A survey of the spiders of Black Rock Forest Preserve in New York (Arachnida: Araneae)

Author(s): Vladimir I. Ovtcharenko, Andrei V. Tanasevitch, and Boris P. Zakharov

Source: Entomologica Americana, 120(1):24-38. 2014.
Published By: The New York Entomological Society
DOI: http://dx.doi.org/10.1664/14-RA-013.1
URL: http://www.bioone.org/doi/full/10.1664/14-RA-013.1

Entomologica Americana 120(1):24–38, 2014

A SURVEY OF THE SPIDERS OF BLACK ROCK FOREST PRESERVE IN NEW YORK (ARACHNIDA: ARANEAE)

Ovtcharenko, Vladimir I.[1], Andrei V. Tanasevitch[2] and Boris P. Zakharov[3]

[1]Natural Sciences Department, Hostos Community College of the City University of New York, 500 Grand Concourse, Bronx, New York, NY 10451, USA
E-mail: vio@hostos.cuny.edu

[2]Laboratory of Synecology, Institute of Ecology and Evolution, Leninsky pr. 33, Moscow 119071, Russia
E-mail: and-tan@mail.ru

[3]Natural Sciences Department, LaGuardia Community College of the City University of New York, 31-10 Thomson Avenue, Long Island City, NY 11101, USA
E-mail: bzakharov@lagcc.cuny.edu

Abstract—The survey results of the spider fauna of Black Rock Forest (BRF), Orange County, New York for 12 years are presented. The BRF spider fauna includes 27 families, 121 genera, and 279 species. Most numerous are the Linyphiidae, which make up 26.9% of all spider fauna. *Pityohyphantes subarcticus* Chamberlin et Ivie, 1943, *Tenuiphantes tenuis* (Blackwall, 1852), and *Erigone dentosa* O.Pickard-Cambridge, 1894 were found for first time in the New York State region. The most diverse community was that of the deciduous forest, where 201 species were found. We also found 83 species in swamp areas; 111 species in the coniferous forest; 141 meadow species and 95 species near rivers and ponds. The most unique spider fauna were in the deciduous forest, whereas it had been previously thought the most unique fauna occurred in meadows. The richness and uniqueness of spider faunas in natural ecosystems strongly depend on the type and state of wild vegetation, which may be used for monitoring the health of the landscape.

Key words: Hudson Highland, richness, deciduous forest, coniferous forest, invertebrate survey, biodiversity.

Introduction

The last list of New York State spiders was completed by Crosby and Bishop in 1928 and included 174 genera and 576 species. Kaston (1981) recorded 184 genera and 462 species of spiders from Connecticut State, and 224 genera and 597 species from surrounding areas. These surveys suggested that the spider fauna of the smaller state, Connecticut, was greater than New York State, which called for further investigation. Spiders are generalized predators and, thus, are abundant and widely distributed. They are important in controlling pest species in wild habitats and are critical to achieving long-term wild-habitat management goals. Our research in Black Rock Forest (BRF) between 1998–1913 is the first comprehensive spider survey of the New York State in the last 80 years (Ovtcharenko et al., 2002, 2009; Ovtsharenko et al., 2011a, b).

Black Rock Forest (BRF), a 1,520 hectare (3,830 acre) nature reserve and research facility, is located in Orange County, New York (41.42267, − 74.03039) and is managed by Black Rock Forest Consortium, a non-profit organization. BRF occupies an area that intersects two major geological features: the Highlands Physiographic Province, also known as the New York-New Jersey Highlands, and the Hudson River Basin near Cornwall, ca. 50 mi north of New York City. BRF is situated within the central, highest portion of the Hudson River Highlands. Spy Rock, located in the Forest, is the highest point at 446 m (1,463 ft) in the Highlands west of Hudson River. The territory encompasses native terrestrial and aquatic ecosystems that are now increasingly rare in the region. The hardwood forest is dominated by *Quercus rubra*, which is typical for the Highlands region (Barringer and Clemants, 2003). On the hilltops and ridges, oaks (*Q. rubra*, *Q. montana*, *Q. alba*, and *Q. coccinea*) create a deciduous tree mix with *Carya glabra* and *Pinus rigida*. The south slopes are dominated by *Q. montana* and the north and low slopes are dominated by *Tsuga canadensis* (Barringer and Clemants, 2003). Other habitat types in the forest include hemlock coves, chestnut-oak woods, and red maple stands. More than 1,000 ft of vertical relief results in great habitat diversity including inspiring

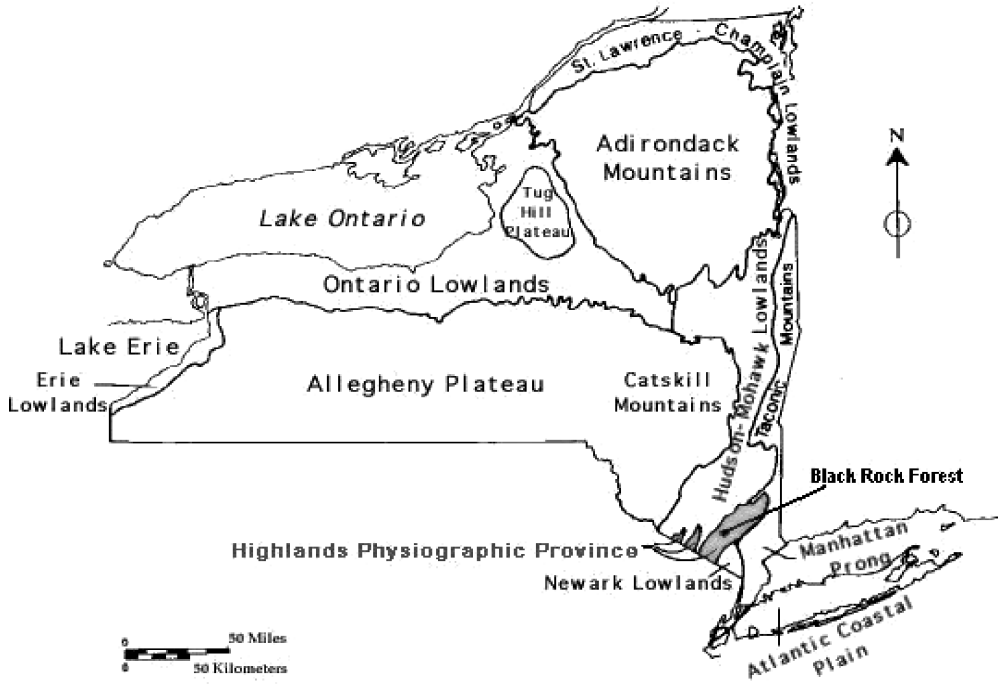

Fig. 1. Location of the Black Rock Forest on geological map of the New York State (After: http://www.blackrockforest.org/docs/about-the-forest/the-forest/index.html).

summits, large headwater wetlands, towering groves of ancient hemlock trees, and a waterfall that drops more than 100 ft. Through more than six decades of careful management and preservation, Black Rock Forest has exuded a nearly pristine quality and supports as wide a variety of plant and animal life as can be found in the region (Schuster, 2009; http://www.blackrockforest.org/docs/about-the-forest/the-forest/index.html).

Spiders are dominant invertebrate predators in most ecosystems and they play a substantial role in healthy ecosystem functioning. They are worldwide in distribution, and include 112 families, 3,924 genera and around 44,540 species (Platnick, 2014). In North America spiders are widely distributed and are found in all climatic zones and all types of habitat except for aquatic habitats. They are mostly carnivorous and are a very important part of the pest controlling mechanism. Conversely, they are themselves a substantial part of the diet of many birds, small ground vertebrates, and other predatory invertebrates.

