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RESEARCH ARTICLE - ANTS

First Data on the Ants of the Algerian Islands, with a Specific Focus on the Habibas Islands

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Abstract

The study of the Algerian islands' myrmecofauna was undertaken for the first time, particularly on Habibas Island. The inventory of Habibas Island identified 13 ant species. The island's plant formations, such as the xerophilous shrub group and the xerophilous halophilous shrub group, show a significant correlation with species distribution. Some species, such as *Pheidole pallidula*, are found in all the formations, while others, such as *Aphaenogaster senilis,* are specific to a single formation. The centesimal and occurrence frequencies of the species vary considerably, highlighting the predominance of *Messor capitatus* on the island. The study also revealed significant differences between Algerian islands and islets in terms of ant species richness. *Tetramorium biskrense, Pheidole pallidula, Messor barbarus, Crematogaster scutellaris*, and *Cataglyphis viatica* are present on several islands, while others are specific to a single island, such as *Crematogaster laestrygon* on the Sahel islet. Statistical modellings, such as simple non-linear and multiple regression, did not show any significant correlation between ant richness and factors such as the island's size, its isolation degree, and its floristic richness. However, the latter does seem to have a more or less significant influence on ant distribution. Spearman's correlation test revealed significant similarities between certain islands, while others showed significant differences. These results highlight the importance of the individual characteristics of each island in determining ant composition.

Introduction

Insular ecosystems are unique and vulnerable environments characterized by exceptional fauna and flora of great importance to biology and biogeography (Mac Arthur & Wilson, 1967; Quézel et al., 1990; Gros-Desormeaux et al., 2016). The theory of island biogeography predicts that islands are home to fewer species than continents, even with the same surface area, due to factors such as isolation, climate, and higher extinction rates (Mac Arthur & Wilson, 1967). This theory also established that the richness of flora and fauna is proportional to the island's size.

However, despite their small size and geographical isolation, island environments are characterized by their exceptional biodiversity, often containing endemic species. This biological singularity highlights the importance of islands as privileged research grounds for island biogeography due to their unique ecological characteristics (Krebs et al., 2014).

Biodiversity within these fragile ecosystems has been meticulously explored in the northern Mediterranean region, as shown by the research carried out by Vidal et al. (1998) and Bonnet et al. (1999). On the other hand, the situation is very different on the southern coast of the Mediterranean, in particular in Algeria. Although this region has a long coastline of over 1,200 km, the number of islands and islets is relatively few. Studies assessing the faunal diversity of Algerian islands are rare, except a few studies focusing on specific taxonomic groups, such as breeding seabirds (Boukhalfa, 1990; Moulaï, 2006; Moulaï et al., 2006; Mouret, 2008; Bougaham & Moulaï, 2013; Durand, 2013; Bakour & Moulaï, 2019),

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on lichens (Bachet et al., 2007). In 2006-2007, 97 species or subspecies of spontaneous plants were recorded, 16 of which were new to the island. Of these species, five (*Spergularia pycnorrhiza, Brassica spinescens, Anthemis chrysantha, Rostraria balansae* and *Fumaria munbyi*) are endemic to the Algerian, Moroccan-Algerian or Spanish-Algerian coasts, and two varieties (*Sonchus tenerrimus* var. *amicus* and *Asteriscus maritimus* var. *sericeus*) are closely endemic to the archipelago (Pons et al., 2013).

Regarding fauna, the Habibas Islands host a wide diversity of nesting seabirds (Bachet et al., 2007; Mouret, 2008; Durand, 2013). The herpetofauna includes species such as *Tarentola mauritanica, Chalcides ocellatus tiligugu, Scelarcis perspicillata perspicillata* and *Macroprotodon abubakeri*. However, the main environmental problem on the island is the invasive presence of the black rat, *Rattus rattus*, and the Yellow-legged Gull, *Larus michahellis* (Bachet et al., 2007).

The archipelago of the Habibas Islands enjoys a semi-arid climate characterised by an alternation between long periods of good weather and short periods of inclement weather. Winds, mainly from the north, are often violent and laden with sea spray. Winds from the south, mainly in summer, have a drying effect (PIM, 2013).

This study was carried out on the main island (35°43'26.61 "N 1° 7'51.56 "W) during the period from 23 to 25 May 2023. To do this, we explored the entire island, taking into account the different plant formations identified during the study (Fig 2), and used two sampling methods: pitfall traps and manual capture. This involves a meticulous inspection of the island in search of ant nests and trails. In each collection area, we placed 10 pots randomly and regularly spaced 10 m apart and then left them in place for 48 hours. Due to the topographical characteristics of each island, we were unable to set up the traps according to the transect or quadrat protocols. The collected specimens were then transported to the Laboratory of Applied Zoology and Animal Ecophysiology (University of Bejaia, Algeria), where they underwent identification. This was based on a variety of reference sources, including the work of Bernard (1968), Cagniant (1968, 1969, 1970, 1997, 2005, 2006, 2009), as well as specialist websites such as www.antarea.com and www.antweb.com.

