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Field Release of Phorid Flies (*Pseudacteon* species) for the Biological Control of Imported Fire Ants

Environmental Assessment
January 2008

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Table of Contents

1. Purpose and Need for the Action

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) is tasked with protecting American agriculture from pests. Imported fire ants (IFA) are red fire ants, *Solenopsis invicta* Buren, black fire ants, *S. richteri* Forel, and a hybrid of those two species. IFA are an important pest of agriculture in the United States and a health hazard to humans, domestic animals, and wildlife. Since being introduced in the southern United States from South America more than 70 years ago, IFA are now an established pest in all or parts of 13 states (Callcott and Collins, 1996).

APHIS, in cooperation with state agriculture departments, has established a quarantine to prevent the artificial spread of IFA. The regulations for this quarantine are in the Code of Federal Regulations (CFR) at 7 CFR 301.81. APHIS is responsible for establishing quarantine areas and regulating the movement of articles that might contain these ants.

The treatment of regulated articles to prevent the artificial spread of IFA often involve the use of pesticides. An Environmental Assessment that addresses the impacts of the IFA Quarantine's regulatory activities has been prepared (USDA APHIS, 2005), and this document will incorporate by reference the information in that Environmental Assessment.

An additional component of the IFA Quarantine is the rearing and field release of phorid flies which are biological control agents that parasitize IFA. The objective of this aspect of the IFA Quarantine is not to eradicate fire ants, but to reduce the overall IFA populations in infested areas and help tilt the ecological balance in favor of native ants that IFA have displaced. Should IFA populations decline, it is then less likely that articles leaving the IFA quarantine area would be infested and cause IFA infestations outside the quarantine area.

APHIS is proposing to expand the number of phorid fly releases from the current 3 species to a total of 8 phorid fly species to control IFA (*Solenopsis invicta*, *S. richteri*, and their hybrid) in 13 States and the Commonwealth of Puerto Rico. The USDA Agricultural Research Service has researched and developed biological control (biocontrol) agents of the genus *Pseudacteon* (phorid flies) which have the potential to reduce the area and intensity of IFA infestations. Fire ant populations in their South American homelands are about 10-20% of those normally found in North America (Porter *et al*., 1997). Escape from the numerous natural enemies left behind in South America is a likely explanation because intercontinental differences in fire ant densities do not appear to be related to differences in climate, habitat, or other factors investigated.

This environmental assessment has been prepared, consistent with the APHIS National Environmental Policy Act implementing procedures (7 CFR part 372), for the purpose of evaluating the extent of the impact the 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 action and alternatives considered in this document. An environmental impact statement must be prepared if implementation of the action may significantly affect the quality of the human environment.

2. Background

2.1 Imported Fire Ants (IFA)

The black imported fire ant, *Solenopsis richteri* Forel, was inadvertently introduced into the United States at the port of Mobile, Alabama, around 1918 (Loding, 1929). The red imported fire ant *Solenopsis invicta* Buren was introduced into the same port some time during the 1930s (Lennartz, 1973). The red fire ant was by far the more successful of the two invaders. After its introduction in Mobile, Alabama, the black imported fire ant was driven northward by competition from the red imported fire ant and currently is restricted to a small region around the tri-state border of Mississippi, Alabama and Tennessee. However, a broad band of hybridization between red and black fire ants extends from the Mississippi River to Atlanta, Georgia (Shoemaker *et al.*, 1996). Red and black fire ants, however, are still considered separate species because hybridization apparently does not occur in native Argentine populations (Ross and Trager, 1990).

Economic damage attributed to IFA in the United States is estimated at nearly $6 billion per year (Lard *et al.*, 2001; Pereira *et al.*, 2002), not including environmental damage. Damage from IFA can be grouped into four major categories: agricultural, electrical, medical, and environmental. IFA adversely affect several important agricultural crops, including soybeans, corn, potatoes, and citrus (Adams,1986; Adams *et al.*, 1988; Banks *et al.*, 1991; Drees *et al.*, 1992). IFA are also known to prey on many beneficial insects including some biological control agents (Eubanks, 2001). IFA are also a major source of electrical problems: transformers, air conditioners, traffic switch boxes, airport lights, and other electrical equipment located on the ground are all susceptible to problems caused by fire ants chewing off insulation, jamming switches, or building mounds in electrical boxes (MacKay and Vinson, 1990; Vinson and MacKay, 1990). Medical problems from stings are the third major category of problems associated with fire ants. Young children are commonly stung dozens to hundreds of times when they stand on fire ant mounds; several people die each year from fire ant stings – mostly bedridden patients in nursing homes or people who are unconscious or otherwise unable to respond to the fire ants. About 1-2% of the population are sensitive or allergic to fire ant stings (Vinson, 1997). Environmental damage is also associated with IFA. High densities of fire ants can displace most native ants from open habitats (Porter and Savignano, 1990), especially in areas disturbed by urbanization, agriculture, or grazing. Deer, mice, shore birds, quail, and lizards are among the vertebrates that can be harmed by high IFA populations (Allen *et al.*,1998; Williams *et al.*, 2003).

