

**Field Release of *Eurytoma* sp. (Hymenoptera: Eurytomidae),
for Biological Control of the Erythrina Gall Wasp,
Quadrastichus erythrinae Kim (Hymenoptera: Eulophidae),
in Hawaii**

**Final Environmental Assessment
April 7, 2008**

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This Final Environmental Assessment (FEA) and Finding of No Significant Impact (FONSI) was prepared by the HDOA Plant Quarantine Branch (approving agency) for the HDOA Plant Pest Control Branch (proposing agency) and submitted to the Office of Environmental Quality Control (OEQC), Department of Health, State of Hawaii, to comply with the provisions of Hawaii Revised Statutes, Chapter 343, Environmental Impact Statements.

The appendix of this FEA contains public comment in the form of five letters of correspondence, four of which were supportive of the Erythrina Gall Wasp Project and one which required a reply to address a question raised by the writer. As a result, this FEA is unchanged from the Draft EA.

I. Proposed Action

An application was submitted by the Plant Pest Control Branch, Hawaii Department of Agriculture (HDOA), to the HDOA Plant Quarantine Branch, 1849 Auiki Street, Honolulu, HI 96819, for a permit to introduce *Eurytoma* sp. (Hymenoptera: Eurytomidae) into the State of Hawaii under the provisions of Hawaii Revised Statutes, Chapter 141, Department of Agriculture, and Chapter 150A, Plant and Non-Domestic Animal Quarantine. *Eurytoma* sp. will be used to control the erythrina gall wasp (EGW), *Quadrastichus erythrinae* Kim, an invasive eulophid wasp that has devastated endemic and introduced erythrina trees in natural and landscaped areas in Hawaii. The EGW is a gall-inducing wasp that causes leaves, leaf petioles, and shoots to become deformed and swollen, followed by leaf drop and reduced photosynthesis, and eventual death of the tree.

II. Need for the Proposed Action

A. Detailed description of proposed action

Purpose of the release

The HDOA proposes to release *Eurytoma* sp. from quarantine containment into the natural environment of the State of Hawaii as a biological control agent to suppress infestations of the EGW. Host specificity studies have been completed in the HDOA Insect Quarantine Facility (IQF) and *Eurytoma* sp. was found to attack only the EGW and not any of the non-target gall-formers tested. Biology studies indicate this parasitoid to be very prolific, long-lived, and well-synchronized with its host. The release of this parasitoid is an effective long-term solution to controlling the invasive EGW.

Need for the release

The main focus of this project will be to save the endemic Hawaiian “wiliwili” tree, *Erythrina sandwicensis* Degener, from extinction. The EGW has invaded all of the inhabited Hawaiian islands and the wiliwili trees face a major challenge for survival. To address the worst case scenario, a seed bank program has been established to preserve the species and its genetic diversity (Hollier 2007). In any case, the establishment of a biological control agent of the EGW is critical for the future survival of the wiliwili tree and other *Erythrina* species that are of great value for windbreak and soil conservation in agricultural areas and for landscaping and screening in residential, commercial, and recreational areas.

Locations of rearing facilities and release sites

The HDOA Insect Quarantine Facility is located at the HDOA Main Office Complex in the city of Honolulu, on the island of Oahu, in the State of Hawaii. The address of the property is 1428 South King Street, Honolulu, Hawaii 96814-2512. If *Eurytoma* sp. is approved for release from quarantine as a biocontrol agent, mass propagation of the wasp will be done in the HDOA Insect Rearing Facility at the same location. Release sites on all islands will be selected according to the availability of EGW-infested *Erythrina* species host plants. *Eurytoma* sp. will be shipped as air cargo to the other Hawaiian islands for release where needed.

Number/quantity to be released

Inoculative releases of available numbers will continue to be made statewide until *Eurytoma* sp. becomes well established and widespread. Numbers released cannot be predicted at this time.

Timing of release

No particular timing of releases is planned. Release sites with endemic *Erythrina sandwicensis* trees infested with the EGW will have preference.

Method of release

Adults of *Eurytoma* sp. will be released on EGW-infested *Erythrina* trees.

Common name and scientific classification

No common name at this time for *Eurytoma* sp. (Hymenoptera: Eurytomidae). This presently undescribed parasitic wasp species is in the process of being described as a new species by Dr. Michael Gates, USDA Systematic Entomology Laboratory, Beltsville, Maryland.

