#51

Reprinted from ANNALS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA, volume 64, number 1, pages 72-77. January 1971.

Relative Abundance of Southern Pine Beetle[1] Associates in East Texas[2]

J. C. MOSER,[3] R. C. THATCHER,[4] AND L. S. PICKARD[3]

ABSTRACT

More than 90 species of insects were identified in bolts taken from east Texas loblolly pines infested by the southern pine beetle, *Dendroctonus frontalis* Zimmermann and by *Ips* engraver beetles (Coleoptera: Scolytidae). Seasonal abundance of the associates generally paralleled that of the southern pine beetle.

Dendroctonus frontalis Zimmermann is probably the most destructive insect in southern forests, and control by natural means is a subject of considerable interest. It has been well documented (e.g., Chamberlin 1939, Craighead 1950) that some obvious parasites and predators take a considerable toll, but the beetle has many less-known associates that may also be important.

Accurate life tables (e.g., Berryman 1968) can be constructed only when all major mortality factors can be assessed. A list of insect associates compiled

[1] *Dendroctonus frontalis* Zimmermann (Coleoptera: Scolytidae).

[2] Received for publication June 13, 1969.

[3] Research Entomologist and Biological Technician, respectively, at the Alexandria Forestry Center, Southern Forest Experiment Station, USDA Forest Service, Pineville, La. 71360.

[4] Present address: USDA Forest Service, Division of Forest Insect and Disease Research, Washington, D. C. 20250.

Table 1.—Insect associates of *Dendroctonus frontalis* and *Ips* spp.

Order, family, and species	Months collected	Height of occurrence[a]	No. samples in which found	No. emerged/ft² bark[b] Range	Mean	Role[c]
ORTHOPTERA (det. A. B. Gurney)						
Gryllidae						
Anixipha sp.	2	2	1	0.6	0.6	Unknown; T. J. Walker[d]
PSOCOPTERA (det. E. L. Mockford)						
Psocidae						
Hyalopsocus floridanus (Banks)	12	1	1	.5	.5	Prob. feeds on algae and lichens on bark surface; E. L. Mockford[d]
Lepidopsocidae						
Echmepteryx hageni (Packard)	5, 6, 8, 10, 12	1–3	6	.5– 1.1	.7	Do.
HETEROPTERA (det. J. L. Herring)						
Anthocoridae						
Lyctocoris elongatus (Reuter)	3, 4, 6–9	1, 2	18	.3– 3.3	.8	Predator of bark beetle eggs and larvae; Fronk 1947
Scoloposcelis mississippensis (Drake & Harris)	1, 3–11	1–4	76	.4– 24.2	3.2	Do.
Aradidae						
Aradus cinnamomeus Panzer	8–10	1–3	15	.4– 2.4	.9	Saprophagous on pines; Blatchley 1926, Usinger and Matsuda 1959
A. inornatus Panzer	7	...	1	...	...	Unknown
Cydnidae						
Species unknown	6	1	1	.8	.8	Unknown
COLEOPTERA						
Staphylinidae (det. D. H. Kistner)						
Leptacinus paurumpunctatus (Gyllenhal)	5, 6, 9	1	3	.4– 0.5	.5	Predator?
Pseudolispinodes tenellus Erickson	5–8, 10	1, 2	4	.4– 2.0	1.1	Do.
13703 (unidentified)	5, 7, 8, 10	1, 2	6	.4– 2.0	1.2	Do.
13704 (unidentified)	5–7	1, 2	3	.5	.5	Do.
Histeridae (det. R. L. Wenzel)						
Cylistix attenuata LeConte	3, 5–9	1–4	43	.4– 14.3	2.6	Predator of bark beetles and associates; R. L. Wenzel[d]
C. cylindrica (Paykull)	3–11	1–3	36	.4– 8.5	1.2	Do.
Epierus pulicarius Erichson	6, 7	1	2	.5– 1.0	.7	General predator, mycophagous; R. L. Wenzel[d]
Platysoma parallelum Say	3, 5–10	1, 2	24	.4– 3.4	.8	Predator of bark beetles and associates; R. L. Wenzel[d]
Plegaderus pusillus LeConte	3–9	1, 2	31	.4– 6.8	1.6	Predator of bark beetle eggs and small larvae; R. L. Wenzel[d]
P. transversus Say	4–10	1, 2	30	.4– 2.0	1.0	Do.
Ostomidae (det. J. R. Barron, D. M. Weisman)						
Temnochila virescens (F.)	7	1, 2	2	.6– .8	.7	Predator on larvae and adults of Df, Ia, Ig, and Ic[e]
Tenebroides collaris (Sturm)	2, 6–10	1–3	18	.4– 1.8	.6	Predator on larvae and adults of Df, Ia, Ic[e]
T. marginatus (Palisot de Beauvois)	6–10	1, 2	5	.4– .6	.5	Predator on bark beetle larvae, ? adults
Cleridae (det. G. B. Vogt)						
Thanasimus dubius (F.)	2–12	1–4	36	.4– 15.1	2.0	Predator on Df, Ia, Ig, and Ic larvae and adults; Thatcher and Pickard 1966
Melyridae (det. J. M. Kingsolver)						
Melyrodes cribratus LeConte	2	1	1	.5	.5	Predator on eggs, larvae, soft-bodied adults; Arnett 1960