The other island environments surveyed, located on Algeria's western, central and eastern coasts (Fig 3), are represented by islands and islets ranging in size from 40 ha to 0.44 ha. Most of these islands are not very far from the mainland, generally less than 2 km from the shore, except for the Habibas islands which are separated from the mainland by nearly 10 km. The data used in this research comes from recent publications, expert reports (NRP project, 2013), unpublished data and personal sampling results (Table 1). It should be noted that all the prospectors used the same sampling methods, namely the use of pitfall traps and manual capture.

Table 1 - List of islands and islets studied along the Algerian coast, and source of data used.

Islands/Islets	Surface area (Ha)	Isolation (m)	Floristic richness	Surveyors/year	Reférence
Rachgoun (Aïn Témouchent)	25	2327	55	S. Bakour & R. Moulaï, 2016	Bakour and Moulaï (2019)
Ile Ronde (Oran)	0,64	590	14	S. Bakour & R. Moulaï, 2016	Bakour and Moulaï (2019)
Grande Habibas (Oran)	34,5	9749	93	S. Bakour, M. Hamimeche, S. Kahlessenane, M. Benabadji, 2023	-
Ile Plane (Oran)	2,3	6688	8	S. Bakour & R. Moulaï, 2016	Bakour and Moulaï (2019)
Tipaza (Tipaza)	0,57	150	5	M. Hamimeche & R. Moulaï, 2016	Unpublished
Sandja (Alger)	0,27	1042	1	M. Hamimeche, 2015	Unpublished
Agueli (Alger)	1,17	649	6	K. Hamadi & R. Moulaï, 2012	NPR Report (2013)
Tigzirt (Tizi-Ouzou)	0,46	150	36	A.Chelli & R. Moulaï, 2012	NPR Report (2013)
Pisans (Bejaia)	1,31	1250	52	A. Henine-Maouche, 2016	Unpublished
El Euch (Bejaia)	1,88	120	60	Henine-Maouche & R. Moulaï, 2016	A. Henine-Maouche et al. (2019)
Garlic Island (Bejaia)	0,46	113	21		
Sahel (Bejaia)	0,46	7	44		
Grand Cavallo Island (Jijel)	3,6	950	82	L. Aissat & R. Moulaï 2009 et 2010	Aissat (2017)
Petit Cavallo Island(Jijel)	3,9	750	101		
Grand Cavallo Ilet (Jijel)	0,44	50	23		
Tazerout (Jijel)	0,74	154	11	H. Amrane, M. Ihdene, M. Hamimeche & R. Moulaï, 2017	Unpublished
Rahbet Teffah (Skikda)	2,5	1000	18	T. Lachouri, L. Mouloudj & R. Moulaï, 2016	Unpublished

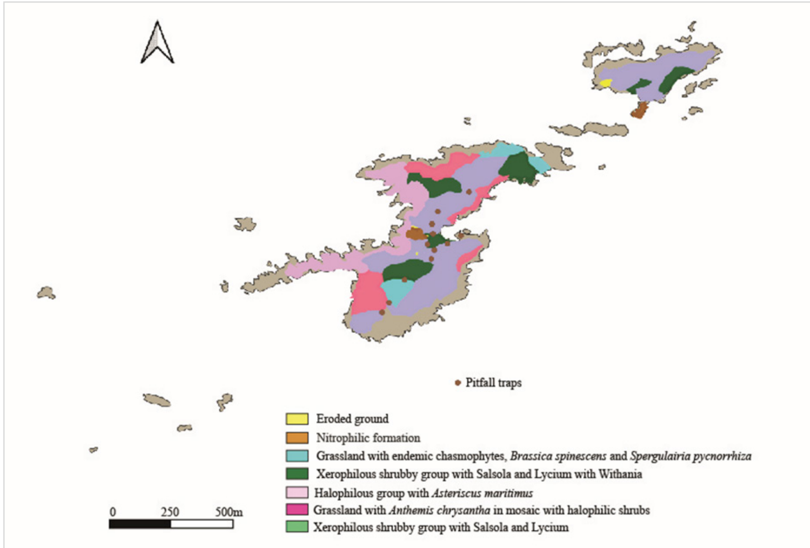

Fig 2 - Map of the different plant formations on Habibas Island and distribution of pitfall traps.

Data analysis

In order to analyse the results obtained from the myrmecofauna's study of island environments, we used ecological indices such as species richness, which provides an overview of the total number of species present, and centesimal frequency and occurrence, which enable us to assess the prevalence and relative distribution of species in these environments. A Principal Component Analysis (PCA) was carried out to examine the distribution to concerning the types of plant formation present on Habibas Island. We also undertook a simple and multiple regression study to explore the correlation between ant richness and various environmental factors such as surface area, isolation and floristic richness. To assess similarities in Formicidae composition between the seventeen islands and islets studied, we applied Spearman's correlation test. All these analyses were performed with XLSTAT Perpetual 2019.2.2.

Results

Inventory and ecological analysis of Formicidae on Habibas Island

The sampling of Habibas Island's Formicidae enabled an inventory to be made of the myrmecofauna living in this environment. Our study identified 13 ant species representing 9 genera and 2 subfamilies: Formicinae (*Camponotus* and *Lepisiota*) et Myrmicinae (*Messor, Aphaenogaster, Crematogaster, Pheidole, Tetramorium*, and *Temnothorax*). The list and distribution of ants according to the type of plant formation present on the island (Fig 2) are presented in Table 2.

