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SPIDERS (ARANEAE) CAPTURED IN MALAISE TRAPS IN SPRUCE-FIR FORESTS OF WEST-CENTRAL MAINE

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ABSTRACT

Spiders of 12 families, 20 genera, and 25 species were captured in modified Malaise traps deployed in spruce-fir forests of Somerset and Piscataquis Counties, Maine. Numbers of species and individuals differed between web-spinner and hunter foraging strategies. Sørensen's similarity quotient (QS) indicated that the Malaise-trapped fauna had greater similarity to arboreal than to terrestrial spider faunas of northeastern spruce-fir forests. Spider-trap interactions include accidental capture and possibly attraction; attractive features include trap architecture, concentrated potential prey, and protective shelter.

INTRODUCTION

Malaise traps (Malaise 1937) and modified versions (Gressitt and Gressitt 1962; Butler 1965; Townes 1962, 1972) primarily were designed for capture of flying insects. Such traps have been acclaimed, "one of the major advances in collecting methods in this century" (Steyskal 1981, p. 225). Malaise-trap captures include numerous species of Diptera, Hymenoptera, and Lepidoptera, with lesser numbers of Heteroptera and Coleoptera (Townes 1972). Other insect orders and arthropod classes including spiders (Arachnida, Araneae) also are trapped; however, to our knowledge Malaise traps have not been purposefully used to collect spiders.

During investigations of insecticidal impacts on terrestrial nontarget organisms (Hilburn 1981), modified Malaise traps were deployed in spruce-fir forests of west-central Maine. The forests were infested with the spruce budworm,

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Fig. 1.—Modified Malaise trap for capturing insects and spiders in spruce-fir forests, west-central Maine.

Choristoneura fumiferana (Clemens), the most destructive defoliator of conifers in the northeastern United States and Canada (Kucera and Orr 1981). Numerous insects and fewer spiders were captured in the Malaise traps; insect captures were summarized by Hilburn (1981). In this paper we describe the Malaise-trapped spiders, compare the trapped fauna with terrestrial- and arboreal-spider faunas of northeastern forests, and identify possible spider-Malaise trap interactions.

METHODS

Spiders were collected in 12 Malaise traps deployed at 12 sampling sites (1 trap/site) in spruce-fir forests of west-central Maine near Moosehead Lake. Three sites were in Somerset County; nine were in Piscataquis County. For details of sampling sites and sampling protocol, see Hilburn (1981) and Hilburn and Jennings (1988).

The Malaise traps were modifications of Townes' (1972) design and were placed on the ground in the herb-shrub layer (Fig. 1). Spiders and insects were captured in 1-pint (0.47-liter) jars containing 70% ethyl alcohol as a killing-preservative agent. Captured specimens were sorted and identified in the laboratory. Although there were six 48-h sampling periods for each site, collected spiders were combined from all sites and over all sampling dates (21 May to 29 June 1980).

Spiders were identified by the senior author; species determinations follow Kaston (1981) and other consulted sources including: Opell and Beatty (1976) for the Hahniidae; Leech (1972) for the Amaurobiidae; Chamberlin and Gertsch (1958) for the Dictynidae; Dondale and Redner (1982) for the Clubionidae; and Dondale and Redner (1978) for the Philodromidae and Thomisidae. Sexually

mature spiders were identified to species; most juveniles, including penultimate males, were identified to generic level. However, juveniles of *Philodromus* spp. were assigned to species group based on carapace and leg markings (Dondale and Redner 1978); a single juvenile of *P. placidus* Banks was identified to species based on characteristic leg markings.

