ISSN: 2347-5129
IJFAS 2014; 2(3): 18-22

www.fisheriesjournal.com
Received: 17-10-2014
Accepted: 27-11-2014

Abdelaziz Maqboul
Laboratory of Biodiversity and Animal Resources, Ibn Tofail University, B.P 133, 14000, Kenitra, Morocco.

Rabia Aoujdad
Laboratory of Biodiversity and Animal Resources, Ibn Tofail University, B.P 133, 14000, Kenitra, Morocco.

Mohamed Fadli
Laboratory of Biodiversity and Animal Resources, Ibn Tofail University, B.P 133, 14000, Kenitra, Morocco.

Mohamed Fekhaoui
Laboratory of Zoology and Animal Ecology, Scientific Institute of Rabat, BP 703 Agdal, Rabat, Morocco.

Correspondence
Abdelaziz Maqboul
Laboratory of Biodiversity and Animal Resources, Ibn Tofail University, B.P 133, 14000, Kenitra, Morocco.

Distribution of freshwater snails in the temporary pond of Annasser in Ouergha watershed, Morocco

Abdelaziz Maqboul, Rabia Aoujdad, Mohamed Fadli and Mohamed Fekhaoui

Abstract
The main goal of this investigation was to study the systematic, description and distribution of freshwater molluscs in the Annasser lakes located in Ouergha watershed (Morocco). The semi-quantitative surveys carried out between September 2002 and December 2005 has focused on four selected stations in the temporary pond. The choice of these stations was based on the molluscan data available, physical structure of the pond, structure associated vegetation, species diversity in each station and the maximum coverage area of the pond. Eight species of freshwater molluscs were collected in the malacological survey. The specific diversity of aquatic snails are positively correlated with the heterogeneity and complexity of natural vegetation and type of substrate of the temporary pond. Indeed, the malacological fauna of the study area is characterized by species of alluvial sedimentation (*Physa acuta* and *Lymnaea peregra*), species typical of stagnant environments rich in organic matter (*Succinea debilis, Pisidium casertanum, Pisidium personatum* and *Pisidium nitidum*) and finally species with affinities for river annexes (*Lymnaea truncatula* and *Ancylus fluviatilis*).

Keywords: Freshwater snails, systematic, distribution, temporary ponds, Morocco.

1. Introduction
Each year, 200.000 deaths are associated with schistosomiasis which affect rural areas but also the suburban and urban environments [1]. It is therefore a major health hazard especially in Africa, where, under developments, lack of hygiene, persistent urinary and faecal peril, promote contamination.

Typological facies of Ouergha watershed are composed by streams of high altitudes, the permanent watercourses of low and medium altitudes, semi-temporary rivers of low and medium altitudes, the dam lakes, springs and finally ponds. The basin supports the largest dam in the country (2nd in Africa). Generally, large hydraulic structures and the creation of retention lakes have significant effects on the environment since they introduce immediate changes in the natural landscape. The unpleasant surprises often caused by these projects are the result of lack of the preliminary studies in field ecology prevention [2]. In this case, species of freshwater molluscs can be introduced with construction of new hydraulic structures from pond and others natural aquatic ecosystems [3]. Some species of them are considerate as intermediate hosts of some parasitic diseases of humans and livestock such as schistosomiasis, fascioliasis and paramphistomosis.

In this review we are concerned with a well-known of distribution of freshwater snail in the temporary pond of Annasser. Indeed, multivariate methods in ecology for Association-analysis use on equal the information provided on the mollusk population by homogenizing the taxonomic structure of the different facies. The use of autecological information is necessary to supplement the results obtained in the biotypological analysis. For this purpose, we used some classic ecological descriptors in order to characterize and compare the description, distribution, functional structure and organization of population mollusk. These descriptors parameters are species richness, species diversity index, equitability index, relative abundance, frequency, degree of preference and Jaccard index of similarity.

