Journal of the American Mosquito Control Association, 20(1):91–93, 2004

SCIENTIFIC NOTE

THE ENDANGERED ILLIDGE'S ANT BLUE BUTTERFLY (*ACRODIPSAS ILLIDGEI*) FROM AN INTERTIDAL HABITAT MANAGED FOR MOSQUITO CONTROL

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ABSTRACT. *Acrodipsas illidgei* is an endangered butterfly inhabiting mangrove forests in southeastern Queensland, Australia. Concern over the effects of mosquito control activities prompted a broad-scale survey for the species at Coomera Island, in southeastern Queensland. The butterfly was recorded on the edge of an old-growth mangrove forest in close proximity to mosquito control runnels. Other forms of mosquito control at Coomera Island are unlikely to impact on the species because of the mode of action of larvicides used and the fact larvae occur within ant colonies formed in hollow stems and branches of mangrove trees. Further studies are required to more fully understand the relationships between mosquito control activities and the population dynamics of endangered species such as *A. illidgei.*

KEY WORDS Butterfly, Queensland, mangrove, mosquito control

Environmental concern regarding the effects of some mosquito control techniques on threatened species has prompted debate at local, state, national, and international forums. Of particular concern in Australia has been the unsubstantiated nontarget threat to endangered species such as Illidge's ant blue butterfly (*Acrodipsas illidgei* (Waterhouse and Lyell)) from mosquito control activities in mangrove and adjacent salt-marsh habitats (Beale 1995, Sands and New 2002).

Acrodipsas illidgei is listed as endangered under Queensland legislation (QPWS 1994) and is recognized internationally as an endangered species by the International Union for the Conservation of Nature (IUCN 2000). Additionally, activities that may affect nationally recognized endangered species invoke the application of the Commonwealth Environmental Protection and Biodiversity Conservation Act (1999). Recently, Sands and New (2002) reviewed the IUCN listings and suggested the formulation of a recovery plan to delist the species to a level commensurate with the habitat quality of its known populations and levels of protection afforded to those habitats, one of which is Coomera Island in southeastern Queensland, Australia.

Larvae of *A. illidgei* live within ant colonies formed in hollow stems and branches of vegetation, including the grey mangrove (*Avicennia marina* (Forssk.) Vierh.) (Braby 2000). Larvae are myrmecophilous and feed on juvenile ants until eclosion, when adults emerge and seek partners. Adults are thought to be active for only a few days and have rarely been observed in the wild because of naturally low population numbers, the small size of adults, and flight activity (Braby 2000).

The aim of this paper is to discuss the habitat of *A. illidgei* at Coomera Island, an important mosquito-breeding site that has experienced mosquito control operations to reduce pest numbers for the past 18 years.

Coomera Island (27.85°S, 153.38°E) is a 268-ha area located in the Southern Moreton Bay Marine Park and was declared a Conservation Park in 1994. Coomera Island supports extensive areas of mangrove and salt marsh and is flooded by the highest spring high tides, exceeding 2.45 m. Dominant mangrove species include grey mangrove and river mangrove (*Aegiceras corniculatum* (L.) Blanco.) with salt-marsh species including marine couch (*Sporobolus virginicus* (L.) Kunth.) and beaded glasswort (*Sarcocornia quinqueflora* (Bunge ex Ung.-Sternb.) A. J. Scott). Mangrove tends to form a dominant community on the lowest regions of the shore and is flooded regularly, whereas salt marsh occurs higher on the shore at sites less frequently inundated.

The island has experienced a range of human influences, including cattle grazing, dredging outfall, and army training, and is currently managed for mosquito control to reduce breeding of the human viral-transmitting species *Ochlerotatus vigilax* (Skuse). One method of mosquito control employed on the island to target mosquito larvae is runnelling. Runnelling involves the construction of shallow (<30-cm-deep) channels that allow regular tidal access to isolated mosquito-breeding pools in the salt marsh. The mosquito larvae are flushed from the salt marsh by tides and exposed to higher levels of predator pressure by fish and other organisms (Hulsman et al. 1989). Runnels are known to have some impacts on the surrounding

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ecosystem, including aiding transport of mangrove seeds to areas where they would not normally be deposited (Breitfuss et al. 2003) and influencing the distribution of some nontarget invertebrates (Chapman et al. 1998, Breitfuss 2001). In 1985, a small area of approximately 0.5 ha was runnelled for mosquito control at a salt-marsh site identified as the major breeding area for *Oc. vigilax* on the island (Hulsman et al. 1989). Although the area modified was small, it was close to mangrove habitat relevant to the butterfly—a large (approximately 5-ha) stand of mature *A. marina.* The remaining salt marsh not runnelled has historically been treated with ground and aerial applications of the larvicides *Bacillus thuringiensis* var *israelensis* (*Bti*; Vectobac®), (*S*)-methoprene (Altosand®), and Temephos (Abate®). More recently, use of Temephos has been discontinued.

