

A survey of ants (Insecta: Hymenoptera: Formicidae) of the Bar'am Forest (northern Israel)

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INTRODUCTION AND SCIENTIFIC BACKGROUND

In recent years the number of studies dealing with ant taxonomy, biodiversity and impact on human economy and welfare has increased substantially (Holway et al. 2002; Vonshak et al. 2010), showing that ants are one of the most important components of natural ecosystems, with both numerical and biomass dominance in most terrestrial habitats (Alonso and Agosti, 2000). However, there is a paucity of broad taxonomic surveys in Israel, such as Soussan (1990) and Vonshak et al. (2010), as compared to work focused on ants ecology, such as Ofer et al. (1978, 1996), Martinez (2008a, b), and Martinez and Inbar (2009).

A study of ants in the TAU insect collections shows that sampling efforts have been unevenly distributed across the country (Vonshak and Ionescu, 2010). One region with noticeably few records is that of northern Israel, close to the Lebanese border (Vonshak and Ionescu, 2010). Therefore, we planed a survey at the Bar'am forest, a location that we consider representative of Mediterranean ecosystems (see

Dan, 1988; Danin, 1988; Jaffe, 1988). Moreover, the Bar'am forest remains the only dense *Quercus calliprinos* forest that has been preserved for centuries in the region. Situated near the Lebanese border, at about 600 meters above sea level, it may be occupied by northern species. Covering 100 ha, it was not cleared up due to ownership by the Maronite church. The mean density of oak trees in the forest is 735 ha⁻¹, and their height 6.6 meters, while the dead wood (which can serve as domatia for ants) volume is 11 m³ ha⁻¹ (Westphal et al., 2009). Other tree species are found mainly on the edges of the forest, and in few clearing zones. The forest is a part of a larger nature reserve, sustaining a mosaic of Mediterranean maquis and batha patches. It is differently managed from the surroundings: cattle are barred from browsing in part of the forest, contrary to the general policy pertaining to nature reserves in Israel. Large plots of planted pine forests cover the land around the oak forest, as do orchards belonging to four villages: the tiny Kibbutz Tsiv'on, in the south, Moshav Dovev in the north-west, Kibbutz Bar'am in the north-east and the large Arab village of Gish in the east. The increase of the local population, who partly subsist on agriculture, creates an increasing pressure on the direct surrounding of the Bar'am forest.

By using the standardized sampling procedures developed for ants (The ALL protocol; Alonso and Agosti, 2000, and Bestelmeyer et al., 2000), we aimed to maximize the number of sampled species per sampling effort. In addition, the collection of data should be compatible with other similar studies and directly usable for ecological investigations. The results will be included in the ongoing revision of the ant fauna of Israel, by A. Ionescu, and will complement previous work in the region by Martinez (2008a, b) and Martinez and Inbar (2009)

OBJECTIVES

The aims of this research were:

1. An intensive sampling effort of ant taxa from a unique forest region in Israel.
2. Identification of the collection.
3. Preparation of taxonomic and ecological papers based on the collected material.
4. Integration of the results obtained by the application of the ALL protocol into the global database on ant biodiversity at <http://antbase.org/databases/ground.htm>, and into the ongoing revision.
5. Comparison of ant biodiversity in the grazed zone with the un-grazed one

6. Relationship between arboreal activity of ants with the presence of aphids and other honeydew producers on trees

METHODS

Manpower

The main work was conducted by JJIM and AI, with the assistance of 1 student and 1 technician.

Time

We could not begin the sampling season in March as planned, because the rainy season in Bar'am this year was late and heavy: it ended in May and reached 996 mm in Kibbutz Baram (650 mm- mean annual rate). Therefore the main sampling season was extended to June and July, while the secondary one will be from September-October.

Sampling

The sampling methods were adopted from Bestelmeyer et al. (2000), and Agosti and Alonso, (2000).

The methods used for this survey were:

1. Direct active sampling: along 6 transects of 200 meters long and 10 meters wide (Picture 1). We sampled all the ant species found during a 2 hour hand collection.

2. Pitfall-trapping on floor and in trees: along the same 6 transects (Map 1). Ten stations of 3 pitfall traps were sunk into the ground with a small flag to mark their position (Fig 1 A, B, C), for 7 days and nights, for a total of 820 day- traps. A pitfall trap was fixed on each of 10 randomly selected trees in each transect to monitor arboreal ant species, during 7 days, for a total of 420 days. Each pitfall trap was made of a 50 ml test tube containing 25 ml of a mixture of water, ethanol, glycerol and acetic acid which was found to be attractive to ants in a previous investigation of the study.