2. Material and methods

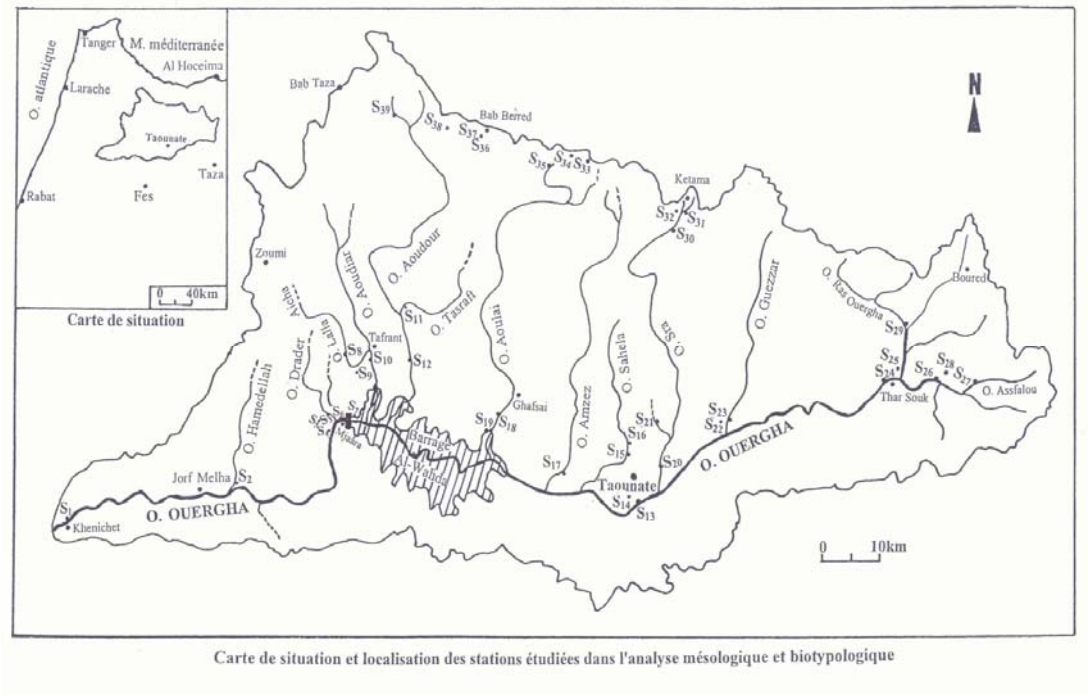
2.1. The study area

The basin area of Ouergha river is located in north of Morocco between 34° 20 '~ 35° 10' north latitude and 3° 50'~ 5° 30' west longitude. Elevations of mountains are between 100 and 2450 m. The total area of the catchment is 7325 km^2. This watershed is set on the southern slopes of the Rif arch mountain chain of Alpine orogeny. In the northern region of the basin, are located the largest number of high ridges of the Rif chain whose high altitude exceed 2000 m. The morphology of the basin is characterized by a relief that contains very strong slopes, a fundamental factor in erosion susceptibility.

The climate of the basin is mediterranean type ranging from suhu mid to semi-arid**.** In these bioclimatic zones are linked different stages of vegetation that are largely related to the altitude. Al-Wahda Dam is situated in the basin of the Ouergha with the retention capacity over than 3,700 million m^3. It is the largest dam in Morocco that can protect Gharb plain against floods and can irrigates 100,000 hectares in the the same plain.

Pond of Annasser (Fig. 1, S_{36} and S_{37} stations) are the only existing important natural stagnant water bodies in the Ouergha basin. They are located 5 km west of Bab Berred city. The substrate is muddy, gravelly, rocky, sandy and muddy. Aquatic vegetation is composed by *Ceratophyllum demersum*, *Scirpus sp*, *Typha angustifolia*, *Juncus sp*, *Polygonum amphibium*, *Potamogeton pectinatus* and grasses.

At each sample, we measured or estimated the following environmental parameters (Table 1): Altitude, the type of water body, width of the water body in beginning of summer, maximum width of the water body, water depth, speed of water current, nature of the substrate, presence of filamentous algae, Abundance of aquatic plants.