Table 1.—(Continued)

Order, family, and species	Months collected	Height of occurrence[a]	No. samples in which found	No. emerged/ft² bark[b] Range	Mean	Role[c]
Tenebrionidae (det. T. J. Spilman, C. A. Triplehorn)						
Corticeus glaber LeConte	1–12	1–4	174	.2– 92.0	6.1	Prob. facultative predator[e]
C. parallelus Melsheimer	2–10	1–4	52	.3– 14.2	1.8	Do.
Crypticus obsoletus (Say)	5	2	1	.8	.8	Plant feeder?; Triplehorn[d]
Opatrinus minimus (Palisot de Beauvois)	5	2	1	.8	.8	Do.
Rhizophagidae (det. J. M. Kingsolver)						
Rhizophagus sp.	9	2	1	.6	.6	Predator; Arnett 1960
Cucujidae (det. T. J. Spilman)						
Catogenus rufus (F.)	1, 10	2, 3	2	.5– .7	.6	Parasite of cerambycids and braconids; Arnett 1960
Nausibius repandus LeConte	1	3	1	.7	.7	Unknown
Silvanus bidentatus (F.)	5	1	1	2.8	2.8	Predator of wb?; Sweetman 1958
Orthoperidae (det. R. Gordon)						
Sacium sp.	3, 8, 9	1, 2	4	.6– .9	.7	Carnivorous; Arnett 1960
Colydiidae (det. J. M. Kingsolver, P. J. Spangler)						
Aulonium ferrugineum Zimmermann	1–12	1–4	86	.4– 13.7	2.0	Predator?; Kingsolver and White 1967
A. tuberculatum LeConte	1–12	1–4	73	.3– 7.9	1.7	Do.
Colydium lineola Say	6	1	1	.5	.5	Predator on ambrosia beetles, cossonids, and borers; Craighead 1950
Lasconotus pusillus LeConte	4, 5, 7, 8	1, 2	8	.4– 1.0	.6	Scavenger; Craighead 1950
L. referendarious Zimmermann	2–10, 12	1–4	114	.2–117.9	5.4	Adult feeding on larvae; Overgaard[d]
Synchita granulata Say	1	1	1	.6	.6	Mycophagous; Craighead 1950
Cerambycidae (det. J. N. Knull, L. Cambre)						
Acanthocinus sp.	5, 7–11	1–4	19	.4– 3.1	1.1	Food competitor[e]
Monochamus carolinensis (Olivier)	7–9	1, 2	5	.5– 1.1	.9	Do.
M. titillator (F.)	5–12	1–4	29	.4– 4.0	1.3	Do.
Neacanthocinus obsoletus (Olivier)	6–9, 11	1–3	24	.4– 4.5	1.1	Do.
Tylocerina nodosus (F.)	7–9	1, 2	9	.4– 1.7	.8	Do.
Curculionidae (det. R. E. Warner)						
Cossonus corticola Say	3–9	1–3	59	.3– 19.8	2.5	Scavenger; Craighead 1950
Pissodes nemorensis Germar	1–3, 7, 10–12	1–4	14	.4– 8.4	2.1	Food competitor[e]
Platypodidae (det. S. L. Wood)						
Platypus flavicornis F.	6, 7	1	2	.4– 1.0	.7	Pinhole borer in sapwood; Thatcher 1960
Scolytidae (det. S. L. Wood, D. M. Anderson)						
Crypturgus alutaceus Schwarz	3–10	1–4	69	.4–364.4	25.2	Food competitor[e]
Gnathotrichus materiarius (Fitch)	3	3	1	.5	.5	Ambrosia beetle[e]
Pityophthorus annectans LeConte	1–12	1–4	47	.4– 35.5	3.0	Food competitor[e]
P. bisulcatus Eichhoff	5, 8	1	2	.4– 1.1	.7	Do.
Dendroctonus frontalis Zimmermann	1–12	1–4	338[f]	1–694	129.5	Bark beetle
Ips avulsus (Eichhoff), *I. grandicollis* (Eichhoff) *I. calligraphus* (Germar)	1–12	1–4	158	1–866	52.3	Do.
DIPTERA						
Sciaridae (det. R. V. Gagné)						
Scatopsciara radialis (Shaw)	1–3, 5, 6, 10–12	1–4	25	.4–167.9	18.5	Mycophagous; R. V. Gagné[d]
Cecidomyiidae (det. R. V. Gagné)						
Cecidomyia sp.	5	3	1	.6	.6	In Pitch; R. V. Gagné[d]
Lestodiplosis sp.	1–12	1–4	79	.3– 91.5	3.4	Predator; R. V. Gagné[d]
Lobodiplosis triangularis Felt	5–7, 9, 10	1–3	16	.1– 1.2	.6	Unknown; R. V. Gagné[d]
Winnertzia sp.	3–12	1–4	38	.3– 8.2	1.3	Mycophagous; R. V. Gagné[d]

