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Contribution to the knowledge of riparian Coleoptera of Ait Aissa wadi region of Beni Tadjite-Talsint "Eastern Morocco"

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- ✓ Temporal variations;
- ✓ stand structure;
- ✓ Coleoptera;
- ✓ Morocco;
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Abstract

In order to determine the temporal distribution of the riparian Coleopterological settlement of Ait Assa wadi, a watercourse located in the south-east of Morocco and studied for the first time, a monthly monitoring was carried out over a period of 15 months, from January 2014 to March 2015. The composition of the global stand and its evolution over time are analyzed. The results of statistical treatments have shown that the factors governing the temporal evolution of riparian fauna include temperature and rainfall.

1 Introduction

The region of Beni Tadjite-Talsint is situated in the Southeast of the High Eastern Atlas between longitudes 03°25' and 03°55' W and latitudes 32°10' and 32°45' N. It belongs to the province of Figuig which is a territory of the Moroccan administrative region of the Oriental. It is composed half of mountains and half of plains. The climate is arid with an average annual rainfall of about 140 mm. It is crossed by several small streams, more or less permanent, coming from the High Atlas. The ecological study of stands colonizing the wetland biotopes of the watersides has not attracted the interest of many entomologists. However, since the 1960s, riparian fauna has been the subject of various studies which have contributed to widening the field of knowledge concerning the structure and functioning of this biocenosis [1-11]. At the Moroccan level, the main works concerned the riparian populations of rivers [12-20] and standing waters [21-26].
Although the rivers of the Moulouya watershed have been the subject of several studies [27-32]. It is not the same for the Oued Ait Aissa. This small watercourse, situated in the south of the eastern Morocco, which is called Oued Bouanane in its lower part and Oued Haiber in its upper part, originates in a mountainous area at JebelsWiyslane "2276m" and Falchou "2296m" and more precisely at the Taghitlbour pass where is the point of confluence between two small streams: Wad Al Mame and Ighzarn Blboul. Wadi Ait Aissa, in its upper part, follows a direction NO-SE and then, after the village of Ait Hmad Ohadou, it follows the direction SE, with a low flow and a seasonal flow.
Virtually no studies or inventories of wildlife and, in particular, riparian beetles have been carried out in this area, particularly on this watercourse. It was only recently that it was the object of prospections [33], in order to establish an inventory of the species of some families of beetles. Until then, data from the literature especially those in the Kocher catalog [34,35] listed only 28 species of beetles in this region.

2. Material and methods

2.1. Description of the study area

The chosen station is located in the northwest of the municipality of Beni Tadjite, 200m upstream from the QsarTijit hill dam, in the bed of the Ait Aissa wadi (Figure 1). It is 1129 m above sea level and is coordinated 32°19' N - 03°29' W. The banks are populated with *Tamarix gallica* L., 1753, *Juncus acutus* L. and *Phragmites communis* (Cav.) Trin. ex Steud., 1841. They constitute a heterogeneous station, particularly the left bank, with different facies “pebbles, gravel, sand, silt, ...”.

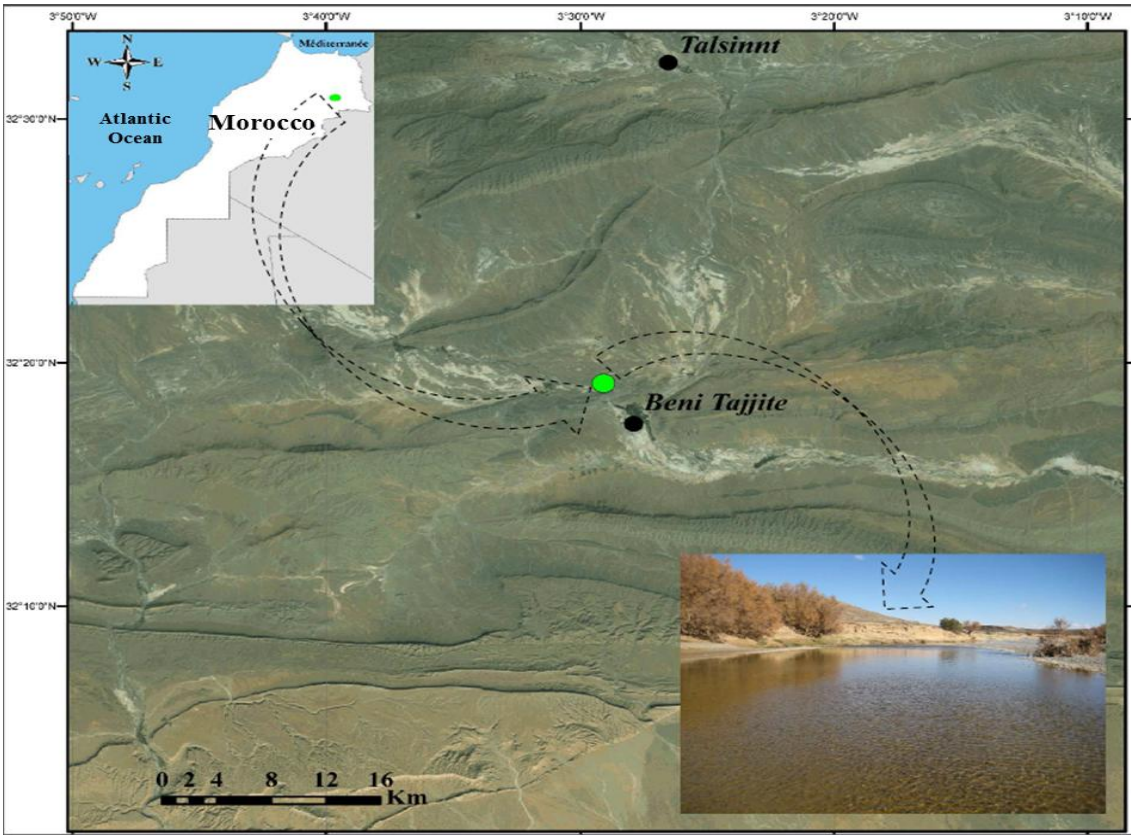

Figure 1 : Localization of the studied region and station

2.2. Sampling techniques

Various sampling techniques have been described by various authors, either quantitative or qualitative, according to the biotopes studied, the experimental protocols and the objectives sought. These include sight hunting, Barber traps, watering of the substrate which causes the release of fauna buried in the cracks and the soil [2, 14, 17, 26, 36… etc] and the standardized quantitative technique [5, 7, 10, 13, 20, 37], which consists of delimiting a surface on the ground by means of a frame made of wood or of strong, rigid, cylindrical or square metal sheet of variable dimensions according to the authors. Our study was conducted for 15 months, from January 2014 to March 2015, on a monthly basis. For each, the beetles were sampled in the different facies of the banks of the station during 3 hours of active research. Harvesting was done by direct sight hunting and under shelters “lifting stones and blocks and removing plant leaves and wood debris” and then watering the substrate with a plastic canister 5 liters for the plots relatively far from the water, while the banks very close to the stream were watered directly by projection of water using a small container with handle of 0.66 liter. The collected individuals were then retained, for each facies, in a vial with an ethyl acetate buffer, labeled, and then either determined in the laboratory using keys, placed on a diaper, and passed to specialists for identification.

The identification of the Elateridae was carried out by J. L. Olagnon, that of the Staphylinidae by R. Outelero, P. Gamarra and M. Tronquet and that of the Tenebrionidae by H. Labrique. The other families were determined by one of us “GC”.