Location of voucher specimens

Voucher specimens are deposited at the USDA Systematic Entomology Laboratory and the Hawaii Department of Agriculture, Plant Pest Control Branch, Taxonomy Unit, Honolulu, Hawaii.

B. Information on the target (host) organism(s)

Classification of target (host or pest) organism

The erythrina gall wasp (EGW), *Quadrastichus erythrinae* Kim (Hymenoptera: Eulophidae), is a serious, highly destructive, invasive species in Hawaii. The female wasp inserts its eggs into young leaves and stems of erythrina trees and the wasp larvae develop within plant tissue, inducing the formation of galls, mainly in leaflets and petioles, but practically all green tissue, even the seed pods. As the infestation progresses, the *Erythrina* leaves curl and appear deformed, while petioles and shoots become swollen. After feeding is complete, the larvae pupate within the galls. The adult wasps emerge by tunneling through tissue to the outside. Heavily galled leaves and stems result in a severe reduction of the growth and vigor of the trees, as photosynthesis is greatly reduced, and the trees eventually die.

Life history of the target organism

The EGW is a newly described species; therefore, no life history information was available in scientific literature. Basic biology studies were done in the HDOA Insectary. The life cycle,

from egg to adult, was determined to be about 20 days. Under the microscope, eggs could not be found in the plant tissue, but larvae were observed at about 4 days after erythrina plants were exposed to ovipositing females. Pupation began at about 14 days. Adult longevity was 4d for females and 8d for males when fed honey in the lab. A newly emerged female had about 60 eggs in its ovaries. Behavioral observations indicated that female wasps preferred to oviposit in young shoots while avoiding expanding or mature leaves.

Pest status of pest organism

The EGW is a highly invasive species of African origin that has devastated native and non-native erythrina trees in Hawaii. This eulophid was only described in 2004 as a new species by Kim et al. (2004) from specimens collected in Mauritius, Reunion, and Singapore, where it was initially reported to have invaded. Later, it was reported to have damaged erythrina trees in Taiwan during 2003 (Yang et al. 2004). During April 2005, it was detected in Hawaii on the island of Oahu, and quickly spread to all of the major Hawaiian islands by August 2005. Its worldwide distribution now includes Hong Kong, mainland China, India, Thailand, Okinawa, Philippines, Guam, and American Samoa (Heu et al. 2006). Having been found recently in Florida during November 2006 (Pemberton, pers. comm.), it now threatens to eventually find its way to California, and then to Mexico and Central and South America, where there are numerous endemic *Erythrina* species. Movement of plant materials and global air travel has been speculated as reasons for the rapid dispersal of this pest.

Erythrina, in the family Fabaceae, is a genus of about 115 species that are distributed throughout the tropics and warm temperate regions of the world (Wagner et al., 1990). Hawaii is home to the endemic wiliwili tree, *Erythrina sandwicensis* Degener, a deciduous species that is found in dry forests on the leeward sides of the islands. *Erythrina variegata* is an introduced ornamental species that has bright red flowers and is commonly used in the landscape at parks, schools, and along roadways in Hawaii. The shade provided by these large, beautiful trees has been eliminated as a result of defoliation. The Department of Parks and Recreation (City and County of Honolulu) has removed about 1,000 dead erythrina trees at great expense (Vorsino 2006). The tall columnar form *E. variegata* (L.) ‘Tropic Coral’, which is known locally as tall erythrina and which was developed for use in agricultural areas as windbreak for soil and water conservation (Rotar et al., 1986), is equally susceptible to EGW infestations. Another introduced ornamental tree, *E. crista-galli* L., a Brazilian species, has some tolerance to the EGW, but galled flowers and stems can be unsightly.

EGW larvae feed within the plant tissues so systemic insecticides are needed for control. Although chemical injection systems and soil drenches have been shown to be effective in some cases, they are expensive and would not be a cost-effective treatment for all erythrina plantings or natural stands. Routine insecticide applications would not be feasible for treating the endemic wiliwili trees in their native habitats.

C. Biology of organism to be released

Eurytoma sp. life history (see Appendix 1 for details and pictures)

The biology studies for *Eurytoma* sp. was done in the HDOA Insect Quarantine Facility. *Eurytoma* sp. is biparental. The adults of both sexes are black in color, but are easily

distinguishable by morphology. The metasoma on the abdomen of the female is oval and compressed laterally, while that of the male is petiolate. The female inserts its ovipositor into the gall to deposit a single egg measuring 0.14 x 0.26 mm. The parasitoid larva feeds externally as an ectoparasitoid on its host by extracting the body fluids with its mandibles. After feeding on one host larva, the parasitoid larva tunnels into adjacent gall chambers and feeds on other host larvae. The parasitoid larva then pupates within the gall. The emerging adult wasp will tunnel its way to the outside, producing a larger exit hole than those made by emerging EGW adults.

