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EENY-676

# Balios Eulophid *Baeoentedon balios* Wang, Huang & Polaszek (Insecta: Hymenoptera: Eulophidae)[1]

Muhammad Z. Ahmed, Yisell Velazquez Hernandez, Antonio Francis, Gregory Evans, Eric Rohrig, Lance Osborne, and Catharine Mannion[2]

*The Featured Creatures collection provides in-depth profiles of insects, nematodes, arachnids and other organisms relevant to Florida. These profiles are intended for the use of interested laypersons with some knowledge of biology as well as academic audiences.*

## Introduction

Most parasitoids commonly used for biological control of whiteflies (Hemiptera: Aleyrodidae) belong to the chalcidoid family Aphelinidae. Whitefly parasitoids belonging to other families, such as those in the genus *Baeoentedon* (Hymenoptera: Eulophidae), are often ignored as potential biological control agents because there is little to no knowledge about their biology and behavior. Girault (1915) erected the genus *Baeoentedon* with a single species, *Baeoentedon peculicornis* Girault, from Australia. *Baeoentedon* was mistakenly presumed to be a parasitoid of true bugs, Psylloidea, and later suspected to be a parasitoid of whiteflies based on its clear relationship with other genera of Euderomphalini: Eulophidae (Lasalle and Schauff 1994). Wang et al. (2014) found three new species of *Baeoentedon* in China: *Baeoentedon balios*, *Baeoentedon bouceki,* and *Baeoentedon virgatus*. Among them, *Baeoentedon balios* was recorded from the whitefly, *Pealius spina*, a serious pest of *Ficus religiosa*, *Ficus arnotiana,* and *Ficus benghalensis*.

In our survey, we discovered the first known instance of *Baeoentedon balios* in the New World found in Homestead, Florida, in December 2014 attacking the ficus whitefly, *Singhiella simplex*, a pest of at least eleven species of ficus including *Ficus altissima*, *Ficus aurea*, *Ficus benghalensis*, *Ficus carica*, *Ficus benjamina*, *Ficus elastica*, *Ficus racemosa*, *Ficus pumila*, *Ficus lyrata*, *Ficus maclellandii*, and *Ficus microcarpa*. In Florida, *Ficus benjamina* appears to be the preferred host of ficus whitefly. Several ficus species are commonly grown in the southern Florida landscape creating thousands of miles of *Ficus benjamina* hedges and trees. *Ficus benjamina* is a favored hedge plant species for numerous reasons such as low cost, fast growth, and ability to withstand heavy pruning to form various shapes including privacy walls. The trend of using ficus hedges in Florida began at least 90 years ago and has since become extremely popular (Gordon and Thomas 1997, FNGLA 2000). This changed in 2007 when ficus whitefly, *Singhiella simplex*, arrived in Florida and became a major problem in landscapes (Avery et al. 2011, Hodges 2007, Legaspi et al. 2013, Mannion 2010a, Mannion 2010b).

If no control applications are applied, the ficus whitefly can cause severe defoliation. In some cases, branch dieback and ultimately plant death may occur (Mannion 2010a,

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2. Muhammad Z. Ahmed, post doctoral associate, Department of Entomology and Nematology, UF/IFAS Tropical Research and Education Center; Yisell Velazquez Hernandez, Department of Entomology and Nematology, UF/IFAS TREC; Antonio Francis, Florida Department of Agriculture and Consumer Services, Division of Plant Industry; Gregory Evans, Animal and Plant Health Inspection Service, USDA; Eric Rohrig, Florida Department of Agriculture and Consumer Services, Division of Plant Industry; Lance Osborne, professor, Department of Entomology and Nematology, UF/IFAS Mid-Florida REC; and Catharine Mannion, professor, Department of Entomology and Nematology, UF/IFAS TREC; UF/IFAS Extension, Gainesville, FL 32611.

Mannion 2010b). Numerous natural enemies including parasitoids, have been reported attacking ficus whitefly populations, but none are sufficient to stop or mitigate severe damage. In our 2014–2016 survey, we found at least three parasitoids in Florida attacking ficus whitefly, including *Amitus bennetti*, *Baeoentedon balios,* and *Encarsia protransvena* (Figure 1). Two of these species have been reported in previous surveys (2007–2013) conducted at various times and locations with *Encaris protransvena* being the most prevalent (Mannion 2010a). Recent surveys suggest that *Baeoentedon balios* has been self-distributing over the last two years and becoming the most consistent and dominant parasitoid attacking ficus whitefly in southern Florida (Figure 2).


