

mortality of the species recovered. All of the braconids collected in this study as well as *E. platyhypenae* and *Eucelatoria rubentis* (Coquillett) were also reared from fall armyworm larvae in southern Texas (Vickery 1929). Wilson (1933) found these same parasites attacking the beet armyworm, *Spodoptera exigua* (Hübner) in Florida. The parasites neither individually by species, nor collectively seemed to significantly reduce the density of the armyworm population.

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*FORMICA INTEGRATA* (HYMENOPTERA: FORMICIDAE)  
3. TRIAL INTRODUCTION INTO FLORIDA<sup>1</sup>

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## ABSTRACT

A small number of nests of the red wood ant, *Formica integra* Nylander, from west-central Georgia were transplanted to a pine and oak site near Gainesville, FL during 1973, with food and protection initially provided. The ants readily preyed on numerous arthropods and attended aphids to obtain honeydew; colonies persisted for periods up to 14 weeks. When protective screens were removed, all *F. integra* ants were killed by the native Florida carpenter ant, *Camponotus abdominalis floridanus* (Buckley), a result predicted earlier by interspecific confrontation tests in the laboratory.

Habitat, nest construction, polygyny, and biometry (Kloft et al. 1973), feeding, trophallaxis, and interspecific confrontation behavior (Wilkinson et al. 1978) of a red wood ant, *Formica integra* Nylander from west-central Georgia have been reported. We determined that *F. integra* has traits desirable for control of certain forest insect pests and decided to move a small

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trial population ca. 560 km southeast of its southernmost known native range near Warm Springs, GA to Gainesville, FL. Our objective was to determine whether *F. integra* would feed and persist under Florida conditions.

#### MATERIALS AND METHODS

*Formica integra* workers, mated queens, and brood plus nest material were transported in 1.2 hl (30 gal) plastic garbage cans. These containers were covered with doubled-cheesecloth and the inside wall was dusted with talc to prevent escape of the ants. At Gainesville, ants and nest material were transferred in 0.5 hl lots to a 1-m diam x 20-cm high, plastic "dry arena" with its inner wall dusted with talc. This dry arena was held in a well-ventilated room until the ants moved through 2 large plexiglass tubes from the dry arena into a "moist arena". The moist arena contained sterilized nest material sprinkled daily with water, artificial diet (Bhatkar and Whitcomb 1970), and 10% honey-water. Eight-mesh hardware cloth screens were placed over openings in the connecting tubes to prevent migration of larger inquilines<sup>5</sup>, but 1 of the mesh openings had to be slightly enlarged to permit passage of *F. integra* queens. Drying was expedited in the dry arena by gentle stirring and irradiation of collected nest material with a lamp when such material was unusually wet. All of the above treatments resulted in migration from the dry arena into the moist arena within 2-4 days. This precautionary screening procedure resulted in relatively clean cultures of *F. integra* for release in the field.

A "field arena", identical to the above moist arena, was next placed in a 2x2x2 m woven fabric cage in the field. Field arenas were provided with sterilized nest material placed over partially-rotted oak wood. Plexiglass tubes with 8-mesh hardware cloth screens led directly from each field arena to the ground outside of the cage. The metal screens permitted *F. integra* workers (but not queens) to pass, and prevented entry of larger insects including possible predators. Two hl of laboratory-screened ants plus nest material were placed in each field arena unless noted otherwise, and honey-water plus diet were provided until the transplanted nest material appeared to be fully rearranged by the ants. Ant behavior and competition were observed until each *F. integra* population was terminated by natural causes.

Three collections of *F. integra* (ca. 10,000 workers-each) were made in Georgia and 5 transplantations were made in Florida during 1973. (1) Workers, sexuals and brood were collected 25 May and transplanted 7 June to a cage located on a dry, open pine site. Eleven year old longleaf pine, *Pinus palustris* Mill., and typical slash pine, *Pinus elliottii* Engelm, var *elliottii*, had been planted at a spacing of 2x4 m, but the slash pine had been gradually thinned to 4x4 m. Many of the more recently-cut slash pine stumps were still infested by the eastern subterranean termite, *Reticulitermes flavipes* (Kollar)<sup>6</sup>, but termite colonies had been partly or totally displaced by the Florida carpenter ant, *Camponotus abdominalis floridanus* (Buckley)<sup>7</sup> in most older stumps. (2) Material was collected 25 May and transplanted 13 June to a moist, shaded oak site adjacent to (1) above. This cage was

<sup>5</sup>Larger inquilines included the scarab beetle, *Cremastocheilus castaneus brevisetosus* Casey (det. R. E. Woodruff) (see Kloft et al. 1979, Lit. Cit.) and larvae of a syrphid fly, *Microdon* sp. (det. D. H. Habeck).

