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Systematic and biological structure of the floral population of temporary pools of the western Mamora forest (Morocco)

H Ouattar, S Sassa, D Mansouri, M Slim, M Fadli*
Laboratory of Nutrition, Health and Environment, Department of Biology, Faculty of Sciences, University IbnTofail, Kenitra, Morocco

Abstract
In the Mediterranean geographical area, temporary pools often form naturally on natural depressions. Annually, the amount and duration of impoundment of these pools depends on the amount of precipitation and some of the melting snow. Often, the biodiversity of these types of wetlands is high. The vegetation of temporary pools is composed of various floristic groups often arranged in concentric bunches around their centers. The structure of these groupings may vary according to the climatic zone of situation of the pond. Thus, we contribute to determining the composition and organization of the vegetation of the temporary pools of the western part of the Mamora forest which is located in north-west Morocco.
The results showed that 56 species were identified. These species have been grouped into 19 botanical families and 40 genera. Likewise, this vegetation is distributed over four concentric belts around the center of the biotope and different in their degree of humidity and the duration of their flooded phase. Plant groups whose systematic structure and species recovery index are still the same from one belt to another. The hygrological and pedological requirements of the species are the main cause of this difference.

Keywords: temporary pond, vegetative stands, structure, Mamora forest, Morocco

1. Introduction
Introduction of natural or artificial origin, a temporary pond is a body of water occupying a depression. In the Mediterranean geographical area. Its extent and duration of impoundment depend on the amount of precipitation of the importance of its watershed and the pedological and geological nature of its biotope. In the Mediterranean region, these pools of ecosystems have a rich biodiversity composed of low vegetation, geophytic and therapeutic groups and biocoenosis with small invertebrates (mostly cladocerans) [1]. Thus, they play many ecological functions [2]. Their plants, for example, contribute to the purification and oxygenation of water and serve as a refuge, nesting supports and food for many animals [3].

In addition, the vegetation of the temporary pools is composed of various floristic groups often arranged in concentric bunches around their centers. The specific structure of these bungs could change throughout the year. Plant and animal populations depend on the alternation of the flood phase, which often begins in winter, and the dry phase that coincides with the summer season [4]. As a result, the species of temporary pools often have life strategies adapted to these particular environmental constraints, particularly those defined by the large spatio-temporal variations of the environment related to climate change [5].

It should be noted that temporary pools, like other wetlands, currently suffer from various constraints that threaten their biodiversity and even their existence. We mention their filling, their pollution, the use of pesticides, overgrazing and various human activities [6, 7]. It is therefore of great interest to determine and monitor the composition of the flora and fauna of these types of wetlands due to their great ecological roles, their primary productivity and their role as giants in the food web. Thus, as part of this contribution, this work aims at estimating the floral biodiversity of temporary pools in Morocco, by developing an overview of the inventory of temporary plant species, locally called "daya", of the western part of Morocco. The Mamora forest (Fig. 1) and determining the systematic structure of the macrophytic and algal flora of their floral procession.

2. Material and Methods
2.1 Choice of study sites
Eight temporary pools were chosen to evaluate the structure of the flora of these types of hydro systems. The choice of these pools was made according to the differential criteria of the dayas most cited in previous works including those reported by Fadli (1987) [8] and Thiery (1986) [9], namely the importance of the flooded area of the pond, the average duration of its flooded phase and its average maximum depth. Figure 1 shows the geographical location of the dayas studied and Table 1 gives their characteristics of dayas.

