J. New York Entomol. Soc. 107(2–3):238–246, 1999

PHOENICOCORIS CLARICORNIS AND *PINOPHYLUS CARNEOLUS* (HEMIPTERA: MIRIDAE): DISTRIBUTION AND SEASONALITY OF TWO SPECIALISTS ON MICROSPORANGIATE STROBILI OF PINES

A. G. WHEELER, JR.

Department of Entomology, Clemson University, Clemson, South Carolina 29634-0365

Abstract.—The phyline mirids *Phoenicocoris claricornis* (Knight) and *Pinophylus carneolus* (Knight) are seldom collected because of their early-season, univoltine life cycles. Surveys were conducted in the eastern United States to delimit their distributions and to determine host-plant relationships. The seasonal history of both plant bugs was studied in southcentral Pennsylvania on Virginia pine (*Pinus virginiana*) during 1976–1977. Known previously from New Jersey and West Virginia, *Phoenicocoris claricornis* is newly recorded from Alabama, Georgia, Kentucky, Maine, Maryland, New Hampshire, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia. New state records for *Pinophylus carneolus,* previously recorded from Maryland, Pennsylvania, Virginia, West Virginia, and Wisconsin, are Alabama, Florida, Georgia, Kentucky, New York, North Carolina, Ohio, South Carolina, and Tennessee. Both mirids develop on the staminate strobili of pines, mainly Virginia pine in the mid- and southern Appalachians and pitch pine (*Pinus rigida*) in the Northeast. Sand pine (*Pinus clausa*) is a host of *Pinophylus carneolus* in northwestern Florida. In southcentral Pennsylvania, overwintered eggs of *Pinophylus carneolus* hatch in early April, and adults appear by early May and are present only until mid- to late-May. The seasonality of *Phoenicocoris claricornis* is similar, its populations developing about a week later than those of *Pinophylus carneolus.*

North American conifers, especially pines (*Pinus* spp.), support a rich mirid fauna. In reporting braconid parasitism of Miridae occurring on lodgepole pine (*P. contorta* Loudon) in Oregon and Wyoming, Lattin and Stanton (1999) remarked that about 50 mirid species are associated with this tree throughout its range in western North America. Even so, mirid diversity of North American conifers and bionomics of the individual species mostly remain undocumented. Exceptions are studies of plant bugs on noble fir (*Abies procera* Rehd.) in the western United States (Cooper 1981) and on arborvitae (*Thuja*), false cypress (*Chamaecyparis*), and juniper (*Juniperus*) in the East (Wheeler and Henry, 1977). The latter paper summarized the scant literature on Miridae of North American conifers.

In the eastern United States, the diverse plant bug fauna of pines, mainly pitch pine (*P. rigida* Mill.) and Virginia (or scrub) pine (*P. virginiana* Mill.), includes two phyline mirids that specialize on the microsporangiate strobili, sometimes referred to as "male" or "pollen" cones or as "catkins." Here I review the previously recorded distributions and hosts of *Phoenicocoris claricornis* (Knight) and *Pinophylus carneolus* (Knight), add new state and host-plant records, and discuss the seasonality, habits, and host relationships of the two species. For a diagnosis and redescription, and illustrations of the adult habitus and male genitalia of *Pinophylus carneolus,* readers should refer to Schwartz and Schuh (1999, this issue); in that

paper, they transfer *carneolus,* previously placed in *Plagiognathus* Fieber, to their new genus *Pinophylus.*

This paper is dedicated to my colleague and friend John T. Polhemus, a heteropterist of international reputation. Although he is renowned for his taxonomic studies on aquatic and semiaquatic Heteroptera, he has (with his son Dan) also described new taxa of Miridae. May his exceptional research productivity continue to flourish.

MATERIALS AND METHODS

Collecting techniques and surveys. During 1975–1999, distributional and host-plant data on *Phoenicocoris claricornis* and *Pinophylus carneolus* were obtained by sampling pitch pine and Virginia pine nearly throughout the ranges of both plant species. Pitch pine was sampled mostly in New England, New York, and the mid-Appalachians, whereas Virginia pine was sampled from Pennsylvania to northern Georgia and northeastern Alabama. *Phoenicocoris claricornis* and *Pinophylus carneolus* were collected by the limb-tap method described by Wheeler (1991) for Miridae of scrub oak (*Quercus ilicifolia* Wangenh.). When collections consisted only of late-instar nymphs, adults were obtained by caging nymphs on host twigs bearing male strobili.