Materials and Methods

Spiders were collected by sifting leaf litter, using pitfall traps, sweeping with insect nets, shaking trees and bushes, and picking up off the substrate. Collections were made in all habitats: deciduous forests, coniferous forests, meadows, swamps, banks of ponds and streams, on hemlock and broadleaf trees, slopes of different exposition, and around buildings on BRF grounds.

Collected material was sorted, identified, labeled, and preserved in vials with 75% ethanol. Identified specimens were used for illustrations; the location where they were collected was mapped using GPS coordinates. We created identification key to families and genera of spiders based on the material we collected. Additionally, an atlas of common species was produced and published on website: http://research.amnh.org/iz/blackrock/.

Results

We found 27 families, 121 genera, and 279 species of spiders. Three species: *Pityohyphantes subarcticus* Chamberlin et Ivie, 1943; *Tenuiphantes tenuis* (Blackwall, 1852); *Erigone dentosa* O.Pickard-Cambridge, 1894 were found for the first time in New York State (Buckle et al., 2001).

Separating what is actually leaf litter catch from ground-dwelling and grass/bush living is difficult.

Table 1. Presence-absence of species across the different habitats of the BRF. + denotes presence.

Family	Species	Habitat/Vegetation				
		Litter & ground	Grass & flowers	Bushes	Tree trunk & under bark	Canopy
Atypidae	*Sphodros rufipes* (Latreille, 1829)	+				
Dysderidae	*Dysdera crocata* C. L. Koch, 1838	+				
Mimetidae	*Mimetus epeiroides* Emerton, 1882		+	+		
Uloboridae	*Uloborus glomosus* (Walckenaer, 1842)	+				
Theridiidae	*Achaearanea rupicola* (Emerton, 1882)	+		+	+	
	Crustulina altera Gertsch et Archer, 1942	+				
	Crustulina sticta (O.Pickard-Cambridge, 1861)	+				
	Dipoena nigra (Emerton, 1882)	+	+	+		+
	Enoplognatha marmorata (Hentz, 1850)		+	+		
	Enoplognatha ovata (Clerck, 1757)	+	+	+		
	Euryopis argentea Emerton, 1882	+	+			
	Neospintharus trigonum (Hentz, 1850)	+				
	Pholcomma hirsutum Emerton, 1882	+	+			
	Robertus banksi (Kaston, 1946)	+				
	Robertus frontatus (Banks, 1892)	+				
	Robertus riparius (Keyserling, 1886)	+				
	Steatoda borealis (Hentz, 1850)	+			+	
	Theridion differens Emerton, 1882		+	+		+
	Theridion frondeum Hentz, 1850			+		+
	Theridion murarium Emerton, 1882		+	+		+
	Thymoites unimaculatum (Emerton, 1882)	+	+	+		+
Theridiosomatidae	*Theridiosoma gemmosum* (L. Koch, 1877)	+				
Linyphiidae	*Agyneta fabra* (Keyserling, 1886)	+	+			
	Agyneta micaria (Emerton, 1882)	+				
	Agyneta simplex (Emerton, 1926)	+	+			
	Agyneta unimaculata (Banks, 1892)	+				
	Agyneta zygia (Keyserling, 1886)	+	+			
	Bathyphantes brevis (Emerton, 1911)	+	+			
	Bathyphantes pallidus (Banks, 1892)	+	+			
	Centromerus cornupalpis (O.P.-Cambridge, 1875)	+	+			
	Centromerus persolutus (O.P.-Cambridge, 1975)	+	+			
	Centromerus sylvaticus (Blackwall, 1841)	+				
	Ceraticelus fissiceps (O.Pickard-Cambridge, 1874)	+	+		+	
	Ceraticelus laticeps (Emerton, 1894)	+	+			
	Ceraticelus minutus (Emerton, 1882)	+	+			
	Ceraticelus similis (Banks, 1892)	+	+			
	Ceratinella brunnea Emerton, 1882	+				
	Ceratinopsidis formosa (Banks, 1892)	+	+			
	Dicymbium elongatum (Emerton, 1882)	+				
	Diplocephalus subrostratus (O. P.-Cambridge, 1873)	+				
	Eridantes erigonoides (Emerton, 1882)	+	+			
	Erigone dentosa O.Pickard-Cambridge, 1894	+				
	Floricomus plumalis (Crosby, 1905)	+				

Table 1. Continued.

Family	Species	Habitat/Vegetation				
		Litter & ground	Grass & flowers	Bushes	Tree trunk & under bark	Canopy
	Grammonota inornata Emerton, 1882	+	+			
	Grammonota inusiata Bishop et Crosby, 1932	+	+			
	Grammonota pictilis Chamberlin et Ivie, 1943	+				
	Halorates oxypaederotipus (Crosby, 1905)	+	+			
	Halorates plumosus (Emerton, 1882)	+	+			
	Hypselistes florens (O. P.-Cambridge, 1875)	+	+			
	Islandiana longisetosa (Emerton, 1882)	+				
	Macrargus multesimus (O.Pickard-Cambridge, 1875)	+	+			
	Maso sundevalli (Westring, 1851)	+				
	Mermessus entomologicus (Emerton, 1911)	+	+			
	Mermessus index (Emerton, 1914)	+				
	Mermessus maculatus (Banks, 1892)		+			
	Mermessus tridentatus (Emerton, 1882)	+				
	Microlinyphia pusilla (Sundevall, 1830)		+	+		
	Microneta viaria (Blackwall, 1841)	+	+			
	Neriene clathrata (Sundevall, 1830)			+		
	Neriene radiata (Walckenaer, 1841)			+		
	Oedothorax trilobatus (Banks, 1896)	+				
	Pityohyphantes subarcticus Chamberlin et Ivie, 1943		+	+		+
	Pocadicnemis pumila (Blackwall, 1841)	+				
	Porrhomma terrestre (Emerton, 1882)	+				
	Scironis tarsalis (Emerton, 1911)	+	+			
	Souessa spinifera (O. Pickard-Cambridge, 1874)	+	+			
	Tapinocyba sp.	+				
	Tennesseellum formica (Emerton, 1882)	+				
	Tenuiphantes sabulosus (Keyserling, 1886)	+	+			
	Tenuiphantes tenuis (Blackwall, 1852)	+				
	Tenuiphantes zebra (Emerton, 1882)	+	+			
	Walckenaeria atrotibialis O.P.-Cambridge, 1878	+				
	Walckenaeria auranticeps (Emerton, 1882)	+				
	Walckenaeria castanea (Emerton, 1882)	+				
	Walckenaeria directa (O.P.-Cambridge, 1874)	+				
	Walckenaeria exigua Millidge, 1983	+				
	Walckenaeria minuta (Emerton, 1882)	+				
	Walckenaeria pallida (Emerton, 1882)	+				
	Walckenaeria spiralis (Emerton, 1882)	+				
	Walckenaeria thrinax (Chamberlin et Ivie, 1933)	+				
	Walckenaeria tumida (Crosby et Bishop, 1931)	+				

Table 1. Continued.

