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Changes in benthic communities in the Middle Atlas springs (Morocco) and their relationship with climate change

Imane Nechad*[1] , Fatima Fadil[1], Mohamed Dakki[2]

[1]*Laboratory of Functional Ecology and Environment, Sciences and Technologies Faculty (Univ. Sidi Mohammed Ben Abdellah), Fèz, Morocco.*

[2]*Scientific Institute Univ. Mohammed V, Av. Ibn Battota, Rabat, Morocco*

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Abstract

The sources of the Moroccan Middle Atlas suffer not only the effects of anthropogenic pressures, but also those of climate change whose impact is difficult to predict. Our goal is to better understand the succession of processions fauna of the upper Guigou. It is a compendium comparative between the benthic fauna collected towards the end of the years 70 (1979) in the sources Arbalou Abrchane, Tit Zil and the Wadi Guigou. As well as those harvested in the same sites, thirty-four years after. This revealed a significant drop in dissolved oxygen concentration decreased from 7.4 (mg/l) in 1979 to 2.52 (mg/l) in 2015. We have also raised an increase in the workload in chlorides and major elements. Benthic fauna, a significant change in population since 1979, with the appearance and installation of more than a dozen of taxa were identified (*Simulium pseudoquinum, Gammarus gauthieri, Phagocata* sp., *Dugesia gonocephala*). Some of these species have become invasive, such as Amphipod crustaceans *Gammarus gauthieri*, either very abundant as *Simulium pseudoquinum*. We note the effect "medium" for the direct selection of the species. Other indirect effects due to the reduction of the three dimensional biogenic structures would have limited recognizably State niches by polluo-sensitive species (Ephemeroptera, Heteroptera, Coleoptera and Trichoptera) and could contribute to the total disappearance of all order plecoptera in favour of a dominance of the polluo-tolerant species (Oligochaetes). Over a period of 35 years, there is a deterioration of the health of aquatic ecosystem studied, a State of art reflected by a decline of the benthic community that lives there.

***Corresponding Author:** Imane Nechad ✉ imanenechad5@hotmail.com

Introduction

It is now accepted that changes in hydrological functioning is related to climate change could significantly affect biodiversity and the functioning of wetlands (Changwon 2008).

In the Middle Atlas region which shelts the most important water supply of the Morocco, water sources are undergoing the effects of climate change, will suffer the stress caused by other changes related to human pressure. However, like the whole of the Maghreb (Rhazi *et al.,* 2006), they are threatened and are sometimes irreversible disruptions. Given these variables and the limits imposed by uncertainties on climate models, especially regarding future changes in precipitation patterns. It is difficult to predict the effects of climate change and human activities on these limnic ecosystems, at the regional and local level. In terms of precautionary management, taking into account past trends is fundamental and likely to document the future trajectories. Have a repository in the long term allows us to have references to anticipate the future (Muller and al., 2012). During our investigations in three stations of study we have confirmed the results of dozens of subsequent work (Giudicelli & Dakki, 1984; Dakki, 1987; Petit & Erpicum 1987, Ghamizi1998, El Alami & Dakki, 1998; Fadil & Dakki. 2001, 2003, 2006, 2009, Nechad *et al.,* 2014; Maqboul *et al.,* 2015 Nechad *et al.,* 2016[a], 2016[b] and 2016[c]), claiming that sources are specific ecosystems capable of sheltering benthic communities abundant and diverse, high productivity, since primary producers, until the upper predator through the meiofauna and macrofauna.

A comprehensive reading of the scientific literature revealed that no work has been undertaken on the hydroecological monitoring long-term sources of the Middle Atlas. Yet, changes in the populations of fish and macro-invertebrates are found everywhere in relation to the effects of climate change and anthropogenic activities (Fayolle-Sanna *et al.,* 2012; Khalanski *et al.,* 2008). In this study, we opened a window on the upstream stations of the Middle Atlas Guigou Wadi in the goal, to analyze and to compare the dynamics of benthic fauna.