Table 2 - List of Formicidae found on Habibas Island and distribution by plant formation.

Nf: Nitrophilous formation; Cg: Chasmophyte grassland; Xsg: Xerophilous shrub grouping; Hg: Halophilous grouping; Acg: Anthemis chrysantha grassland; Hxsg: Haloresistant xerophilous shrub grouping.

Species	Plant formation					
	Nf	Cg	Xsg	Hg	Acg	Hxsg
Camponotus foreli	-	-	+	-	-	-
Camponotus micans	-	+	+	-	+	+
Camponotus pexus	-	+	-	-	+	-
Lepisiota frauenfeldi	-	-	-	+	-	+
Aphaenogaster senilis	-	-	+	-	-	-
Crematogaster laestrygon maura	-	-	+	-	-	+
Messor capitatus	-	-	+	+	-	+
Messor sanctus	-	+	+	-	+	-
Pheidole cicatricosa	-	-	+	+	-	+
Pheidole pallidula	+	+	+	+	+	+
Temnothorax nigritus	-	-	+	-	-	-
Tetramorium biskrense	-	+	+	-	+	+
Tetramorium semilaeve	+	-	+	-	-	+
Richness: 13	**2 sp**	**5 sp**	**11 sp**	**4 sp**	**5 sp**	**8 sp**

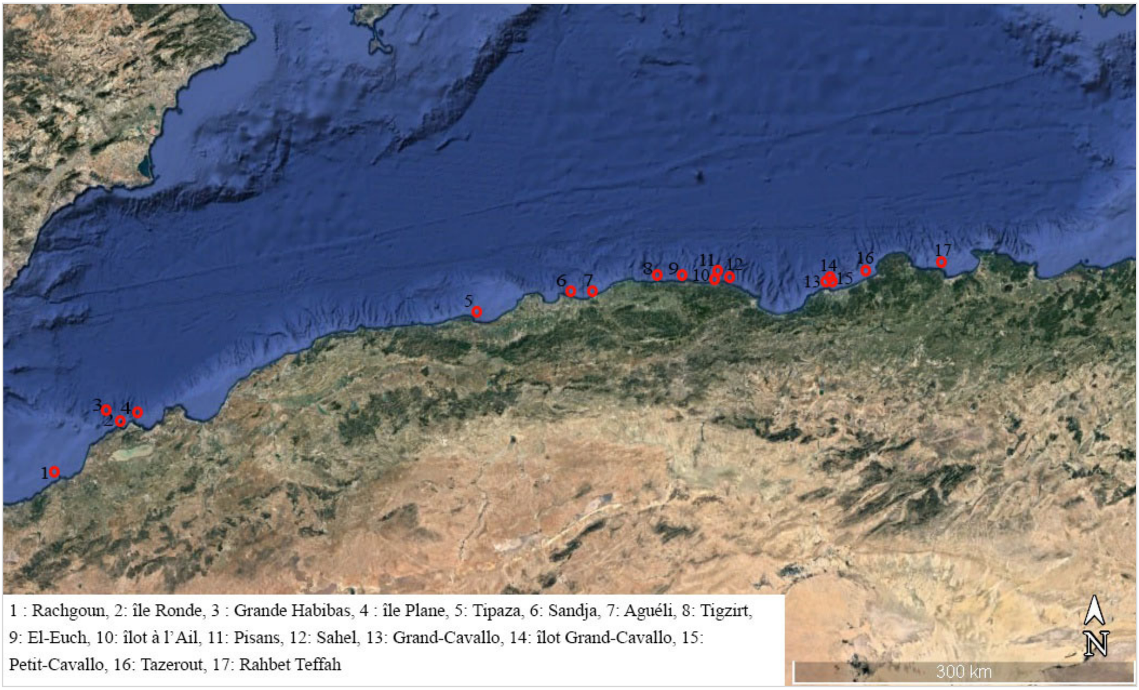

Fig 3 - Location of the islands and islets studied along the Algerian coast.

Some species were only sampled in a single plant formation, such as *Temnothorax nigritus, Camponotus foreli* and *Aphaenogaster senilis* found in the xerophilous shrub grouping, while *Pheidole pallidula* is the only species that appeared in all the plant formations. The other species were sampled in two, five or eight different formations.

Principal Component Analysis

A Principal Component Analysis (PCA) was carried out to understand the distribution of ants according to plant formations on the Habibas island (Fig 4). The first principal component (F1) explains 43.95% of the total variance, while the second principal component (F2) explains 30.92%. The xerophytic shrub grouping has the highest contribution (29.280%) with the F1 axis, while the Chasmophyte grassland has the highest contribution (43.66%) with the F2 axis. The PCA shows a positive correlation between the nitrophilous formation and the Chasmophyte grassland ($R^2 = 0.735$) and between the xerophilous shrub grouping and the halophilous grouping ($R^2 = 0.670$).

