Ants (Hymenoptera: Formicidae) of Rockwood Park, New Brunswick: An Assessment of Species Richness and Habitat

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Abstract - Based on samples from 5 discrete habitat types (*Thuja occidentalis* [Eastern White Cedar] stand, Eastern White Cedar fen, old field, Acadian Mixed Forest, peat bog) we report the first assessment of ant species richness for a specific locale in New Brunswick. We identified 30 ant species across 3 subfamilies and 9 genera as present in Rockwood Park, a heavily wooded, 890-ha municipal park within the city of Saint John. All ant species encountered were native. Given our estimate of a total of 85–96 ant species present in New Brunswick (based on New Brunswick Museum records and studies of ants in northeastern North America), we found ~35% in Rockwood Park. Major differences were evident in the assemblages of ant species among the 5 habitat types examined. While each habitat included generalist ant species shared across habitat types, ant species unique to each habitat were also present. Of the habitats studied in Rockwood Park, peat bogs and Eastern White Cedar stands supported the ant assemblages that were the most diverse, including several species that have rarely been encountered in North America. Both peat bogs and Eastern White Cedar stands in New Brunswick are widely exploited for commercial purposes. Our results suggest that environmental assessments of such habitats may need to consider the presence of rare, specialist ant species.

Introduction

Ants are a diverse family of arthropods found abundantly throughout terrestrial environments (Creighton 1950, Ward 2007). While often regarded as pests due to aggressive behavior, painful stings, and the scavenging feeding habits of some species (Groden et al. 2005, Menke et al. 2010), ants also provide a multitude of ecosystem services that include soil aeration, regulation of other organisms, and nutrient cycling (Crist 2009, Erickson et al. 2014, Oberg et al. 2012, Ohashi et al. 2007). Despite this economic and environmental significance, there has been little formal assessment of ant diversity in Maritime Canada, and none within the province of New Brunswick.

Over the past 60 years, ant diversity in New Brunswick, has been mentioned only briefly in the literature, including Creighton (1950), Sanders (1964), and Francoeur and Loisellle (1984). Online resources, including AntWeb (https://www.antweb.org/) and BugGuide (http://bugguide.net/node/view/15740) post records reportedly from New Brunswick, but data on New Brunswick ants remain

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scant. Here we report the outcome of an assessment of ant species richness within Rockwood Park (RWP), a heavily wooded, 890-ha municipal park in the city of Saint John, NB, Canada. This is the first detailed assessment of ant species for a specific locale within New Brunswick. Our objective here is to provide the basis for New Brunswick-wide conservation assessments of this ecologically important group of insects.

Methods

Study site and collection methods

RWP (45.30°N, 66.05°W; Fig. 1) covers 890 ha dominated by upland Acadian Mixed Forest (a forest type defined by the presence of tree species characteristic of

