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## First evaluation of the structure and the entomological biodiversity of the Maâmora forest and the Merja of Fouarat (Kenitra, Morocco)

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**Abstract**

The purpose of this study is to place the insects of the two different areas (Maâmora Forest and Merja of Fouarat) in the Gharb plain region (33° to 34° N and 6° to 8° E); they are located in the sub-humid bioclimatic floor to mild winter. The realization of this place was made from two sampling methods: net fauchoir and sight hunting. The sampling permits to identify 55 species divided into seven orders and 25 families. In the Maâmora forest, we found that 40 identified species, 13 are the main enemy insects of the cork oak, which is considered as the main essence of the Maâmora forest especially the *Lymantria dispar*. In addition, it is the order of Coleoptera which is the most dominant with 17 species, the diversity index  $H'$  is equal to 3.28 bits and the equitability  $E$  has 0.89 bits. In the Merja of Fouarat, 46 species are captured and corresponded to the diversity  $H'$  of 3.35 bits as well as to the equitability  $E$  of 0.87. The Merja of Fouarat, a wetland of the Gharb region, contributes to regional biodiversity and should imperatively be elevated to nature reserve status.

**Keywords:** The Maâmora Forest, Merja of Fouarat, insects, structure, diversity indices

**Introduction**

The study of entomological fauna is an essential element in the dynamics and functioning of the terrestrial and aquatic ecosystems. Its ecological role as well as the bio-indicator character of some can indicate the health status of these ecosystems and determine certain factors related to the degradation of these ecosystems. These are good indicators of the ecosystem quality and the impact of the forest environmental management <sup>[1,2]</sup>. In addition to these roles, they are actors in the functioning of ecosystems that intervene at all levels of the tropical webs. They can be primary consumers (phytophagous insects), secondary or tertiary consumers (predators, super-predators, parasites, hyperparasites). The saprophages (saproxylophages, necrophages, coprophages, detritivores) are indispensable actors in the cycle of matter (organic matter, mineral elements...). The presence or absence of processions of species permits to check a good functioning of the ecosystem.

The objective of this study is to contribute to the determination of an entomological inventory of the western Maâmora forest and the surrounding land area of Fouarat Lake. Similarly, the results of this work will enrich the entomological data bank and provide insights into the biodiversity of the Gharb Plain insect population and the Maâmora forest.

**Materials and methods**

The study was conducted from mid-April to 20 April, from 20 to 25 May and from 25 to 30 September (2013-2014) in the two areas of the Gharb plain namely the Maâmora forest, which is located in the Northwestern of Morocco, bordering the Atlantic Ocean, between the meridians 6°00' and 6° 45' west longitude, and the parallels 34°00' and 34° 20' north latitude <sup>[3]</sup> (Fig. 1), and the Merja of Fouarat at the altitude of (34° 15' N, 06° 32' W), which is situated in the Maâmora plateau (Fig. 2).

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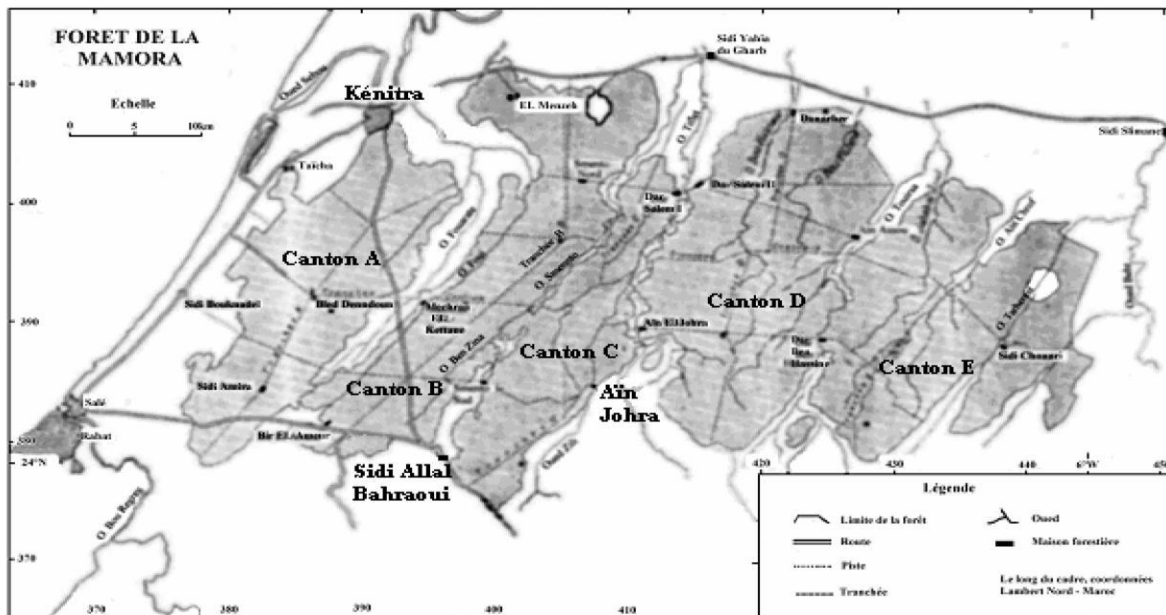


