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CONIFEROUS-HABITAT ASSOCIATIONS OF SPIDERS (ARANEAE) ON RED SPRUCE FOLIAGE

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ABSTRACT

Coniferous-habitat associations were determined for 16 species of adult spiders collected from red spruce foliage in northern Maine. Most of the spiders have been found on three or more (range one to 15) conifer species. Spider-conifer habitats were positively correlated ($r = 0.96$) with geographic states and provinces. Mean conifer-habitat associations did not differ between web spinner and hunter species. Significantly more species of spiders from red spruce foliage were associated with northern conifers than with western conifers, but not with southern conifers.

Comparison of the red spruce fauna with 16 selected spider-tree faunal studies showed that 1) Sørensen's similarity quotients (QS) were significantly greater for genera than for species, and 2) mean species QS values were significantly greater for northern than for southern but not for western conifers. The spider fauna on red spruce is closely allied with that on other northern conifers; however, none of the 16 spider species are restricted to conifers.

INTRODUCTION

The arboreal spider fauna of North American trees has received little attention; fewer than 25 coniferous and deciduous tree species have been studied in detail (Jennings 1976). Recent studies include: spiders on red pine, *Pinus resinosa* Ait., white spruce, *Picea glauca* (Moench) Voss, and northern white-cedar, *Thuja occidentalis* L., in Minnesota (Stratton, Uetz, and Dillery 1979); spiders on white fir, *Abies concolor* (Gord. and Glend.) Lindl. ex Hildebr., in California (Dahlsten et al. 1977) and in Oregon (Mason and Torgersen 1983). Additional spider-tree association records are scattered throughout the araneological and entomological literature; most records are incidental to other study objectives.

During our investigations on natural enemies of the spruce budworm, *Choristoneura fumiferana* (Clem.), we collected spiders of 10 families, 16 genera, and 21 species from foliage of red spruce, *Picea rubens* Sarg., in northern Maine. Mean spider densities during two sampling periods and spider-budworm

relationships were discussed in an earlier paper (Jennings and Collins 1987). Here we summarize the known coniferous-habitat associations for each of the 16 species found on red spruce foliage, and compare the spider fauna on red spruce with that of other coniferous species in North America. Our purposes for these comparisons were: 1) to identify (by spider and conifer species) the known spider-coniferous habitat associations, 2) to determine possible relationships between spider-coniferous habitats and geographic states and provinces, 3) to determine the degree of similarity between the spider fauna on red spruce and that found on other conifers, and 4) to determine possible patterns of association or differences in association among geographic regions. This information may be useful to forest pest managers who are concerned with identifying potentially important predators of coniferous pests.

METHODS

Habitat Associations.—We searched the araneological and entomological literature for spider-tree faunal studies and for habitat-association records of spiders collected from North American conifers. Standard reference sources were consulted including Biological Abstracts, Zoological Record, and Centre International de Documentation Arachnologique Liste. In addition, a DIALOG search was made from the AGRICOLA database at the National Agricultural Library, Beltsville, Maryland. The database search was limited to North American literature that included information and identities of both spiders and trees.

Because tree habitats may vary by spider species, and spiders identified to generic level only may include numerous species, we restricted our search to the 16 species of adult spiders found on red spruce foliage (Jennings and Collins 1987). In searching the older literature, recent spider synonymies were considered, e.g., *Pityohyphantes phrygianus* (Koch) [= *P. costatus* (Hentz)] (Kaston 1981), *Neoscona minima* F.O.P.-Cambridge [= *N. arabesca* (Walck.)] (Berman and Levi 1971), and *Araneus displicata* (Hentz) [= *Araniella displicata* (Hentz)] (Levi 1974). Consistent with Dondale (1959), records of *Grammonota pictilis* (O. P. Cambridge) collected on balsam fir, *Abies balsamea* (L.) Mill., in New Brunswick were considered to belong to *G. angusta* Dondale.

Habitat associations were recorded by spider and tree species. Only coniferous tree species were considered, though many of the red spruce spiders also occur on broad-leaved deciduous trees. Common and scientific names of trees follow Little (1979). Both evergreen and cone-bearing species of the families Cupressaceae, Pinaceae, and Taxodiaceae were included.