Carte de situation et localisation des stations étudiées dans l'analyse mésologique et biotypologique

Fig 1: Location of the sampling stations in Ouergha watershed

Table 1: Abiotic records of stations studied in the pond of Annasser

	Morpho-dynamic parameters						Substrate parameters			
	Alt (m)	TP (class)	LMo (m)	LMx (m)	Pr (cm)	VC (cm/s)	SG (%)	SF (%)	AF (class)	VA (%)
S_{36}	1200	2	84	120	234	0	0	100	4	70
S_{37}	1200	2	42	65	125	0	0	100	3	80

Legend table

Alt: altitude, **TPE**: type of water body (1-source, 2-dam or pond, 3-rivulet, 4-stream and river), **LMo**: width in beginning of summer, **LMx**: maximum width **Pr**: water depth, **VC**: speed of water current, **SG**: coarse substrate, **SF**: thin substrate, **AF**: filamentous algae (1-unnoticeable, 2-scarce, 3-abundant, 4-very abundant, **VA**: aquatic vegetation (1-no plants, 2-intermediate, 3-abundant density, 4-very abundant plant).

2.2. Zonation of the temporary pool

We divided the temporary pool of Annasser into 4 habitats according to vegetation zonation forming four areas characterized by dominant plant species:

- a first zone (biotope P1) dominated by *Ceratophyllum demersum*, the depth of the water layer is between 85 and 125 cm,,
- A second zone (biotope P2) composed by Scirpus sp, the depth is between 50 and 85 cm,
- A third zone (biotope P3) formed by *Typha angustifolia*, *Juncus spp*, *Polygonum amphibium* and *Potamogeton pectinatus.* The depth of this belt is between 15 and 50 cm,
- A last zone (biotope P4) composed by a lawn grass. the depth of which is between 0 and 15 cm.

2.3. Sampling methods

2.3.1. Sampling by Surber sampler

This method was used in rivers and springs. The Surber sampler consists of two interlocking frames that support a capturing net. One frame outlines the area of stream bed to be sampled while the other supports the net. The sampler is intended for use in shallow (30 cm or less) flowing waters. We used a colander square (32 cm square) which is fitted with a mosquito net of 0.8 mm mesh size. The principle consists in scraping the bottom within the area bounded in front of the filter surface. The fauna stopped by strainer is recovered and taken for identification.

2.3.2. Quadrat method

The quadrat method has been widely used in plant and faunal studies. A quadrat is a four-sided figure which delimits the boundaries of a sample plot. Quadrat sampling involves counting all individuals within a known area (or volume). Since density (*D*) and population size (*N*) are related, as *N* = *D* x area, we can estimate the density for the sample and from this compute the total population.

2.3.3. Visual search

Visible species are taken by hand. Hunting shall be performed during a delimited period between 15 to 30 minutes. The alternative is not to set a time and consider that the sampling is completed when the habitat was enough sampled.

2.4. Expression of results

2.4.1. Species richness

Species richness is a fundamental measurement of community and regional diversity, and it underlies many ecological models and conservation strategies. It is defined by the number of species that includes in an ecosystem.

2.4.2. Index of species diversity

The index the most used is the Shannon-Wiener expressed by the following formula:

$$H = -\sum_{i=1}^{S} \frac{ni}{N} \log_2 \frac{ni}{N}$$

s: Total number of species present,
ni: number of individuals of the species rank "i"
N: total number of individuals.

The index of species diversity is high when the taxonomic richness is important and the distribution of individuals among taxa is balanced.

2.4.3. Equitability

Knowledge of species diversity index is used to determine equitability:

$$e = \frac{H}{\log_2 S} = \frac{H}{H'}$$

It varies between 0 and 1, tends to 0 as almost all species corresponds to a single species and tends toward unity when each species is represented by the same number of individuals.

2.4.4. Relative abundance

Relative abundance of a species is the percentage of the number of this species relative to the total number of individuals collected from a station. It is expressed by the following formula:

$$Pi = \frac{Ab\ (a)}{Ab\ (t)} \times 100$$

Où, Ab(a) : abondance absolue de l'espèce "a ",
Ab(t) : nombre total d'individus.

2.4.5. Frequency

The frequency of a species represents the percentage of samples where the species is present relative to the total number of samples. It is given by the following formula:

$$Fi = \frac{Pa}{Pt} \times 100$$

Pa: number of samples where the species "a" is harvested,
Pt: total number of samples. We adopt the proposed Vala [4]:
- Basic species: Pi> 10% and Fi> 50%
- Constant species: Pi <10% and Fi> 50%
- Companion species: 20 <Fi <50%
- Catch species: 5 <Fi <20%
- Sporadic species: Fi <5%.