Chi-square analysis (χ^2, $P = 0.05$) was used to test the null hypothesis of equal spider distribution (individuals) between foraging strategies (web spinner, hunter). Because web spinners generally are more sedentary and less mobile than hunters, we suspected that Malaise-trap catches may be biased toward capture of hunters. Sørensen's similarity quotient (QS), as defined by Price (1975, p. 341), was used to compare habitat associations (terrestrial, arboreal) for the Malaise-trapped spiders. The formula used was: QS = 2C x 100/(A + B), where A is the number of species observed in this study, B is the number of species in the compared study (e.g., Loughton et al. 1963), and C is the number of species common to both studies. Because sampling methods and intensities varied considerably among studies, the calculated QS values give only general indications of faunal affinities, not absolute associations. The comparisons were limited to spider-faunal studies of northeastern forests having spruce (*Picea* spp.) and fir (*Abies balsamea* (L.) Mill.) components.

RESULTS AND DISCUSSION

Spider taxa.—Spiders of 12 families, 20 genera, and at least 25 species were collected in Malaise traps deployed in spruce-fir forests of west-central Maine (Table 1). Species composition differed by foraging strategy; species of web spinners were more prevalent (56.0% of total species) than species of hunters (44.0%). Species richness per family ranged from one (Hahniidae, Dictynidae, Thomisidae) to four (Salticidae).

Spider numbers.—Of 86 total specimens collected, most (46.5%) were males; juveniles (32.6%) and females (20.9%) comprised the remainder. Four penultimate males were included in the juvenile category. The abundance of males is probably the result of greater male sexual-cursorial activity (Muma and Muma 1949); male spiders may move considerable distances in search of females. Individuals were distributed unevenly by foraging strategy, i.e., more hunters (54.6% of total specimens) were caught in the Malaise traps than web spinners (45.4%). However, the uneven distribution of individuals was not statistically significant ($\chi^2 = 0.74$, df = 1, $P > 0.05$) between foraging strategies.

Males and females of the sac spider *Clubiona canadensis* Emerton were by far the most commonly collected spider in the Malaise traps; this species accounted for 25.6% of all specimens.

Habitat associations.—Most of the species of spiders taken in Malaise traps have been collected in other northeastern spruce-fir forests (Loughton et al. 1963; Renault 1968). Comparisons with previous spider-faunal studies indicated that the Malaise-trapped fauna had greater similarity (i.e., higher QS values) to the arboreal fauna than to the terrestrial fauna of northeastern forests (Table 2). And, by definition (QS < 50; Price 1975) the Malaise-trapped fauna was distinct from all compared terrestrial and arboreal faunas. The relatively low similarity (QS = 11.5) between pitfall collections (Hilburn and Jennings 1988) and Malaise-trap

Table 1.—Species and numbers of spiders (Araneae) in Malaise traps, spruce-fir forests of west-central Maine, 1980.

FAMILY	SPECIES AND NUMBER
	WEB SPINNERS
HAHNIIDAE	*Antistea brunnea* (Emerton) 1 female
AMAUROBIIDAE	*Amaurobius borealis* Emerton 1 male
	Callobius bennetti (Blackwall) 3 males
DICTYNIDAE	*Dictyna phylax* Gertsch & Ivie 1 male
THERIDIIDAE	*Theridion differens* Emerton 2 males
	Theridion pictum (Walckenaer) 1 female
	Theridion spp. 1 penult. male, 3 juv.
LINYPHIIDAE	*Frontinella pyramitela* (Walckenaer) 1 juv.
	Microlinyphia mandibulata (Emerton) 1 female
ERIGONIDAE	*Dismodicus bifrons decemoculatus* (Emerton) 2 males, 4 females
	Hypselistes florens (O.P.-Cambridge) 1 male, 2 females
	Undet. spp. 1 penult. male, 3 juv.
ARANEIDAE	*Araneus* sp. 1 juv.
	Araniella displicata (Hentz) 1 male
	Nuctenea sp. 1 juv.
TETRAGNATHIDAE	*Tetragnatha versicolor* Walckenaer 2 females
	Tetragnatha sp. 1 penult. male, 5 juv.
	HUNTERS
CLUBIONIDAE	*Clubiona canadensis* Emerton 17 males, 5 females
	Clubiona kastoni Gertsch 1 male
	Clubiona trivialis C. L. Koch 1 male, 1 female
	Clubiona spp. 1 penult. male, 6 juv.
PHILODROMIDAE	*Philodromus exilis* Banks 3 males
	Philodromus placidus Banks 1 juv.
	Philodromus spp. (*rufus* group) 2 juv.
	Tibellus oblongus (Walckenaer) 3 males
THOMISIDAE	*Misumena vatia* (Clerck) 2 males
SALTICIDAE	*Eris* sp. 1 juv.
	Metaphidippus flavipedes (G. & E. Peckham) 1 male
	Metaphidippus protervus (Walckenaer) 1 female
	Sitticus finschii (L. Koch) 1 male