Data Analyses.—Although our literature search did not represent a random sample (i.e., all known available studies were included), we considered the data generated by these faunal studies to meet random-sample criteria (i.e., all potential coniferous habitats were available for study; none were selectively biased for our comparison purposes). We used nonparametric procedures (Sokal and Rohlf 1981) for statistical comparisons. The Wilcoxon two-sample test was used to test for differences between and among means ($P = 0.05$). For comparisons involving more than two means, all 2-mean combinations were performed.

Correlation analysis (Sokal and Rohlf 1981) was used as a measure of association between spider-coniferous habitats and geographic states and

provinces. We defined a spider-coniferous habitat as the collection of a spider species from or on a conifer species, e.g., *Dictyna brevitarsus* Emerton collected from foliage of *Abies balsamea* (L.) Mill. in New Brunswick (Renault 1968). Regression analysis was not used because we were interested in the degree of association (interdependence) between the two variables, not the dependence of one on the other. Habitat records without geographic locality were excluded from the analysis.

Sørensen's similarity quotient (QS), as defined by Price (1975), was used to determine the degree of similarity between the spider fauna on red spruce and that found on other coniferous species. The formula used was: $QS = 2c \times 100/(a + b)$, where a = the number of spider genera or species in study A; b = the number of spider genera or species in study B; and c = the number of spider genera or species common to both studies.

To determine possible patterns of association among geographic areas, each conifer species was assigned to one of three broadly defined regions—northern, southern, or western—based on distributional ranges of trees given by Little (1979). We then calculated mean QS values for each region and performed statistical tests to determine possible differences and associations among regions. Likewise, mean numbers of spider species in common with red spruce were determined and compared for each region.

RESULTS AND DISCUSSION

Coniferous-Habitat Associations.—The 16 species of adult spiders found on red spruce foliage and their habitat associations with North American conifers are summarized in Table 1. With only one exception, *Xysticus discursans* Keyserling, most of the spiders have been collected from three or more conifer species (range 1 to 15). Included are habitat affinities with balsam fir, *Abies balsamea* (L.) Mill., and white fir, *A. concolor* (Gord. and Glend.) Lindl. ex Hildebr.; oldfield common juniper, *Juniperus communis* var. *depressa* Pursh., and *Juniperus* spp. (may include *J. chinensis* L., eastern red cedar, *J. virginiana* L., and Rocky Mountain juniper, *J. scopulorum* Sarg.); tamarack, *Larix laricina* (Du Roi) K. Koch, and western larch, *L. occidentalis* Nutt.; Norway spruce, *Picea abies* (L.) Karst., white spruce, *P. glauca* (Moench) Voss, and red spruce, *P. rubens* Sarg.; jack pine, *Pinus banksiana* Lamb., sand pine, *P. clausa* (Chapm. ex Engelm.) Vasey ex Sarg., lodgepole pine, *P. contorta* var. *latifolia* Engelm., shortleaf pine, *P. echinata* Mill., Jeffrey pine, *P. jeffreyi* Grev. and Balf., ponderosa pine, *P. ponderosa* Dougl. ex Laws., red pine, *P. resinosa* Ait., eastern white pine, *P. strobus* L., Scotch pine, *P. sylvestris* L., loblolly pine, *P. taeda* L., and Virginia pine, *P. virginiana* Mill.; Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco; baldcypress, *Taxodium* sp.; and northern white-cedar, *Thuja occidentalis* L.

Predictably, coniferous-habitat associations were positively and highly correlated ($r = 0.96$) with geographic states and provinces (Fig. 1). This indicates that, within limits, the more localities sampled, the greater the likelihood of finding more coniferous-habitat associations. However, numbers of available coniferous species vary among states and provinces, and some spider species have limited ranges.

Considering habitat association by spider foraging group indicates that web spinners have been found and reported from more species of conifers ($\bar{x} = 7.9$

Table 1.—Coniferous-habitat associations of spiders from red spruce foliage.

