Ipps spp. natural enemy relationships in the Gulf Coastal states

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SECTION TEN

Ips spp. Natural Enemy Relationships in the Gulf Coastal States

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INTRODUCTION

Colonization of southern yellow pines by *Ips* spp. bark beetles results in the creation of a habitat utilized by a large complex of insect associates. The beneficial insect component, i.e., predatory and parasitic species, associated with *Ips calligraphus* and *I. grandicollis* is dominated by predators. In the Gulf coastal states of Louisiana and Texas, nearly 99 percent and 95 percent, respectively, of the beneficial complex in terms of numbers of adults obtained from exclusion studies were known predators or facultative predators.

In Louisiana on felled loblolly and slash pines the species composition of *Ips* broods consisted of *I. calligraphus* (80.2 percent), *I. avulsus* (11.2 percent), and *I. grandicollis* (8.2 percent). In Texas on loblolly and shortleaf pines the complex consisted of *I. grandicollis* (72 percent), *I. avulsus* (20 percent), and *I. calligraphus* (8 percent). Studies conducted by Riley and Goyer (1986) revealed that the emergent *Ips* spp. broods were reduced 30.8 percent as a result of insect predators and parasites.

In the two states 32 species of predators representing 15 families and 14 species of parasites representing 7 families were recorded (Bing 1985, Riley and Goyer 1986).

LOUISIANA STUDIES

In Louisiana, the most abundant predators were *Lonchaea* sp. larvae (Diptera: Lonchaeidae) which accounted for 45.2 percent of all predators and 44.7 percent of the entire beneficial complex. The adults and larvae of *Aulonium* spp. (Coleoptera: Colydiidae) accounted for 17.5 percent of all predators. Adults of the family Staphylinidae accounted for 6.8 percent of all predators and the adults and larvae of all histerid species accounted for 6.0 percent. *Scoloposcelis mississippensis* Drake and Harris, (Hemiptera: Anthocoridae), comprised 4.3 percent of all predators while the predatory genera of *Zabrachia* (Diptera: Stratiomiidae), *Corticeus* (Coleoptera: Tenebrionidae), and *Plegaderus* sp. (Coleoptera: Histeridae) accounted for 3.6, 2.1, and 1.0 percent, respectively. *Platysoma attenuatta* (Coleoptera: Histeridae) (LeConte), *Temnochila virescens* (F.) (Coleoptera: Trogositae), and *Thanasimus dubius* (F.) (Coleoptera: Cleridae) comprised 1.5, 1.4, and 1.0 percent, respectively, of all predators (Fig. 1). Several of the predators of *Ips* were recovered in the larval stage at, and identification, in many cases, could not be made below generic or family taxon.

The most abundant species of parasite was *Roptrocerus eccoptogastri* (Hymenoptera: Ptermalidae) comprising 37.3 percent of the total parasite complex but only 0.5 percent of the total beneficial complex. An unidentified wasp in the family Encyrtidae was the second most abundant parasite species accounting for 19.0 percent of all parasites and 0.2 percent of all beneficials.

Stein and Coster (1977), in their study of SPB in loblolly and shortleaf pines in Texas, found that 12 predator and 9 parasite species comprised 99 percent of their natural enemy complex. Parasites in their study were found in much greater abundance than in the present study. Composition of their most abundant predators were similar to ours with the exception of *Lonchaea* sp. (our most abundant species). Moser et al. (1971) also found a greater composition of parasites than we did.