2.2 The phorid fly biological control agents *Pseudacteon* species

At least 20 species of *Pseudacteon* flies have been found attacking fire ants in South America (Porter and Gilbert, 2004). Up to nine species of these flies have been found at a single site. Each species has a distinctively shaped ovipositor (Porter, 1998a) that is presumably used in a lock-and-key fashion to lay eggs in a particular part of its host's body. These flies appear to be common and active throughout most of the year (Fowler *et al*., 1995), but different species are sometimes more active at different times of the day (Pesquero *et al*., 1996). Most species are broadly distributed (Borgmeier, 1969; Borgmeier and Prado, 1975; Folgarait *et al*., 2005; Calcaterra *et al*. 2005) across a wide range of habitats and climates.

Female *Pseudacteon* flies usually contain a hundred or more torpedo-shaped eggs (Zacaro and Porter, 1999). During oviposition, one egg is rapidly injected into the ant thorax with a short hypodermic shaped ovipositor. Shortly after hatching, maggots of *Pseudacteon* flies move into the heads of their hosts where they develop slowly for 2-3 weeks (Porter *et al*., 1995b). Just prior to pupation, the third instar maggot (Porter, 1998a) appears to release an enzyme that dissolves the membranes that hold the exoskeleton together. The maggot then proceeds to consume the entire contents of the ant's head, a process that usually results in rapid decapitation of its living host (Porter, 1998a). The headless body is usually left with its legs still twitching. Worker ants apparently carry the larva infested head capsule outside their nest several hours after the host is killed. The maggot then uses hydraulic extensions to push the ant’s mouth parts aside after which it pupates within the empty head capsule positioned so that the anterior three segments harden to form a plate that precisely fills the ant’s oral cavity (Porter, 1998a). The remainder of the puparium remains unsclerotized and is protected by the ant’s head capsule which functions as a pupal case. Pupal development requires 2-3 weeks depending on temperature. Adult flies are mature and ready to mate and oviposit about 3 h after emergence.

Adult *Pseudacteon* flies can live a week or two (Fadimiro *et al*., 2005); however, high rates of activity associated with oviposition will shorten their lives to 1-3 days. Adults will eat a little sugar water or honey water if they accidentally contact it while running across a surface. However, flies are not attracted to honey, sugary solutions, or various kinds of fruits, vegetables, raw meat, prepared foods, animal excrement, or carrion (Porter, 1998a; Porter, 2000).

During attacks, fire ant workers are keenly aware of the presence of phorid flies. A single female fly usually stops or greatly reduces the foraging efforts of hundreds of fire ant workers in only a minute or two (Porter *et al*., 1995c). As soon as a fly appears, most workers rapidly retreat into exit holes or find cover. Other workers curl into a stereotypical c-shaped posture (Porter, 1998a) that has not been seen except when the ants are under attack by phorids. The flies inhibit fire ant foraging as long as they are present, often for periods of several hours. Reduced foraging activity appears to facilitate competition from ants that might otherwise be excluded from food sources in fire ant territories (Feener, 1981; Orr *et al*., 1995). Several flies are also sufficient to stop nest construction or freeze the activity of entire colonies in laboratory nest trays (Porter *et al*., 1995c). The overall impact of these flies on fire ant populations is unknown; however, it is clearly sufficient to have caused the evolution of a number of phorid-specific defense behaviors.

3. Alternatives Including the Action

This environmental assessment analyzes potential environmental consequences of a program to reduce IFA populations in the U.S. and Puerto Rico through the release of phorid flies (species of *Psuedacteon*), which are biological control agents. The two alternatives considered are 1) no action (APHIS will continue to release only the three *Psuedacteon* species that have currently been approved for release) and 2) the release of an additional five *Psuedacteon* species.