3. Sweeping and beating vegetation for arboreal ants: 5 branches of each of 10 randomly selected trees in each transect were beaten with a stick over a tray to actively monitor arboreal ant species.

All the ants found active or in pitfall traps were separated from other insects and conserved in a mixture of 80% of ethanol and brought to the laboratory of the National Museum in Tel Aviv University for species identification.

In our program, we intend to use two other sampling methods: baits and leaf litter extraction: these methods will be used during our second sampling season, in October 2011.

RESULTS AND DISCUSSION

We caught 1369 ants belonging to a total of 34 species (Table 1). The majority of ants and ant species (24) were obtained using the soil pitfall traps, followed by the active search. Cumulative species curve shows that three transects of pitfall traps should be enough to sample the 24 ant species that we obtained by using this method (Fig 1A). The second cumulative species (Fig 1B) shows that each method adds species, apart from the traps on trees. These two results indicate that working on 6 transects of 200 m each was adequate, but that we need to continue our research, adding at least another sampling method.

From a taxonomic point of view, our main results were as follows: three of the 34 species from Bar'am, *Camponotus lateralis* (Olivier), *Plagiolepis pallescens* Forel and *Solenopsis* cf. *fugax*, were recorded for the first time from the Upper Galilee. *Camponotus lateralis* was recorded only once by Forel in 1910 from Jerusalem. Therefore, after 100 years the presence of this species in Israel is confirmed. *P. pallescens* was found until now from lower regions, the Jordan Valley, the central Coastal Plain, the Judean Foothills and the central Negev. *S. cf. fugax* was collected on Mount Hermon and the Golan Heights. All three taxa are widespread northern Mediterranean species reaching their southern distribution range in Israel.

Although these are only preliminary results comparing ant communities in two forests in the same region, it seems that the Bar'am and Meron forest (unpublished results) have quite different ant faunas with only 18 species in common (Table 2). These are either very common ants or species confined to the northern regions of Israel. The wider distribution of the ground dwelling species unique to the two forests suggests that two causes, altitude and forest structure, may contribute to the observed differences. Seven of the 13 species unique to the Bar'am forest, *Cerapachys piochardi* (Emery), *Dorylus fulvus punicus* Santschi, *Monomorium bicolor judaicum* Menozzi, *Myrmecina graminicola* (Latreille), *Temnothorax* sp. IL09, *Tetramorium*

davidi Forel and *Tetramorium* sp. IL03 were also collected from the Carmel forest, thus at lower altitudes. However, six of the eight species unique to the Meron forest, *Anochetus bytinskii* Kugler & Ionescu, *Cataglyphis* sp. IL03, *Messor semirufus* (André), *Monomorium mayri* Forel, *M. sahlbergi* Emery and *Pheidole pallidula* (Nylander), are shrubs and open land species, thus expected to be rarely collected in forests. The forests on Mount Carmel and mount Merom are dense Mediterranean maquis – a structure rich in tree species, and with small patches of open habitats. In six sites situated near Bar'am Forest and mount Merom, covered with Mediterranean maquis, Martinez and Inbar listed 25 epigeic ant species with arboreal activity (2009). Previously, Martinez (2008a, b) found 19 and 23 ant ground nesting species, respectively, in pine forest, open batha, edge of the maquis and along roads, contrary to Martinez and Margalit (2011) who counted 36 species in open batha in the Bar'am region. These researches were carried out around Bar'am forest. It is surprising that the more homogenous habitat of Bar'am forest was supporting so many ant species, more than the heterogeneous Mediterranean maquis.

We will reveal the ecological findings of this research and discuss them in the final report which will be submitted at the end of the year.

FUTURE WORK

In October we will continue with the sampling of ants in Bar'm forest, as done in September, using 2 different methods:

- 1- leaf litter extraction: in 10 points along each of 6 transects, we will collect a volume of 15 liters of leaf litter and extract the ants in the laboratory.
- 2- Baits: to collect dominant species, we will use tuna and jam baits on 60 paper trays scattered in the forest. The geographic position of each tray will be recorded using a GPS.

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Map 1: Transects in Baram forest. Transects 1, 2 and 3 are situated in the grazing zone, while transects 4, 5 and 6 are outside.