2.4.6. Ecological preferences

The ecological preferences or degree of preference adopted Dakki [5]. expresses the preference of species to a type of biotope. It is expressed by the formula:

$$d_{iJ} = 1 - \frac{S_i}{\log_2 J}$$

with:

$$S_i = -\Sigma \frac{n_{ij} + 1}{\Sigma\left(n_{ij} + 1\right)} \log_2 \frac{n_{ij} + 1}{\Sigma\left(n_{ij} + 1\right)}$$

- D_{iJ}: degree of preference of the species "i" in a sample of "J" habitats,
- N_{ij}: density of the species "i" in the habitat "j".

If the degree of preference of a species is high, its ecological niche is limited. If it is low, the species is little demand on the environmental factors and can perform its ecological niche in many habitats.

2.4.7. Jaccard index

It compares the common species in a biotop according to the following formula:

$$J = \frac{Pab}{(Pa + Pb) - Pab} \times 100$$

- *Pa:* number of species of the first survey "a",
- *Pb:* number of species of the second survey "b",
- *Pab:* number of species common to both surveys "a" and "b".

3. Results

3.1. Species richness

Eight species of freshwater molluscs were sampled in the four component biotopes of temporary pool, they are:

- *Lymnaea truncatula*
- *Radix peregra*
- *Physa acuta*
- *Ancylus fluviatilis*
- *Succinea debilis*
- *Pisidium casertanum*
- *Pisidium personatum*
- *Pisidium nitidum.*

The physical structure of the temporary pond is recognized to have an important influence on the density and composition of species communities. Indeed, the species richness in those biotop increases with the heterogeneity of habitat serving for protection against predators as well as the diversification of ecological niches that allow sharing of resources [6, 7, 8]. Ghamizi [9] have been reported 40 superficial species of freshwater snail in Morocco.

3.2. Index of species diversity and equitability

The highest index was recorded in the biotop P3 (H = 1.68) where all species in the pond were sampled, and in the habitat P4 (H = 0.96) where 3 species were collected: *Lymnaea truncatula*, *Physa acuta* and *Succinea debilis.* The diversity index is null in the station P1 where only *Physa acuta* can be harvested. The equitability index is higher in habitats P3 and P4 (respectively e = 0.86 and 0.88).

We deduce from these results that the structure of the freshwater molluscs is well balanced in the biotope P3, where there is a condensed vegetation which constitutes their preferred substrate.

3.3. Relative abundance and frequency

The values of relative abundance and frequency in the temporary pond biotops (Fig. 2) indicate that the distribution of freshwater mollusc in the four habitats are relatively balanced. Indeed, no sporadic or catch species were identified. In addition, both species are classified as basic of the facies *(Physa acuta and Lymnaea truncatula),* a unique constant species *(Lymnaea peregra)* and five other companion species (*Pisidium personatum, Pisidium casertanum, Pisidium nitidum, Succinea debilis* and *Ancylus fluviatilis*).

3.4. Ecological preferences and stational affinity

Populations of *Physa acuta* are well represented in the pond (Di = 0.13). They occupy all vegetation strata in the center of the area, from submerged vegetation to the riparian consisting of grasses. So, the species seems to be indifferent to the vegetation layers. *Lymnaea truncatula* (Di = 0.58) and *Succinea debilis* (Di = 0.78) are rather associated to habitats where vegetation is shaved or submerged. This preference also seems to be related to the amphibious lifestyle of both species. On the other hand, *Ancylus fluviatilis* (Di = 0,74), *Lymnaea peregra* (Di = 0,32), *Pisidium casertanum* (Di = 0,77), *Pisidium personatum* (Di = 0,86) and *Pisidium nitidum* (Di = 0,60) prefer habitats with a dense aquatic vegetation. However, the type of the substrate in the characterization of the micro-habitat species of *Pisidium* seems to be essential for the explanation of their distribution across the pond.

3.5. Niche overlap indice

Niche overlap indice (Table 2) is high between *Physa acuta* and *Lymnaea peregra* (O = 0.94). The two species usually compete for food and space occupation [10, 11]. The degree of niche overlap is also important between species of *Pisidium* genus and most of species living in the P3 biotope which are *Lymnaea peregra*, *Physa acuta* and *Ancylus fluviatilis* (values are between 0.87 and 1). This high indice can be explained by the lifestyle difference between those small lamellibranchs and other pulmonata species. However, it is noteworthy that *Lymnaea truncatula* prefers to achieve its ecological niche separately from other species, except *Succinea debilis* where the niche of the two species overlap completely.

