

# Evaluation of the Riverine Vegetation of Wadi Tafna in the Tlemcen region (Western Algeria)

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## Abstract

The vegetal landscape of riverine forest bordering streams of course, has a character linked to the high volatility of the intermittence of the latter. The watercourse temporary (wadis) are characterized by a vegetation and flora of Mediterranean type, (Tamarix, Nerium, Vitex, Phoenix...) in contrast to the permanent water courses at the level of the vegetation of leafy bed major European type, based mainly, poplar, ash or alder.

In Western Algeria, the riverine forest vegetation is complex and fragile environments to several utilities. Latter by its diversity and these developed root systems will thus limit erosion of the banks and provide a stable structure to the formation. To identify and quantify the riverine forest on the Mediterranean coast in the South, especially in Western Algeria, we conducted surveys on land with an area of 100 m<sup>2</sup> for each record, and then each species was conducted of two indices (abundance – dominance and sociability).

The factorial analysis of correspondences has carried out us to classify these plant species according to the degree of salinity of the Wadi, the substrate and the slope. The riverine vegetation of wadi Tafna has been classified as follows: The so-called purely riverine forest vegetation is which are directly linked to the Wadi (in contact with the water and who are): *Tamarix africana*; *Nerium oleander*; *Fragmites communis*; *Chenopodium album*; *Rumex bucephalophorus*; etc.

Vegetation low riverine forest is usually trained pre-forestieres species on siliceous substrate and are: *Crateagus monogyna*; *Halimium halimifolium*; *Withania frutescens*; *Atriplex halimus*; *Acacia sp*; *Zygophyllum sp*; *Bryonia dioica*; *Calycotome intermedia*; *Suaeda sp*.

In conclusion, the inadequacy of our knowledge of the biology and ecology of vegetation riverine forest of our region requires multiscale study and multidisciplinary in order to better understand the structure and operation of all hydro-system. These phyto-sociological and phyto-dynamic data lead to classify these plants according to ecological factors of their site and understand its evolution and diversity through the study area.

**Keywords:** Riverine vegetation; Phyto-sociological; Dominance; Wadi Tafna; Tlemcen; Western Algeria; Phyto-dynamic; Ecology; Hydro-system

## Introduction

The temporary nature of water courses in the Mediterranean region in terms of ecological and biological environments very heterogeneous and therefore extremely varied and rich.

In the Mediterranean, the riparian forest is a physiological all peculiar and still poorly understood from the point of view typology and especially dynamic, particularly in Western Mediterranean [1].

Riverine forest are forest formations temporarily saturated wet soil-climate of the edge of a stream, the analysis of the structures of riparian forest vegetation is still poorly known. Only a few countries or regions have been the subject of work; This is the case in Mediterranean France, are to include the work of Braun – Blanquet et al. [2], Tchou [3] in lower Languedoc, Loisel [4,5], La Praz [6] and Varese [7] to the South-East of the France and in Corsica those of Dierschke [8] and

Gamisans [9] for the Paca region, south of the France Barbero [10] for the Spain Alcazar-Ariza et al. [11]; Rivas-Martinez et al. [12], the Italy and Brullo and Spampinato [13]; Pignatti [14], but also the Algeria and the Western Mediterranean basin as a whole Bensettiti and Lacoste [15].

The work we present here concerns the recovery of vegetation in the region of Tlemcen. It is associated with a high percentage of salt, always greater than 60%. These represented formations and primarily relate to the importance of the salt deposits and the presence of gypsum and water [1].

The purpose of this study is to identified vegetation riverine forest of the middle and lower Tafna place Northwest of the Mediterranean southern part Algeria, and to classify them by degree of position of the stream of water; the degree of humidity and salinity.

This study was conducted on the basis of phytosociological surveys, to determine the close affinities of different plant groups of *Tamarix africana*. Secondly, the knowledge of this richness has allows to make the proposals leading to the preservation and improvement of these

fragile environments, to limit degradation and to promote their development in a rational manner.

