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Phyto-Ecologic Survey of a Complex of Temporary Pools Gauthier Pools (Northeastern Algeria)

[1]Zouaidia Hanene, [2]Mezedjri Lyamine, [1]De Bélair Gérard and [3]Tahar Ali
[1]Laboratory of Research of Humid Zones, Department of Biology,
Faculty of Sciences, University Badji Mokhtar, Annaba Algeria
[2]Department of Biology, Faculty of Sciences, University of Skikda, Algeria
[3]Department of Biology, Faculty of Sciences, University Badji Mokhtar, Annaba, Algeria

Abstract: The temporary ponds appear like real laboratories of survey of the living world are again so little known as regards to vegetation or to fauna. This is especially regrettable than they became very rare and are threatened of disappearance. The industrialization, the change of the hydrologic performance, the irrational use of their resources and the development of the tourism on the Mediterranean periphery is as many menacing factors. We led an ecological survey of a complex of 9 temporary pools Gauthiers pools situated in the oriental Numidia (Northeastern Algeria). A floristic inventory has been established for these nine stations and permitted to note that the set of the complex is very rich in plant species and of which some have a statute of rarity. An analysis of wealth and the diversity as well as a multivariate statistical analysis has been applied on the data gotten during two years of study (1999 and 2002). The results permitted to put in evidence the existence of a floristic gradient due to the action of the biotic factors (predation by fishes), to abiotic factors (nature of the substratum, conductivity, hydro period, turbidity) and to the interaction between the two.

Key words: Wetlands, temporary ponds, *Orientale numidia*, aquatic vegetation, statistical analysis, bio-diversity, specific wealth

INTRODUCTION

The wet lands (humid zones) are located to the interface of the aquatic and the terrestrial surroundings. The multifunctional role of this zones, (ecological function, food, reproduction, shelter and haven) duct to confer them a statute of natural infrastructure (Samraoui and Belair, 1998).

These surroundings form with the tropical forests and the corals reefs, the richest middles of our planet. They shelter a fauna and a unique flora indeed, but fill a fundamental ecological role whose effects go well beyond their simple geographical cutoff also (Mulhausser and Monnier, 1995).

The temporary pools constitute a type of very singular environment, the very irregular seasonality of their hydrologic cycle conferring them a dynamics that always attracted the scientists (Grillas and Roche, 1997). In the Mediterranean basin, their interest and their bio-geographic originality are not anymore to demonstrate, but their ecological value begins rightly to be recognized by the policies and the decision-makers; they are often the object of indifference and contempt and are confronted to various threats, in addition to be appreciated badly of all times.

In Algeria, the survey on the pools is relatively old (Gauthier, 1928; Gauthier-Lievre, 1931), but it has been disregarded to the detriment of vulnerable middles and numerous studies confirmed the presence of rare species or characteristic of the ponds: *Marsilea*, *Isoetes*, *Damasomium*, *Branchipodes* etc.

Corresponding Author: Zouaidia Hanene, Laboratory of Research of Humid Zones, Department of Biology, Faculty of Sciences, University Badji Mokhtar, Annaba, Algeria