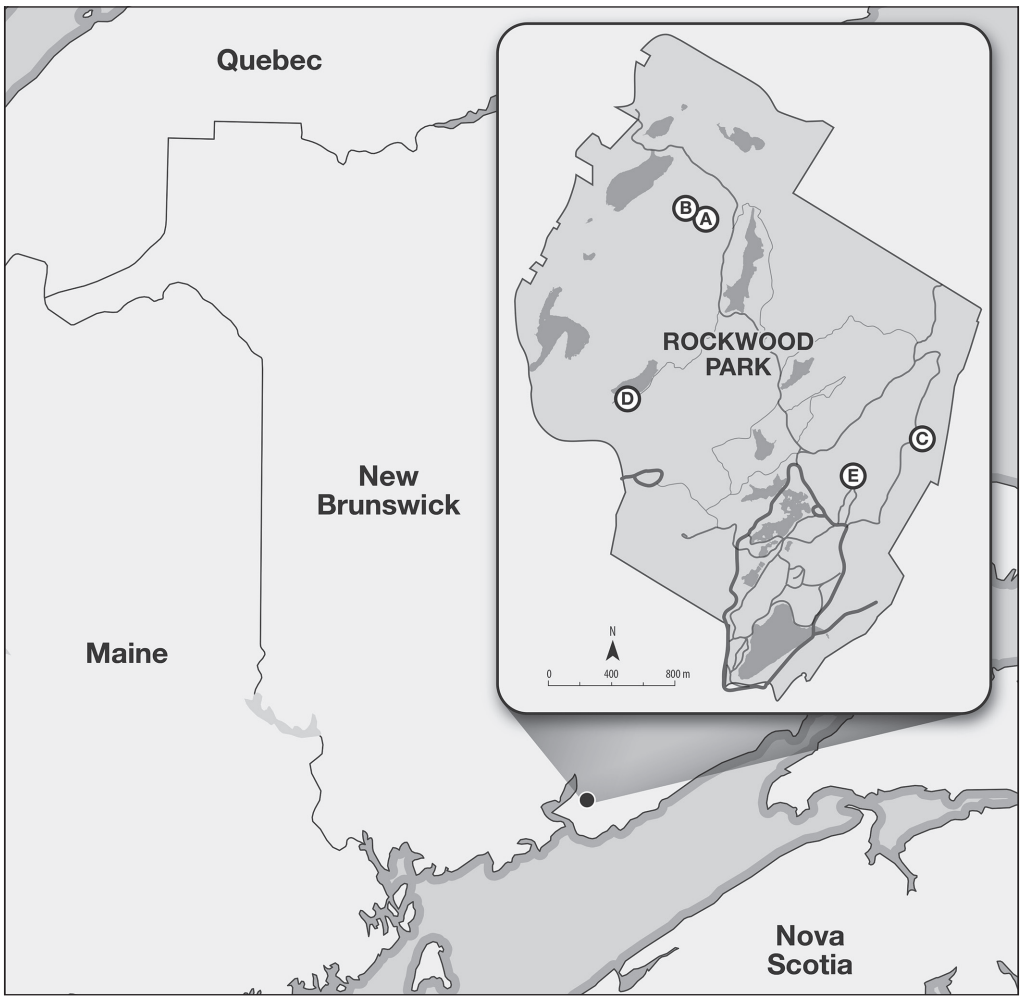

Figure 1. Map of Rockwood Park, Saint John, NB, Canada. Letters mark sample sites and correspond to the following habitats: (A) Eastern White Cedar stand, (B) Eastern White Cedar fen, (C) old field, D) Acadian Mixed Forest, and (E) peat bog. Irregular dark polygons mark lakes.

North America's eastern deciduous forest and boreal forest zones and confined to Maritime Canada; see Loo and Ives 2003) and is one of the largest municipal parks in North America. The park is bounded by semi-urban and urban habitat, the latter including a network of multi-lane highways and industrial and residential developments. In addition to Acadian Mixed Forest, bog habitat and *Thuja occidentalis* L. (Eastern White Cedar, hereafter also "cedar") stands are also widespread in the park, while smaller areas encompass fens and anthropogenically disturbed habits such as old fields. Each of these habitats presents diverse resources for generalist ant species, as well as unique conditions that could support ants specialized for wet, acidic, or open conditions (Crist 2009, Lyford 1963, MacKay 1993). We collected ants in RWP every 1 to 2 weeks during June–July 2014 at 5 sampling sites representative of a variety of park habitat types (cedar stand, cedar fen, old field, Acadian Mixed Forest, and peat bog). We conducted ant sampling using an adaptation of the standard Ants of the Leaf Litter (ALL) protocol for the collection of ground-dwelling ants (Smith et al. 2014). We used 5 standard trapping techniques, including pitfalls (set for a 5-hour period), baited traps (protein with sugar bait), sifting leaf litter, mini-Winkler extractors (1.75 liters), and one hour of active searching, to estimate the species richness of soil- and litter-dwelling ants. At each site, 3 investigators simultaneously completed surveys of 3 replicate 50-m transects, which included pitfall and bait traps every 10 m and 5-L leaf-litter sifts every 20 m (Smith et al. 2014). These transects were a minimum of 250 m apart. We retained the leaf litter and soil from the sifts for placement in the mini-Winkler traps. To document habitat types at each site, we took a high-resolution panoramic photograph (GigaPan image; Smith et al. 2014). Images representative of the 5 habitat types sampled are shown in Figures 2A–E. Links to all GigaPan photographs can be found at an online gallery (http://gigapan.com/galleries/b72015270f8b4f832eb943aca4a74157).

Specimen processing

We pointed all individuals collected and identified each to species based on morphology, utilizing Cannon (1998), Schofield et al. (2016), Creighton (1950), Ellison et al. (2012), Smith (1957), Taylor (1967), Trager et al. (2007a, b), Weber (1950), Wilson (1955), and Wing (1968). Representatives of all ant species collected in RWP have been deposited in the collection of the New Brunswick Museum. Specimens from this study barcoded for the Barcode of Life Datasystem have images and geospatial metadata publicly available online at dx.doi.org/10.5883/DS-ADNBA.