2.3. Multivariate analyzes

A) PCA: Principal Component Analysis is a statistical method of analyzing data. Its objective is to summarize the information contained in the data on a reduced number of dimensions that best reflects the proximities between observations and / or between variables [27-31]. This widely used method of analysis highlights the significant correlations between the different variables, it allows to visualize the similarities between the observations and the links between the variables [38].

B) CFA "Component Factor Analysis" : from Verneaux [39], this method proves to be an efficient means for the research of biocenotic structures in running water. This author was able to define the typological structure of the Doubs hydrographic network.

3. Results and discussion

3.1. Stand analysis

Table 1: Inventory of the main identified taxa, their ecological group and distribution: with R: riparian, H: hygrophil, T: terrestrial, A: aquatic, NC: not classified "see table in appendix"

Taxa	Biotope	Distribution
Family Carabidae		
Subfamily Pterostichinae		
Abacetus (Astigis) salzmanni Germar, 1824	H	Ibero-Maghrebian
Amara (Paracelia) simplex Dejean, 1828	T	Southern Mediterranean
Subfamily Trechinae		
Bembidion (Bembidionetolitzkya) coeruleum Audinet-Serville, 1	R	West Mediterranean
Bembidion (Emphanes) latiplaga flavibase De Monte, 1956	R	West Palearctic
Bembidion (Euperyphus) fluviatile unctulum Antoine, 1941	R	West Palearctic
Bembidion (Euperyphus) ripicola Dufour, 1820	R	West Mediterranean
Bembidion (Notaphus) varium Olivier, 1795	R	Palearctic
Bembidion (Ocydromus) atlanticum megaspilum Walker, 1871	R	Palearctic
Bembidion (Peryphus) hummleri hummleri Müller, 1918	R	Palearctic
Bembidion (Peryphus) subflavescens Antoine, 1944	R	Maghrebian
Tachys (Paratachys) bistriatus Duftschmid, 1812	R	Holo-Mediterranean
*Tachyura (Sphaerotachys) hoemorrhoidalis*Ponza, 1805	R	Ponto-Mediterranean
Tachyura (Sphaerotachys) lucasi Jacquelin du Val, 1852	R	Mediterranean
Tachyura (Tachyura) bisbimaculata Chevrolat, 1860	R	North African
Tachyura (Tachyura) curvimana Wollaston, 1854	R	West Mediterranean
Perileptus areolatus dissidens Alluaud, 1932	R	Endemic
Subfamily Melaeninae		
Cymbionotum semelederi Chaudoir, 1861	H	Palearctic Saharo- Sindian
Subfamily Scaritinae		
Dyschiriodes (Dyschiriodes) angusticollis Putzeys, 1866	R	Ibero-Maghrebian
Dyschiriodes (Dyschiriodes) clypeatus Putzeys, 1866	R	Saharo- Sindian
Dyschiriodes (Paradyschirius) parallelus ruficornis Putzeys, 18	R	West European
Dyschirius beludscha ganglbaueri Znojko, 1927	R	Ibero-Maghrebian
Subfamily Cicindelinae		
Lophyra (Lophyra) flexuosa Fabricius, 1787	R	CircumMediterranean
SubfamilyHarpalinae		
Stenolophus (Egadroma) marginatus Dejean, 1829	R	Palearctic
Stenolophus (Stenolophus) teutonus Schrank, 1781	H	Palearctic
Acupalpus (Acupalpus) maculatus Schaum, 1860	R	Palearctic
Subfamily Platyninae		
Paranchus albipes Fabricius, 1792	H	West Palearctic
Subfamily Lebiinae		
Syntomus lateralis lateralis Motschulsky, 1855	H	Mediterranean
Apristus striatipennis Lucas, 1846	R	North African
Lionychus albonotatus Dejean, 1825	R	CircumMediterranean

Microlestes corticalis Dufour, 1820	R	Palearctic
Microlestes luctuosus Holdhaus, 1904	T	Palearctic
Family Staphylinidae		
Aloconota cf *languida* Erichson, 1839	H	Palearctic
Bledius tricornis Herbst, 1784	R	Palearctic
Ischnopoda cf *umbratica* Erichson, 1839	R	European
Carpelimus (Troginus) exiguus Erichson, 1839	T	Palearctic
Nehemitropia lividipennis Mannerheim, 1830	T	Cosmopolitan
Neobisnius procerulus Gravenhorst, 1806	H	West Palearctic
Philonthus (Philonthus) alcyoneus devillei Chapmann, 1932	R	Holo-Mediterranean
Philonthus (Philonthus) cf *caerulescens* Lacordaire, 1835	R	European
Philonthus (Philonthus) cf *mannerheimi* Fauvel, 1869	NC	European
Platystethus (Craetopycrus) cornutus Gravenhorst, 1802	T	Subcosmopolitan
Gabrius nigritulus Gravenhorst, 1802	T	European
Gauropterus fulgidus fulgidus Fabricius, 1787	R	Palearctic
Stenus (Stenus) mendicus mendicus Erichson, 1840	H	Palearctic
Tachyporus (Palporus) nitidulus Fabricius, 1781	T	Palearctic
Tachyusa balteata Erichson, 1840	R	European
Tachyusa cf *constricta* Erichson, 1837	R	European
Family Elateridae		
Negastrius pulchellus Linné, 1761	NC	Holarctic
Heteroderes algirinus Lucas, 1846	NC	West Mediterranean
Zorochros angularis Candèze, 1869	H	Palearctic
Zorochros curtus Germar, 1844	H	Mediterranean
Family Aphodiidae		
Pararhyssemus coluber Mayet, 1887	T	Saharo- Sindian
Pleurophorus maghrebinicus Pittino & Mariani, 1986	T	Endemic
Rhyssemodes orientalis Mulsant & Godart, 1874	T	Palearctic
Family Coccinellidae		
Coccinella (Coccinella) septempunctata algerica Kovář, 1977	T	Maghrebian
Family Tenebrionidae		
Gonocephalum (Gonocephalum) setulosum angustum Lindberg, 1950	T	Palearctic
Gonocephalum (Gonocephalum) patruele Erichson, 1843	T	Saharo- Sindian
Gonocephalum (Gonocephalum) rusticum Olivier, 1811	T	Mediterranean
Leichenum pulchellum pulchellum Lucas, 1846	R	Mediterranean
Sclerum armatum Waltl, 1835	T	Mediterranean
Sepidium tricuspidatum wagneri Erichson, 1841	T	Maghrebian
Family Dytiscidae		
Nebrioporus (Nebrioporus) clarkii Wollaston, 1862	A	Circum-Mediterranean
Hygrotus (Coelambus) confluens Fabricius, 1787	A	Ponto-Mediterranean
Family Hydrophilidae		
Laccobius sp.	A	------------------
Family Dryopidae		
Dryops sp.	A	------------------
Family Hydraenidae		
Coelostoma (Coelostoma) hispanicum Küster, 1848	A	Ibero-Maghrebian
Ochthebius sp.	A	------------------
Ochthebius sp. 1	A	------------------
Ochthebius sp. 2	A	------------------

Anthicidae and Heteroceridae could not be determined. They will therefore be taken into account only partially.

3.1.1. The faunistic composition

All the 1332 individuals harvested are classified by families "Table 1 contains the inventory of the taxa of the global population, their biogeographical distribution and the ecological group to which they belong". Carabidae are the most important family, accounting for 52% of individuals and 44% of taxa harvested throughout the stand (Figures 3 and 4), followed by the Staphylinidae family in terms of taxonomic richness "25%" and the Tenebrionidae in terms of abundance "11%". 8 subfamilies represent the carabics, the Trechinae subfamily is the most important with about 37% of the individuals and 20% of the taxa of the whole stand, the Lebiinae are the second most important, accounting for 7% of the taxa and 8% of the individuals. Followed by Scaritinae and Harpalinae-Platyninae in terms of taxonomic richness "6% each" and Scaritinae in terms of abundance "4%".

