Ant species of the *Tierra de pinares* (Castilla y León, España) and potential recolonization sources for logged sites

[Hormigas de la Tierra de Pinares (Castilla y León, España) y fuentes potenciales de recolonización de áreas taladas]

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Abstract: We asked in this work about the ant species that inhabit pine forests, the riparian vegetation zones and the surrounding matrix (arable land, grazing areas) of “Tierra de Pinares” on the northern plateau of the Iberian Peninsula as potential sources of recolonization of logged sites. A total of 38 ant species were collected in the study. 31 ant species were detected in the pine forests, 17 along the Adaja River, and 22 species in the surrounding sample matrix sites. The process of colonization of cleared areas of the pine forest seems to depend basically on the ant species of the pine forest itself. The ant assemblages of riparian vegetation and cereal steppes surrounding pine forests are closer among them than to the ant assemblages of the pine forest.

Keywords: ants, logging, Iberian Peninsula, Tierra de Pinares.

Resumen: En este estudio nos preguntamos sobre las especies de hormigas que habitan en pinares, zonas de vegetación de ribera y la matriz circundante (tierras de cultivo, zonas de pastoreo) de la “Tierra de Pinares” situada en la submeseta norte de la península ibérica como fuentes potenciales de recolonización de zonas de pinares sometidas a talas periódicas. Se capturó un total de 38 especies de hormigas. Se detectaron 31 especies de hormigas en pinares, 17 a lo largo del río Adaja, y 22 especies en la matriz circundante. El proceso de colonización de áreas de pinares taladas parece depender fundamentalmente de las especies de hormigas del propio pinar. Los conjuntos de hormigas de la vegetación de ribera y la estepa cerealista que rodean los pinares se parecen más entre ellos que al conjunto de hormigas del pinar.

Palabras clave: hormigas, talas forestales, Tierra de Pinares.

Introduction

Pine forests (*Pinus pinea* L. and *Pinus pinaster* Ait.) on the northern plateau of the Iberian Peninsula, located in a region known as Tierra de Pinares (Pine Land) have a long history of use and management (Aránzazu *et al*., 1997). The exploitation of pine forests in the Pine Land is managed through selective logging with relatively short periods of time between logging events and pine nut exploitation. Information exists about the use and exploitation of pine forests (logging, harvesting pine nuts, and resin collection) in human settlements of the First Iron Age in the area of study. These pine species do not sprout, so they are very sensitive to human disturbance. There are some studies about the use of the ants as a source of information of changes that have occurred after logging and during the forest recovery process (Abril & Gómez, 2013; Gómez & Abril, 2011). Specifically in this study we asked about the ant species that inhabit the same pine forest, the riparian vegetation zones or the surrounding matrix as potential sources of recolonization of logged sites. The pine forests under study are Forests of Public Use in the province of Valladolid and the Environment Service of the Government of Castilla y León is the management authority. At the same time, this work offers information about the myrmecological fauna present in the Valladolid province at the northern plateau of the Iberian Peninsula.

Material and methods

The study was carried out in *Tierra de Pinares* (Pine Land) situated on the northern plateau of the Iberian Peninsula (Fig. 1). The