Figure 1. Parasitoids of ficus whitefly. (a) *Amitus bennetti*; (b) *Baeoentedon balios* Wang, Huang & Polaszek; (c) *Encarsia protransvena*.
Credits: Muhammad Z. Ahmed, UF/IFAS


Figure 2. Ficus whitefly nymphs parasitized by *Baeoentedon balios* Wang, Huang & Polaszek. (a) Underside; (b) Upper side of leaves of *Ficus benjamina*.
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## Distribution

*Baeoentedon balios* has been reported in two countries (the US and China). It was first reported from China in Xiamen, Fujian province in 2014 (Wang et al. 2014). In the US, it has only been found in Florida. Weekly surveys were performed in four counties of south Florida (Broward, Miami-Dade, Monroe, and Palm Beach) in 2015 and 2016 to study the distribution of *Baeoentedon balios* (Figure 3). Only those locations where ficus hedges were not treated with insecticides were surveyed. The surveys indicated that most of these locations were infested with ficus whitefly. Parasitoids were also present in most of these locations (Figure 3). Among the various parasitoid species, the new parasitoid *Baeoentedon balios* was dominant compared to the other reported parasitoids, *Amitus bennetti* and *Encarsia protransvena*.

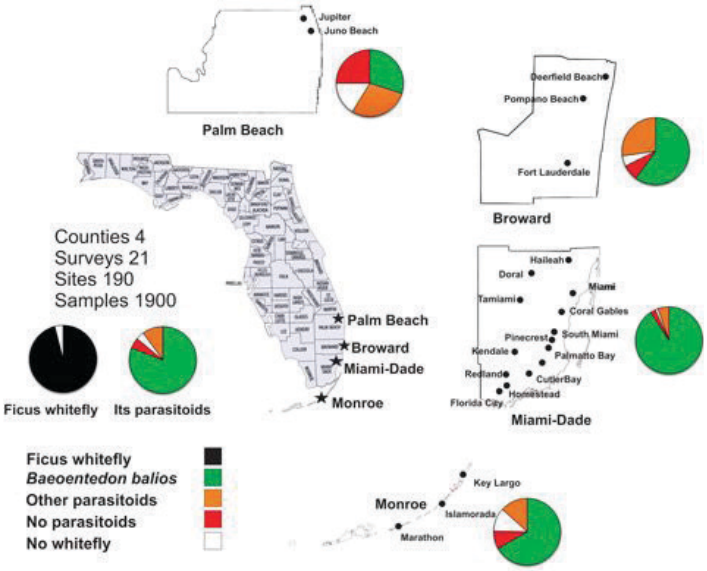


Figure 3. Distribution of *Baeoentedon balios* Wang, Huang & Polaszek, a parasitoid of ficus whitefly, in four counties of Florida based on our surveys from 2015–2016.
Credits: Muhammad Z. Ahmed, UF/IFAS

## Description and Biology

*Baeoentedon balios* develops through six life stages: egg, three nymphal instars, a pupal-like stage, and adult. Adults have a body length of about 0.9 mm (~1/32 in), with the head and thorax color metallic blue-black, and the abdomen mostly pale yellow. The antennae have a mostly white scape and the legs are pale yellow. Figures of male and female adults of this parasitoid and of another ficus whitefly parasitoid, *Amitus bennetti*, are presented to differentiate between them (Figures 4 and 5); videos of nymphs being parasitized by these parasitoid species are also provided (Video 1–7).

Biological studies of the life history (egg to adult) of *Baeoentedon balios* were conducted at the UF/IFAS Tropical Research and Education Center in Homestead. The development time is approximately 19–24 days at room temperature (25±1°C (77±33.8°F), 65±5% RH, 12:12 L:D). *Baeoentedon balios* development in a whitefly is depicted in Figure 6. Maximum observed female longevity was 28 days, and adult survival of both males and females

after emergence was more than 50%. These characters suggest that *Baeoentedon balios* could be a potentially effective biological control agent of ficus whitefly.