Our results are consistent with those of Zitouni [26] who observe that riparian fauna in eastern Morocco is characterized by a clear dominance of Staphylinidae and Trechinae, as in most riparian environments [5, 7, 8, 10, 12].

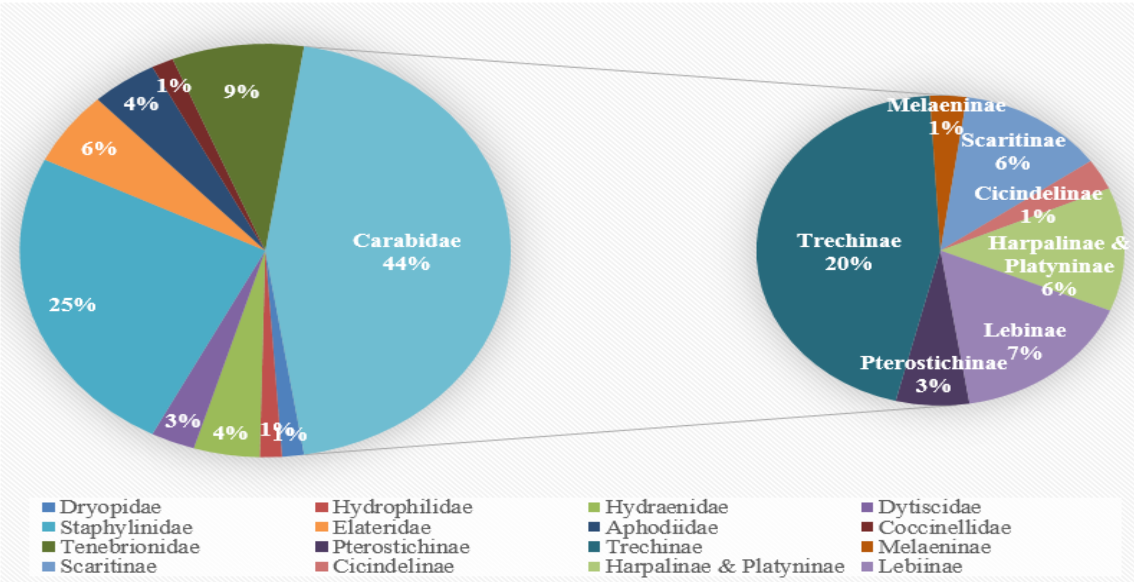

Figure 3 : Richness of the different families of the global population and of the subfamilies of carabic

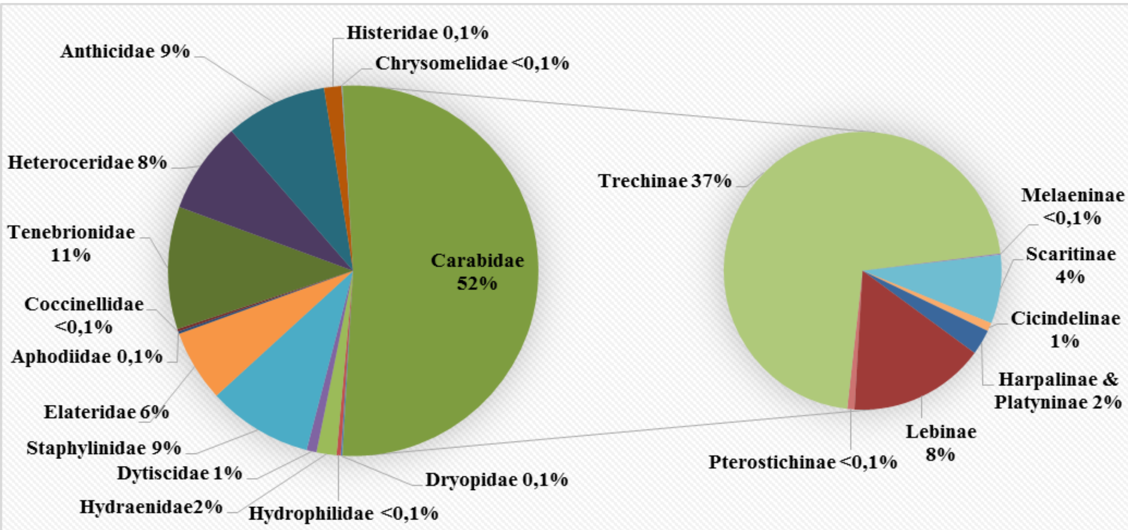

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Figure 4 : Abundance of different families of global stands and subfamilies of the carabics

1.2. Ecological composition

The fauna of the banks consists of a mixture of species coming from terrestrial and aquatic domains as well as taxa subservient the particular biotope of the banks [5, 10]. Strict riparian species constitute the base stand of the riverbank environment [8], accounting for 82% of the total and dividing 36 taxa, whether 46% of the stand

(Figures 5 and 6). The hygrophilous species constitute a group strongly linked to the banks but in a more flexible way than the riparian, this category constitutes 5% of the individuals harvested, distributed among 10 taxa ie 13% of the total population. Whereas terrestrial species, which can be found in other environments and whose distribution is very wide, represent 17 taxa, ie 24% of the stand and 6% of the total harvested.
Several authors report the presence of aquatic species in the shoreline area [8, 10], these species may have run aground or come to shore for food, breeding or imagination. This category is represented by 8 taxa ie 10% of the stand and 3% of the total individuals.

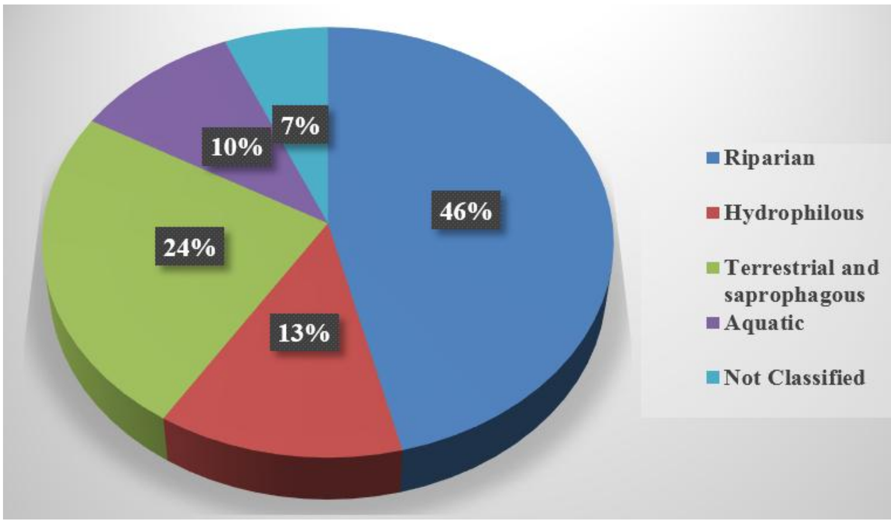

Figure 5 : Proportions of ecological types, in number of species of the global stand

