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Preliminary Survey of the Terrestrial Isopods (Isopoda), Millipedes (Diplopoda), Harvestmen (Opiliones), and Spiders (Araneae) of Toft Point Natural Area, Door County, Wisconsin

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PRELIMINARY SURVEY OF THE TERRESTRIAL ISOPODS (ISOPODA), MILLIPEDES (DIPLOPODA), HARVESTMEN (OPILIONES), AND SPIDERS (ARANEAE) OF TOFT POINT NATURAL AREA, DOOR COUNTY, WISCONSIN

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ABSTRACT

Toft Point Natural Area is a National Natural Landmark owned and managed by the University of Wisconsin – Green Bay and located on the Lake Michigan shore of Wisconsin's Door Peninsula. With twelve biotic communities on 700 acres, Toft Point contains considerable biological diversity. We conducted a preliminary survey of the arachnids (spiders and harvestmen, excluding mites and pseudoscorpions), millipedes (diplopods), and terrestrial isopods (Isopoda: Oniscoidea).

Sampling occurred on three dates in 2001 using leaf litter collection with Berlese extraction and a timed collection by hand that incorporated a variety of techniques. Specimens from a 1992 survey and assorted collecting events were also used to compile a species list. The list includes five isopods, four millipedes, six harvestmen, and 113 spiders, including 16 new state records (two millipedes and 14 spiders) and 90 new Door County records. Litter collection and sampling in wetland habitats were both especially productive.

Toft Point Natural Area, a National Natural Landmark, encompasses 700 acres on Wisconsin's Door Peninsula. It is owned and managed by the University of Wisconsin – Green Bay and is protected as a State Natural Area (Wisconsin Department of Natural Resources 1999). Toft Point is on the Lake Michigan shore just east of the town of Baileys Harbor (Figure 1, inset). This peninsular location on the shore of this immense lake results in a climate that is unusually cool in summer and relatively mild in winter, supporting natural communities that are unique to northeast Wisconsin.

Two unpublished studies by UW – Green Bay students examined non-insect arthropods at Toft Point. In 1991, Dreux Watermolen reported five individuals of the millipede *Narceus annularis* (Rafinesque). Watermolen (1995a) reported this species from another location in Door County. In 1992, Whitehouse reported 31 spider species in 11 families. These two studies provided a baseline for our work.

Our objective was to conduct a preliminary survey of the terrestrial isopods, millipedes, harvestmen, and spiders at Toft Point. Knowledge of these groups is important in the study of community structure as they include predators, herbivores, and detritivores, groups that are very diverse (Araneae) and depauperate (Isopoda) and highly mobile taxa (Araneae) and relatively poor dispersers (Diplopoda). The spider survey of Blasczyk et al. (1992), conducted in a similar setting and nearby location, led us to anticipate finding at least 100 spider species in 16 families at Toft Point.

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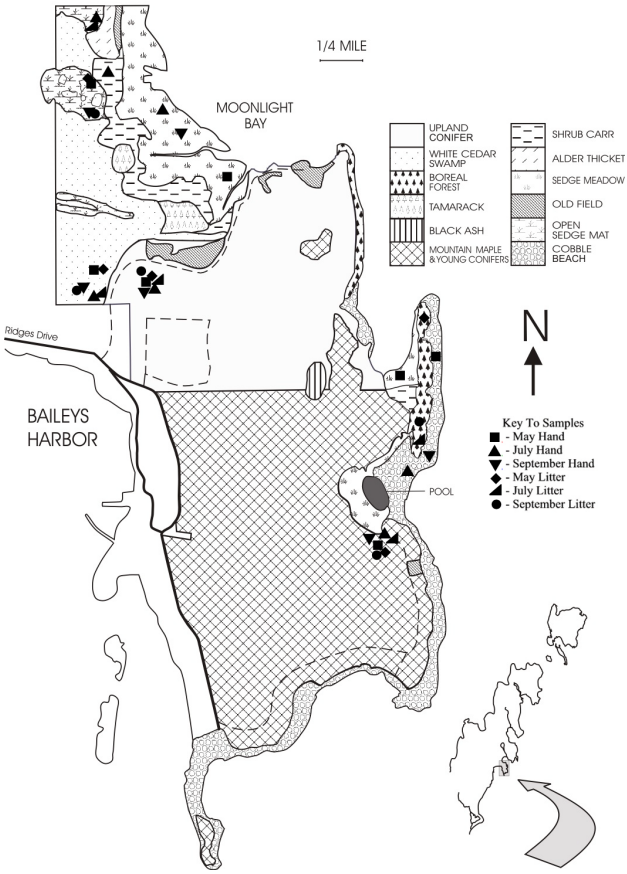