The species *Messor capitatus* is associated with the halophilous grouping and the xerophilous shrub grouping, while *Tetramorium semilaeve* makes the greatest contribution to the Chasmophyte grassland (73.153%).

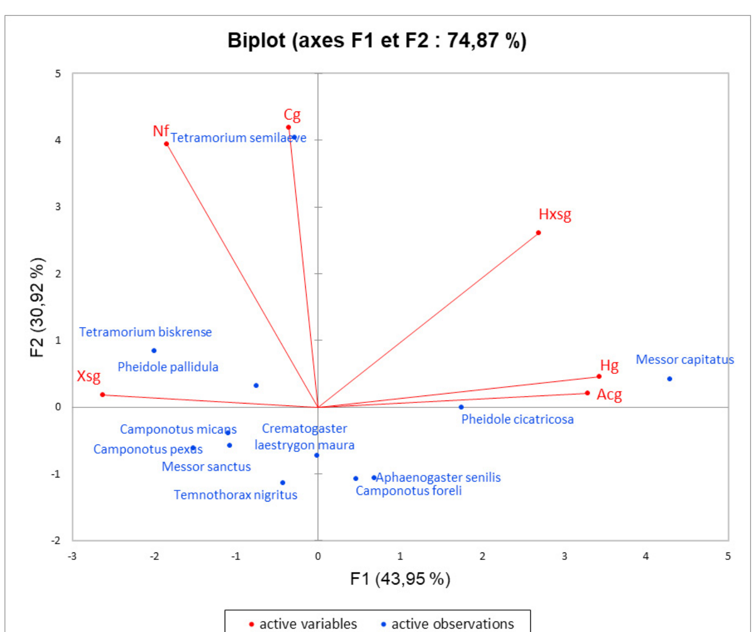

Fig 4 - Principal Component Analysis of the ant species' distribution about plant formations on Habibas Island.

Centesimal frequencies and occurrences of ants from the Habibas Islands

Frequency values vary considerably from one species to another, ranging from 0.92 to 22.94% for centesimal frequencies and from 16.67 to 100% for occurrences (Fig 5). Some ants have high frequencies of occurrence but low centesimal frequencies, such as *Pheidole pallidula, Tetramorium biskrense* and *Camponotus micans.* Although *Messor capitatus* has a frequency of occurrence of 50%, it's the most abundant ant on the island with a frequency of 22.93% (Fig 5). It is followed by *Tetramorium semilaeve* (Fc = 16.51% and Fo = 66.66%) and *Pheidole cicatricosa* (Fc = 11% and Fo = 50%).

Inventory of Formicidae on islands and islets along the Algerian coast

Sampling of Formicidae on the various islands and islets of the Algerian coast has enabled us to produce an inventory of the myrmecofauna living in these environments. Our sampling enabled us to identify a total of 39 ant species representing 14 genera and 3 subfamilies: Dolichoderinae (Tapinoma), Formicinae (*Camponotus, Cataglyphis, Lasius*, *Lepisiota* and *Plagiolepis*) et Myrmicinae (*Messor*, *Aphaenogaster*, *Crematogaster*, *Pheidole, Tetramorium*, and *Temnothorax*) (Table 3).

These results suggest a variation in the distribution of ant species between stations. Some species are present on several islands, such as *Tetramorium biskrense, Pheidole pallidula, Messor barbarus, Crematogaster scutellaris* and *Cataglyphis viatica*, while others are only present on one island, such as *Temnothorax nigritus, Lepsiota frauenfeldi, Messor capitatus, Messor sanctus, Tetramorium semilaeve, Crematogaster laestrygon maura, Aphaenogaster senilis, Camponotus micans, Camponotus pexus, Camponotus foreli* and *Pheidole cicatricosa*, which were only sampled on the main island of Les Habibas. *Lasius flavus* and *Crematogaster laestrygon* were sampled only on the Sahel Islet and *Messor antennatus* only on the Pisan island.

Simple non-linear and multiple regression

For this study, we used a statistical modelling approach, in particular a simple non-linear regression curve supported by multiple regression, to explore the relationships between formicidae richness and various environmental factors, such as the island's size, isolation's degree and its floristic richness. This methodology will enable us to quantify the potential links between these variables and analyse how these factors influence ant diversity on the islands and islets studied.

These statistical tests revealed significant correlations between ant richness and floristic richness ($R^2 = 0.4355$) and a relatively significant correlation with the surface area of the island ($R^2 = 0.1597$). On the other hand, the regression between ant density and soils was not significant ($R^2 = 0.0023$) (Fig 6). The results of the multiple regression carried out with a confidence interval of 95% and the variance analysis did not provide significant results concerning the distribution of ants about the island's characteristics (P-value = 0.115). In addition, the coefficient of determination (R^2) was 0.356, suggesting that the model explained only a small part of the variation in ant richness (Fig 7). Nevertheless, the standardised residuals/richness indicates that there is a positive correlation between ant richness and the factors studied for the Sahel Islet and, to a lesser extent, for the Grand Cavallo Islet and Ronde Island. However, for Petit Cavallo Island, there was an unexpected negative correlation for the formicids' distribution. Although its surface area is somewhat large (3.9 Ha) and has a good floristic richness (101 species), there are only 5 ants. The main island of Les Habibas has the greatest richness (13) despite being almost 10 km from the coast.