Table 2: Overlapping niches between aquatic molluscs in the temporary pool of Annasser

	P. nitidum	***P. personatum***	***P. casertanum***	***S. debilis***	***A. fluviatilis***	***P. acuta***	***L. peregra***	***L. truncatula***
L. truncatula	0,13	0,13	0,13	1	0,13	0,38	0,13	1
L. peregra	0,98	0,98	0,98	0	0,98	0,94	1	
P. acuta	0,87	0,87	0,87	0,25	0,86	1		
A. fluviatilis	1	1	1	0	1			
S. debilis	0	0	0	1				
P. casertanum	1	1	1					
P. personatum	1	1						
P. nitidum	1							

3.6. Habitat Affinity

The faunal affinity between habitats are generally low and not exceeding 50% similarity which observed between P1 and P2 biotops (Table 3). Therefore, the physical structure of the pond has a significant influence on the diversity and composition of the malacological population.

Table 3: Biocenotic affinities (in %) between the four biotope the temporary pool of Annasser

	P_4	**P_3**	**P_2**	**P_1**
P_1	33,33	14,28	50	100
P_2	25	28,57	100	
P_3	25	100		
P_4	100			

4. Discussion

The temporary pond of Annasser has a heterogeneity of two types of habitat: quiet areas rich in aquatic vegetation and organic matter in the riparian banks and, on the other hand, sector with agitated habitats, poor in aquatic vegetation and organic matter of the sediment. Both of them has a particular specific richness. Most of freshwater snails harvested in this temporarily stagnant waters are confined to the coastal zone, while *Physa acuta*, species the most characteristic of the facies studied, was the only species that can colonize the deep areas inside the pond. Ramdani and Ghamizi [9, 12] indicated that this species is common in Morocco and can colonize all continental water bodies. This species has shown a clear indifference the abiotic environmental conditions for

recolonization and development of its ecological niche in diverse habitats. The ability is related to the reproductive system that is preferentially self-fertilizing [13, 14]. This capacity keeps insurance reproduction during episodes of colonization of new habitats (flood) or during colonization of habitats subject to ecological disturbances like drying, predation and alteration of environmental conditions). The insurance reproduction hypothesis seems to confer the status of invasive species for *Physa acuta* [15, 16]. Therefore, freshwater molluscs are closely associated to aquatic vegetation that represent for fauna a substrate, a source of food and a shelter. They are also sensitive to the physical structure the substart. In this sense, several studies have shown that the specific diversity of aquatic snails are positively correlated with the heterogeneity and complexity of natural vegetation and type of substrate [7, 8, 16, 17, 18, 19].

Furthermore, the presence of three species of *Pisidium* genus, which are elective species for biotop rich organic matter [20], indicates the eutrophic character of sediments of the pond subject of our study. These species are able to withstand extremes of pH and temperature, unlike other aquatic snails [21].

Lymnaea truncatula and *Succinea debilis*, species characteristic of temporary environments. Falkner et al. [22] indicate the special temporary nature of some areas of the pond. It should be noted that the presence of *Ancylus fluviatilis* indicates an active feed of water in the pond since the permanent pond and other surrounding sources.

5. Conclusion

The temporary pool of Annasser is characterized by:

- Species characteristic of alluvial sedimentation (*Physa acuta* and *Lymnaea peregra*)
- Species typical of stagnant environments rich in organic matter (*Succinea debilis*, *Pisidium casertanum*, *Pisidium personatum* and *Pisidium nitidum*)
- Species with affinities for river annexes (*Lymnaea truncatula* and *Ancylus fluviatilis*).

It must be noted that the local presence of *Lymnaea truncatula* and *Succinea debilis* and P4 biotope cannot be correlated to the nature of the substrate. Those species are semi-terrestrial species commonly found in the stations in the process of eutrophication, which has been in progress in the pond.