The goal is to highlight qualitative and quantitative species changes and the appearance of species considered as invasive. On the request of the Scientific Institute of Rabat, we have begun a pilot project, the first of its kind in the sources of the Middle Atlas. It is in fact, a comparative study between the benthic fauna collected towards the end of the years 70 (1979) in sources Arbalou Abrchane (AA), Tit Zil (TZ) and the Wadi Guigou (O.Gui.) at the level of the bridge Guigou and those harvested in the same sites, thirty-four years after (2015). With a view to a more comprehensive as possible, and given that the abiotic conditions are constantly interacting with the living, we had to do a comparative study of some physical and chemical parameters of the environment on the same profile of years.

Material and methods

Study sites

This sample of stations includes a wide variety of biotopes of the crenal.

Source Aghbalou Aberchane (AA)

This resurgence (Fig. 1), about 7m wide, out of the basalts to 4m distance from the bed of the Guigou and 1m above the latter. Because of its high flow rate, it is the main source of the Guigou. It is located at 1920 m of altitude and 800m upstream of Foum Khnag and about 15km south of Timhdite. The water is cold (9 to 10°C in summer), while in the Guigou, just before the confluence of the source, the temperature reaches 25°C in August (Dakki, 1986).

Source Tit Zill

This resurgence (Fig. 1 and 2), gushes at 1571m. The total flow of the waters flowing in the Guigou would be 400-700 l/s (C.E.I.B.M., 2015). The herbaceous cover of the substrate is less important, but bryophytes are abundant on the surface of the blocks running fast, the rest is essentially Pebble gravel and sand; It is covered 70% of aquatic phanerogams.

Wadi Guigou to the bridge of Hamza

Located at an altitude of 1520m, the Wadi Guigou borders the rural Guigou Boulemane province, reached 7 to 11m width.

The current, lively upstream of the bridge, becomes low downstream. The substrate, formed mainly of pebbles, gravels and Sands with equal importance, covers a well-developed Herbarium and algae.

Sampling of the macro invertebrate benthic

Schedule of sampling

In a perspective of temporal comparative analysis over a period of 35 years, we opted for 3 stations representing the course of the Wadi Guigou for the what, we carried out samples during the spring months of March and may during the two years of 2014 and 2015. For this kind of comparative study we felt it was best to collect samples, just after the spring thaw, when the last larval forms are present, but have yet to undertake their final maturation in order to have a more precise idea on the benthic settlement of these stations.

