leaflets and the leaf stem of *L. microphyllum*. The eggs are initially very flat and almost transparent but as they mature they swell and the developing larva is visible inside. The first three larval instars feed by scraping the surface of the leaf. The fourth- and fifth-instar larvae usually eat the entire leaf, but there can still be some leaf scraping. Most of the leaf consumption is by the fourth and fifth instars. Larvae will drop from

the leaf or stem on a silken thread when threatened. The fifth-instar spins a very loose web of silk on the leaf or stem and pupates beneath it. There is no cocoon protecting the pupa, and there has been no diapause[3] observed. The life cycle takes approximately 23-24 days at 27 º C. Eggs hatch in 7 days, larvae pupate in 10-11 days, and pupae develop to adults in 5-7 days. Females lay a few eggs during the first night after emergence as adults, but most eggs are laid on the second night. Realized fecundity (eggs laid) varied greatly in the laboratory with a range in one test of 0 to 219 eggs. The median for 15 females was 101 eggs.

Dispersal of *N. conspurcatalis* has not been formally studied in the field or the laboratory. However, in northern Australia, the moth is often the first herbivore (plant feeder) to recolonize stands of *L. microphyllum* following flooding or bushfires. This suggests that it readily disperses within its environment. In the laboratory, *N. conspurcatalis* adults are able to fly. The wide geographic range of the moth, coupled with the fact that *L. microphyllum* is not very abundant and is relatively scattered in its native range of northern Australian and Southeast Asia, suggest that *N. conspurcatalis* may have reasonable dispersal abilities. The greater abundance of *L. microphyllum* in Florida (compared to its home range), the frequent on-shore winds, and the lack of hills or mountains that could block movement may promote the dispersal of *N. conspurcatalis* after introduction. Ability to disperse can increase the potential for the agent to establish and spread in the environment.

N. conspurcatalis causes damage to *L. microphyllum* by defoliation. Only the larval stage causes damage to *L. microphyllum*. Plant defoliation is expected to slow the growth of *L. microphyllum* even if it does not kill the vines, and would permit light penetration to underlying plants, thus encouraging recovery of afflicted habitats. In laboratory studies, defoliated potted *L. microphyllum* plants regrow slowly.

III. Affected Environment

A. Areas affected by *L. microphyllum*

L. microphyllum climbs over plants, including tall trees, forming massive walls of vegetation. It forms thick mats on the ground that displace native plants. Fires can be carried quickly to the tops of trees by burning fern and then spread by the floating, burning pieces. Because it reproduces by millions of spores spread by wind and other physical carriers, new

[3] A period during which growth or development is suspended and metabolic rate is reduced; a period of dormancy not immediately referable to adverse environmental conditions.

infestations can arise great distances from existing populations. Young *L. microphyllum* plants are often found on moist portions (moss collars) of tree buttresses.

In 1973, *L. microphyllum* was limited to small portions of Martin and Palm Beach Counties along the eastern coast and to some sites in the inland Highlands County in Florida. By 1993, it had expanded greatly in Martin and Palm Beach Counties and was also found in Glades County for an estimated infestation of 11,213 hectares (Pemberton and Ferriter, 1998). In 1997, an estimated 15,892 hectares were infested in 15 counties from coast to coast along the southern half of the Florida peninsula (Pemberton and Ferriter, 1998). By January 2002, the infestation was estimated at more than 40,470 hectares and is still expanding (Pemberton, 2003). The weed is a severe problem in many parks and preserves in south Florida including Loxahatchee National Wildlife Refuge, the Panther Refuge, Audubon Corkscrew Sanctuary, J. Dickinson Park, Fakahatchee Strand Preserve State Park, and Everglades National Park. First detected in Everglades National Park in 2001, the weed was found to occupy an estimated 900 hectares of coastal marsh spread over 40 miles (Pemberton, 2003). Among the most invaded communities are Everglades tree islands. A recent model predicts that *L. microphyllum* has the potential to occupy most of the cypress swamps and Everglades tree islands in the southern third of Florida by 2009 (Volin et al., 2004).

In the continental United States, *L. microphyllum* also has the potential to invade the Gulf Coast of Mexico and southern Texas with its wind borne spores (Pemberton et al., 2002). A single spore carried by the wind is capable of starting a new infestation (Lott et al., 2003).