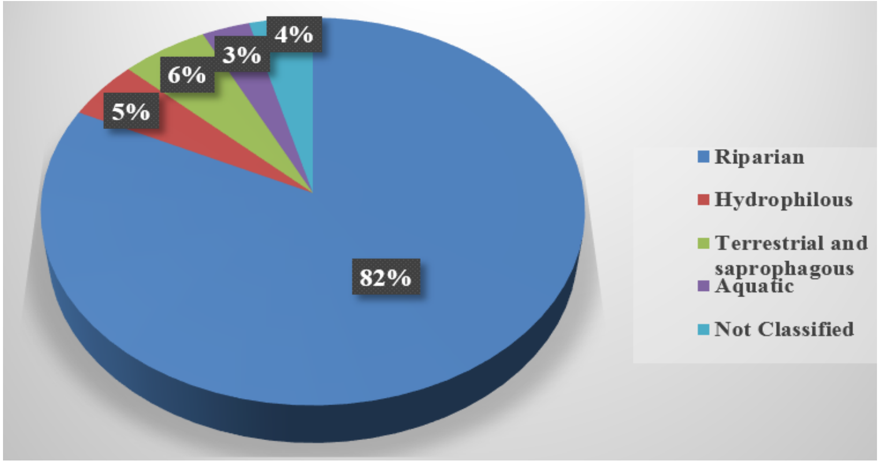

Figure 6: Proportions of ecological types, in number of individuals of the global stand

3.1.3. Biogeographic composition

The analysis of the riparian stand composition shows that it consists mainly of Mediterranean species “46%”, followed by species with a wide distribution in the Palearctic domain “34%” and European species “11%”. The cosmopolitan elements and those of holarctic or Saharo-Sindian distribution constitute a minority “with respectively 3%, 1% and 5%”. Among the Mediterranean elements, the categories whose distribution is restricted, namely Ibero-Magrebian, Maghrebian and Moroccan endemics, make up 17% of the total population, while the circum-Mediterranean corotype brings together 15% of the total population (Figure 7).
The coleopterological riparian population of the study area is characterized by a clear dominance of the Palearctic elements typically Mediterranean and a high rate of Ibero-Maghrebian endemism. Our results confirm those of Dakki [40, 41], Sánchez-Ortega & Tierno de Figueroa [42], El Alami [43], Taybi *et al.* [44] and Mabrouki *et al.* [28] who report that the communities of the Mediterranean regions are characterized by a low diversity of species compared to those of central and continental Europe while presenting a high rate of endemism.

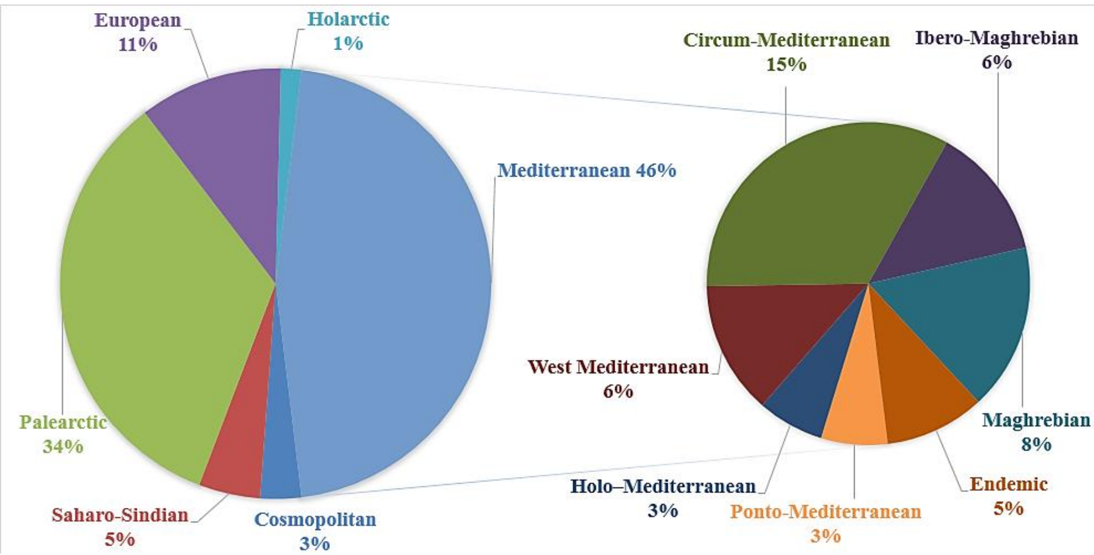

Figure 7 : Biogeographic distribution of global stand taxa

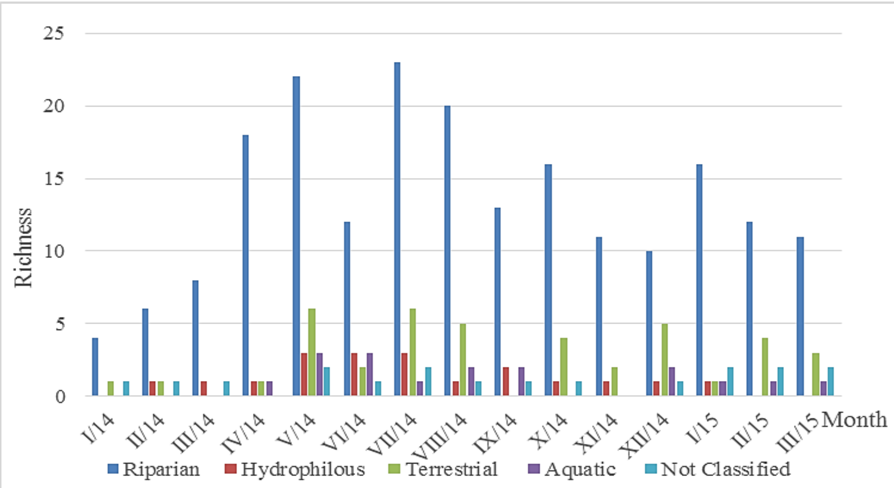

Figure 8 : Variation of relative abondance according to ecological groups

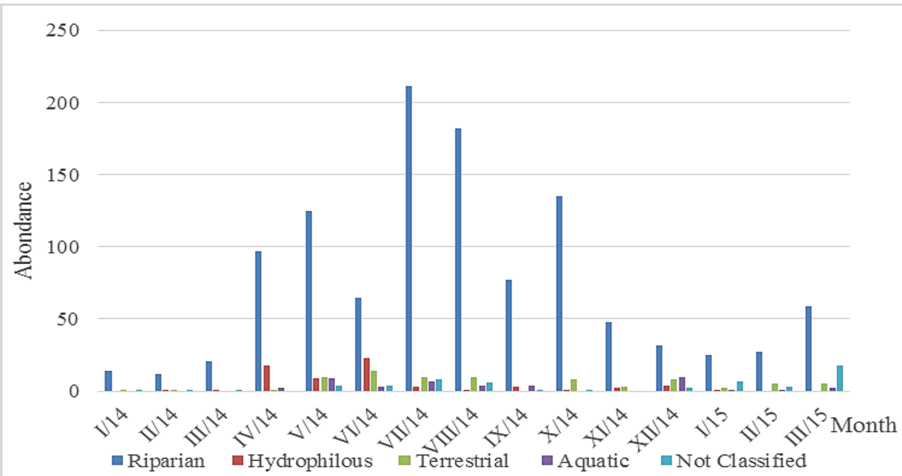

Figure 9 : Variation of relative richness according to ecological groups

The Carabidae family dominated riparian populations throughout the study (Figure 10), with a peak observed in July. The highest abundance of the riparian Tenebrionidae, represented by three species, occurs in July and especially in August while that of Anthicidae appears in October and Staphylinidae occurs in April and especially in July. Within the carabidae, the Subfamily of the Trechinae is the most represented throughout the period of the study (Figure 11), with a maximum recorded, as for the family, in July. From these two figures we can clearly deduce that the Trechinae dominate the carabic and riparian populations of the studied station.