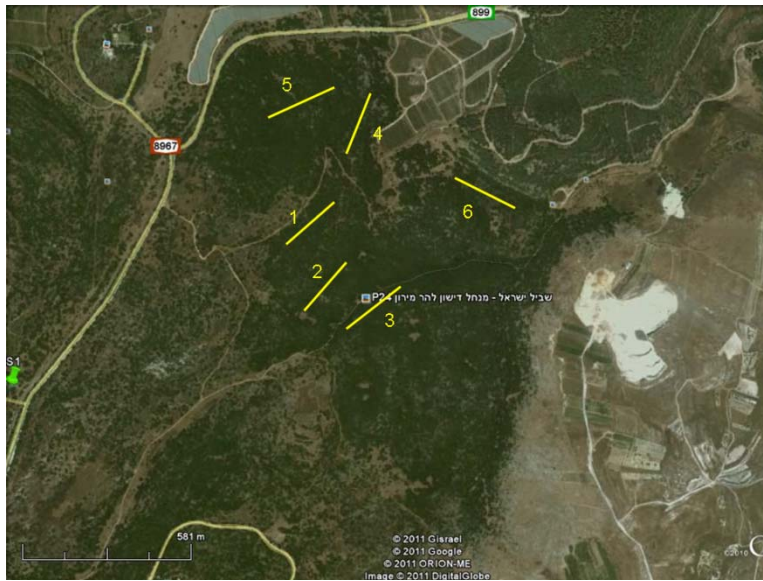
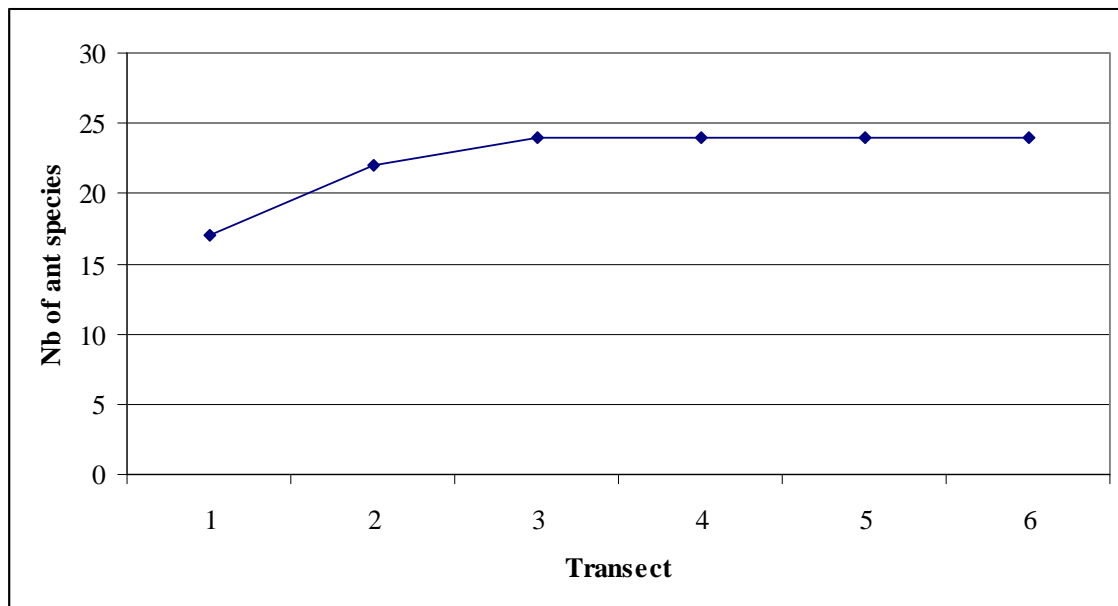


Fig 1. Cumulative ant species curves.

