Biodiversity and Ecology of Mosses in Northeastern Algeria: Case of the Watershed Tonga.

Biodiversité et écologie des mousses au Nord-Est Algérien : cas du bassin versant du Lac Tonga.

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ملخص

تقع الحديقة الوطنية للقالة أقصى الشمال الشرقي من الجزائر. تحمل مجموعة من النظم البيئية الطبيعية من الأحياء المائية البحرية إلى الغابات، ويمر من نوع البحيرات المائية. حوض بحيرة تونغا ه و جزء من هذه المجموعة. نظرا لتنوع النباتات الحزازية وبعدها من مختلف مصادر التلوث، ستة وعشرون محطة كانت محور هذه الدراسة،أين تم الكشف على مئة و ثلاثة و خمسون صنف من الحزازيات. من الجهة الموغفولوجية أو الشكلية تم تقسيم الأصناف المدرجة إلى مئة و سبعة صنف وحيدة التفرع وستة و أربعون متعددة التفرع و من الجهة المنهجية تم إدراج هذه الأصناف إلى ستة و أربعون عائلة. نظرا لأهمية النتائج يمكننا القول بأن حوض بحيرة تونغا تحتوي على مجموعة هائلة من الحزازيات.

الكلمات المفتاحية. الحزازيات - *الأصناف المدرجة - بحيرة تونغا - شمال شرق الجزائر.*

Résumé

Le parc national d'El-Kala est situé à l'extrême Nord-est de l'Algérie, Il renferme un ensemble d'écosystèmes naturels allant de l'aquatique maritime au forestier en passant par le type aquatique lacustre. Le bassin versant du lac Tonga fait partie de cet ensemble de paysages. Compte tenu de la diversité des bryophytes et de l'éloignement des différentes sources de pollution, vingt-six stations, appartenant aux différentes formations forestières, ont fait l'objet de notre étude. L'inventaire floristique a révélé l'existence de cent cinquante-trois espèces de mousses. D'un point de vue morphologique, les taxons répertoriés sont divisés en cent sept acrocarpes (sporophytes situés aux sommets des rameaux de la tige)et quarante-six espèces pleurocarpes (sporophytes se développent latéralement aux tiges), d'un point de vue systématique représentés par vingt-neuf familles botaniques ,Nous pouvons déduire alors que le bassin versant du Lac Tonga est riche en bryophytes.

Mots clés : Mousses – Inventaire - Bassin versant - Lac Tonga - Nord-est Algérien.

Abstract

The national park of El-Kala is located in the extreme North-east of Algeria. It holds a set of natural ecosystems from the maritime aquatic to the forests, passing by the aquatic lacustrine type. The Tonga lake watershed is a part of this set of landscape. Taking into account the diversity of bryophytes and the remoteness of the various sources of pollution, twenty-six stations from different forestal formations were the subject of our study. The inventory revealed one hundred fifty-three mosses species. From a morphological point of view, the listed taxa are divided into one hundred seven acrocarpous (sporophytes located at the tops of the branches of the stem) species and forty-six pleurocarpous (Sporophytes develop laterally to the stems)species, while from a systematic point of view, with twenty-nine families, We can then deduce that the watershed of Lake Tonga is rich in bryophytes.

Key words: Mosses– Inventory – Watershed -Tonga Lake - North-east of Algeria.

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1. INTRODUCTION

El-Kala National Park Management Plan drawn up by Benyacoub *et al*., 1998 [1], revealed the existence of a remarkable biodiversity Characterized by the presence of several endemicrare species, an important mosses study was conducted.

Mosses are ancient plants, rather discrete and unknown, making the evolutionary transition between the algae (all with thallus) and the vascular or superior plants (all with typical stem), such as *pteridophyta* (ferns and horsetails) and flowering plants, and like the majority of non-vascular plants, they constitute a vast universe of approximately 10 000 species around the world [2,3].

Most people assume that mosses grow only in humid shady places. In fact, mosses may appear larger and more abundant in the woods.There are various factors that affect the growth and distribution of mosses. Examples of such factors are climate (including aspects such as yearly temperature and rainfall ranges), substrate chemistry (e.g. whether it is alkaline or acidic), physical factors such as surface texture, umbrage degree, the nature of the surrounding vascular plants and pollution levels [4].

The inventory of the bryophytic wealth is of particular interest in the watershed where the quality of the soil and humid habitats are subjected to an anthropic pressure that is not compatible with the conservation of this capital [5].

The aim of this study is to compile a list of the mosses flora of the national park of El-Kala. A random stratified sampling design was established, we based on the guides to do the identification[5]. The nomenclature of the presented species is based on Hill et al. (2006).