Fig 1: Location of Maâmora forest [4].



Fig 2: Location of Merja of Fouarat

The study was limited to the period of adult activities, the collection methods were as follows: sight hunting, mowing herbaceous vegetation and shrub [5]. The determination of the harvested species was carried out at the laboratory of the

Faculty of Sciences (Kenitra, Morocco).

**Results**

**Table 1:** Global list of captured species in the two different study areas.

Orders	Families	Taxons	F M	M F
Coleoptera	Scarabeidae	<i>Copris hispanus</i>	16	7
		<i>Thorectes distinctus</i>	23	13
		<i>Scarabaeus Sacer</i> L	34	12
		<i>Scarabaeus cicatricosus</i>	16	7
		<i>Phylloganathus excavatus</i>	8	8
		<i>Polyphylla maroccana</i>	4	13
		<i>Aethiessa floralis</i>	56	13
	Cerambycidae	<i>Oryctes nasicornis</i>	6	8
		<i>Cerambyx cerdo</i>	5	0
	Buprestidae	<i>Stenochorus sp</i>	14	8
		<i>Coroebus florentinus</i>	5	0
	Platypodidae	<i>Coroebus undatus</i>	4	0
<i>Platypus cylindrus</i>		6	0	

	Tenebrionidae	<i>Akis sp</i>	68	15
	Coccinellidae	<i>Harmonia sp</i>	23	12
	Carabidae	<i>Carabus sp</i>	55	13
	Dynastidae	<i>Dipelicus sp</i>	12	14
Diptera	Chironomidae	<i>Chironomidae sp</i>	0	100
	Culicidae	<i>Culex pipeiens</i>	0	34
		<i>Uranotaenia balfouri</i>	0	26
		<i>Uranotaenia unguilata</i>	0	38
		<i>Culex theileri</i>	0	23
	Tabanidae	<i>Chrysops sp</i>	5	5
	<i>Tabanus sp</i>	13	45	
Odonata	libellulidae	<i>Brachythemis leucostica</i>	0	46
		<i>Crocothemis erythrea</i>	0	8
		<i>Orthetrum trinacria</i>	6	12
	Lestidae	<i>Lestes Virens</i>	0	4
		<i>Lestes macrostigma</i>	0	6
		<i>Sympecma fusca</i>	0	3
	Aeshnidae	<i>Anax parthenope</i>	0	6
	<i>Hemianax ephippiger</i>	0	4	
Lepidoptera	Lymantriidae	<i>Lymantria dispart</i>	67	0
	Tortricadae	<i>Tortrix viridana</i>	23	0
	Pieridae	<i>Pieris brassicae</i>	23	3
		<i>Pieris rapae</i>	34	6
		<i>Pieris napi</i>	16	5
		<i>Colias crocea</i>	15	10
		<i>Colias hyale</i>	17	23
	Lycaenidae	<i>Maculinea sp</i>	0	7
Hymenoptera	Formicidae	<i>Crematogaster scutellaris</i>	48	0
		<i>Formica sp</i>	100	100
	Apidae	<i>Apis mellifera</i>	34	45
		<i>Bombus pratorum</i>	12	8
		<i>Crabro sp</i>	23	14
Hemiptera	Pentatomidae	<i>Chinavia hilaris</i>	12	0
		<i>Graphosoma lineatum</i>	12	26
		<i>Nezara viridula</i>	0	7
	Lygaeidae	<i>Spilostethus pandurus</i>	8	13
Pyrrhocoridae	<i>Pyrrhocoris apterus</i>	6	13	
Orthoptera	Mantidae	<i>Mantis religiosa</i>	3	0
	Acrididae	<i>Aiolopus sp</i>	19	12
		<i>Oedipoda sp</i>	0	2
		<i>Calliptamus sp</i>	3	6
		<i>Docioptaurus sp</i>	3	3
Total: 7	25	55	857	806

FM: Forest of Maãmora, MF: Merja of Fouarat

At the level of the two different areas studied, 55 species belonging to 7 orders and 25 families are identified during the study period which had taken place between April and September 2013-2014 (Table 1).