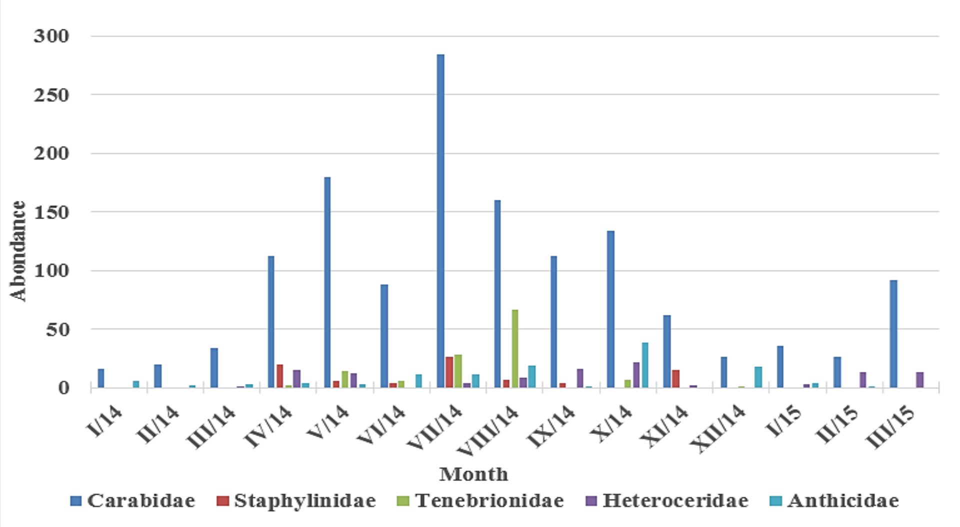

Figure 10 : Variation in relative riparian abundance by family

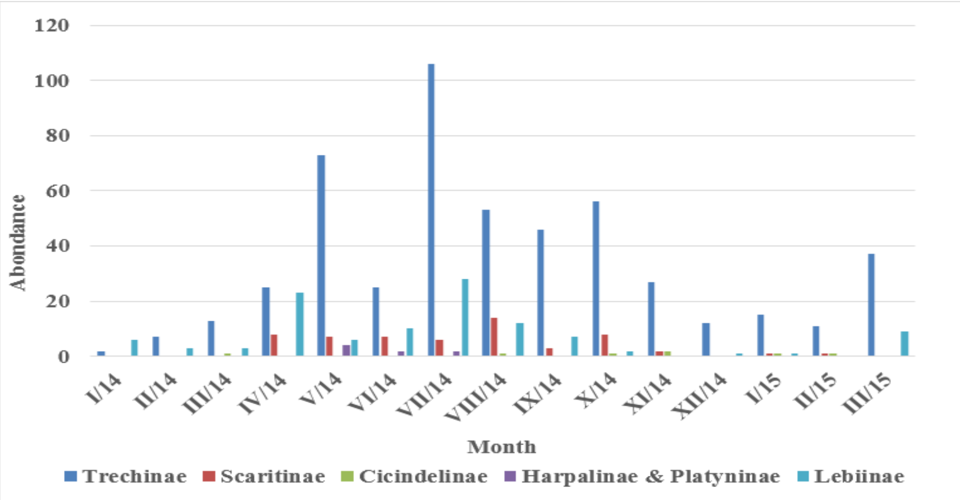

Figure 11: Variation in relative abundance of riparian carabics by Subfamilies

3.2. Typological study

Precipitation and temperature are likely to play a role in the distribution of riparian fauna over time. A study of the overall mesological structure of the environment from these two abiotic descriptors will serve as a basis for a comparative analysis of the temporal distribution of riparian fauna. For temperature, the lack of data for the first five months was replaced by an extrapolated average of the data for the years 2014 and 2015. The analysis of these two mesological parameters of the different months of prospecting in principal components makes it possible to discriminate at the plane F1-F2 three groups (Figure. 12).

Group A : It includes the six months during which the average monthly temperature "see appendix" exceeds 15 ° C, the months from April to September. The rainiest months in this group are to the left of the F1 axis, May and September, which record respectively 37 and 28 mm. The F1 axis jointly expresses the two mean monthly precipitation and temperature gradients.

Group B : It includes the rest of the months of the year except November, the months from October to March, the average monthly temperature of which does not exceed 15 ° C. The month of February tends to approach the next group by its rainfall "of the order of 53 mm".

Group C : It is the only month of November that completely isolates itself from other months by its high rainfall “which reaches 104 mm”.

The transition between the first two groups takes place during the months of October and April “respectively 2014 and 2015”.

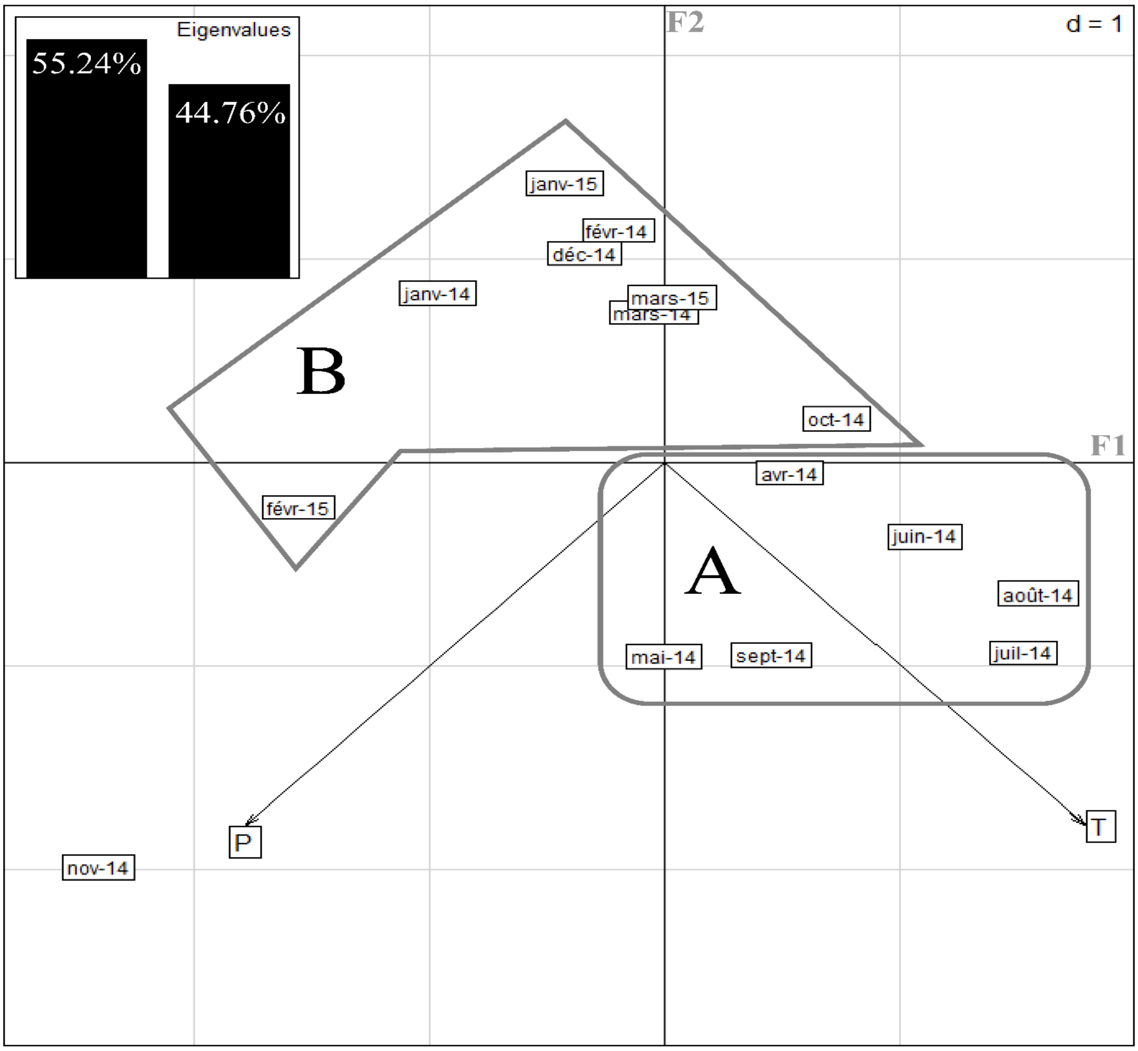

Figure12 : F1-F2 ACP’s Plan: Biplot, cloud-survey structure and mesological parameters