<sup>6</sup>*R. flavipes* was determined by L. A. Hetrick.

<sup>7</sup>Ants were determined by W. F. Buren.

located under the canopy of a large live oak, *Quercus virginiana* Mill., within 3 m of the trunk. (3) Material was collected 2 August and transplanted 18 September to cage (1) above. This cage was then rigged with a tarpaulin to keep the nest dry during cold, wet weather. (4) One hl of material was collected 17 October and transplanted to cage (1) on 19 October. *Formica integra* workers in Georgia were clumped in protected places like crevices inside non-decayed oak heartwood and few callow adults and pupae were present in this material. (5) Material was collected 17 October and 2 hl were transplanted on 19 October to a new cage located 3 m north of cage (1) on the dry-open pine site. No tarpaulin was placed over this cage.

### RESULTS

Feeding and predation occurred primarily on warm, sunny days, but ants remained inactive when nest (5) above became wet and cold. *Formica integra* workers established foraging columns up to 10 m long over the ground surface and once extended a column to the top of a pine 10 m tall. Numerous unidentified arthropod larvae, pupae, and adults were carried back to the nests as prey, but larger prey could not be carried through the 8-mesh screen. Several colonies of the redheaded pine sawfly, *Neodiprion lecontei* (Fitch), partially defoliated a longleaf pine near nest (1) throughout October, but foraging columns did not reach this tree and prey on the larvae. *Aphis coreopsides* (Thos.) and *A. spiraeicola* Patch<sup>3</sup> fed on a common composite flower in the test area called beggar's tick, *Bidens pilosa* L., and were attended by *F. integra* workers.

Six species of small ants that entered the field arenas to feed on honey-water and diet were *Cyphomyrmex minutus* Mayr, *Pheidole metallescens* Emery, *Paratrechina* sp., *Cardiocondyla* sp., and the fire ants, *Solenopsis geminata* (Fab.) and *Solenopsis* sp. Sporadic fighting between *S. geminata* and *F. integra* was observed, but *F. integra* appeared to tolerate or ignore small ants in its nest area.

Sporadic fighting also occurred between *F. integra* and a medium-sized ant, *Crematogaster ashmeadi* Mayr, that nested in the bark of pine trunks. Two species of larger ants, *Formica pallidefulva* Latreille and *Odontomachus brunneus* (Patton), fled soon after contact with *F. integra* workers.

Florida carpenter ants killed all transplanted *F. integra* ants within periods ranging from 5 days at the moist oak site [see (2) above] to 14 weeks at the pine site [see (3) (4) above]. Only smaller *C. a. floridanus* workers could enter into *F. integra* nests through the hardware cloth screens and such attacks were easily warded off by *F. integra*. When screens were removed briefly to allow outward passage of *F. integra* queens transported by workers, larger *C. a. floridanus* workers and especially "soldiers" usually entered the nests overnight. Dead ants recovered from one such encounter included 4 small *C. a. floridanus* and 83 *F. integra* workers. No dead *C. a. floridanus* "soldiers" or large workers were ever found.

<sup>3</sup>Aphids were det. by A. N. Tissot. Additional (unpublished) records of aphids attended by *F. integra* near Warm Springs, GA during May-June 1973 included *Aphis chetasapa* Hottes and Frison on *Prunus* sp., *Holochaitophorus quercicola* (Monell) on *Quercus prinus* L., *Patchia virginiana* Baker on *Castanea dentata* (Marsh.) Borkh., and *Calaphis castanea* (Fitch), also on *C. dentata*.