A total of 1639 individuals belonging to 55 species were harvested in the two study areas. This entomological biodiversity is divided into 7 orders and 55 taxonomic families. The Coleoptera order dominates with 8 families

including the Scarabaeidae which is mostly represented. In the second place, the order of Lepidoptera includes 4 families which are presented as follows: Lymantridea, Tortricadae, Pieridae, and Lycaenida. The Hemiptera, Odonata and Diptera are represented by three families for each, whereas the Hymenoptera and Orthoptera are represented by a small number not exceeding 2 families (Fig. 3).

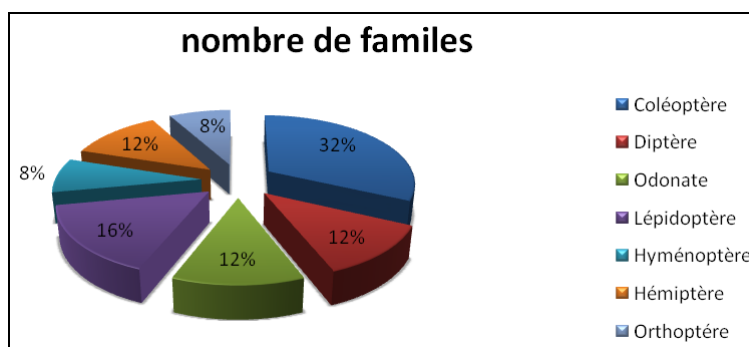


Fig 3: Illustrates the different proportions of the orders listed in the two study areas.

**Table 2:** Relative abundance according to the orders captured in the two study areas.

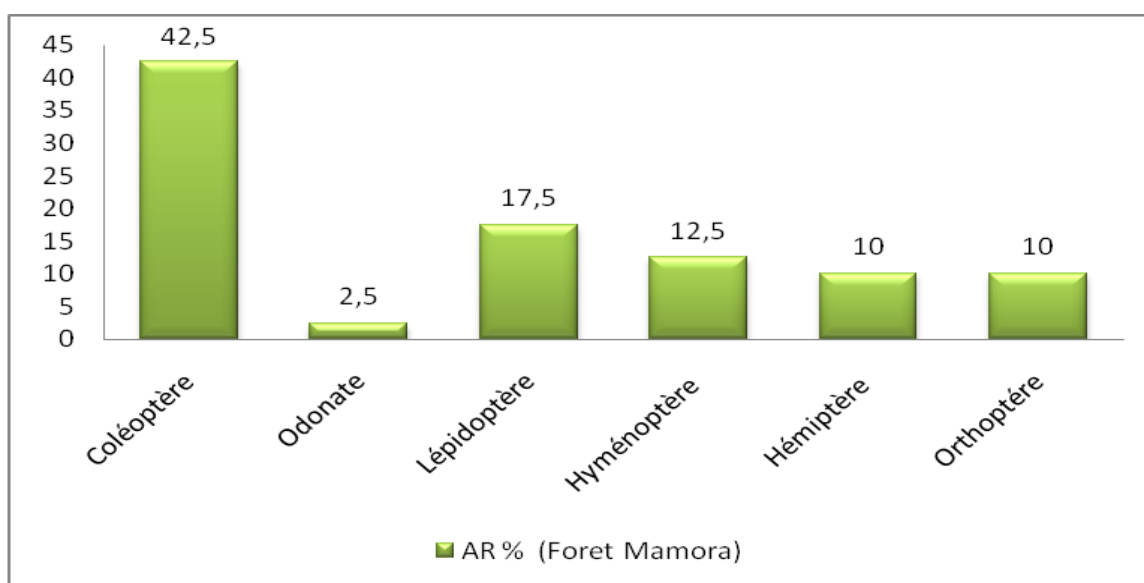
Order	FM		MF	
	Ni	AR %	Ni	AR %
Coleoptera	17	42.5	13	28.26
Diptera	2	5	7	15.21
Odonata	1	2.5	8	17.39
Hymenoptera	5	12.5	4	8.69
Orthoptera	4	10	4	8.69
Hemiptera	4	10	4	8.69
Lepidoptera	7	17.5	6	13.04
	7	40	46	100

Ni: Number, AR: Relative abundance abundance, FM: Forest of Maâmora, MF: Merja of Fouarat.