## Materials and Methods

### Study site

The study area (Figure 1) covers the middle and lower Tafna. The Tafna with an area of 7245 km<sup>2</sup> watershed is located northwest of the Western Algeria. It extends over the whole of the region of Tlemcen (77% of the total area) and extends to the realm of the Morocco. The Interior of this basin, there are three main areas:

**East zone:** Its main wadis are Oued Chea, Oued Isser and Oued Sikkak and Confluence the Mafrouche.

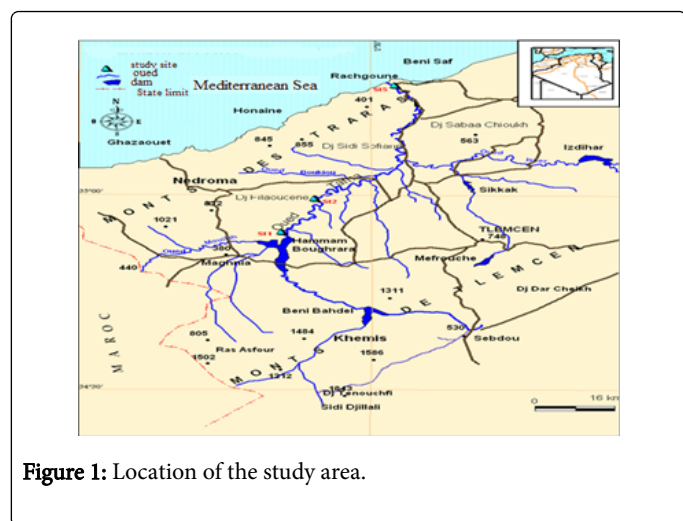
**West zone or high Tafna:** Its main wadis are Wadi Tafna, Oued Mouilah and Oued El Khemis.

**North zone or middle and lower Tafna:** It starts virtually after the Hammam Boughrara dam and extends effective at the mouth of Wadi Tafna on Mediterranean Sea.

The main drains in this area are the Wadi Tafna with wadi Zitoune on the South side and Boukiou on the north side.

The main watercourse of the Tafna, long about 170 km, originates in the Tlemcen Mountains to the cave of Ghar Boumazaa (Tafna High) level downstream of the dam of Béni Bahdel stream formed the maze by carving steep gorges, leading to the plain of Maghnia.

This western part is mainly fed by the Oued Mouilah and the wadis of the slope north of mountains of Tlemcen to the dam of Hammam Boughrara (average Tafna). The watercourse of the Tafna crosses Remchi Plains, or it receives its major tributary Oued Isser, his journey ends in an estuary in the middle of the beach of Rachgoun (Figure 1 and Table 1).

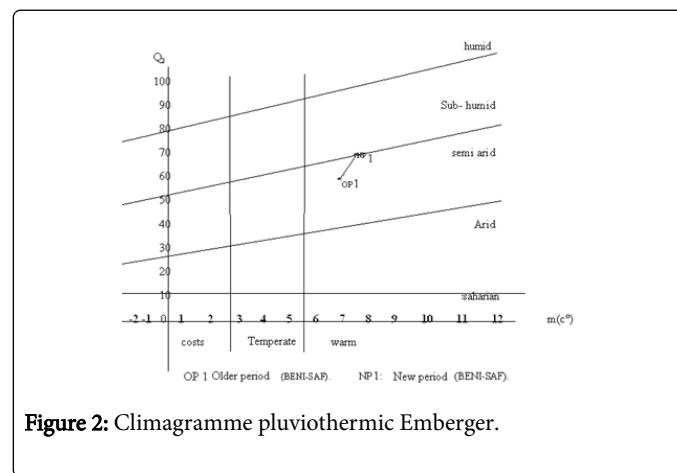


Stations	Latitude	Longitude
Station 1 Sebdo	34.906448°	-1.647157°
Station 2 Dj Fellaoucene	35.245958°	-1.437833°
Station 3 Rachgoun	35.284316°	-1.456887°

**Table 1:** Location of stations of studies.

Some tributaries of the Tafna as Oued el Khemis, Oued Mouilah, Oued Isser, Wadi Sikkak and Oued Chouly, are permanent and are never full; on the other are temporary, non-powered and that depend on rainy seasons.

The bioclimatic study for two periods (1913-1938) and (1970-2002), (Figure 2) showed vertical indent of each station in direct relation with the Q<sub>2</sub> [16] Station Beni – Saf, despite falling on of the value of Q<sub>2</sub> always under floor lower semi-arid to hot winter.



This climate favors the extension of a vegetation therophytic xerophyte.

To enhance riverine vegetation we have made 200 surveys in total; and each survey was conducted in a floristically homogeneous surface.

The surface of the record must equal at least to the minimum area, containing almost all of the species present.

The execution of statements is accompanied by the rehabilitation of the site characters. (Location, altitude, exposure, recovery rate, substrate, slope etc...); then, each species is affected by two indices, the first relates to the abundance-dominance, the second sociability.