Table 1.—(Continued)

Order, family, and species	Months collected	Height of occurrence[a]	No. samples in which found	No. emerged/ft² bark[b] Range	Mean	Role[c]
Stratiomyiidae (det. W. W. Wirth)						
Zabrachia polita Coquillett	5–8	1–4	15	.4– 4.4	1.5	Scavenger?; Craighead 1950
Therevidae (det. W. W. Wirth)						
Psilocephala haemorrhoidalis (Macquart)	5, 8	1, 3	2	.6– .9	.7	Predator?; L. Knutson[d]
Empididae (det. L. V. Knutson)						
Drapetis sp.	7	1	1	.5	.5	Unknown
Dolichopodidae (det. G. Steyskal)						
Medetera bistriata Parent	1–12	1–4	250	.2– 27.9	4.4	Predator of scolytid brood[e]
Lauxaniidae (det. R. H. Foote)						
Species unknown	1, 8	1, 3	2	.6– .9	.8	Scavenger?
Lonchaeidae (det. J. F. McAlpine)						
Lonchaea auranticornis McAlpine	1, 4–6, 11, 12	1–4	27	.4– 10.2	2.5	Predator?; Craighead 1950
L. polita Say	1	1	1	4.7	4.7	Do.
Tachinidae (det. C. W. Sabrosky)						
Spathimeigenia spinigera Townsend	10	1	1	.4	.4	Parasite of sawflies; Stone et al. 1965
HYMENOPTERA						
Braconidae (det. P. M. Marsh)						
Apantcles sp.	8	1	1	.9	.9	Parasite of Lepidoptera; Muesebeck et al. 1951
Atanycolus comosifrons Shenefelt	5, 7, 8	1, 2	8	.4– 1.1	.6	Parasite of wb larvae; Muesebeck et al. 1951
Cenocoelius nigrisoma (Rohwer)	5, 7, 11	1–3	4	.5– 1.7	1.0	Parasite of Df and wb; Muesebeck et al. 1951[e]
Coeloides pissodis (Ashmead)	2–12	1–4	67	.4– 23.2	3.2	Parasite of Df, Ic, Ig, *Pissodes nemorensis;* Muesebeck et al. 1951, Krombein 1958, Krombein and Burks 1967[e]
Dendrosoter sulcatus Muesebeck	2–12	1–3	116	.2– 28.1	4.0	Parasite of Df, Ia, Ic, Ig; Muesebeck et al. 1951, Krombein 1958, Krombein and Burks 1967[e]
Doryctes sp.	5–8	1	6	.4– 1.2	.6	Parasite of Df[e]
Spathius pallidus Ashmead	2–12	1–3	35	.3– 8.3	1.3	Parasite of Df, Ig, wb[e]
Ichneumonidae (det. L. M. Walkley)						
Cremastus sp.	9	1	1	.5	.5	Parasite of Lepidoptera; Muesebeck et al. 1951.
Scambus sp.	8	1	1	.6	.6	Do.
Eulophidae (det. B. D. Burks)						
Melittobia chalybii Ashmead	1, 8	1	2	.4– 0.6	.5	Parasite of aculeate Hymenoptera or their parasites; Krombein and Burks 1967