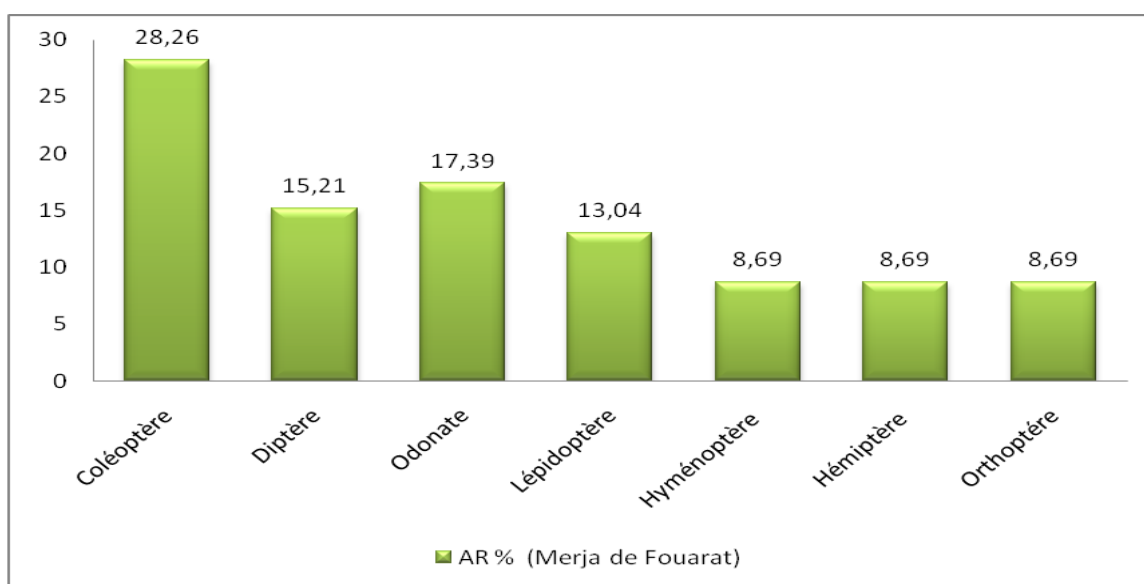
At the level of the Maâmora Forest, among the 40 species identified, it is the Coleoptera with 17 species or 42.5% are

the most abundant, followed by the Lepidoptera with 7 species or 17.5%, the Hymenoptera are represented by 5 species (12.5%); the Orthoptera and Hemiptera are represented by 4 species for each or 10%. The other orders such as the Diptera and Odonata are respectively (2; 1 species) participated in a weak level (Table 2; Fig. 4).

At the level of the Merja of Fouarat, the global inventory of the captured species includes 46 species, the order of Coleoptera is the richest in species (13 species); it represents 28.26% (Table 2; Fig. 5), followed by the Odonata with 8 species (17.39%). The Diptera are represented by 7 species, that is to say, 15.21% followed by the Lepidoptera with 6 species (13.04%). Moreover, the Hymenoptera, the Hemiptera and the Orthoptera are represented by 4 species for each (8.69%).



**Fig 4:** Relative abundances of species according to the orders captured in the Maâmora forest during the period of study.



**Fig 5:** Relative abundances of species according to the orders captured in the Merja of Fouarat during the period of study.

The figure 6 shows the entomological diversity in species and in individuals, mainly in the two study areas. It appears that the Merja of Fouarat is very diverse from a species point of view, but the Maâmora Forest is less diverse compared to the

Marja of Fouarat. From an individual point of view, the Merja of Fouarat is less diversified than the Maâmora Forest. In this context, it is very remarkable that the Coleoptera are the most diversified in the two different study areas.