B. Plants related to *L. microphyllum* and their distribution

1. Taxonomically related plants

Lygodium species and other plants related to *L. microphyllum* are the most likely non-target plant species that could potentially be attacked by *N. conspurcatalis.* The genus *Lygodium* occurs in tropical areas with 30-40 species worldwide (Wikström et al., 2002). There is only one native *Lygodium* species in North America, *L. palmatum*. This species is state-listed as threatened in Maryland, state-listed as endangered in Indiana, Michigan, New York, and Vermont, a plant of special concern in Connecticut and Massachusetts, and a rare plant in Pennsylvania, but is not federally-listed. There is also an invasive Asian species in the United States, *L. japonicum*, which Florida considers a noxious weed.

Additional species of *Lygodium* are native to the Caribbean area and Central and South America. These species could be threatened by natural

dispersal from large *N. conspurcatalis* populations in southern Florida or by dispersal through trade or transportation. These species include *L. cubense* Kunth, *L. oligostachyum* (Willd.) Desv., *L. venustum* Sw., and *L. volubile* Sw.

Pemberton (1998) discussed *Lygodium* and its relationship to other ferns. The genus *Lygodium* has been placed in the family Schizaeaceae (Wunderlin and Hansen, 2000), along with two Florida native genera, *Actinostachys* and *Anemia*. In this EA, the genus *Lygodium* is included in the family Lygodiaceae, the genus *Anemia* in the family Anemiaceae, and the genus *Actinostachys* in the family Schizaeaceae, following the classification scheme of Wagner and Smith (1993).

There are six species of pineland ferns in the genus *Anemia* in North America and Puerto Rico: *Anemia adiantifolia* (L.) Swarz, *Anemia hirsuta* (L.) Sw., *Anemia hirta* (L.) Sw., *Anemia mexicana* Klotzsch, *Anemia portoricensis* Maxon, and *Anemia wrightii* Baker. There is one North American species within the genus *Actinostachys, A. pennula* (Swartz) Hooker (also considered by some authors to be *Schizaea pennula* Swartz). There are four other species of *Schizaea* in North America: *S. fluminensis* Miers ex Sturm, *S. poeppigiana* Sturm, *S. pusilla* Pursh, and *S. robusta* Baker.

2. Distribution

Lygodium palmatum is a temperate species ranging along the Appalachian Mountains throughout the eastern United States. It is generally local and rare except for the Cumberland Plateau of Kentucky and Tennessee where it is locally abundant in poorly drained, acidic soils, especially after disturbance. It occurs in woods, thickets, and bog margins in humus-rich, acid soils (Naumann, 1993). The southernmost limits appear to be northeastern Alabama (Cherokee County) and near Charleston, South Carolina (probably from ornamental plantings). Its presence in Florida has never been confirmed and is doubtful (Nelson, 2000).

Lygodium japonicum occurs in Asia and Queensland, Australia (Ferriter 2001). In the United States it is naturalized in the warmer regions of all coastal states from Texas to Virginia including the southern part of Arkansas. It occurs in wet woods, marshes, roadside ditches, riverbanks, and other wet, disturbed sites (Naumann, 1993).

Pemberton (1998) has reported the following *Lygodium* distributions: *L. cubense* occurs in Cuba, *L. heterodoxum* occurs in southeastern Mexico and Central America, *L. oligostachyum* occurs in Cuba and Hispaniola, *L. venustum* occurs in southwestern Brazil though South America, Central America, Cuba, Grenada, Hispaniola, Jamaica, Mexico, and Trinidad, and

L. volubile occurs in northern Argentina to northern South America, Cuba, Guatemala, Jamaica, and Trinidad.

Actinostachys (*Schizaea*) *pennula* is reported only from Dade and Palm Beach Counties at the tip of the Florida peninsula and from Pinellas County near Tampa in damp forests and open baylands (Naumann, 1993).

Schizaea pusilla is reported from Delaware, New Jersey, and New York in the United States and from New Brunswick, New Caledonia, and Newfoundland in Canada, occurring in bogs, wet, sandy depressions, and crevices of ledges along shores (Naumann, 1993). *S. fluminensis* and *S. poeppigiana* are reported from Puerto Rico. *S. robusta* is reported from Hawaii.