A. Ants from soil pitfall traps



B. Cumulative curve following the sampling methods

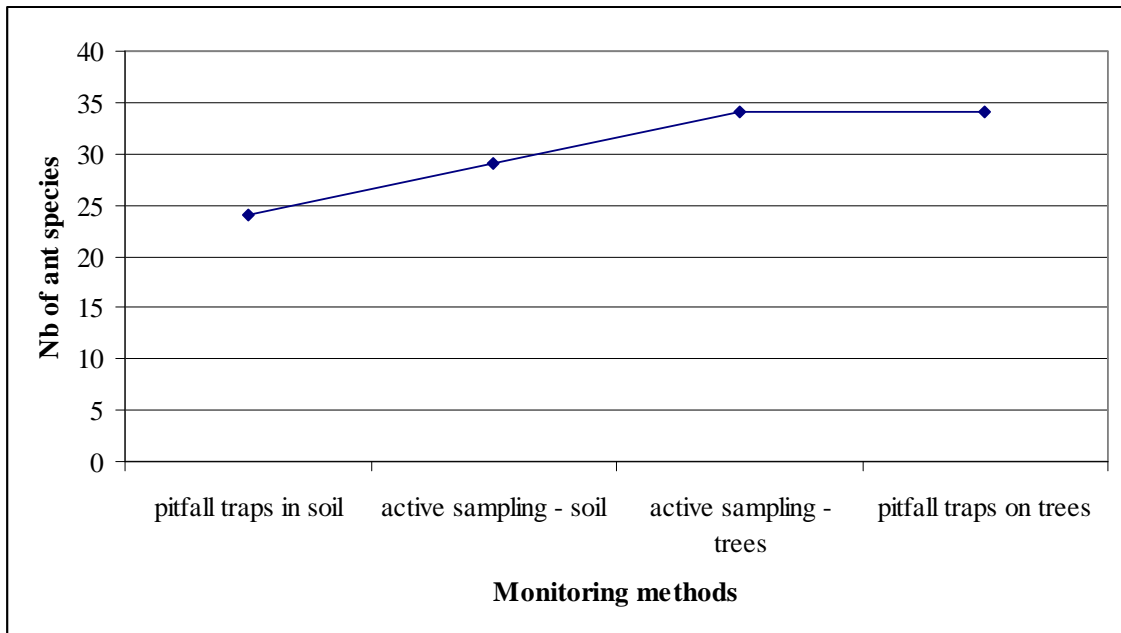


Table 1: All the ant species found at present in the research in Bar'am forest. 1= presence of the species. In yellow – the most important taxonomic finds.

		Bar'am total	TREES		SOIL	
			hand	trap	hand	Trap
1	<i>Aphaenogaster epirotes</i> (Emery)	1				1
2	<i>Aphaenogaster syriaca schmitzi</i> Forel	1	1		1	1
3	<i>Camponotus dalmaticus</i> (Nylander)	1	1			1
4	<i>Camponotus festai</i> Emery	1	1	1	1	1
5	<i>Camponotus jaliensis</i> Dalla Torre	1	1		1	
6	<i>Camponotus kefir</i> Ionescu	1			1	1
7	<i>Camponotus lateralis</i> (Olivier)	1	1	1	1	1
8	<i>Camponotus libanicus</i> André	1				1
9	<i>Camponotus rebecca</i> e Forel	1	1			
10	<i>Camponotus sanctus</i> Forel	1				1
11	<i>Camponotus truncatus</i> (Spinola)	1	1	1		
12	<i>Cerapachys piochardi</i> (Emery)	1			1	
13	<i>Crematogaster ionia</i> Forel	1	1	1	1	1
14	<i>Crematogaster jehovae jehovae</i> Forel	1			1	1
15	<i>Crematogaster jehovae mosis</i> Forel	1			1	
16	<i>Crematogaster lorteti</i> Forel	1	1		1	
17	<i>Dorylus fulvus punicus</i> Santschi	1			1	1
18	<i>Lasius</i> sp. ISRA(SMNG)	1	1	1	1	1
19	<i>Lepisiota bipartita</i> (Smith, F.)	1	1			1
20	<i>Monomorium bicolor judaicum</i> Menozzi	1	1		1	1
21	<i>Monomorium venustum</i> (Smith, F.)	1			1	1
22	<i>Myrmecina graminicola</i> (Latreille)	1				1
23	<i>Plagiolepis ancycensis</i> Santschi	1	1		1	1
24	<i>Plagiolepis pallescens pallescens</i> Forel	1			1	
25	<i>Solenopsis fugax</i> (Latreille)	1	1			
26	<i>Tapinoma israele</i> Forel	1	1		1	1
27	<i>Tapinoma simrothi phoeniceum</i> Emery	1	1	1	1	1
28	<i>Temnothorax bulgaricus aeolius</i> Forel	1				1
29	<i>Temnothorax</i> sp. IL09	1	1	1	1	1
30	<i>Temnothorax niger</i> (Forel)	1	1			
31	<i>Tetramorium davidi</i> Forel	1			1	1
32	<i>Tetramorium meridionale</i> Emery	1				1
33	<i>Tetramorium punicum</i> (Smith, F.)	1		1	1	
34	<i>Tetramorium sahlbergi</i> Finzi	1			1	1
	Total species	34	18	8	22	24

Table 2. Comparison of ant species collected in Bar'am on trees and soil and Meron (soil surface -). Distribution in Israel: number of zoogeographical regions / geographic dispersal (N = North, E = East, W = West, S = South, C = center) following Vonshak and Ionescu-Hirsch (2009).