In evaluating the parasite complex of southern bark beetles, several researchers (e.g., Berisford and Franklin 1969, 1972, Stein and Coster 1977, Goyer and Finger 1980) found *Roptrocerus eccoptogastri* (also cited by some workers as *R. xylophagorum*) to be the most abundant parasite

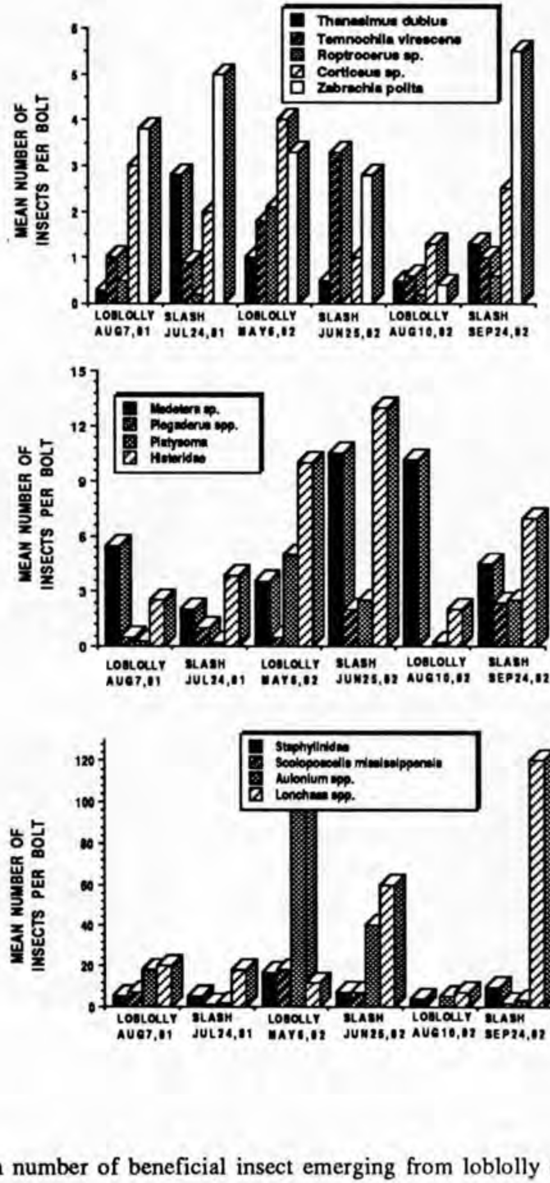

Fig. 1. Mean number of beneficial insect emerging from loblolly and slash pines in Louisiana.

species as in our study. Berisford and Franklin (1969, 1972), studying *Ips avulsus* and *I. grandicollis* associates, found 4 parasite species made up 95 percent of their total insect beneficial complex, with *R. eccoptogastri* comprising 75 percent of all parasites found. Their data reflected insects collected attacking the trees, whereas the numbers in our study reflect those insects emerging from *Ips*-infested bolts (Fig. 1, Fig. 2).

Lonchaea sp. showed two peaks of abundance, one from the September 1981 felling date and one from the June 1982 felling date, Fig. 2. There was no corresponding abundance peak from the previous September felling date. Bing (1985) found *Lonchaea* to be most abundant May through June in Texas.

Several predator and parasite species (e.g. *P. attenuatta*, *S. mississippensis*, *Corticeus* spp., staphylinids, *Aulonium* spp., and *R. eccoptogastri*) appeared to follow an abundance pattern similar to that of *Ips* beetles.

Smith and Goyer's studies (1980) of *Corticeus glaber* from SPB-infested logs showed similar seasonal abundance patterns to those of our study (peaks in spring and fall and lower populations in the summer). They found *C. parallelus* though, to be only abundant in June. Bing (1985) found *Corticeus* spp. to be most abundant in May and July. Stein and Coster's study (1977) showed a peak population of *Corticeus* spp. in spring and a decline through summer. Abundance patterns of *S. mississippensis* as observed by Stein and Coster (1977) revealed a pattern which contrasted from ours. They found *S. mississippensis* populations to build from February through September. Bing (1985) found *S. mississippensis* to peak July through August and in October. Studies of *R. eccoptogastri* (reared from infested boles) by Goyer and Finger (1980) revealed populations of this parasite to be highest in late spring. However, they found a second peak for this parasite in August which is not seen in our data. Bing (1985) and Stein and Coster (1977) found *Roptrocerus* numbers in a pattern similar to ours (a peak in May and low numbers at other times).