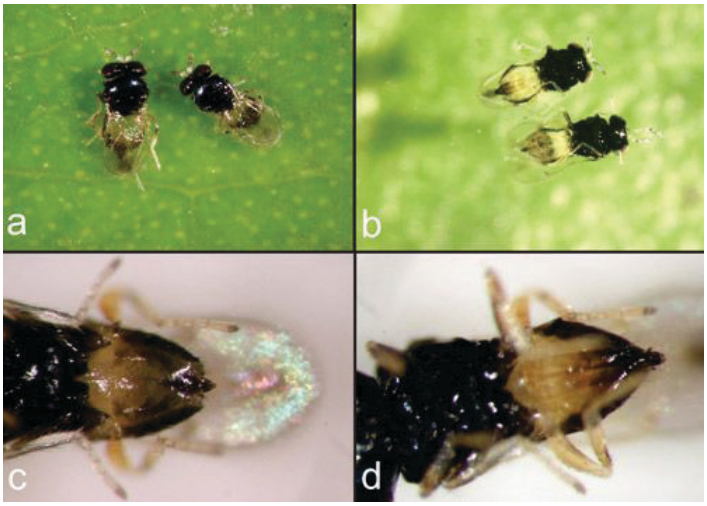


Figure 4. Male and female of the parasitoid *Baeoentedon balios* Wang, Huang & Polaszek. (a) Dorsal side; (b) Ventral side female on left and male on right; (c) Male genitalia; (d) Female genitalia.
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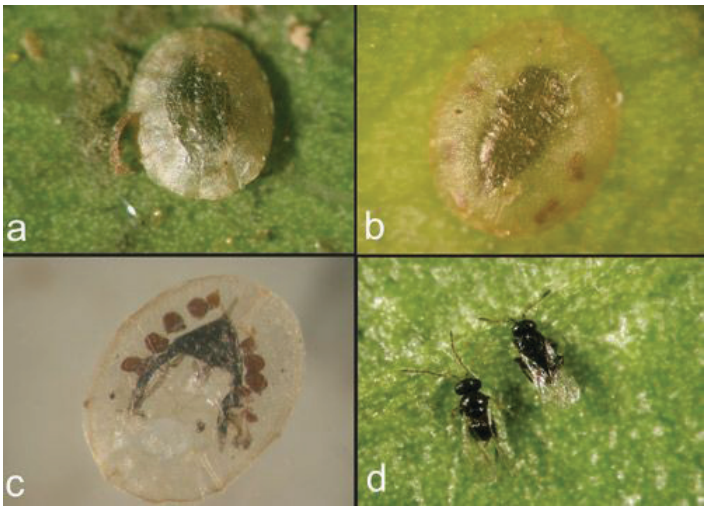


Figure 5. Nymphs of ficus whitefly parasitized by *Amitus bennetti*. (a–b) Parasitized ficus whitefly nymphs; (c) Pupal exuvia after emergence of *Amitus bennetti*; (d) The dorsal view of an adult male (on right side) and female (on left side) of *Amitus bennetti*.
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## Parasitism Potential

*Baeoentedon balios* can parasitize the first through the third instars of the ficus whitefly. Approximately 2% (3 out of 60) of ficus whiteflies were parasitized during the first instar, 16% (10 out of 60) during the second, and 12% (7 out of 60) during third, suggesting that *Baeoentedon balios* exhibits a preference for the second instar (Figure 7, Videos 1–3). In addition, many of the non-parasitized whitefly nymphs died after being probed and/or fed on by parasitoid adults.

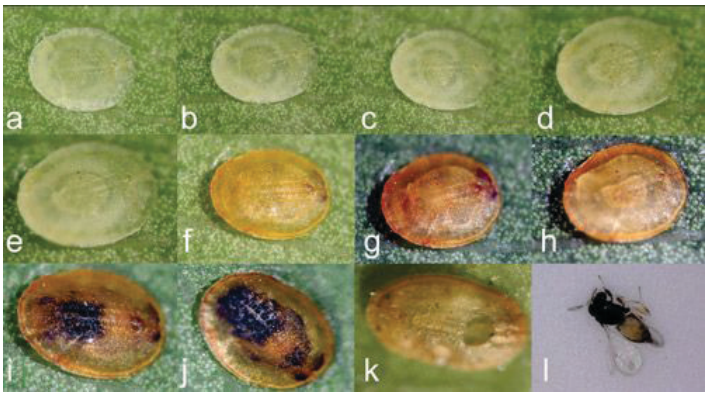


Figure 6. Development of second instar nymphs of ficus whitefly after being parasitized by *Baeoentedon balios*. (a–e) Larval stages; (f–h) Pre-pupation stage; (i–j) Pupal stage; (k) Exit hole after adult parasitoid emerged; (l) Female adult of *Baeoentedon balios* Wang, Huang & Polaszek
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Mortality rates were 76% (46 out of 60) for first instar nymphs, 46% (28 out of 60) for second instar, and 36% (22 out of 60) for third instar. This evidence suggests that *Baeoentedon balios* can control ficus whitefly nymph populations by killing them during the process of feeding, probing, and parasitizing.