Conifer species	Locality	Reference(s)
	Dictyna brevitarsus Emerton	
Abies balsamea	New Brunswick	Loughton et al. (1963), Renault (1968) Renault and Miller (1972)
Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
Pinus strobus	Wisconsin	Coppel and Smythe (1963)
	Theridion montanum Emerton	
Abies balsamea	New Brunswick	Loughton et al. (1963), Renault (1968) Renault and Miller (1972)
Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
	New Mexico	Levi (1957)
Pinus ponderosa	New Mexico	Levi (1957)
	Theridion murarium Emerton	
Abies balsamea	New Brunswick	Loughton et al. (1963), Renault (1968) Renault and Miller (1972)
Abies concolor	Oregon	Mason and Torgersen (1983)
Juniperus communis var. *depressa*	Michigan	Drew (1967)
Juniperus spp.	Kansas	Heinrichs and Thompson (1968)
	New Mexico	Levi (1957)
Picea abies	Massachusetts	Taylor (1928)[1]
Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
	Connecticut	Kaston (1981)
Pinus banksiana	Michigan	Allen et al. (1970)
	Indiana	Lowrie (1948)
Pinus echinata	Arkansas	Peck et al. (1971)[1]
Pinus ponderosa	New Mexico	Levi (1957)
Pinus resinosa	Ontario	Martin (1966)
Pinus strobus	Wisconsin	Coppel and Smythe (1963)
	Massachusetts	Taylor (1928)
Pinus sylvestris	Massachusetts	Taylor (1928)
Pinus taeda	Arkansas	Peck et al. (1971)
	Oklahoma	Bosworth et al. (1971)
Pinus virginiana	Maryland	Howden and Vogt (1951)
Pinus sp.	Connecticut	Kaston (1981)
Pseudotsuga menziesii	British Columbia	Turnbull (1956)
Thuja occidentalis	Michigan	Drew (1967)
	Pityohyphantes costatus (Hentz)	
Abies balsamea	New Brunswick	Loughton et al. (1963), Renault (1968) Renault and Miller (1972)
Abies concolor	Oregon	Mason and Torgersen (1983)
	California	Ohmart and Dahlsten (1979)
Picea glauca	Quebec	Manuel (1984)
Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
Pinus contorta var. *latifolia*	Alberta	Powell (1971)
Pinus resinosa	Minnesota	Stratton et al. (1979)
	Connecticut	Bean and Godwin (1955)
Thuja occidentalis	Michigan	Drew (1967)

Table 1.—Continued.

	Grammonota angusta Dondale	
Abies balsamea	New Brunswick	Loughton et al. (1963), Renault (1968) Renault and Miller (1972)
Larix laricina	Manitoba	Ives (1967)
Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
Pinus banksiana	Manitoba	Bradley and Hinks (1968)
	Eustala anastera (Walckenaer)	
Abies balsamea	New Brunswick	Levi (1977)
Juniperus spp.	Kansas	Heinrichs and Thompson (1968)
	Nebraska	Worley and Pickwell (1927)
Larix occidentalis		Levi (1977)
Picea glauca	New Brunswick	Levi (1977)
Picea rubens	Maine	Jennings and Collins (1987)
Pinus banksiana	Michigan	Allen et al. (1970)
Pinus clausa	Florida	Levi (1977)
Pinus echinata	Arkansas	Peck et al. (1971)
Pinus taeda	Arkansas	Peck et al. (1971), Levi (1977)
Taxodium sp.		Levi (1977)
	Neoscona arabesca (Walckenaer)	
Abies balsamea	New Brunswick	Renault (1968)
Abies concolor	Oregon	Mason and Torgersen (1983)
Juniperus communis var. *depressa*	Michigan	Drew (1967)
Juniperus sp.		Berman and Levi (1971)
Larix laricina		Berman and Levi (1971)
Picea rubens	Maine	Jennings and Collins (1987)
Pinus echinata	Arkansas	Peck et al. (1971)
Pinus strobus	Wisconsin	Coppel and Smythe (1963)
Pinus taeda	Arkansas	Peck et al. (1971)
	Oklahoma	Bosworth et al. (1971)
Pinus virginiana	Maryland	Howden and Vogt (1951)
	Araniella displicata (Hentz)	
Abies balsamea	New Brunswick	Loughton et al. (1963) Renault and Miller (1972)
Juniperus communis var. *depressa*	Michigan	Drew (1967)
Picea glauca	Minnesota	Stratton et al. (1979)
Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
Pinus banksiana	Manitoba	Bradley and Hinks (1968)
	Michigan	Allen et al. (1970)
Pinus echinata	Arkansas	Peck et al. (1971)
Pinus jeffreyi	California	Dahlsten (1961)[1]
Pinus ponderosa	California	Dahlsten (1961)
Pinus resinosa	Ontario	Martin (1966)
Pinus strobus	Wisconsin	Coppel and Smythe (1963)
	Maine	Procter (1946)
Pinus taeda	Arkansas	Peck et al. (1971)
	Oklahoma	Bosworth et al. (1971)
Pseudotsuga menziesii	British Columbia	Turnbull (1956)
	Clubiona canadensis Emerton	
Abies balsamea	New Brunswick	Loughton et al. (1963) Renault (1968) Renault and Miller (1972)

Table 1.—Continued.

Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
Thuja occidentalis	Michigan	Drew (1967)
	Philodromus exilis Banks	
Abies balsamea	New Brunswick	Renault (1968)
Abies sp.		Dondale and Redner (1968)
Juniperus sp.		Dondale and Redner (1968)
Picea glauca	Ontario	Dondale (pers. comm.)
	Nova Scotia	
	New Brunswick	
Picea rubens	Maine	Jennings and Collins (1987)
Pinus strobus	Ontario	Dondale (pers. comm.)
	Nova Scotia	
Thuja occidentalis	Ontario	Dondale (pers. comm.)
	Philodromus placidus Banks	
Abies balsamea	New Brunswick	Loughton et al. (1963)
		Renault (1968)
		Renault and Miller (1972)
Juniperus communis var. *depressa*	Michigan	Drew (1967)
Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
Pinus banksiana	Manitoba	Bradley and Hinks (1968)
	Michigan	Allen et al. (1970)
Pinus echinata	Arkansas	Peck et al. (1971)
Pinus resinosa	Minnesota	Heimer et al. (1984)
Pinus sp.	Maine	Procter (1946)
Pinus taeda	Arkansas	Peck et al. (1971)
	Misumena vatia (Clerck)	
Juniperus communis var. *depressa*	Michigan	Drew (1967)
Picea rubens	Maine	Jennings and Collins (1987)
Pinus banksiana	Manitoba	Bradley and Hinks (1968)
Pinus echinata	Arkansas	Peck et al. (1971)
Pinus taeda	Arkansas	Peck et al. (1971)
Pseudotsuga menziesii	British Columbia	Turnbull (1956)
	Xysticus discursans Keyserling	
Picea rubens	Maine	Jennings and Collins (1987)
	Xysticus punctatus Keyserling	
Abies balsamea	New Brunswick	Renault (1968)
Picea glauca	Minnesota	Houseweart and Kulman (1976)
Picea rubens	Maine	Jennings and Collins (1987)
Pinus banksiana	Manitoba	Bradley and Hinks (1968)
	Michigan	Allen et al. (1970)
Pinus echinata	Arkansas	Peck et al. (1971)
Pinus resinosa	Minnesota	Heimer et al. (1984)
Pinus strobus	Wisconsin	Coppel and Smythe (1963)
Pinus taeda	Arkansas	Peck et al. (1971)
	Oklahoma	Bosworth et al. (1971)
Pseudotsuga menziesii	British Columbia	Turnbull (1956)
	Salticus scenicus (Linnaeus)	
Picea rubens	Maine	Jennings and Collins (1987)
Pinus echinata	North Carolina	Ramsey (1941)[1]
Pinus taeda	North Carolina	Ramsey (1941)
	Oklahoma	Bosworth et al. (1971)

Table 1.—Continued.

	Metaphidippus flavipedes (G. & E. Peckham)	
Abies balsamea	Maine	Jennings and Houseweart (1978)
	New Brunswick	Loughton et al. (1963)
		Renault (1968)
		Renault and Miller (1972)
Juniperus communis var. *depressa*	Michigan	Drew (1967)
Picea glauca	Minnesota	Houseweart and Kulman (1976)
Picea rubens	Maine	Jennings and Collins (1987)
Picea sp.	New Brunswick	Renault and Miller (1972)
Pinus banksiana	Manitoba	Bradley and Hinks (1968)
	Michigan	Allen et al. (1970)
Pinus echinata	Arkansas	Peck et al. (1971)
Pinus resinosa	Ontario	Martin (1966)
	Minnesota	Heimer et al. (1984)
Pinus strobus	Wisconsin	Coppel and Smythe (1963)
Pinus taeda	Arkansas	Peck et al. (1971)
Pseudotsuga menziesii	British Columbia	Turnbull (1956)
Thuja occidentalis	Michigan	Drew (1967)

[1]Collections not separated by tree species.

$\pm$ 1.6) than have hunters ($\bar{x}$ = 5.8 $\pm$ 1.2); however, the means for these two groups were not significantly different by the Wilcoxon two-sample test. Coniferous foliage is a suitable habitat substrate for both spider groups. Stratton et al. (1979) found greater percentages of web-builders than hunters on pine, spruce, and cedar in Minnesota; but the relative composition of the two foraging groups was not significantly different among tree species.