3.3. Structure biotypologique

factorial analysis of the correspondence of the dataset consisting of 15 surveys / 32 species with abundance transformation in absence-presence gives a factorial plane F1 and F2 with a structure very similar to that of the PCA “structure of the cloud-Records and mesological parameters” by isolating the month of November (Figure 14). In order to clarify the possible relationship between the biotypological structure and the environmental variables, we have compared the coordinates of the readings “months” on the first two factorial axes “derived from the CFA” with the values of the two mesological parameters in the distribution of riparian fauna.

The temperature parameter has a good negative linear correlation with the axis F1 of the AFC, this correlation is of the order of -65.73% “r = -0.657”. The F1 axis, which expresses 16.41% of the total inertia of the CFA, thus reveals a temperature gradient that increases from right to left. The F2 axis, which represents 15.06% of the total inertia of the CFA, expresses a rainfall gradient, which is positively correlated 81.74% “r = 0.817” with the precipitation factor.

In biotypology, the first two axes of the CFA accumulate 31.47% of the total inertia and represent three groups that are similar to those defined in the mesological study.

The analysis of the structure resulting from the CFA shows clearly that there is a temporal structuring and differentiation in the stands. The latter is governed, inter alia, by two dominant factors, temperature and rainfall.

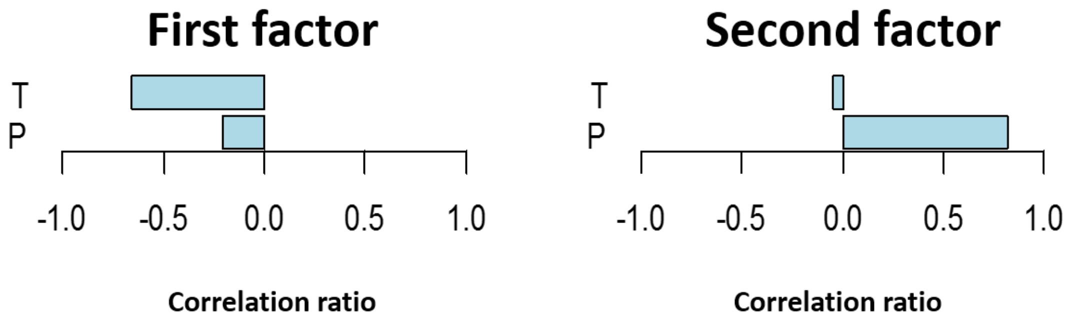

Figure 13 : Correlation relationship between the mesological parameters and the first two axes of the CFA

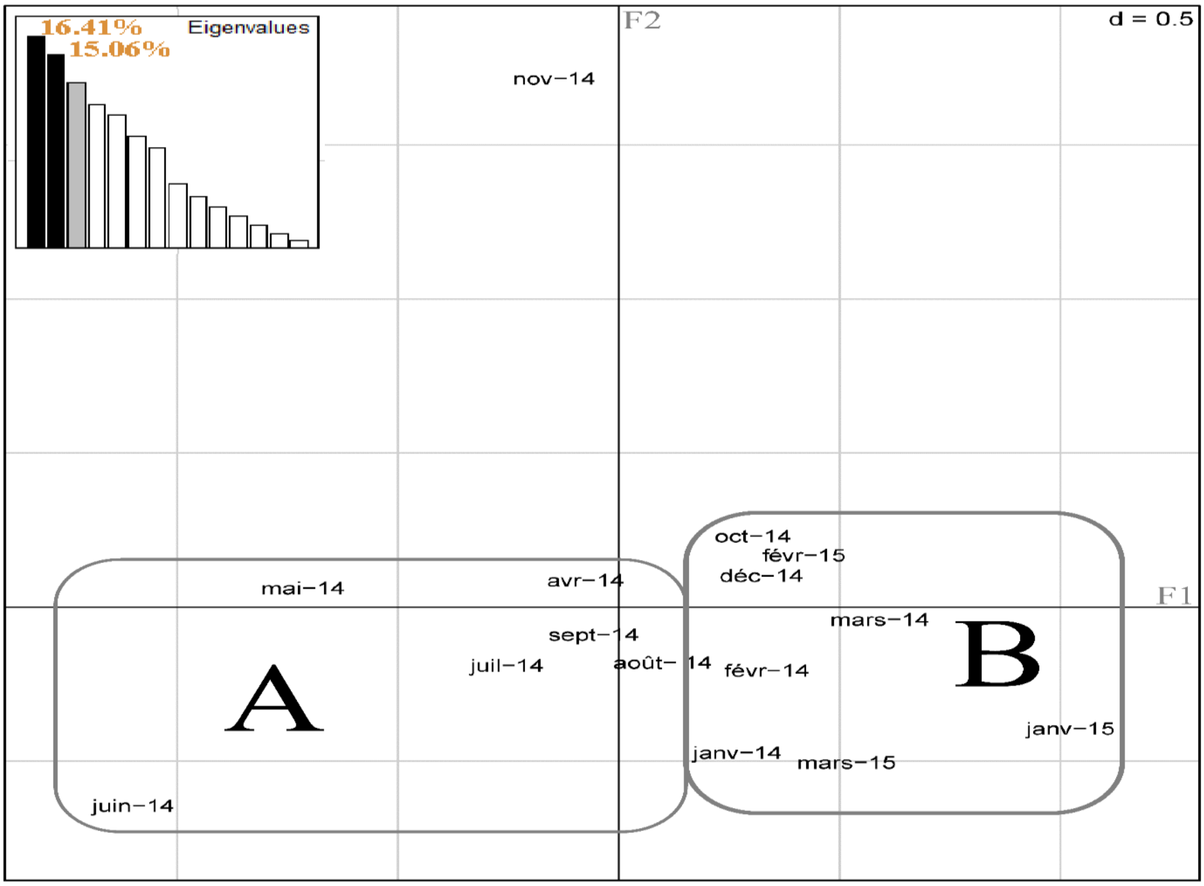

Figure 14 : F1-F2 CFA's plan: structure of the cloud -records

The order of the species on the factors F1 and F2 of the CFA approximates the species whose temporal distribution is close. This order, as well as the density of a given taxon "appendix", was therefore adopted for the presentation of species. Cuttings in these sequences (F1 and F2) make it possible to define three riparian faunistic groups.

The axis F1 of the CFA separates two groups according to their thermal affinity by placing on the left a thermophilic group which appears almost only when the mean monthly temperature exceeds 15 ° C and to the right another riparian eurytherme grouping, which groups the species indifferent to the average monthly temperature, indeed this grouping is met almost all the year.

