

**FIRST HOST RECORDS FOR THE  
NEARCTIC SPECIES *TRIRAPHIS DISCOIDEUS*  
(HYMENOPTERA: BRACONIDAE: ROGADINAE)<sup>1</sup>**

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**ABSTRACT:** Limacodid larvae were collected from 2004 – 2007 on leaves of the following host plants in the District of Columbia and Maryland: *Carya glabra*, pignut hickory; *Quercus alba*, white oak; *Quercus rubra*, northern red oak; *Nyssa sylvatica*, black gum; *Prunus serotina*, black cherry; and *Fagus grandifolia*, American beech. Field-collected larvae were brought to the laboratory where they were kept in isolation for the purpose of rearing parasitoids. The rogadine braconid *Triraphis discoideus* (Cresson) was reared from the following host-host plant combinations: *Acharia stimulea* (Clemens), *Adoneta spinuloides* (Herrich-Schäffer), *Lithacodes fasciola* (Herrich-Schäffer), and *Parasa chloris* (Moore) on red oak; *Euclea delphini* (Boisduval) on black gum and red oak; *Isa textula* (Herrich-Schäffer) on American beech, red oak, and white oak; *Natada nasoni* (Grote) on American beech, black gum, red oak, and white oak; *Prolimacodes badia* Hübner on black cherry and red oak; and an undetermined species of *Tortricidia* Packard on American beech. Host use was previously unknown for *T. discoideus*. Host use and phenology are discussed for *Triraphis harrisinae* (Ashmead), the only other described species of *Triraphis* in the Nearctic Region.

**KEY WORDS:** American beech, black cherry, black gum, Limacodidae, Nearctic, northern red oak, parasitoid, phenology, pignut hickory, *Triraphis harrisinae*, white oak

Rogadinae is a large subfamily of Braconidae with ~857 described species as of mid-August 2008 (Yu et al., 2005; R. Kula, pers. obs.). *Triraphis* Ruthe currently contains 22 species, with 12, 6, 6, and 2 in the Oriental, Neotropical, Palearctic, and Nearctic regions, respectively (Yu et al., 2005; Valerio, 2006). Like all species of Rogadinae, species of *Triraphis* are koinobiont endoparasitoids of lepidopteran larvae and pupate within the mummified remains of their hosts (Shaw, 1997). However, unlike many rogadines, *Triraphis harrisinae* (Ashmead) does not glue the host mummy to a substrate (Smith et al., 1955). Known hosts for species of *Triraphis* are larvae in the families Dalceridae, Limacodidae, Lycaenidae, Lymantriidae, Megalopygidae, Riodinidae, Tortricidae, and Zygaenidae (Yu et al., 2005; Zalvidar-Riveron et al., 2008). The lymantriid and tortricid records are questionable because it is unclear whether or not hosts were isolated, and all other records are from species of Zygaenoidea, Lycaenidae, and Riodinidae. Thus, aside from the lymantriid and tortricid records, known hosts are restricted to two monophyletic groups (Wahlberg et al., 2005; Niehuis et al., 2006). Larvae of species in the two groups have retractile heads and tend to have

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short prolegs and thoracic legs (M. Epstein, pers. comm.). Rudow (1918) reported *Triraphis tricolor* (Wesmael) from the cynipid *Andricus curvator* Hartig, but this record is considered invalid since all confirmed hosts of rogadines are lepidopterans (S. Shaw, pers. comm.).

The two described species of *Triraphis* that occur in the Nearctic Region are *T. harrisinae* and *Triraphis discoideus* (Cresson). Yu et al. (2005) list *Acharya apicalis* (Dyar), *Harrisina americana* (Guérin-Méneville), and *Lithacodes fasciola* (Herrich-Schäffer) as known hosts of *T. harrisinae*. Clausen (1956) reported *T. harrisinae* as established in California for control of *Harrisina metallica* Stretch. The colony used for releases in California was started using wasps reared from *H. americana* and undetermined *Acoloitus* Clemens larvae collected in Florida and Illinois (Smith et al., 1955). Three of the authors of this article, JTL, SMM, and TS, reared several specimens of *T. discoideus* from limacodid larvae collected in the District of Columbia and Maryland. Host use was previously unknown for this species, and the first host records are reported below.

