

# Timing of Adult Emergence and Flight Period of *Rhyssa howdenorum* (Hymenoptera: Ichneumonidae), a Parasitoid of *Sirex nigricornis* (Hymenoptera: Siricidae), in Central Louisiana<sup>1</sup>

James R. Meeker<sup>2</sup>, C. Wood Johnson, Chris A. Steiner, William W. Bruce, and Kamal J. K. Gandhi<sup>3</sup>

Alexandria Field Office, Forest Health Protection, USDA Forest Service, 2500 Shreveport Highway, Pineville, Louisiana 71360 USA

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Following the 2004 detection and subsequent spread of *Sirex noctilio* F. (Hymenoptera: Siricidae) in North America, increased attention has been given to furthering our limited understanding of native *Sirex* spp. and their associated fungal symbionts and natural enemies (Long et al. 2009, Can. Entomol. 141: 153 - 157). *Sirex noctilio*, a woodboring wasp (woodwasp), is considered a relatively innocuous insect of pines (*Pinus* spp.) in its native range (Asia, Europe and North Africa). However, where previously introduced in many areas of the Southern Hemisphere, *S. noctilio* is noted for its tree-killing ability and is recognized as a worldwide invasive pest of pines (Ciesla 2003, J. For. 101: 18 - 23). The insect has a wide host range, and many North American pines have been demonstrated to be susceptible hosts (Schiff et al. 2012, Can. J. Arthro. Ident. No. 21. 305 p.). To date, the tree-killing impacts of *S. noctilio* in northeastern North America have been limited compared with the outbreaks and widespread tree mortality events in the Southern Hemisphere, though nearly 20% stem mortality has occurred in places in the Northeast, with mortality occurring predominantly on suppressed, damaged, or debilitated trees (Dodds et al. 2010, Can. J. For. Res. 40: 212 - 223). Due to the existing uncertainties and concern about how *S. noctilio* might perform in North America in the future (Ryan et al. 2012, Agric. For. Entomol. 14: 187 - 195), especially if or when it encounters the vast pine forests of the southeastern U.S., studying the native pine siricids and their communities of associated organisms can reduce knowledge gaps about *Sirex* in general, and help determine consequences of its introduction or invasion. A better understanding of the ecology of native siricids and their natural enemies may also provide tactics and tools for management of *S. noctilio*

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<sup>2</sup>Corresponding author (email: jrmeeker@fs.fed.us).

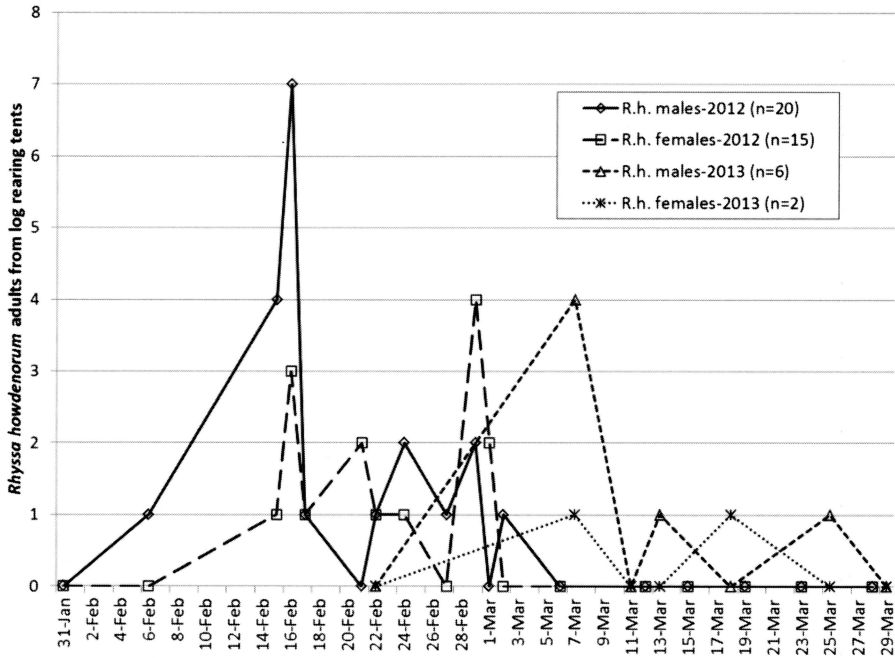
<sup>3</sup>Daniel B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia 30602.

in the future, in North America and elsewhere (Coyle and Gandhi 2012, Environ. Entomol. 41: 731 - 739).