Family	Species	Habitat/Vegetation				
		Litter & ground	Grass & flowers	Bushes	Tree trunk & under bark	Canopy
Tetragnathidae	*Leucauge venusta* (Walckenaer, 1842)		+	+		
	Pachygnatha autumnalis Marx, 1884	+	+	+		
	Tetragnatha laboriosa Hentz, 1850		+	+		
	Tetragnatha straminea Emerton, 1884		+	+		
	Tetragnatha versicolor Walckenaer, 1842		+	+		+
Araneidae	*Araneus cornutus* Clerck, 1757			+		+
	Araneus diadematus Clerck, 1757		+	+		+
	Araneus marmoreus Clerck, 1757					+
	Araneus saevus (L. Koch, 1872)					+
	Araneus trifolium (Hentz, 1847)					+
	Araniella displicata (Hentz, 1847)		+	+		+
	Argiope aurantia Lucas, 1833			+		
	Cyclosa conica (Pallas, 1772)		+	+	+	+
	Hypsosinga rubens (Hentz, 1847)	+	+			+
	Mangora placida (Hentz, 1847)	+	+	+		+
	Metepeira labyrinthea (Hentz, 1847)			+	+	+
	Neoscona arabesca (Walckenaer, 1842)		+	+		+
Lycosidae	*Allocosa funerea* (Hertz, 1844)	+				
	Arctosa virgo (Chamberlin, 1925)	+				
	Hogna rabida (Walckenaer, 1837)	+	+			
	Pardosa mackenziana (Keyserling, 1877)	+				
	Pardosa milvina (Hentz, 1844)	+	+			
	Pardosa moesta Banks, 1892	+	+			
	Pirata aspirans Chamberlin, 1904	+				
	Pirata insularis Emerton, 1885	+	+			
	Pirata minutus Emerton, 1885	+	+			
	Pirata montanus Emerton, 1885	+			+	
	Pirata sedentarius Montgomery, 1904	+	+			
	Schizocosa bilineata (Emerton, 1885)	+				
	Schizocosa ocreata (Emerton, 1885)	+				
	Trabeops auranticus (Emerton, 1885)	+				
	Trebacosa marxi (Stone, 1890)	+	+			
	Trochosa terricola Thorell, 1856	+				
Pisauridae	*Pisaurina mira* (Walckenaer, 1837)		+			
Oxyopidae	*Oxyopes salticus* Hentz, 1845	+	+			
Agelenidae	*Agelenopsis naevia* (Walckenaer, 1842)	+	+		+	
	Agelenopsis pennsylvanica (C. L. Koch, 1843)	+	+			
	Agelenopsis utahana (Chamberlin et Ivie, 1933)	+				
	Cicurina arcuata Keyserling, 1887	+	+			
	Cicurina brevis (Emerton, 1890)	+	+			
	Cicurina pallida Keyserling, 1887	+				
	Cicurina robusta Simon, 1886	+				
	Coras juvenilis (Keyserling, 1881)	+				
	Coras medicinalis (Hentz, 1821)	+				
	Wadotes calcaratus (Keyserling, 1887)	+				
	Wadotes hybridus (Emerton, 1890)	+				
Hahniidae	*Hahnia cinerea* Emerton, 1890	+	+			
	Neoantistea agilis (Keyserling, 1887)	+				
	Neoantistea magna (Keyserling, 1887)	+				

Table 1. Continued.

Family	Species	Habitat/Vegetation				
		Litter & ground	Grass & flowers	Bushes	Tree trunk & under bark	Canopy
Dictynidae	*Dictyna bostoniensis* Emerton, 1888		+			
	Dictyna foliacea (Hentz, 1850)			+		
	Dictyna minuta Emerton, 1888		+			
	Dictyna sublata (Hentz, 1850)		+	+		+
	Dictyna terrestris Emerton, 1911		+			
	Lathys foxi (Marx, 1891)	+	+			
Amaurobiidae	*Callobius bennetti* (Blackwall, 1846)	+				
	Callobius ferox (Walckenaer, 1830)	+				
Anyphaenidae	*Anyphaena pectorosa* L. Koch, 1866	+	+	+		
Liocranidae	*Agroeca minuta* Banks, 1895	+	+			
	Agroeca ornata Banks, 1892	+	+			
	Phrurotimpus alarius (Hentz, 1847)	+	+			
	Phrurotimpus borealis (Emerton, 1911)	+	+			
	Scotinella pugnata (Emerton, 1890)	+	+			
Clubionidae	*Clubiona bishopi* Edwards, 1958			+		+
	Clubiona bryantae Gertsch, 1941	+		+		+
	Clubiona johnsoni Gertsch, 1941			+		
	Clubiona kastoni Gertsch, 1941	+		+		+
	Clubiona saltitans Emerton, 1919					+
	Clubiona spiralis Emerton, 1909			+		
Corinnidae	*Castianeira cingulata* (C. L. Koch, 1841)	+	+			
	Castianeira gertschi Kaston, 1945	+	+			
Gnaphosidae	*Callilepis pluto* Banks, 1896	+				
	Drassodes auriculoides Barrows, 1919	+				
	Drassyllus fallens Chamberlin, 1922	+				
	Gnaphosa fontinalis Keyserling, 1887	+				
	Gnaphosa parvula Banks, 1896	+				
	Haplodrassus bicornis (Emerton, 1909)	+				
	Haplodrassus hiemalis (Emerton, 1909)	+				
	Herpyllus ecclesiasticus Hentz, 1832	+				
	Litopyllus temporarius Chamberlin, 1922	+				
	Sergiolus capulatus (Walckenaer, 1837)	+				
	Urozelotes rusticus (L. Koch, 1872)	+				
	Zelotes duplex Chamberlin, 1922	+				
	Zelotes fratris Chamberlin, 1920	+				
Philodromidae	*Ebo latithorax* Keyserling, 1884	+	+		+	
	Philodromus exilis Banks, 1892		+		+	+
	Philodromus imbecillus Keyserling, 1880		+			
	Philodromus laticeps Keyserling, 1880			+		
	Philodromus marxi Keyserlingi, 1884		+			+
	Philodromus minutus Banks, 1892		+		+	
	Philodromus placidus Banks, 1892		+	+	+	+
	Philodromus rufus quartus Dondale et Redner, 1968		+	+	+	+
	Philodromus vulgaris Hentz, 1847	+	+		+	+
	Thanatus arcticus Thorell, 1872		+			
	Thanatus striatus C. L. Koch, 1845	+	+			
	Tibellus oblongus (Walckenaer, 1802)		+	+		

Table 1. Continued.

Family	Species	Habitat/Vegetation				
		Litter & ground	Grass & flowers	Bushes	Tree trunk & under bark	Canopy
Thomisidae	*Bassaniana versicolor* (Keyserling, 1880)			+	+	+
	Misumena vatia (Clerck, 1757)		+	+		
	Misumenops asperatus (Hentz, 1847)		+	+		
	Ozyptila americana Banks, 1895	+				
	Xysticus elegans Keyserling, 1880		+	+	+	+
	Xysticus ferox (Hentz, 1847)	+	+			
	Xysticus fraternus Banks, 1895	+	+	+		
	Xysticus gulosus Keyserling, 1880	+	+			
	Xysticus luctans (C. L. Koch, 1845)	+	+		+	
	Xysticus punctatus Keyserling, 1880	+		+		+
	Xysticus triguttatus Keyserling, 1880		+			
Salticidae	*Eris marginata* (Walckenaer, 1837)	+				
	Ghelna canadensis (Banks, 1897)	+	+			
	Habrocestum pulex (Hentz, 1846)	+	+		+	
	Habronattus decorus (Blackwall, 1846)	+	+	+		
	Habronattus viridipes (Hentz, 1846)		+	+		+
	Hentzia mitrata (Hentz, 1846)	+	+		+	
	Maevia inclemens (Walckenaer, 1837)		+		+	+
	Neon nellii Peckham et Peckham, 1888	+	+			
	Pelegrina peckhamorum Kaston, 1973	+	+		+	+
	Phidippus audax (Hentz, 1845)	+	+			
	Phidippus clarus Keyserling, 1885		+			
	Sitticus fasciger (Simon, 1880)	+	+	+	+	+
	Synageles noxiosus (Hentz, 1850)		+	+		
	Talavera minuta (Banks, 1895)	+	+			+
	Zygoballus nervosus (Peckham et Peckham, 1888)			+		
	Zygoballus rufipes Peckman et Peckman, 1885		+	+		

Many spider species drop to the ground when disturbed by collecting, for example, by sweeping with a hand-net. Some spiders also have diurnal and seasonal movement. At night and in rainy weather, spiders may hide in leaf litter, but in the sunny daytime they move up a grass blade or bush to hunt. Young spiders also may live in leaf litter or on the ground, and move to grass, bush, or tree only when they reach adulthood. Hence some grass, bush, or tree inhabiting spiders may be collected in pitfall traps, which are designed to capture ground-dwelling species. Thus, the vertical distribution of spiders from soil to canopy has to be carefully scrutinized on the basis of collecting technique. Therefore, we tentatively divided the habitats into 5 categories: a) litter and ground; b) grass and flowers; c) bush; d) tree trunk and bark; and e) canopy (Table 1).