## METHODS

Limacodid larvae were collected from 2004 – 2007 on leaves of the following host plants: *Nyssa sylvatica*, black gum (Cornaceae); *Fagus grandifolia*, American beech (Fagaceae); *Quercus alba*, white oak (Fagaceae); *Quercus rubra*, northern red oak (Fagaceae); *Carya glabra*, pignut hickory (Juglandaceae); and *Prunus serotina*, black cherry (Rosaceae). The insect fauna associated with American beech, black cherry, red oak, and white oak is of interest because these trees are commonly used to produce wood products (American Hardwood Export Council, <http://www.ahec.org/>). Collections were limited to limacodids because three of the authors (JTL, SMM, and TS) are studying host plant use by limacodid larvae as part of an ongoing research project. The aforementioned tree species were searched because they are common host plants in the mid-Atlantic region.

Larvae were brought back to the laboratory where they were kept individually in closed plastic deli containers (540 ml; Fabri-Kal, Kalamazoo, Michigan) with moistened filter paper discs (7.5 cm diameter; VWR, West Chester, Pennsylvania) and leaves of the host plant species from which they were collected. Containers were cleaned out, old leaves were removed, filter paper discs were remoistened, and new leaves were added to each container several times per week throughout larval development. Each container, including parasitoid(s) and host remains, was placed in a freezer at -20° C when one or more parasitoids were observed to have emerged. Wasps were later removed from the freezer, dehydrated following Heraty and Hawks (1998), point mounted, labeled, and deposited in the Smithsonian Institution National Museum of Natural History, Washington, DC (USNM).

The second and third authors identified limacodid larvae using Wagner (2005) and a digital reference library of larval images photographed by the second author (for early instars). Larval images in this library were retroactively identified to

species by comparing reared adult specimens to Covell (2005). The first author identified parasitoids as *T. discoideus* using Shaw (1997) and Achterberg (1991) and through comparison with specimens at the USNM, including seven homotypes (i.e. nontype specimens compared to a primary type) each for *T. discoideus* and *T. harrisinae*. Data in the material examined are presented in a uniform format based on original label data; the following abbreviations are used: California (CA), District of Columbia (DC), Florida (FL), Maryland (MD), Massachusetts (MA), New Jersey (NJ), New York (NY), North Carolina (NC), Pennsylvania (PA), Virginia (VA), County (Co.), collected (coll.), and emerged (em.).

### RESULTS AND DISCUSSION

*Triraphis discoideus* (Fig. 1) was reared from nine host species collected on five host plant species (Table 1). Larvae collected on pignut hickory did not yield *T. discoideus*. Specimen-level data are presented in the material examined below. All were solitary koinobiont endoparasitoids, and host mummies were not glued to substrates. The site of adult emergence from host mummies was often posterolateral (75.0%), sometimes posterodorsal (21.9%), and rarely posterodorsolateral (3.1%). As mentioned above, species of *Triraphis* attack larvae in families other than Limacodidae. This research was limited to limacodids, and the host range of *T. discoideus* beyond Limacodidae merits future investigation.

Marsh (1979) listed *T. harrisinae* from *L. fascicola*, but *T. harrisinae* was not reared during the course of this research. Marsh (1979) did not indicate the basis for this record, and there are no specimens of *T. harrisinae* at the USNM pur-



Figure 1. Lateral habitus of female *T. discoideus*. Scale bar = 1.0 mm.

portedly reared from *L. fascicola*. Additional rearing from *L. fasciola* is warranted to confirm this record. Harrison (1963) reported *T. harrisinae* from *A. apicalis*, but *T. harrisinae* was not reared from the congener *Acharia stimulea* (Clemens) during the course of this research.

*Triraphis discoideus* and *T. harrisinae* have overlapping geographic distributions (Yu et al., 2005), but the two species appear to differ in terms of seasonal phenology. Among Nearctic specimens at the USNM, the earliest and latest occurrence of *T. discoideus* is June 25 and September 17, respectively; the earliest and latest occurrence of *T. harrisinae* is September 15 and October 29, respectively. Seventy-six percent of limacodid larvae in this study were collected before September, with 53, 276, 690, 312 and 2 larvae collected in June, July, August, September, and October, respectively. Larvae collected in September and October might be more likely to yield *T. harrisinae*. Ongoing collecting of late-season limacodid larvae should help resolve this issue.