Exotic conifers excepted, i.e., *Picea abies* and *Pinus sylvestris*, significantly more (P = 0.02) species of spiders from red spruce foliage were associated with northern conifers ($\bar{x}$ =7.4 $\pm$ 1.5) than with western conifers ($\bar{x}$ = 2.9 $\pm$ 0.8), but not with southern conifers ($\bar{x}$ = 4.4 $\pm$ 1.9). This supports our hypothesis that the spider fauna on red spruce is closely allied with other northern conifers; however, elements may also occur on southern conifers, and to a lesser degree on western conifers. Mean numbers of red spruce species associated with western and southern conifers did not differ significantly.

Among individual species, *Theridion murarium* Emerton showed the greatest range of coniferous habitats, being found on at least 15 species of conifers. Six other spider species have been collected from seven or more conifer species: *Araniella displicata* (Hentz) (12), *Metaphidippus flavipedes* (G. & E. Peckham) (11), *Xysticus punctatus* Keyserling (9), *Eustala anastera* (Walckenaer) (8), *Neoscona arabesca* (Walckenaer) (8), and *Pityohyphantes costatus* (Hentz) (7). The remaining spiders from red spruce foliage are reported from six or fewer conifers. Apparently *Xysticus discursans* has been collected and reported from only one conifer, *Picea rubens*; however, this association may be accidental because the normal habitat for this spider is near the ground (Dondale and Redner 1978).

The number of coniferous-habitat associations for individual spider species does not necessarily correspond with or indicate their habitat specificity. None of the 16 species found on red spruce are restricted to that tree species, or to

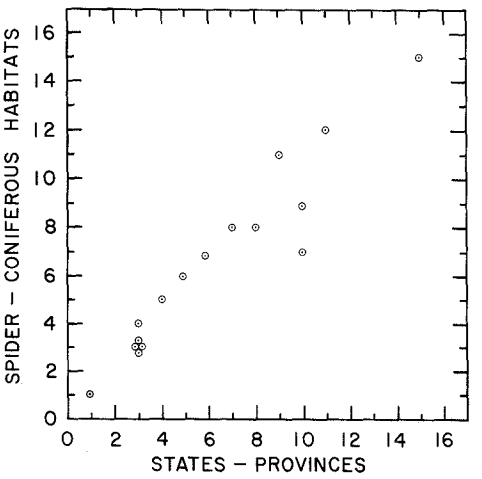

Fig. 1.—Relationship between spider-coniferous habitats and states and provinces; correlation analysis, $r = 0.96$ (Sokal and Rohlf 1981). Each point represents the number of conifer species and states and provinces from which one of the red spruce spiders ($n = 16$) has been reported.

conifers. For example, many of the species, including *Theridion murarium*, *Metaphidippus flavipedes*, *Araniella displicata*, *Eustala anastera*, and *Neoscona arabesca*, also occur on a variety of broad-leaved trees and shrubs. *Misumena vatia* (Clerck) and *Clubiona canadensis* Emerton are frequently collected from shrubs and forbs; *Salticus scenicus* (Linnaeus) is found in synanthropic habitats (Kaston 1981). *Xysticus discursans* is usually taken by pitfall traps and sweep nets in both grassland and wooded areas (Dondale and Redner 1978). *Grammonota angusta* Dondale, *Philodromus placidus* Banks, and *Xysticus punctatus* are typically found on conifers.

Spider-Faunal Studies.—Sørensen's similarity quotients (QS values) for 16 spider-tree faunal studies are shown in Table 2. Not included are studies lacking complete species lists (Dahlsten et al. 1977; Renault and Miller 1972; Stratton et al. 1979) and studies where tree-habitat association was uncertain (Fox and Griffith 1976). As expected, QS values were significantly greater ($P < 0.01$) for genera than for species, i.e., more genera than species were shared in common among the studies. QS values for species were generally < 30, no doubt because sampling methods and intensities varied considerably among the studies. However, despite these differences, the red spruce fauna showed more similarities with spider faunas on northern conifers than on southern or western conifers. Mean species QS values were significantly greater ($P = 0.03$) for northern conifers ($\bar{x} = 18.4 \pm 2.2$) than for southern conifers ($\bar{x} = 9.0 \pm 1.5$), but not for western conifers ($\bar{x} = 13.2 \pm 0.8$). Southern and western QS means also did not differ significantly; however, the level of statistical significance ($P = 0.08$) shows possible distinction. With only two exceptions, *Larix laricina* and *Pinus resinosa*, QS values for northern conifers were generally > 15; whereas, those for southern and western conifers were generally < 15.