Species richness

We tallied species richness (number of species present) across all 3 transects for a given habitat and also examined the distribution of both species and genera across habitats.

Results

We identified 30 ant species across 3 subfamilies and 9 genera among the 648 specimens collected in RWP (Table 1). Table 1 also reports the habitat types occupied and the generalized ecological category for each ant species based on

Anderson (1997) and Ellison et al. (2012). No non-native ant species were found in RWP in the habitats we sampled. Six ant species occurred across all 5 habitats

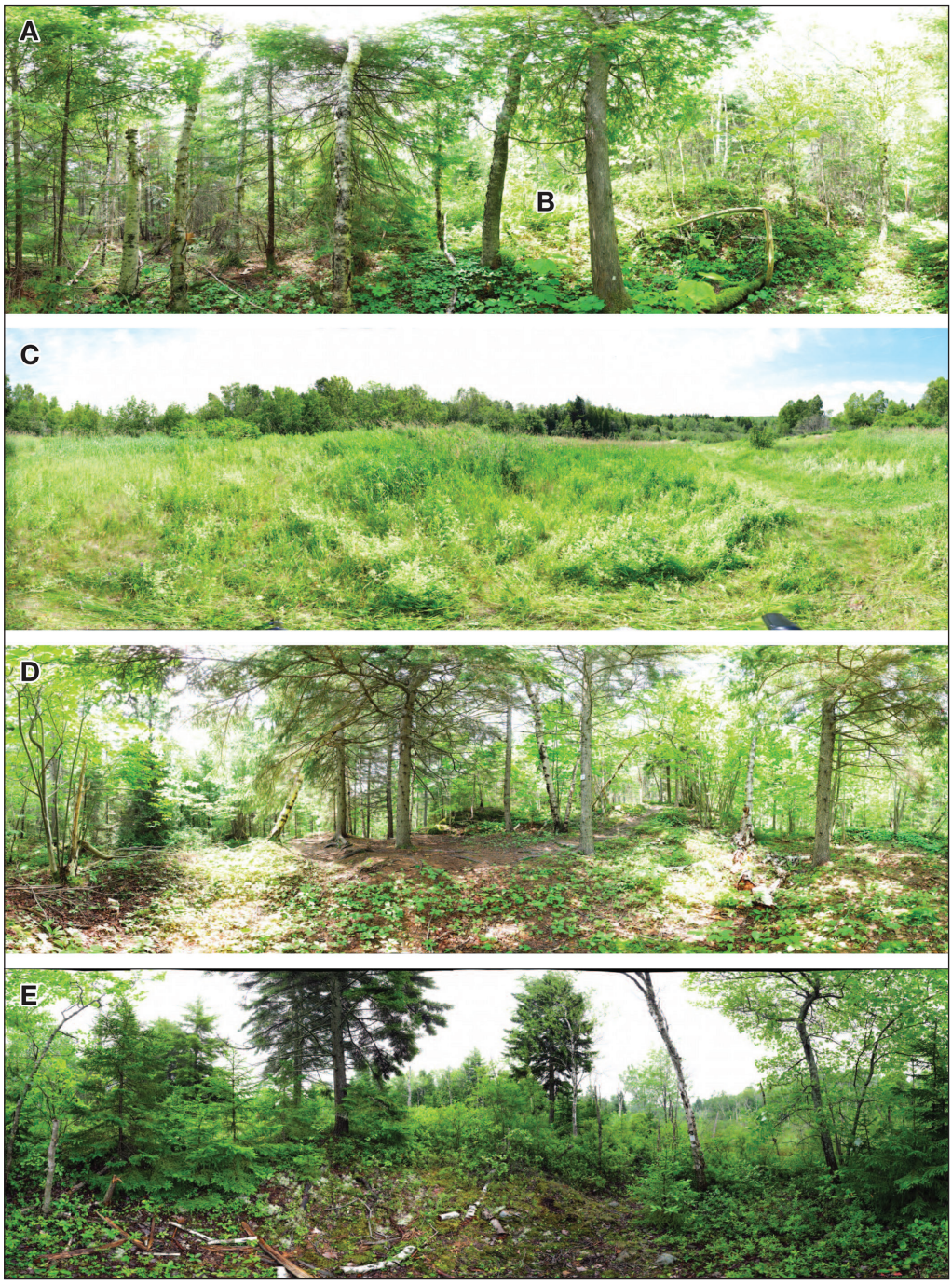

Figure 2. Representative GigaPan images of habitats sampled for ants in Rockwood Park, Saint John, NB, Canada. (A) Eastern White Cedar stand in foreground, (B) Eastern White Cedar fen, (C) old field, (D) Acadian Mixed Forest, and (E) peat bog.