Seasonal abundance of histerids as a group, including their larvae, showed maximum numbers from the June felling date, lowest numbers in August, and an intermediate level in the fall. *Plegaderus* sp. adults had three peaks of similar magnitude each coinciding with a slash pine felling date, Fig. 1. Contrasting these results, Stein and Coster's (1977) findings on seasonal abundance for *Platysoma* spp. (including *P. attenuata*, *P. cyclindrica*, and *P. parallelum*) and also for *Plegaderus* sp. showed a gradual rise in populations from spring through September. Populations of *Plegaderus* sp. were higher on shortleaf pine than on loblolly pine.

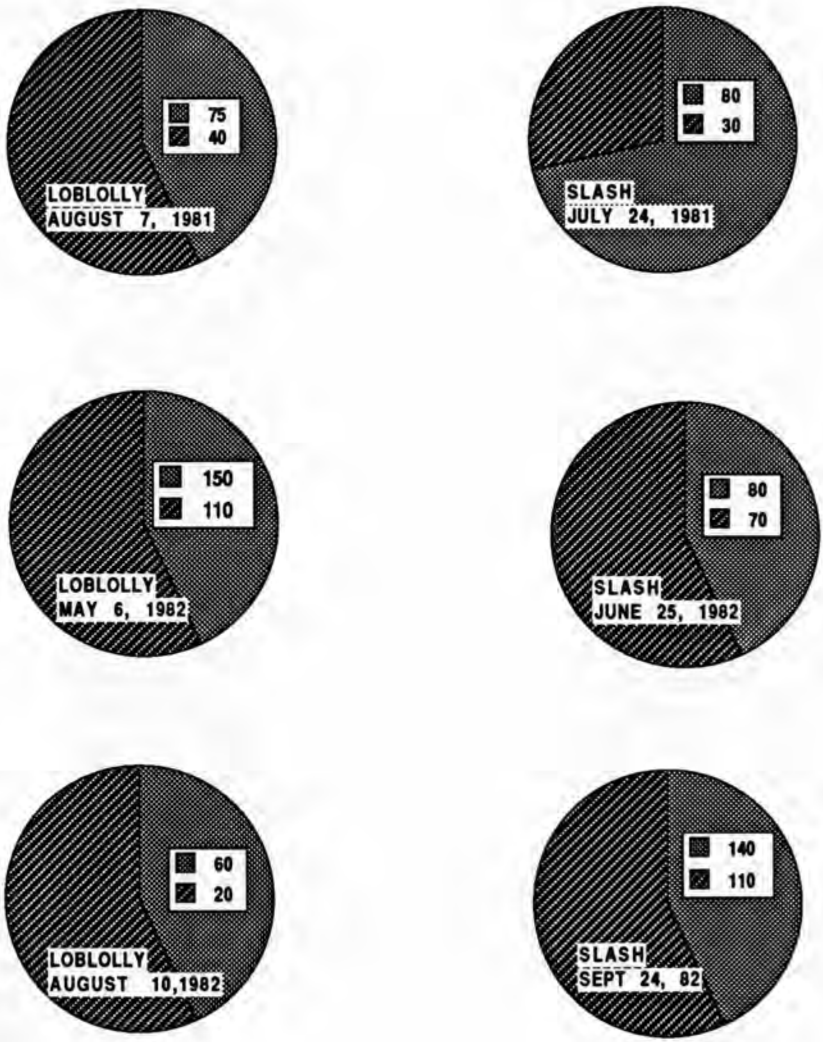

Fig. 2. Mean number of *Ips* spp. and beneficials emerging per 100 sq. cm. from loblolly and slash pine bolts in Louisiana; top number is *Ips* and lower number is beneficials.

TEXAS STUDIES

Medetera bistriata (Diptera: Dolichopodidae) made up 17.2 percent of the predator complex and 17.1 percent of the beneficials (Fig. 3). *Medetera bistriata* was found in relatively uniform populations throughout the season. Moser et al. (1971) and Dixon and Payne (1979) both found this fly a very abundant predator of *D. frontalis*. Moser et al. (1971) found *M. Bistriata* present year round. Riley and Goyer (1988) found *M. Bistriata* most abundant in June and August.