Figure 1. Map of Toft Point Natural Area showing approximate sampling locations and natural communities.

METHODS & MATERIALS

Toft Point (Door County, Wisconsin: 45°04′00′′ N, 87° 05′30′′W) is comprised of twelve different biotic communities within 700 acres (Figure 1). G. Fewless and J. Trick of the UW – Green Bay herbarium provided the following descriptions of the communities. Upland conifer forest was dominated by *Pinus strobus* and *Thuja occidentalis*. Boreal forest was dominated by *Thuja occidentalis,* with *Abies balsamea, Picea glauca, Pinus strobus,* and *Betula papyrifera* also present. Young forest (mountain maple and young conifers) was dominated by *Acer spicatum* with a few individuals of *Pinus strobus* and *Betula papyrifera*. White cedar swamp was also dominated by *Thuja occidentalis* and supported a few individuals of *Larix laricina, Fraxinus nigra,* and *Betula papyrifera.* The shrub-carr community was dominated by the shrubs *Myrica gale, Potentilla fruticosa, Betula glandulosa,* and *Salix candida*. Sedge meadow was dominated by *Carex stricta, Carex aquatilis,* and *Calamagrostis canadensis*. Open portions of the open sedge mat were dominated by *Carex lasiocarpa* and *Carex buxbaumii*. The disturbance of waves and the presence of stones of variable size affect the

vegetation found on the cobble beach. Plant species found there include *Veronica Anagallis-aquatica, Cardamine pensylvanica, Rorippa palustris, Juncus arcticus, Carex viridula,* and *Ranunculus flammula*. The old field community was dominated by the species *Poa pratensis, Poa compressa, Elytrigia repens, Chrysanthemum leucanthemum, Hieracium aurantiacum, and Equisetum arvense* with many other forbs.

Sampling occurred on 8 May, 17 July, and 22 September 2001, at locations indicated in Figure 1. Nine communities were sampled; four (upland conifer, white cedar, young forest, and open sedge mat) were selected for intensive, replicated sampling using both litter collection and timed collection by hand. Only litter collection took place in the boreal forest and only collection by hand took place on the cobble beach and in the sedge meadow. A few specimens were collected during travel between habitat types. A total of 35 samples were collected: 15 litter samples and 20 collections by hand.

The litter collection method consisted of one concentrated, pooled sample. Handfuls of litter taken from various microhabitats at the site were shaken through a sieve into a cloth bag. This concentrated litter was transferred into a standard 4 L canvas bag and heat/light extracted via Berlese funnel for three days. Specimens were extracted into a 50/50% propylene glycol/water mixture, which was subsequently rinsed with water in a standard 200 μm sieve and transferred into clean 70% ethanol.

The timed collection by hand consisted of 0.5 person-hour of collecting. This technique is a variation of the methods used by Coddington et al. (1991). A combination of techniques were used which, depending on a site's vegetation, included sweeping herbaceous vegetation, brushing/shaking woody vegetation onto a nylon beating sheet, searching by hand within vegetation and at ground level, and turning over rocks and logs. These techniques were intended to produce arthropods not revealed by other methods. These were put directly into 70% ethanol upon collection. All specimens were separated from vegetative material, sorted into groups (isopods, millipedes, harvestmen, and spiders), and placed in clean 70% ethanol for determination.