Tumidiscapus sp.	8	2	1	1.1	1.1	Unknown
Encyrtidae (det. B. D. Burks)						
Oobius sp.	3	3	1	.6	.6	Egg parasite; Burks[d]
Eupelmidae (det. B. D. Burks)						
Eupelmus cyaniceps cyaniceps Ashmead	8	1, 3	3	.6– 1.0	.8	General parasite; Muesebeck et al. 1951
Lutnes sp.	6	1	1	.4	.4	Prob. parasite of bark beetles; B. D. Burks[d]
Torymidae (det. B. D. Burks)						
Roptrocerus xylophagorum (Ratzeburg)	1–12	1–4	211	.2– 97.9	10.1	Parasite of Df, Ia, Ig, Ic[e]
Pteromalidae (det. B. D. Burks)						
Heydenia unica Cook & Davis	3–12	1–4	84	.3– 25.0	3.8	Parasite of Df, Ia[e]
Pachycrepoideus sp.	11	3	1	.8	.8	Parasite of Diptera; Muesebeck et al. 1951
Rhopalicus pulchripennis (Crawford)	3, 5, 6, 10, 12	1–4	15	.4– 5.8	1.2	Parasite of scolytids and *Pissodes;* Muesebeck et al. 1951

Table 1.—(Continued)

Order, family, and species	Months collected	Height of occurrence[a]	No. samples in which found	No. emerged/ft² bark[b] Range	Mean	Role[c]
Eurytomidae (det. R. E. Bugbee)						
Eurytoma tomici Ashmead	3–11	1, 2	9	.4– 1.0	.6	Parasite of *Dendroctonus*; Bushing and Bright 1965
Scelionidae (det. B. D. Burks)						
Probaryconus sp.	3, 8	1, 2	3	.4– 0.6	.5	Egg parasite?
Platygasteridae (det. B. D. Burks)						
Leptacis sp.	5, 6	1, 3	2	.4– 0.6	.5	Cecidomyiid parasite?
Platygaster, n. sp.	8	3	1	6.4	6.4	Do.
Platygaster sp.	5, 6	1, 2	5	.4– 2.3	.8	Do.
Formicidae (det. M. R. Smith, D. R. Smith)						
Camponotus nearcticus Emery	9	4	1	2.1	2.1	Feeds on honeydew, dead and living insects; Creighton 1950, Wheeler 1926
Crematogaster ashmeadi Mayer	3–12	1–4	48	.3– 12.6	1.8	Do.
C. clara Mayr	7	1	2	.5– 0.6	.5	Do.
Dorymyrmex pyramicus (Roger)	8	1	1	.9	.9	Do.
Leptothorax schaumi Roger	9	2	1	.5	.5	Do.
Monomorium minimum (Buckley)	6, 7, 9	1, 3	4	.5– 3.7	1.3	Do.
Paratrechina parvula (Mayr)	6	3	1	.4	.4	Do.
Pheidole m. metallescens Emery	6, 8	1, 2	2	.8– 0.9	.9	Feeds on insects; Creighton 1950
Solenopsis (Diplorhoptrum) sp.	8	1	1	.4	.4	Unknown