6. References

1. Der-Werf MJV, Vlas SJ, Brooker CWNS, Looman NJD, Nagelkerke JDF, Engels D. Quantification of clinical morbidity associated with schistosome infection in sub-Saharan Africa. Acta Trop 2003; 86:125-139.
2. Zongo D, Kabre BG, Dianou D, Savadogo B, Poda JN. Importance of malacological factors in the transmission of *Schistosoma haematobium* in two dams in the Province of Oubritenga (Burkina Faso). Research Journal of Environmental Sciences 2009; 3(1):127-133.
3. Diaw OT, Vassiliades G. Impact of the construction of dams and of hydro agricultural development on animal parasite pathology: helminthological studies. Report of the situation in Senegal 1991, 7.
4. Vala JC. Diptère Sciomyzidae de France. Systématique, biologie, structure et dynamique des communautés. Ph.D thesis, University of USTL, Montpellier, 1985, 287.
5. Dakki M. Recherches hydrobiologiques sur le Haut Sebou (Moyen Atlas). Une contribution à la connaissance faunistique, écologique et historique des eaux courantes sud-méditerranéennes. Ph. D thesis, University of Med V, Rabat, Morocco, 1986, 214.
6. Schoener TW. Ressource partitioning in ecological communities. Science 1974; 185:27-39.
7. Brönmark C. Freshwater snail diversity: effects of pond area, habitat heterogeneity and isolation. Oecologia 1985; 67:127-131.
8. Heino J. Lentic macroinvertebrate assemblage structure along gradients in spatial heterogeneity, habitat size and water chemistry. Hydrobiologia 2000; 418:229-242.
9. Ghamizi M. Les mollusques des eaux continentales du Maroc. Systématique, bio-écologie et malacologie appliquée. Ph.D thesis, University of Cadi Ayyad, Marrakech, Morocco, 1998, 560.
10. Brown KM. Resource overlap and competition in pond snails: an experimental analysis. Ecology 1982; 63:412-422.
11. Kawata M, Ishigami H. The growth of juvenile snails in water conditioned by snails of a different species. Oecologia 1982; 91:245-248.
12. Ramdani M, Dakki M, Kharboua M, Agbani MAE, Metge G. Les gastéropodes dulcicoles du Maroc: Inventaire commenté. Bull Inst Sci Rabat 1987; 11:135-140.
13. Wethington AR, Dillon RTJ. Selfing, outcrossing, and mixed mating in the freshwater snail *Physa heterostropha*: lifetime fitness and inbreeding depression. Invert. Biol. 1997; 116:192-199.
14. Jarne P, Perdieu MA, Pernot AF, Delay B, David P. The influence of self-fertilization and grouping on fitness attributes in the freshwater snail *Physa acuta:* population and individual inbreeding depression. J Evol Biol 2000; 13:645-655.
15. Dillon RT, Wethington AR, Rhett JM, Smith TP. Populations of the European freshwater pulmonate *Physa acuta* are not reproductively isolated from American *Physa heterostropha* or *Physa integra.* Invert. Biol. 2002; 121: 226-234.
16. Brown KM, Lodge DM. Gastropod abundance in vegetated habitats: the importance of specifying null models. Limnol. Oceanograph. 1993; 38: 217-225.
17. Wolff WJ. The Mollusca of the estuarine region of the rivers Rhine, Meuse and Scheldt in relation to the hydrography of the area. I. The Unionidae. Basteria 1968; 32:13-47.
18. Brown KM, Temporal and spatial patterns of abundance in the gastropod assemblage of a macrophyte bed. American Malacological Bulletin 1997; 14:27-33.
19. Downes BJ, Lakes PS, Schreiber ESG, Glaister A. Habitat structure, resources and diversity: the separate effects of surface roughness and macroalgae on stream invertebrates. Oecologia 2000; 132:569-581.
20. Mouthon J. Peuplements malacologiques lacustres en relation avec la physico-chimie de l'eau et des sédiments. II. Les espèces. Annls Limnol 1992; 28(2):109-119.
21. Meier-Brook VC. Der ökologische indicator wert mitteleuropäicher *Pisidium* - Arten (Mollusca, Eulamellibranchia). Eiszeitaler Gegenwart 1975; 26:190-195.
22. Falkner G, Bank RA, Von Proschwitz T. Check-list of the non-marine Molluscan species-group taxa of the states of Northen, Atlantic and Central Europe (CLECOMI). Heldia 2001; 4(1-2):1-76.