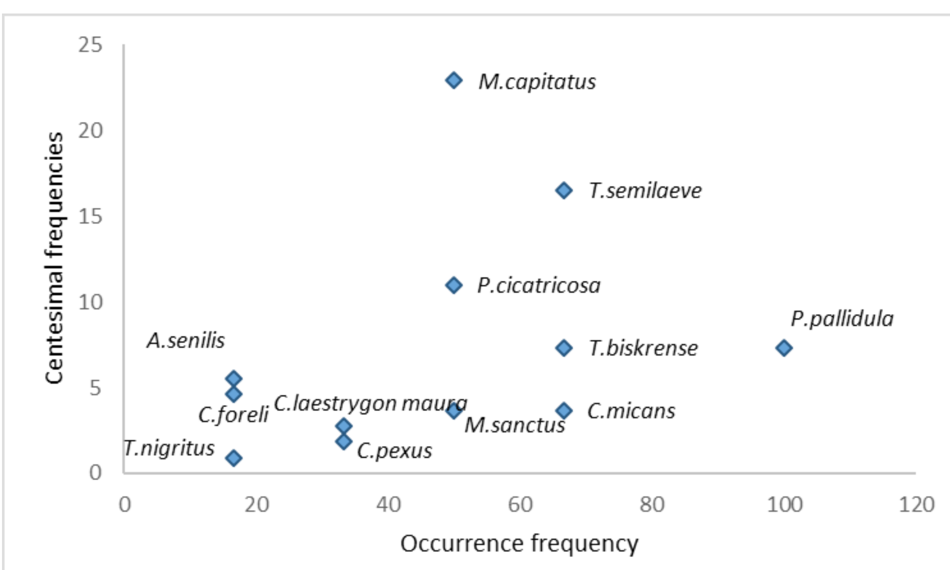

Fig 5 - Distribution of Habibas ant species according to centesimal and occurrence frequencies.

Table 3. Inventory of formicids found on all the islands and islets surveyed in Algeria.

1: Rachgoun Island, 2: Ronde Island, 3: Habibas Island, 4: Plane Island, 5: Tipaza Island, 6: Sandja Island, 7: Agueli Island, 8: Tigzirt Island, 9: El-Euch Island, 10: Garlic Islet, 11: Pisans Island, 12: Sahel Islet, 13: Grand-Cavallo Island, 14: Grand-Cavallo Islet, 15: Petit-Cavallo Island, 16: Tazerout Island, 17: Rahbet Teffah Island.

Species/Stations	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Tapinoma magnum	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	+
Tapinoma simrothi	-	-	-	-	-	-	-	-	+	+	-	+	+	-	+	-	-
Camponotus vagus	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-
Camponotus foreli	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Camponotus gestroi	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Camponotus micans	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Camponotus pexus	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Camponotus ruber	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-
Camponotus sp1	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Camponotus sp2	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Colobopsis truncata	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cataglyphis viatica	-	-	-	-	-	-	-	+	+	+	-	+	+	+	+	-	+
Lasius flavus	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Lasius sp	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Lepisiota frauenfeldi	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plagiolepis schmitzii	-	-	-	-	+	-	-	-	+	+	+	-	-	-	-	-	-
Aphaenogaster sardoa	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Aphaenogaster senilis	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aphaenogaster testaceo-pilosa	-	+	-	-	-	-	+	-	-	+	+	-	+	-	+	-	-
Aphaenogaster sp	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crematogaster auberti	-	-	-	-	+	-	-	-	-	-	+	-	+	-	+	-	+
Crematogaster laestrygon	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Crematogaster laestrygon maura	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crematogaster scutellaris	+	+	-	-	-	-	-	+	-	-	+	+	+	+	+	-	-
Messor antennatus	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Messor barbarus	-	+	-	+	-	-	+	+	+	-	-	+	+	+	+	-	-
Messor capitatus	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Messor sanctus	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Messor structor	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Messor picturatus	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Messor sp1	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-
Messor sp2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pheidole cicatricosa	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pheidole pallidula	+	+	+	+	-	+	+	-	+	+	+	+	+	-	+	-	-
Temnothorax nigritus	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetramorium biskrense	+	+	+	+	-	-	-	-	+	+	+	-	+	-	+	+	+
Tetramorium semilaeve	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monomorium salomonis	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Monomorium subopacum	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-
Richness: 39	**8**	**9**	**13**	**5**	**3**	**1**	**5**	**5**	**7**	**6**	**7**	**12**	**9**	**5**	**9**	**2**	4