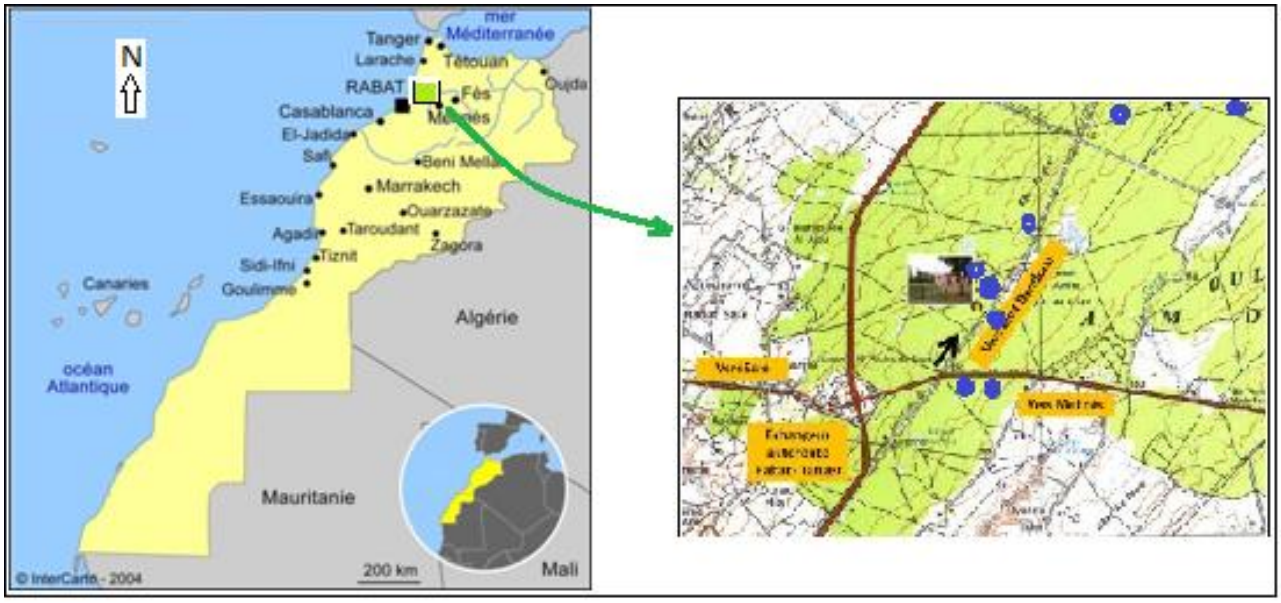

Fig 1: Geographic location of the temporary pools studied (●) [10]

2.2 Method of collection of flora

The collection of the flora was carried out four times a year while starting with a first at the impoundment of the pond, then a second when the daya in open water at its maximum extension, a third time at the end of the impoundment and last one month that is to say after the dry daya. The inventory of taxa developed takes into account all the identified species.

The transects method has been proposed to monitor the specific structure of the plant population constituting the vegetable procession of the pond. The layout of the transects and their locations have been made in such a way that these transects cross the moisture gradient and can start with the area being exposed to the flooded area. Thus, as pointed out in previous work [8, 9], the environmental moisture gradient was used as a criterion for the choice and location of transects.

In each day, along these transects, the main species that appear will be carefully surveyed along this line. For the follow-up, it will be enough to return to the same place at intervals of time which were chosen according to the duration of the flooded phase of the daya. The width of the transect is 1 m and its length depends on the site where the monitoring is carried out

3. Results and Discussion

Four pedological and hygrological belts (C1, C2, C3, C4) were differentiated according to the degree of humidity and the pedological nature of the sediment. The list and recovery index of inventoried taxa are grouped in Table 1.

Table 1: Botanical families, species, and their distribution on the four vegetable belt noted on temporary pools.

Botanical families	Species	Recovery index of species in the four differentiated plant belts			
		C4	C3	C2	C1
Asteraceae	*Leontondon hispidulus* l.	-	+	-	-
	Carlina racemosa L.	-	1-	-	-
	Filago gallica L.	-	+	-	-
	Hedypnois arenaria (Schousb.) Dc.	+	+	-	-
	Hypoechaeris glabra L.	1	-	-	-
	Ormenis mixta (L.) Dumort	-	1	-	-
	Tolpis barbata (L.) Gaertn.	1	+	1	-
			1		
Brassicaceae	*Malcolmia broussonetii* (L.) R.Br.	1	-	-	-
Caryophyllaceae	*Spergularia arvensis* (L.) Cambess.	+	-	-	-
	Paronychia echinata Lamk.	+	1	-	-
	Illecebrum verticillatum L.	-	2	-	-
	Loeflingia hispanica L.	+	-	-	-
Cistaceae	*Citus salvifolius* L.	+	-	-	-
	Corynephorus fasciculatum L.	1	-	-	-
	Helianthemum guttatum (L.) Mill.	2	1	-	-
Cyperaceae	*Cyperus longus* L.	-	1	1	-
	Scirpus cernuus Live Wire	-	-	1	-
	Scirpus holoschoenus L.	-	1	-	-