Since 2005 we have been conducting annual investigations of the native wood-wasp, *Sirex nigricornis* F., in Central Louisiana, predominately from September into January, overlapping with the adult flight season from October into December (Johnson et al. 2013 J. Entomol. Sci. 48: 173 - 183). Over the course of the first 7 yrs of study, we never observed any of the ichneumonid parasitoids of *S. nigricornis* reported to occur in the eastern U.S. (Coyle and Gandhi 2012, Environ. Entomol. 41: 731 - 739). In an attempt to identify other potential parasitoids of *S. nigricornis* other than the frequently encountered *Ibalia leucospoides ensiger* Norton (Hymenoptera: Ibalidae), we altered our trap tree rearing protocol for the 2011 - 2012 and 2012 - 2013 *Sirex* emergence period. Instead of dismantling rearing tents and discarding logs weeks after woodwasp and *I. I. ensiger* emergence had terminated (i.e., January), we kept and monitored rearing tents into the following spring and summer. Our objective was to determine if other hymenopteran parasitoids of *S. nigricornis* occurred in Central Louisiana and, if so, the phenology of the free-living adults.

Rearing material was created in the fall of 2010 and 2011 from 8 healthy and uninfested loblolly pine (*Pinus taeda* L.) trees located on the Catahoula Ranger District of the Kisatchie National Forest, Grant Parish, LA. Trees were felled, bucked, and stacked adjacent to residual top material, beginning shortly after the native *S. nigricornis* flight season began and prior to peak flight activity in November, as described in detail elsewhere (Haavik et al. 2013, Entomol. Exp. Appl. 149:177 - 184). Following oviposition by wild *S. nigricornis* females attracted to trap logs, these log stacks were left in place in the forest until September of the following year (prior to *Sirex* emergence). Then the logs were placed inside screened rearing tents located under an open-sided pole barn at the Catahoula Work Center, Kisatchie National Forest, Grant Parish, LA. As in previous years, all *S. nigricornis* and associated insects, such as *I. I. ensiger*, were then periodically collected, identified, sexed, and counted from the 8 rearing tents, each containing all the trap tree bole sections from a single tree.

Beginning on 6 February 2012, a live adult male *Rhyssa howdenorum* (Townes) was collected from 1 of the rearing tents. Shortly thereafter other adult male and female specimens emerged (Fig. 1). Although previously reported from elsewhere in the southeastern U.S. (Kirk 1974, J. Georgia Entomol. Sci. 9: 139 - 144; Porter 2001, Insecta Mundi 15: 129 - 137), our collections of *R. howdenorum* are a new state record for Louisiana. The late winter to early spring tent rearing results from logs (from which *S. nigricornis*, *I. I. ensiger*, and other insects had emerged from the previous year), yielded a total of 35 adult *R. howdenorum* (20 males and 15 females). No *R. howdenorum* emerged from the 4 trap trees created on the early felling date (22 October 2010). However, 3 of the 4 trap trees created on 5 November 2010 (all of which produced from 60 - 115 *S. nigricornis* each) produced both male and female *R. howdenorum* adults (with totals of 6, 15, and 14 specimens per tree). Interestingly, a single adult female specimen of *Rhyssa lineolata* (Kirby) was recovered on 1 March 2012 from the same tree that generated 14 *R. howdenorum*. Furthermore, of the 3 trees which produced *R. howdenorum*, 2 failed to produce any *I. I. ensiger*, one of which also yielded the lone *R. lineolata*. All *R. howdenorum* were collected between 6 February and 2 March 2012 (Fig. 1). These are the earliest recorded collection dates for the species, which elsewhere has been collected from late April into August, with most collections occurring in June (Porter 2001; Townes and Townes 1960, U.S. Natl. Mus. Bull. 216: 1 - 676). Because the rearing environment was artificial (i.e., logs protected