Based on a series of gall dissections containing “parasitized” EGW, the approximate duration of *Eurytoma* sp. life stages were as follows: egg (2d), larva (11d), and pupa (4d); first adult emergence (17d). Longevity of *Eurytoma* sp. adults, when fed honey, was 40d for females and 20d for males. The female wasp host-feeds by puncturing an EGW larva in the gall and drinking the droplet of host body fluid that oozes out after withdrawing its ovipositor.

Results of fecundity tests indicate a mean oviposition period of 37d and a post-oviposition period of 13d. During the oviposition period, the three females each produced a total of 105, 239, and 152 progeny, respectively, for a mean total fecundity of 165. A mean of 4.3 progeny were produced per day during the oviposition period. The life cycle (egg to adult) of the progeny was 18d for both females and males. The progeny were 25% female and 75% male.

Natural geographic range of *Eurytoma* sp.

Eurytoma sp. was collected from Masai Camp, Arusha Region, Tanzania on January 27, 2006 by HDOA Exploratory Entomologist Mohsen Ramadan. It was the dominant parasitoid reared from galled leaves of *Erythrina abyssinica*. Specimens were sent to Dr. Michael Gates (USDA-SEL), who is collaborating with Dr. Gerard Delvare (CSIRO-France) to describe this new species. Collections made by Ramadan in other regions of Tanzania yielded similar parasitoids.

Host range of *Eurytoma* sp. (see Appendix 1 for details)

No information on non-target hosts of *Eurytoma* sp. was available in the scientific literature. Host specificity tests were done in the HDOA Insect Quarantine Facility, the objective of which was to determine if this parasitoid would attack any non-target gall-forming insects. The seven species tested included one Hawaiian endemic psyllid, four beneficial species (three tephritids and one eriococcid used for weed biological control), and two immigrant wasps (one agaonid and one eulophid). Behavioral responses (i.e., attraction to galled plants) and parasitism by *Eurytoma* sp. were determined in choice tests between non-target gall-formers and the EGW (control). *Eurytoma* sp. females showed little attraction to plants with galls of non-target species and clearly preferred *Erythrina* plants with EGW galls. No parasitoid emergence resulted from exposures of non-target species to the parasitoid. Subsequent gall dissections showed no evidence of parasitism. *Eurytoma* sp. was demonstrated to be very host specific to the EGW.

Host range list

Information not available in scientific literature.

Parasites/hyperparasites

During processing and colonization in the HDOA Insect Quarantine Facility, *Eurytoma* sp. was not found to be attacked by other parasitoids.

Status as hyperparasite

This information is not available in scientific literature because *Eurytoma* sp. is an undescribed species that has not been studied previously. During field observations in Tanzania and host specificity studies in the HDOA IQF, *Eurytoma* sp. only targeted the EGW and did not develop by preying on any other species.

III. Alternatives to the Proposed Action

The actions being considered in this EA are (1) No Action (not issuing a permit) or (2) issuing a permit for release of *Eurytoma* sp. The no action alternative will allow the EGW to cause further damage to existing endemic Hawaiian wiliwili trees. The issuance of a permit would result in field releases of *Eurytoma* sp. that would, if successful, suppress EGW population densities to levels where this pest will no longer be a serious threat to cause the extinction of the endemic wiliwili. The successful suppression of EGW infestations will also enable future propagation and planting of the introduced ornamental erythrina trees for landscaping and the tall erythrina for windbreak in agricultural areas and for screening in residential areas.

IV. Environmental Impacts of the Proposed Action and Alternatives

Expected environmental impacts of the proposed release

Environmental impacts associated with the no action alternative of not issuing permits for release will result in the complete loss of the endemic *E. sandwicensis* species. The use of a natural enemy is believed to be the only long term solution to the EGW problem and would not require any further use of chemicals.

Potential impacts on human environment

There will be no impact of the release of *Eurytoma* sp. on the human environment in Hawaii. This parasitoid does not harm humans, animals, or plants. It will only target and prey on immature stages of the EGW in Hawaii.