Fabaceae	*Anthyllis hamosa* Desf.	1	-	-	-
	Lotus hispidus Desf. Ex Dc.	-	1	1	-
	Ornithopus ebractealus (Mill.)	1	1	-	-
	Ornithopus isthmocarpum Brot.	1	-	-	-
	Trifolium campestre Schreb.	1	1	-	-
	Trifolium cernuum Subsp.	1	1	-	-
	Trifolium cherleri L.	-	1	+	-
	Trifolium filiforme Sibth.	2	1	1	-
	Trifolium isthmocarpum Brot.	1	1	-	-
	Trifolium nigrescens Viv.	3	2	-	-
	Trifolium resupinatum L.	2	2	-	-
	Trifolium tomentosum L.	2	-	-	-
Gentianaceae	*Centaurium pulchellum* (Sw.) Druce	-	1	1	-
	Erodium *cicutarium* subsp. bipinnatum (Cav.)	1	-	-	-
		-	-	-	-
Isoetaceae	*Isoetes histrix* Bory	-	1	-	-
Juncaceae	*Juncus bufonius* L.	-	2	-	-
	Juncus capitatus Weig.	-	1	1	-
	Juncus pygmaeus Rich. Ex Thuill.	-	-	1	-
Lythraceae	*Lythrum hyssopifolia* L.	-	+	1	-
Plantaginaceae	*Plantago coronopus* L.	1	2	1	-
Poaceae	*Anthoxanthum ovatum* Lag.	-	1	-	-
	Briza minor L.	1	+	-	-
	Cynodon dactylon (L.) Pers.	2	-	-	-
	Gaudinia fragilis (L.) P. Beauv.	1	1	-	-
	Paspalum distichum L.	-	-	3	-
	Polypogon maritimum Willd.	1	-	-	-
	Agrostis salmantica (Lag.) Kunth - Gbif	-	-	1	-
	Glyceria fluitans (L.) R.Br., 1810	-	-	2	2
Primulaceae	*Anagalis parviflora* L.	+	1	-	-
Ranunculaceae	*Ranunculus muricatus* L.	-	1	+	-
	Ranunulus aquatilis L.	-	-	2	+
	Ranunculus parviflorus L.	-	1	-	-
	Ranunculus sardous f. sardous	-	1	1	-
Polygonaceae	*Rumex bucephalophorus* L.	1	1	-	-
Elodeaceae	*Elodea sp*	-	-	-	+
Lemnadeae	*Lemna gibba* L.	-	-	-	1
Characeae	*Chara sp*	-	-	-	2
Zygnemataceae	*Spirogyre sp*	-	-	1	2

With regard to plant groups, taking into account plants with at least one recovery index equal to or greater than 2, we have distinguished four C1, C2, C3 and C4 belts.

- C1: This is a deep open water zone. It occupies the center of the pond and its surface from one pool to another. The sediment is silty. Vegetation is only represented by Chara and Spyrogira algae, *Lemnea gibba* and *Elodea sp*, and *Glyceria fluitans*.
- C2: This is a berm encircling C1. Its width depends on the pond. It is a flooded area whose depth allows the installation of rooted vegetation. The sediment is clayey. We distinguished 15 species with a recovery index greater than or equal to 1. But the most overlapping species are *Paspalum distichum* and *Ranuculus aquatili*s, and and *Glyceria fluitans*.
- C3: This is the area characterized by a high moisture content of the sediment without being really flooded. The sediment is sandy-clay. The harvested vegetation is rich, 27 systematic taxa have been identified, and the overlapping species are *Trifolium nigrescens*, *Trifolium resupinatum*, *Illecebrum verticillatum*, *Juncus bufonius*, and *Plantago coronopus*.
- C4: This is a transition zone between the "mare" ecosystem and the freight ecosystem itself. The sediment is sandy loam. A certain degree of soil moisture is felt there. 22 species with a recovery index greater than or equal to 1 have been identified. However, the most overlapping species are *Trifolium nigrescens*, *Trifolium resupinatum*, *Trifolium tomentosum*, *Trifolium filiforme* and *Cynodon dactylon*, *Helianthemum guttatum*.