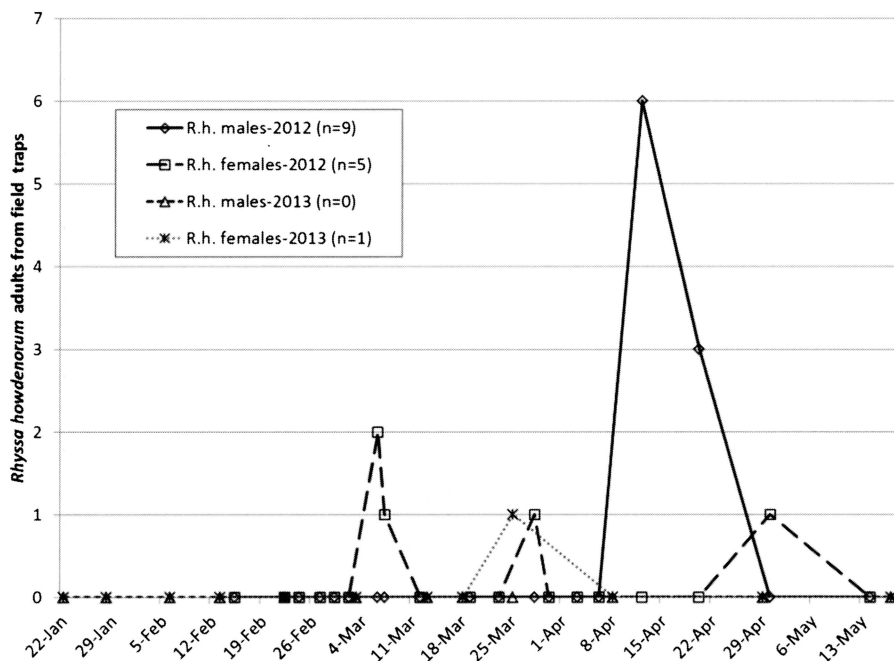


**Fig. 1. Emergence patterns of *Rhyssa howdenorum* in 2012 ( $n = 35$ ) and 2013 ( $n = 8$ ), from *Sirex nigricornis* infested loblolly pine logs placed in outdoor rearing tents at the Catahoula Work Center, Catahoula Ranger District, Kisatchie National Forest, in Central Louisiana.**

from direct sun and rain  $\geq 5$  months prior to emergence of *R. howdenorum*), it was speculated that the emergence from logs in tents preceded the natural flight period of wild populations in the area, as it had for *Sirex* and *Ibalia*.

Thus, following initial collections of *R. howdenorum* from logs in rearing tents, 8 unbaited 8-unit Lindgren funnel traps were installed on 8 February 2012, immediately above *Sirex* trap tree log decks in the forest (which were created during the fall of 2011 and on which *S. nigricornis* had been observed ovipositing). On 6 March 2012, 2 female *R. howdenorum* were initially captured in separate traps. Subsequently, a total of 14 *R. howdenorum* (5 females and 9 males) were eventually collected from 5 of the 8 traps, ranging from 1 - 7 specimens per trap location. Field collection of the natural population occurred sporadically from the first week in March through late April, with a peak collection of 6 males occurring on 12 April 2012 (Fig. 2). *Rhyssa howdenorum* females were also observed flying around trap tree log stacks on 7 and 23 March, with apparent oviposition into a *Sirex*-infested log noted on the latter date. The vast majority of field collections from the wild population similarly predate any previously published collection records of *R. howdenorum* in the U.S.