Most spiders we found inhabited ground and litter habitats, and to a lesser degree, grass and flowers. Orb-web weavers (Araneidae) and long-jawed orb-web spiders (Tetragnathidae) were typically found in bushes and the canopy. Only crab spiders (Thomisidae and Philodromidae) were common on tree trunks and were also found under the bark of trees. The most species rich families in BRF were: Linyphiidae (26.9% of all spider fauna), Salticidae (9.3%), Lycosidae (9.0%), Theridiidae (8.2%), Gnaphosidae (7.2%), Philodromidae (6.1%), Thomisidae (5.4%), Araneidae (5.0%), and Agelenidae (4.3%). The most numerous species in BRF were: *Microneta viaria* (Blackwall, 1841) (Linyphiidae), *Pirata minutes* Emerton, 1885 (Lycosidae), *Agelenopsis pennsylvanica* (C. L. Koch, 1843) (Agelenidae), *Phrurotimpus alarius* (Hentz, 1847), *Ph. borealis* (Emerton, 1911) (Liocranidae), and *Sergiolus capulatus* (Walckenaer, 1837) (Gnaphosidae), all of which inhabit ground and litter habitats. On grasses, the most abundant was *Halorates oxypaederotipus* (Crosby,

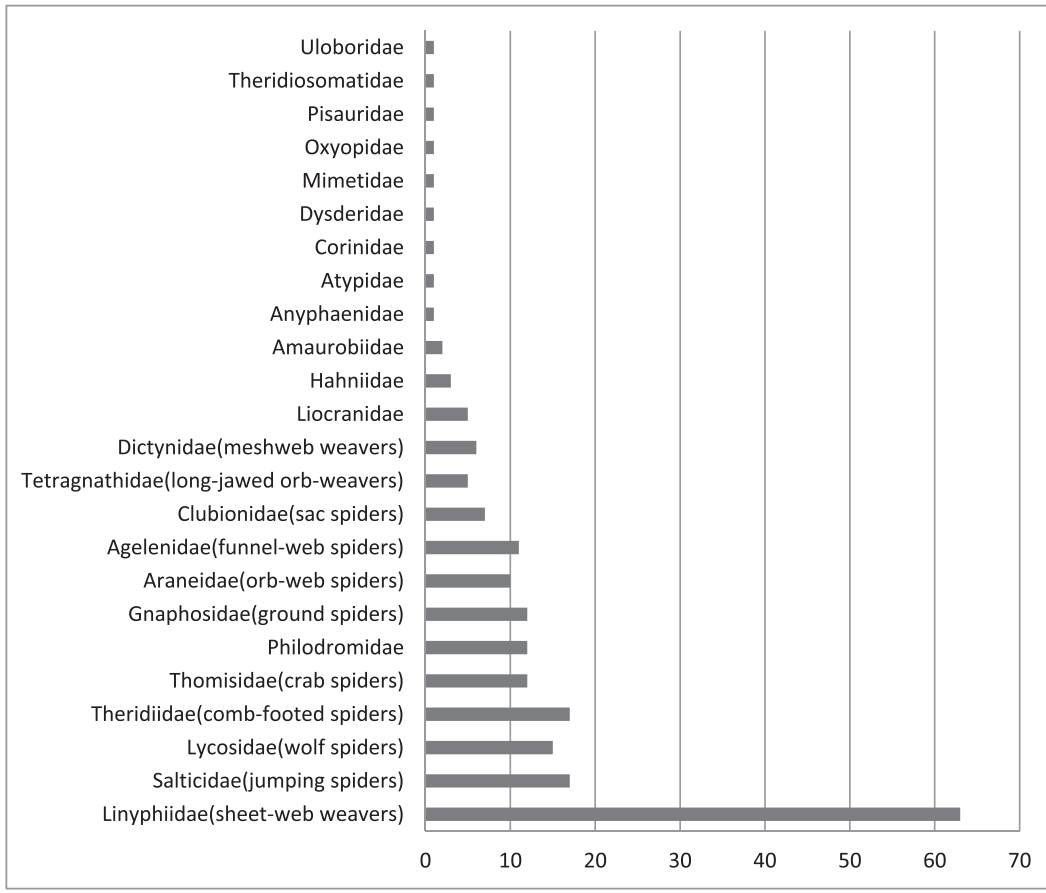

Fig. 2. Composition of the deciduous forest spider fauna of BRF. Vertical = family of spiders, horizontal = number of species.

1905) (Linyphiidae), whereas *Misumena vatia* (Clerk, 1757) (Thomisidae), a Holarctic species, was, found preying on flowers.

Deciduous forests are the richest ecosystems on the grounds of BRF. These forests are dominated almost everywhere by *Quercus rubra*. South slopes are dominated by *Q. montana*. Other dominant tree species include *Quercus alba*, *Q. coccinea*, *Gaylussacia baccata*, *Kalmia latifolia*, primarily on north facing slopes, and *Vaccinium angustifolium*, and *Viola conspersa* (Barringer and Clemants, 2003). Here were found spiders in 24 families, 113 genera, and 201 species. The abundance of spiders was highest in the deciduous forests of the Black Rock Forest. Linyphiid spiders are the dominant (63 species) group here. Actually, 25 species of spiders were found only in deciduous forests, they are: *Cicurina arcuata* Keyserling, 1887 (Agelenidae), *Sphodros rufipes* (Latreille, 1829) (Atypidae), *Clubiona bryantae* Gertsch, 1941, *Clubiona saltitans* Emerton, 1919 (Clubionidae), *Drassodes auriculoides* Barrows, 1919, *Haplodrassus bicornis* (Emerton, 1909), *Herpyllus ecclesiasticus* Hentz, 1832, *Litopyllus temporaries* Chamberlin, 1922, *Urozelotes rusticus* (L. Koch, 1872) (Gnaphosidae), *Centromerus persolutus* (O. Pickard-Cambridge, 1875), *Eperigone index* (Emerton, 1882), *Floricomus plumalis* (Crosby, 1905), *Grammonota inornata* Emerton, 1882, *Walckenaeria castanea* (Emerton, 1882), *Walckenaeria pallida* (Emerton, 1882) (Linyphiidae), *Scotinella pugnata* (Emerton, 1890) (Liocranidae), *Schizocosa bilineata* (Emerton, 1885), *Trabeops auranticus* (Emerton, 1885) (Lycosidae), *Hentzia mitrata* (Hentz, 1846), *Phidippus audax* (Hentz, 1845), *Sitticus fasciger* (Simon, 1880),