Anemia wrightii is reported in the U.S. only from Dade County, Florida, on the tip of the peninsula. *A. adiantifolia* is reported from the four southernmost counties on the Florida peninsula plus the contiguous Palm Beach and Martin Counties and from three contiguous central counties along the coast: Citrus, Hernando, and Levy. It occurs in open to lightly shaded, rocky slopes and in hammocks and pine woods, often on limestone (Naumann, 1993). *A. mexicana* is reported only from Texas in lightly shaded limestone outcrops of the Edwards Plateau (Naumann, 1993). *A. hirsuta, A. hirta*, and *A. portoricensis* are reported from Puerto Rico.

IV. Environmental Consequences

A. No Action

1. Impact of spread of *L. microphyllum*

Lygodium microphyllum grows in wetland and mesic habitats including hammocks, cypress swamps, flatwoods, bayheads, and disturbed sites. Once established, *Lygodium* climbs and blankets other vegetation, ultimately causing mortality to mature canopy and subcanopy trees in the case of *L. microphyllum* (Roberts, 1996; 1997). Sometimes, *Lygodium* covers other vegetation so completely, it is not possible to see other plants beneath it (Pemberton and Ferriter, 1998). Near the ground surface, a thick mat of old and new fronds also forms that kills native plants by light deprivation, including herbs and tree seedlings that would ordinarily maintain the forest canopy if allowed to mature. Rare plant species such as the tropical curlygrass fern (*Actinostachys pennula*) are severely imperiled by the spread of *L. microphyllum* into their last remaining habitats, such as the northern Everglades tree islands. Effects of *Lygodium* on native wildlife appear to be significant, but are in need of

investigation" (Ferriter, 2001).

Pemberton and Ferriter (1998) predicted the fern would spread northward in Florida along the coasts within the boundaries of USDA hardiness Zone 9A. The confirmation by Pemberton (2003) of *L. microphyllum* in Orange County, Florida (Zone 9A) supports this prediction. Volin et al. (2004) predict that *L. microphyllum* will spread to most of south Florida by 2014. This model predicts that the climbing fern has the potential to occupy most of the cypress swamps and Everglades tree islands in the southern third of Florida by 2014. These communities represent about 30% of the Greater Everglades Ecosystem. The model predicts that about 30% of the land area in the southern part of Florida could be infested. Goolsby (2004) used the climate-matching program CLIMEX to predict the potential distribution of *L. microphyllum* in North and South America. The CLIMEX model was fitted from climate data from the known distribution of the fern in the Old World. The CLIMEX model was based on intensive surveys for the plant near its ecoclimatic limits in China and Australia. The model predicts that climate is suitable for further expansion of *L. microphyllum* northwards into central Florida and southward into large parts of the Caribbean, Central and South America. Current occurrence in central Florida and USDA hardiness zone information also suggests that the climbing fern has the potential to invade the Gulf Coast of Mexico and southern Texas with its wind borne spores (Pemberton et al., 2002; Pemberton, 2003). *Lygodium microphyllum's* gametophytes have been recently found to be self fertile, which means that a single spore carried by the wind is capable of starting a new infestation (Lott et al., 2003).

2. Impact from use of other control methods

Chemical control

The continued use of chemical herbicides and mechanical controls at current levels would be a result if the "no action" alternative is chosen. In addition to being expensive to agencies that manage *L. microphyllum*, control tactics based entirely on the use of herbicides can lead to negative environmental side effects including undesirable chemical residues both in the ecosystem (soil, water) as well as adverse effects on non-target organisms. Herbicides and cutting of vines only provide temporary weed suppression, and in addition to being expensive, they can cause a great deal of non-target damage, and spread spores to new locations. Ferriter (2001) summarizes current control efforts and reports that various herbicides have given excellent control of the vines but that regrowth and non-target damage usually occurs. Herbicides disussed included glyphosate (Rodeo®), triclopyr (Pathfinder ®, Garlon®), 2,4-D (Weedar®, Vanish®), fosamine (Krenite®), and imazapyr (Arsenal ®)

Mechanical control

Cutting vines will result in death of the vines above the cut location, but will not kill the lower portion of the plant. Regrowth will occur after physical removal (hand-pulling) or burning. Use of heavy equipment has limited value because site access is often limited, and equipment can disturb soils and non-target vegetation and transport spores to new locations. Flooding does not kill established vines but seems to prevent germination of spores on flooded soils.