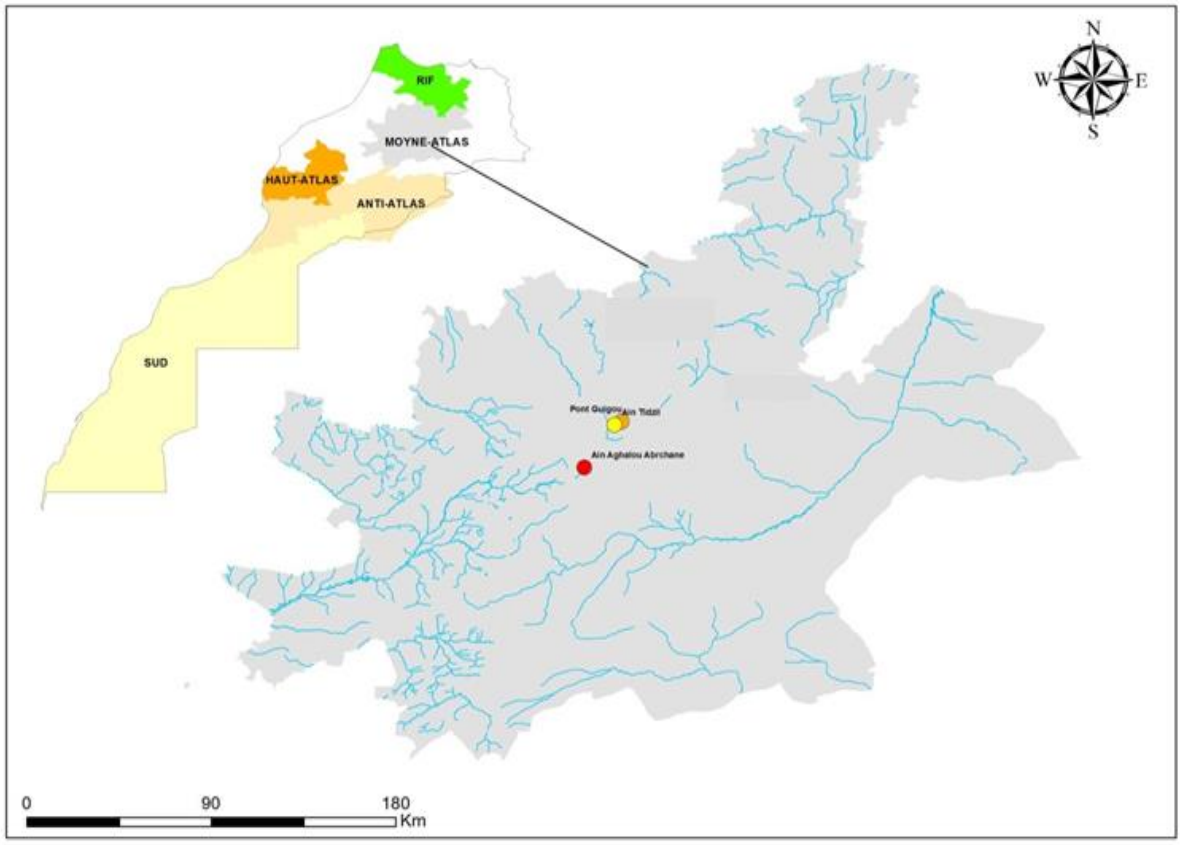

Fig. 1 . Geographical situation of the stations of studies.

Table 1. Abiotic of the study sites and map parameters.

	Guigou Bridge	Tit Zil	Aghalou Abrchane
Province	Boulemane	Boulemane	Ifrane
Commune	Guigou	Guigou	Timhdite
Longitude	-4,895	-4,925	-5,057
Latitude	33.348	33,333	33,149
Altitude (m)	1520m	1571m	1920m
Annual precipitation (mm)	412.89	412.89	484.4
Thermal gap (M-m)	43.3	43.3	31.6
The current speed (cm/s)	63	78	85
Flow type	fast	fast	fast
Dominant vegetation cover	Cryptogammes	Filamentous algae, bryophytes	Phanérgammes
Transparency of the water	Medium	Medium	High
Granulometric composition	Silt and clay (30%)	Silt and clay (5%)	Silt and clay (5%)
	Sand (25 %)	Sand (20 %)	Sand (10 %)
	Gravel (20%)	Gravel (30%)	Gravel (15%)
	Pebble (15%)	Galet (25%)	Galet (40%)
	Block (10%)	Block (20%)	Block 30%)

Method of sampling

For a general sampling, we opted for a net surber to a width of mesh of 400µm. In order to collect, the maximum of Macroinvertebrates colonizing the site, we should spend 30-45 minutes on the rocky beaches to return stones and search for invertebrates. The collected samples are fixed in formalin at 40%, and then stored in water from the source to 10%. The sorting of samples is done using the loupe. Zoological groups are separated in the pill boxes containing 70% alcohol. The species in each group are sorted, identified, counted, and classified among functional feeding groups according to (Tachet 2006).

In addition to these biological surveys, samples of water samples for bacteriological and physicochemical analyses was made during the year of study in the same sampling places to have precisely the evolution of these parameters in local time and control their synchronism with the benthic communities of sources.

Analysis of the physical and chemical parameters of the water

Methods of analysis are those recommended by the standards (Rodier 1996). Measures of temperature, pH, and conductivity were conducted in the field using a multiparameter pH/conductivity Analyzer/temperature Cyber Scan PC10. The methods used are: the Massing for dissolved oxygen, the bicarbonates, chlorides, calcium and magnesium and the sulfates and the ortho molecular absorption spectrophotometry phosphates (Table 2).