Table 1. Host-host plant combinations that yielded *T. discoideus* with localities where host larvae were collected. LBRP = Little Bennett Regional Park, PI = Plummers Island, PNWR = Patuxent National Wildlife Refuge (all Maryland); RCP = Rock Creek Park, USNA = United States National Arboretum (both District of Columbia).

Host	Host Plant	Locality
<i>Acharia stimulea</i> (Clemens)	<i>Quercus rubra</i>	PI
<i>Adoneta spinuloides</i> (Herrich-Schäffer)	<i>Q. rubra</i>	LBRP
<i>Euclea delphinii</i> (Boisduval)	<i>Nyssa sylvatica</i> <i>Q. rubra</i>	RCP PI
<i>Isa textula</i> (Herrich-Schäffer)	<i>Fagus grandifolia</i> <i>Quercus alba</i> <i>Q. rubra</i>	LBRP, RCP PNWR PNWR
<i>Lithacodes fasciola</i> (Herrich-Schäffer)	<i>Prunus serotina</i> <i>Q. rubra</i>	USNA PI
<i>Nadata nasoni</i> (Grote)	<i>F. grandifolia</i> <i>N. sylvatica</i> <i>Q. alba</i> <i>Q. rubra</i>	LBRP, RCP, PNWR RCP PI, RCP PI, RCP
<i>Parasa chloris</i> (Moore)	<i>Q. rubra</i>	PI
<i>Prolimacodes badia</i> Hübner	<i>P. serotina</i> <i>Q. rubra</i>	RCP LBRP
<i>Tortricidia</i> Packard	<i>F. grandifolia</i>	PNWR

