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DEAD LEAF CLUSTERS AS HABITATS FOR ADULT *CALLIODIS*
TEMNOSTETHOIDES AND *CARDIASTETHUS LURIDELLUS* AND OTHER
ANTHOCORIDS (HEMIPTERA: HETEROPTERA: ANTHOCORIDAE)John D. Lattin¹

ABSTRACT

Two species of Anthocoridae (Hemiptera: Heteroptera) were found in dead-leaf clusters of black oak in west-central Michigan, *Calliodis temnostethoides* and *Cardiastethus luridellus*. These clusters resulted from full-leaved trees being blown over by a severe wind storm in May 1998. They contained spiders, springtails, tubiliferan thrips, small beetles, and psocids, besides the predaceous anthocorids. Such habitats are well-known for some bugs elsewhere. Because only adults were collected, it was assumed that the more permanent habitat was likely to be under bark. Further attention to this habitat likely will result in additional records for other species of Anthocoridae.

The family Anthocoridae contains 400–600 known species and is found throughout the world in a variety of habitats. They are small (1.4–4.4 mm) and chiefly predaceous as nymphs and adults on small insects and other arthropods (Lattin 1999). Some species include plant food in their diets and a few appear to be entirely phytophagous (e.g. *Paratriphleps laeviusculus* (Champion) (Bacheler and Baranowski 1975). Their small size and limited flight capabilities point to trivial movement combined with aerial dispersal by the wind as major means of long-distance dispersal (Glick 1939, 1957, Glick and Noble 1961, Southwood 1960). This paper documents the occurrence of two lesser-known species of Anthocoridae, *Calliodis temnostethoides* (Reuter) and *Cardiastethus luridellus* (Fieber), that were found in dead leaf clusters resulting from oak trees in full leaf being blown over in a severe wind storm in western Michigan. These leaf clusters contained a variety of small arthropods, besides these two anthocorids.

Dead-leaf clusters and Anthocoridae. The occurrence of a variety of anthocorid species in dead-leaf clusters (and on dead branches and accumulations of dead leaves on the ground) is well documented in the literature. Usinger (1946) mentioned six species found in such habitats on Guam. Zimmerman (1948) cited three species in three genera in the Hawaiian Islands found on dead-leaf clusters—“. . . where it [*Physopleurella mundula* (White)] preyed largely on Psocidae.” and Herring (1967) reported *Lasiochilus palauensis* Herring was collected “. . . beating dead branches.”

These leaf clusters, in situations of high temperature and humidity, combined to produce an ideal environment for the growth of fungal spores, pro-

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viding food for various arthropods (Mockford 1993). Such assemblages provide prey for spiders and minute pirate bugs (Anthocoridae). At least four distinct taxa of Psocoptera were found in these clusters in Michigan, along with spiders, springtails, small beetles, a tubiliferan thrips, and the two species of Anthocoridae.

Dispersal. Southwood (1960) identified two major types of movement, trivial and migratory. The normal movement of anthocorids appears to be trivial because their sustained flight is limited compared to many other groups. Long-distant dispersal appears to be via wind currents. Small anthocorids are known from the air column; Glick (1939) reported *Orius insidiosus* (Say) from as high as 1538 m over southern Louisiana and, later (1957), the same species from 615 m as well as *O. tricolor* (White) from 154 m and *Xylocoris californicus* (Reuter) from 61.5 m over Texas. Dispersal of anthocorids over long distances was postulated by Usinger (1946), Zimmerman (1948), Leston (1957), and Herring (1967) who felt that such aerial dispersal was the most likely means of over-water transport in the Pacific Region. The Hawaiian Islands, for example, appear to have had at least three colonization events to explain the present native anthocorid fauna—*Lilia dilecta* (White), the only endemic genus; *Orius persequens* (White), the only native species of this widespread genus; and the five native species of *Lasiochilus* Reuter, another, cosmopolitan large genus. The origins of the ancestors has not yet been clarified but appear to have been from the southeast, at least in part (i.e., North and Central America) rather than from the west-northwest. Severe storms often originate off the coast of Mexico and move northwest (Morain 1984). Only careful systematic analysis will clarify this matter.