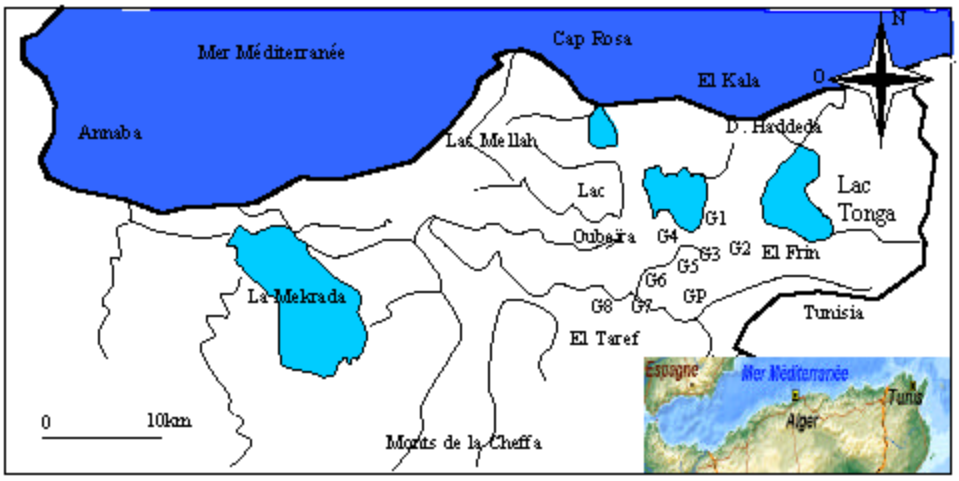

Fig. 1: Geographical situation of the gauthier pools in the *Oriental numidia*

To preserve, manage and better to understand these complex middles and in the aim to know their working and their diversity, we achieved this work that appears in the setting of the research led by the Laboratory of Research of the Humid Zones (LRHZ).

The objective considered of this study was:

- To make the floristic inventory of a complex of temporary pools.
- To describe the structure of these pools with the help of the multivariate statistical analyses of data accumulated during two years (1999 and 2002).
- To identify the important factors governing the structure and the working of these pools to assure an integrated approach on the one hand of their management and on the other hand to find some solutions to the problems of their conservation.
- To compare our results to those gotten previously to refine the studies and to confirm the previous results.

MATERIALS AND METHODS

Presentation of the Study Zone

The Numidia contains a big number of exceptional humid sites in Maghreb by their measurements and notably by their diversity (depth, saltiness) (Van Dijk and Ledant, 1980). This wealth results in a big flora and fauna diversity. Another particularity of the Numidia is the presence of species of various bio-geographic origins (Samraoui *et al*., 1992; Belair and Samraoui, 1994; Samraoui, 1998) and the existence of relic's species of Afro-tropical origin (Samraoui and Bélair, 1997; Samraoui *et al*., 1993).

The oriental Numidia shelters a set of humid zones that has for northern limit the Mediterranean Sea and for southern and oriental limits the hills of the Tellien Atlas, coinciding at the East with the Algero-Tunisian border (Fig. 1).

The *Oriental numidia* corresponds to the morphological limit defined by Marre (1987) as the extremity of the Tell (Samraoui and Belair, 1998). The western limit of this set is marked by the Seybouse wadi. The geographical position of Algeria, its physical configuration and the diversity of its climate confer him important wetland (DGF, 2001).

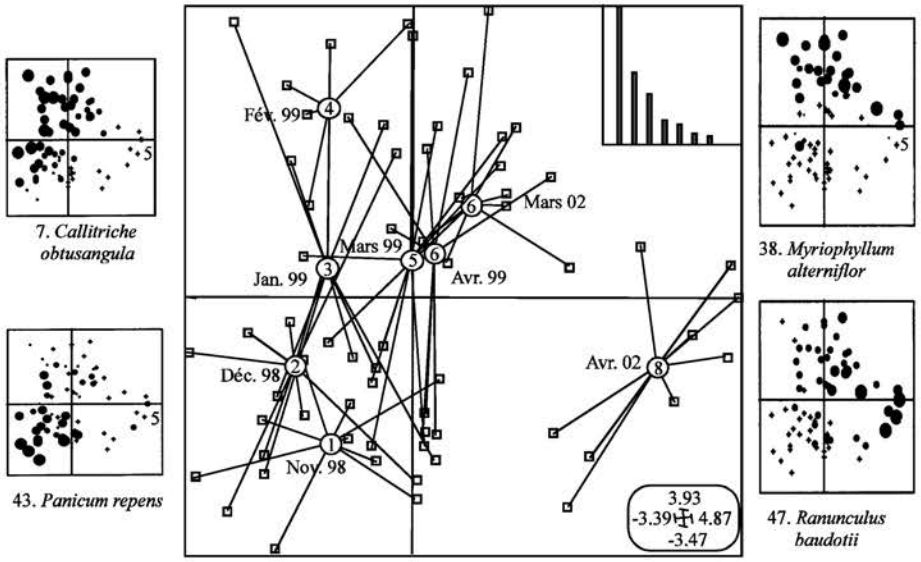

Fig. 2: Discriminate analysis (based ACP). Factorial map 1×2 on 8 dates × 9 stations × 74 plant species

The Algerian Northeast and more especially the region of El-Kala possesses a set of unique wet lands in Maghreb by its dimension and diversity: lakes, ponds, pools, aulnaies etc., forming a mosaic of remarkable biotopes where we can see to coast themselves of the endemic, boreal and tropical species in a sector that gathers more than the half of aquatic fauna and flora of the country (Samraoui and Belair, 1998).