Table 2. Parameters measured and the methods used to perform their analysis.

Parametrs	Unit	Measuring equipment and method of analysis
Temperature	°C	Analyzer multi parameters Cyber Scan
Conductivity	µS/cm	Analyzer multi parameters Cyber Scan
pH		Analyzer multi parameters Cyber Scan
Dissolved O_2	mg/l	Winklermethod
Total hardness	mg/l	EDTA Complexometry of with eriochrome black
Calcium hardness	mg/l	EDTA Complexometry of with calcone
Magnesiumhardness	mg/l	Difference between total and calcium hardness
Alkalinity	meq/l	Volumetric dosing with sulfuric acid and methyl orange
Organic matter	mg/l	Oxidizability of hot potassium permanganate
Chlorides	mg/l	Metering,withMohrmethod
Sulphates	mg/l	absorption spectrometryat 650 nm
Orthophosphates	mg/l	absorption spectrometry at 750 nm

Results and discussion

Physicochemical parameters of the medium

From a perspective of a study the most comprehensive as possible, and given that the abiotic conditions are constantly interacting with the living, we had to do a comparative study of some physical and chemical parameters of the environment on the same profile of years (35 years). Even if all factors are not equally important, these are rather complex interactions that are critical to life in running water. Species select their Habitat taking into account combinations of factors rather than isolated factors.

The "macrodistribution" of animals would, however, essentially under the dependence of the speed of the current, temperature, and concentration of ions. Table 3 is a summary table that presents all of the thermal and physicochemical measures.

Table 3. Comparison of physicochemical data on a 35-year profile.

Physicochemical parameters of the Medium	O. Gui		TZ		AA	
	1979	2015	1979	2015	1979	2015
Temperature (°C)	14,2	15.05	11.75	13.7	9.7	10.5
pH	-	7.89	-	7.33	-	7.6
Conductivity (µS/cm)	660	788	600	631.75	360	364.75
Calcium hardness (mg/l)	47,7	144.076	52.4	96.22	42.9	81.92
Magnesian hardness (mg/l)	17,3	52.27	2.9	79.05	5.8	36.92
Chlorides (mg/l)	30	52.36	30	12.51	15	7.125
Sulfates (mg/l)	37,5	56.13	25	30.08	25	17.73
Organic matter (mg/l)	12	13.4	8	1.16	1	0.811
Dissolved oxygen (mg/l)	7,4	2.52	7.9	6.56	8.6	8.31

The Wadi Guigou who is a body of water, we note that the impact of the anthropization and indeed outstanding, reflected in large part by a decrease of dissolved oxygen, this aspect is illustrated by a concentration of 7.4 (mg/l) in 1979 happening at 2.52 (mg/l) in 2015. In addition, there is an increase in the organic load of 12 (mg/l) to 13.4 (mg/l). We also report an increase in the workload in chlorides and major elements, and subsequently the electrical conductivity. The evolution of these parameters follows pace in two stations TZ and AA but less rigorous because these two sites are sources arise phreatic waters and no surface water.

Numerous settlements dotted around the sites surveyed strongly influence the quality of their waters and subsequently of the ecosystems that are completely upset. A State of place that will be confirmed the comparative study of limnetic wildlife.

Comparative study of limnetic wildlife

In his study of typology (Dakki, 1979) became interested in the distribution of Trichoptera, Ephemeroptera, Plecoptera, and beetles Elmidae. This research group has gathered in a group all species occupying the same biotope or neighbouring biotopes, but of the same "type". The results obtained during the subsequent work obtained by Pr Dakki 1979 as well as those collected during our research work thirty-five years after are illustrated in the tables of 4 to 16.

