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## NATURAL HISTORY OF THE FLAT BUG *ARADUS GRACILICORNIS* IN FIRE-KILLED PINES (HETEROPTERA: ARADIDAE)

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The Aradidae (Heteroptera) is a widely distributed family of characteristically flat bugs, including 128 species in North America north of Mexico, of which 84 are in the genus *Aradus* (Taylor 2002). Most species of *Aradus* feed on fungi, especially fungi associated with dead trees (Froeschner 1988). A European species, *A. laeviusculus* Reuter, is known to be associated with fungi found on fire-killed or fire-damaged conifers (Lappalainen & Simola 1998).

*Aradus gracilicornis* Stål is a relatively small (4.8–5.8 mm in length) black species. Adults are most easily recognized by the unusually long and slender antennae and the whitish wings with black markings (Fig. 1a). A redescription of the species, including genitalic structures, has been provided by Heiss (1993). It occurs from North Carolina south through Florida (also Cuba), west into New Mexico (Froeschner 1988). Blatchley (1926) reported specimens collected from under the bark of oak, and by sweeping along the margin of a pond. Our study was intended to provide more information on the natural history of this species. This is part of a larger effort to document the relationship between fire and insects in natural habitats of south Florida.

The Archbold Biological Station (ABS) is a private research field station in south-central peninsular Florida, Highlands Co. Most habitats of the ABS are managed by relatively small control burns in an attempt to mimic natural fire frequencies attributed to lightning. On 12 February, 2001, an accidentally ignited fire burned over 300 ha of the ABS under drought conditions with a high wind. This intense fire killed large numbers of south Florida slash pine (*Pinus elliotii densa* Little & Dorman). In March, 2002, we began a study to determine whether *A. gracilicornis* breeds in fire-killed trees.

The main building of the ABS is located at 20°10'50"N, 81°21'00"W. Our study site was west of the main buildings in pine flatwoods and seasonal pond habitats with sparsely distributed *P. elliotii*. Bands of bark about 60 cm wide encircling the tree were taken from 55 trees of varying sizes. The outer bark of south Florida slash pine is made up of fine loose layers, between which the *A. gracilis* conceal themselves. Each band of bark was broken into pieces 3 cm × 3 cm or smaller and placed in a sifter with a 5 mm mesh. The bark was then shaken vigorously, and the sifted bark bits

extracted into cups of alcohol with a Tulgren funnel. Collections began on 8 March 2002, and ended on 10 June 2002. Voucher specimens are in the ABS collection of arthropods.

*Aradus gracilis* can occur in large numbers in fire-killed *Pinus elliotii*, and a few fire-killed trees could probably produce hundreds, if not

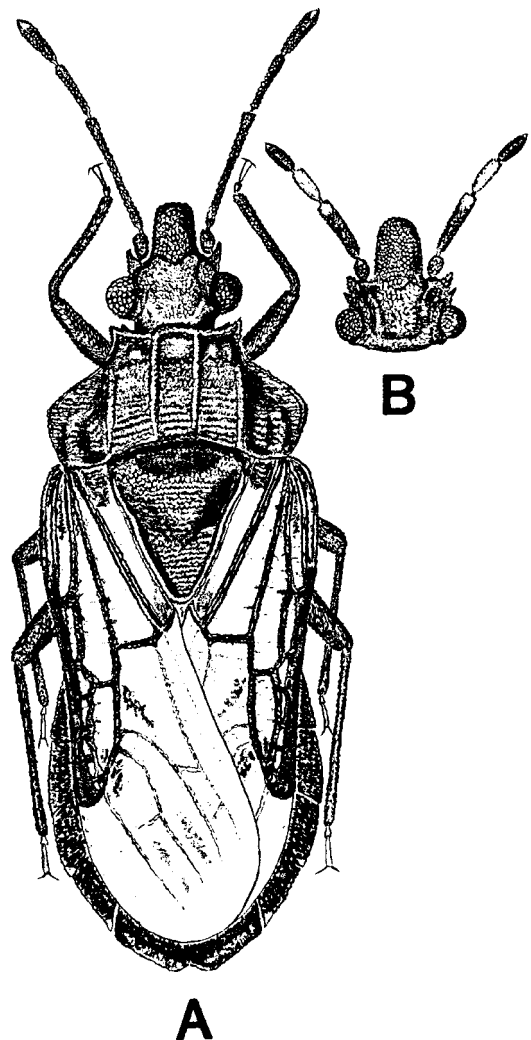


Fig. 1. *Aradus gracilicornis*. A: Adult male; length of specimen 5.2 mm. B: Head of nymph; length of specimen 5.6 mm.

thousands of individuals. Specimens were extracted from 27 of the 55 trees sampled. Bugs per sample ranged from 1 to 68. Six samples had more than 20 individuals. Considering the width of the band of bark removed from each tree (about 60 cm), it seems likely that some trees produce hundreds of *A. gracilicornis*. This high population after a large fire might not be typical of all sites. The annual occurrence of small fires at the ABS may increase or stabilize the local reservoir of individuals that colonize dead trees, relative to sites where fires are larger but less frequent.