collections at the *same* study sites support this conclusion. The Malaise-trap spiders probably are representative of the intermediate herb-shrub layer; however, comparative studies are lacking for these strata.

Some of the Malaise-trapped species are commonly associated with terrestrial habitats; others are commonly associated with arboreal habitats. The amaurobiids, *Amaurobius borealis* Emerton and *Callobius bennetti* (Blackwall), frequently are found on or near the ground (Kaston 1981); *C. bennetti* also occurs under loose bark of spruce and fir trees killed by the spruce budworm (Jennings, unpubl. data), and on foliage of balsam fir (Loughton et al. 1963). Likewise, *Dictyna phylax* Gertsch & Ivie, *Araniella displicata* (Hentz), *Philodromus exilis* Banks, *P. placidus*, and *Metaphidippus flavipedes* (G. & E. Peckham) are most commonly found on foliage of conifers (Renault 1968; Dondale and Redner 1978; Jennings and Collins 1987b); rarely are these species found on the ground. A related species of *Philodromus, P. lutulentus* Gertsch, has been taken in Malaise traps elsewhere (Dondale and Redner 1978).

Table 2.—Comparison of Malaise-trapped spiders with terrestrial and arboreal spider faunas of northeastern forests (QS = Sørensen's Similarity Quotient). *Species list incomplete.

Habitat	Sampling Method	Forest Community	Locality	QS	Source
Terrestrial	Pitfall traps	Mixed boreal	Shebandowan, Ontario	6.0	Freitag et al. 1969
Terrestrial	Pitfall traps	Red spruce stand	University Forest, New Brunswick	14.6	Carter & Brown 1973*
Terrestrial	Pitfall traps	Fir-spruce	Elmsville and Priceville, New Brunswick	14.3	Varty & Carter 1974*
Terrestrial	Pitfall traps	Spruce-fir	Piscataquis County, Maine	9.4	Jennings et al. 1988
Terrestrial	Pitfall traps	Spruce-fir	Somerset and Piscataquis Counties, Maine	11.5	Hilburn & Jennings 1988
Arboreal	Pole-pruned branches	Fir-spruce (Balsam fir)	Green River Watershed, New Brunswick	27.8	Loughton et al. 1963
Arboreal	Pole-pruned branches	Fir-spruce (Balsam fir)	Green River Watershed, New Brunswick	23.6	Renault (1968)
Arboreal	Pole-pruned branches	Spruce-fir (Red spruce)	Piscataquis County, Maine	30.4	Jennings & Collins (1987a)

A few of the Malaise-trapped spiders in west-central Maine are known to frequent both terrestrial and arboreal habitats or intermediate herb-shrub strata. The sac spider *Clubiona canadensis* Emerton has been taken in pitfall traps, under stones, and in leaf litter (Dondale and Redner 1982); this species also occurs on foliage of red spruce, *Picea rubens* Sarg. (Jennings and Collins 1987a), and balsam fir (Loughton et al. 1963; Renault 1968). Specimens of *C. trivialis* are common inhabitants of spruce, fir, and pine (*Pinus*) foliage, but also are found under loose bark, under stones, and in leaf litter. Another species of sac spider, *Trachelas tranquillus* (Hentz), has been taken "in the folds and crevices of Malaise traps" (Dondale and Redner 1982, p. 126); Platnick and Shadab (1974) also report this species from Malaise traps. The crab spider *Misumena vatia* (Clerck) has been collected commonly on flowers and foliage of many herbs, shrubs, and deciduous trees (Dondale and Redner 1978), and coniferous trees (Jennings and Collins 1987b). *Tibellus oblongus* is usually found in tall grass (Dondale and Redner 1978), and occasionally in pitfall traps (Varty and Carter 1974; Jennings et al. 1988).