Trichoptera

Examination of the overall distribution of this order (Table 4), it turns out that minimum abundances are obtained after 35 years and a rapid deterioration of the biocenosis trichopterologique, extinction of all pre-existing taxa (*Agapetus berbericus, Hydropsyche maroccana, Psychmyia pussilla, Orthotrichia angustella, Allotrichia pallicornis, Tinodes algirica, Athrispodes taounate, Orthotrichia angustella, Micropterna nycterobia, Agapetus dolichopteros and Ithytrichia lamellaris*) for two new specimens *Agapetus incertilus* and *Beraeodos* sp. except for *Hydropsyche fezana* is still home in the three stations but with a much lower abundance. This species, unique in its kind in the Middle Atlas, people varied biotopes and has a wide altitudinal distribution (400 to 1920m). Larvae are found mainly under the rocks exposed in a strong current, but sometimes become muscicoles as in the AA source or they can achieve a density of 80 ind/m 2, it should be noted that these three studies are particularly rich in preys (Chironomidae, Oligochaetes). Regarding this new resident, and according to a study conducted by (El Alami & Dakki 1998), *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 would confirm the assumption that a change in environmental conditions would be at the origin of these biocenotiques changes at the level of the study sites.

Table 4. comparative List species of the order Trichoptera AA, TZ and O.GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Trichoptera	*Agapetus berbericus*	-	-	-	-	+	-
	Hydropsyche maroccana	-	-	-	-	+	-
	Psychmyia pussilla	-		-		+	
	Orthotrichia angustella	-	-	-	-	+	-
	Hydroptila vectis	+	-	+	-	+	-
	Allotrichia pallicornis	-	-	-	-	+	-
	Tinodes algirica	-	-	-	-	+	-
	Hydropsyche fezana	-	+	+	+	+	-
	Athrispodes taounate	-	-	+	-	+	-
	Rhyacophila munda oreina	+	-	+	-	+	-
	Orthotrichia angustella	-	-	-	-	+	-
	Micropterna nycterobia	+	-	-	-	-	-
	Agapetus dolichopteros	-	-	+	-	-	-
	Ithytrichia lamellaris	-	-	-	-	+	-
	Agapetus incertilus	-	+	-	-	-	+
	Beraeodos sp	-	-	-	+	-	-

Ephemeroptera

In the entire Guigou network, the community of Ephemeroptera consisted of 21 species, either a wealth equal to that of other water courses of the Mediterranean region which half also lived in Europe.

In the light of the results achieved five of ecological order comments:

1. Species (*Baetis rhodani, Caenis luctuosa*) *Euryeces* and fluvialtiles to trend thermophilic species, are the dominant element.
2. Disappearance of the *Ecdyonurus* sp, the *Ecdyonurus rotschildi* in favour of the *Ecdyonurus ifranensis*
3. Disappearance of the majority of the species of the station O. Guigou
4. Appearance of the species *Caenis pusilla, Ecdyonurus ifranensis, Cloeon* sp and *Procleon* sp
5. The Baetis occupy all of the contacted stations, is also the dominant sort numerically.

This rapid degradation of the ephemeropathic population prompts us to stipulate the hypothesis of a challenge by changes in the abiotic conditions of the environment.

This hypothesis is confirmed by a mass of physicochemical changes in the environment after 35 years (Table 3) And which are translated by an increase in the temperature of the Ca^{2+} content and the organic charge as well as a decrease in dissolved oxygen level.

Table 5. Comparative faunistic list of species of the order Ephemeroptera listed in AA, TZ and O.GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Ephemeroptera	*Baetis rhodani*	+	+	+	+	+	+
	Baetis alpinus	-	+	+	+	+	-
	Baetis pavidus	-	-	-	+	+	-
	Ecdyonurus sp	-	-	+	-	+	-
	Caenis luctuosa	-	+	+	+	+	+
	Ecdyonurus rotschildi	-	-	-	-	+	-
	Caenis pusilla	-	+	-	+	-	-
	Ecdyonurus ifranensis	-	+	-	+	-	+
	Heptagenia sp	+	+	+	+	+	-
	Cloeon sp	-	+	-	+	-	-
	Procleon sp	-	-	-	-	-	+