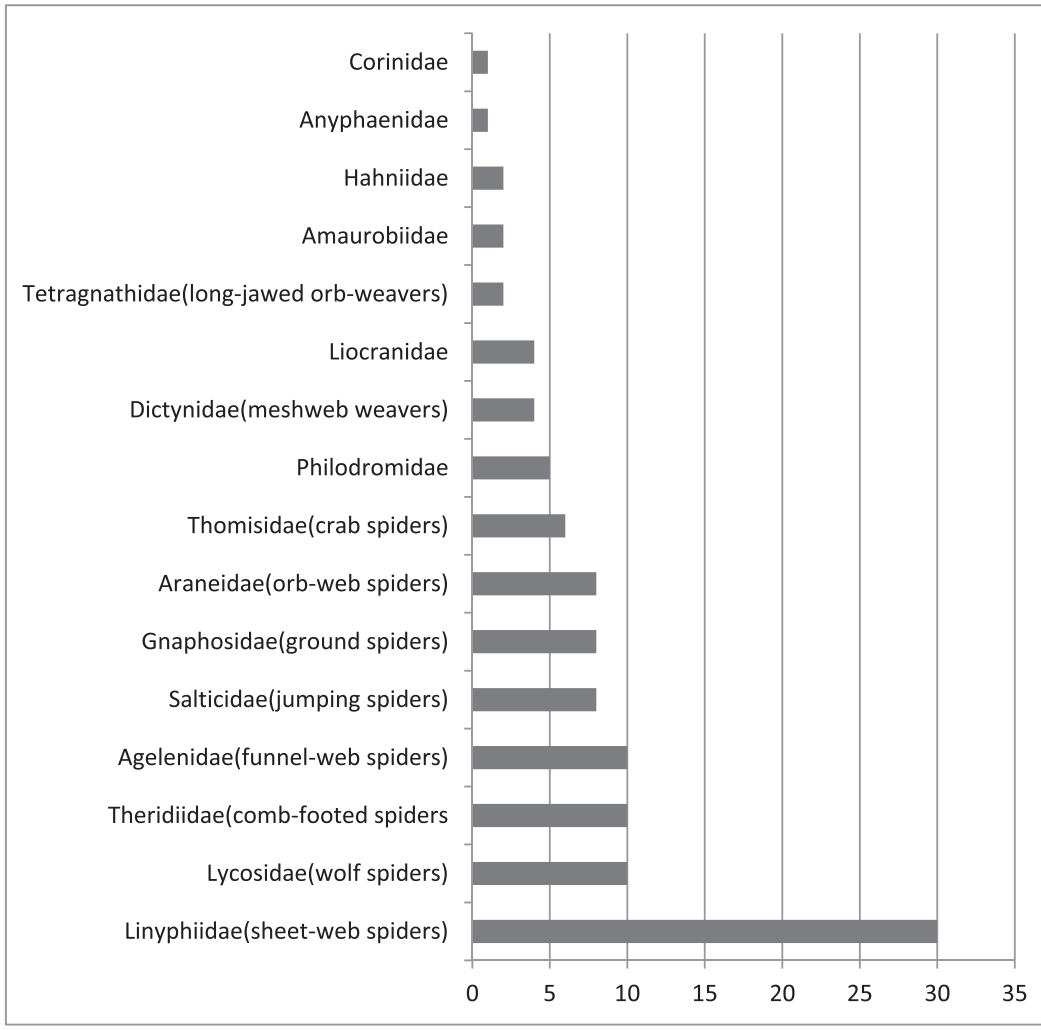

Fig. 3. Composition of the coniferous forest spider fauna of BRF. Vertical = family of spiders, horizontal = number of species.

Talavera minuta (Banks, 1895) (Salticidae), *Crustulina altera* Gertsch et Archer, 1942, *Dipoena nigra* (Emerton, 1882) (Theridiidae), and *Ozyptila americana* Banks, 1895 (Thomisidae).

The coniferous forests were inhabited by spiders of 16 families, 65 genera and 111 species. These types of forests are most common on the northern and lower slopes and dominated by *Tsuga canadensis*, and, in some places, *Pinus rigida*. The understory of the forest consists of shrubs, among which the most common is *Hamamelis virginiana,* and a rich fern covering, which are dominated by *Dryopteris carthusiana*, *D. marginalis* and *Polystichum acrostichoides* (Barringer and Clemants, 2003). We found that the coniferous forests had significantly less diversified spider fauna than the deciduous forests. As in deciduous forests, Linyphiid spiders were completely dominant in number of species and overall numbers. Moreover, 12 species were unique to coniferous forests and were not found in other habitats. These species were: *Gnaphosa muscorum* (L. Koch, 1866), *Haplodrassus signifier* (C. L. Koch, 1839), *Herpyllus propinquus* (Keyserling, 1887) (Gnaphosidae), *Bathyphantes albiventris* (Banks, 1892), *Macrargus multesimus* (O. Pickard-Cambridge, 1875), *Oedothorax montiferus* (Emerton, 1882) (Linyphiidae), *Pardosa fuscula* (Thorell, 1875), *Pardosa xerampelina*

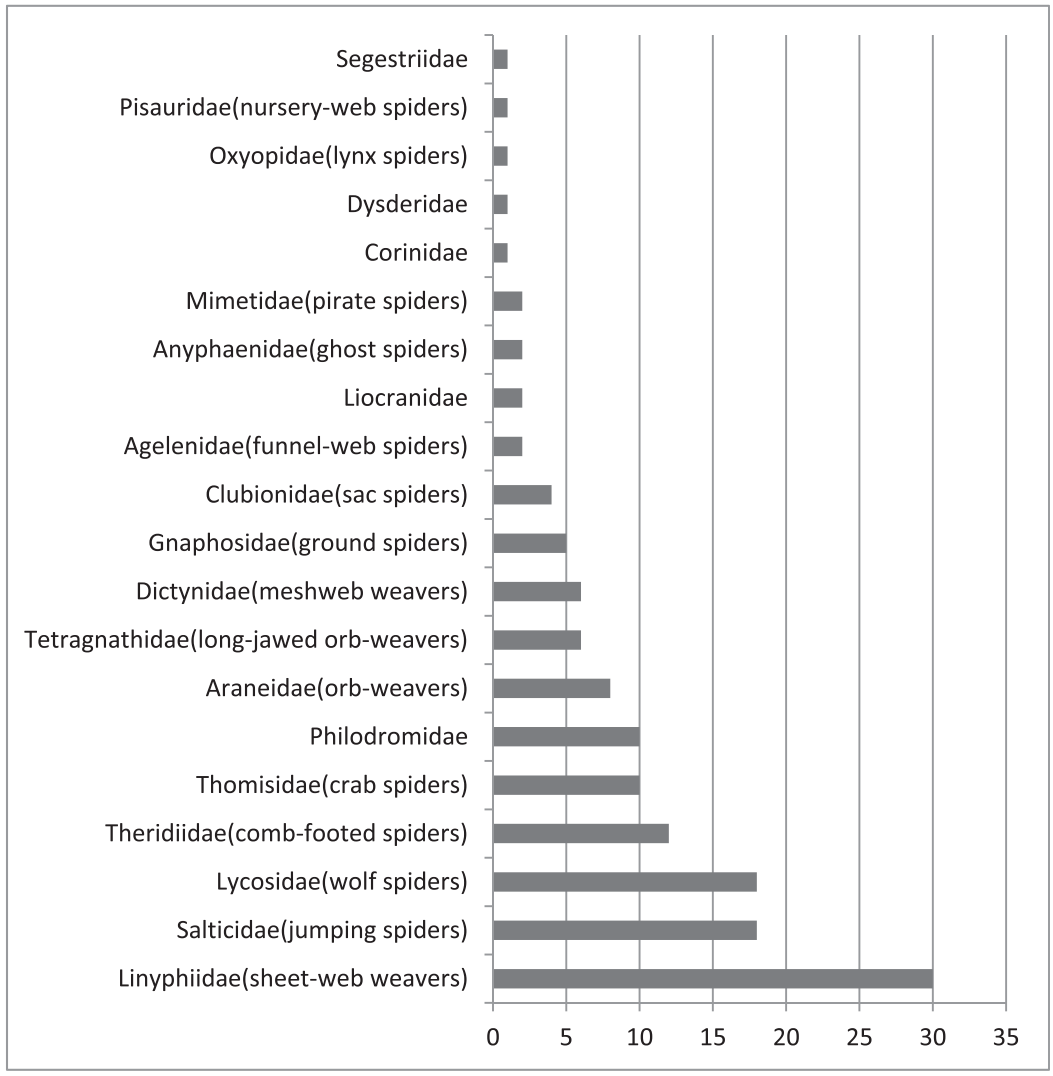

Fig. 4. Composition of the meadows spider fauna of BRF. Vertical = family of spiders, horizontal = number of species.