Species of Hahniidae are small spiders that spin delicate sheet webs near the ground (Kaston 1981). *Antistea brunnea* (Emerton) has been taken by pitfall traps in spruce-fir forests of Maine (Jennings et al. 1988; Hilburn and Jennings 1988), but not from the tree canopy layer. The erigonids also are small spiders that live chiefly under dead leaves near the ground (Kaston 1981); however, some species, e.g., *Hypselistes florens* (O. P.-Cambridge), are taken in large numbers by sweeping bushes and grasses (Kaston 1981), and on foliage of balsam fir (Loughton et al. 1963; Renault 1968).

Both species of comb-footed spiders captured in the Malaise traps, *Theridion differens* Emerton and *T. pictum* (Walckenaer), are common inhabitants of conifers (Renault 1968; Kaston 1981); however, *T. differens* also occurs in grass and low bushes (Kaston 1981). The bowl and doily spider, *Frontinella pyramitela* (Walckenaer), spins a characteristic sheet web in low branches, bushes, and tall grass (Kaston 1981), and on foliage of balsam fir (Loughton et al. 1963; Renault 1968). The platform spider, *Microlinyphia mandibulata* (Emerton), spins a platform-like sheet web, "usually in grass two to six inches from the ground," (Kaston 1981, p. 124); however, this species also has been taken on foliage of balsam fir (Renault 1968).

Notably absent from the Malaise-trap collections in west-central Maine were species of Agelenidae, Gnaphosidae, and Anyphaenidae. The agelenid funnel-weavers are frequently taken in pitfall traps (Carter and Brown 1973; Jennings et al. 1988; Hilburn and Jennings 1988) and on coniferous-tree foliage (Loughton et al. 1963; Renault 1968) in northeastern forests. Species of *Coelotes* and *Wadotes* are found under loose bark and stones; species of *Agelenopsis* spin their funnel webs in grasses and on bushes (Kaston 1981). Gnaphosid spiders also are frequently taken in pitfall traps in northeastern spruce-fir forests; species of *Haplodrassus* and *Zelotes* have been taken on foliage of balsam fir (Loughton et al. 1963; Renault 1968). Gnaphosid species reported taken in Malaise traps include: *Drassodes saccatus* (Emerton) (Platnick and Shadab 1976); *Herpyllus ecclesiasticus* Hentz (Platnick and Shadab 1977); *Nodocion floridanus* (Banks) (Platnick and Shadab 1980a); and *Cesonia bilineata* (Hentz) (Platnick and Shadab 1980b). *Sergiolus cyaneiventris* Simon has been collected "in insect flight traps," (Platnick and Shadab 1981). Of these gnaphosid species, only *H. ecclesiasticus* has been recorded from Maine.

Spiders of the family Anyphaenidae are long-legged active hunters (Dondale and Redner 1982); some inhabit foliage of trees and shrubs, others are found in leaf litter and in crevices under logs and stones on the forest floor. Interestingly, none have been taken in pitfall traps or in foliage samples from northeastern spruce-fir forests. Species of anyphaenids recorded taken in Malaise traps include: *Aysha gracilis* (Hentz), *Wulfila saltabundus* (Hentz), *Anyphaena pectorosa* L. Koch, and *Anyphaena aperta* (Banks), all reported by Dondale and Redner (1982); *Anyphaena maculata* (Banks), *Anyphaena pectorosa*, *Anyphaena fraterna* (Banks), and *Wulfila alba* (Hentz), all reported by Platnick (1974). Only *W. saltabundus* has been taken in Maine and Nova Scotia; the other species have more southern distributions (Platnick 1974; Dondale and Redner 1982).