Material Examined: all USA and at USNM. *Triraphis discoideus*: DC: 2 f [date and collector unknown]; 1 f 29.VI [year and collector unknown]; 1 f Rock Creek Park, coll. 13.VIII.2004 em. 23.VIII.2004, J. T. Lill, ex *Prolimacodes badia* on *Prunus serotina*, #04-885; 1 f data as previous except coll. 28.VIII.2005 em. 2005 [date unknown], ex *Natada nasoni* on *Quercus rubra*, #05-831; 1 f data as previous except coll. 31.VII.2006 em. 4.VIII.2006, ex *Euclea delphinii* on *Nyssa sylvatica*, #06-306; 1 f data as previous except coll. 14.VIII.2006 em. 2006 [date unknown], ex *N. nasoni*, #06-329; 1 m data as previous except on *Quercus alba*, #06-331; 1 m data as previous except on *Fagus grandifolia*, #06-349; 2 f data as previous except coll. 8.IX.2006, ex *Isa textula*, #06-555 and #06-556; 1 f United States National Arboretum, coll. 6.VII.2005 em. 25.VII.2005, J. T. Lill, ex *Lithacodes fasciola* on *P. serotina*, #05-332; FL: Orange Co. 1 f Winter Park, 4.VII.1942, H. T. Fernald; MD: Montgomery Co. 1 f Cabin John, 31.VII.1921, J. R. Malloch; 1 f Glen Echo, 10.VII.1921, J. R. Malloch; 22 f 5 m data as previous except 17.VII.1921 (1 f), 23.VII.1921 (2 f), 8.VIII.1921 (2 f), 21.VIII.1921 (1 f), 28.VIII.1921 (7 f), 25.VI.1922 (1 m), 12.VII.1922 (1 f), 16.VII.1922 (1 m), 23.VII.1922 (1 f), 30.VII.1922 (1 f), 6.VIII.1922 (1 m), 22.VIII.1922 (3 f 2 m), 10.VIII.1923 (1 f), 21.VIII.1923 (2 f); 1 m Little Bennett Regional Park, coll. 31.VII.2007 em. 13.VIII.2007, J. T. Lill, ex *Adoneta spinuloides* on *Q. rubra*, #07-498; 1 m data as previous except coll. 2.VIII.2007 em. 20.VIII.2007, ex *N. nasoni* on *F. grandifolia*, #07-543; 1 m data as previous except em. 13.VIII.2007, #07-548; 2 m data as previous except em. 20.VIII.2007, #07-550 and #07-552; 1 m data as previous except coll. 16.VIII.2007, ex *P. badia* on *Q. rubra*, #07-619; 1 m data as previous except coll. 23.VIII.2007 em. 2007 [date unknown], ex *I. textula* on *F. grandifolia*, #07-689; 2 f Plummers Island, 27.VIII.1922, J. R. Malloch; 2 f Plummers Island, coll. 22.VII.2004 em. 2.VIII.2004, J. T. Lill, ex *L. fasciola* on *Q. rubra*, #04-726 and #04-742; 1 m data as previous except ex *N. nasoni*, #04-764; 1 m data as previous except coll. 26.VII.2004 em. 6.VIII.2004, ex *Parasa chloris*, #04-789; 1 f data as previous except em. 4.VIII.2004, #04-804; 1 f data as previous except coll. 3.VIII.2006 em. 16.VIII.2006, ex *N. nasoni*, #06-343; 1 f data as previous except em. 2006 [date unknown], ex *P. chloris*, #06-344; 1 f data as previous except coll. 18.VIII.2006, ex *E. delphinii*, #06-380; 1 m data as previous except ex *N. nasoni*, #06-381; 1 f data as previous except ex *P. chloris*, #06-393; 1 f data as previous except ex *N. nasoni* on *Q. alba*, #06-396; 1 f data as previous except on *Q. rubra*, #06-401; 1 f data as previous except coll. 3.VIII.2006, #06-af; 1 f data as previous except coll. 18.VIII.2006, ex *Acharya stimulea*, #06-ag; Prince George's Co. 1 m Patuxent National Wildlife Refuge, J. T. Lill, coll. 17.VIII.2004 em. 25.VIII.2004, ex *Tortricidia flexuosa/pallida* on *F. grandifolia*, #04-920; 1 f data as previous except coll. 28.VIII.2007 em. 2007 [date unknown], ex *N. nasoni*, #07-758; 1 m data as previous except coll. 30.VIII.2007 em. 4.IX.2007, ex *I. textula* on *Q. alba*, #07-860; 1 f data as previous except em. 11.IX.2007, on *Q. rubra*, #07-886; 1 m data as previous except em. 2.X.2007, on *Q. alba*, #07-895; MA: Nantucket Co. 1 f

Nantucket, 6.VIII. [year indecipherable], C. W. Johnson; 1 f data as previous except 17.VIII. [year indecipherable]; NJ: Middlesex Co. 1 m New Brunswick, 20.VII [year and collector unknown]; NY: Suffolk Co. 1 f Hampton Bays, 31.VII.1954, L. Wilcox; NC: Dare Co. 1 m Kill Devil Hills, 18.VII.1950, K. V. Krombein; Polk Co. 1 f Tryon, [date unknown], H. G. Dyar; PA: Luzerne Co. 1 f Hazleton, summer 1897 [date unknown], W. G. Dietz, C. F. Baker #2539; VA: Arlington Co. 1 f Rosslyn, [date unknown], H. H. Smith; 2 f Chain Bridge, 4.IX.1921, J. R. Malloch; 1 m data as previous except 17.IX.1921; 1 m Falls Church, 8.VIII.1918, [collector unknown]. *Triraphis harrisinae*: CA: Riverside Co. 4 f 5 m Riverside [lab colony started with wasps from FL and Illinois], IX.1951 [date unknown]; FL: Bradford Co. 1 f Brooker, 29.X.1949, A. Tissot; Polk Co. 1 f Davenport, 3.X.1952, [collector name indecipherable]; Alachua Co. 5 f 5 m 1 [sex unknown] Gainesville, 15.IX.1954, C. N. Patton; Duval Co. 2 f Jacksonville, [date indecipherable/unknown and collector unknown]; PA: Dauphin Co. 2 f Harrisburg, IX [date unknown], G. S. Champlain; VA: 1 m Virginia Beach, 27.IX.1911, H. G. Dyar; 3 f 5 m data as previous except date unknown.

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