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First note on the phenology for the Diptera, Trichoptera, Odonates, Heteroptera and Hydracariens of three sources in the Middle Atlas (Morocco).

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ABSTRACT

A phenological and ecological study on five groups of Macroinvertebrates (Diptera, Trichoptera, Odonates and Hydracariens) has been undertaken in three sources in the Middle Atlas (Ain Regrag, Sidi Bouali and Tataw). The systematic analysis of the samples allowed listing a total of 11 taxa. Fauna inventory is essentially dominated by Dipterans (34%), the Heteroptera (25%), the Odonates (17%), the Hydracariens (17%) and the Trichoptera (8%). The phenology of the species depends on several abiotic factors of the environment, (Temperature, electrical conductivity, dissolved oxygen, organic matter, speed of the current...), the factor "season" plays a role in structuring of species that confined the Tataw source.

Keywords: macroinvertebrates, phenology, ecology, sources, Middle Atlas.

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INTRODUCTION

Before the beginning of the eighties, wetlands in the Middle Atlas (Morocco) were among the environmental community the least known of the Morocco. Their benthic fauna, in particular, attracted few zoologists and remained largely unknown. The work of [1] was a real turn in the biodiversity of wetlands on Moroccan history. These test of General typology of the Moroccan continental waters have revealed an amazing diversity, also by abiotic characteristics that the biological components. After this first revolution in the history of Moroccan macrobenthic investigations, several publications have seen the days [2-3-4-5-6-7-8-9-10-11-12-13-14], contributed fully to the development of the biodiversity of wetlands of Morocco in general and the Middle Atlas in particular. But up to date no work has addressed the phenology of wildlife Benthic in the Middle Atlas apart from some work who are dedicated to the studies of the *gammarus* biological cycles [15, 16], yet the phenological monitoring is a key element in any ecological approach, it tells us about the appearance of larvae and adult forms of the benthic macrofauna. The abnormally twisted appearance of phenological events is a biotic index to changes in various factors (interaction inter / intraspecific, fertility...) or abiotic (speed of current, temperature of the water, other physical and chemical factors of the environment...). This study is a first note on the phenology of five macrobenthic groups (Diptera, Odonates, Trichoptera, Odonates, and Hydracariens) colonizing the sources in the Middle Atlas. For this reason, we opted for three great source of the top Sebou (Middle Atlas, Morocco) with of the organic components (e.g.: vegetation), physical (e.g.: Temperature, nature of the substrate, flow) and chemical (e.g.: Ca^{2+} , Mg^{2+} ...) different.

MATERIAL AND METHODS

Study sites

Located in the North Centre - the Morocco and at the foot of the Pre-Rif, the Fez - Boulemane Region which part the main resorts, extends over an area of 20 318 km², the relief of the region consists essentially of the hills at the foot of the Rif ranging in altitude from 400 m and 500 m, mountains of MY with a highlight of 2796 m to Tichoukt high the Missouri (700 m to 1200 m) hills and Plains of Sais (400 m to 700 m above sea level). As he was quoted before, the diversity of forms of relief in the region corresponds different bioclimatic floors. Thus, the region is characterized by a continental climate in its northern part (cold and dry winter and hot summer). the average rainfall is 450 mm; wet and cold in the mountainous areas of the centre and the average precipitation exceeds 600 mm, and semi desert South where the average rainfall does not exceed the cap of 250 mm (Figure 1) in the Highlands of the province of Boulemane.

Ain Tataw

Located in the eastern part of the Middle Atlas, the mother source waters (flow 430 l/s), as well as those of the secondary resurgences that are scattered on a surface of about 700 m² flowing to the Oued Sebou and regulate, so its flow regime. These waters are a source of drinking water and irrigation, It is also a unique source since it hosts exclusively a freshwater crustacean *Gammarus marmouchensis* that is nowhere in the Morocco apart from this emergence.