Literature search for other host records

There are no records in scientific literature regarding this new species.

Host specificity in country of origin

Field observations, including the dissections of galls, during two exploratory trips in Tanzania disclosed that *Eurytoma* sp. was strictly an ectoparasitic species associated with gall-forming eulophid species on erythrina trees. This was subsequently confirmed by host specificity testing in the HDOA Insect Quarantine Facility.

Interactions with established biocontrol agents

No biocontrol agents have been previously released in Hawaii to suppress EGW infestations. No locally established natural enemies have been detected in association with EGW infestations.

Potential impact on T&E species

Host specificity testing done in the HDOA Insect Quarantine Facility showed that *Eurytoma* sp. will not attack any non-target, gall-forming insects. Consequently, there is no anticipated impact on any threatened or endangered insect species.

Impact to related non-target potential hosts

Host specificity testing done in the HDOA Insect Quarantine Facility showed that *Eurytoma* sp. will not attack any non-target, gall-forming insects. One of the seven non-target, gall-forming insects tested, *Ophelimus* sp., is in the same family (Eulophidae) as the target pest. *Ophelimus* sp., a gall-former on *Eucalyptus* leaves, was not targeted by *Eurytoma* sp. females.

The EGW, *Quadrastichus erythrinae*, which is a primary host of *Eurytoma* sp. in East Africa and presently the quarantine propagation host of *Eurytoma* sp. in Hawaii, is classified in the family Eulophidae of the Order Hymenoptera. The family Eulophidae is a large group of rather small insects. The majority of the species in this family are parasitic wasps that attack a wide variety of pests, including the immature stages of beetles, flies, moths, planthoppers, and thrips. Very few eulophids are significant pests of plants. The EGW is a very serious exception.

Host specificity testing routinely begins with the most closely related species of the target pest or host. In Hawaii, the family Eulophidae consists of about 62 species in 35 genera. Most of these species are parasitic wasps, nine of which are native (endemic) and 27 of which were purposely introduced for biological control. There are also 21 adventive species that arrived on their own. The status of five species is uncertain. Since the native and biocontrol species are all parasitic wasps, they were not selected as candidates for host specificity testing. The females of *Eurytoma* sp. have only targeted and oviposited within the galls of gall-forming eulophids.

Potential of *Eurytoma* sp. to act as a hyperparasite

Behavioral studies done in the HDOA Insect Quarantine Facility showed that *Eurytoma* sp. females had no interest in ovipositing in the galls of other gall-forming insects, nor did they attempt to oviposit anywhere else during quarantine studies, suggesting that *Eurytoma* sp. will not act as a hyperparasitoid. *Eurytoma* sp. females only oviposited within the galls of the EGW.

Potential of *Eurytoma* sp. to attack non-targets

Host specificity and behavioral studies in quarantine have shown that *Eurytoma* sp. will only target and, thus, prey upon the immature stages of the EGW. *Eurytoma* sp. females did not show any interest in non-target gall-formers that were tested. Historically, a parasitoid collected in association with the target pest in the native range of the pest has proven to have a high degree of specificity. The native range of origin of the EGW (*Quadrastichus erythrinae*) was found to include Tanzania. This significant discovery was made by HDOA Exploratory Entomologist Mohsen Ramadan at Chalinze, Tanzania in December 2005. Species determination of specimens collected by Ramadan was made by Dr. John La Salle (CSIRO Australia), an international authority of eulophid wasps (see Appendix 2). Ramadan made field observations and dissections of the galls of *Erythrina* spp. during two explorations in East Africa for EGW natural enemies and determined that *Eurytoma* sp. was the dominant parasitoid in many localities in Tanzania.

V. Listing of Agencies and Persons Consulted

Dr. John La Salle of CSIRO Australia (Commonwealth Scientific and Industrial Research Organisation), a world authority on the family Eulophidae, made the identification of *Quadrastichus erythrinae* (see Appendix 2).

Dr. Gerard Delvare, CSIRO France, a specialist in taxonomy and systematics of Chalcidoidea, including Eurytomidae.

Dr. Michael Gates, USDA-SEL (United States Department of Agriculture, Systematic Entomology Laboratory), a specialist in taxonomy and systematics of Chalcidoidea, including Eurytomidae.

VI. References

Heu, R. A., D. M. Tsuda, and W. T. Nagamine, J. A. Yalamar, and T. H. Suh. 2006. Erythrina gall wasp, *Quadrastichus erythrinae* Kim. Hawaii Department of Agriculture, New Pest Advisory 05-03. 2 pp.