	Taxa	Bar'am		Meron Soil	Distribution in Israel		
		Trees	Soil		#	Dispersal	
1	<i>Aphaenogaster epirotes</i> (Emery)		+		2	N	
2	<i>Aphaenogaster syriaca schmitzi</i> Forel	+	+	+	11	NCEW	
3	<i>Camponotus dalmaticus</i> (Nylander)	+	+		5	NCS	
4	<i>Camponotus festai</i> Emery	+	+	+	3	N	
	NSEW	9	+	+	+	<i>Camponotus jaliensis</i> Dalla Torre	5
	N	2	+	+		<i>Camponotus kefir</i> Ionescu	6
	C	1		+	+	<i>Camponotus lateralis</i> (Olivier)	7
	N	1	+	+		<i>Camponotus libanicus</i> André	8
	NCSEW	12	+	+	+	<i>Camponotus rebecca</i> Forel	9
	NCSEW	13	+	+		<i>Camponotus sanctus</i> Forel	10
	NCEW	5			+	<i>Camponotus truncatus</i> (Spinola)	11
	NC	3		+		<i>Cerapachys piochardi</i> (Emery)	12
	NCE	8	+	+	+	<i>Crematogaster ionia</i> Forel	13
	NCSEW	18	+	+		<i>Crematogaster jehovae</i> Forel	14
	NCSEW	5		+		<i>Crematogaster jehovae mosis</i> Forel	15
	NCEW	8		+	+	<i>Crematogaster lorteti</i> Forel	16
	NCSEW	14		+		<i>Dorylus fulvus punicus</i> Santschi	17
	NC	3	+	+	+	<i>Lasius</i> sp. ISRA(SMNG)	18
	NCSEW	16	+	+	+	<i>Lepisiota bipartita</i> (Smith, F.)	19
	NEW	5		+	+	<i>Monomorium bicolor judaicum</i> Menozzi	20
	NCSEW	17	+	+		<i>Monomorium venustum</i> (Smith, F.)	21
	NC	4		+		<i>Myrmecina graminicola</i> (Latreille)	22
	NCSEW	19	+	+	+	<i>Plagiolepis ancycensis</i> Santschi	23
	CSEW	4		+		<i>Plagiolepis pallescens</i> Forel	24
	N	2			+	<i>Solenopsis</i> cf. <i>fugax</i> (Latreille)	25
	NCSEW	11	+	+	+	<i>Tapinoma israele</i> Forel	26
	NCSEW	18	+	+	+	<i>Tapinoma simrothi phoeniceum</i> Emery	27
	N	2	+	+		<i>Temnothorax bulgaricus aeolius</i> Forel	28
	NW	2		+	+	<i>Temnothorax</i> sp. IL09	29
	N	1			+	<i>Temnothorax niger</i> (Forel)	30
	NCSEW	12		+		<i>Tetramorium davidi</i> Forel	31
	NCEW	7		+		<i>Tetramorium meridionale</i> Emery	32
	NCSEW	14	+	+	+	<i>Tetramorium punicum</i> (Smith, F.)	33
	NCSEW	8	+	+		<i>Tetramorium sahlbergi</i> Finzi	34
	NC	5	+			<i>Anochetus bytinskii</i> Kugler & Ionescu	
	NEW	6	+			<i>Bothriomyrmex syrius</i> Forel	
	NW	3	+			<i>Cataglyphis</i> sp. IL03	
	NCSEW	11	+			<i>Messor semirufus</i> (André)	
	NCSEW	11	+			<i>Monomorium mayri</i> Forel	
	NCSEW	12	+			<i>Monomorium sahlbergi</i> Emery	
	NCEW	14	+			<i>Pheidole pallidula</i> (Nylander)	

NSEW	5	+			<i>Tetramorium lanuginosum</i> Mayr	
		26	31	19	Total species	