Coleoptera

Among the aquatic insects, Beetles are ideal candidates, to be used as excellent indicators of biodiversity of aquatic ecosystems, because of their great diversity specific and functional. They're exceptional indicators of environmental conditions and descriptors by excellence of space-time changes in river systems (dulcification or salinization of water, reduction of the renewal process, enrichment in organic matter, etc.) (Richoux, 1994, Moreno and *et al.,* 1997; Millán *et al.,* 2001a and b; 2002). This group occupied the entire study stations; although the number of species that made him up was relatively low (7 species), he was of great ecological interest, particularly in the zoning. The species in the genera Elmis, Limnius and Normandia showed a replacement well marked between them; Esolus and Oulimnius are represented by a single species. We note that this low diversity of settlement has been accentuated by a disappearance of this entire coleopterogeological heritage except for *Elmis maugetii* which still persists in its original refuges, besides we note the advent of a new genus *Agabus* sp. The Agabus mostly meet in Europe and in the north of Africa, some species however belong to America. Any interpretation of this state of the art would be difficult because of the significant gaps in our knowledge of the ecology of these species. But the hypothesis of a deterioration of these benthic populations following a decay of the abiotic conditions of the environment due to strong anthropization and climate change is present.

Table 6. Comparative faunistic list of beetle species listed in AA, TZ and O.GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Coleoptera	*Elmis atlantis*	+	-	+	-	+	-
	Elmis maugetii	-	-	+	+	+	+
	Oulimnius fuscipes	-	-	+	-	+	-
	Limnius opacus	-	-	-	-	+	-
	Normandia substriata	-	-	-	-	+	-
	Deroneetos fairnairee	-	-	-	-	-	+
	Agabus sp	-	+	-	+	-	-

Stoneflies

Only two species comprised wildlife plecopterologique, stations considered, according to Berthelemy (1966), « areas where the Stoneflies are most abundant in species as individuals, are located upstream of those dominated most of the other groups». Kamler (1965) showed that water with high average thermal daily, are poorer in *Plecoptera* and *Ephemeroptera* and conversely, plecoptera dominate species and density in the low average thermal waters. If we apply these findings to top Sebou, the Guigou should be the richest in stoneflies, in fact, they appeared in two stations only. It is so difficult to decide between eurythermie, absence of water deciduous trees, high salinity and pollution, to declare one of these factors as main responsible for the poverty of the Guigou in stoneflies, as 35 years after, we notice a total disappearance of this order in the stations to study (Table 7).

Table 7. Comparative faunistic list of species of the order Pleacoptera listed in AA, TZ and O.GUI in 1979 and 2015.

Ordre	Espèce	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Stoneflies	*Protonemura talboti*	+	-	-	-	-	-
	Perla marginata	-	-	-	-	+	-

Diptera

A comprehensive data analysis in 1978 reveals that the order of Diptera disappears study sites while he emerges and proliferates in the same stations 35 years after, also should be reported as four collected species, *Simulium ornatum* and *Simulium pseudoquinom* are needed in abundance in the three study sites are the most tolerant forms of clean water with a variety of ways to collect oxygen (Vivier 1986).

Table 8. Comparative faunistic list of species of the order Diptera listed at AA, TZ and O.GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Diptera	*Simulium ornatum*	-	+	-	+	-	-
	Simulium costatum	-	-	-	+	-	+
	Simulium pseudoquinom	-	+	-	+	-	+
	Simulium quadrifila	-	-	-	-	-	+

Odonates

Calopteryx heamorrhoidalis 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 (Dijkstra 2007). The larvae of this small Dragonfly home stations AA and TZ which are both niches.

In Morocco, the species is considered of very common and widespread in the country its habitat is characterized by a strong flow during part of the year, at least which is in strong correlation with obtained Collections. The species deserted the Wadi Guigou having a fable with two sources TZ and AA (Table 10) current speed. Having said that we don't have a clear idea about its ecology. To explain his absence from all the power of the Wadi Guigou towards the end of the 1970s.