Ain Regrag

It is part of the hydrogeological unit of the Causse way Atlasique. She deaf aquifer material of the corridor Fez-Taza, the main value of this exsurgence (AR), lies in its particularity, permanent running water high volume 305 l/s despite; Ain Regrag is not just a jealously preserved by local communities throughout its history, water resource, it is also a real resort with its Lake and its flat shores covered with shaved vegetation (grass) which makes a particular type of source of fresh water in North African Mountain

Ain sidi Bouali

Located in the middle of an olive grove, at 18 km from the town of Sefrou, the main sources and its resurgence are completely natural, like in Ain Regrag, Sidi Bouali source is located within the liasiques touches

thanks to its spiritual value and up to the last years the source was not plundered by the activity anthropogenic, the neighbouring population sought rather to preserve.

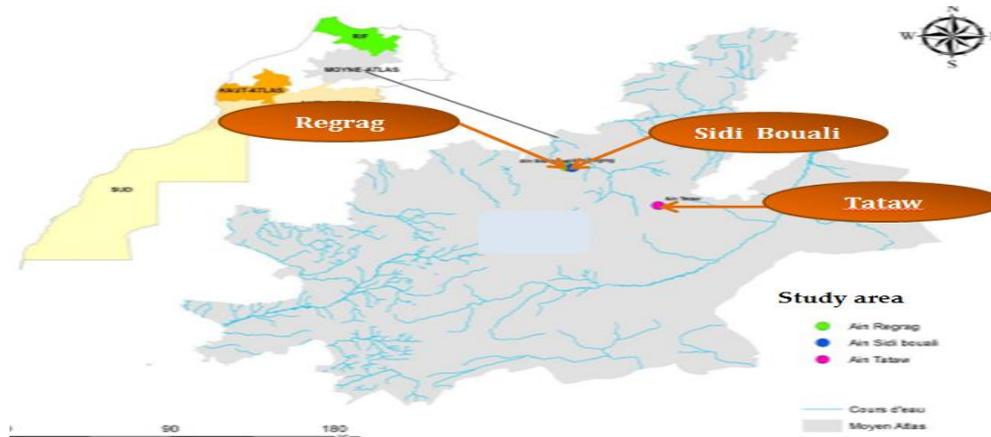


Figure1: Location of the three study sites

Sampling of benthic macrofauna

The objective of our work was all at once to describe the benthic communities of the Middle Atlas Moroccan sources as well as their phenology and subsequently their response to biotic and abiotic of the workplace disruption. This has led us to define a plan and coherent and consistent sampling methods, allowing the comparison of data in space and in time.

Sampling

Sampling is crucial, since all the steps that follow and lead eventually to a conclusion on the assessment and determination of knowledge are based on reliability and representativeness of the samples collected. For a general sample, we opted for a net surber with a width of mesh 400µm. Tests are done primarily at the level of the substrates most biogenic present at the level of the station and in the speed range or they are the most represented.

Additional sampling methods

In order to collect, the maximum of Macroinvertebrates colonizing the site, we should spend 30 to 40 minutes on the rocky beaches to return stones and search for invertebrates. It loosened stones with Tongs agencies and keep them in a vial or jar.

Sorting and identification

Samples sorting is done using the loupe by observation of successive portions, spread out in a glass dish. In our work and view the magnitude of the desired results, we have aimed the genera and species, as taxonomic reach units. To the family level, we have referred to the key [17]. But given the complexity of the taxonomic levels, the identification has proved a case of specialists of different universities. Our employees are thanked for their contributions.

RESULTS AND DISCUSSION

Limnetic Inventory of three stations to study

The counting of the data collected refers to 1053 specimen captured along the companion of picking during twelve months of sampling at a monthly frequency (table 1). A good taxonomic richness is synonymous with good health of the environment and the AR station which culminates in biodiversity with 11 species; the order of Diptera is the most represented with 4 species (*Simulium Pseudoquinum*, *Simulium ornatum*,

Simulium sergenti, *Simulium costatum*), follow-up of the Heteroptera with 3 kinds (*Gerris* sp, *Nepa* sp, *Aquarius* sp) et en queue de file les odonates, les Hydracariens et les Trichoptères.