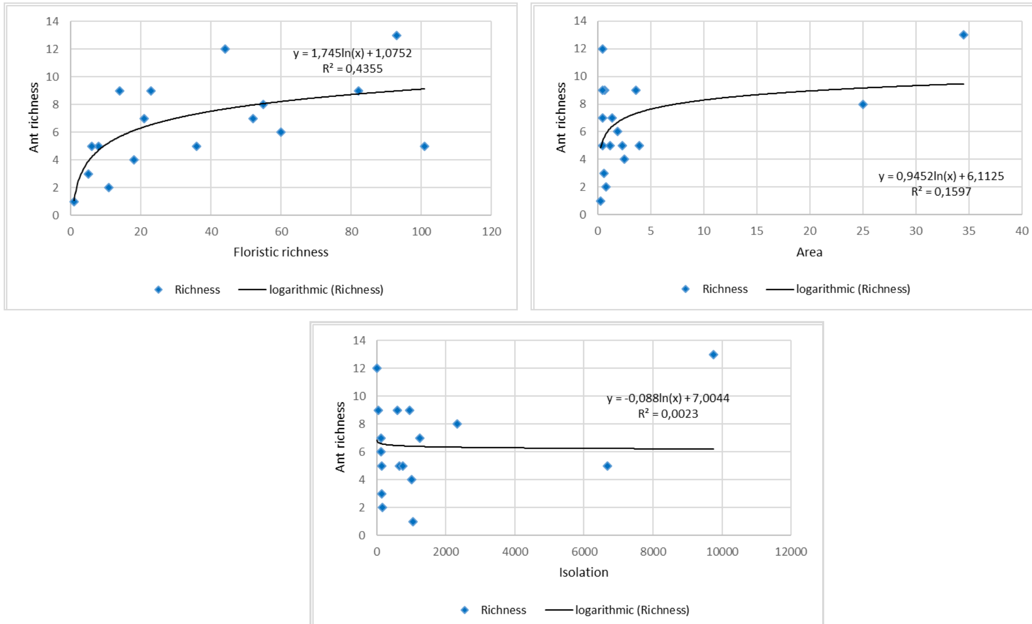

Fig 6 - Non-linear regression analysis: Effects of surface area, isolation and floristic richness on ants' richness.

Similarity between islands and islets

To compare the similarities in Formicidae composition between the seventeen islands and islets studied, we used Spearman's correlation test (Fig 8). From this matrix, we can see that Grand Cavallo Island and Petit Cavallo Island have a very high similarity (0.996), which means that they share all their species. Relative similarity was observed between El Euch Island and Garlic Islet (0.595), between Round Island and Plane Island (0.570) and between Plane Island and Grand Cavallo Island (0.570), suggesting similarities between species.

On the other hand, there is no similarity between Habibas Island and El Euch Island on the one hand and Pisans Island on the other (similarity of 0). The same observation is between Ronde Island and the island of Rahbet Teffah. This means that the ants are completely different on these islands and that they have distinct ant populations. These similarity values can be useful for grouping islands and islets according to their common characteristics (Fig 8).

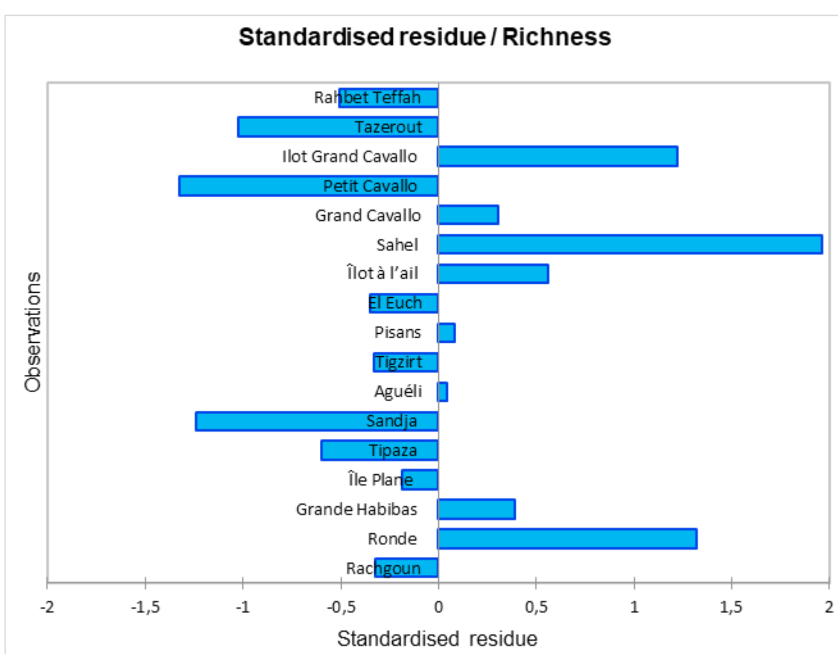

Fig 7 - Multiple regression analysis: Effects of size, isolation and floristic richness on ant richness.