The relief is constituted of hills and low mountains of which the culminating point is the Djebel Ghora at 1202 m, as well as of the intra-highlander small basins that the wadis borrow and of the depressions occupied by paludal formations in lacustrine (Marre, 1987). The hydrographic network is characterized by a big complexity. The differential relief and the recent tectonics disrupted the evolution of the network hydrologic, decomposed in several units (Samraoui and Belair, 1998).

The studied stations are including within the National Park of Kala El, they are located along the track of EL Frine to El Kala, between Lake Tonga and Lake Oubeïra (Fig. 2). The first four pools are neighboring, the others are irregularly dispersed.

The complex of the nine pools has been selected on the basis of several criteria:

- The nine pools (G_1 in G_9) are located in the same region (*Oriental numidia*); they are submitted to the same climatic conditions.
- They share the same substratum although differences to this level exist.
- These selected sites are easily accessible and near the one to the other.

Sampling

We conducted a monthly systematic sampling to the level of the nine stations that constitutes the Gauthier pools, in homage to the couple Gauthier-Lievre (1931) and that are classified: from 1 to 4 at the superior Gauthiers from 5 to 8 at the lower Gauthiers and at a well.

The statements of the present's aquatic vegetation have been done for every station. The species of plants are identified while valuing their degrees of dominance according to a scale of five coefficients. For the abiotic variables; the measures of the conductivity, the turbidity, the dissolved oxygen and the temperature has been taken at the time of the sampling.

Two samples have been done, in the months of March and April from the year 2002 because the ponds are not put back in water because of the excessive dryness of this year. They have been accumulated and analyzed with the six samples done during the period between the month of November 1998 and the month of April 1999.

Data Analysis

Two main analyses have been applied on the collected data: principal components analysis (ACP) and the analysis of the co-inertia with the help of the statistical software ADE4 (Chessel and Doledec, 1992).The first is a method of ordination of the statements or description of the inter-variables structures, used as soon as the variables are quantitative and transcribed in very varied units (Redaounia, 1999). Present data are accumulated therefore in a picture for the two years and for every station of survey.

The statements are represented by columns and the species by line and every raise-species intersection indicate the presence or the absence of the species. The point cloud represented either by the statements, either by the species whose multi-dimensional space is characterized by privileged elongation directions.

It is thereafter about factorial axes that contain a certain proportion of the total information of the data and on these axes took two to two are achieved of the projections of raised points or point's species. The proper values and the inertia rate which quantify the part of explained information by the different axes, permit to decide the number of axes to keep (Chessel and Bournaud, 1987).

With regard to the co-inertia, it is an analysis whose main objective is to describe the structure of a matrix of data (vegetation-variables) structural on the same statistical units (Chessel and Thioulouse, 1996). The two systems of coordinates become super imposable. Every arrow represents every station by the variables of the middle (origin) and by vegetation that we find there (extremity).

RESULTS

Influence of the Abiotic Variable on the Gauthier Pools

The measures of the ecological variables notably the temperature of water, the conductivity and the dissolved oxygen showed that these parameters vary from a station to the other and influence the presence or the absence of the plant species therefore in every pool as well as their development since such parameters condition the breathing and the photosynthetic activity of essence.

Otherwise, drainage and the hydro period of the water plans, also play a very important role in maintains and wealth of species.

Studies on the temporary pools underlined the environment obvious uncouthness that they especially provide by the phases of setting in water and drainage (Metallaoui, 1999).

Vegetation of the Gauthier Pools

The pool offers as other aquatic surroundings a multi-strata vegetation characterized by plants with different ecological requirements where the thermal stratification finds its influence on the knowing middle that the temperature of water generally finds to the level of the air temperature since soil stocks the heat of the sun and transmits it later to water (Beignet and Dammanget, 1997).

The complex of Gauthier's pools is provided of a very varied flora. This diversity of the plant communities offer to multiple species (aquatic, amphibious and sometimes terrestrial) an ecological dog house on the one hand; and on the other hand, by their interactions with the animal communities, it assures to the set of the pools, these well delimited ecosystems, their working since they are located to the extremity of the aquatic food chain.