Whitehouse's 1992 survey consisted of three three-day collecting trips (18-21 June, 10-12 July, and 14-16 August). Sweep netting was conducted in the sedge meadow, shrub carr, and old field communities. Pitfall traps, each a 2 L plastic bottle with its top portion removed, set into the ground were used in the upland conifer forest and old field communities. Ethanol was used as a preservative. Traps were used on two of the sampling trips and were left for three days before collection. Leaf litter searches consisted of selecting several 0.5m × 0.5m areas, placing all litter from this area on a white bed sheet and sorting all spiders from this litter. On two of the sampling trips, five to seven points were selected in the upland conifer forest and three to five points were selected in the boreal forest. Visual day searches were conducted in the old field, sedge meadow, shrub-carr, white cedar swamp, upland conifer forest, and boreal forest, with special attention being paid to cryptic habitats. Visual night searches were also conducted in the upland conifer forest, old field, and boreal forest on one sampling trip.

Other specimens from Toft Point were also included in our study: those collected by Whitehouse in 1992, by Draney in 2002, and specimens referred to Draney by G. Fewless from collection by hand in 1994 and A. Opiola from litter collection in 2002. Draney determined harvestmen and spiders; some determinations were provided or confirmed by Kaspar and D. Buckle. Kaspar and Draney reexamined specimens from Whitehouse's 1992 work. Snyder determined millipedes based on original descriptions (Chamberlin 1922, Shear 1972, Hoffman 1974, Shelley 1998) and isopods using a key (Jass and Klausmeier 1996b) aided by Hopkin's (1991) descriptions and drawings. Spider nomenclature is based on Platnick (2004); plant nomenclature on Gleason & Cronquist (1991).

New spider state and county records are based on Cokendolppher & Lee (1993), Buckle et al. (2001), Kaspar's unpublished county level list, and that of J. Jass of the Milwaukee Public Museum. All specimens have been deposited in the Richter Museum at UW – Green Bay.

RESULTS

Isopoda: Of 11 known Wisconsin species (Jass & Klausmeier 1996a), five were found in our survey, that yielded 423 individuals. New county records are *Trichoniscus pusilius* Brandt and *Hyloniscus riparius* (C. L. Koch) (Jass & Klausmeier 1996a). The most abundant were *Trachelipus rathkei* (Brandt) and *H. riparius* with *T. rathkei* most widespread. This reflects the fact that *T. rathkei* is the most common and widespread isopod in Wisconsin (Jass & Klausmeier 1996a). Isopods were effectively collected by both methods.

Diplopoda: Among 326 specimens were four species. *Ophyiulus pilosus* (Newport) was the most common. Two new state records were *Cleidogona celerita* Williams & Hefner and *Pseudopolydesmus sp*. Of special interest is *Petaserpes mutabilis* (Causey): this species has rarely been reported from Wisconsin, and is a new county record (Watermolen 1995b). *Cleidogona celerita* and *P. mutabilis* were only collected by the litter method, while the other two species were collected with both methods.

Opiliones: Six species in three families were collected, all collected by hand. *Caddo agilis* Banks appears to be a parthenogenetic species: males have never been found (Shear 1975). Our survey also only found females.

Araneae: We determined 113 species in 17 families, including four species determined only to genus and three probably undescribed species of Linyphiidae. Eighty-five species are new county records, 14 of which are also new state records. Most new state records (86%) were collected in the wetland habitats of the open sedge mat, sedge meadow, or white cedar swamp. All three of the probable new species were also collected in a wetland habitat (open sedge mat).

Three new state records are also range extensions. Southern range extensions are *Araneus groenlandicola* (Strand), which is found as far north as Greenland and near Hudson Bay in Canada (Levi 1971), and *Glyphesis idahoanus* (Ch.), which has been found in Idaho and several Canadian provinces (Buckle et al. 2001). A western range extension is *Cheniseo fabulosa* Bishop & Crosby which has only been reported from New York, from the type specimen and paratype (Bishop & Crosby 1935, Buckle et al. 2001).