Table 1: List fauna of the three research stations

	Tataw	Ain Regrag	Sidi Bouali
Simulium Pseudoquinum	71	93	126
Simulium ornatum	62	6	9
Simulium sergenti	4	9	1
Simulium costatum	0	10	18
Calopterix hemoroidalis	17	19	27
Calopterix splendens	9	4	5
Agapitus incertilus	422	0	0
Gerris sp	24	6	10
Nepa sp	0	3	0
Aquarius sp	0	13	16
Hydrachnidia sp	18	26	12
Piona uncata	10	3	0

Phenology of benthic groups

Arthropods /insectes (Diptera)

This class is represented by a single family of the simuliidae. The development of all the preimaginal stages of the simuliid held in running water. Eggs are usually stuck in sticky clumps on immersed media (herbs, roots, leaves, branches, stones, rocks, etc.). The duration of incubation varies by species and for the same species, with the temperature. The larvae are mobile but live on substrates immersed by their posterior Crown of hooks [18].

Simulium pseudoquinum

A species that is part of the fauna of the rivers of the Mediterranean up to an altitude of 1,000 metres. It is found in permanent or temporary streams. The anthropophilie of the females is questionable [19-20]. This taxon is widely distributed throughout the Palearctic region. The South of Great Britain, the Morocco and the Canary Islands are its western limit around the Mediterranean. In Morocco, this species is common and well represented in most of the streams of the country [21]. The monthly quantitative count of this small inhabitant of freshwater, tells us in the first place with its line of ubiquitous character given its permanent presence in three stations study, ongoing and overlapping populations throughout the year and finally a greater abundance of this species in source Sidi Bouali at may 2013 months (Figure2).

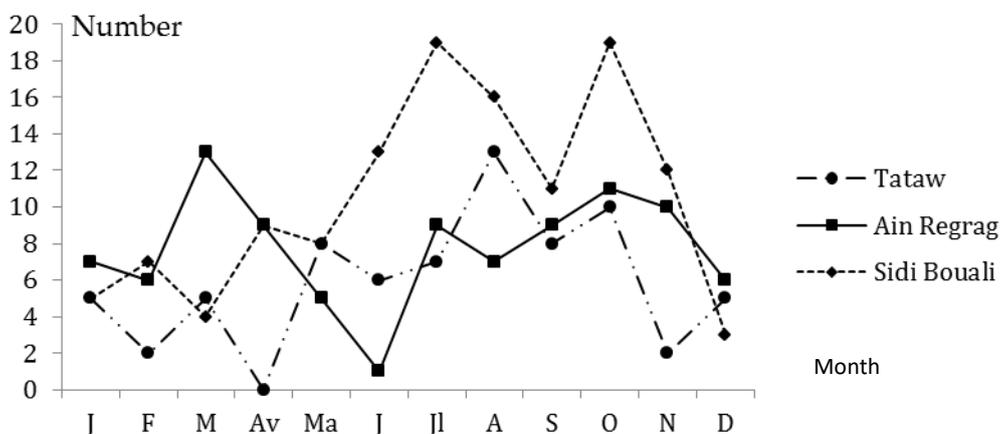


Figure 2: Temporal Evolution of *Simulium pseudoquinum*

Simulium ornatum

A species that has a very large Palearctic distribution. Also known as "Black fly", it can cause a serious nuisance to humans and domestic animals. Its importance is more pronounced because of its ability to serve as vectors of several agents of very serious diseases. bites are painful and can cause serious problems through the skin [22]. It is very common in Europe, but much less common in Africa [21]. In Morocco, it was harvested in rivers of the gir wadis Ouara, Moulay bitch and Ouad Laou [21]. *Simulium ornatum* which is occasionally at Ain Regrag and Sidi Bouali, three generations per year in source Tataw. The pupation of the first, during the overwintering generation takes place from March to April. The second generation begins in June and ends in July; the third generation in the month of October (Figure3).