in RWP (*Camponotus herculeanus*, *Lasius neoniger*, *Myrmica alaskensis*, *M. detritinodis*, *M. fracticornis*, and *M. latifrons)*. Two ant species (*Formica aserva* and *F. pergandei*), which engage in dulosis, or slave-making, were present in the cedar stand, Acadian Mixed Forest, and peat bog habitats. Of the habitats sampled, the peat bog supported the most diverse ant assemblage in RWP, with 18 species (60% of the total), followed by the cedar stand with 17 species (57%).

Table 1. Ant species recorded from Rockwood Park, Saint John, NB, Canada, with habitat types occupied and generalized ecological roles (Anderson 1997, Ellison et al. 2012).

Subfamily/ Species	Cedar fen	Cedar stand	Old field	Acadian Forest	Peat bog	Ecological category
Dolichodrinae						
Dolichoderus plagiatus (Mayr)					X	Bog specialist
Dolichoderus pustulatus (Mayr)					X	Bog specialist
Dolichoderus taschenbergi (Mayr)					X	Bog specialist
Tapinoma sessile (Say)		X		X	X	Opportunist
Formicinae						
Camponotus herculeanus (L.)	X	X	X	X	X	Dominant
Formica aserva (Forel)			X	X	X	Dulotic/specialist predator
Formica glacialis (Wheeler)		X		X		Cold-climate specialist
Formica integra (Nylander)		X	X			Opportunist
Formica neogagates (Viereck)		X			X	Dominant
Formica neorufibarbis (Emery)					X	Dominant
Formica pergandei (Emery)		X		X		Dulotic/specialist predator
Formica subaenescens (Emery)		X			X	Cold-climate specialist
Formica subsericea (Say)			X			Opportunist
Formica ulkei (Emery)			X	X		Dulotic/specialist predator
Lasius alienus (Foerster)		X	X		X	Opportunist
Lasius neoniger (Emery)		X		X	X	Opportunist
Myrimicinae						
Leptothorax AF-can (undescribed)		X	X	X	X	Cryptic species
Leptothorax AF-erg (undescribed)					X	Cryptic species
Leptothorax sphagnicola (Francoer)			X			Bog specialist
Myrmica alaskensis (Wheeler)	X	X	X	X	X	Cold-climate specialist
Myrmica detritinodis (Emery)		X	X	X	X	Dominant
Myrmica fracticornis (Forel)		X	X	X	X	Dominant
Myrmica incompleta (Provancher)	X					Cold-climate specialist
Myrmica latifrons (Stärcke)		X	X	X	X	Opportunist
Myrmica nearctica (Weber)		X	X	X		Cold-climate specialist
Stenamma brevicorne (Mayr)	X	X	X		X	Cryptic species
Stenamma diecki (Emery)				X		Cryptic species
Stenamma impar (Forel)	X	X		X		Cryptic species
Temnothorax ambiguus (Emery)	X	X		X	X	Cryptic species
Temnothorax longispinosus (Roger)				X		Cryptic species
Total species richness	5	17	14	16	18	

There were differences among habitats in the ant genera we found. While the genera *Camponotus*, *Myrmica*, and *Stenamma* were present in all RWP habitats sampled, *Temnothorax* and *Dolichoderus* were encountered infrequently and only in the old field or mixed forest and peat bog, respectively. *Stenamma* species were found to be most abundant in the cedar fen. *Formica* species were particularly rich in the cedar stand. *Dolichoderus* species were confined to peat bog habitat (Table 1). With the exception of the cedar fen, all RWP habitats support at least 1 *Formica* spp, 1 *Myrmica* spp., 1 *Lasius* spp., and 1 *Stenamma* spp., and all habitats share *Camponotus herculeanus*. Assuming our methods were equally effective in sampling both *Formica* and *Myrmica* spp., the former appears to be more selective in use of habitat. On average, the 9 *Formica* spp. were found in 1.9 habitats/species (median = 2), while the 6 *Myrmica* spp. averaged 3.5 habitats/species (median = 4).