Abundance-dominance expresses the space occupied by the projection on the ground of all the individuals of each species. This coefficient allows the following scale [17]. Species introduced to recovery and low abundance until the number. 5 top recovery 75 with abundance any.

Sociability expresses the mode of distribution of individuals of the same species contribution to the other one. It is assessed according to the scale proposed by Braun Blanquet [17].

1 individual of the species are isolated.

5 individuals of the species are in continuous stands.

Once made statements, they were ordered by a factorial analysis of correspondences (A.F.C) and a hierarchical ascending classification (C.A.H).

For this analysis we will focus on the environmental determination of the floristic diversity and syntaxonomique analysis which will be devoted to the description of the phytosociological units of the riverine vegetation.

The software calculates the statistical distance between surveys based on the frequencies of the listed species.

The cloud “point’s lines” or “points columns” stretches along a preferred direction which corresponds to the factorial axis of analysis. Every factorial axis is characterized by an Eigen value which translates the inertia of the cloud of point along the axis. The inertia rate represents the percentage of the axis in the total inertia of the cloud. The Eigen value and the rate of inertia are higher that the cloud of points is well structured along a factorial axis.

The hierarchical ascending classification begins with the construction of a table of distance between statements of the Starter Kit. From the first table of distance, the algorithm finds the couple's statements with the shortest distance so the more homogeneous.

### Coding

For computer processing of the data, a number is assigned to each of the surveys, in the order of their execution for example: expenditures 1→R1.

Similarly, taxa have been coded by the first letter characterizing the kind followed by a number in order of repetition of the corresponding kind, in the following manner:

- *Achillea leptophylla* → A1
- *Aegilops triuncialis* → A2

### Digital processing

Basic data consist of a dual input matrix where surveys are arranged in rows and plant species in column, at the intersection is the index of abundance-dominance or presence-absence.

In this regard, we have opted for the second index since according to all Phyto-ecologues.

Preference is given to him for the identification of plant groupings. This index takes the value '1' in the event of presence and the '0' if there is no value that also has the advantage of simplicity and universality.

### Results and Discussion

Ecological significance of axes:

The factorial analysis of correspondences of the 200 surveys conducted is divided on 03 stations with (Figures 3 and 4).

The Eigen values of the axis (1 and 3) are respectively 0.243 et 0.740. They demonstrate a heterogeneous structure of the cloud (Table 1a).

<b>Variance</b>	4.1389	3.4066	2.8177	10.3532
<b>% rate of inertia</b>	0.295	0.243	0.201	0.740

**Table 1a:** Eigen values of the axis.

Factorial maps showing plans for projections 2/1 and 3/1 exam at finding 03 sets very contrasting and coarser in plan 3/2.

Despite the low percentage of the Eigen values, the majorities of species have a contribution greater than or equal to 0.50.



**Figure 3:** Dense riparian forest along the Wadi Tafna.



**Figure 4:** The riparian forest along a bend of the Tafna.

Research of the ecological significance of the factorial axes will rely on the confrontation of species with strong contributions and its distribution on the one hand the positive side and on the other hand the negative side of each axis (Table 2). We will thus attempt to specify what will be the major ecological factors in the diversification of the sword.

<b>Codes</b>	<b>Axe1</b>	<b>Axe2</b>	<b>Axe3</b>
DC	-12,54,65,996	-17,24,74,244	-0,91931916
DG	0,59824525	0,88266772	-0,91878064
ASP	0,59824525	0,88266772	-0,91878064
IV	0,59824525	0,88266772	-0,91878064
FC	0,59824525	0,88266772	-0,91878064
OP	0,59824525	0,88266772	-0,91878064
CA	12,43,29,675	0,68891375	12,73,58,992
SN	0,59824525	0,88266772	-0,91878064