(Keyserling, 1877) (Lycosidae), *Enoplognatha rugosa* Emerton, 1908, *Euryopis funebris* (Hentz, 1850), *Theridion lyricum* Walckenaer, 1842 (Theridiidae), *Ozyptila conspurcata* Thorell, 1877 (Thomisidae).

Meadows were characterized by spiders of 20 families, 69 genera and 141 species. Of these, 12 species were found only in this ecosystem: *Wulfila saltabundus* (Hentz, 1847) (Anyphaenidae), *Zelotes hentzi* Barrows, 1945 (Gnaphosidae), *Diplostyla concolor* (Wider, 1834) (Linyphiidae), *Arctosa emertoni* Gertsch, 1934, *Pardosa saxatilis* (Hentz, 1844), *Schizocosa avida* (Walckenaer, 1837), *Schizocosa humilis* (Banks, 1892), *Schizocosa saltatrix* (Hentz, 1844) (Lycosidae), *Mimetus puritanus* Chamberlin, 1923 (Mimetidae), *Marpisa lineate* (C. L. Koch, 1846) (Salticidae), *Pachygnatha clercki* Sundevall, 1823 (Tetragnathidae), *Ozyptila georgiana* Keyserling, 1880 (Thomisidae).

Swamps were represented by 14 families of spiders, 51 genera, and 83 species of spiders, where the habitat was dominated by *Acer rubrum* and *Ilex verticillata*. Among the grasses that create this habitat, the most common were *Viola blanda*, *V. pubescens*, *Hydrocotyle americana* and *Carex lurida*

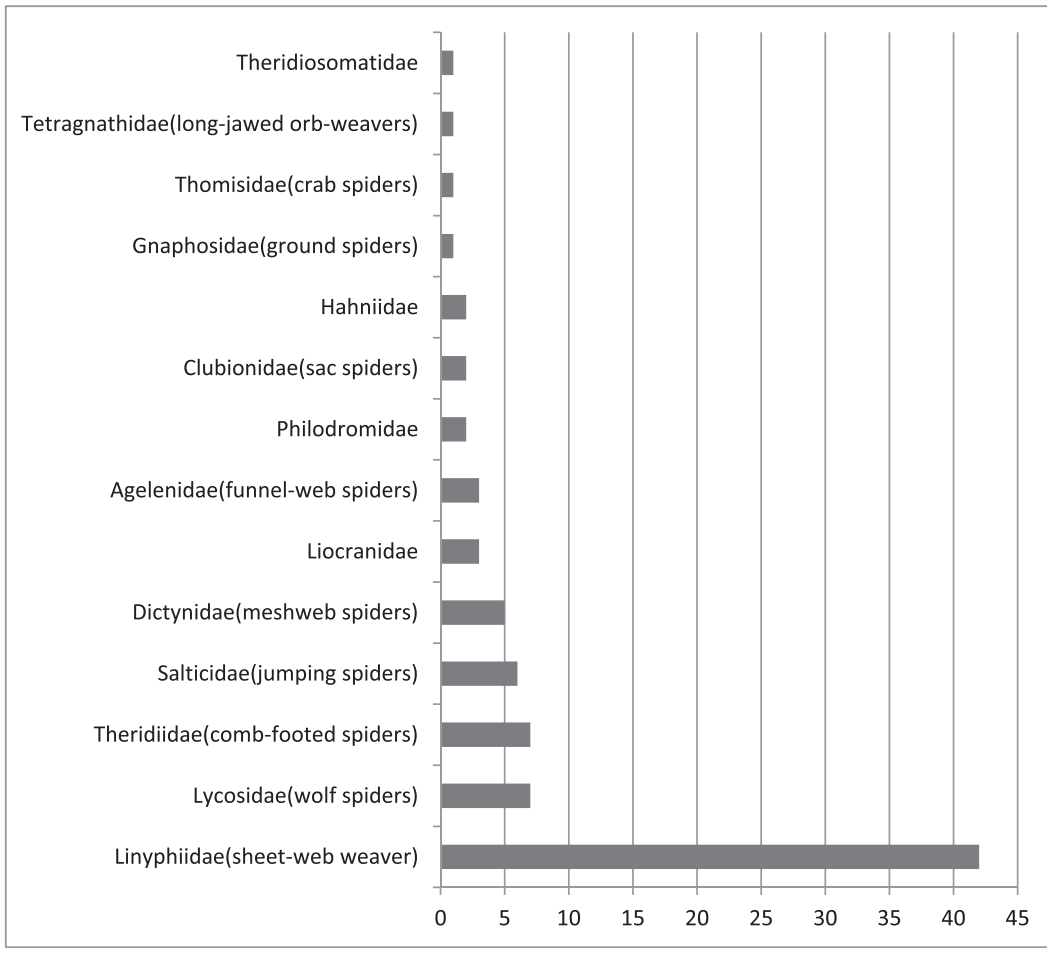

Fig. 5. Composition of the swamps spider fauna of BRF. Vertical = family of spiders, horizontal = number of species.

(Barringer and Clemants, 2003). The swamps were the least spider-populated areas in BRF. Nonetheless, seven species of spiders were found only on this habitat: *Aphileta misera* (O. Pickard-Cambridge, 1882), *Eperigone contorta* (Emerton, 1882), *Eperigone undulate* (Emerton, 1914), *Floricomus nasutus* (Emerton, 1911), *Grammonota gigas* (Banks, 1896), *Grammonota ornata* (O. Pickard-Cambridge, 1875) (Linyphiidae), *Pachygnatha tristriata* C. L. Koch, 1845 (Tetragnathidae).

On the banks of ponds and streams, we collected spiders from 19 families, 58 genera and 95 species. The wet soil of pond banks and streamsides were richly covered by trees: *Acer pensylvanicum*, *A. rubrum*, *A. saccharum*, *Betula alleghaniensis*, *Tilia americana*, and shrubs of *Rhododendron viscosum*. Of the grasses, the most common were *Hydrocotyle americana*, *Carex lurida* and *Impatiens capensis* (Barringer and Clemants, 2003). Eleven spider species were found only in this habitat type: *Clubiona maritime* L. Koch, 1867 (Clubionidae), *Drassyllus niger* (Banks, 1896) (Gnaphosidae), *Ceraticelus carinatus* (Emerton, 1911), *Erigone autumnalis* Emerton, 1882 (Linyphiidae), *Hogna helluo* (Walckenaer, 1837), *Pirata piratica* (Clerk, 1757) (Lycosidae), *Thanatus maritimus* (Menge, 1875) (Philodromidae), *Dolomedes scriptus* Hentz, 1945, *Dolomedes tenebrosus* Hentz, 1844 (Pisauridae), *Evarcha hoyi* (Peckham et Peckham, 1883), *Pelegrina galathea* (Walckenaer, 1837) (Salticidae).