New state records are indicated by an asterisk under Distribution; for information on hosts, see Host plants under each species. A parenthetical "N" (N) indicates a collection consisting only of nymphs (see also Seasonal history and habits of both mirids). The numbers of adult males and females collected are given mostly for 1999 surveys. Voucher specimens have been deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C., and the Pennsylvania Department of Agriculture, Harrisburg.

Seasonal history and habits. Seasonality of both mirid species was studied on Virginia pine in the Valley and Ridge Province of Pennsylvania at a site 16 km NNE. of Harrisburg in West Hanover Township, Dauphin County. The site was about 2 km NNW. of Piketown (N40°23.6′, W76°46.2′; elev. 180 m). Mirids were sampled at least weekly or biweekly from early April until early or mid-June—that is, until neither univoltine, early-season species could be detected; trees thus were sampled twice after neither species was present in samples. Sample dates in 1976 were 8, 11, 17 and 30 April; 5, 14, and 22 May; and 1 and 9 June. In 1977, mirids were sampled on 3, 10, 18, 24, and 27 April; 1, 3, 8, 15, and 23 May; and 5 and 12 June. On each date, all individuals of *Phoenicocoris claricornis* and *Pinophylus carneolus* (usually <10 of both species) beaten from Virginia pines during 30–45 minutes were identified to stage in the field and the numbers of each stage recorded; early instars were sorted to stage in the laboratory.

Additional information on seasonal history of these plant bugs in Pennsylvania was obtained by sampling Virginia pine five times at Paxinos, Northumberland County, during April and May 1975–1977. Supplemental data on seasonality were obtained in 1999 during surveys to determine the bugs' distributions, mainly in the mid-and southern Appalachians. Virginia pine was sampled in Alabama, Georgia, Kentucky, North Carolina, Ohio, South Carolina, Tennessee, Virginia, and West Virginia. Pitch pine and table mountain pine (*P. pungens* Lamb.) were also sampled in the Appalachians where they co-occurred with Virginia pine.

In the field, nymphs of *Phoenicocoris claricornis* and *Pinophylus carneolus* oc-

curred consistently on male strobili of Virginia pine; their feeding behavior, however, was difficult to observe. To verify their suspected feeding on male reproductive structures of their hosts, early and late instars were placed on excised terminals of Virginia pine in plastic boxes (ca. 22°C) and their behavior observed under a binocular microscope.

The oviposition sites of *Pinophylus carneolus* were determined by cutting terminal shoots from Virginia pine in late March, holding the shoots in the laboratory at ca. 21°C and 35% RH, and examining them daily for the presence of first instars. Once neonates of the mirid were detected, egg shells marking sites of oviposition could be located.

Phoenicocoris claricornis (Knight)

Distribution. Described in *Lepidopsallus* Knight by Knight (1923) (and transferred to *Phoenicocoris* Reuter by Stonedahl [1990]) from a female collected on 29 May (no year given) at Lakehurst, N.J., *Phoenicocoris claricornis* has since been reported only from West Virginia (Wheeler et al. 1983). The following additional records were obtained during the present study.