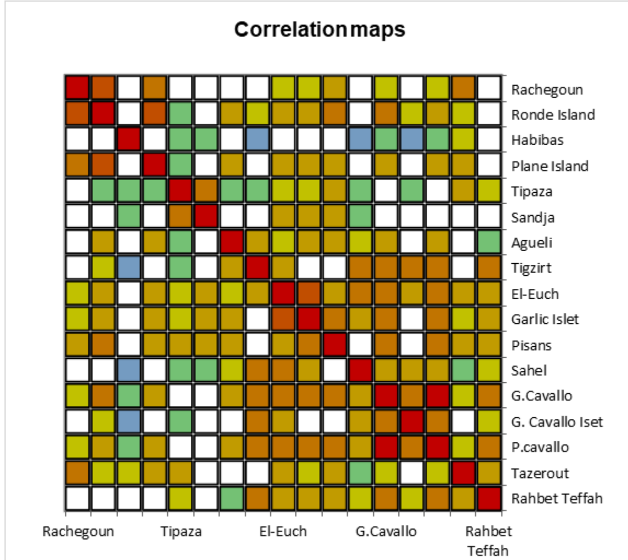

Fig 8 - Correlation map of ants similarities between the islands surveyed.

Discussions

One of the aims of this study was to update the pioneering data of Bernard (1958) on the myrmecofauna of the Habibas islands. Our sampling enabled us to record 13 species of Formicidae, whereas Bernard sampled only 6 species. These were *Messor sanctus, Pheidole pallidula, Crematogaster auberti, Tetramorium pinucum, Lepisiota frauenfeldi* and *Camponotus sylvaticus*. Of the 13 species recorded, only *Pheidole pallidula* and *Lepisiota frauenfeldi* are common to both inventories. Our inventory is therefore missing four species. This can be explained by spatial variability: ant populations can vary from one place to another, even on a small scale (possible differences between Bernard's sampling sites (1958) and ours). or temporal variability: the populations of some ant species may vary from year to year due to environmental factors or competition with other species, knowing that in an island environment, the species extinction rate is between 1,000 and 10,000 times higher than it would be naturally on geological timescales (Gros-Desormeaux et al., 2016).

Lack (1976) suggests that the reduction in species richness observed in this study could also be attributed to barriers to colonisation resulting mainly from ecological factors and the specific communities' organisation. In this study's context, the resistance of island communities to colonisation by new species may be contributing to the reduction in the species richness of Formicidae. It should also be noted that island environments are conducive to species capable of expanding their ecological niche (Lack, 1976). This means that they are better able to exploit a wide range of resources and environmental conditions, demonstrating their ability to adapt to different habitats, adjust their diets according to availability, and withstand changing climatic conditions. Specific depletion on the islands varies according to the group, with a drastic reduction in the number of predators and modified trophic pyramids, characterised by a widening of the base and a narrowing of the tip (Blondel, 1995). Colonisation is favoured by species that are abundant and widespread on the continent, with a better ability to colonise and persist on an island. Species that are generalist and flexible in their choice of habitats are often favoured (Sara and Morand, 2002). However, some species encounter obstacles such as limited dispersal capacity, excessive specialisation or competition with species already present on the island (McArthur & Wilson, 1967).

The principal component analysis (PCA) carried out provided us with interesting information for understanding the distribution of ants according to the plant formations present on Habibas. The analysis suggests that ants react distinctly to the different plant formations on Habibas Island, which may be due to food preferences or specific ecological niches. For example, *Tetramorium semilaeve* was sampled in nitrophilous formations, in the xerophilous shrubby grouping and in the xerophilous haloresistant shrubby grouping. The nitrophilous formation on the island develops on loose soil enriched with nitrates and phosphates from Yellow-legged Gulls (Bachet et al., 2007). It should be noted that this species prefers xerophilous environments (Lebas et al., 2016), particularly grazed environments and matorrals, and coexists with *Pheidole pallidula* (Cagniant, 1997). The latter was found in all the environments sampled, as it is a common species, widespread everywhere (Cagniant, 1968). *Crematogaster laestrygon maura has* been observed exclusively in the two xerophilous shrub groups. Ants of this species build their nests under stones in more or less degraded areas (Cagniant, 2005) and inhabit the rock gardens of the Atlas (Cagniant, 1962). According to the observations of Bachet et al. (2007), the physiognomy of this grouping is similar to low shrubland.

Lepisiota frauenfeldi is a xerophilous (Bernard, 1958) and very halophilous (Bernard, 1971) species, so it is no surprise to find it in both halophilous and xerophilous groupings. *Aphaenogaster senilis, Camponotus foreli* and *Temnothorax nigritus* were only sampled in the xerophilous shrub grouping as these species prefer arid and thermophilous environments with nests under stones (Forel, 1894; Lebas et al., (2016). *Aphaenogaster senilis* builds its nests on shallow, sandy ground at low altitudes (Lebas et al., 2016) and it was in this type of habitat that it was sampled.

The values of the centesimal and occurrence frequencies allowed us to note that *Messor capitatus* is the most abundant species on the island because it is a fairly common species whose colonies are very populous, numbering thousands of workers (Lebas et al., 2016). It should be noted that ants of the *Cataglyphis* genus are absent from this survey, even though they are thermophilic, very xerophilic species that prefer dry soils (Bernard, 1958 and Lebas et al., 2016).