The apparent similarity among spider faunas on northern conifers is also evidenced by comparable QS values, particularly for tree species often found growing in the same forest stand, e.g., *Abies balsamea*, *Pinus strobus*, and *Thuja occidentalis* (Table 2). Surprisingly, *Larix laricina*, a common resident of northeastern spruce-fir forests, had a very low QS value; conversely, *Juniperus communis* var. *depressa*, an inhabitant of old fields and cutover forests, had a relatively high QS value. We are unable to explain these dissimilarities.

Table 2.—Comparison of red spruce spider fauna with spider faunas of other coniferous species by geographic region. QS = Sørensen's similarity quotient.

Conifer species	State-Province	QS value		Reference
		Genera	Species	
	NORTHERN REGION			
Abies balsamea	New Brunswick	30.4	19.5	Renault (1968)
Abies balsamea	New Brunswick	37.7	24.0	Loughton et al. (1963)
Juniperus communis var. *depressa*	Michigan	57.1	27.8	Drew (1967)
Larix laricina	Manitoba	51.8	6.1	Ives (1967)
Pinus banksiana	Michigan	46.2	21.4	Bradley and Hinks (1968)
Pinus banksiana	Michigan	38.5	18.8	Allen et al. (1970)
Pinus resinosa	Ontario	25.8	10.5	Martin (1966)
Pinus strobus	Wisconsin	59.5	19.4	Coppel and Smythe (1963)
Thuja occidentalis	Michigan	38.5	18.2	Drew (1967)
	SOUTHERN REGION			
Juniperus spp.	Kansas	37.5	9.5	Heinrichs and Thompson (1968)
Pinus echinata and *P. taeda*[1]	North Carolina	25.9	3.2	Ramsey (1941)
Pinus echinata and *P. taeda*[1]	Arkansas	27.7	10.3	Peck et al. (1971)
Pinus taeda	Oklahoma	32.4	11.6	Bosworth et al. (1971)
Pinus virginiana	Maryland	32.3	10.5	Howden and Vogt (1951)
	WESTERN REGION			
Abies concolor	Oregon	54.6	14.0	Mason and Torgersen (1983)
Pseudotsuga menziesii	British Columbia	36.7	12.5	Turnbull (1956)

[1]Collections not separated by tree species.

In addition to geographic region, tree height and growth form may also influence resident spider faunas. For example, within the same northern region, spider faunas on young, plantation red pine and on tamarack generally had low QS values compared with other species. Martin (1966) concluded that young red pine seedlings planted in an old field do not form an influential part of the community, and ecological conditions remain those of an old field. No doubt the sparse, clumped needles of tamarack provide fewer microhabitats for spiders than the dense, dispersed foliage of spruce. Stratton et al. (1979) found the highest number of spider species and individuals on foliage of white spruce compared with red pine and northern white-cedar.

Notably absent from these faunistic comparisons, including our own study, are investigations involving two or more coniferous species sampled at the same time, place, and intensity. For such studies, we predict that QS values will be much higher, particularly for conifers growing in the same forest stand and of similar growth form, height, and age. Under these conditions, faunal similarities may approach the QS-50 limit, below which communities are arbitrarily considered distinct (Price 1975). None of the species faunistic comparisons in Table 2 approached this limit, probably because the conifers studied were widely separated in time, place, and sampling methodology.

Finally, the paucity of information about spider-coniferous habitat associations is evident from both Tables 1 and 2. Apparently less than 30% of the 82 native species of conifers (Little 1979; families Cupressaceae, Pinaceae, and Taxodiaceae) have even been examined for spiders, much less studied in detail. The maximum

number of conifer species sampled in any one state or province was four; likewise, only one conifer, *Picea glauca*, has been studied in five states and provinces. We conclude that additional faunistic studies are needed: 1) to define the spider fauna of any one conifer species, and 2) to determine habitat specificities and associational ranges of individual spider species. Such information will help to elucidate potential predator-prey relationships involving spiders and pests of conifers.

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