Medetera bistriata was found in significantly larger numbers in loblolly pine. It was found in constant numbers throughout the season in loblolly pine; however, in shortleaf pine they were found in very low numbers in May increasing to about the same numbers found in loblolly pine by August. *Medetera bistriata* also was found in significantly higher numbers in the top of the tree suggesting they are attracted to the section of tree with the highest population of bark beetles.

Scoloposcelis mississippensis, found in peak numbers in July through August and in October, made up 5.8 percent of the predator complex and 5.4 percent of the beneficial complex. Stein and Coster (1977) found *S. mississippensis* in peak populations in the fall whereas Riley and Goyer (1988) found it most abundant in May and June following peak numbers of bark beetles.

Scoloposcelis mississippensis was found in significantly larger numbers in shortleaf than in loblolly pine. In loblolly pine, it was found in peak numbers in July suggesting, as Riley and Goyer (1988) found, that it follows an abundance pattern similar to the *Ips* beetles. In the rest of the season it was found in very low numbers. *Scoloposcelis mississippensis* occurred sporadically in shortleaf pine but increased at the end of the season.

Lonchaea spp. and *Zabrachia polita* made up 5.6 percent and 4.0 percent of the predator complex (5.0 percent and 3.8 percent of the beneficial complex) respectively. They showed a seasonal abundance pattern with *Lonchaea* spp. most common from May to July and *Z. polita* most common in August through October. Moser et al. (1971) found *Lonchaea* spp. present from April to June and *Z. polita* abundant in May through August. Riley and Goyer (1988) found *Lonchaea* spp. the most abundant predator in her study, with peaks in June and again in September; she also found *Z. polita* most abundant in May through June and again in August through September. Her study did not show the relationship found by Bing (1985) between *Lonchaea* spp. and *Z. polita*.

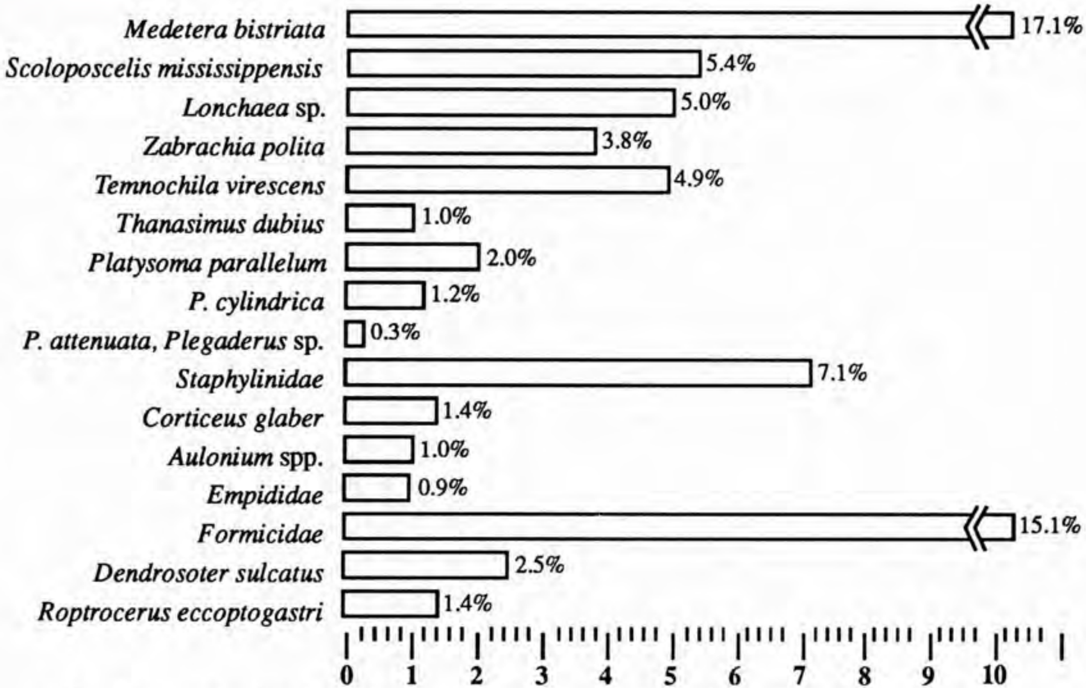

Fig. 3. Percent beneficial complex by species, lobolly and shortleaf pine, Texas.