[a] 1 = 17–18 ft; 2 = 34–35 ft; 3 = 51–52 ft; 4 = 68–69 ft.
[b] Emergence data for insects with long life cycles (i.e., cerambycids) are conservative.
[c] Df = *Dendroctonus frontalis*; Ia = *Ips avulsus*; Ig = *I. grandicollis*; Ic = *I. calligraphus*; wb = wood borers.
[d] Personal correspondence.
[e] Observed by authors.
[f] This number represents only those bolts from which brood adults emerged; all 383 bolts were attacked by *D. frontalis*.

by Overgaard (1968) was a 1st step in this direction. Another requisite is information on the abundance of competing forms (Berryman 1967). In the study reported here, we tallied density of all associates found during 3½ years of sampling in an outbreak area of east Texas. The data indicate occurrence by time of year and height in tree. The report is a byproduct of research on the seasonal activity of the southern pine beetle (Thatcher and Pickard 1964), and a revision of previously published lists (Thatcher 1960).

METHODS AND MATERIALS

Sampling was begun in May 1960 and continued through October 1963. Sample bolts 12 in. long (in 1960 and 1961) or 18 in. long (in 1962 and 1963) were taken at 16-ft intervals up the bole of 187 dominant and codominant pines containing the southern pine beetle in late life stages. Sampling was biweekly from March through October of each year and monthly from November through February. Two trees were felled on each sampling date, and 1–4 bolts were obtained per tree, depending on the length of stem infested by the southern pine beetle; in all, 383 bolts were processed. The trees were randomly selected from a 17-county area in the lower Gulf Coastal Plain of eastern Texas.

Entire 12-in. bolts, or equivalent lengths from the longer bolts, were placed singly in cans for rearing. Emerging insects were collected daily, identified, and counted. On completion of rearing, the number of specimens emerging per square foot of bark was determined for each species.

RESULTS

As Table 1 indicates, associates of 96 species emerged from the bolts; for comparative purposes the table also records data on *D. frontalis*. The black turpentine beetle, *D. terebrans* (Olivier), had attacked some of the trees, but the infestations were always below the 16-ft point on the boles and hence were not represented in the bolts.

The associates included 24 hymenopterous parasites of subcortical insects, of which 9 are known to parasitize 1 or more pine bark beetle species. The most frequently encountered wasps were *Cocloides pissodis*, *Dendrosoter sulcatus*, *Spathius pallidus*, *Heydenia unica*, and *Roptrocerus xylophagorum*.

As many as 29 of the species may be predators of bark beetles. *Scoloposcelis mississippensis*, *Thanasimus dubius*, *Medetera bistriata*, *Cylistix cylindrica*, *C. attenuata*, and *Plegaderus pusillus* were the most abundant.

The emergents also included 9 species that compete for the food supply, i.e., the inner bark utilized by bark beetles. The remainder were fungus feeders, scavengers, plant feeders, pinhole borers, transients, or insects with unknown roles (Thatcher 1960).

Except for *T. dubius*, seasonal abundance of the leading parasites and predators, as well as many of the less prominent species, closely paralleled that of the southern pine beetle. Emergence of this bark beetle was highest in spring and early summer, but tapered off from July through early September (Thatcher and Pickard 1964).