Nineteen species in 11 families were determined only from Whitehouse's 1992 material and four species, including three new county records, were from specimens not collected in either the 1992 or 2001 surveys (Table 1). Eleven species in five families were found in both the 1992 and 2001 surveys. In total, the material from Whitehouse represents 30 species in 11 families including 21 new county records, six of which are also new to Wisconsin.

The 2001 survey collected 90 species in 17 families, of which 79 species were found only during this survey. These 90 species include 67 new county records, 11 of which are also reported here as new to Wisconsin (Whitehouse collected three of these in 1992). Approximately 19% of 1316 individuals collected were adults. Fifty (55.6%) species were collected by hand and 35 (38.8%) were taken by the litter method. Only 5 (5.6%) species were collected by both methods. Thirty-nine (58.2%) new county records were collected only by hand, including four new state records and 25 (37.3%) were taken only by the litter method, including seven new state records. All three probable new species were taken using litter collection. Three (4.5%) new county records were collected using both methods.

Table 1. Species List for Toft Point Natural Area, Door County, Wisconsin.

		Habitats										
Family	**Species**	**BF**	**CB**	**LS**	**OF**	**OS**	**SC**	**SM**	**UC**	**WC**	**YF**	**Methods**
Isopoda												
Cylisticidae	*Cylisticus convexus* (DeGeer)	M							M			L
Porcellionidae	*Porcellio spinicornis* Say		S									H
Trachelipidae	*Trachelipus rathkei* (Brandt)	MJ	MS			S			MJS	M	MS	H L
Trichoniscidae	*Hyloniscus riparius* (C. L. Koch)*	MJ							MJS		MJS	H L
	Trichoniscus pusilius Brandt*	M										L
Diplopoda												
Cleidogonidae	*Cleidogona celerita* Williams & Hefner**	M				MS			MS	MS	MJS	L
Julidae	*Ophyiulus pilosus* (Newport)	MJS	M			M			MJS	MJS	MJS	H L
Polydesmidae	*Pseudopolydesmus* sp.**		S			M				MS		H L
Polyzoniidae	*Petaserpes mutabilis* (Causey)*	MJS							J			L
Opiliones												
Caddidae	*Caddo agilis* Banks								W			
Gagrellidae	*Leiobunum vittatum* (Say)		S						W		J	H
	Leiobunum ventricosum (Wood)										J	H
	Leiobunum calcar (Wood)							J				H
Phalangiidae	*Phalangium opilio* L.		JS									H
	Odiellus pictus (Wood)		*J*						S*W*	S		H
Araneae												
Agelenidae	*Agelenopsis utahana* (Ch. & I.)*									J		H
Amaurobiidae	*Amaurobius borealis* Emerton*								MS	M		L
Araneidae	*Araneus groenlandicola* (Strand)**							S				H
	Araneus marmoreus Clerck*										JS	H
	Araneus saevus (L. Koch)*				A1							
	Araniella displicata (Hentz)*										J	H
	Argiope aurantia Lucas							S				H

Table 1. Continued.