Spider-trap interactions.—Are spiders attracted to Malaise traps? Or, is their presence in these traps accidental? Based on numbers and species collected during this study, we suggest that the interactions of spiders with Malaise traps may be more than accidental. Although some initial encounters with Malaise traps may be accidental, we suspect that spiders respond favorably to attractive features of a suitable habitat. However, this hypothesis needs testing under controlled conditions.

Three possible features that may influence attraction of spiders to Malaise traps are: (1) the physical architecture of the traps, (2) the presence of abundant potential prey, and (3) the sheltered protection from the elements and from natural enemies. Spiders respond to structural features within habitats (Greenquist and Rovner 1976) and many species colonize man-made structures (Fowler 1980; Robinson 1981; Streit and Roser-Hosch 1982; Stevenson and Dindal 1981) and man-made environments (Duffey 1975). There is increasing evidence that structural features within habitats play important roles in habitat selection by spiders (Riechert and Gillespie 1986). Spiders also respond to increases in prey density (Riechert and Gillespie 1986), and abundance of prey influences habitat selection (Turnbull 1964; Riechert and Luczak 1982). Because Malaise traps attract numerous flying insects, especially Diptera, Hymenoptera, and Lepidoptera (Townes 1962), these traps are sources of aggregated prey density. Spiders respond to aggregations of prey (MacKay 1982; Riechert 1976). We suspect that spiders may be attracted to concentrations of insects, especially near the apex and catchment jar of Malaise traps. For Malaise-trap maintenance, Martin (1977, p. 27) advises, "look inside the trap, especially the entrance to the killing bottle, for spider webs, which must be removed and the spiders captured and killed, if possible." In Maine, Hilburn observed spider webbing near the apex of a Malaise trap without catchment jar; the web was positioned to capture insects exiting from the trap.

Avoidance of predators also affects habitat selection by spiders (Riechert and Gillespie 1986). In this respect, Malaise traps may provide spiders temporary shelter and protection from their natural enemies, such as birds and predatory wasps (Pompilidae and Sphecidae). The traps also may provide shelter from rain and extremes of temperature.

CONCLUSION

Although Malaise traps are widely used for capture of flying insects (see Steyskal (1981) for a bibliography on Malaise traps), rarely are spiders recorded

among the captured fauna. We found only two previous studies (Wilkinson et al. 1980; Hauge and Midtgaard 1986) that included spiders among Malaise-trap captures. A few isolated records of individual species taken in Malaise traps are found in the araneological literature (e.g., Dondale and Redner 1982; Platnick 1974; Platnick and Shadab 1976, and others); most records concern species of Anyphaenidae, Clubionidae, and Gnaphosidae. We suspect that spiders may occur more commonly in Malaise-trap collections than is reported in the entomological-araneological literature. The sparsity of published information on Malaise-trapped spiders may be due to the failure of investigators to collect, identify, and report such captures. Personal communications with investigators who frequently use Malaise traps support these conclusions; both Robert W. Matthews and Richard H. Roberts have observed spiders in their Malaise traps on numerous occasions, but the spiders were not collected and identified.

Finally, Malaise traps may supplement (but not supplant) other methods used for collecting and sampling spiders, especially for species in the herb-shrub layer. Malaise traps also may be useful for testing hypotheses concerning aggregation responses of spiders to increased prey densities.

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LITERATURE CITED

Butler, G. D., Jr. 1965. A modified Malaise insect trap. Pan-Pacific Entomol., 41:51-53.

Carter, N. E. and N. R. Brown. 1973. Seasonal abundance of certain soil arthropods in a fenitrothion-treated red spruce stand. Canadian Entomol., 105:1065-1073.

Chamberlin, R. V. and W. J. Gertsch. 1958. The spider family Dictynidae in America north of Mexico. Amer. Mus. Nat. Hist. Bull. 116. 152 pp.

Dondale, C. D. and J. H. Redner. 1978. The crab spiders of Canada and Alaska (Araneae: Philodromidae and Thomisidae). Canadian Dept. Agric. Publ., 1663. 255 pp.