The Gauthier stations don't possess all same floristic composition; the aquatic vegetation being very sensitive to the variations of the middle. Several factors as the depth, the nature of the substratum, the pH of waters, the brightness, etc., permit to understand the distribution of these plant formations and to interpret the differences of floristic composition of a pool to the other. A structuring of vegetation results from it.

Vertical Structure

On the vertical plan, vegetation is distributed while forming some strata. This stratification can be consequent of an inter-specific competition for light and for water. Within every pool, several belts of vegetation follow each other of the coastal zone where limit the domain of implantation of the mesophytes until the deep zone characterized by the absence of fixed plants. The surface of water is occupied by plants to leaves and to floating flowers.

Horizontal Structure

The existences of a gradient provoked then by the increase of the soil humidity in the exonded part by the increase of the thickness of the aquatic tablecloth flooded, drag a horizontal distribution of the species and groupings according to a zoned disposition (Feltzines, 1984; Mekki, 1998) that when it is developed regularly, constitute belts of vegetation.

The width and the composition floristic of these belts depend on a big number of factors substratum, abiotic and biotic. Among the first, we can mention: the topographic profile, the seasonal level variations, the climatic factors and among the second the human and animal actions.

In a general manner, we can recognize:

- Terrestrial vegetation situated on the supra-littoral zone: normally exonded and that includes species bound to the presence of a watertable of which fluctuations vary with those of the water surface. It is occupied by hygrophilous vegetation as *Lythrum junceum* and *Paspalum distichum*.
- Aquatic vegetation: who occupies the infra-littoral zone: It is constituted by hydrophytes species as *Callitriche obtusangula* and *Ranunculus baudotii* that only is developed in the flooded surroundings but that undergo a temporary exondation often in summery period.
- Amphibious vegetation (Table 1): that finds its place on the coastal zone submitted to the swing of waters, to the contact of the terrestrial vegetation and the aquatic vegetation; it often presents the particular adaptations allowing them to cross the alternating periods of egress and submersion. (Ex: *Glyceria fluitans*, *Juncus bulbosus*, *Juncus heterophyllus*).
- Vegetation that occupies the actual coastal zone that belongs at the surrounding environment and no to the flooding domain, containing some mesophytes species: *Ranunculus macrophyllus*, *Asphodelus aestivus*.

Vegetation Analysis

The inventory of the nine studied stations and the realization of 67 summaries permitted to identify 74 floristic species that has first been submitted to an analysis of ACP then to an inter-classes analysis.

For the ACP, the majority of information was contained in the first four axes that contribute to explain 23, 15, 9 and 7% of the total inertia.

Concerning the discriminative analysis; inter-classes (Between analyses), it allowed us to see the distribution of the species according to the stations and statement (temporal aspect) and the distribution of the stations according to the species (spatial aspect). For the typology of the stations, we kept the first three axes of which the values of inertia are, respectively: 43, 22 and 15%. For the separation of the dates, the values are the following: 53, 17 and 10% of the global inertia.

Table 1: Index of the species plant of the nine stations and their bio-geographic origins

Plants	B	R	Plants	B	R
Hydrophytes			**Amphiphytes**		
Callitriche obtusangula	3	4	*Alisma plantago-aquatica*	7	1
Callitriche truncata	2	1	*Alopecurus bulbosus*	2	1
Myriophyllum alterniflorum	5	2	*Apium crassipes*	3	4
Ranunculus baudotii	9	-	*Bellis repens*	1	4
Hygrophytes			*Cotula coronopifolia*	9	2
Ranunculus muricatu	2	-	*Echinodorus ranunculoides*	7	1
Ranunculus sardous	2	-	*Eleocharis palustris*	9	-
Scirpus cernuus	9	-	*Galium palustre*	3	-
Silene coeli-rosa	2	-	*Glyceria fluitans*	9	-
Spergula arvensis	2	2	*Hypericum humifusum*	5	2
Trifolium repens	5	2	*Illecebrum verticillatum*	2	4
Trifolium filiforme	5	1	*Isoetes histrix*	2	1
Trifolium resupinatum	2	1	*Isoetes velata*	2	1
Poa trivalis	3	-	*Juncus bufonius*	9	-
Mesophytes			*Juncus maritimus*	9	-
Asphodelus aestivus	2	1	*Juncus heterophyllus*	2	1
Bellis annua	2	-	*Juncus pygmaeus*	4	2
Hypocheris radicata	3	-	*Juncus conglomeratus*	6	-
Linaria reflexa	2	1	*Lythrum junceum*	2	2
Olea europea	2	1	*Mentha pulegium*	3	1
Ranunculus macrophyllus	2	1	*Oenanthe globulosa*	5	1
Rubus ulmifolius	5	-	*Panicum repens*	8	-
Cicenda filiformis	2	5	*Poa annua*	2	3
Anthoxanthum odoratum	5	-	*Ranunculus ophioglossifolius*	2	1
Eryngium barrelieri	2	2	*Scirpus inclinatus*	9	4