From the results we note therefore that the vegetation of the temporary pools studied is organized in concentric belts encircling a deep open water zone is without rooted vegetation. Thus, the plant groups, the specific structure and the specific richness of the plant population are not always the same in these plant belts.

Moreover, as indicated by Fadli (1987) [8] in the ponds of the Mamora forest, the hygrometric degree, the duration of the flooded phase and the pedological nature of the sediment, or soil, vary according to these belts. Thus, we can say that there are variables related to the sediment moisture content of its pedological nature and the duration of aquatic recovery of the belt that are responsible for variations in species specific structure and recovery rate of belts. This same finding was noted in the temporary pools of another region of Morocco (Ben Slimane Forest) by Rhazi *et al*., (2005) [11]. Similarly, the

ecological preferences of the identified plant species are a determining factor in the presence or absence of a particular species in each plant belt. Indeed, in the C4 belt, where the sediment remains unflooded during the entire annual cycle of the pond and where this soil is sandy most of the species harvested are psamophilous or grow on dry soils. We cite Cynodon dactylon [12] and *Helianthemum guttatum* [13].

In the C3 belt, which benefits from the flooded phase during a certain time of the year and keeps a certain degree of moisture during the rest of the year, and the soil is partly clayey, the species identified prefer these conditions. We mention *Plantago coronopus* [14] and *Juncus bufonius* [15]. The C2 is populated by species that prefer or support prolonged flooding while keeping the roots in the sediment. The depth of the flood water must not exceed a certain value. We cite *Ranunulus aquatilis* [16] and *Illecebrum verticillatum* [17, 18]. Finally, in C1, the deepest part of the pond that no longer allows the installation of rooted vegetation, or plants that support total immersion, are the algae, *Elodea sp*, and *Lemna sp* that inhabit the biotope. The chemical factor is also involved in determining the status of species in a particular belt. *Trifoium filiforme*, besides being a preference for well-drained soils, is a bioindicator of a soil rich in bases and organic matter and subject to strong water contrasts [19].

4. Conclusion

The results showed that, for a temporary pond, from the center of the biotope to the forest ecosystem, the degree of hydrometry, the pedological nature and the duration of the flooded phase differ. Thus, starting from this center, four concentric belts have been differentiated. According to the results we the vegetation of the temporary pools studied is organized in concentric belts encircling a zone with deep free water is without rooted vegetation.

In addition, the study of the systematic composition, the structure of the floristic communities and the species recovery index showed that these variables can vary from one belt to another. The ecological preferences of the identified plant species are a determining factor in the presence or absence of this or that species in a particular plant belt. Thus, on the transition belt between the ecosystem "temporary pond" (fourth belt, C4) are the species supporting the aridity of the medium and preferring a sandy soil that characterize the environment. Towards, the center (C3 belt), species that require a certain level of the medium's moisture content associated with species that supports a wide variation of this degree. In C2, species that support or require the biotope to be temporarily flooded but not as long as the flood duration of the central part of the pond (C1) whose species support or require a longer flood period.