AH	12,43,29,675	0,68891375	12,73,58,992	VSP	-16,55,02,173	0,39723967	0,25048005
CHA	0,71386152	-16,32,67,055	-14,77,066	CP	-16,55,02,173	0,39723967	0,25048005
EA	0,59824525	0,88266772	-0,91878064	SM	-16,55,02,173	0,39723967	0,25048005
FS	0,59824525	0,88266772	-0,91878064	TT	-16,55,02,173	0,39723967	0,25048005
AA	0,59824525	0,88266772	-0,91878064	ES	-15,39,40,546	-2,11,80,986	-0,3078053
SV	0,59824525	0,88266772	-0,91878064	VASP	-1,17,11,405	0,42651718	0,12368403
TG	-0,89315164	0,09987357	10,05,24,662	RP	-1,17,11,405	0,42651718	0,12368403
NO	-0,886395	0,81987334	-0,48782982	OC	-1,17,11,405	0,42651718	0,12368403
CAA	0,59824525	0,88266772	-0,91878064	CG	-0,41047274	-22,82,57,505	17,57,76,923
SA	12,43,29,675	0,68891375	12,73,58,992	AR	-1,17,11,405	0,42651718	0,12368403
RC	-13,70,27,623	0,79059583	-0,3610338	CI	0,42911602	-20,26,02,672	-0,86555215
PP	0,59824525	0,88266772	-0,91878064	CC	10,74,16,752	-22,19,78,068	13,26,81,841
AT	0,59824525	0,88266772	-0,91878064	AS	0,42911602	-20,26,02,672	-0,86555215
ZL	0,71386152	-16,32,67,055	-14,77,066	ET	0,42911602	-20,26,02,672	-0,86555215
TL	0,61875636	11,47,80,968	-11,49,66,634	PR	0,42911602	-20,26,02,672	-0,86555215
WF	0,9785911	-19,72,42,148	0,24592874	ASA	0,47066903	-0,64171751	-0,52344301
LM	0,46369792	0,67930524	-0,63885265	AP	0,47066903	-0,64171751	-0,52344301
LOM	0,46369792	0,67930524	-0,63885265	CHH	0,47066903	-0,64171751	-0,52344301
MV	-1,38,92,073	-19,28,10,492	-0,63939117	THG	0,47066903	-0,64171751	-0,52344301
LB	0,46369792	0,67930524	-0,63885265	CUS	0,47066903	-0,64171751	-0,52344301
AHA	0,48420903	0,9444472	-0,86973835	AVS	11,15,72,053	-0,83547147	16,68,92,755
SAV	0,46369792	0,67930524	-0,63885265	ASM	0,47066903	-0,64171751	-0,52344301
CT	0,46369792	0,67930524	-0,63885265	LAO	0,47066903	-0,64171751	-0,52344301
UM	0,46369792	0,67930524	-0,63885265	FV	0,47066903	-0,64171751	-0,52344301
AD	0,33401086	0,75445352	-0,53815249	OE	0,47066903	-0,64171751	-0,52344301
PSP	0,33401086	0,75445352	-0,53815249	FRC	11,15,72,053	-0,83547147	16,68,92,755
ZSP	0,33401086	0,75445352	-0,53815249	EG	10,36,39,892	-0,25877623	18,08,31,744
NG	-16,34,51,062	0,66238163	0,01959435	PL	0,95855125	0,29555759	18,85,10,377
JM	-16,55,02,173	0,39723967	0,25048005	BD	0,95855125	0,29555759	18,85,10,377
HM	-12,55,74,482	0,26085122	1,69,35,468	OM	0,95855125	0,29555759	18,85,10,377
INV	-16,55,02,173	0,39723967	0,25048005	EV	0,95855125	0,29555759	18,85,10,377
SS	-16,55,02,173	0,39723967	0,25048005	CIC	0,95855125	0,29555759	18,85,10,377
CS	-16,55,02,173	0,39723967	0,25048005	MO	0,95855125	0,29555759	18,85,10,377
PC	-16,55,02,173	0,39723967	0,25048005	AG	0,71277666	0,3529231	11,35,79,996
SH	-15,39,40,546	-2,11,80,986	-0,3078053	ACSP	0,51384537	0,42654106	0,40650229
RB	-10,09,97,024	0,2034857	24,42,85,061				
PO	-16,55,02,173	0,39723967	0,25048005				
AM	-16,55,02,173	0,39723967	0,25048005				

**Table 2:** Contributions of the taxa for the first three lines of the A.F.C.



### Plan 2/1:

**The negative side:** *Daucus carota*; *Marrubium vulgare*; *Scolymus hispanicum*; *Echinops spinosus*; *Rumex bucephalophorus*; *Hordeum murinum*; *Tamarix africana*; *Chenopodium album*; *Alopecurus muricatus*; *Nerium oleander*; *Marrubium vulgare*.

**The positive side:** *Bryonia dioica*; *Avena sterilis*; *Withania frutescens*; *Arthrocnemum glaucum*; *Atriplex halimus*; *Acacia sp*; *Arundo donax*; *Typha latifolia*; *Calycotome intermedia*; *Ziziphus lotus*; *Zygophyllum sp*; *Suaeda fructicosa*.