These environmental consequences may occur even with the implementation of the biological control alternative, depending on the efficacy of *N. conspurcatalis* to reduce *L. microphyllum* in Florida.

B. Issue the permit for environmental release

1. Impact of *N. conspurcatalis* on non-target plants

The target weed *L. microphyllum* is the only known host of *N. conspurcatalis* in its native range. Research demonstrated that *N. conspurcatalis* was found to be specific to the genus *Lygodium.* In choice and no choice host specificity tests conducted in Australia and Florida (Pemberton and Goolsby, 2005) the moth was able to complete development only on the target weed, *L. microphyllum*, another invasive weed – the Japanese climbing fern (*L. japonicum*), and the native North American climbing fern (*L. palmatum*). None of the four native *Lygodium* species that occur in the Caribbean supported development of the moth. No development occurred on any of the other test plants which included 46 species of ferns belonging to 25 genera and 18 families (see Appendix 1 for a list of plants tested).

The native climbing fern *L. palmatum* supported development of *N. conspurcatalis.* However, the moth is a tropical-subtropical species currently limited to Florida, whereas *L. palmatum* is a temperate species occurring north of Florida. This indicates that it is unlikely that the moth will be unable to live where this native fern occurs. The CLIMEX model predicts that the northeast coast of Florida will be the most northerly area where *L. microphyllum* can live in the United States (Goolsby, 2004). *Lygodium japonicum*, which supported full development of the moth, ranges farther north into Virginia, which is in Plant Hardiness Zone 7 (USDA, ARS, 1990). Lethal lower limit temperature studies of *N. conspurcatalis* found no survival at -7^{o}C. (Pemberton and Goolsby, 2005). This indicates that the moth should be restricted to Plant Hardiness Zones 10, 9b, and perhaps 9a (USDA, ARS, 1990). Hardiness Zone 8a is the warmest zone that the native *L. palmatum* is known to occur, which is too cold for *N. conspurcatalis.* There has been no indication of a winter

diapause in the field; the moth is active throughout the year in its native region. Stress tests of moths exposed to simulated winter temperature minimums corresponding to Charleston, South Carolina, the southern limits of *L. palmatum* distribution, were conducted. Results demonstrated the moth's inability to survive in this 8b zone (Goolsby and Pemberton, 2004). All but a few *L. palmatum* populations occur in Appalachia, the Midwest (Indiana and Michigan) and New England, that are too cold for establishment of *N. conspurcatalis*.

N. conspurcatalis is specific to only three species in the genus *Lygodium*: the target *L. microphyllum, L. japonicum, and L. palmatum.* No other fern including the nearest non-*Lygodium* ferns, *Actinostachys* and *Anemia* species, supported development of *N. conspurcatalis.* The lack of larval development on the four species of Caribbean *Lygodium* indicates that *N. conspurcatalis* poses no danger to those plants even if the moth is able to migrate to those areas. On the contrary, the moth might be a potential control agent, if the climbing fern invades the Caribbean islands which are climatically suitable for the weed.

2. Uncertainties Regarding the Environmental Release of *N. conspurcatalis*

Once a biological control agent such as *N. conspurcatalis* is released into the environment and becomes established, there is a slight possibility that it could move from the target plant (*L. microphyllum*) to attack nontarget plants, such as native *L. palmatum*. Host shifts by introduced weed biological control agents to unrelated plants are rare (Pemberton, 2000). Native species that are closely related to the target species are the most likely to be attacked (Louda et al., 2003). If other plant species were to be attacked by *N. conspurcatalis*, the resulting effects could be environmental impacts that may not be easily reversed. Biological control agents such as *N. conspurcatalis* generally spread without intervention by man. In principle, therefore, release of this biological control agent at even one site must be considered equivalent to release over the entire area in which potential hosts occur and in which the climate is suitable for reproduction and survival. Post- release evaluations of *N. conspurcatalis* populations and their effects on *L. microphyllum* and other non-target species will be conducted by ARS researchers.