Family	Species	Habitats										Methods
		BF	CB	LS	OF	OS	SC	SM	UC	WC	YF	
	Argiope trifasciata (Forskal)					S						H
	Cyclosa conica (Pallas)*								*S*	*M*		H
	Hypsosinga pygmaea (Sundevall)*					J		W				H
	Hypsosinga rubens (Hentz)*						J					H
	Larinioides cornutus (Clerck)		J					JSW			JS	H
	Larinioides patagiatus (Clerck)*										J	H
	Mangora gibberosa (Hentz)*				W							
	Mangora placida (Hentz)*									*M*		H
	Neoscona arabesca (Walckenaer)		J			J		JSW				H
	Zygiella nearctica Gertsch*	W										
Clubionidae	*Clubiona norvegica* Strand**							W				
	Clubiona riparia L. Koch						J					H
Corinnidae	*Castianeira descripta* (Hentz)		S									H
	Phrurotimpus alarius (Hentz)*								M			
	Phrurotimpus borealis (Emerton)*										S	L
Dictynidae	*Cicurina arcuata* Keyserling*								J			L
	Cicurina brevis (Emerton)*									S		
	Emblyna annulipes (Blackwall)*										J	H
	Emblyna hentzi (Kaston)*							W				
Gnaphosidae	*Gnaphosa parvula* Banks*		J									H
	Herpyllus ecclesiasticus Hentz*				*W*							
	Sergiolus sp.					M						L
	Zelotes sp.										M	L
Hahniidae	*Antistea brunnea* (Emerton)*					S						L
inyphiidae	*Bathyphantes pallidus* (Banks)*								W			
	Centromerus denticulatus (Banks)**									MS		L
	Centromerus longibulbus (Emerton)**									M		L
	Centromerus persolutus (O. P.-Cambr.)*	S							MS	MS	S	L
	Centromerus sylvaticus (Blackwall)*										S	L

Table 1. Continued.

Family	Species	Habitats										
		BF	CB	LS	OF	OS	SC	SM	UC	WC	YF	Methods
	Ceraticelus emertoni (O. P.-Cambr.)*				A2							
	Ceraticelus fissiceps (O. P.-Cambr.)*	S							MJ		MJS	H L
	Ceraticelus micropalpis (Emerton)*									M		L
	Ceratinops sp. Prob. N.					M						L
	Cheniseo fabulosa Bishop & Crosby**					S						L
	Erigone atra Blackwall		J			J		JW				H L
	Glyphesis idahoanus (Ch.)**									M		L
	Grammonota gigas (Banks)**					M						L
	Grammonota ornata (O. P.-Cambr.)**					M						L
	Grammonota pictilis (O. P.-Cambr.)*								JS		J	H
	Grammonota vittata Barrows*							W				
	Helophora insignis (Blackwall)*									S		H
	Hybauchenidium cymbadentatum (Crosby & Bishop)*									M		L
	Hypselistes florens (O. P.-Cambr.)*							W				
	Incestophantes calcaratus (Emerton)**								SW			H
	Islandiana flaveola (Banks)*									S		L
	Unknown sp. cf. *Islandiana*					S						L
	Lepthyphantes alpinus (Emerton)**								W			
	Meioneta fabra (Keyserling)**							W				
	Neriene clathrata (Sundevall)*									M		L
	Oreonetides sp. Prob. N.					S						L
	Pityohyphantes costatus (Hentz)*								M	M	J	H
	Pocadicnemis americana Millidge*								J			L
	*Satilatlas arenarius (Emerton)**		*M*									*H*
	Sisicottus montanus (Emerton)*	S							W			L
	Sisicus penifusifer Bishop & Crosby									MS		L
	Tapinocyba simplex (Emerton)									S		L
	Tenuiphantes sabulosus (Keyserling)										M	L

Table 1. Continued.

Family	Species	Habitats										Methods
		BF	CB	LS	OF	OS	SC	SM	UC	WC	YF	
	Tenuiphantes zebra (Emerton)	M								S		H L
	Walckenaeria communis (Emerton)*									M		L
Liocranidae	*Agroeca ornata* Banks*								MS			H L
Lycosidae	*Pardosa distincta* (Blackwall)				W							
	Pardosa fuscula (Thorell)*			M		J		MJ				H
	Pardosa moesta Banks*						J					H
	Pirata insularis Emerton									J		H
	Pirata montanus Emerton*									S		L
	Pirata piraticus (Clerck)*		J									H
	Schizocosa sp.										M	L
	Trochosa terricola Thorell*		N						M		M	H
Philodromidae	*Philodromus imbecillus* Keyserling*									J		H
	Philodromus placidus Banks*									J		H
	Philodromus rufus quartus Dondale & Redner*							W				
	Tibellus maritimus (Menge)*							S				H
	Tibellus oblongus (Walckenaer)*							W				
Pisauridae	*Pisaurina* prob. *brevipes* (Emerton) **					*S*						H
Salticidae	*Admestina wheeleri* Peckhams*									S		L
	Eris militaris (Hentz)							W			S	H
	Naphrys pulex (Hentz)*								M			H
	Pelegrina flavipes (Peckhams)*								M	S		H
	Pelegrina insignis (Banks)*										S	H
	Pelegrina proterva (Walckenaer)*										S	H
	Phidippus clarus Keyserling							W				
	Salticus scenicus (Clerck)		*A3*									H
	Synageles noxiosus (Hentz)*							M				H
	Zygoballus nervosus (Peckhams)*							S				H
Tetragnathidae	*Leucauge venusta* (Walckenaer)*									*W*		