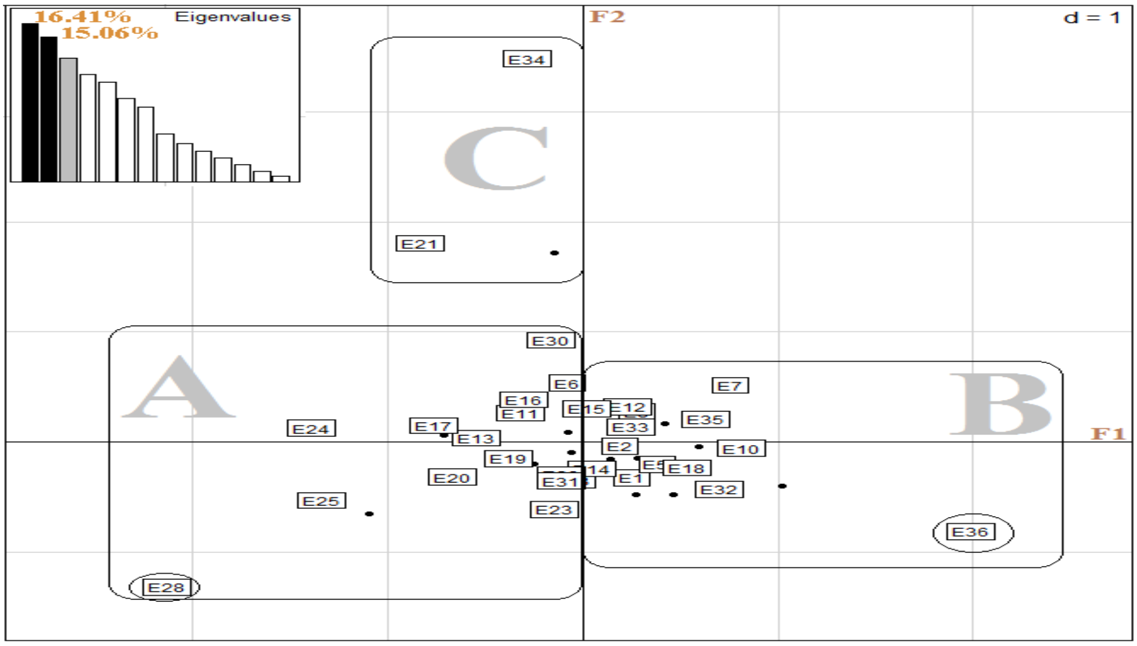

Figure 15: F1-F2 CFA's plan: cloud-species structure

Group A :
This thermophilic group is made up of the following species: *Acupalpus maculatus* "E24", *Philonthus* sp. "E22", *Stenolophus marginatus* "E25", *Microlestes corticalis* "E17", *Philonthus alcyoneus devillei* "E20", *Dyschiriodes parallelus ruficornis* "E13", *Leichenum pulchellum pulchellum* "E19", *Dyschiriodes angusticollis* "E11", *Bembidion atlanticum megaspilum* "E16", *Tachyusa balteata* "E30", *Bembidion hummleri hummleri* "E23", *Tachyusa* cf *constricta* "E31", *Gauropterus fulgidus fulgidus* "E29" and *Bembidion fluviatile unctulum* "E6". *Tachys bistriatus* "E28" is completely isolated on the left, the latter appearing only during the month of June.

Group B :
This eurytherm group consists of the following species: *Apristus striatipennis* "E3", *Bembidion latiplaga flavibase* "E15", *Tachyura hoemorrhoidalis* "E14", *Bembidion ripicola* "E2", *Dyschiriodes clypeatus* "E12", *Bembidion varium* "E33", *Tachyura bisbimaculata* "E1", *Bembidion subflavescens* "E8", *Perileptus areolatus dissidens* "E5", *Lionychus albonotatus* "E18", *Bembidion coeruleum* "E35", *Tachyura curvimana* "E32", *Lophyra flexuosa* "E7" and *Dyschirius beludscha ganglbaueri* "E10". *Tachyura lucasi* "E36" Appearing only in the month of January 2015 is completely isolated to the right of this grouping suggesting that it prefers fresh temperatures.

Group C :
The F2 axis of the CFA, which reflects rainfall, isolates *Ischnopoda* sp. "E34" and *Bledius tricornis* "E21", these two species probably have a preference for rainy months.

Conclusion

All the individuals harvested are represented mainly by the Carabidae family as much in terms of abundance as in richness, itself dominated by the Trechinae Subfamily. The strict riparian community of the study area constitutes the base stand of the riverbanks, accounting for 82% of the total, characterized by a clear dominance of the Palearctic elements typically Mediterranean and a high rate of Ibero-Maghrebian endemism. This riparian group dominates the coleopterological stand during the 15 months of study "between 2014 and 2015", both for abundance and for relative richness.
Precipitation and temperature, taken into account as abiotic descriptors, have served us to make a global mesological structure of the environment. The comparison between the CFA and these two mesological parameters made it possible to discriminate the three following major groups: a thermophilic affinity group preferring an average monthly temperature exceeding 15°C, an eurytherm group insensitive to changes in mean monthly temperature, and a group that has a probable preference for rainy months.

References

1. Girard C., *L'Entomologiste*., 21 (6) (1965) 66-74.
2. Amiet J.L., *Annls Mus. Hist. nat. Paris*., 46 (1967) 125-213.
3. Novoa F., *Bol. Soc. Españ. Hist. Nat.*, 78 (1980) 133-141.
4. Favet C., PhD thesis, Aix-Marseille III, (1981) 377.
5. Favet C., *Bull. Mus. Hist. Nat. Marseille*., 44 (1984) 47-61.
6. Favet C., *Mésogée*. 48 (1988) 103-110.
7. Bigot L., Gautier G., *Bul Mus Hist Nat Marseille*., 41 (1981) 13-30.
8. Bigot L., Gautier G., *Ecol Medit.*, 8 (4) (1982) 11-36.
9. Boumezzough A., PhD thesis, Université d'Aix-Marseille III. (1983)191.
10. Boumezzough A., *Ecol Mediterr*., 9 (2) (1983) 3-33.
11. Boumezzough A., Musso J.J., *Ecol Mediterr*., 9 (1) (1983) 31-56.
12. Gautier G., *L'entomologiste*., 43 (5) (1987) 247-259.
13. Boumezzough A., PhD thesis, Université d'Aix-Marseille III. (1988) 180.
14. Chavanon G., Chavanon L., *Bull. Mens. Soc. Linn. Lyon.*, 61 (2) (1992) 39-45.
15. Chavanon G., Chavanon L., *Bull. Mens. Soc. Linn. Lyon.* 61 (10) (1992) 353-358.
16. Chavanon G., *L'Entomologiste.*, 49 (5) (1994) 63-77.
17. Chavanon G., PhD thesis, Université Mohammed I^{ier}, Oujda, (1994) 129.
18. Chavanon G., Rahhou I., Chavanon L., *Bull. Mens. Soc. Linn. Lyon.*, 64 (4) (1995) 188-192.
19. Chavanon G., Mahboub M., *L'Entomologiste*., 54 (3) (1998) 119-127.
20. Mahboub M., D. E. S., Université Mohammed I^{ier}, Oujda, (1998) 236.
21. Maachi M., PhD thesis, Faculté des Sciences, Rabat, (1985) 137.
22. Agtay F., Bigot L., *Sciences de l'Eau*., 6 (3) (1987) 311-318.
23. Maachi M., Radouani M., *Ecol Mediterr*., 19 (1/2) (1993) 29-38.
24. Zitouni N., Chavanon G., *Ecol Mediterr.*, 22 (1/2) (1996) 63-75.
25. Zitouni N., Chavanon G., *Mésogée,* 61 (2005) 79-85.
26. Zitouni N., PhD thesis, Université Mohamed Premier Oujda. (2003) 130.
27. Mabrouki Y., Taybi A.F., Bensaad H., Berrahou A., *J. Mater. Environ. Sci.*, 7 (1) (2016) 231-243.
28. Mabrouki Y., Taybi A.F., Chavanon G., Vinçon G., Berrahou A., *J. Mater. Environ. Sci.*, 7 (6) (2016) 2178-2193.
29. Mabrouki Y., Taybi A.F., Berrahou A., *RSE.*, 30-1 (2017). (in press).
30. Taybi A.F., PhD thesis, Université Mohamed premier, Oujda Morocco. (2016) 270.
31. Taybi A.F., Mabrouki Y., Berrahou A., Chaabane K., *J. Mater. Environ. Sci.*, 7 (1) (2016) 272-284.
32. Taybi A.F., Mabrouki Y., Berrahou A., Peris-Felipo F.J., Chaabane K., *J. Mater. Environ. Sci.*, 7 (7) (2016) 2445-2452.
33. Chavanon G., Daoudi L., Labrique H., *Bull Soc Entomol Mulhouse.*, 71 (2) (2015) 23-32.
34. Kocher L., *Bull. Inst. Sci, Rabat.*, (1956 to 1959) 11.
35. Kocher L., *Bull. Inst. Sci, de Rabat.*, 34 (1969) 117- 127.
36. Alluaud C., *L'Entomologiste*., 3 (1947) 72-76.
37. Alquier C., PhD thesis, Université d'Aix-Marseille III, (1974) 143.
38. Foucart T., *Rev Stat Appl.*, 31 (1983) 61-75.
39. Verneaux J., PhD thesis, Besançon, (1973) 257.
40. Dakki M., PhD thesis. Rabat. (1986) 181.
41. Dakki M., *Bull. Inst. Sci, de Rabat*., 42 (1987). 1-99.
42. Sánchez-Ortega A., Tierno de Figueroa J.M., *Mitt. Schweiz. Entomol. Ges.*, 69 (1996) 77–94
43. El Alami M., PhD thesis. Université Abdelmalek Essaadi, Tétouan. (2002) 240.
44. Taybi A.F., Mabrouki Y., Ghamizi M., Berrahou A., *J. Mater. Environ. Sci.* 8 (4) (2017) 1401-1416.