*__Alabama:__ Dekalb Co., Rt. 117, 1 km W. of Hammondville (2♂) & Sulphur Springs, 22 Apr. 1999 (2♂, 1♀). *__Georgia:__ Murray Co., Rt. 76, NW. of Chatsworth, 22 Apr. 1999 (1♀). *__Kentucky:__ McCreary Co., Stearns, 24 Apr. 1999 (N); Madison Co., Rt. 21, Berea, 24 Apr. 1999 (N) & 2 May 1999 (1♀); Nelson Co., Rt. 62, 2.6 km E. of Boston, 2 May 1999 (3♂). *__Maine:__ Oxford Co., Rt. 113, S. of Fryeburg, 19 June 1993; York Co., Rt. 95, 1.7 km SE. of West Kennebunk, 19 June 1993. *__Maryland:__ Prince George's Co., Beltsville, 4 May 1986; Washington Co., Rt. 40, 3.2 km E. of Rt. 56 E. of Indian Springs, 3 May 1982 (N). *__New Hampshire:__ Merrimack Co., Concord, 19 June 1993. *__New York:__ Albany Co., Albany, 4 June 1994; Clinton Co., Rt. 87 exit 36, 5.4 km SW. of Plattsburgh, 12 June 1993 & 5 June 1994 (N); Saratoga Co., County Airport, 5.6 km NNW. of Ballston Spa, 12 June 1993 & 4 June 1994; Warren Co., Queensbury, 12 June 1993 & 4 June 1994. *__North Carolina:__ Buncombe Co., Rts. 19–23, 2.5 km NNW. of Weaverville, 3 May 1999 (N); Gaston Co., Crowder Mountain State Park, 22 Apr. 1988; Guilford Co., Rt. 68, nr Oak Ridge, 11 Apr. 1982 (N); Jackson Co., Sylva, 25 Apr. 1999 (N); Rockingham Co., Rt. 220 nr Madison, 11 May 1978 & Reidsville, 11 May 1987. *__Ohio:__ Athens Co., Rts. 7–50, 3.5 km NE. of Coolville, 1 May 1999 (N); Monroe Co., T-565, SE. of Marr, 29 May 1994. *__Pennsylvania:__ Dauphin Co., numerous collections at main sample site (see Materials and Methods for dates); Lancaster Co., Mason Dixon Rd., S. of Wakefield, 25 May 1978 (N); Lebanon Co., Rt. 443, 4.8 km S. of Suedburg, 10 May 1977 (N); Luzerne Co., Nanticoke, 5 May 1977 (N); Montour Co., jct. Rts. 45 & 642, 1.7 km W. of Mooresburg, 10 May 1977 (N); Northumberland Co., Rt. 901 S. of Ranshaw, 10 May 1977 (N) & Paxinos (several collections, April–May 1975–1977); Perry Co., Rt. 322, 3.2 km E. of Newport exit, 21 Apr. 1977 (N); Union Co., Rt. 15, White Deer, 21 Apr. 1977 (N). *__South Carolina:__ Greenville Co., Caesars Head State Park, Pinnacle Falls, 16 Apr. 1997 (N); Pickens Co., Boggs Rock, 1.6 km N. of Liberty, 23 Apr. 1988 & Glassy Mountain Heritage Preserve, 4.8 km NE. of Pickens, 3 May 1996. *__Tennessee:__ Campbell Co., Caryville, 3 May 1999 (1♂); Knox Co., Rt. 75 exit 110, 2.7 km SE. of Powell, 23 Apr. 1999 (N); McMinn

Co., Athens, 22 Apr. 1999 (1♀). ***Virginia:** Alleghany Co., Rt. 64, 2 km E. of Callaghan, 9 May 1999 (1♀); Bath Co., Rt. 703, Bald Knob, 28 May 1993 (N); Bland Co., Walker Mountain, Rt. 717, 0.3 km N. of Wythe Co. line SSE. of Bland, 8 May 1999 (1♀); Botetourt Co., Eagle Rock, 8 May 1999 (2♂, 6♀) & Rt. 81 Rest Area, 2.4 km N. of jct. Rt. 640, SE. of Fincastle, 11 May 1978, 10 May 1979, 24 Apr. 1981 (N), 8 May 1987 (N); Buckingham Co., Rt. 15, 4 km NNE. of Dillwyn, 24 Apr. 1981 (N); Montgomery Co., Rt. 460, 7 km N. of Blacksburg, 8 May 1999 (N).

Host plants. Recorded from Virginia pine in West Virginia (Wheeler et al. 1983), *Phoenicocoris claricornis* was found mostly on this host plant during my surveys. *Pinus virginiana* was the host for collections in Ohio and Pennsylvania south to Alabama and Georgia, except for three collections from *P. rigida.* At the main study site in Dauphin Co., Pennsylvania, a fourth instar was beaten (1 May 1977) from a mature pitch pine within 50 m of the stand of Virginia pine used for weekly or biweekly sampling. Two early instars were found on pitch pine at White Deer, Union Co., Pennsylvania, on 21 April 1977. A late instar was beaten (28 May 1993) from an extensive stand of stunted pitch pine on Bald Knob, Bath Co., Virginia. At the few sites in the mid-Appalachians where Virginia and pitch pine were both common—for example, Walker Mountain in Bland Co., Virginia—*Phoenicocoris claricornis* was found only on *Pinus virginiana.*

North of the range of Virginia pine, however, pitch pine was the only host on which *Phoenicocoris claricornis* was found. Collections from Maine, New Hampshire, and New York were all from *Pinus rigida.*