Table 1. Continued.

Family	Species	Habitats BF	CB	LS	OF	OS	SC	SM	UC	WC	YF	Methods
	Pachygnatha xanthostoma C. L. Koch*									S		H
	Tetragnatha caudata Emerton*							J				H
	Tetragnatha elongata Walckenaer*										J	H
	Tetragnatha extensa (L.)**							JW				H
	Tetragnatha laboriosa Hentz							J				H
	Tetragnatha pallescens F. O. P.-Cambr.*							JW				H
	Tetragnatha versicolor Walckenaer*		*J*			J		W	J			H
Theridiidae	*Argyrodes trigonum* (Hentz)*								*JS*			H
	Enoplognatha caricis (Keyserling)*		J									H
	Enoplognatha ovata (Clerck)*	*W*							JW	JW	J	H
	Euryopis sp.					M						L
	Robertus banksi (Kaston)*									M		L
	Steatoda albomaculata (De Geer)*				W							
	Steatoda borealis (Hentz)				W							
	Takayus lyricus (Walckenaer)*								J			H
	Theridion differens Emerton										J	H
	Theridion glaucescens Becker										J	H
Thomisidae	*Misumena vatia* (Clerck)							W				
	Ozyptila distans Dondale & Redner*	M							A2			L
	Xysticus ellipticus Turnbull et al.**							W				
	Xysticus gulosus Keyserling*		A3									H

*=Door County Record; **=Wisconsin State Record.
Habitats: BF - Boreal Forest; CB - Cobble Beach; LS – Lakeshore; OF – Old field; OS - Open Sedge Mat; SC – Shrub-carr; SM – Sedge Meadow; UC - Upland Conifer Forest; WC - White Cedar Swamp; YF - Young Forest;.
Phenology data: M=May, J=July, S=September, N=November (Snyder/Draney data); italics refers to immature specimens, otherwise only adult specimens were used; W=Collected by J. Whitehouse, 1991-1992; A=Additional specimens from various collectors. A1 = G. Fewless, October 1994, Open area on sandy soil. A2 = A. Opiola, Summer 2002. A3 = M. Draney, October 2002.
Methods (refers to Snyder/Draney data): L = Litter H = Collection by hand.

DISCUSSION

Our combination of methods produced many spider species with little overlap: only five species were collected by both methods. Litter collection yielded the most new state records and many rare species. Temporal spacing of sampling events was necessary to find the most spider species in an adult state, since many spiders cannot be identified to species in an immature state. Every habitat subjected to repeat sampling yielded species unique to that habitat.

The vast majority of new state record species were found in certain habitat types: sampling wetlands proved a very important component of this survey. Discovery of so many new spider state records in wetland habitats suggests that Toft Point has a truly unique wetland spider fauna, but more likely suggests that wetland habitats in Wisconsin are undersampled relative to other habitat types. The results shown here represent only a few days of fieldwork on a site rich in habitat diversity. Both the minimal amount of overlap between the 1992 and 2001 surveys and a large number of unique species found in auxiliary collections (those by Fewless or Opiola) are evidence that many more species remain to be reported here. Clearly, much work remains in order to provide a complete list of the fauna at Toft Point and throughout Wisconsin.

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