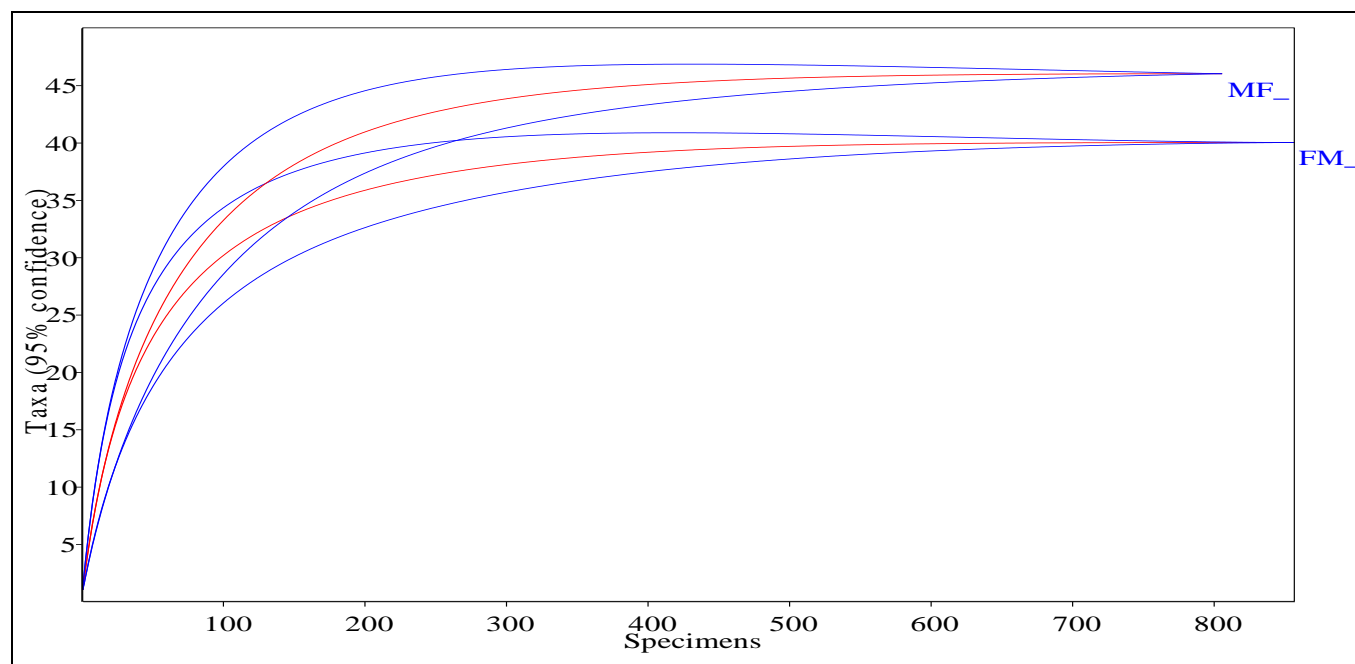


Fig 6: Relative abundance and specific richness of the insects captured in the two study areas during the period.

### Ecological indices of structures

#### The Shannon-Weaver Diversity ( $H'$ ) and the equitability ( $E$ ) in the two study areas

The Shannon-Weaver Diversity Index estimates the diversity of insects at the level of the two different study areas. Thus, these values of  $H'$  and of the equitability index 'E' are placed in the (Table 3).

Table 3: Diversity Index of the Shannon-Weaver ( $H'$ ) and the equitability ( $E$ ) in the two study areas.

Parameter	FM	MF
Taxa	40	46
Number of individuals	857	806
Shannon_H (bit)	3.28	3.35
Evenness ( $e^{H/S}$ ) or Equitability	0.89	0.87

H: Shannon's Index; E: Equitability

The Shannon-Weaver diversity values range from 3.28 to 3.35 bits in the two study areas, which expresses the diversity of the sampled population.

The equitability ( $E$ ) values recorded during the sampling period in the two study areas for 8 months tend towards 1. They vary between 0.87 and 0.89 in which the forest of Maâmora has an 'E' that is equal to 0.89. Also, the Merja of Fouarat has an 'E' which is equal to 0.87. This implies that the number of different species tends to be in equilibrium with each other.

### Discussion

#### Analysis of entomological diversity in the two study areas

The analysis of the structure of the entomological populations in all the study areas revealed the presence of 55 species divided into 7 orders and 25 taxonomic families. The order Coleoptera remains the most dominant with 17 species of which the Scarabaeidae are represented with numbers of 8 species.

The total number of sampled individuals during the different samples is 1639 of which 857 individuals in the Maâmora forest and 806 in the Merja of Fouarat.