Michigan, 1998. A severe windstorm hit the central coast of western Michigan in late May 1998 with winds reported to have reached 120 mph. Many trees were blown down in this area, especially black oak (*Quercus velutina*), around Pentwater, Michigan, although the woods contained other tree species of conifers and nonconifers. The deciduous trees and shrubs were in full leaf, contributing to the loss of some trees. I visited the area just north of Pentwater for a few days in late July 1998. Some collecting was done, mainly on conifers looking for anthocorids. On the last day, I beat the dead-leaf clusters of black oak, and there I found various arthropods and two species of Anthocoridae! These small bugs were *Calliodis temnostethoides* and *Cardiastethus luridellus*. All arthropods inside the leaf clusters were potential prey, but the four species of Psocoptera seemed to be the most likely (Péricart 1972).

Clark et al. (1998) compared Reid's paradox regarding the rapid dispersal of certain plants with large seeds with the dispersal theory. Michigan was used for the graphic presentation of a model of wind dispersal of seeds. This paper is relevant to the present situation of movement of oaks into Michigan in postglacial times, perhaps explaining some of the genetic mixes in some oaks (Voss 1985). Voss (1985) stated that black oak is quite variable in Michigan, reflecting past geographical movement and contact with other species. According to this author, black oak extends into the lower two-thirds of Michigan and is an inhabitant of "... dry sandy woods ..." certainly the habitat at Pentwater. These woods contain maples, scattered jack pine, sassafras, some junipers, witch-hazel, and others. Curiously, black oak seemed more vulnerable than the other trees.

Michigan Anthocoridae in dead-leaf clusters. Two species of anthocorid adults were collected from the dead-leaf clusters from the fallen black oaks near Pentwater, Michigan, *Calliodis temnostethoides* and *Cardiastethus luridellus*. Little is known about either species except for the notes of Kelton

(1978). Apparently, this is first nontaxonomic reference to *Cardiastethus luridellus* since its description in 1860.

Calliodis temnostethoides (Reuter) 1884

Asthenidea temnostethoides Reuter 1884: 605 (Ill.); Drake and Harris 1926: 37 (N.Y., Ill., Fla., Tex.) Blatchley 1926: 631 (Ill., N.Y.); Torre-Bueno 1930: 16 (N.Y.)

Calliodis temnostethoides, Carayon 1972: 347; Kelton 1978: 54 (Sask., Ont., Que., N.S., P.Ed., N.B.); Laroche 1984:260; Henry 1988: 25 (Conn., Fla., Ill., Mo., N.B., N.S., N.Y., Ont., P.Ed., Que., Tex.).

Calliodis temnostethoides was described from Illinois by Reuter (1884) as a species of *Asthenidea* Reuter. Ultimately, that genus was found to be a synonym of *Calliodis* Reuter (Carayon 1972), thus the present combination. Henry (1988) summarized past locations (see above) but previously, Kelton (1978) had also included Saskatchewan. In spite of its wide distribution, little is known of its habits. Drake and Harris (1926) cited only "sweeping." Kelton (1978) provided more information on its habits when he wrote "Habitat. - collected under the bark of *Carya* spp., *Picea* spp., *Pinus sylvestris*, and *P. banksiana*, and in bracket fungi growing on *Betula papyrifera*." He provided a habitus drawing of the adult, the clasper, and the ostiolar canal.

Now, Michigan can be added to the records when two specimens were collected on 21 July 1998, just north of Pentwater (Oceana County), beaten from dead leaf clusters of *Quercus velutina* (black oak), along with a specimen of *Cardiastethus luridellus* in the company of at least four species of Psocoptera, Collembola, a tubiliferan Thysanoptera, small beetles, and spiders.

Although any of the above could, and perhaps did, serve as potential prey, the species of Psocoptera seem most reasonable. Carayon, cited in Péricart (1972), stated that these small insects were prey for *Calliodis* and that a number of the genera in the subtribe Calliodina Carayon was largely Neotropical, being found in detritus, dead leaves, partially dried fruit, nests whereas others are subcortical. Zimmerman (1948), quoting Perkins (1913), explained how the predatory anthocorid *Physopleurella mundula* (White) occurred in the webs made by psocids that feed upon fungal spores growing under the webs on the excretions of scale insects.

Cardiastethus luridellus Fieber 1860

Cardiastethus luridellus Fieber 1860: 271 (Pa.); Reuter 1884:142; Van Duzee 1916:35; Van Duzee 1917: 296; Blatchley 1926:643; Torre-Bueno 1930:20; Henry 1988:22 (Pa.).