The sampling of formicids in various islands and islets of the Algerian coast enabled us to draw up an inventory of the myrmecofauna living in these environments, with a census of 39 ant species. The greatest richness was observed on Habibas Island (Oran) with 13 species and on the Sahel Islet (Bejaia) with 12 species. This similarity is all the more surprising given that the two islands do not share the same characteristics (surface area, distance from the continent and floristic richness). These results align with those found on the island of Djerba in Tunisia, which has 17 species (Bernard, 1971), Galite (Tunisia) with 12 species and Lempedusa (Italy) with 9 species (Bernard, 1958). The lowest species richness was recorded on the island of Tazerourt (2 species) and the island of Sandja (1 species), as was the island of Linosa (Italy) with 3 species and the island of Lampionne (Italy) with a single species (Bernard, 1958).

The myrmecofauna of the islands and islets of the Algerian coast is very poor compared with that of Bagaux Island (France) with 28 species (Berville et al., 2015), Corsica with 83 species, Sicily with 79 species or Sardinia with 64 species (Casevitz-Weulersse, 1991). Of the 39 species recorded, eight belong to the genus *Messor*, a presence consistent with the region (Berberia) which is probably the cradle of the genus (Bernard, 1958). According to Bernard, the absence of *M. sanctus* and *M. capitatus* from the other islands can be attributed to their competition with *M. barbarus*.

The genus *Camponotus* is one of the largest groups of Formicinae with over 900 species, 24 of which are found in North Africa (Bernard, 1968; Cagniant, 1996). Although the species of this genus have a preference for dry, sloping soils (Bernard, 1968), our study identified only 8 species, characterised by low abundance. Although very common in the Mediterranean, the *Tapinoma* genus is rarely found on Algerian islands and islets. This observation can be explained by its intolerance to the humid air of the summer seasons and not to rain, as these species generally thrive in moist clay soils and regularly watered surfaces (Bernard, 1958 and Lebas et al., 2016).

The species *Monomorium salomonis*, which is widespread in Algeria, is known for its preference for warm and dry environments (Cagniant, 1968 and Lebas et al., 2016) and colonises bare ground (Bernard, 1979). However, it's absent from many of the islands and islets along the Algerian coast, except Rachgoun Island, Plane Island and Round Island. This disparity may be linked to the drier climate on the islands of Algeria's west coast. This region belongs to the semi-arid bioclimatic zone. In comparison, the other Algerian islands in the centre and east are sub-humid and humid bioclimatic zones.

The linear regression curve revealed that the factors studied (surface area, isolation and floristic richness) are not responsible for the ant richness of the islands and islets investigated and suggest that other variables not included in the model play a key role in ant richness on these islands. Only the floristic richness has a significant impact on the distribution of Formicidae. Other factors may play a role in the presence or absence of some species, such as food resources (Lomolino, 2000 and Vanderwoude et al., 2014), ecological conditions (strong winds laden with salt spray) (Bernard, 1958 and Berville et al., 2015), the soil's nature (Bernard, 1971) or the diversity of habitats present on the islands (Casevitz-Weulersse, 1991). However, we point out that further studies must cover a survey time longer than ours in this study or even sample ants in different seasons to overcome the lack of collection of ant species with cryptic life histories or varying population density due to seasonality.

Using Spearman's correlation test to assess compositional similarities, only two islands (Grand Cavallo and Petit Cavallo) were found to be very similar, which can be attributed to their relatively close proximity (around 4 km). Other islands have similarities of between 50 and 60%. On the other hand, the other islands show marked differences from one another. In the island biogeography model approach, an increase in the surface area of a territory increases the chances of offering varied habitat conditions, which translates into an increase in the number of species present (Blondel, 1995). However, it's important to note that this model of island biogeography is not universally applicable. The dynamics of island communities vary according to several parameters, including topographical features, biotope diversity, the intrinsic attributes of colonisers, the number of predators and the history of each island (Lomolino, 2000, Gros-Desormeaux et al., 2016). These variations explain the difference in myrmecofauna on all the islands studied.

For example, although *Crematogaster scutellaris* is commonly associated with oak, particularly cork oak, this species is able to build its nests in various tree species such as fruit trees, ornamental trees and various types of pine (Villemant & Fraval, 2002; Cagniant, 2005; Lebas el al., 2016). On our islands, the nests are built mainly on shrubs such as *Pistacia lentiscus* and *Phillyrea angustifolia*. Despite the ecological variability of this species, it is remarkable that *Crematogaster scutellaris* do not occur on Habibas Island, although the island seems to meet its requirements.

Conclusion

The study highlighted the diversity and complexity of the myrmecofauna of the Algerian islands. The results suggest specific distribution patterns, but also significant variations between islands. The vegetation type influenced community composition, but island features (Area and isolation) don't. This study contributes to a better understanding of the island's myrmecological fauna and the factors that influence the composition of ant communities on the islands. Finally, for a better understanding of Algerian island ants, it would be useful to extend the investigations to other islands, especially those in eastern Algeria. It's also essential to explore in depth the many factors that influence their presence or absence in order to enrich our knowledge of the ecology of island ants.

Author`s Contributions

SB: Investigation.
SK: Investigation.
MB: Investigation.
MH: Investigation.
AH-M: Concetualization, investigation, data curation, formal analysis, writing-initial draft, writing-review & editing.
RM: Investigation, writing-initial draft, writing-review & editing.

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