B: Bio-geographic distribution, 1. Endemic, 2. Mediterranean, 3. Eur-euras, 4. Atlantic-Mediterranean, 5. Euro-Mediterranean, 6. Paleo-tempered, 7. Boreal/Holarctic, 8. Tropical, 9. Cosmopolitan, 10. Others, R: Rarity, 1. Common Enough, 2. Rare, 3. Rare Enough, 4. Very rare, 5. Very very rare, Lack of information

Results Interpretation

Temporal Aspect

On the axis 1 *Callitriche obtusangula* appears in winter during the whole period of flooding and begin to disappear toward the end of the spring. *Panicum repens* is present in fall as soon as the pool gets in water and persist until the spring.

Ranunculus baudotii occupies the pool during the whole period of setting in water (winter). *Apium crassipes* and *Cotula coronopifolia* appear abundantly in the months of January and February. *Echinodorus ranunculoïdes* reveals its presence during all the winter until the end of the spring. *Elatine Brochoni* is an autumnal species. *Juncus maritimus* is especially present in the months of March and April.

The axis 2 designates two vernal species: *Lythrum numulariaefolia* and *Myriophyllum alterniflorum* who's flowering starts in the month of March and can go until the month of May (summer). *Poa annua* is present from November until April (Fig. 2).

Figure 3 shows a projection of the factorial card (1.2) that permits to see distinctly the temporal structure of the analysis. This perfect organization of the dates according to the species can be explained by the seasonal succession.

Spatial Aspect

The axis 1 separates the stations in two groups of the Gauthier pools: The first group constituted by the pools G_1, G_2, G_3 and G_4 that is marked by an abundant population in *Myriophyllum alterniflorum* and *Isoetes velata* (Fig. 3).

The second group constituted by the pools G_5, G_6, G_7 and G_8 is especially determined by the presence of *Panicum repens*, *Juncus subulatus* and *Echinodorus ranunculoïdes*. This axis also permits to see the continuity of a real gradient between the active stations of G_1 until G_8.

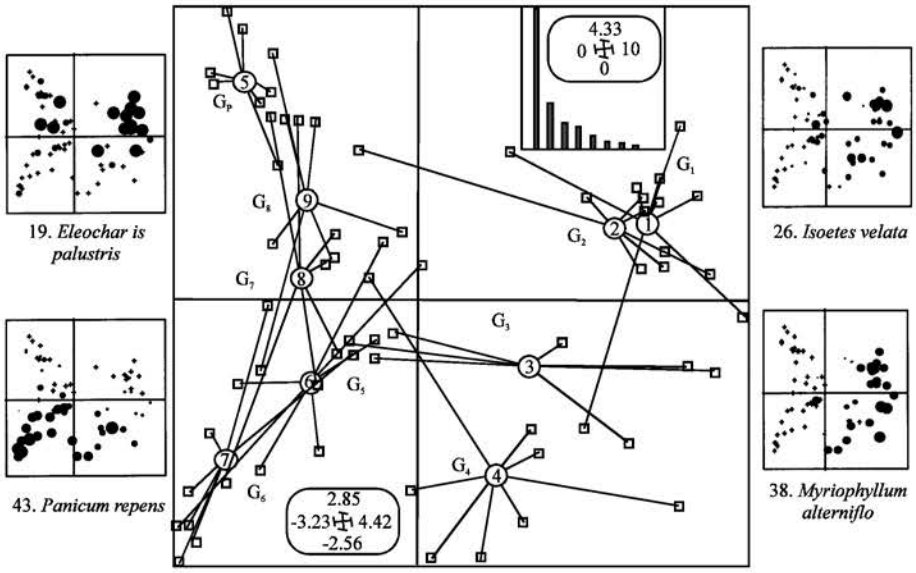

Fig. 3: Discriminate analysis. Factorial map 1×2 on 9 stations × 8 dates × 74 plant species