Table 9. Comparative faunistic list of species of the order odonates listed at AA, TZ and O.GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Odonates	*Calopteryx heamorrhoidalis*	-	+	-	+	-	-

Gastropod mollusk

Like bivalves, gastropods depend on the presence of calcium in the water to complete their life cycle. The analysis of the composition of the malacological settlement of the three study sites proves their advent in the Limnological population after 35 years (Table 10).

Actually, it's a climb in altitude, given their past presence in the lower Guigou (Dakki M. 1979). This would mean an inconvenience to their living environment as a result of anthropogenic pollution or global warming waters or may be the two combined causes.

Table 11. Comparative faunistic list of the Ostracods species listed in AA, TZ and O.GUI in. 1 979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Ostracodes	*Cypridopsis sp*	-	+	-	+	-	-

Ostracods

Research on the Morocco Ostracods are very limited (Nachite and Al 2010), those of freshwater are little studied, although this group is present in europe by more than 200 species (El Hmaidi 2010), a lot of these micro-crustaces never did have the description or detailed taxonomic study. They are however recognised as valuable indicators of environments and palaeo environments. On a time scale of 35 years, we notice the appearance of this order represented by the kind *Cypridopsis* sp. in the two sources AA and TZ as well abiotic conditions (rich in dissolved oxygen depletion in organic matter, etc.) than biotic (important vegetation cover) quite suitable to the development of this kind. But a more detailed study of their ecology would be required to explain their absence in the end of the 1970s, despite the earlier presence of more appropriate environmental conditions.

Table 10. Comparative faunistic list of the gastropod species listed in AA, TZ and O.GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Gastropod	*F. planorbidae*	-	-	-	+	-	-
	Mélanopsis preamorsa	-	-	-	-	-	+
Bivalves	*Pisidium personatum*		-		+		-

Hydracariens

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. is a taxon that don't Fig. in the biocenosis harvested in 1978 and who people the three emergences studied during our years of study (Table 12), but is still a little reluctant for a good proliferation, as harvest numbers are not 4 individuals per sample. Yet it is the most numerous and the most present aquatic mites group (Corolla J.P *et al.,* 2012), This same conclusion is made for hydracarien *Piona uncata* but who swarm just in the two sources AA and TZ.

Amphipods

Gammaridae amphipods are common hosts of surface water; they serve as food for many fish, birds and other predators such as planarians and leeches.

Thus, they occupy an important place in the food chain, these are some interesting candidates to follow the contamination of aquatic environments through their sedentary life cycle (Geffard *et al.,* 2007, Schaller *et al.,* 1948). Each of these species of Amphipod crustaceans has a centre of geographical dispersion and specific biological requirements.

This is the case *Gammarus gauthieri* who deserted sites studies in 1978 and which has yet been subject a study detailed in its development cycle in 2009 in the AA source (Fadil F., Dakki M., 2009). This research group has shown that the sexual activity of g. gauthieri is continuous in the sources of the Middle Atlas, with a first sexual peak in August and a second one in January. The food flow and changes in photoperiod are very probably the most determinants (Fadil F., Dakki M., 2009). Our surveys have confirmed this hypothesis, (Table 13) revealing the presence of this crustacean of freshwater in the AA source, but also in the TZ source and Wadi Guigou.

Table 12. Comparative faunistic list of species of the order Hyacarians listed in AA, TZ and O. GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Hydracariens	Hydrachnidia sp		+		+		+
	Piona uncata		-		+		-

Table 13. Comparative faunistic list of Amphipod species listed in AA, TZ and O. GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Amphipods	*Gammarus gauthieri*	-	+	-	+	-	+

Achaetes

The Group of Achaetes is of great interest medical and veterinary, since they could cause mortality both among livestock and humans. However, we do not know the program, nor struggle means used officially in Morocco against the leeches (Dakki, M. and Tachet H., 1987), more so, they can be used as biological pollution indicators because they only live in a low oxygen pressure. Their sensitivity or resistance to pollution vary according to the species which makes them interesting study to assess the quality of the water, this practically absent order on all the top Guigou in 1978, deserted three stations to study while our fundraisers show his massive presence (more than 25 individuals in collection) of the two species *Glossiphonia* sp and *Helobdella* sp in Wadi Guigou 35 years after (Table 14).