The great majority of specimens were nymphs: 418 out of 444 specimens. The scarcity of adults in samples spread out over three months suggests that adults leave their natal tree soon after their final molt.

In our study, larger trees produced proportionately more *A. gracilicornis*. *Aradus gracilicornis* occurred in all 13 of the largest trees (over 60 cm dbh) sampled, and in less than half the trees in smaller size classes. Since the bands of bark are larger on large trees than small trees, comparisons are based on numbers of bugs/m sq. of bark surface sampled. The 13 trees over 60 cm dbh produced an average of 19.1 bugs/m sq. (range: 2.7-46.3), compared to 1.4 bugs/m sq. in 21 trees 45-60 cm dbh (range: 0.0-4.7). At this point it does not seem appropriate to analyze these results statistically because it is unlikely that the insects are responding directly to tree size, but rather to the occurrence of certain fungi that, in this instance, were more abundant in large trees. It is even possible that the progression of decomposition is faster in small trees, and most of the flat bugs had left the small trees earlier in the year. One reason why we sampled so many small trees was that *A. gracilis* were found in a small tree in early February of 2002. Although our project extended over three months, it was still a relatively short-term study following a single fire.

*Aradus gracilicornis* nymphs that were found in bark were usually associated with a thin, dry fungal film occurring between layers of outer bark. Several of these nymphs were reared to maturity. This showed that the elongation of the antennae occurs suddenly at the last molt. At the final molt there is also a change in antennal markings: the antennae, which in the nymph are black with a white band (Fig. 1b), become entirely black. Banded antennae occur in adults of a few species of *Aradus*, such as the North American species *A. uniformis* Heidemann and *A. abbas* Bergroth, and the holarctic species *A. signaticornis* Sahlberg. The function of this conspicuous banding, which occurs in both sexes as well as nymphs, is unknown. It seems unlikely that there is visual communication between nymphs of *A. gracilicornis* inhabiting dark cavities in pine bark. It is possible that *A. gracilis* belongs to a lineage that had white antennal bands in the adult, and this pattern is vestigial in the nymph.

The bark of fire-killed pines retains a rich fauna for more than a year after the fire, long after the first flush of scavengers, mostly phloeom-consuming scavengers such as *Ips* (Scolytinae) and *Melanophila* (Buprestidae), have left the tree. The following arthropods occurred in samples with nymphs of *A. gracilicornis*. These arthropods are not necessarily close associates of this species; we present them to place *A. gracilicornis* in the context of the arthropod assemblage found in dead pines at a particular stage of decomposition. The number following the name of an arthropod indicates the number of samples (out of 27) that had both *A. gracilicornis* and the arthropod listed; numbers of individuals are not tallied. Polyxenida, Polyxenidae, *Polyxenus* sp. (1); Pseudoscorpionida, unidentified to family (14); Araneida, Clubionidae (1), Salticidae (1), Thomisidae (1), unidentified to family (3); Collembola, unidentified to family (9); Dermaptera, Labidiidae, *Marava pulchella* (Serville) (4); Psocoptera, unidentified to family (4); Coleoptera, Carabidae, *Tachyta nana inornata* (Say) (8); Ptiliidae, *Ptinella* sp. (7); Curculionidae, *Cossonus corticola* Say (3), *Platypus flavicornis* (Fabricius) (1); Elateridae, unidentified larvae (10); Trogositidae, unidentified larvae (2); Histeridae, *Platysoma parallelum* (Say) (2), *Plegaderus transversus* Say (2), *Becanius punctifrons* LeConte (1); Tenebrionidae, *Corticeus thoracicus* (Melsheimer) (1), *Hymenorus* sp. (2); Anthribidae, *Euparius paganus* Gyllenhal (1); Cerambycidae, unidentified larva (1); Buprestidae, unidentified larva (1); Colydiidae, *Colydium nigripenne* LeConte (1); Sphindidae, *Sphindus americanus* LeConte (1); Staphylinidae, *Nacaeus tenellus* (Erichson) (1), *Coproporus* sp. (1); Coleoptera, larvae unidentified to family (6).

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#### SUMMARY

*Aradus gracilicornis* is the first aradid known to benefit significantly from the fires that are a normal feature of most natural pine habitats in southeastern North America. It is probable that there are additional species of aradids that congregate in fire-killed trees in the Southeast, or in parts of the Southwest where fires occur regularly. Many insect species that breed in fire-killed pines, such as Scolytinae in the genera *Ips*, *Pityophthorus*, *Dendroctonus*, *Orthotomicus*, and *Xyleborus*, also occur on the ABS in wind-thrown

or felled trees. There is no reason to believe that *A. gracilicornis* is restricted to fire-killed trees, but it is clearly a member of the large group of insects that are associated with fire in the Southeast.

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