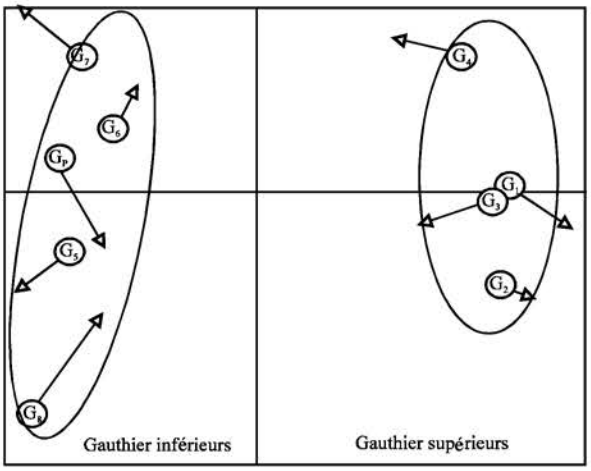

Fig. 4: Factorial plan 1×2 of the co-inertia (11 variables × 74 species floristic)

The species: *Glyceria fluitans* and *Myriophillum alterniflorum* are normally absent in the lower Gauthier's and the well.

The factorial plan 1×2 (Fig. 3) puts in evidence the presence of a floristic gradient according to the stations which follow themselves (G_1-G_8); G_P being particular.

Analysis of the Co-Inertia

This analysis has been achieved while using two types of matrixes, the first, (9 stations × 74 floristic species) on which we did an A.C.P analysis (matrix of interrelationships) and whose first three factorial axes contribute to 69, 13 and 10%. The second representing the abiotics variables

(9 stations × 11 variables) from which we achieved an ACP analysis (matrix of covariance) where we kept the first four axes that contain 53, 18, 10 and 8% of the global inertia, respectively.

For the analysis of co-inertia we kept the first two factorial axes that contain the majority of information and that contribute to 74 and 3% of the global inertia (Fig. 4).

DISCUSSION

The Mediterranean wet lands that count among the most productive middles of our planet constantly undergo increasing pressures. They have been disregarded at all times and have been managed badly in spite of their multi-functionality and their biologic diversity. It is only since some years that the attitude opposite the humid zones changed, some efforts have been accomplished toward a real recognition of the functions and values of these ecosystems in the world (DGF, 2001) thanks to numerous pioneers' research and studies (Krebs, 1985; Collins *et al*., 1995) based on the control of their abundance and their flora and fauna wealth in order to understand their distribution (Quezel and Santa, 1962-1963) to make better know them and to contribute to promote the setting in work of the efficient protective measures for these ecosystems.

A fundamental question in ecology is to understand the distribution and the abundance of the species. On the other hand we are limited to a model that consists to study a complex of temporary pools and especially to understand the distribution and the abundance of the aquatic flora presents in those middles.

Present results show that our pools complex is organized according to a precise diagram. This organization implies the existence of factors structuring the aquatic flora. Among these important environmental variables governing the organization of the temporary pools, our survey identifies:

The role of the substratum that shows a separation:

- Superior Gauthier (G_1-G_4) to substratum sand- sandstone.
- Lower Gauthier (G_5-G_8) to gritty substratum that encourages the presence of the species preferring this substratum.
- The G_P pool to clay-slimy substratum.
- The sites in short Hydro-period: G_7 and G_p that are characterized by a weak depth and by a less dense plant cover in relation to the other pools more deep and richer cash plant.
- An effect of proximity separating the couples: G_1/G_4; G_2/G_3; G_5/G_6 and G_7/G_8 with the oddness of the station G_{well}: poor in taxa, plant cover little dense.

Present results confirm studies of Hulbert and Mulla (1987), Bounaceur (1997), Hecnar and M'Closkey (1997), Hammouda (2000), Metallaoui (1999), Layachi (1997), Redaounia (1999), Benslimane (2001) and Sebti (2001).