Dondale, C. D. and J. H. Redner. 1982. The sac spiders of Canada and Alaska (Araneae: Clubionidae and Anyphaenidae). Canadian Dept. Agric. Publ., 1724. 194 pp.

Duffey, E. 1975. Habitat selection by spiders in man-made environments. Proc. 6th. Int'l. Arachn. Cong., Amsterdam IV. 1974:53-67.

Fowler, H. G. 1980. "Trap nests" for studying desert web-building spiders (Araneae: Pholcidae). Entomol. News, 91:136-138.

Freitag, R., G. W. Ozburn and R. E. Leech. 1969. The effects of sumithion and phosphamidon on populations of five carabid beetles and the spider *Trochosa terricola* in northwestern Ontario and including a list of collected species of carabid beetles and spiders. Canadian Entomol., 101:1328-1333.

Greenquist, E. A. and J. S. Rovner. 1976. Lycosid spiders on artificial foliage: Stratum choice, orientation preferences, and prey wrapping. Psyche, 83:196-209.

Gressitt, J. L. and M. K. Gressitt. 1962. An improved Malaise trap. Pacific Insects, 4:87-90.

Hauge, E. and F. Midtgaard. 1986. Spiders (Araneae) in Malaise traps from two islands in the Oslofjord, Norway. Fauna norv. Ser. B, 33:98-102.

Hilburn, D. J. 1981. The effects of aerial spraying for spruce budworm with carbaryl and *Bacillus thuringiensis* of non-target terrestrial arthropods. MS Thesis, Univ. of Maine at Orono. 58 pp.

Hilburn, D. J. and D. T. Jennings. 1988. Terricolous spiders (Araneae) of insecticide-treated spruce-fir forests in west-central Maine. Great Lakes Entomologist, (in press).

Jennings, D. T., M. W. Houseweart, C. D. Dondale and J. H. Redner. 1988. Spiders (Araneae) associated with strip-clearcut and dense spruce-fir forests of Main. J. Arachnol., 16:55-70.

Jennings, D. T. and J. A. Collins. 1987a. Spiders on red spruce foliage in northern Maine. J. Arachnol., 14:303-314.

Jennings, D. T. and J. A. Collins. 1987b. Coniferous-habitat associations of spiders (Araneae) on red spruce foliage. J. Arachnol., 14:315-326.

Kaston, B. J. 1981. Spiders of Connecticut. 2nd. ed. Bull. Connecticut State Geol. Nat. Hist. Surv., 70. 1020 pp.

Kucera, D. R. and P. W. Orr. 1981. Spruce budworm in the eastern United States. U.S. Dept. Agric., For. Serv., For. Insect Dis. Leafl. 160. 7 pp.

Leech, R. 1972. A revision of the nearctic Amaurobiidae (Arachnida: Araneida). Mem. Entomol. Soc. Canada, 84. 182 pp.

Loughton, B. G., C. Derry and A. S. West. 1963. Spiders and the spruce budworm. Pp. 249-268, *In* The Dynamics of Epidemic Spruce Budworm Populations. (R. F. Morris, ed.). Mem. Entomol. Soc. Canada, 31. 332 pp.

MacKay, W. P. 1982. The effect of predation of western widow spiders (Araneae: Theridiidae) on harvester ants (Hymenoptera: Formicidae). Oecologia (Berlin), 53:406-411.

Malaise, R. 1937. A new insect-trap. Entomol. Tidskr., 58:148-160.

Martin, J. E. H. 1977. The insects and arachnids of Canada. Part 1. Collecting, preparing, and preserving insects, mites, and spiders. Canadian Dept. Agric. Publ., 1643. 182 pp.

Muma, M. H. and K. E. Muma. 1949. Studies on a population of prairie spiders. Ecology, 30:485-503.

Opell, B. D. and J. A. Beatty. 1976. The nearctic Hahniidae (Arachnida: Araneae). Bull. Mus. Comp. Zool., 147(9):393-433.

Platnick, N. 1974. The spider family Anyphaenidae in America north of Mexico. Bull. Mus. Comp. Zool., 146(4):205-266.