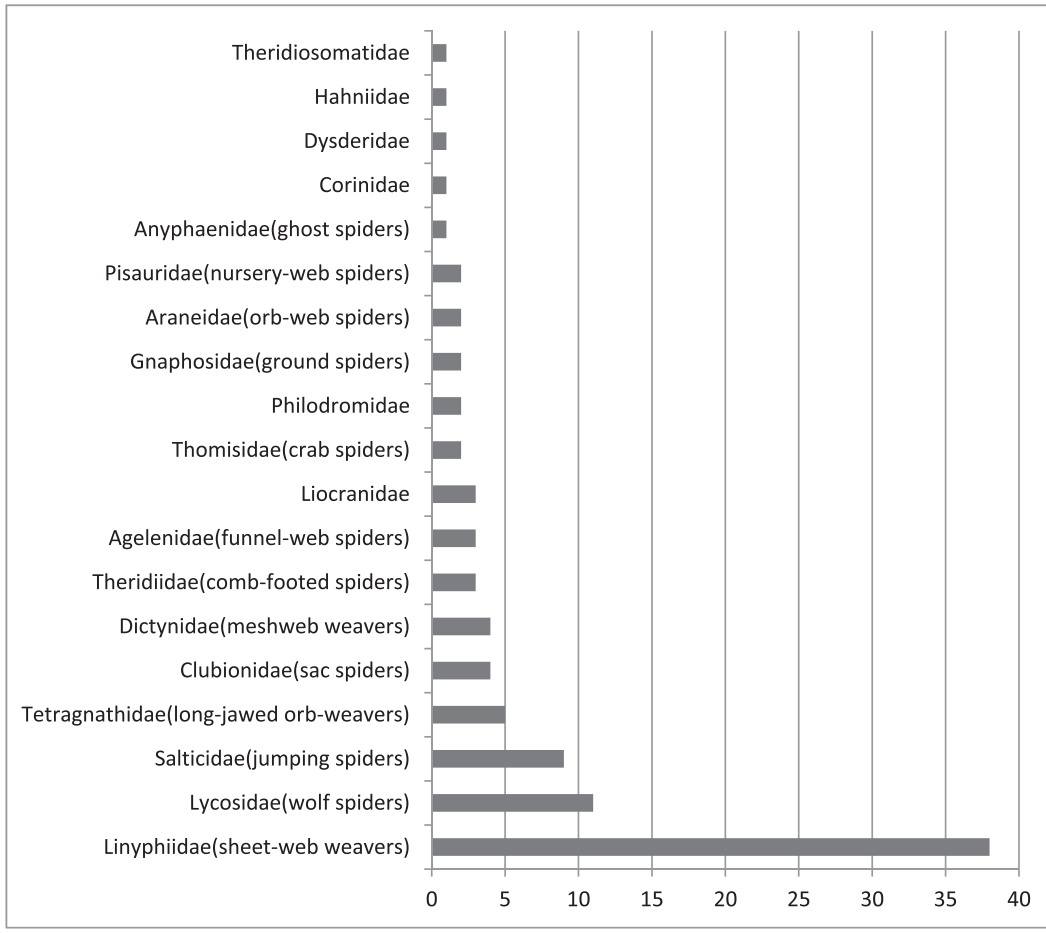

Fig. 6. Composition of the banks spider fauna of BRF. Vertical = family of spiders, horizontal = number of species.

Discussion

Our study revealed that the deciduous forests have the richest spider community of 201 species. This habitat also has the greatest number of species that were found only here on the grounds of BRF (25 species). Meadows held the next greatest spider fauna richness, with a total of 141 species. Twelve species were found only here and no where else. The poorest spider fauna is in the swamp areas, with only 83 spider species. However, even here, we found 7 species that are unique to this habitat (Fig. 7). These data correspond well with the diversity of vegetation, and, thus, the microhabitat diversity. Spider fauna is indirectly dependent on the composition of vegetation, which may be used for monitoring landscape dynamics. The deciduous forest in our study is the richest ecosystem. Microhabitats here are formed in vertical (canopy, tree trunks, litter, ground surface, and soil) and in horizontal (micro-relief specificity, vegetation distribution, etc.) dimensions. On the other hand, swamps have significantly less diversity of microhabitats. Swamp vegetation is less diverse and more homogeneously distributed. Comparison of deciduous and coniferous forests also supports this conclusion.

The ratio of species that are specific to a particular biotope to the total number of species registered in a particular area (biotope peculiarity) is also highest for the deciduous forests (12.4%), whereas for the coniferous forests it is only 10.8% (Fig. 8). The coefficient of peculiarity demonstrates the uniqueness of the spider community in the particular habitats. This index is

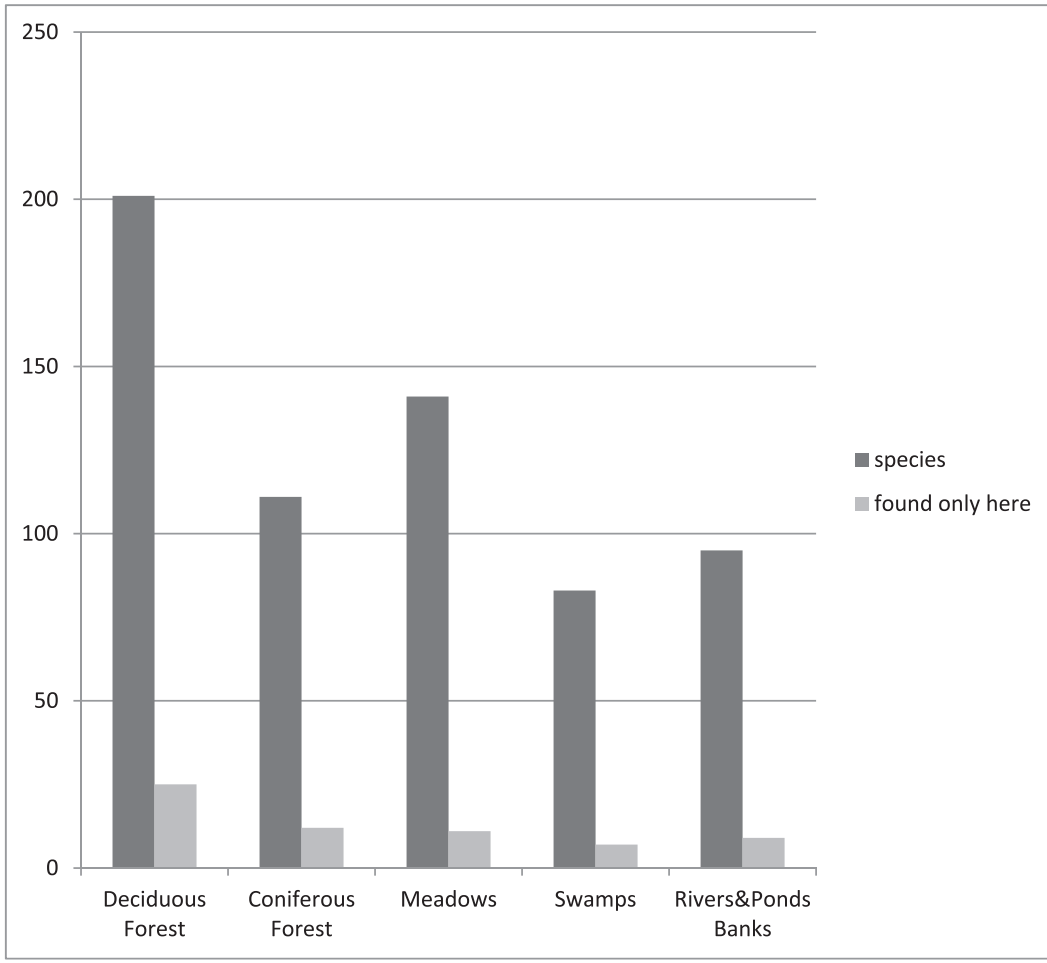

Fig. 7. Comparative richness of spider communities of different habitats of BRF. Vertical = number of species.

lowest for the spider fauna of meadows. This result suggests that spider communities of the meadows in BRF are formed mostly by species that invade on this type of habitat from surrounding forestry ecosystems, and that meadows generally support few species that are specific to this habitat. In the comparatively recent past, most of this territory was covered with forest and it is likely that meadows have not evolved yet a unique spider fauna.