Two beetles *Temnochila virescens* and *Thanasimus dubius* made up 5.2 percent and 1.1 percent of the predator complex (4.9 percent and 1.0 percent of the beneficial complex) respectively. Both species showed peak populations in July suggesting that they follow the same abundance pattern as the *Ips* beetles. Stein and Coster (1977) found *T. dubius* most abundant from February through May. Moser et al. (1971) found it present all year long except in January, and *T. virescens* present only in July. Riley and Goyer (1988) found *T. dubius* most numerous in September with a smaller peak in May through July. In our study *T. virescens* was found in larger numbers than *T. dubius* throughout the season. Billings and Cameron (1984) found that *T. virescens* was attracted almost exclusively to *Ips* attractants but showed little response to *D. frontalis* attractants. *Thanasimus dubius*, however, was attracted in significantly larger numbers to *D. frontalis* attractants than to *Ips* attractants. This preference of *T. virescens* for *Ips* beetles explains the higher numbers of *T. virescens* than *T. dubius*.

The histerid beetles made up 4.0 percent of the predator complex (3.7 percent of the beneficial complex). The histerids complex is made up of two major and two minor species. *Platysoma parallelum* and *P. cylindrica* made up 2.1 percent and 1.3 percent of the predator complex, (2.0 percent and 1.2 percent of the beneficial complex) respectively. The two minor species, *P. attenuata* and *Plegaderus* sp. made up 0.3 percent and 0.3 percent of the parasite complex. The two most abundant histerids both had peak populations in July; however, *P. cylindrica* also had a peak in May. Stein and Coster (1977) found *Platysoma* spp. most abundant in September. Riley and Goyer (1988) found maximum numbers of histerids in May and June following an abundance similar to the *Ips* beetle.

Five species of staphylinid beetles made up 7.5 percent of the predator complex (7.1 percent of the beneficial complex). The three species of *Placusa* made up 6.3 percent of the predator complex. The combined staphylinid species were found in peak numbers in July along with the *Ips* bark beetles. Moser et al. (1971) and Riley and Goyer (1988) found staphylinids occurring from May through October, with the majority of the species occurring in May and June and in September along with the bark beetle populations.

Corticeus glaber, making up 1.4 percent of the predator complex and 1.4 percent of the beneficials, was found in high numbers in May and July. This early season peak was also found by Smith and Goyer (1980), also found a peak in emergence during October and November. Moser et al (1971) found *C. glaber* present year round. Stein and Coster (1977) found peak numbers emerging from February to May. Riley and Goyer (1988) found *C. glaber* most abundant in May.

Two *Aulonium* species were collected with the most common species (*A. tuberculatum*) making up 1.0 percent of the predator complex (1.0 percent of the beneficial complex); the other species (*A. ferrugineus*) made up only 0.02 percent of the predator complex. The *Aulonium* spp. combined were found in two peaks throughout the summer, one in July and another in September. Moser et al. (1971) found them present year round. Riley and Goyer (1988) found them present in peak numbers in May.

An empidid fly species was found to make up 0.9 percent of the predator complex and 0.9 percent of the beneficial complex. The empidid species was most abundant in May and June and present at low levels the rest of the season. Moser et al. (1971) found them present only in July. No other seasonal information is available on empidids associated with bark beetles in the southeastern United States.

In Texas in 1983, *Sacium* sp. (Coleoptera: Orthoperidae) was the most abundant facultative predator making up 30 percent of the predator complex and 28.1 percent of the beneficial complex. *Sacium* sp. is carnivorous, occurring under decaying bark or rotting fungus-covered plant material (Moser et al. 1971, Arnet 1973, Dixon and Payne 1979). *Sacium* sp. populations increased from May through June, peaked in July and September, and declined sharply in October. The peak in July suggests that it follows an abundance pattern similar with *I. grandicollis*. Moser et al. (1971) found *Sacium* sp. most abundant in March and again in August through September.