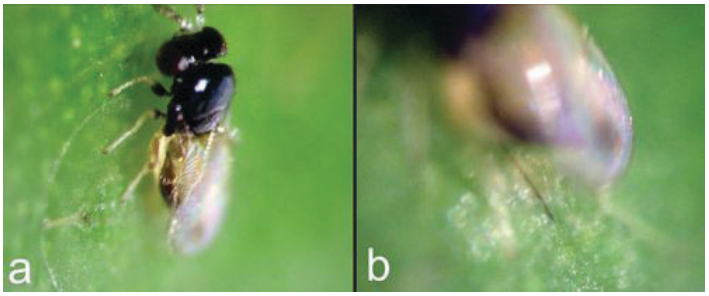


Figure 7. *Baeoentedon balios* Wang, Huang & Polaszek, a parasitoid, parasitizing a ficus whitefly nymph. (a) Parasitoid inserting its ovipositor in the dorsal thorax of the second instar; (b) Close-up of Figure 7a, showing inserted ovipositor.
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## Parasitism Symptoms

- tiny pinhole marks on middle right side of whitefly nymphs
- whitefly nymphs turn dark yellow
- parasitoid body, including a dark head, thorax, and brown abdomen, appear inside the whitefly nymph
- round exit hole in whitefly nymph from which adult parasitoid has emerged

**Videos 1–7.** Parasitoids on ficus whitefly nymphs. Video 1 and Video 2: *Baeoentedon balios* parasitizing the first instar. Video 3: *Baeoentedon balios* feeding and probing the second instar. Video 4: *Amitus bennetti* attempting to

parasitize the eggs and first instar nymph. Video 5: *Amitus bennetti* parasitizing the first instar. Video 6: *Amitus bennetti* parasitizing the second instar. Video 7: *Amitus bennetti* parasitizing the third instar. Videos by Muhammad Z. Ahmed and Mauricio Jose, UF/IFAS.

## Hyperparasitism

We also found a male specimen of a hyperparasitoid, *Encarsia variegata* (Hymenoptera: Aphelinidae), parasitizing ficus whitefly nymphs that had already been parasitized by *Baeoentedon balios*. This male was found at a site where *Encarsia variegata* females, which are primary parasitoids, were also found parasitizing another whitefly species, the solanum or pepper whitefly, *Aleurotrachelus trachoides*, which feeds on Duranta hedges (Figure 8).

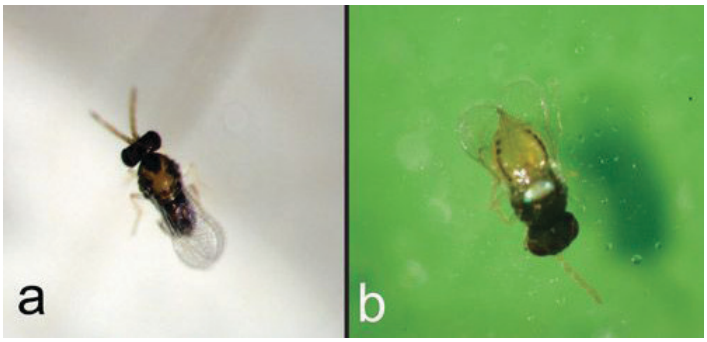


Figure 8. *Encarsia variegata*, a hyperparasitoid of *Baeoentedon balios* Wang, Huang & Polaszek. (a) Male; (b) Female.
Credits: Muhammad Z. Ahmed and Yisell Velazquez Hernandez, UF/IFAS