To address issues relating to potential impacts from runnelling and larvicides on the endangered *A. illidgei,* a broad-scale survey of mangrove sites was conducted. Initially, mangrove sites were categorized in terms of age and size, with the largest old-growth sites being separated from smaller, younger habitats (age was determined by plant height and trunk diameter characteristics). Sampling, with a standard butterfly net, was opportunistic and was conducted between 0900 and 1500 h on clear, sunny, and generally windless days.

On September 9, 1999, a single female *A. illidgei* was collected from the exposed edge of an old-growth habitat directly adjoining and 400 m from the runnelled salt marsh (the specimen is deposited at the Queensland Museum). Subsequent surveys revealed no further adults; however, 1 month after the initial discovery of the adult female, 2 larvae of the butterfly were found in the nest of *Crematogaster* Lund (*laeviceps* group) ants (these ants tend the butterfly larvae) from the same mangrove tree from which the adult female was collected. Ant surveys were conducted opportunistically because the species is conspicuous on the trunk of inhabited mangroves. No *A. illidgei* were observed in any of the younger mangrove areas surveyed.

A number of other butterflies also were recorded from the mangrove edge, including the saltpan blue (*Theclinesthes sulpitius* (Miskin)), Miskin's blue (*Theclinesthes miskini* (T. P. Lucas)), the common grass-blue (*Zizina labradus* (Godart)), and the copper jewel (*Hypochrysops apelles apelles* (Fabricus)). The 1st 3 species breed in salt marsh but utilize mangroves for nutrition and mating sites, whereas the latter species is associated with mangroves for breeding.

Modern mosquito control programs aim to deliver effective and relatively low-impact operational and technical options. In Australia, organizations such as the Mosquito and Arbovirus Research Committee (Inc.) investigate current control options and provide unbiased recommendations for alternative approaches that offer the highest standards of control and environmental consideration.

The use of physical methods of control, such as runnelling, would be highly unlikely to result in degradation of identified butterfly breeding habitats. Runnelling can promote extension of mangroves into areas of salt marsh where they previously have been restricted and this is the case at the runnelled area on Coomera Island (Breitfuss et al. 2003). However, natural disasters and threatening processes may ultimately compromise butterfly breeding habitats and recovery programs (Sands and New 2002).

Yanno (1996) referred to a number of threatening processes affecting the Schaus swallowtail butterfly (*Papilio aristodemus ponceanus*) in southern Florida tropical hardwood forests. In an effort to preserve remaining breeding sites, the Monroe County Mosquito Control District discontinued use of aerial and ground application of mosquito insecticides (not stated whether they are larvicides or adulticides) and a concerted effort to release captive-bred pupae and adults was initiated. However, high predation on the 1st installment of pupae by a flock of neotropical migratory birds (Yanno 1996) highlights the fact that natural phenomena also can constrain recovery efforts.

In the case of *A. illidgei,* the current use of aerially applied larvicides (such as microbials and larval growth regulators [LGRs]) are unlikely to impact the breeding habitat of the butterfly. First, because the butterfly larvae occur in ant colonies formed in hollow stems and branches, they would rarely be exposed to larvicides; and, 2nd, microbials such as *Bti* and LGRs such as (*S*)-methoprene have a low toxicity to nontarget organisms when applied at label rates (Brown et al. 1999, Lawler et al. 1999, Boisvert and Boisvert 2000, Brown et al. 2000).

Although environmental concerns associated with ungoverned use of broad-scale pesticides are valid, no information has been published to relate current mosquito control operations with deleterious impacts on threatened butterflies in Australia. This preliminary study provides evidence for broader investigations into the relationships between operational and ecological aspects of mosquito control and their impacts on significant nontarget species. Specifically, quantified collections of adult and immature *A. illidgei* (and its ant host) will be necessary to more fully understand the threatening processes impacting this species on Coomera Island, and if any mosquito control activity is associated with changes in the population dynamics of the species.

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