Seasonal history and habits. At the main study site in southcentral Pennsylvania, overwintered eggs of *Phoenicocoris claricornis* hatched from early to mid-April. By late April, populations consisted of fourth- and fifth-instar nymphs in 1976 and 1977. Adults only were observed on 14 May 1976, the 5 May sample consisting solely of late instars (3 IVs, 15 Vs). Adults, still present on 22 May, were not encountered during sampling on 1 and 9 June. In 1977, fourth and fifth instars were collected on 1 and 3 May; by 8 May, a few adults (N = 3) were present with larger numbers of fifth instars (N = 14). Adults outnumbered fifth instars on 15 May (8:3), adults were present on 23 May, but they were not seen during sampling on 5 and 12 June. A generalized seasonality of *Phoenicocoris claricornis* in southcentral Pennsylvania is shown in Fig. 1.

Less frequent sampling at Paxinos, Northumberland Co., Pennsylvania, indicated a similar seasonality. Fifth instars were found on 4 May 1976 and fifth instars and a smaller number of adults on 10 May 1977; in 1975, fifth instars were observed on 21 May and only adults a week later. In Botetourt Co., Virginia, adults and a fifth instar were found on 11 May 1978 and adults on 10 May 1979. New York and New England populations developed about a month later than those in central Pennsylvania; late instars and adults were observed in early June and adults in mid-June.

A population in eastern Ohio consisted of fourth and fifth instars on 1 May 1999. In Kentucky and Tennessee, late instars (mostly Vs) were observed with a few teneral adults during 23–24 April. On 22 April, adults were found in northeastern Alabama and Georgia; the few remaining nymphs were parasitized by a euphorine braconid. At higher elevations in western North Carolina (>600 m), fifth instars were observed on 25 April and 3 May.

Nymphs of *Phoenicocoris claricornis* develop on the clustered, catkin-like staminate strobili that form at the base of current-season growth of Virginia and other host pines. Male strobili of Virginia pine are 10–20 mm long (Flora of North America Editorial Committee 1993). Early instars feed from the outside of Virginia pine's red-brown or yellow microsporangiate strobili, presumably obtaining nutrition from the microsporangia (pollen sacs) and their developing pollen grains. Pollen dissemination in *Pinus virginiana* usually begins during late April to early May in south-central Pennsylvania (Fig. 1) where this mirid's seasonal history was studied. Once the microsporophylls separate at anthesis, the nymphs, by then mostly late instars, also feed within the strobili.

Pinophylus carneolus (Knight)

Distribution. Knight (1927) described this plant bug (in *Plagiognathus*) from Maryland and Virginia. Subsequent records are Pennsylvania, West Virginia, and Wisconsin (Henry and Wheeler, 1988). The listing of *Pinophylus carneolus* (as *Plagiognathus carneolus*) from the District of Columbia (Henry and Wheeler, 1988) likely represents a misreading of Knight and McAtee's (1929) paper on Miridae of the District of Columbia and vicinity, which included only the Maryland and Virginia records noted in the original description. Both localities mentioned by Knight (1927)—Odenton, Md., and Falls Church, Va.—are near Washington, D.C. The following records extend the known distribution of *Pinophylus carneolus.*