5. References

1. Paradis G, Pietri CL, Di Borgo MLP, Sorba L. La végétation des mares temporaires méditerranéennes de la Corse. Bulletin de la Société des sciences historiques et naturelles de la Corse N°, 2009, 728-729.
2. Charles Marion C, Déborah V. (SPN/MNHN), Etat de conservation des mares temporaires méditerranéennes, habitat d'intérêt communautaire. Direction de la Recherche, de l'Expertise et de la Valorisation. Direction Déléguée au Développement Durable, à la Conservation de la Nature et à l'Expertise Service du Patrimoine Naturel. Rapport SPN 2015-56.
3. Ariana E, Grier S, Justin P, Wright, Bonnie M McGill, Curtis R. Environmental Conditions Influence the Plant Functional Diversity Effect on Potential Denitrification. Journal List PLoS Onev. 2011; 6(2):PMC3032786.
4. Lumbreras A, Marques JT, Belo AF, Cristo M, Fernandes M, Galioto D, *et al*. Assessing the conservation status of Mediterranean temporary ponds using biodiversity: a new tool for practitioners. Hydrobiologia. 2016; 782:187-199 DOI 10.1007/s10750-016-2697-7
5. Böckelmann J, Tremetsberger K, Šumberova K, Grausgruber H, Bernhardt KG. Fitness and growth of the ephemeral mudflat species Cyperus fuscus in river and anthropogenic habitats in response to fluctuating water-levels. Flora. 2017; 234:135-149
6. Zahangeer AM. Status of Biodiversity at Wetland Ecosystem of Mohangonj Upazila in Netrakona District. Advances in Ecology, 2014, Article ID 642450, 8 pages. http://dx.doi.org/10.1155/2014/642450
7. Frasquet SMT, Altur V, José AS. Wetland Planning: Current Problems and Environmental Management Proposals at Supra-Municipal Scale (Spanish Mediterranean Coast). 2014; 6:620-641; doi:10.3390/w6030620
8. Fadli M. Etudes écologique et systématique des Crustacés et Anostracés des dayas du Maroc. Thèse de 3eme cycle. Faculté des Sciences, Université Mohammed V Agdal, Rabat, 1987.
9. Thiéry A. Les Crustacés Branchiopodes (Anostraca, Notostraca et Conchostraca) du Maroc occidental. I: Inventaire et répartition. Bulletin de la Société d'histoire naturelle de Toulouse. 1986; 122:145-155.
10. Image source: Site Web: https://www.bing.com/images/search?q=for%c3%aat+de+la+mamora+maroc&FORM=HDRSC2
11. Rhazi M, Grillas P, Médail F, Rhazi L. Consequences of shrub clearing on the richness of aquatic vegetation in oligotrophic seasonal pools in Southern France. Phytocoenologia. 2005; 35:489-510.
12. Hameed MM. Physiological and biochemical adaptations of *Cynodon dactylon* (L.) Pers. from the Salt Range (Pakistan) to salinity stress. Flora - Morphology, Distribution, Functional Ecology of Plants. 2008; 203(8):683-694.
13. Gtari M, Sbissi I, Gtari FG, Neffati M, Ouzari H, Boudabous A, *et al*. Diversity of the desert truffle *Terfezia boudieri* Chatin. in southern Tunisia. Revue canadienne de microbiologie. 2011; 57(7):599-605
14. Al Hassan M, Pacurar A, María P López-Gresa, María P Donat-Torres, Josep V Llinares, Monica Boscaiu, Oscar Vicente. Effects of Salt Stress on Three Ecologically Distinct *Plantago* Species. PLoS One. 2016; 11(8):e0160236. Published online doi: 10.1371/journal.pone.0160236
15. Cope TA, Stace CA. Aggregate in Western Europe. Watsonia. 1978; 12:113-28.
16. Cook CDK. On the determination of leaf form in *Ranunculus aquatilis*. New Phytol. 1969; 68:469-480.

17. Jalas J, Suominen J. ed. Caryophyllaceae (Alsinoideae and Paronychioideae). Atlas Florae Europaeae: Distribution of Vascular Plants in Europe. ***6***. Cambridge University Press, 1998, 154. ISBN 978-0-521-34272-8.
18. Pearman DA. The status of Coral-necklace *Illecebrum verticillatum* L. (Caryophyllaceae) in Great Britain. Watsonia. 2008; 27:143-148.
19. Ducerf G, Thiry C. Les Plantes bio-indicatrices, Briant, Éditions Promonature, 2003. (ISBN 978-2-9519258-0-9).