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Rotar, P. P., R. J. Joy, and P. R. Weissich. 1986. "Tropic Coral" tall erythrina. Univ. Haw. CTAHR Res. Ext. Ser. 072.

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Yang, M. M., G. S. Tung, J. La Salle, and M. L. Wu. 2004. Outbreak of erythrina gall wasp on *Erythrina* spp. (Fabaceae) in Taiwan. Plant Prot. Bull. 46:391-396.

VII. Appendix

Appendix 1 – The five attached letters of correspondence were received during the 30-day public comment period for the release of *Eurytoma* sp. for the biological control of the erythrina gall wasp. Four commenters were supportive of the project and one required a response to address a question by the writer.



"Carol L Kwan"
<ckwan@hawaii.rr.com>
10/09/2007 02:13 PM

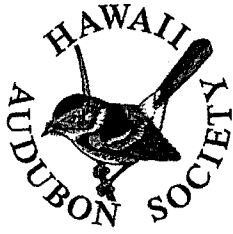
To <Neil.J.Reimer@hawaii.gov>
cc <Kenneth.K.Teramoto@hawaii.gov>
bcc
Subject Erythrina Gall Wasp Biocontrol (HRS 343 DEA)

Dr. Reimer,

I have reviewed the Draft EA for the Field Release of *Eurytoma* sp. and I support its release in Hawaii. Thank you and all of your staff for your hard work in finding a biological control for the Erythrina gall wasp.

Carol

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October 4, 2008

Dr. Neil J. Reimer
Manager
Plant Pest Control Branch
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1428 S. King Street
Honolulu, HI 96814-9522

Hawaii Audubon Society Public Comments

Re: Erythrina Gall Wasp Biocontrol Project

The Hawaii Audubon Society would proffer the following comments supporting the release of parasitic eurytoma wasp for control of the gall wasp infestation.

The primary mission of the Hawaii Audubon Society is to foster community values that result in the protection and restoration of native ecosystems and conservation of natural resources through education, science and advocacy in Hawaii and the Pacific. For the last several years the Society, with other conservation organizations, advocated for enhanced habitat protection for our endemic plants and wildlife, and also for more aggressive inspection efforts by the Hawaii Department of Agriculture to prevent the introduction of harmful invasive species.

We would note that the Hawaii Department of Agriculture has had a poor track record in preventing the introduction of harmful plants, animals and insects into Hawaii's unique and fragile ecosystems. At the same time the Society would applaud the Department for acting quickly and proactively with respect the current Erythrina Gall Wasp infestation.

The prospect of losing any native species is disheartening, but for the wasp to potentially kill off an entire population of native "wiliwili", the keystone species of the native low dryland forest and one of Hawaii's rarest habitats, is especially worrisome.

We have reviewed the department's draft plan and concur with its' findings. We believe that releasing the parasitic eurtoma wasp will offer the best environmentally-friendly and long term solution in controlling this harmful infestation. We also would note that this solution is in full accordance with the 2007 USDA's Wildlife Habitat Incentives Program (WHIP) Plan priorities for the State of Hawaii, which are to:

- Promote the restoration of declining or important native wildlife habitats.

- Protect, restore, develop or enhance wildlife habitat of at-risk species (candidate species, and state and federally-listed threatened and endangered species).
- Reduce the impacts of invasive species on wildlife habitats.

We also hope that this will serve as a wake-up call for the Department of Agriculture in general and the Plant Pest Control Branch in particular, that more attention needs to be spent in preventing invasive occurrences such as the Gall wasp, Pickleworm, Coqui frog, Asian citrus psyllid, Macadamia felted coccid, Glassywinged sharpshooter, the Micona, Fireweed, Banana Poka, and the Long thorn kiawe.

We appreciate the opportunity to submit comments on this important issue, and reiterate our support this critical biocontrol measure.

Respectfully submitted,

pp.