In addition, these agents may not be successful in reducing *L. microphyllum* populations in the continental United States. Worldwide, biological weed control programs have had an overall success rate of 33 percent; success rates have been considerably higher for programs in individual countries (Culliney, 2005). Actual impacts on *L. microphyllum* by *N. conspurcatalis* will not be known until after release occurs and post-release monitoring has been conducted.

3. Cumulative Impacts

"Cumulative impacts are defined as 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 regardless of what agencies or person undertakes such other actions" (40 CFR 1508.7).

Management of *L. microphyllum* in Florida

Since 1998, Florida's Department of Environmental Protection, Bureau of Invasive Plant Management, Upland Invasive Plant Management Program, has controlled more than 14,000 acres of *Lygodium japonicum* and *Lygodium microphyllum* at a cost of approximately $8.2 million (DEP, BIPM, 2006). This acreage does not include work done by federal and local governments. The Lygodium Strike Team is comprised of experienced weed control specialists under contract with the Bureau. They are prepared to provide either foliar applications or "poodle-cuts" (cut vines 4-5 feet up from the ground and apply herbicide to the rooted portion of the plant). The Florida Department of Environmental Protection is planning increased effort for aerial spraying of herbicides to attempt to reduce *L. microphyllum* infestations in Loxahatchee National Wildlife Refuge. State level chemical control efforts have been made on conservation lands within the Everglades region managed by the SFWMD. Florida State parks and refuges in southern Florida have used both aerial and ground based herbicide applications in attempts to control the weed. Everglades National Park has been treating *L. microphyllum* infestations within the park with aerial applications of herbicides for about 5 years and these efforts continue. Various levels of government including State of Florida and Counties are assisting the control of *L. microphyllum* on private lands.

The only biological control agent for *L. microphyllum* to be released to date (*Austromusotima camptozonale*) has not definitively established in Florida. The moth was first released during February 2005 and releases involving about 15,000 individuals per year have been made in 2005, 2006 and 2007 in Martin and Palm Beach Counties. At some release sites the moths bred for several generations after being released, but no evidence of persistence of the moths was acquired after the hot rainy summer periods. The second approved biological control agent, a gall mite named *Floracarus perrepae*, was permitted for release in December, 2006. Field releases to attempt to colonize the mite will begin during the spring or early summer 2007 (R. Pemberton, pers. comm.).

Release of *N. conspurcatalis* will have no negative cumulative impacts in the continental United States because of its host specificity to *L. microphyllum*. Effective biological control of *L. microphyllum* will have

beneficial effects to current Everglades restoration activities and *L. microphyllum* management activities, and may result in a long-term, non-damaging method to control *L. microphyllum* in south Florida, and prevent its spread into other areas potentially at risk from invasion.

4. Endangered Species Act

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

There are 23 federally listed ferns and fern allies in the United States. Most of these species occur in Hawaii and Puerto Rico, but some occur in Alaska, Alabama, Georgia, Florida, South Carolina, Louisiana, Mississippi, Michigan, NewYork, and Tennessee. None of these species are related to *Lygodium* ferns.

N. conspurcatalis is able to develop on only three *Lygodium* species as host plants and it will not attack any federally listed threatened or endangered plant species. The moth is a tropical-subtropical species known only to attack *L. microphyllum* in its native Australia and Southeast Asia home range. In host specificity testing, *N. conspurcatalis* was able to complete its life cycle only on three *Lygodium* species; the target weed (*L. microphyllum*), *L. japonicum*, and the native *L. palmatum*.

North America: *N. conspurcatalis* occurs only in subtropical and tropical Australia and Asia. Studies examining the moth's ability to survive at lower temperatures indicate that it will be unable to survive in USDA cold hardiness zone 8b (Pemberton and Goolsby, 2005). The six federally listed North American ferns and fern allies (*Thelypteris pilosa* var. *alabamensis*, *Polystichum aleuticum, Asplenium scolopendrium* var. *americanum, Isoetes melanospora, I. louisianensis, and I. tegetiformans*) live in colder zones than those where the moth can survive. In addition, the host specificity is limited to the genus *Lygodium*, which is unrelated to any federally listed threatened or endangered plant in the continental United States.