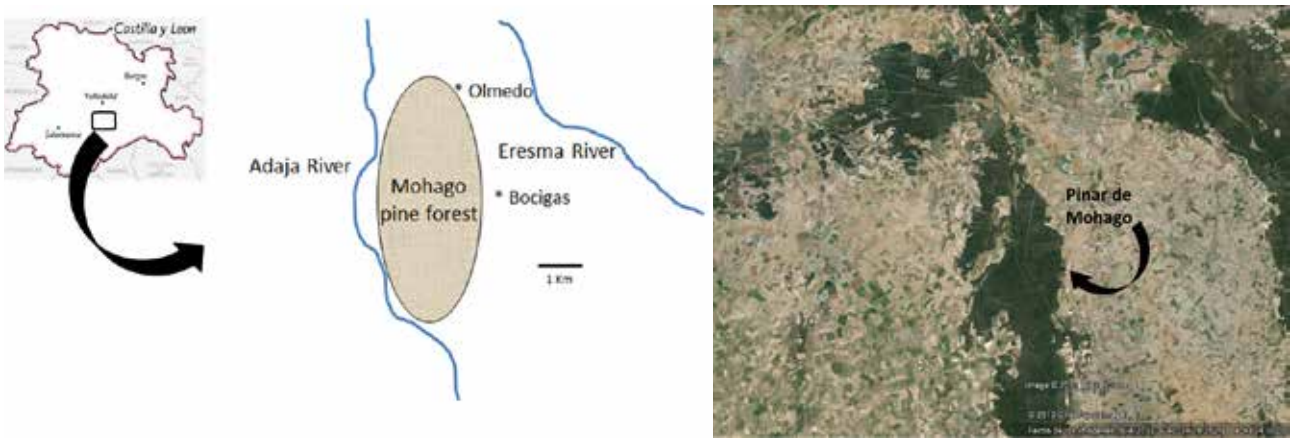

Figure 1. *Location of studied Mohago pine forests in Tierra de Pinares, Castilla y León, Spain.*
Figura 1. *Localización del pinar de Mohago en la Tierra de Pinares, Castilla y León, España.*

pine forests selected (Mohago pine forest) are located near the village of Olmedo (41°17'N, 4°41'W, elevation 750 – 780 m). This is a zone with large pine forests surrounded by a matrix of arable land, grazing areas, and pine forest fragments.

Ants were sampled at twenty-five sites in the Mohago pine forest. In order to test the potential relevance of ant assemblages of riparian vegetation zones and the surrounding matrix as recolonization sources for logged sites, ants were sampled in five sites along the Adaja River (close to the studied pine forest) (Fig. 1) and five steppe sites in the surrounding matrix. Each of the sites of the Mohago pine forest corresponds to a *tranzón*, a quadrangular unit of management with similar area (25 – 30 ha). Also, for this analysis we only used sites logged after two years because in that time the presence of any new ant nest originated by an ant queen after a nuptial flight from an ant nest out of the pine forest could be detected.

Sampling was conducted in the warmer season, during June and July 2009. At each site, three sample points were randomly established. Ants were sampled at each sample point using two methods: pitfall trapping (3 traps open for 48 hours; 2.5 cm diameter; partly filled with methylene glycol as a preservative, and five meters apart forming a triangle) and hand collecting (1 person x 30 minutes) around the trap triangle. A total of 225 traps were placed in the pine forests (3 traps x 3 sample points x 25 sites) and 37.5 hours of hand collecting (0.5 hours x 3 sample points x 25 sites) took place. In riparian and steppe zones, 90 traps were placed (3 traps x 3 sample points x 10 sites) and 15 hours of hand collecting (0.5 hours x 3 sample points x 10 sites) took place. All ants were sorted to species and identified. The presence of each ant species in the trapping and hand collecting samples was recorded. All specimens were preserved and deposited in the laboratory of the PECAT-Research Group, University of Girona.

Multivariate analyses were carried out to investigate differences in the structure of ant assemblages between the ant assemblages of the Adaja River and the surrounding matrix and the logged sites in the Mohago pine forest. Non-metric multidimensional scaling (NMDS) ordinations were performed with PRIMER v.6 software (Clarke & Warwick, 2001) on Bray-Curtis similarity matrices using site-specific species abundance data. Data on the ant species abundances were expressed as frequency scores (from 0 to 3) that represent the number of sample point occurrence by site. Similarity analysis (ANOSIM, Clarke & Warwick, 2001) was used to test the significance of differences in assemblage composition between the categories.

Results and discussion

A total of 38 species (2012 total captures) were collected in the study. 31 ant species were detected in the pine forests, 17 along the Adaja River, and 22 species in the surrounding sample matrix sites. The richest genera were *Camponotus* (6 species) –basically in the forest-, *Formica* (4 species), and *Messor* (4 species) (Table I). The species with the highest occurrence in the pine forest sample points were *Pheidole pallidula* (Nylander) (94.7% of sample points, n=75), *Messor capitatus* (Latr.) (71.2%), *Cataglyphis velox* Santschi (68.9%) and *Crematogaster scutellaris* (Olivier) (59.8%).

No differences were observed between the

Table I. *Summary of the ant species occurrences during the study. * Ant species captured in other samples not included in the analysis; these ant species are included in the table to offer a more complete ant diversity list of the study zone.*
Tabla I. *Lista de las especies de hormigas detectadas en el estudio. *Especies de hormigas capturadas en otras muestras no incluidas en el análisis; estas especies se incluyen en la tabla para ofrecer una lista de especies más completa de la zona.*