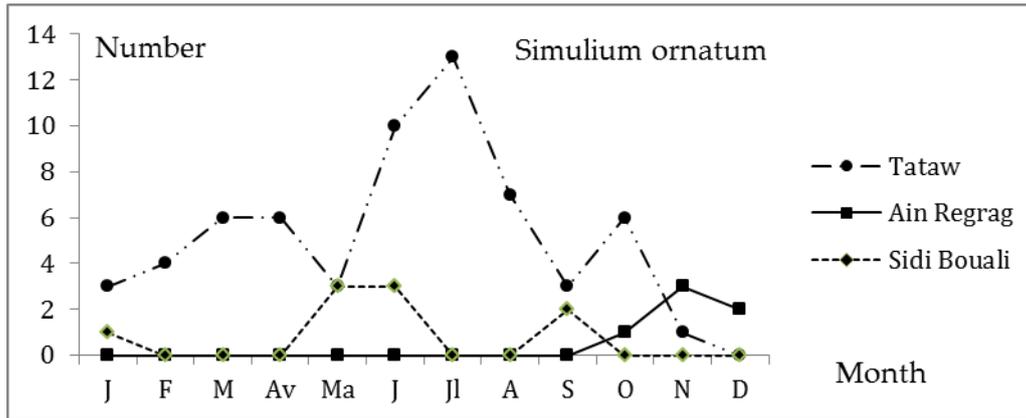


Figure 3: Temporal Evolution of *Simulium ornatum*

Simulium sergenti

The second representative of the subgenus *Wilhelmia* to the Morocco, it has a distribution ibero-Maghreb [23-24-25 -26-27]. Its northern border lies in the Portugal and Spain [28]. In the Central and southern Morocco, the taxon occupies a wide range of altitude, since the level of the sea up to 1630 m altitude [29-30]. In the Rif, it goes back beyond 341 m in stations of the Laou. This mountain species to small number of filaments (4), was harvested in different stations of studies, it is true that collected maximum was recorded during the sampling of the month of April 2013 at Ain Regrag (3 individuals), but it is a presence that remains still meaningful for a species considered rare in Morocco [31] (figure 4).

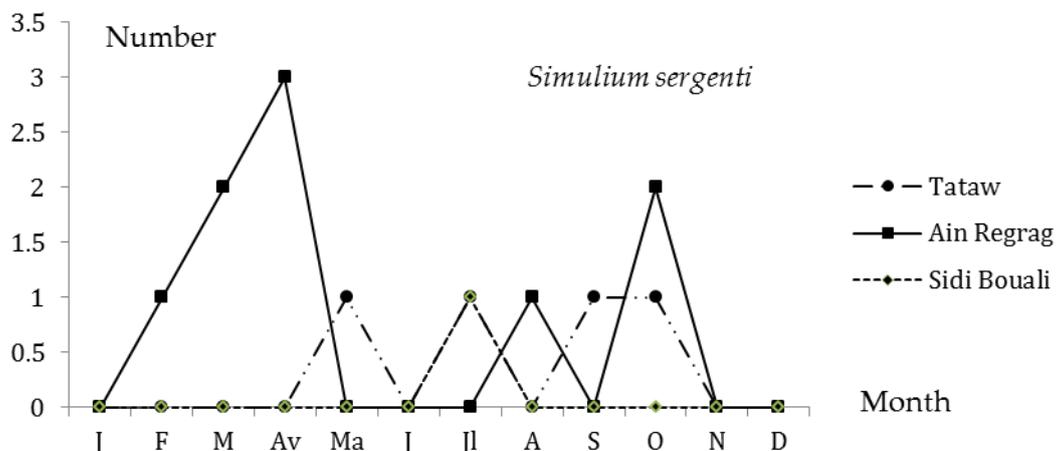


Figure 4: Temporal Evolution of *Simulium sergenti*

Simulium costatum

This taxon has a wide distribution of Palearctic [32]. In Morocco, the species has been collected in the High Atlas and the Rif [21-33-34]. In the MA, the species occurs at medium altitudes mountains such as Ain Regrag and Sidi Bouali and absent from Ain Tataw, located at 1700 m altitude. The presence of *Simulium costatum* in both sources is intermittent, the maximum is reached during the month of October 2013 in Sidi Bouali (Figure 5).