There appear to be no data available on this species, other than the original description from Pennsylvania by Fieber in 1860. The references above are catalogs or papers that repeat the original description and/or location. Reuter (1884), Blatchley (1926), and Torre-Bueno (1930) included the species in keys to the known species of *Cardiastethus* based on characters given by Fieber. The specimen is in the Systematic Entomology Laboratory at Oregon State University. The occurrence of the adult bugs in a dead-leaf cluster is similar to Usinger (1946) who reported *C. minutissimus* Usinger as "... beaten from dead leaves of a fallen tree ..." and "... on dead, leaf-covered branches ..." in Guam. At the same time, he recorded *Lasiochilus marianensis* Usinger, *Physopleurella mundula* (White), *Poronotus sodalis* (White), and *Cardiastethus fulvescens* (Walker) from similar habitats. The absence of

nymphs from the Michigan collection suggests that the adults dispersed from another habitat, quite possibly from beneath bark. With the great abundance of the dead-leaf clusters this year, next year should produce a larger population of these bugs. Searching under bark, on dead branches, and in litter samples may produce these bugs as such places often have abundant psocids (Mockford 1993). Certainly, adults of these tiny bugs could be dispersed by wind activities given the proper conditions. The genus *Cardiastethus* is largely warm temperate to tropical in distribution, suggesting that *C. luridellus* may be found under the bark of broad-leafed, rather than coniferous, trees.

DISCUSSION

The occurrence of adult *Calliodis temnostethoides* and *Cardiastethus luridellus* in dead-leaf clusters on fallen black oak trees in Michigan suggests that similar habitats will yield these and other species. Their occurrence in such habitats is well known in other parts of the world, especially in the Pacific Region. More study is needed to find the habitats of the immature stages, likely beneath the bark of dead and dying oak trees. Both of these bug species are small and easily overlooked. More importantly, it is apparent that aside from a few economically important species [e.g., *Anthocoris musculus* (Say), *A. tomentosus* (Péricart), *A. antevolens* White, *Orius insidiosus* (Say), and *O. tristicolor* (White)], and several species of stored product anthocorids, we know remarkably little about the habits of North American species. There are exceptions, too, in some forest inhabiting species. [e.g. *Elatophilus inimicus* (Drake and Harris) and its association with the scale, *Matsucoccus resinosa* Bean and Godwin (Lussier 1965)]. A perfect example is the virtual absence of information on *Cardiastethus luridellus*, described from Pennsylvania by Fieber in 1860! One has only to examine the superb book of Péricart (1972) on the western Palearctic fauna to see how far we have to go. Many of our genera are found in the Old World as well, making Péricart's work even more relevant to us.

Both of the species discussed here belong to genera well represented in warmer climates. Carayon (1972) suggested a Neotropical distribution for most of the genera of the subtribe Calliodini of which *Calliodis* is the type genus. According to Kelton (1978), *Calliodis temnostethoides* extends northward into southern Canada, and Henry (1988) added Florida and Texas. No other species of *Calliodis* is found so far north; the other species occur in Florida and Mexico (Henry 1988) whereas additional species occur to the south. Kelton (1978) reported *C. temnostethoides* from under the bark of deciduous and coniferous trees. Therefore, it seems reasonable to expect similar habitats in the Pentwater, Michigan, area to yield the nymphs and adults as well, in addition to the occurrence of adults in dead-leaf clusters. The utilization of prey items found in dead-leaf clusters would enhance their dispersal and survival by strong winds because such habitats are common in post-storm conditions.

Cardiastethus is the type genus of the tribe Cardiastethini. It is a large, widely distributed taxon found in the warmer parts of the world. According to Carayon (1972), several of the genera included in this tribe live under the bark of trees (e.g., *Dufouriellus* Van Duzee and *Xylocoridea* Reuter), suggesting the possibility of subcuticular life for some *Cardiastethus*. Several specimens of *Cardiastethus borealis* Kelton were beaten from lodgepole pine and ponderosa pine in eastern Oregon. Kelton (1978) also beat this species from jack pine (*Pinus banksiana*), ponderosa pine (*Pinus ponderosa*), and Scot's

pine (*Pinus sylvestris*) in Canada. *C. borealis* does not look like the regular species of *Cardiastethus* and might well represent another genus. According to Kelton, it is found along the southern edge of Canada from British Columbia to Nova Scotia. Not many species of *Cardiastethus* are as boreal as this one, and our knowledge of *Cardiastethus luridellus* is even more rudimentary. Its related species are found to the south in the United States, suggesting a deciduous rather than coniferous "host tree."

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