In both study areas, the dominance of Coleoptera is very

remarkable with 17 species in the Maâmora forest and 13 species in the Merja of Fouarat; this can be explained by the fact that the Coleoptera, on the one hand, occupy terrestrial, semi-aquatic and aquatic environments [6,7]. On the other hand, the Coleoptera are occupied by the major drivers structuring Coleoptera assemblages and influencing species abundance and richness including temperature, rainfall, organic matter content of the soil, altitude and abundance of vegetation [8].

In this work, the obtained results show the presence of 46 species of insects in the Merja of Fouarat which is a wet area of the Gharb plain. In that case, this present results are different from the results found by Slim *et al.*, (2016,2017) [9,10] in the Sidi Boughaba biological reserve, which is considered as a wet area and classified as a Ramsar site; it includes both the matorral and the aquatic formations, where it found 75 species. This can be explained by several factors on which the richness of the entomological species depends on the example of the nature of the substrate, sunshine, vegetation cover. In addition to these factors, we find the sampling methods and techniques [10].

The abundance of Coleoptera in the Maâmora forest can be explained by the fact that it is characterized by a flexibility with regard to abiotic and biotic factors [11] such as: the presence of organic matter (Carpophagous species) and vegetation cover for the phytophagous species [10], and the nature of the substrate for the sabolicol species [12].

In the other side, at the Maâmora forest [13] inventoried 13 species of Coleoptera that are the insect enemies of the cork oak, which is considered as the main species of the Maâmora forest followed by the Lepidoptera that are represented by the *Lymantria dispar* and *Tortrix viridana* which are defoliators of the cork oak.

Concerning the order of Diptera, the presence of the culicidae mosquitoes especially the *Uranotaenia balfouri* and *Uranotaenia unguiculata* vector of the diseases is due to the fact that the waters of the Merja of Fouarat are polluted by the untreated liquid discharge, and also by the influence of certain factors on which the distribution of mosquitoes depends [14].

The diversity of the Hymenoptera order is mainly represented

by the Apidae and Formicidae families, it should be noted that we have practically recorded the same species in the two study areas. This omnipresence is explained by the great dispersal capacity of ants and Apis and by their ability to colonize diverse sites.

Concerning the ecological indices of structure, the Shannon-Weaver diversity index values ( $H'$ ) calculated for the entire study period are 3.28 bits noted in the Maâmora forest, 3.35 bits in the Merja of Fouarat, reflecting a relatively high level of diversity.

Concerning the two study areas, all the equitability values are close to 1. In this context, we can say that the numbers of sampled species tend to be in equilibrium with each other. As for the values of the total equitability, they are equal to 0.89 mentioned in the forest of Maâmora and 0.87 in the Merja of Fouarat.

### Conclusion

The investigation conducted in the Maâmora Forest and the Merja of Fouarat allowed us to harvest a total of 1639 individuals belonging to 55 species. This entomological biodiversity was divided into 7 orders and 25 taxonomic families. In number and in species, the order of Coleoptera has the most important numbers of 17 families. This order represents 68% of the global entomological diversity of which Scarabaeidae are the most represented. Secondly, the order of the Lepidoptera includes the following families: the Lymantriidae, the Tortricidae, the Pieridae and the Lycaenidae. The other orders are represented by a weak number not exceeding 3 families. Among the identified entomological diversity, we find the Phyllophagous species, the Leafminers, the saproxylophages and the strict predators which are mostly present.