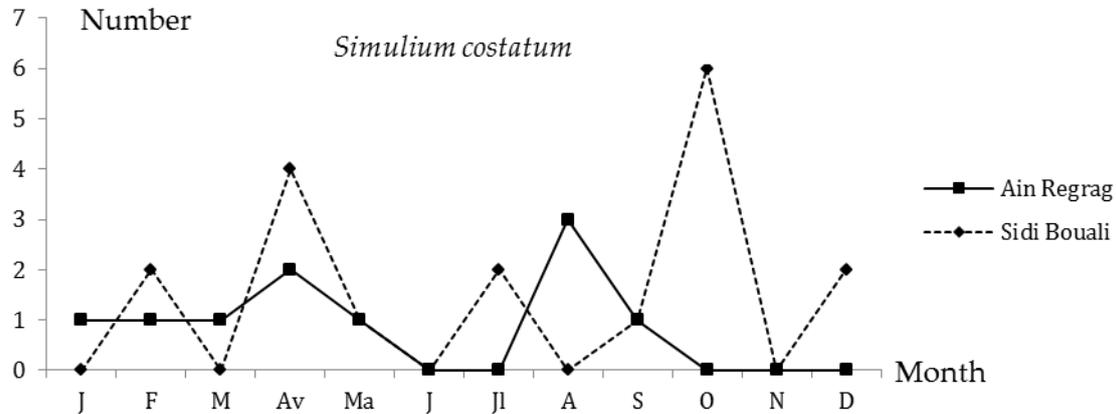


Figure 5: Temporal Evolution of *Simulium costatum*

Arthropods /Insectes (Odonates)

Calopteryx haemorrhoidalis

It is an endemic species of the Mediterranean West is common on the waterways of South-Western Europe, of the Islands (Balearic Islands, Corsica, Sardinia, Sicily), the Morocco, North of the Algeria and Northern of the Tunisia [35]. The larvae of this small Dragonfly home the three stations of studies all with numbers that fluctuate between 1 and 5 individuals by sampling their maximum recorded in may 2013 with a collection of 8 individuals. (Figure 6).

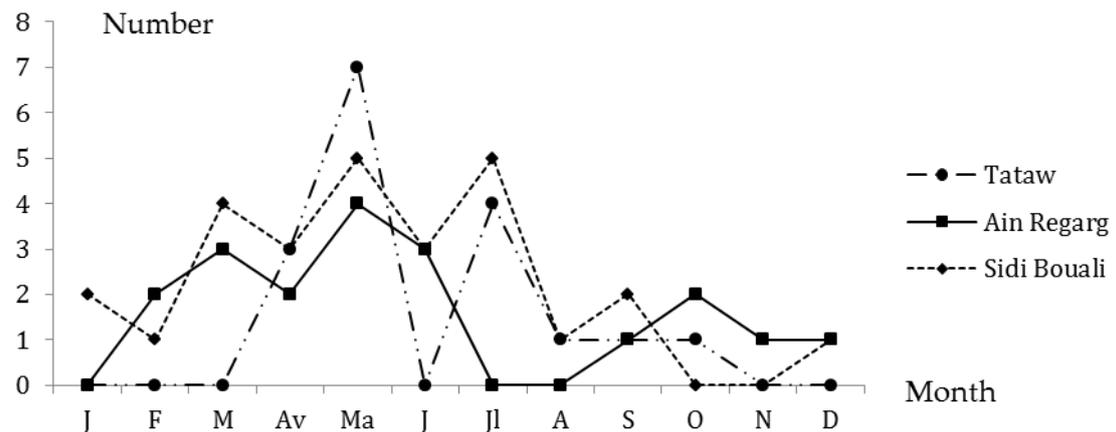


Figure 6: Temporal Evolution of *Calopteryx haemorrhoidalis*

Calopteryx splendens

This species that originated in Eurasia, colonizes all Europe except Iberian Peninsula [36], To the Morocco (she has been found in several regions of the Eastern Morocco and the Rif [37], During our surveys

we have harvested it in three emergences discontinuous presence and numbers very weak not exceeding 2 individuals per collection (Figure 7).