Discussion

Total ant species in New Brunswick, including both native and non-native, is uncertain. However, our estimates based on New Brunswick Museum records and the northeastern North America literature (Cannon, 1998, Creighton, 1950, Ellison et al. 2012, Smith 1957, Taylor, 1967, Trager et al. 2007, Weber 1950, Wilson 1955, Wing 1968) indicate the province may support 86–95 ant species. With a least 30 species, RWP therefore supports a relatively rich ant fauna within a relatively restricted area (~35% of the total estimated number of ant species of New Brunswick in 890 ha). The only assessment of ant species in coastal northeastern North America in an area of size comparable to RWP was carried out in Acadia National Park (ANP), a wooded, mountainous, 19,020-ha park along the northeastern coast of Maine (Ouellette et al. 2010) . Ouellette et al. (2010) report 42 species from ANP across 5 subfamilies. Most of the species documented in RWP are also present in ANP (Ouellette et al. 2010).

Geographically, RWP is situated at an intermediate latitude (45° N), such that boreal endemics, like *Leptothorax sphagnicola*, and extreme thermophilous species, including the Dolichoderines, co-occur. The result is an assemblage of ant species in RWP that encompass a wide variety of life histories. Mound-building and soil-nesting ant species in RWP, including *Formica glacialis*, *F. integra*, *F. neoniger*, *Lasius alienus*, and *L. neoniger*, are integral to soil nutrient cycling and aeration (Del Toro et al. 2015, Ewers et al. 2015, Folgarait 1998, Wilson 1955). *Dolichoderus* spp. are responsible for a significant amount of the decomposition and growth of peat within bogs (MacKay 1993, Yoshimura and Fisher 2011). Socially parasitic *Formica* spp. are considered indicative of healthy forest (Stephens and Wagner 2006). The presence of the social parasites *F. aserva* and *F. pergandei* in the Acadian Mixed Forest and cedar stands of RWP would therefore appear to attest to the health of woodlands in the park.

Of the ants encountered in RWP, 27 species are widespread across North America. The remaining 3 species (*Formica ulkei*, *Leptothorax* AF-erg, and *L. sphagnicola*) appear to be restricted to northeastern North America (Ellison et al. 2012). *Leptothorax sphagnicola* has been rarely reported and to date is known

only from a small number of sites in eastern Canada (Francoeur 1986). *Leptothorax* AF-erg, encountered in the RWP peat bog, is currently being described (A. Francoeur, Department of Biology, University of Quebec at Chicoutimi, QC, Canada, pers. comm.).

Peat bogs and cedar stands harbor the most diverse ant faunas in RWP and include some ant species that have been rarely reported and may ultimately be deemed of conservation concern in Maritime Canada. Both peat bogs and cedar stands in New Brunswick are widely exploited for commercial purposes. Peat bogs cover about 2% of the of the terrestrial land mass of New Brunswick, and there were 52 leases permitting peat extraction on New Brunswick Crown Land as of 2014 (Government of New Brunswick 2014). New Brunswick is the leading producer of peat in Canada and a significant exporter of peat internationally (Government of New Brunswick 2014). Although widespread in New Brunswick and western Prince Edward Island, Eastern White Cedar has a limited distribution in Maritime Canada and since 1988 has been listed as a vulnerable species in Nova Scotia (Nova Scotia Department of Natural Resources and Lemieux 2010). For centuries cedar has been exploited for timber in New Brunswick; cedar stands have been preferentially cleared for agriculture and, more recently, have been clear-cut (Loo and Ives 2003). This activity has led overall to declines in cedar in the Acadian Mixed Forest (Loo and Ives 2003). Loo and Ives (2003) note that cedar stands do not regenerate well following clear-cutting. This intense exploitation of habitats that are limited in the region and non-renewable, combined with our results, suggest that environmental assessments prior to the extraction of peat or the clear-cutting of cedar stands in New Brunswick may need to consider the presence of rare, specialist ant species.

While this study examined some of the major habitats within RWP for ant species richness, some park habitats remain unsampled. Anthropogenically disturbed areas on the RWP periphery and small stands of hardwood and softwood-dominated woodland scattered throughout RWP have yet to be investigated for ants, suggesting additional ant species may be present within RWP. Nonetheless, our investigation of the ants of RWP should provide the basis for a more geographically comprehensive study of the conservation status of this ecologically important group of insects in New Brunswick.

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