It is undoubtedly an alarming signal of a deterioration of the quality of the waters of this station.

Table 14. Comparative Faunistic List of Achaean species listed at AA, TZ and O. GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Achaetes	*Glossiphonia* sp	-	-	-	-	-	+
	Helobdella sp	-	-	-	-	-	+

Turbellaria

Turbellariae are free plathelminthes (they are not parasites), they are also called Planar for many. On a 35-year profile (Table 15), we noticed the disappearance of *Polycelis feline* and *Acromyadenium maroccanum* for the benefit of the three new visitors Phagocata sp, *Dugesia gonocephala* and *Dugesia tigrina*, who apparently were well acclimatized to their home environment. It is commonly accepted in the literature that *Dugesia gonocephala* is a rheophile cosmopolitan species which lives high at low altitude (Keller and others & Melhorn W.N., 1973). This state of the art which is not confirmed by our study. For what is of *Dugesia tigrina*, it is a very tolerant species that spreads quickly and constantly at the expense of its congeners. Finally, *Phagocata* sp. the most harvested Turbellaries eurytope it is recognized that she prefers to confine the sources (*Carpenter, 1969*), she meets in the niches AA and TZ system.

Table 15. Comparative faunistic list of Turbellaria species listed in AA, TZ and O. GUI in 1979 and 2015.

Ordre	Species	AA		TZ		O.GUI	
		1979	2015	1979	2015	1979	2015
Turbellaria:	*Polycelis feline*	+	-	+	-	-	-
	Acromyadenium maroccanum	+	-	+	-	-	-
	Phagocata sp	-	+	-	+	-	+
	Dugesia gonocephala	-	+	-	+	-	+
	Dugesia tigrina	-	-	-	+	-	+

Conclusion

Benthic fauna, a change of stand is important since 1979, with the appearance and installation of more than a dozen of taxa (*Simulium ornatum, Simulium pseudoquinum, Gammarus gauthieri, Phagocata* sp., *Dugesia gonocephala* and *Pisidium personatum*). Some have become invasive, such as the crustacean Amphipod *Gammarus gauthieri*, or very abundant

like Diptera *Simulium pseudoquinum*, signs of a high variability including thermal environmental conditions. On the other hand, indigenous invertebrates appear to be in sharp decline as beetles (*Elmis maugetii*). And what's alarming, is the total disappearance of the Stoneflies that are the sentinels bioindicators. Wadi Guigou to the pond Ait Hall is the most affected by the reductions in species richness and abundance, totally invaded by the Oligochaetes and buy them who behave in opportunistic species characteristic of a medium enriched with organic matter, temporary hypoxies observed in this environment cause the disappearance of the macrofauna (Rosenberg, 2001; Gray., 2007; Laudien *et al.,* 2002.

The succession of processions fauna at the time characterized a more or less degraded state of environment according to the model described by Pearson & Rosenberg (1978).

The change of species diversity in anthropisees areas like the bridge Guigou has a direct effect on the functional diversity of macrofauna assemblages. In addition to the direct selection of the species by the conditions of the environment, the indirect effects due to the reduction of the three dimensional biogenic structures limit State niches by polluo-sensitive species such as the mayflies and beetles. or a total annihilation of a whole order of stoneflies. The results show the interest to a multidisciplinary study to assess the ecological state of environment. The combination of macrofauna and toxicity within a context eco toxicological test is interesting in some impact studies, and their application in relevant ecological engineering.

This paper presents preliminary results. Future studies would determine more accurately the areas and aquatic ecosystems in particular interest of conservation in the Middle Atlas, as well as gaps in the network of the protected areas of the Morocco.

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