Three species of ants (*Crematogaster* sp. and two unidentified species) made up 16.1 percent of the predators and 15.1 percent of the beneficials. These predators attack bark beetle adults and larvae on and under the bark surface (Dixon and Payne 1979).

Dendrosoter sulcatus (Hymenoptera: Braconidae) was the most abundant parasite making up 38.4 percent of the parasite complex and 2.5 percent of the beneficial complex. Dixon and Payne (1979) found it the third most abundant in their study. Bing (1985) found *D. sulcatus* most abundantly in May and June and again in September. Stein and Coster (1977) found in most abundantly in the spring and summer, and Moser et al. (1971) found both species present all year long. There were no significant differences in populations of *D. sulcatus* between the tree species. There was, however, significantly more *D. sulcatus* in the top of the trees probably due to a combination of thinner bark and higher beetle populations.

The second most numerous parasite, *Roptrocerus eccoptogastri*, comprised 22.3 percent of the parasite complex and 1.4 percent of the beneficials. Moser et al. (1971) and Dixon and Payne (1979) found it to be the most abundant parasite. Berisford and Franklin (1972) and Goyer and Finger (1980) both found *R. eccoptogastri* to be the major parasite in the parasite complex. *Roptrocerus eccoptogastri* was most abundant in Texas in May and found at low numbers throughout the rest of the season. Stein and Coster (1977) found it most abundant from March through May. Riley and Goyer (1988) found *R. eccoptogastri* most abundant in May .

Eleven minor parasites were found in association with *Ips* bark beetles. An encyrtid wasp made up 12.1 percent of the parasites (0.8 percent of the beneficials). Three braconid wasps, *Coeloides pissodis*, *Spathius pallidus*, and *Meteorus hypophloei* made up 2.3 percent, 0.9 percent, and 1.3 percent of the parasite complex (0.2 percent, 0.1 percent, and 0.1 percent of the beneficials), respectively. An Ichneumonid wasp made up 3.0 percent of the parasites (0.2 percent of the beneficials). Three pteromalid wasps (*Heydenis unica* and two species near *Dinotiscus*) made up 0.7 percent and 5.0 percent of the parasites (0.1 percent and 0.3 percent of the beneficials), respectively. A scelionis wasp (*Probaryconus* sp.) made up 5.4 percent of the parasite complex (0.4 percent of the beneficials). Two platygasterid wasps (*Platygaster* sp. and an unidentified species) made up 6.1 percent and 2.5 percent of the parasites (0.4 percent and 0.2 percent of the beneficials), respectively.

Cerambycids are thought to be either food competitors (Moser et al. 1971), or to kill bark beetles by their forging behavior (Miller 1984). Three cerambycids, *Monochamus titillator*, *M. carolinensis*, and *Neacanthocinus obsoletus*, were found to make up only about 1 percent of the total associate complex, however, they have the ability to destroy a large section of the phloem resource. Cerambycids increased significantly in August and September from a constant early season level. This increase may be due to the increased availability of phloem due to a drop in *Ips* numbers. Another reason for this increase may be that cerambycids function better in hotter weather than *Ips* beetles, thus enabling them to respond quicker and in larger numbers to a downed tree. Miller (1984) suspected that cerambycids did not arrive at a downed tree as quickly in cooler months as they did in late summer.

CONCLUSIONS

Overall, the temporal and numerical relationship between *Ips* spp. and their insect enemies indicated a density dependent relationship in felled pines in the Gulf coastal states of Louisiana and Texas. Some species of beneficials preferred different temperatures and ecological niches thus avoiding competition for *Ips* prey. Data indicated significant population reduction as a result of the combined feeding by the beneficial complex.

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Potential for BIOLOGICAL CONTROL of *Dendroctonus* and *Ips* BARK BEETLES

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and
Mitchel C. Miller