## DISCUSSION

Possible elimination of *F. integra* by *C. a. floridanus* in the field had been predicted by the results of interspecific confrontation tests in the laboratory (Wilkinson et al. 1978), even though carpenter ant "soldiers" had not been involved in these earlier tests. Fighting between these 2 species (which occupy similar ecological niches) might in part explain why their geographical ranges do not overlap (Fig. 1). Interspecific competition for limited resources is suggested to be a factor in determining the distribution of various animal species (Diamond 1978).

Introduction of *F. integra* into Florida and management for forest pest control purposes would be difficult because of competition from native populations of *C. a. floridanus*. The standard practice in Florida of clearcutting slash pine pulpwood plantations every 20-30 years also is incompatible with known methods of red wood ant management. Further red wood ant research is not recommended under current Florida conditions, but we do not suggest that *F. integra* cannot be successfully managed for forest protection within its native range.

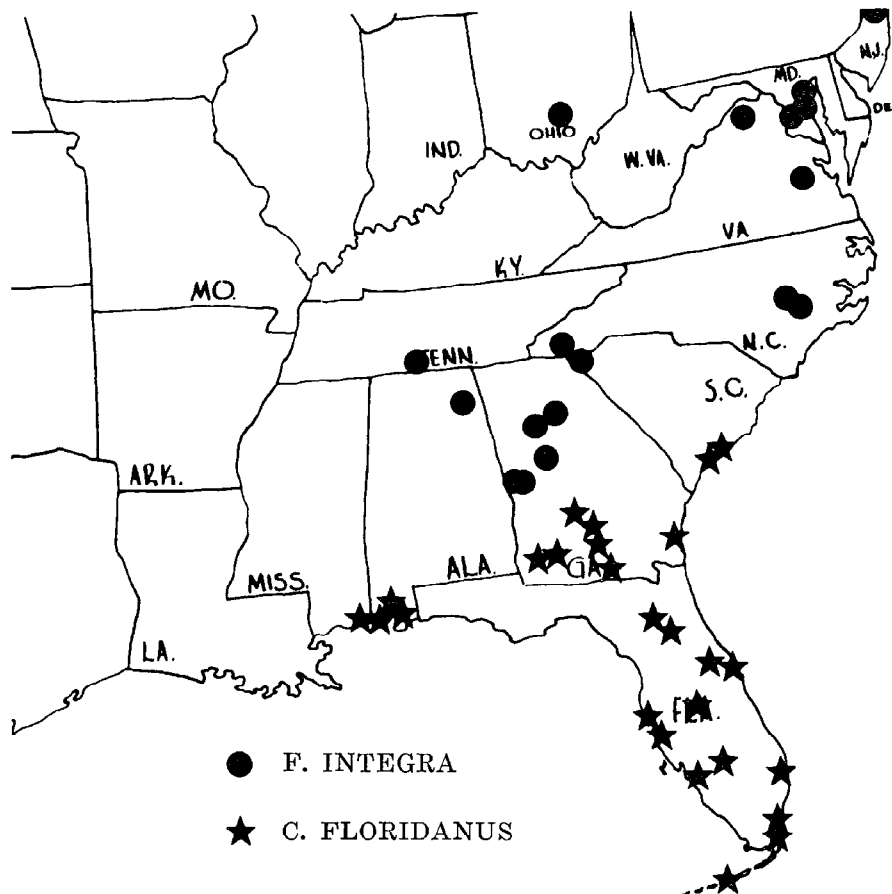


Fig. 1. Known distribution of *Camponotus abdominalis floridanus* (stars) and *Formica integra* (circles) in the southeastern USA (from Florida State Collection of Arthropods, USNM, and field collection records).

*Camponotus a. floridanus* is common in slash pine plantations of all ages in Florida where it has been observed to prey on newly-emerged pine sawfly adults (unpubl.), but almost nothing is known about its relation to other slash pine pests. It is recommended that the role of the Florida carpenter ant be investigated to determine if it has potential for management as a control agent.

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### EFFECTS OF *HELIOTHIS VIRESCENS*<sup>1</sup> LARVAL SIZE ON PREDATION BY *GEOCORIS PUNCTIPES*<sup>2,3</sup>

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#### ABSTRACT

The ability of nymphal and adult *Geocoris punctipes* (Say) to successfully attack and kill *Heliothis virescens* (F.) larvae of different sizes was evaluated. Successful predation or prey consumption decreased as larval size

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<sup>2</sup>Hemiptera: Lygaeidae.

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