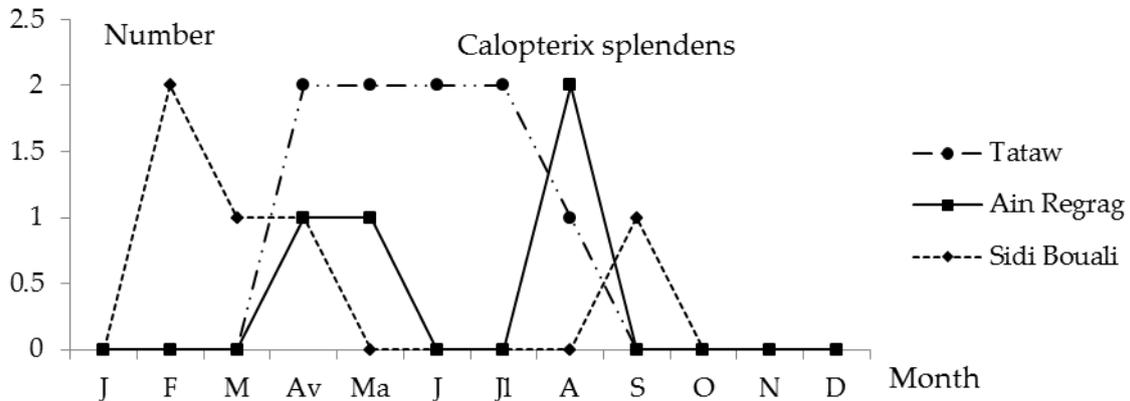


Figure 7: Temporal Evolution of *Calopterix splendens*

Arthropods /insectes (Heteroptera)

The Heteroptera are one of the orders of insects to have done better "return to aquatic life" since about about 10% of the known species are aquatic. The vast majority of these are unmodified. Mainly confined to stagnant water (but there are freshwater species), the Heteroptera have exploited all the possibilities offered by Lake, ponds and pools.

***Nepa* sp**

This small insect commonly called the Bedbug scorpion, in reference to the shape of its front legs. Adapted to aquatic life, he is known by his piercing-sucking snout and her skating on the surface of the waters [38], is very occasionally in the source Tataw while that two other sources have not had the chance to host this tiny visitor to the terrestrial ancestors.

***Gerris* sp**

The *Gerris* has a narrow body covered by two pairs of wings. The first leg is abductor, the other two as long as the body are willing in X and used for propulsion. It feeds essentially insects fell into the water and dead bodies, its bite is painful, the *Gerris* are of excellent "bioindicators", their way of life making them particularly sensitive to pollution [39], according to our surveys, it is a ubiquitous species located in the three stations to study despite the abiotic differences in their environments (Figure 8).

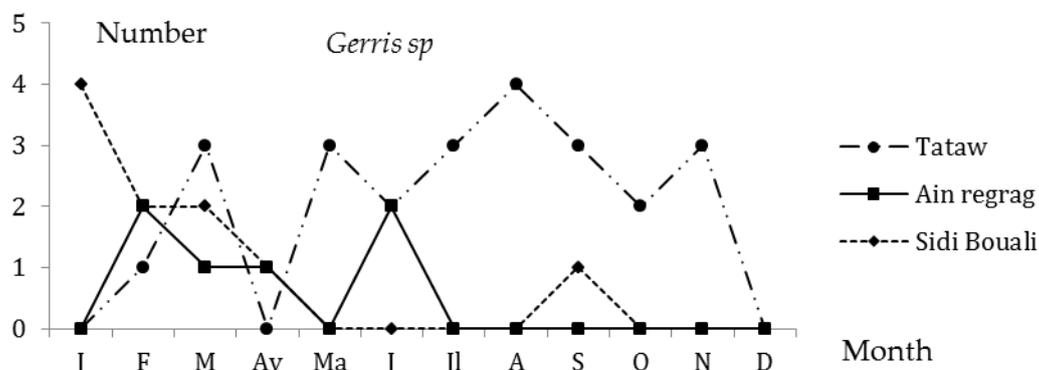


Figure 8: Temporal Evolution of *Gerris* sp.

Aquarius sp

Commonly called "water spider", it is not an arachnid, but a water bug. The *Aquarius* is distinguished from the *Gerris* kind by the absence of wings that reveals his abdomen to checkerboard designs [40] Also, unlike *Gerris*, *Aquarius* is found only in the two sources of Ain Regrag and Sidi Bouali, the source Tataw crops did not reveal his presence the collected maximum is 5 individuals in the Ain Regrag emergence in may 2013 (Figure 9).