- The presence of a floristic gradient put in evidence by the species and that is due to the nature of the substratum and to the conductivity.
- A seasonal effect marked by the present species in the stations and characterizing the different seasons. Therefore this shows the importance of the phenology and the organization of the plant cover according to the time, since the pool gets in water until its drainage.
- The results gotten by the calculation of the specific wealth and the indications of the diversity are in conformity with those gotten by the multivariate statistical analyses.

Our survey has especially been concentrated on the inventory of the nine ponds flora, on their biodiversity and on their function. It allowed us to confirm the studies led by the Gauthier-Lievre couple of the point of specific wealth.

Such study confirm, on the ecological plan that the pool ecosystem, presents an incontestable interest due to its functional mobility and its biodiversity. It allowed us to contribute to knowledge more profound of flora joined to these middles, of their natural evolution all along the year and their response to the environmental changes driving to determine the factors structuring these communities.

However, of such middles should make the object of a lasting management, which respects their specific characteristics and takes in account the real reasons of their disappearance and their deterioration while resorting to the present complementary orientations and notably some:

- To inventory the temporary pools, as far as possible.
- To make recognize their presence and their values and specific functions.
- To look after to maintain that their function own hydrologic.
- To stay up has what their natural resources are used in a lasting way and non overexploited.
- To recognize the engagement of the local communities and the autochthonous populations towards the temporary ponds and the importance that these wetlands don for them and while sustaining their management and their protection.
- To assure their continuous surveillance, to identify and to counter all threat on their values and functions, while taking account permanently of the uses and traditional management.

CONCLUSION

Present research is a contribution to the survey phyto-ecologic of a complex of temporary pools (Gauthier Pool) situated in the oriental Numidia, in the Northeast Algeria. It is a survey based at on a comparative (inter-annual comparison) and confirmative research at the same time and whose acquired results permit to note that:

- This ecosystemic complex is rich of a very varied aquatic flora. This is confirmed by the floristic inventory of every station of the complex.
- The calculations of the specific wealth as well as various indications of diversity also confirm this result and show a big inter-station variability.
- The multivariate statistical analysis (ACP, Co-Inertia) done on the inventory of the flora of this complex puts in evidence the presence of a gradient according to which the stations separated in two groups (superior Gauthier and lower Gauthier). This gradient is determined by the biotic and abiotic factors.
- The inter-annual comparison (between the two years: 1999-2002) indicates that several rare species disappeared as *Ormenis paraecox* and *Lotus decumbens*. This allowed us to formulate the following hypothesis: this disappearance is probably the consequence of the exceptional dryness of the year 2002.

The temporary pool remains a specific wet land where the smallness of the object must not conceal the complexity of the working. Its importance is not proportional to its size. To preserve and to manage these middles, it is necessary to know the value of their biodiversity, of their working and to become aware of their social functions as humid ecosystems.

Finally, we hope that the set of this knowledge must serve to guide the choices of the administrators and the protectors of the nature. These works must be the subject of a future dialogue and studies more deepened on the biology and the ecology of the species bound to these middles in view of their protection.

To keep the nature is equivalent to preserve the bases of the man's life as much that of all creatures of the planet. Without diversity, the future of the earth becomes precarious.

REFERENCES

Beignet, A. and L. Dommanget, 1997. The mail of the nature: Special ponds. The National Society of the Nature protection (France).

Belair, G. and B. Samraoui, 1994. Death of a lake: Lac Noir in Northern Algeria. Environ. Conservat., 21: 169-172.

Benslimane, N., 2001. Contribution to the ecological survey of the humid zones of the Numidia: Case of the ponds of the oriental Numidia and the zones of Guerbes. Eng. Memory. University of Annaba.

Bounaceur, F., 1997. Contribution to the ecological survey of *Gambusia affinis* (Baird and Girard, 1853) in 3 humid sites of the National Park of El Kalal. Thesis of Magistery, National School of Agronomy.

Chessel, D. and M. Bournaud, 1987. Recent progress in analysis of the ecological data. Communication to the 4eme symposium of the AFIE. Manage. Ecol. Syst.

Chessel, D. and S. Doledec, 1992. ADE Software. Multivariate analysis and graphical display for environmental data (Version 4). Université de Lyon.