The negative side is dominated by the species settling on for the Tafna High flood level, while the positive side is dominated mainly by species that settled on the upper part of the Wadi Tafna characterizing thus Matorral training by the presence of *Arthrocnemum glaucum*; *Suaeda fructicosa* and *Calycotome intermedia*.

This axis shows the species indifferent substrate and independent deputy in a changing gradient substrate.

The riverine vegetation for upstream (station 3 Rachgoun) under semi-arid climate arid a (Sebdou station 1), one of the species planted the most tolerant at these conditions is *Tamarix africana* in wet depressions and near the lightly soiled marshes; While the halophytes species (*Zygophyllum*, *Atriplex*, *Suaeda*) and hydrophytic vegetation (*Nerium oleander*) are the most suitable for freshwater and brackish water bodies respectively.

The vegetation of the watercourse transitional (wadis) or for low rate, essentially thermomediterranean upstairs, dominated by various *Tamarix* (Tamaricaceae) and *Neriumoleander* (Neriaie) and this mostly to the South and east of the Mediterranean belongs to the order of *Tamaricetalia africanae* [18].

### Plan 3/1:

**Negative side:** *Daucus carota*; *Marrubium vulgare*; *Scolymus hispanicum*; *Echinops spinosus*; *Rumex bucephalophorus*; *Hordeum murinum*; *Tamarix africana*; *Chenopodium album*; *Alopecurus muricatus*; *Nerium oleander*; *Marrubium vulgare*; *Acacia radiana*; *Ricinus communis*.

**Positive side:** *Pistacia lentiscus*; *Bryonia dioica*; *Avena sterilis*; *Withania frutescens*; *Arthrocnemum glaucum*; *Atriplex halimus*; *Acacia cyanophylla*; *Arundo donax*; *Asparagus stipularis*; *Typha latifolia*; *Calycotome intermedia*; *Ziziphus lotus*; *Zygophyllum sp*; *Solanum sp*; *Robinia pseudoacacia*.

The positive side of this axis is in particular species that characterize Matorral formations, and the negative side revealing a less degraded than the first pole. *Acacia radiana*; *Ricinus communis*; *Acacia cyanophylla*; *Solanum sp*; *Robinia pseudoacacia* are allochthonous species that arrive to play a physiognomic role in communities, and contributes to the procession of hygrophilous associated species such as (*Typha latifolia*; *Juncus maritimus*; *Arundo donax*; *Carex sp*).

The positive side dominated by the thorny xerophytic species, while the negative side contains hygrophilous species. This axis translated a moisture gradient in the opposite direction of the axis.

### Significance

This work is intended to identify the riverine vegetation that exists in the region of Tlemcen, it led a floristic survey field to quantify species riverine forest by excellence, for this they used a MINITAB

software to bring out any riverine species on relationship with *Tamarix africana*.

For the first time has been a statistical study on vegetation riparian forest, which aims to determine species faithful of the Wadi is supporting drought, if it of course dry periods and also to develop the territory of Wadi Tafna in the Tlemcen region.

The goal is to complete a comprehensive inventory of the vegetation of the region of Tlemcen.

### Conclusion

The riverine forest formations are relatively more complex and are integrated into a few separate units, since depending on whether they are related to fresh or brackish water, communities vary: these thickets consist of *Tamarix africana* and *T. gallica* (*Tamaricion africanae*) to the West and South.

Gamisans [9] has defined various groups organizing themselves around *T. africana*; the *Tamaricetum gallicae*. Braun-Blanquet and Bolòs [18] are also in the Western Mediterranean. Halophilic Tamaricaceae are very much present in Spain and the South of the Mediterranean where various groups have been defined by Rivas-Martínez et al. [12]. The rate of soil salinity is a preponderant factor in the distribution of riparian vegetation in bioclimates semi-arid and arid as well demonstrated Salinas et al. [19].

In Western Algeria, riverine forest is complex and fragile environments to multiple utilities.

- The riverine vegetation of great diversity and developed root system will promote the anchor, so limiting the erosion of the banks.
- The riparian forest has a vocation of ecotone: buffer zone, interface between the floodplain and stream water (water quality).
- The riparian forest is a mosaic of environments complex and interactive, fruit of the influence of the course of water and human. All of these structures of vegetation have suffered and suffered heavy damage under the influence of anthropogenic actions of all kinds. Despite the very large global ecological value of these eco-complex, they are unfortunately almost everywhere away from interim measures while threats remain very strong.

The inadequacy of our knowledge of the biology and ecology of riverine forest of our region requires a multiscale and multidisciplinary study to better understand the structure and operation of all of the relevant hydro-system.

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