Puerto Rico and the Virgin Islands: The climate in this area is suitable for the moth but there is no likely pathway from Florida to Puerto Rico and the Virgin Islands. This biological control agent will not be released in Puerto Rico or the Virgin Islands. No ferns or fern allies are federally listed in the Virgin Islands but eight are listed in Puerto Rico (*Adiantum vivesii, Cyathea dryopteroides, Elaphoglossum serpens, Polystichum calderonense, Tectaria estremerana, Thelypteris inabonensis, T.*

verecunda, and *T. yaucoensis*). However, none of these plants are related to *L. microphyllum*.

Hawaii: Ten federally listed ferns and allies occur in Hawaii (*Asplenium fragile* var. *insulare, Diellia falcata, D. pallida, D. erecta, D. unisora*, *Diplazium molokaiense, Adenophorus periens, Marsilea vilosa, Pteris ligatei,* and *Ctenitis squamigera*). None of these species are related to *L. microphyllum.* The climate of Hawaii is suitable for *N. conspurcatalis* but natural or purposeful spread from Florida to Hawaii would be unlikely. *L. microphyllum* does not occur in Hawaii and there are no native *Lygodium* species in Hawaii. *L. japonicum*, which is a potential host of the moth, occurs sparingly as a naturalized plant on Hawaii so might be able to support modest populations of the moth. There would be no effect on federally listed threatened or endangered plants because of the specificity of the moth to *Lygodium*.

APHIS has determined that *N. conspurcatalis* will have no effect on any threatened or endangered plant species because of the very limited host range of the moth, the taxonomic separation between the target weed and listed ferns and fern allies, the inability of the moth to live in the climatic zones where North American listed ferns and fern allies occur, and the geographic distance of Florida from Puerto Rico and Hawaii, where other federally listed ferns and fern allies occur.

V. Other Issues

Consistent with Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," APHIS considered the potential for disproportionately high and adverse human health or environmental effects on any minority populations and low-income populations. There are no adverse environmental or human health effects from the field release of *N. conspurcatalis* and will not have disproportionate adverse effects to any minority or low-income populations.

Consistent with EO 13045, "Protection of Children From Environmental Health Risks and Safety Risks," APHIS considered the potential for disproportionately high and adverse environmental health and safety risks to children. No circumstances that would trigger the need for special environmental reviews is involved in implementing the preferred alternative. Therefore, it is expected that no disproportionate effects on children are anticipated as a consequence of the field release of *N. conspurcatalis*.

VI. Agencies, Organizations, and Individuals Consulted

The Technical Advisory Group for the Biological Control Agents of Weeds (TAG) recommended the release of *Neomusotima conspurcatalis* on March 21, 2006. TAG members that reviewed the release petition (Pemberton and Goolsby, 2005) included representatives from the U.S. Fish and Wildlife Service, Bureau of Indian Affairs, Cooperative State Research, Education, and Extension Service, National Park Service, Environmental Protection Agency, Bureau of Land Management, U.S. Forest Service, the U.S. Army Corps of Engineers, Bureau of Reclamation, Florida Natural Areas Inventory, California Department of Food and Agriculture, Oregon Department of Agriculture, Agriculture and Agri-Food Canada, Environmental Health Canada, Health Canada.

This EA was prepared and reviewed by APHIS and ARS. The addresses of participating APHIS units, cooperators, and consultants (as applicable) follow.

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Policy and Program Development
Environmental Services
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Riverdale, MD 20737

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Permits, Registrations, Imports, and Manuals
4700 River Road, Unit 133
Riverdale, MD 20737

U.S. Department of Agriculture
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Invasive Plant Research Laboratory
3225 College Ave.
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Appendix 1. Plants tested for host specificity to *N. conspurcatalis* (Pemberton and Goolsby, 2005). Species in bold are plants native to Florida.