Given the discovery of *R. howdenorum* in Central Louisiana in 2012, the procedures were repeated again in 2013 to add to initial findings. Rearing material from 8 trap trees was created (as before) in the fall of 2011 and was brought into rearing tents on 14 September 2012. Following emergence of all *S. nigricornis* and *I. l. ensiger*



**Fig. 2. Collections of *Rhyssa howdenorum* in 2012 ( $n = 14$ ) and 2013 ( $n = 1$ ), from 8 Lindgren funnel traps installed over trap tree log decks presumably infested with *Sirex nigricornis*, on the Catahoula Ranger District Kisatchie National Forest, in Central Louisiana.**

over the remainder of 2012, *R. howdenorum* was first collected from 3 of the rearing tents (i.e., 3 of the 8 trap trees) on 7 March 2013 (1 male, 3 males, and 1 female respectively), an entire month later than in 2012 and days after the end of the emergence period the year prior. Emergence may have been delayed in 2013 relative to 2012 due to the colder start to the year in 2013, when average daily temperatures from 1 January to 7 March averaged nearly 2°C cooler in 2013. Over the remainder of March, only 3 more specimens were collected, all from 2 of the previous 3 positive trees, with the final specimen of the season collected on 25 March 2013 (Fig. 1). All 3 of the trees which produced *R. howdenorum* in 2013 also produced much more abundant collections of *I. l. ensiger* (i.e., 22, 19 and 27 specimens per tree). One of the few trees which produced *R. howdenorum* in 2013 was one on which a wild female *R. howdenorum* was observed ovipositing in the field on 23 March 2012. *Rhyssa howdenorum* also emerged from trap tree log decks originally created on 2 separate dates, 21 (2 trees) and 28 (1 tree) October 2011. Field trapping of 5 females and 9 males at the above rearing material in 2012 may have contributed in part to the reduced numbers of *R. howdenorum* retrieved from rearing material in 2013, as compared with those of 2012 (8 versus 35 specimens).

Field trapping in 2013 was initiated on 22 January 2013, as before, where blank funnel traps were placed immediately above trap tree log decks created in the fall of

2012. Traps were collected and serviced weekly through June; however, only a single *R. howdenorum* was collected in 2013 on 25 March (Fig. 2). This single wild specimen was collected at the approximate midpoint of the flight period observed the year prior.

Over the course of 2 years (2012, 2013), we collected 59 specimens of *R. howdenorum* (35 males and 23 females) in Central Louisiana (43 from rearing *Sirex* material and 16 from field trapping). Adults were recovered as early as the first week of February (from rearing material) and as late as the end of April, with the natural flight period appearing to occur during the spring, from the beginning of March through April. Although collected from the southeastern U.S. for introduction into Australia as a potential biocontrol agent against *S. noctilio* (Kirk 1974), *R. howdenorum* evidently has not been released into the Southern Hemisphere (Hurley et al. 2007, Agric. For. Entomol. 9: 159 - 171). Similarly, *R. howdenorum* is not mentioned among the array of parasitoids that have been or may be used in the management of *S. noctilio* (Cameron 2012, Pg. 103 - 117 *In The Sirex Woodwasp and its Fungal Symbiont: Research and Management of a World-wide Invasive Pest*, Slippers et al. (eds.), Springer Science+Business Media B.V.). Yet, in this study parasitism of *S. nigricornis* by *R. howdenorum* itself ranged from a low of 4% to as high as 19% per tree. In addition, the timing of adult flight and female oviposition of *R. howdenorum* in the early spring, only 3 - 6 months after oviposition by *S. nigricornis* the previous fall (and following the colder winter months of the year), suggests that *R. howdenorum* is more likely a parasitoid of early to mid-instar *S. nigricornis* in Central Louisiana, and not one of later, larger woodwasp larvae and pupae, as has been noted for other rhyssine parasitoids of *Sirex* spp. (Murphy 1998 Pg. 31 - 35 *In Proc. Conference: Training in the Control of Sirex noctilio by the Use of Natural Enemies*. U.S.D.A For. Ser. FHTET-98 - 13; Spradbery 1970, Anim. Behav. 18: 103 - 114). Given the findings above, *R. howdenorum* may be one of the natural enemies of *S. nigricornis* that may help regulate *S. noctilio* populations should it arrive in the Southeast, and may warrant further consideration for use against *S. noctilio* in the Southern Hemisphere in the future.

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