Chessel, D. and J. Thioulouse, 1996. Programmation ADE-4: Multivariate analyses and graphic expression of environmental data FISCH MODULES 6 MODULES graphic C.N.R.S Univ. Lyon I.

Collins, N.H., J. Biggs, A. Corfield, M.J. Hodson, D. Walker, M. Whitfield and P.J. Williams, 1995. Temporary and permanent ponds: An assessment of the effects of drying out on the conservation value of aquatic macroinvertebrates communities. Biol. Conserv., 74: 125-33.

Direction General of the Forests, 2001. Atlas of the Algerian humid zones of international importance. Imp. Anep.

Feltzines, J.C., 1984. Dynamic, sociological and ecological study of the vegetation of the ponds of the East center from France. Importance of the inter-specific competition in the organization of vegetation and the distribution of the groupings and associations Theses: 2nd cycle U..T Lille.

Gauthier, H., 1928. Research on the fauna of the continental waters of Algeria and Tunisia. Algiers. Imp. Minerva.

Gauthier-Lievre, L., 1931. Research on the flora of the continental waters of North Africa. Special memory. Bull. Sor. Hist. Nat. Afr. North, Algiers.

Grillas, P. and J. Roche, 1997. Végétation des marais temporaires: Ecologie et Gestion. Skinner and Crivelli, A.J.

Hammouda, S., 2000. Impact of *Gambusia affinis* on the aquatic middles. Eng. Memory. University of Annaba.

Hecnar, S.J. and R.T. M'Closkey, 1997. The effects of predatory fish on amphibian species richness and distribution. Biol. Conserv., 79: 125-131.

Hulbert, S.H. and M.S. Mulla, 1987. Impact of mosquitofish (*Gambusia affinis*). Predation on plankton communities. Hydrobiolgia, 83: 125-151.

Krebs, J.C., 1985. Ecology. The Experimental Analysis of Distribution and Abendance. 2nd Edn. Harper and Row. New York.

Layachi, N., 1997. Comparative survey of two dunes ponds: G. Estah and G. Dakhla (North is Algerian). Eng. Memory. University of Annaba.

Marre, A., 1987. The Algerian Oriental Tell. Decollo to Tunisian Border. Survey Geomorphologic. Vol. 1, 2. Office of the Academic Publications.

Mekki, M., 1998. Comparative survey of the ecology of four dunes depressions of the Algerian North-East. Engineering Memory. University of Annaba.

Metallaoui, S., 1999. Ecological survey of the pools endoreics and temporary. Thesis of Magistery. University of Annaba.

Mulhausser, B.M. and Monnier, 1995. Guide of fauna and the flora of the lakes and of the ponds of Europe.

Quezel, P. and S. Santa, 1962-1963. New flora of Algeria. CNRS. Paris. Flight 1 and 2.

Redaounia, A., 1999. Survey of a gradient floro-faunistique and environmental on a sample of nine ponds (POOL GAUTHIER). Engineering Memory. University of Annaba.

Samraoui, B., G. Belair and S. Benyacoub, 1992. A much threatend lake: Lac des Oiseaux in Northern Alegria. Environ. Conserv., 19: 264-267, 276.

Samraoui, B., S. Benyagoub, S. Mecibah and H.J. Dumont, 1993. Afrotropical libellulids (insecta, odonata) in the lake district El-Kala, Northeastern Africa with a rediscovery of Urothemis edwardsii (Selys) and Acisoma panorpoïdes ascalaphoides (Rambur). Odonatologica, 22: 365-372.

Samraoui, B. and G. Belair, 1997. The Guerbes-Senhadja wetlands (N.E. Algeria) Part I: An Overview. Ecologie, 28: 233-250.

Samraoui, B., 1998. Status and seasonal patterns of adult rhopalorera (Lepidoptera) in North-Eastern Algeria. Nachr. Entomol. Ver. Apollo, N.F., 19: 285-298.

Samraoui, B. and G. Belair, 1998. The humid zones of the Orientale NumidiA: Balance of the knowledge and perspectives of management. Synthesis (Special No.) 4: 1-90.

Sebti, S., 2001. Contribution to a typological survey of the temporary pools of the oriental Numidia. Engineering Memory. University of Annaba.

Van Dijk, G. and M.J.P. Ledant, 1980. Report of observation on the birds in the region of Annaba. Rap. Dactyl.