(2017) , http://www.jmaterenvironsci.com

Appendix: Matrix of data reordered according to the F1 axis of the AFC

Riparian Coleoptera

		Code	juin-14	mai-14	juil-14	nov-14	avr-14	sept-14	août-14	janv-14	févr-14	oct-14	déc-14	févr-15	mars-15	mars-14	janv-15
Tachys (Paratachys) bistriatus Duftschmid, 1812	1	E28	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acupalpus (Acupalpus) maculatus Schaum, 1860	2	E24	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Philonthus (Philonthus) sp. (pr. caerulescens Lacordaire, 1835)	3	E22	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Stenolophus (Egadroma) marginatus Dejean, 1829	4	E25	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
Bledius tricornis Herbst, 1784	5	E21	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-
Microlestes corticalis Dufour, 1820	6	E17	-	3	-	-	2	-	-	-	-	-	-	-	-	-	-
Philonthus (Philonthus) alcyoneus devillei Chapmann, 1932	7	E20	2	4	1	-	20	1	1	-	-	-	-	-	-	-	-
Dyschiriodes (Paradyschirius) parallelus ruficornis Putzeys, 1846	8	E13	-	6	-	-	1	1	-	-	-	-	-	-	-	-	-
Leichenum pulchellum pulchellum Lucas, 1846	9	E19	6	14	28	-	2	-	67	-	-	7	1	-	-	-	-
Dyschiriodes (Dyschiriodes) angusticollis Putzeys, 1866	10	E11	7	1	6	2	5	2	14	-	-	2	-	1	-	-	-
Bembidion (Ocydromus) atlanticum megaspilum Walker, 1871	11	E16	4	7	1	3	1	-	-	-	-	3	1	1	-	-	-
Ischnopoda sp. (pr. umbratica Erichson, 1839)	12	E34	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Tachyusa balteata Erichson, 1840	13	E30	-	-	21	12	-	-	3	-	-	-	-	-	-	-	-
Bembidion (Peryphus) hummleri hummleri Müller, 1918	14	E23	2	5	3	-	-	-	1	-	-	-	-	-	1	-	1
Tachyusa sp. (pr. constricta Erichson, 1837)	15	E31	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-
Gauropterus fulgidus fulgidus Fabricius, 1787	16	E29	-	-	1	-	-	3	1	-	-	-	-	-	-	-	-
Bembidion (Euperyphus) fluviatile unctulum Antoine, 1941	17	E6	-	4	1	3	3	-	-	-	2	1	1	-	-	-	-
Apristus striatipennis Lucas, 1846	18	E3	10	3	21	-	20	7	11	6	3	1	-	-	5	3	-
Bembidion (Emphanes) latiplaga flavibase De Monte, 1956	19	E15	-	3	1	1	3	5	3	-	-	4	-	1	2	-	-
Tachyura (Sphaerotachys) hoemorrhoidalis Ponza, 1805	20	E14	-	1	24	-	2	-	4	-	-	-	-	-	-	-	1
Bembidion (Euperyphus) ripicola Dufour, 1820	21	E2	13	38	21	18	12	19	19	1	3	43	1	3	18	7	3
Dyschiriodes (Dyschiriodes) clypeatus Putzeys, 1866	22	E12	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-
Bembidion (Notaphus) varium Olivier, 1795	23	E33	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-
Tachyura (Tachyura) bisbimaculata Chevrolat, 1860	24	E1	5	6	14	-	-	13	8	1	1	2	5	3	12	1	3
Bembidion (Peryphus) subflavescens Antoine, 1944	25	E8	-	4	33	2	1	7	6	-	-	2	1	1	-	3	1
Perileptus areolatus dissidens Alluaud, 1932	26	E5	-	5	1	-	3	1	5	-	1	-	2	1	3	2	1
Lionychus albonotatus Dejean, 1825	27	E18	-	-	7	-	1	-	1	-	-	1	1	-	4	-	1
Bembidion (Bembidionetolitzkya) coeruleum Audinet-Serville, 1821	28	E35	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Tachyura (Tachyura) curvimana Wollaston, 1854	29	E32	-	-	7	-	-	-	7	-	-	-	-	1	1	-	3
Lophyra (Lophyra) flexuosa Fabricius, 1787	30	E7	-	-	-	2	-	-	1	-	-	1	-	1	-	1	1
Dyschirius beludscha ganglbaueri Znojko, 1927	31	E10	-	-	-	-	1	-	-	-	-	5	-	-	-	-	1
Tachyura (Sphaerotachys) lucasi Jacquelin du Val, 1852	32	E36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Anthicidae		E4	11	3	11	-	4	1	19	6	2	39	18	1	-	3	4
Heteroceridae		E9	-	-	4	2	15	16	-	-	-	22	-	13	-	1	3
Heteroceridae (petit)		E26	-	10	-	-	-	-	1	-	-	-	-	-	1	-	-
Heteroceridae (grand)		E27	-	2	-	-	-	-	8	-	-	-	-	-	12	-	-

	juin-14	mai-14	juil-14	nov-14	avr-14	sept-14	août-14	janv-14	févr-14	oct-14	déc-14	févr-15	mars-15	mars-14	janv-15
Abondance	65	125	211	48	97	77	182	14	12	135	32	27	59	21	25
Richness	12	22	22	11	18	13	20	4	6	16	10	11	10	8	13
Average monthly temperature in ° C	19.81	17	25.18	9.56	15	19.45	23.95	3	5	14.59	4.39	4.56	7.57	7.5	2.06
Precipitation in mm	4	37	7	104	9	28	0	21	0	0	5	53	2	5	0