Ips engraver beetles were present in all months but usually were most numerous late in summer. While the 3 common species were not distinguished in the tallies, *I. avulsus* was the most plentiful.

Except for 1 anthocorid and 3 histerids, tree-height distribution of associates approximated that of scolytids.

Overgaard's rearings (1968) generally yielded the same bark beetle parasites and predators, plus a few additional species from bolts collected in Louisiana or Mississippi. Early season emergence of hymenopterons from Texas material was similar for both studies, but in late summer Overgaard found a 2nd peak of activity that was not apparent in our data.

REFERENCES CITED

Arnett, R. H., Jr. 1960. The Beetles of the United States. Catholic University Press, Washington, D. C. 1111 p.

Berryman, A. A. 1967. Estimation of *Dendroctonus brevicomis* (Coleoptera: Scolytidae) mortality caused by insect predators. Can. Entomol. 99: 1009–14.

1968. Development of sampling techniques and life tables for the fir engraver *Scolytus ventralis* (Coleoptera: Scolytidae). Ibid. 100: 1138–47.

Blatchley, W. S. 1926. Heteroptera, or True Bugs of Eastern North America, with Especial Reference to the Faunas of Indiana and Florida. Nature Publishing Co., Indianapolis. 1116 p.

Bushing, R. W., and D. E. Bright. 1965. New records of hymenopterous parasites from California Scolytidae (Coleoptera). Can. Entomol. 97: 199–204.

Chamberlin, W. J. 1939. The Bark and Timber Beetles of North America North of Mexico. Oregon State Coll. Coop. Ass., Corvallis. 513 p.

Craighead, F. C. 1950. Insect Enemies of Eastern Forests. USDA Misc. Publ. 657. 679 p.

Creighton, W. S. 1950. The Ants of North America. Harvard Univ., Mus. Comp. Zool. Bull. 104. 568 p.

Fronk, W. D. 1947. The southern pine beetle—its life history. Va. Agr. Exp. Sta. Tech. Bull. 108. 12 p.

Kingsolver, J. M., and R. E. White. 1967. A review of the genus *Aulonium* for the United States. Proc. Entomol. Soc. Washington 69: 149–54.

Krombein, K. V. 1958. Hymenoptera of America north of Mexico. Synoptic catalog. USDA Agr. Monogr. 2. First suppl. 305 p.

Krombein, K. V., and B. D. Burks. 1967. Hymenoptera of America north of Mexico. Synoptic catalog. USDA Agr. Monogr. 2. Second suppl. 584 p.

Muesebeck, C. F. W., K. V. Krombein, H. K. Townes, et al. 1951. Hymenoptera of America north of Mexico. Synoptic catalog. USDA Agr. Monogr. 2. 1420 p.

Overgaard, N. A. 1968. Insects associated with the southern pine beetle in Texas, Louisiana, and Mississippi. J. Econ. Entomol. 61: 1197–201.

Stone, A., C. W. Sabrosky, W. W. Wirth, R. H. Foote, and J. R Coulson. 1965. A catalog of the Diptera of America north of Mexico. USDA Agr. Handb. 276. 1696 p.

Sweetman, H. L. 1958. The Principles of Biological Control. Wm. C. Brown Co., Dubuque, Iowa. 560 p.

Thatcher, R. C. 1960. Bark beetles affecting southern pines: a review of current knowledge. USDA Forest Serv. South. Forest Exp. Sta. Occas. Pap. 180. 25 p.

Thatcher, R. C., and L. S. Pickard. 1964. Seasonal variations in activity of the southern pine beetle in east Texas. J. Econ. Entomol. 57: 840–2.

1966. The clerid beetle, *Thanasimus dubius*, as a predator of the southern pine beetle. Ibid. 59: 955–7.

Usinger, R. L., and R. Matsuda. 1959. Classification of the Aradidae. British Museum (Natural History), Separate Publication. 390 p.

Wheeler, W. M. 1926. Ants, Their Structure, Development and Behavior. Columbia University Press, New York. 633 p.