*__Alabama:__ Dekalb Co., Rt. 117, 1 km W. of Hammondville, 22 Apr. 1999 (1♀); Jackson Co., sandstone outcrop, Flatrock, 10 Apr. 1997 (1♀). *__Florida:__ Walton Co., Sandestin Blvd., 16 km E. of Destin between Rt. 98 and Horseshoe Bayou, 1–2 Mar. 1999 (1♂, 3♀). *__Georgia:__ Chattooga Co., Rt. 48, 2 km E. of Menlo, 22 Apr. 1999 (3♀); Rabun Co., Clayton, 22 Apr. 1999 (2♀); Towns Co., Hiawassee, 22 Apr. 1999 (N). *__Kentucky:__ Laurel Co., London, 23 Apr. 1999 (N); McCreary Co., Stearns, 24 Apr. 1999 (N); Madison Co., Rt. 21, Berea, 24 Apr. 1999 (N); Nelson Co., Rt. 62, 2.6 km E. of Boston, 2 May 1999 (1♂); Whitley Co., Corbin, 3 May 1999 (1♂, 2♀). __Maryland:__ Prince George's Co., Beltsville, 7 May 1986; Washington Co., Rt. 40, 3.2 km W. of Rt. 56, NW. of Big Pool, 13 May 1982 (1♀). *__New York:__ Albany Co., Albany, 4 June 1994; Saratoga Co., County Airport, 5.6 km NNW. of Ballston Spa, 4 June 1994; Warren Co., Queensbury, 4 June 1994. *__North Carolina:__ Buncombe Co., Rts. 19–23, 2.5 km NNW. of Weaverville, 3 May 1999 (2♂, 4♀); Clay Co., Hayesville, 22 Apr. 1999 (N); Gaston Co., Crowder Mountain State Park, 22 Apr. 1988; Guilford Co., Rt. 68 nr Oak Ridge, 11 Apr. 1982 (N); Jackson Co., Sylva, 25 Apr. 1999 (1♂); Rockingham Co., Rt. 220, 5.6 km S. of Virginia state line nr Stoneville, 9 Apr. 1979 (N), 13 May 1979 & 6 Apr. 1980 (N); Swain Co., Cherokee, 25 Apr. 1999 (1♂). *__Ohio:__ Athens Co., Rts. 7–50, 3.5 km NE. of Coolville, 1 May 1999 (1♂); Gallia Co., Rt. 160, 5 km NW. of Gallipolis, 1 May 1999 (N); Monroe Co., Rt. 260, 8 km S. of Marr, 1 May 1999 (N); Washington Co., Little Hocking, 1 May 1999 (N). __Pennsylvania:__ Cumberland Co., nr Newburg, 5 May 1973 (N); Dauphin Co., numerous collections at main sample site (see Materials and Methods for dates); Franklin Co., Orbisonia, 17 Apr. 1974 (N); Fulton Co., Licking Cr. Twp. NW. of McConnellsburg, 11 May 1983 (N); Huntingdon Co., 6.4 km S. of Orbisonia, 15 May 1973 (1♂, 2♀); Lancaster Co., Mason Dixon Rd., S. of Wakefield, 25 May

1978 (1♀); Montour Co., jct. Rts. 45 & 642, 1.7 km W. of Mooresburg, 10 May 1977 (1♀); Northumberland Co., Rt. 901 S. of Ranshaw, 10 May 1977 & Paxinos (several collections, April–May 1975–1977); Washington Co., Rt. 519 nr Houston, 21 May 1973. ***South Carolina:** Lancaster Co., Rt. 200, S. of Lancaster, 9 Apr. 1988 (N) & Springs Park, 8 km N. of Great Falls, 9 Apr. 1988; Pickens Co., Boggs Rock, 1.6 km N. of Liberty, 23 Apr. 1988. ***Tennessee:** Campbell Co., Caryville, 3 May 1999 (1♂, 2♀); Knox Co., Rt. 75 exit 110, 2.7 km SE. of Powell, 23 Apr. 1999 (2♀); Morgan Co., Sunbright, 24 Apr. 1999 (N); Scott Co., Rt. 27, Helenwood, 24 Apr. 1999 (1♂). **Virginia:** Alleghany Co., Rt. 64, 4.8 km NNE. of Jerrys Run, 9 May 1999 (N); Bath Co., Rt. 703, 2 km S. of Bald Knob, 9 May 1999 (N); Bland Co., Walker Mountain, Rt. 717, 0.3 km N. of Wythe Co. line SSE. of Bland, 30 Apr. (N) & 8 May 1999 (12♂, 8♀); Botetourt Co., Eagle Rock, 8 May 1999 (2♂, 6♀) & Rt. 81 Rest Area, 2.4 km N. of Rt. 640 SE. of Fincastle, 11 May 1978 (1♀) & 13 Apr. 1984 (N); Buckingham Co., Rt. 15, 4 km NNE. of Dillwyn, 24 Apr. 1981 (2♂, 1♀); Montgomery Co., Rt. 460, 7 km N. of Blacksburg, 8 May 1999 (1♀). **West Virginia:** Greenbrier Co., Rt. 64, Alta, 9 May 1999 (3♂, 1♀); Wood Co., Rt. 14, 2 km N. of Mineral Wells, 30 Apr. 1999 (N).