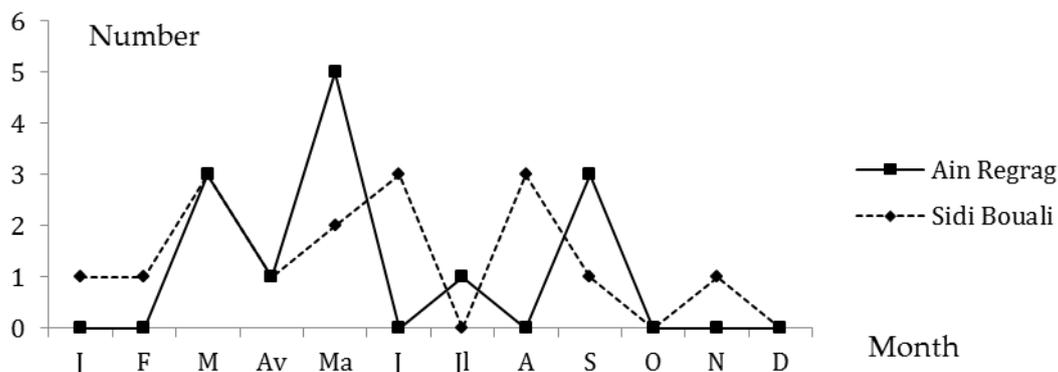


Figure 9: Temporal Evolution of *Aquarius* sp.

Arthropodes /Arachnides

The Hydracariens have an essential characteristic: they are associated with (according to different degrees of dependency) an invertebrate host, with more or less strict requirements. Mite-host relationships are varied: the host may be parasitized, prey or means of transport. In the latter case, the phase phoretique is a prerequisite for the completion of the cycle.

Hydrachnidia sp

This taxon is in the three studied emergences, with a clear preference for Ain Regrag but remains all the same a little reluctant for a good proliferation, as harvested numbers do not exceed 6 individuals per sample (Figure 10). Yet it is the most numerous and the most present aquatic mites group [41].

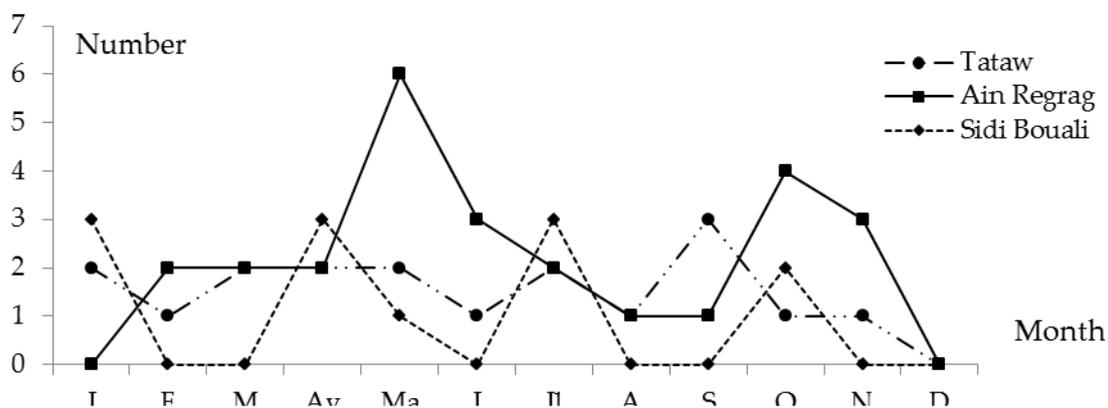


Figure 10: Temporal Evolution of *Hydrachnia* sp.

Piona uncata

This species has been collected sporadically in the calm waters of the borders of the source Tataw, during the summer season, this species lacks in Ain Regrag and Sidi Bouali (figure 11) sources. This absence

seems linked to the diet of this freshwater spider, in fact, the larvae of the Hydracariens live set in parasite on an insect [42], this leads us to think that it is their host who not confined to study stations and so subsequently the parasite disappears [42].