Plant Family	Test Plant Species	Common name of test plants
Pteridophyta		
Lygodiaceae	*Lygodium microphyllum* FL	Old World climbing fern
Lygodiaceae	*Lygodium japonicum* (Thunb.) Sw.	Japanese climbing fern
Lygodiaceae	*Lygodium palmatum* (Bernhardi) Swartz	American climbing fern
Lygodiaceae	*Lygodium oligostachyum* (Willdenow) Desv.	none
Lygodiaceae	*Lygodium venustum* Sw.	none
Lygodiaceae	*Lygodium cubense* Kunth	Cuban climbing fern
Lygodiaceae	*Lygodium volubile* Sw.	none
Anemiaceae	***Anemia adiantifolia* (L.) Swartz**	pine fern
Anemiaceae	***Anemia wrightii* Baker**	Wright's pineland fern
Aspleniaceae	***Asplenium platyneuron* (L.) Britton, Sterns, & Poggenburg**	ebony spleenwort
Aspleniaceae	***Asplenium scolopendrium* L.**	Hart's-tongue fern
Aspleniaceae	***Asplenium nidus L.***	bird's-nest fern
Azollaceae	***Azolla caroliniana* Willdenow**	mosquito fern
Blechnaceae	***Blechnum serrulatum* Richard**	swamp water fern
Blechnaceae	***Woodwardia areolata* (L.) T. Moore**	netted/narrow leaf chain fern
Blechnaceae	***Woodwardia virginica (*L.) Smith**	Virginia chain fern
Cyatheaceae	*Cyathea cooperi* (F. J. Muell.) Domin	Australian tree fern
Dennstaedtiaceae	***Pteridium aquilinum* (L.) Kuhn**	bracken fern
Dryopteridaceae	***Athyrium filix-femina* Roth**	Lady fern
Dryopteridaceae	***Ctenitis sloanei* (Poeppig ex Sprengel) C. V. Morton**	Florida tree fern
Dryopteridaceae	*Cyrtomium falcatum* (L.f.) C. Presl	Japanese holly fern

Dryopteridaceae	***Dryopteris ludoviciana* (Kunze) Small**	Southern Wood fern
Dryopteridaceae	***Polystichum acrostichoides* (Michaux) Schott**	Christmas fern
Dryopteridaceae	*Rumohra adiantiformis* (G. Forst) Ching	leather leaf fern
Dryopteridaceae	***Tectaria fimbriata* (Willdenow) Proctor & Lourteig**	least halberd
Dryopteridaceae	***Tectaria heracleifolia* (Willdenow) L. Underwood**	broad halberd
Dryopteridaceae	***Nephrolepis biserrata* (Swartz) Schott**	giant sword fern
Dryopteridaceae	*Nephrolepis cordifolia* (L.) C. Presl	tuberous sword fern
Dryopteridaceae	***Nephrolepis exaltata* (L.) Schott**	wild Boston fern
Equisetaceae	***Equisetum hyemale* L.**	rough horsetail
Marsileaceae	*Marsilea vestita* Hooker & Greville	water clover
Ophioglossaceae	***Ophioglossum petiolatum* Hooker**	slender adders-tongue
Osmundaceae	***Osmunda cinnamomea* L.**	cinnamon fern
Osmundaceae	***Osmunda regalis* L.**	royal fern
Polypodiaceae	***Phlebodium aureum* (L.) J. Smith**	goldfoot fern
Polypodiaceae	*Platycerium bifurcatum* (Cav.) C.Chr.	staghorn fern
Polypodiaceae	***Pleopeltis polypodioides* (L.) E.G. Andrews & Windham**	resurrection fern
Pteridaceae	***Adiantum capillus-veneris* L.**	southern maidenhair fern
Pteridaceae	***Pteris bahamensis* (J. Agardh) Fee**	Bahama ladder brake
Pteridaceae	*Pteris vittata*	Chinese Ladder brake
Salviniaceae	*Salvinia minima* Baker	water fern
Schizaeaceae	***Actinostachys pennula* (Swartz) Hooker**	ray spiked fern
Selaginellaceae	*Selaginella pallescens* Spring	peacock fern
Selaginellaceae	*Selaginella uncinata* (Desvauxex Poiret) Spring	blue spike-moss
Thelypteridaceae	***Thelypteris kunthii* (Desvaux) C.V. Morton**	Southern shield fern

Gymnosperms

Taxodiaceae	***Taxodium distichum* (L.) Richard**	bald-cypress

Angiosperms

Poaceae	*Oryza sativa* L.	Rice
Poaceae	*Saccharum officinarum* L.	sugarcane
Rutaceae	*Citrus sinensis (L.) Osbeck* Macf.	orange