3.1 No Action

The regulations of the Council on Environmental Quality (CEQ) for implementing the procedural provisions of the National Environmental Policy Act (40 CFR parts 1500-1508) require the inclusion of a "No Action" alternative. Consistent with CEQ's guidance (CEQ-NEPA 40 Q&As, number 3), APHIS defines "No Action" as meaning "No Change," i.e., continuing with the present course of action. Under this alternative, three phorid fly species, *Pseudacteon curvatus*, *P. litoralis*, and *P. tricuspis*, would continue to be released, however, no other phorid fly species would be released.

3.2 Implement Program to Release Five Additional Phorid Fly Species (Preferred alternative)

Under this alternative, APHIS is proposing to release an additional five species of phorid flies: *Pseudacteon cultellatus, P. nocens, P. nudicornis, P. obtusus, P. sp.* near *obtusus*. These releases would not occur at the same time or place, but rather over the course of many years as the exploration and development of rearing and release methods develop for these species.

3.3 Alternative Not Considered

A number of approaches have been taken to reduce IFA populations in the United States, with insecticides being the most commonly used approach. Because insecticide use and other approaches are not proposed by APHIS and are typically beyond the control of APHIS, they will not be analyzed in this document. In addition, the release of biological control agents other than phorid flies will not be analyzed.

4. Affected Environment

The environment affected by this action would be the environment in the 13 states where IFA are currently established: Alabama, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina, Tennessee, and Texas, as well as the Commonwealth of Puerto Rico. A map of the IFA Quarantine area is at: http://www.aphis.usda.gov/ppq/maps/fireant.pdf . Future areas where IFA will spread naturally cannot be accurately determined, but as those areas are infested it is likely that phorid flies could also inhabit those areas.

5. Environmental effects of the action and the alternative

5.1 No Action Alternative

The effect of the No Action alternative would be that IFA populations would be suppressed by three phorid flies (*Pseudacteon curvatus*, *P. litoralis*, and *P. tricuspis*) at levels far below the levels of suppression that could be obtained should eight phorid fly species be released. While two of the three phorid fly species that have been released have successfully become established and are actively parasitizing fire ant colonies, there has been much less reduction in overall colonies than could be realized if five other phorid fly species were to also be released.

The host specificity of *Pseudacteon* flies was tested in the field at three areas in South America with 23 species of ants from 13 genera (Porter et al., 1995a). *Pseudacteon* flies were attracted only to *Solenopsis* fire ants. Porter and Alonso (1999) conducted forced tests with *P. litoralis* and *P. tricuspis* in quarantine facilities in Gainesville, Florida with native ants in six genera. Generally, ants in these genera were ignored by these flies. Several possible attacks were observed, but no larvae developed from them. Porter (2000) also conducted forced tests in quarantine with a third fly species, *P. curvatus*, using 19 species of ants from 12 genera. As with the previous two species, *P. curvatus* did not develop in ants outside the genus *Solenopsis.*

Field tests in Brazil with *P. tricuspis* and *P. litoralis* demonstrate that both flies show a very strong preference for fire ants from Brazil (Porter, 1998b) over the tropical fire ant, *Solenopsis geminata*, which is native to parts of the United States. Laboratory choice and no-choice tests at quarantine facilities in the United States also indicate that *P. tricuspis*, *P. litoralis,* and *P. curvatus* have a high degree of preference for the imported fire ant *S. invicta* over the native fire ants *S. geminata* and *S. xyloni* (Gilbert and Morrison 1997, Porter and Alonso 1999, Porter 2000). Post release host specificity tests for *P. tricuspis and P. curvatus* (Vazquez and Porter, 2005; Morrison and Porter, 2006) confirm that pre-release laboratory tests accurately predicted high levels of host specificity. The decapitating fly *P. litoralis* has not yet been established in the field so post-release tests are currently not available.

5.2 Implement Program to Release Five Additional Phorid Fly Species (Preferred alternative)

Under this alternative, APHIS is proposing to release an additional five species of phorid flies: *Pseudacteon cultellatus, P. nocens, P. nudicornis, P. obtusus, P. sp.* near *obtusus*.