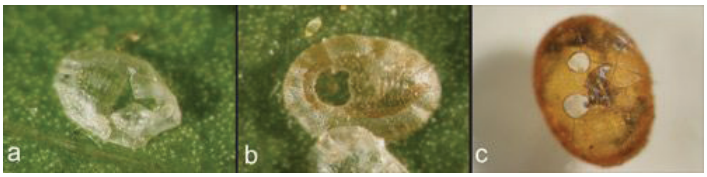


Figure 9. Pupal exuvia of whitefly and parasitoid adults. (a) The T-shaped emergence hole indicates it is the pupal exuvia of whitefly adult; (b) The circular emergence hole indicates it is the pupal exuvia of parasitoids; (c) Multiple circular holes indicate multiple emergences of either parasitoids or hyperparasitoids.
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Figure 10. The developmental stage of *Baeoentedon balios* Wang, Huang & Polaszek. (a) The hyperparasitized larva of *Baeoentedon balios* within a ficus whitefly nymph; (b) The dead pupal stage of *Baeoentedon balios* within a ficus whitefly nymph; (c) Pupal exuvia of *Baeoentedon balios*.
Credits: Muhammad Z. Ahmed and Yisell Velazquez Hernandez, UF/IFAS

## Hosts

Whiteflies are considered the primary hosts of *Baeoentedon balios*. Thus far, it has only been observed parasitizing two ficus whitefly species, *Singhiella simplex* and *Pealius spina*.

## Maintaining Populations in the Field

Although adult *Baeoentedon balios* can fly or be carried by wind and spread over small distances, the primary mode of distribution is likely through the movement of ficus plants with parasitized ficus whitefly nymphs. In most of our surveys of sprayed hedges, we often found populations of this parasitoid at the edges where pesticide application may have been less thorough. In greenhouse experiments, populations of ficus whitefly remained low in the presence of *Baeoentedon balios*. In one survey, we observed differences in the level of defoliation (visual observation of leaves) on hedges planted opposite to each other at the same site. The hedge with less defoliation contained a higher number of natural enemies, including this new parasitoid, compared to the hedge with more defoliation (Figure 11). Both hedges were infested with ficus whitefly and were likely treated similarly because they were maintained by the same landscaper. It was noted that the hedge with more natural enemies and less defoliation was in closer proximity to a papaya grove and other ornamental plants, and the hedge with more defoliation was closer to an open, grassy area. It is possible that other plants might provide a refuge for natural enemies and potentially contributed to the increased activity on the hedge with less defoliation.

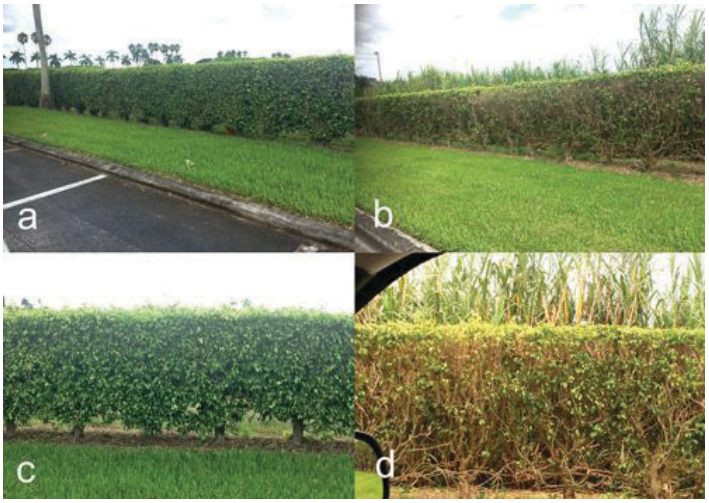


Figure 11. *Ficus benjamina* hedges in ornamental landscape at a Florida Keys outlet center, Florida City, Florida. (a–b) Hedges on both sides of the road with a distance of approximately 50 feet between them showing levels of defoliation; (c–d) Close-up of hedges in figures 10a–b.
Credits: Muhammad Z. Ahmed, UF/IFAS

Careful monitoring for natural enemies is essential before any heavy pruning or pesticide applications. Natural enemies, including parasitoids, may encounter pesticides directly from foliar sprays or residues on plant surfaces but also may be exposed indirectly through ingestion of, or exposure to, pesticide-treated hosts. Insecticides can be severely detrimental to parasitoids. Therefore, the presence of untreated refuge such as banker plants/crops allows natural enemies to escape pesticide exposure and may be helpful to their establishment and persistence (Smith and Liburd 2015). Insecticide applications can also be manipulated by adjusting timing, placement or method to minimize exposure to parasitoids.

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