Host plants. Knight (1927) based his description of *Pinophylus carneolus* on specimens W. L. McAtee found "breeding" on *Pinus virginiana.* Virginia pine also is the host recorded for this plant bug in West Virginia (Wheeler et al., 1983). In Wisconsin, Rauf et al. (1985) observed feeding by *Pinophylus carneolus* on staminate strobili of jack pine (*Pinus banksiana* Lamb.). Similar habits on jack pine were reported for another phyline mirid, *Microphylellus nigricornis* Knight (a synonym of *M. flavipes* [Provancher]), but the observations of Rauf et al. (1985) were based on a misidentification of *Pinophylus carneolus* males (T. J. Henry, pers. comm.). Males of this sexually dimorphic species are more slender and typically are darker than the yellowish-brown females. Knight (1927) described the male as pale to yellowish brown, but some males in his type series might have been teneral.

Host relationships are similar to those of *Phoenicocoris claricornis.* My collections from Pennsylvania to the southern Appalachians were all from Virginia pine. Unlike *Phoenicocoris claricornis, Pinophylus carneolus* was not collected in that region on pitch pine. But northern populations (New York), like those of *Phoenicocoris claricornis,* were found only on pitch pine. Northern populations apparently also develop on jack pine, at least in Wisconsin (Rauf et al., 1985).

In northwest Florida, I collected *Pinophylus carneolus* on sand pine (*Pinus clausa* [Chapm. ex Engelm.] Vasey ex Sarg.), a conifer restricted to Florida and extreme southern Alabama. Populations of this pine in the Florida panhandle, which are disjunct from those of peninsular Florida, belong to the geographic race Choctawhatchee (var. *immuginata* D. B. Ward) (Brendemuehl, 1990). Closely related to Virginia pine in subsection *Contortae* of the genus *Pinus* (Parker et al., 1997), *P. clausa* can be artificially hybridized with *P. virginiana* (Brendemuehl, 1990).

Seasonal history and habits. The seasonal history of *Pinophylus carneolus* is similar to that of *Phoenicocoris claricornis,* the hatching of overwintered eggs and appearance of adults occurring about a week earlier (Fig. 1). At the main study site in Pennsylvania, first instars were observed on 11 April in 1976 (none were seen on 8 April) and were first found on 3 April in 1977. The 30 April sample consisted only of fifth instars (N = 11) in 1976; adults (N = 3) and a fifth instar were found

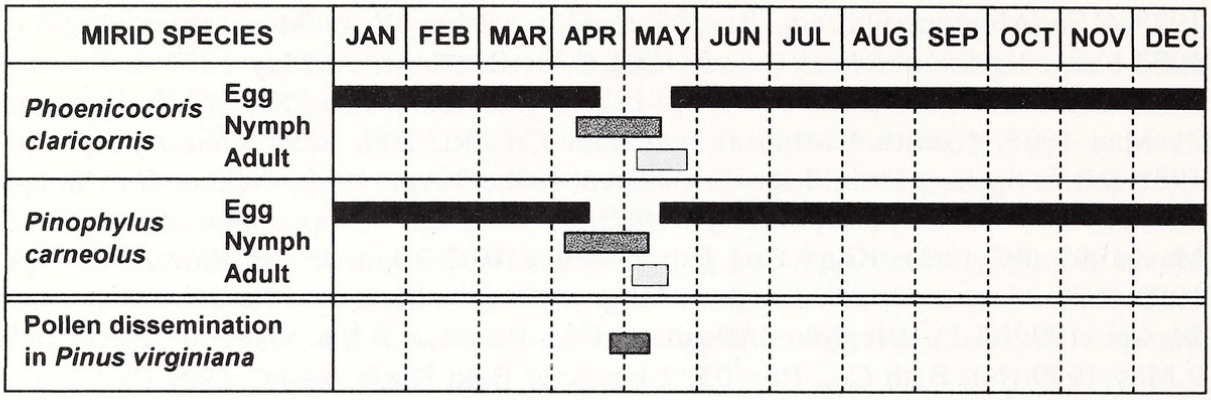

Fig. 1. Generalized seasonality in southcentral Pennsylvania of the mirids *Phoenicocoris claricornis* and *Pinophylus carneolus,* which specialize on the microsporangiate strobili of pines. Also shown is the approximate period of pollen dissemination in Virginia pine at the main study site.

on 5 May. In 1977, fourth (N = 2) and fifth instars (N = 10) were present on 24 April; fifth instars on 27 April; and one fourth instar, two fifth instars, and four teneral adults on 1 May. Adults were still present (N = 1) on 14 May 1976, but they were not observed in the 22 May or 1 June samples. In 1977, adults were found (N = 2) on 15 May but were not collected during sampling on 23 May or 5 June.