All known flies in the genus *Pseudacteon* are parasites of ants (Porter and Gilbert 2004). They have never been reported to attack any other kind of organism, and virtually all phylogenetically related phorid genera are also ant parasites (Brown 1993, Disney 1994). Their elaborate ovipositors and the adaptation for pupation in the head capsules of worker ants further supports the conclusion that they are very specialized parasites (Porter 1998a).

Pseudacteon species that attack fire ants appear to be specific to fire ants (Porter and Gilbert 2004). Several species of *Pseudacteon* flies are specific parasites of ants in other genera (e.g.: *Crematogaster*, *Dorymyrmex*, *Linepithema*), but none of these species are known to attack ants outside of the genus of their primary host (Porter and Gilbert, 2004; Disney, 1994). Most if not all *Pseudacteon* flies, which attack fire ants, are apparently specific to different species groups within the genus *Solenopsis*. For instance, at least five species are known to parasitize *S. geminata* in the United States, but they have never been collected attacking imported fire ants even though they clearly have had the opportunity (Feener, 1987; Morrison et al., 1997). Laboratory oviposition tests with *P. nudicornis* and the small species near *P. obtusus* show no attraction to native fire ants (Porter and Gilbert, 2004). Laboratory choice and no-choice tests summarized by Porter and Gilbert (2004) show that *P. obtusus, P. nocens, and P. cultellatus* all have a high degree of preference for the imported fire ant *S. invicta* over the native fire ants *S. geminata* and *S. xyloni* (Gilbert and Morrison,1997; Porter and Alonso, 1999; Porter, 2000). Thus, all five species show a high degree of specificity to imported fire ants.

A strong preference for imported fire ants means that these flies will pose little or no risk to native fire ants. In fact, releases of these flies are much more likely to benefit native fire ants because imported fire ants are their primary enemy and these flies will almost certainly have much greater impacts on imported fire ants than native fire ants (Porter, 2000). Finally, risks to native fire ants need to be balanced against potential benefits to native ants in other genera and numerous other native organisms that are negatively affected by imported fire ants including quail, mice, lizards, deer, and numerous rare and endangered species.

Several additional considerations are also important in regard to the potential field release of these *Pseudacteon* flies– 1) Since native fire ants already have several species of native *Pseudacteon* phorids that parasitize them (Disney 1994), new *Pseudacteon* parasitoids from South America would not be completely novel parasitoids for which these ants have no defense. Consequently, risks should be lower than otherwise. 2) new *Pseudacteon* species will, at best, stress imported fire ant populations thus reducing their ability to compete with native ants. Consequently, there is no chance that releasing new species of flies will eradicate *S. invicta* or any of the native fire ants either. 3) *S. geminata* and *S. xyloni* are still very common species. *S. geminata* is found from South Carolina through Florida and over into Texas. *S. xyloni* is distributed across the entire southern United States. Both native species are often considered pests in areas where they occur (Smith 1936; Smith 1965; Thompson 1990). 4) Native fire ants were never as abundant as the imported species (Porter *et al.* 1988; Porter 1992; Vinson 1994) so there is little or no likelihood that they would simply replace each other as community-dominating pests.

5.3 Endangered Species Act

No endangered or threatened species listed by federal or state governments utilize imported fire ants as a primary food source. To the contrary, imported fire ants are known to cause negative impacts for many native species including some threatened and endangered species. Therefore, releases of this fly are expected to produce no negative impact on endangered or threatened species and may in fact provide major benefits to many of these species.

5.3.1 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 action considered in this document.

5.4 Cumulative impacts

Under NEPA, one must analyze whether the action is related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 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” (40 CFR 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” (40 CFR 1508.7).

Because it is not possible to predict how quickly or how extensively these biological control agents will spread, it is not possible to definitively quantify the cumulative impact that these releases may have on reducing IFA populations. However, it is anticipated that releasing these agents in combination will substantially decrease the existing populations of IFA and allow native ants a chance to re-populate areas previously infested with IFA.

6. Listing of Agencies and Persons Consulted

Environmental Services
Policy and Program Development
Animal and Plant Health Inspection Service
U.S. Department of Agriculture

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Soil Inhabiting Pests Section
Center for Plant Health Science and Technology
Plant Protection and Quarantine
Animal and Plant Health Inspection Service
U.S. Department of Agriculture
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Imported Fire Ant and Household Insects Research Unit
Center for Medical, Agricultural, and Veterinary Entomology
Agricultural Research Service
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