	Mohago pine forest	Adaja River	Surrounding Matrix
Sub-family Dolichoderinae			
Tapinoma madeirense Forel, 1895	+	+	+
Tapinoma nigerrimum (Nylander, 1856)	+	+	+
Sub-family Formicinae			
Camponotus cruentatus (Latreille, 1802)	+	+	
Camponotus foreli Emery, 1881	+		
Camponotus lateralis (Olivier, 1792)	+		
Camponotus piceus (Leach, 1825)	+		
Camponotus pilicornis (Roger, 1859)	+		
Camponotus sylvaticus (Olivier, 1792)	+		
Cataglyphis cursor (Fonscolombe, 1846)	+	+	+
Cataglyphis velox Santschi, 1929	+		+
Formica cunicularia Latreille, 1798	+	+	+
Formica gerardi Bondroit, 1917	+*		
Formica rufibarbis Fabricius, 1793	+	+	+
Formica sanguinea Latreille, 1798		+	
Iberoformica subrufa (Roger, 1859)	+		+
Lasius alienus (Foerster, 1850)	+	+	+
Plagiolepis pygmaea (Latreille 1798)	+		
Polyergus rufescens (Latreille, 1804)	+*		+*
Sub-family Myrmicinae			
Aphaenogaster iberica Emery, 1908	+	+	+
Aphaenogaster senilis Mayr, 1853			+*
Cardiocondyla elegans Emery, 1869			+*
Chalepoxenus kutteri Cagniant, 1973	+		
Crematogaster auberti Emery, 1869	+		+
Crematogaster scutellaris (Olivier, 1792)	+	+	
Diplorhoptrum latro (Forel, 1894)	+		
Goniomma hispanicum (André, 1883)	+		+
Messor barbarus (Linnaeus, 1767)	+	+	+
Messor bouvieri Bondroit, 1918	+	+	
Messor capitatus (Latreille, 1798)	+	+	+
Messor structor (Latreille, 1798)	+*		
Myrmica sabuleti Meinert, 1861		+	+
Oxyopomyrmex sp.	+		
Pheidole pallidula (Nylander, 1849)	+		
Temnothorax niger (Forel, 1894)			+
Temnothorax racovitzae (Bondroit, 1918)	+	+	+
Temnothorax recedens (Nylander 1856)	+	+	+
Tetramorium caespitum (Linnaeus, 1758)	+	+	+
Tetramorium forte Forel, 1904	+		+
Total ant species	33	17	22

mean number of ant species observed by site (Mohago pine forest sites = 7.88 ± 1.74; Adaja River sites = 7.2 ± 3.35; surrounding matrix = 7.8 ± 2.28 ant species; one way ANOVA F = 0.22, p = 0.80). Multidimensional scaling and ANOSIM Global R values for ant species abundance scores clearly separate pine forest sites from river and surrounding matrix sites (Global R = 0.909, p < 0.01) (Fig. 2). The pair-wise test showed that the river and the surrounding matrix ant assemblages were not different (R = 0.132, p = 0.16).

The process of colonization of cleared areas of the Mohago pine forest seems to depend basically on the ant species of the pine forest itself. Following a process of forest clearing, there was a possibility that species of ants, especially in open areas surrounding pine forests, could establish new colonies. However, it seems that the ant assemblages of riparian vegetation and cereal steppes surrounding pine forests are closer among them than to the ant assemblages of the pine forest. This may be because the pine forests are areas with a temperate microclimate and are not as cold as either the steppes or, of course, the banks of rivers. The climate of the study area is continental Mediterranean with long and cold winters and the forest would have somewhat milder microclimate.

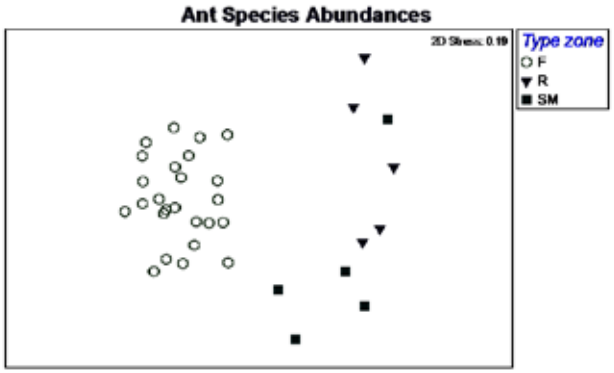

Figure 2. *NMDS ordination of Mohago pine forest sites logged after two years (F), the Adaja River sites (R), and the surrounding matrix sites (SM) based on ant species abundance.*

Figura 2. *Ordenación NMDS basada en la abundancia de especies de los lugares muestreados en el pinar de Mohago (con un mínimo de dos años tras haber sido talados) (F), los puntos de muestreo en el rio Adaja (R) y en la matriz circundante (SM).*

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