As in *Phoenicocoris claricornis,* fifth instars and mostly teneral adults were found in the southern Appalachians during late April and in Kentucky and Ohio in early May. Adults were collected in early March in northwestern Florida. In northern New York, fifth instars and adults were found in early June. There is thus at least a three-month difference between the appearance of adults in southern versus northern populations of this univoltine plant bug.

Eggs of *Pinophylus carneolus* were inserted at the bases of needles within 2–3 mm of the developing staminate strobili. Nymphs, like those of *Phoenicocoris claricornis,* feed on the microsporangiate strobili of host pines. The tan or yellowish-brown nymphs are well camouflaged on host strobili. Nymphs and adults were not found on small, nonreproductive trees and were consistently most numerous on heavily flowering trees.

DISCUSSION

Nymphs of the phyline mirids *Phoenicocoris claricornis* and *Pinophylus carneolus,* as specialists on male reproductive structures of Virginia and certain other pines, occur consistently on host branches that bear microsporangiate strobili. Like nearly all other pines, *Pinus virginiana* is monoecious, the male and female strobili borne separately on the same tree (Carter and Snow, 1990). Male strobili of many pines are more numerous in the lower crown (Burns and Honkala, 1990). Nymphs of both mirids were found only on trees that had attained a permanent reproductive stage. The minimum age of staminate "flower" production in Virginia pine is about eight years (Righter, 1939).

In southcentral Pennsylvania, adults of *Phoenicocoris claricornis* and *Pinophylus carneolus* appear by early May and die within two or three weeks. Among the Miridae associated with Virginia pine at the main study site (>20 species; A. G.

Wheeler, unpubl. data), these univoltine phylines are the first to develop. Their early-season occurrence largely explains the scarcity of specimens in collections and the lack of literature on their bionomics.

The known ranges of both mirid species are similar. *Phoenicocoris claricornis* was found from central Maine to northeastern Alabama and *Pinophylus carneolus* from northern New York to northwestern Florida. The western limits of their ranges are inadequately known. In the present study, *Phoenicocoris claricornis* and *Pinophylus carneolus* were found as far west as central Kentucky and Tennessee; the latter species, however, has been reported from as far west as Wisconsin (Rauf et al., 1985). Known altitudinal ranges of these mirids are also similar: from near sea level in both species, with *Phoenicocoris claricornis* ranging to about 1,250 m above sea level and *Pinophylus carneolus* to about 1,170 m.

Both mirids are common on Virginia pine, which occurs from northeastern Mississippi north to Long Island, New York (Carter and Snow, 1990). North of Long Island, pitch pine is the only known host in the Northeast. Where pitch pine co-occurs with Virginia pine in the mid- and southern Appalachians, *Phoenicocoris claricornis* was found occasionally on pitch pine, but *Pinophylus carneolus* was collected only on Virginia pine. Neither species was observed to develop on table mountain pine. Additional field work in the Appalachians is needed to clarify host relationships of both plant bugs in that region. *Pinophylus carneolus,* which occurs on jack pine in Wisconsin (Rauf et al., 1985), should be searched for on this conifer in northern New York and in New England. Sand pine, a host of *Pinophylus carneolus* in the Florida panhandle, might also serve as a host plant in peninsular Florida, although northwestern Florida could represent the southern extent of this plant bug's range.

ACKNOWLEDGMENTS

I appreciate Dan Polhemus' invitation to be part of this Festschrift issue for John Polhemus. My sincere thanks also go to Thomas J. Henry (Systematic Entomology Laboratory, % Smithsonian Institution, Washington, D.C.) for clarifying the identity of "*Microphylellus nigricornis*" reported from Wisconsin, Steven J. Krauth (Department of Entomology, University of Wisconsin, Madison) for sending specimens of "*M. nigricornis*" to Dr. Henry, John F. Townsend (Department of Biological Sciences, Clemson University) for his help with interpreting the morphology of pine strobili, David W. Boyd (Department of Entomology, Clemson University) for preparing Fig. 1, Peter H. Adler (Department of Entomology, Clemson University) for useful comments on a draft of the manuscript, Stephen H. Bennett (SC Department of Natural Resources, Columbia) for permission to collect insects at Glassy Mountain Heritage Preserve, and Bill Murrell (SC Department of Parks, Recreation & Tourism, Cleveland) for accompanying a field trip to Caesars Head State Park.