Conclusions

The spider fauna of the BRF includes 27 families, 121 genera, and 279 species. Most numerous are Linyphiidae, which represent 26.9% of all spider fauna. *Pityohyphantes subarcticus* Chamberlin et Ivie, 1943, *Tenuiphantes tenuis* (Blackwall, 1852), and *Erigone dentosa* O.Pickard-Cambridge, 1894 were found for the first time in New York State. The most diverse spider community is found in the deciduous forest areas (201 species). The poorest spider fauna are in swamp areas (83 species). The deciduous forest also has the most unique spider fauna, whereas the least unique spider fauna is in the meadows. Collected data suggest that the richness and uniqueness of the spider fauna of wild habitats strongly depends on the type and state of wild vegetation, and may be used for monitoring of landscape health.

Acknowledgements

We are grateful to the staff of Black Rock Forest for their available advice and assistant with practical

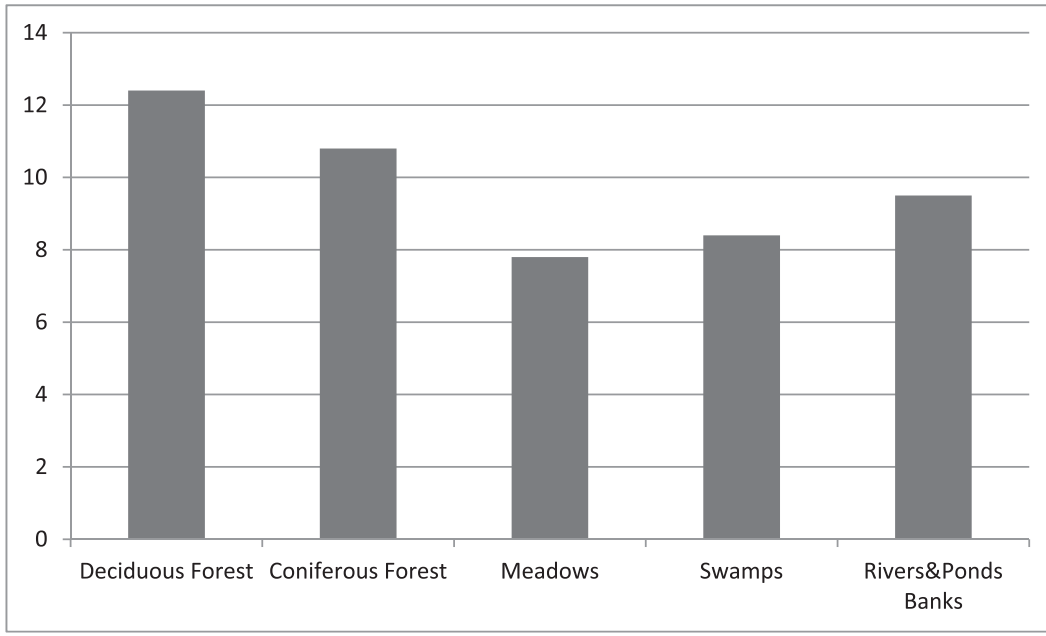

Fig. 8. Measure of Specific Biotopes. Coefficient of peculiarity (vertical): A/B*100; A = number of specific species, B = number of species on biotope, Swamps: 8 of 9 specific species are Linyphiidae (moss inhabitants).

matters and to the Black Rock Forest Consortium Small Grants for Scientific Research and Education program awarded to Dr. V. I. Ovtcharenko and Dr. B. P. Zakharov. We also thankful to the City University Research Foundation for awarded grant TRADB-42-342. We thank the Division of Invertebrate Zoology of the American Museum of Natural History and particular Dr. N. I. Platnick for support of spider's research at the laboratory. We are especially grateful to the Director of BRF Dr. William Schuster for his guidance and support. Authors thank Dr. Sandra Dickinson from La-Guardia Community College (CUNY) and Dr. Christine Johnson from American Museum of Natural History for improving our language and Dr. Holly Porter-Morgan for the help with information on BRF flora.

Literature Cited

Barringer, K. and S. Clemants. 2003. Vascular flora of Black Rock Forest, Orange County, New York. Journal of the Torrey Botanical Society 130: 292–308.

Black Rock Forest Consortium. 2013, Online at http://www.blackrockforest.org/docs/about-the-forest/the-forest/index.html.

Brennan, K. E. C., J. D. Majer and M. L. Moir. 2005. Refining sampling protocols for inventorying invertebrate biodiversity: influence of drift-fence length and pitfall trap diameter on spiders. The Journal of Arachnology 33: 681–702.

Buddle, C. M. and M. L. Draney. 2004. Phenology of Linyphiids in an old-growth deciduous forest in central Alberta, Canada. The Journal of Arachnology 32: 221–230.

Buckle, D. J., D. Carroll, R. L. Crawford and V. D. Roth. 2001. Linyphiinae and Pimoidae of America north of Mexico: checklist, synonymy, and literature. *In* Contributions à la connaissance des Araignées (Araneae) d'Amérique du Nord. (P. Paquin & D.J. Buckle, eds.). Fabreries, Supplément 10: 90–191.

Coddington, J. A., L. H. Young and F. A. Coyle. 1996. Estimating spider species richness in a southern Appalachian cove hardwood forest. The Journal of Arachnology 24: 111–128.

Colwell, R. K. and J. A. Coddington. 1994. Estimating terrestrial biodiversity through extrapolation. Phil. Trans. R. Soc. Lond. B 345: 101–118.

Crosby, C. R. and S. C. Bishop. 1926. A list of the insects of New York, with a list of the spiders and certain other allied groups. Cornell University, Agricultural Experiment Station, 101: 1034–1121.

Kaston, B. J. 1948 (1981). Spiders of Connecticut. Bulletin Connecticut Geological and Natural. History Survey Bull 70: 1–874.

Ovtcharenko, V. I., K. M. Catley and A. V. Tanasevitch. 2002. Biodiversity of spiders of the Black Rock

Forest. The Northeast Natural History Conference VII, April 24–27, 2002, Albany, NY: 18 pp.

Ovtcharenko, V., A. Tanasevitch and B. Zakharov. 2009. Diversity and seasonal dynamics of spiders in oak forests of Black Rock Forest near New York City. 25 European Congress of Arachnology, August 16–21, 2009, Alexangroupoli, Greece: 91 pp.

Ovtsharenko, V. and B. Zakharov. 2011. Biodiversity, seasonal dynamics and biomass of spiders and other soil invertebrates in oak forests of Black Rock Forest. Black Rock Forest Consortium, Seventh Research Symposium, June 20, 2011, Cornwall, NY: 8–9.

Ovtsharenko, V. and B. Zakharov. 2011. Seasonal dynamics and biomass of spiders and other soil invertebrates in oak forests of Black Rock Forest, NY. Annual Meeting of the American Arachnological Society, July 8–12, 2011, Portland, OR: 59 pp.

Platnick, N. I. 2014. The world spider catalog, version 14.5, American Museum of Natural History, online at http://research.amnh.org/iz/spiders/catalog/index.html

Schuster, W. 2009. Comparison of Black Rock Forest to other forests throughout the Highlands region. Black Rock Forest Consortium, Sixth Research Symposium, June 22, 2009, Cornwall, NY: 14 pp.

Received March 9, 2014; accepted 4 July 2014