Platnick, N. I. and M. U. Shadab. 1974. A revision of the *tranquillus* and *speciosus* groups of the spider genus *Trachelas* (Araneae, Clubionidae) in North and Central America. Amererican Mus. Novitates, 2553:1-34.

Platnick, N. I. and M. U. Shadab. 1976. A revision of the spider genera *Drassodes* and *Tivodrassus* (Araneae, Gnaphosidae) in North America. American Mus. Novitates, 2593:1-29.

Platnick, N. I. and M. U. Shadab. 1977. A revision of the spider genera *Herpyllus* and *Scotophaeus* (Araneae, Gnaphosidae) in North America. Bull. American Mus. Nat. Hist. 159:1-44.

Platnick, N. I. and M. U. Shadab. 1980a. A revision of the North American spider genera *Nodocion, Litopyllus*, and *Synaphosus* (Araneae, Gnaphosidae). American Mus. Novitates, 2691:1-26.

Platnick, N. I. and M. U. Shadab. 1980b. A revision of the spider genus *Cesonia* (Araneae, Gnaphosidae). Bull. American Mus. Nat. Hist., 165:335-386.

Platnick, N. I. and M. U. Shadab. 1981. A revision of the spider genus *Sergiolus* (Araneae, Gnaphosidae). American Mus. Novitates, 2717:1-41.

Price, P. W. 1975. Insect Ecology. John Wiley & Sons, New York. 514 pp.

Renault, T. R. 1968. An illustrated key to arboreal spiders (Araneida) in the fir-spruce forests of New Brunswick. Canada Dept. Fisheries and Forestry, For. Res. Lab., Fredericton, New Brunswick. Internal. Rept. M-39, 41 pp.

Riechert, S. E. 1976. Web-site selection in the desert spider *Agelenopsis aperta*. Oikos, 27:311-315.

Riechert, S. E. and R. G. Gillespie. 1986. Habitat choice and utilization in web-building spiders. Pp. 23-48, *In* Spiders: Webs, Behavior, and Evolution. (W. A. Shear, ed.). Stanford Univ. Press, Stanford, California. 492 pp.

Riechert, S. E. and J. Luczak. 1982. Spider foraging: behavioral responses to prey. Pp. 353-385, *In* Spider Communication: Mechanisms and Ecological Significance. (P. N. Witt and J. S. Rovner, eds.). Princeton Univ. Press, Princeton, New Jersey. 440 pp.

Robinson, J. V. 1981. The effect of architectural variation in habitat on a spider community: an experimental field study. Ecology, 62:73-80.

Stevenson, B. G. and D. L. Dindal. 1981. A litter box method for the study of litter arthropods. J. Georgia Entomol. Soc., 16:151-156.

Steyskal, G. C. 1981. A bibliography of the Malaise trap. Proc. Entomol. Soc. Washington, 83:225-229.

Streit, B. and S. Roser-Hosch. 1982. Experimental compost cylinders as insular habitats: colonisation by microarthropod groups. Rev. Suisse Zool., 89:891-902.

Townes, H. 1962. Design for a Malaise trap. Proc. Entomol. Soc. Washington, 64:253-262.

Townes, H. 1972. A light-weight Malaise trap. Entomol. News, 83:239-247.

Turnbull, A. L. 1964. The search for prey by a web-building spider *Achaearanea tepidariorum* (C. L. Koch) (Araneae, Theridiidae). Canadian Entomol., 96:568-579.

Varty, I. W. and N. E. Carter. 1974. Inventory of litter arthropods and airborne insects in fir-spruce stands treated with insecticides. Canadian For. Serv., Maritimes For. Res. Centr. Info. Rep. M-X-48. 32 pp.

Wilkinson, J. D., G. T. Schmidt and K. D. Biever. 1980. Comparative efficiency of sticky and water traps for sampling beneficial arthropods in red clover and the attraction of clover head catepillar adults to anisyl acetone. J. Georgia Entomol. Soc., 15:124-131.

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