LITERATURE CITED

Brendemuehl, R. H. 1990. *Pinus clausa* (Chapm. ex Engelm.) Vasey ex Sarg. Sand pine. pp. 294–301 *in* R. M. Burns and B. H. Honkala (tech. coords.), Silvics of North America, Vol. 1. Conifers. U.S. Dep. Agric. For. Serv. Agric. Handb. 654.

Burns, R. M. and B. H. Honkala, tech. coords. 1990. Silvics of North America, Vol. 1. Conifers, U.S. Dep. Agric. For. Serv. Agric. Handb. 654:675 pp.

Carter, K. K. and A. G. Snow, Jr. 1990. *Pinus virginiana* Mill. Virginia pine. Pp. 513–519 *in* R. M. Burns and B. H. Honkala (tech. coords.), Silvics of North America, Vol. 1. Conifers. U.S. Dep. Agric. For. Serv. Agric. Handb. 654.

Cooper, G. M. 1981. The Miridae (Hemiptera: Heteroptera) associated with noble fir, *Abies procera* Rehd. M.S. thesis, Oregon State University, Corvallis, 135 pp.

Flora of North America Editorial Committee. 1993. Flora of North America North of Mexico, Vol. 2. Pteridophytes and Gymnosperms. Oxford University Press, New York, 475 pp.

Henry, T. J. and A. G. Wheeler, Jr. 1988. Family Miridae Hahn, 1833 (=Capsidae Burmeister, 1835). The plant bugs. Pp. 251–507 *in* T. J. Henry and R. C. Froeschner (eds.), Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States. E. J. Brill, Leiden.

Knight, H. H. 1923. Family Miridae (Capsidae). Pp. 422–658 *in* W. E. Britton (ed.), Guide to the Insects of Connecticut. Part IV. The Hemiptera or Sucking Insects of Connecticut. Conn. Geol. Nat. Hist. Surv. Bull. 34.

Knight, H. H. 1927. Descriptions of twelve new species of Miridae from the District of Columbia and vicinity (Hemiptera). Proc. Biol. Soc. Wash. 40:9–18.

Knight, H. H. and W. L. McAtee. 1929. Bugs of the family Miridae of the District of Columbia and vicinity. Proc. U.S. Natl. Mus. 75(13):1–27.

Lattin, J. D. and N. L. Stanton. 1999. Host records of Braconidae (Hymenoptera) occurring in Miridae (Hemiptera: Heteroptera) found on lodgepole pine (*Pinus contorta*) and associated conifers. Pan-Pac. Entomol. 75:23–31.

Parker, K. C., J. L. Hamrick, A. J. Parker and E. A. Stacy. 1997. Allozyme diversity in *Pinus virginiana* (Pinaceae): intraspecific and interspecific comparisons. Am. J. Bot. 84:1372–1382.

Rauf, A., D. M. Benjamin and R. A. Cecich. 1985. Insects affecting seed production of jack pine, and life tables of conelet and cone mortality in Wisconsin. For. Sci. 31:271–281.

Righter, F. I. 1939. Early flower production among the pines. J. For. 37:935–938.

Schwartz, M. D. and R. T. Schuh. 1999. New genera and species of conifer-inhabiting phyline plant bugs from North America (Heteroptera: Miridae). J. New York Entomol. Soc. (in press).

Stonedahl, G. M. 1990. Revision and cladistic analysis of the Holarctic genus *Atractotomus* Fieber (Heteroptera: Miridae: Phylinae). Bull. Am. Mus. Nat. Hist. 198:1–88.

Wheeler, A. G., Jr. 1991. Plant bugs of *Quercus ilicifolia:* myriads of mirids (Heteroptera) in pitch pine-scrub oak barrens. J. New York Entomol. Soc. 99:405–440.

Wheeler, A. G., Jr. and T. J. Henry. 1977. Miridae associated with Pennsylvania conifers. 1. Species on arborvitae, false cypress, and juniper. Trans. Am. Entomol. Soc. 103:623–656.

Wheeler, A. G., Jr., T. J. Henry and T. L. Mason, Jr. 1983. An annotated list of the Miridae of West Virginia (Hemiptera-Heteroptera). Trans. Am. Entomol. Soc. 109:127–159.