### References

1. Nageleisen LM, Bouget C. L'étude des insectes en forêt: méthodes et techniques, éléments essentiels pour une standardisation. Synthèse des réflexions menées par le groupe de travail «Inventaires Entomologiques en Forêt». Les Dossiers Forestiers n°19, Office National des Forêts, 2009.
2. Nicolas M. Le rôle des insectes dans les écosystèmes forestiers: Les insectes et la forêt. CRPF de Bretagne, 2009.
3. Aafi A, Achhal EA, Benabid A, Rochdi M. Richesse et la diversité floristique de la subéraie de la Mamora (Maroc). Journal of Acta Botanica Malacitana. 2005; 30:127-1. Available from: [https://www.researchgate.net/publication/280234131\\_The\\_systematic\\_structure\\_composition\\_mode\\_of\\_action\\_of\\_the\\_Cork\\_oak\\_enemy\\_insect\\_Quercus\\_Suber\\_L\\_case\\_of\\_Mamora\\_forest\\_Kenitra\\_Morocco](https://www.researchgate.net/publication/280234131_The_systematic_structure_composition_mode_of_action_of_the_Cork_oak_enemy_insect_Quercus_Suber_L_case_of_Mamora_forest_Kenitra_Morocco) [accessed Apr 13 2018].
4. Lamote M, Bourliere F. Problèmes d'Ecologie- l'Echantillonnage des Peuplements Animaux des Milieux Terrestres. Ed. Masson et Cie, Paris, 1969, 303.
5. Metro A, Sauvage CH. Flore des végétaux ligneux de la Mamora. La nature au Maroc, Rabat, 1955, 498.
6. Hansen M. The Hydrophilidae (Coleoptera) of Fennoscandia and Denmark, Fauna Entomologica Scandinavia, 1987, 253.
7. Nilson AN, Holmen M. The aquatic Adephaga 5 (Coleoptera) of Fennoscandia and Denmark. 11. Dytiscidae. Fauna Ent. Scand. 32. E.J. Brui, Leiden,

- 1995, 192.
8. Jong-Kook J, Yujeong P, Hyoseok L, Joon-Ho L, Sang-Hyun K, Tae Young *et al.* A comparison of diversity and composition of carabid beetles between overpasses and underpasses in fragmented forest areas. Journal of Asia-Pacific Entomology. 2017; 20:1267-1277.
9. Slim M, Zouaki N, Lougraimzi H, El Ghali L, Zidane L, Fadli M. Diversity, Composition and Systematic Structure the Terrestrial Entomofauna of a Ramsar site: The Biological Reserve of Sidi Boughaba, Mehdi (Morocco). 975~Journal of Entomology and Zoology Studies. 2016; 4(4):975-982 Available from: [https://www.researchgate.net/publication/306106651\\_Diversity\\_Composition\\_and\\_Systematic\\_Structure\\_of\\_the\\_Terrestrial\\_Entomofauna\\_of\\_a\\_Ramsar\\_site\\_The\\_Biological\\_Reserve\\_of\\_Sidi\\_Boughaba\\_Mehdi\\_Morocco](https://www.researchgate.net/publication/306106651_Diversity_Composition_and_Systematic_Structure_of_the_Terrestrial_Entomofauna_of_a_Ramsar_site_The_Biological_Reserve_of_Sidi_Boughaba_Mehdi_Morocco) [accessed Apr 13 2018].
10. Slim M, Ouattar H, Zouaki N, Zaouai F, El Ghali L, Fadli M. Estimation of entomological biodiversity: the biological reserve of Sidi Boughaba as a case study (Mehdi, Morocco), ~747~Journal of Entomology and Zoology Studies. 2017; 5(5):747-75.
11. Lorenz W. Nomina Carabidarum, A directory of the scientific names of ground beetles (Insecta, Coleoptera «Geodephaga»: Trachypachidae and Carabidae incl. Paussinae, Cincidelinae, Rhysodinae). 2th ed., 2005, 993.
12. Idrissi L. Contribution à l'étude écologique des Coléoptères sabulicoles de Sidi Boughaba (Maroc), 1982, 157-178.
13. Slim M, Alwashali E, Zouaki N, El Ghali L, Fadli M. The systematic structure, composition, mode of action of the Cork oak enemy insect (Quercus Suber L.), case of Mamora forest, Kenitra, Morocco, The International Journal of Multi-disciplinary Sciences, 2015, 1(1):1-29. Available from: [https://www.researchgate.net/publication/280234131\\_The\\_systematic\\_structure\\_composition\\_mode\\_of\\_action\\_of\\_the\\_Cork\\_oak\\_enemy\\_insect\\_Quercus\\_Suber\\_L\\_case\\_of\\_Mamora\\_forest\\_Kenitra\\_Morocco](https://www.researchgate.net/publication/280234131_The_systematic_structure_composition_mode_of_action_of_the_Cork_oak_enemy_insect_Quercus_Suber_L_case_of_Mamora_forest_Kenitra_Morocco) [accessed Apr 13 2018].
14. Allami A, Slim M, Alwashali E, Sassa S, Kouradi R, Fadli M. Mosquitoes (Diptera, Culicidae) of eleven important hydrosystems in the plain of the Gharb and Rabat-Salé cities (Morocco): Species richness, geographic distribution, and density evolution. Environmental Science: An Indian Journal, 2015; 10(10):359-371.