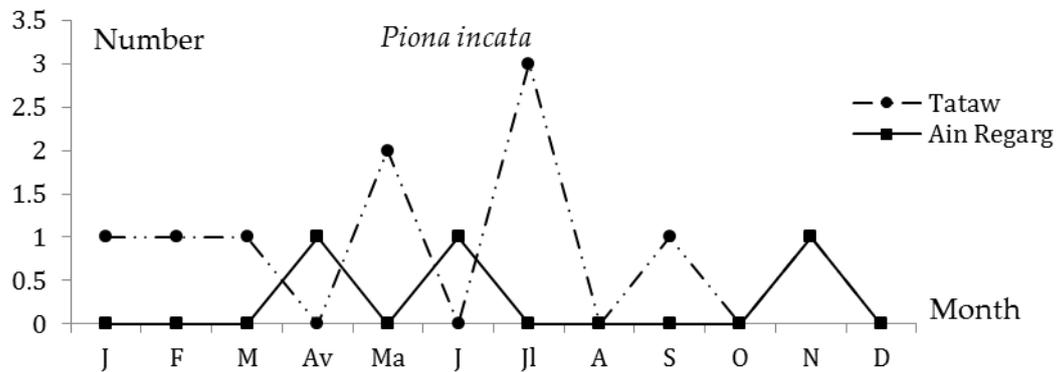


Figure 11: Temporal evolution of *Piona uncata* .

Arthropods /insectes (Trichoptera)

Agapitus incertilus

According to a study conducted by [5], *Agapitus incertilus* live streams of medium and low altitude, with a strong preference for the small stream of source, where the temperatures are consistently above 14°C. Data that differ slightly from this we noticed during our companions of sampling, the species found exclusively in the source Tataw 1700 m altitude and temperature and always less than 12 ° c, while it is completely absent sources Ain Regrag and sidi Bouali, where the average temperature hovers around 18 °C it may that the Ca²⁺ concentration parameter would be a limiting factor for this species (Figure 12).

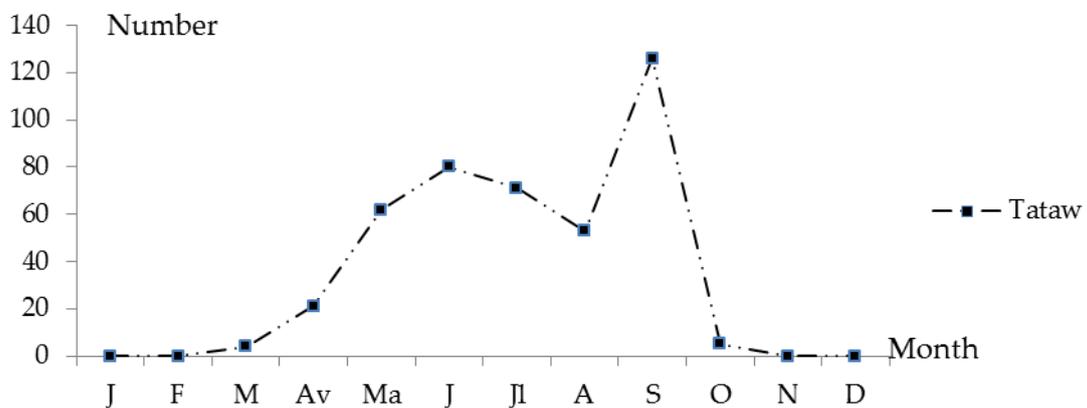


Figure 12: Temporal Evolution of *Agapitus incertilus*

CONCLUSION

This work is devoted to study phenological and ecological of five orders : Diptera, Hetroptera, Trichoptera, Odonates and Hydracariens, taxonomic groups whose biological rhythms were not investigated in the wetlands of the Middle Atlas and more especially sources, Yet with a heritage significance in the bio-indication, and a perspective of bio-monitoring, these orders fauna deserve attention particulate and should be the object of several work investigating their ecology. This study revealed the presence of a relatively rich fauna and diversified, we have noted the presence of 11 species are all common in the Middle Atlas. It should be noted that the seasonal alternations are structuring in the phenology of the species studied, It also depend on abiotic factors of the environment (Temperature, electrical conductivity, dissolved oxygen, organic matter,

speed of the current...), also it should be noted that Diptera are the dominant group and the most ubiquitous of all investigated orders.

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