Elizabeth Kumable
President



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October 9, 2007

Dr. Neil J. Reimer, Manager
Plant Pest Control Branch
State of Hawaii Department of Agriculture
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Dr. Reimer:

Subject: Erythrina Gall Wasp Biocontrol (HRS 343 DEA)

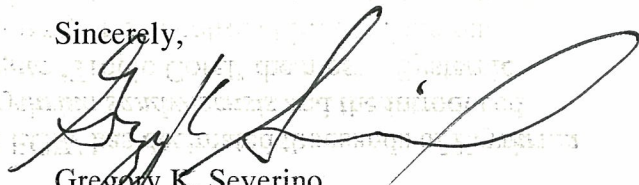
We have reviewed the Draft Environmental Assessment (EA) dated September 2007 titled "Field Release of *Eurytoma* sp. (Hymenoptera: Eurytomidae), for Biological Control of the Erythrina Gall Wasp, *Quadrastichus erythrinae* Kim (Hymenoptera: Eulophidae), in Hawaii". This letter is our written testimony in support of releasing the *Eurytoma* sp. for biological control of the Erythrina Gall Wasp (EGW) in Hawaii.

As discussed in the Draft EA, the EGW has decimated thousands of *Erythrina* trees in Hawaii, affecting the endemic *Erythrina sandwicensis* and the introduced *Erythrina variegata* and *Erythrina variegata* 'Tropic Coral' the most. Systemic chemical treatments have brought modest temporary control at best and are not economically feasible over the long term in landscapes. They are also logistically impractical in our native forests.

Your thorough testing in a controlled environment has demonstrated that the *Eurytoma* sp. targets only the EGW. As such, we are comfortable that it will not harm the environment if it is released in Hawaii.

We appreciate your diligence and efficiency in this matter. Having a biological control for the EGW in the foreseeable future is welcome news to Aloha Arborist Association and the entire green industry. Mahalo nui loa.

Sincerely,



Gregory K. Severino
President



"Liu, Randy"
<Randy.Liu@starwoodhotels.com>

10/10/2007 08:09 AM

To <Neil.J.Reimer@hawaii.gov>

cc

bcc

Subject comments on Erythrina Gall Wasp Biological control

Hi Neil, based on your writings, it looks like a good bet!

Thank You,

Randy Liu
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October 12, 2007

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OEQC FAX: 586-4186
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Honolulu, Hawai'i 96813

Subject: Erythrina Gall Wasp Biocontrol Draft Environmental Assessment

Dear Dr. Reimer:

I read the 8-page DEA and some questions still remain unanswered:

If the *Eurytoma sp.* eradicates the erythrina gall wasp (EGW), as you hope it will, then what? What will the *Eurytoma sp.* feed on after? In tests, the *Eurytoma sp.* attacks EGW eggs. Your DEA, however, does not specify what the *Eurytoma sp.* will likely attack should that particular food source disappear. Has there been a test done with the *Eurytoma sp.* without EGW eggs? What would it attack instead to survive? If these tests have not been done, is it possible to do them? These are questions I hope would be addressed before releasing any alien insect into our fragile environment.

Thank you for consideration of my comments.

Sincerely,



Audrey Tantamjarik

State of Hawaii
DEPARTMENT OF AGRICULTURE
Plant Pest Control Branch
1428 S. King Street
Honolulu, HI 96814

FACSIMILE TRANSMITTAL SHEET

TO:	Audrey Tantamjarik	FROM:	Neil Reimer
COMPANY:	PBR Hawaii	DATE:	10/12/2007
FAX NUMBER:	808-523-1402	TOTAL NO. OF PAGES INCLUDING COVER:	1
RE:			

URGENT FOR REVIEW PLEASE COMMENT PLEASE REPLY PLEASE RECYCLE

NOTES/COMMENTS:

Thanks for your comments on our DEA for EGW. To answer your questions, we do not expect the Eurytoma sp. to eradicate EGW. Biological control will not result in eradication but we do anticipate a severe reduction in EGW. The Eurytoma attacks the EGW larvae not the egg, just for clarification. We did extensive host specificity tests with Eurytoma against other gall forming insects in Hawaii and none were attacked by Eurytoma. These were no-choice tests meaning that the EGW was not presented to the natural enemy as a host in these experiments just the potential nontarget hosts. The Eurytoma did not attack and was not able to develop on any gall forming insect except EGW. These types of nontarget impact studies have been an essential part of our biocontrol introduction program since the mid 1970's. There has been no host switching or unanticipated attacks by introduced natural enemies on nontargets since these types of studies were implemented. If for some reason, EGW did become extinct in Hawaii then these introduced parasites would die out and become extinct because they are unable to develop on any other insects in Hawaii.

Again, I appreciate you taking the time to comment on this and will be happy to answer any questions you may have. You can reach me at Neil.J.Reimer@hawaii.gov or 973-9522.