2. MATERIALS AND METHODS

2.1. The study area

In the extreme North-east of Algeria locates a great set of landscape where bioclimatic vegetation levels range from sub-humid to wet, generating a nuance of the ecosystem. This set has quickly attracted the attention of the national authorities in 1983, they turned a part of it (78400 ha) into a National Park called the Park of El-Kala that became international in 1992 and was classified as a biosphere reserve [7]. The importance of this area is in the diversity of its ecosystems which contain the most important humid complex in Algeria. The Ramsar convention on the wetlands of international interest recognizes eight sites including the lake Tonga [1].

The Tonga Lake Watershed

Geographic Location

Covering an area of 15000 ha, with geographical coordinates: Latitude 36°51’37’’ N, longitude 8°29’52’’ E, bordered to the West by the water division line which separates the two watersheds of the lakes Tonga and Oubeira, to the North by a dune ridges line, to the East by the Algerian-Tunisian borders and finally to the West by the heights of El-Aioune and Djebel El-Ghora (Fig. 1) [8].

Geology

The watershed of Tonga consists of various geological formations:marsh soils made of silts of shallows, silty alluviums made of sand and silt.Pontian formations made of conglomerates of argillaceous cements, quartz and whitish sandstones of Numidia forming abrupt reliefs, Numidian clays made of schistose argillaceous marl, clays, sandstones and black lime stones from the middle Eocene which constitute the foothills surrounding the lake [9, 10].The origins oflakeTonga are from the Quaternary, tectonic movements enabled the digging of its bowl down to the sea [11].

Geomorphology

The Tonga lake watershed is characterized by a significant height (9% of low slopes, 11% of average slopes and 80% of strong and vigorous slopes). It also constitutes a physiognomy of mountain landscape that is strongly dissected by a dense set of streams.Their average altitude varies, in North from 75 to 100 m of dune ridges altitude, in the West, it does not exceed 171 m, in the East, the sandstones culminate to an altitude of 530 m (Kef Radjala), 573m (Kef Baba brik) and to 594 m (Kef Eddemenn), in the South, the heights of El-Aioune (Djebel Kourima and Kef El-Hammam) 561 m[12].

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Climate

Climate research on the humid complex of El-Kala revealed its origins. According to de Belair (1990) [7], this complex is found in the temperate sub-humid in the North, in the moderate humid and the hot humid in the North-east, in the temperate humid in the South and in the East, and in the hot and temperate humid in the West on western hills.Thus, it is a real mosaic of bioclimatic levels that we have to explore.
Joleaud (1946) [10] wrote that El-Kala has the biggest analogy among the living environments in Southern France and Algeria. Durand (1954) [14] compared this region to the atlantic regions with temperate climate. It is this climatic mosaic with its extraordinary botanic origins and environmental diversity that made Joleaud write (1936) [10]"unlike the majority of these countries, this region has conserved the pure traces of ancient North African tropical climate, juxtaposed here and related to a community of flora and fauna in an openly preponderate European affinity. This is the wonderful biogeographical dual character of the extreme Algerian North-east".

Pedology

The study on soils, conducted by Durand (1954) [14] in the Tonga lake watershed, permitted to highlight a number of soils that were grouped into two major categories: zonal and azonal soils, according to defined natural conditions. The described types are: dune soils, marsh soils in the central part of the lake, peat soils at the alders in the North of Tonga, prairie soils, solods, acid soils, alluvial soil and saturated soils. A study was conducted by B.N.E.H. (1983) [15], refined Durand's study in some way. It focused on the rivers of the lake Tonga and the estuaries of its two rivers (El Hout and El Eurg) and retained only three soil types: regosols, hydromorphic gley soils, and vertic soils.

Vegetation

The forestall formation of the Tonga lake watershed is related to the presence of a substratum of an acidic origin [16]. Thus, the sandstone hills are mostly covered with cork oak "*Quercus suber*", and exceptionally, mixed Maritime pine or Cluster pine "*Pinus pinaster* Aiton" in the North-east until Djebel Segleb which totally supplants it by place. We also observe Portuguese oak "*Quercus faginea* Lam." in the North, along with Djebel Haddada until Djebel Kourima, forming pure micro-settlements located in cool valleys [7]. Dunes, situated in the West of Messida, are occupied in whole by maritime pines andStone pine, is also called the Italian stone pine, Umbrella pine and Parasol pine "*Pinus pinea* L.".The kermes oak "*Quercus coccifera* L" is found in scattered settlements playing the role of the fixer of dune clusters [17]. The marshy meadows, which are not occupied by agriculture, are covered by Knotgrass, Water finger-grass, Couch paspalum, Eternity grass, Gingergrass, and Thompson grass "*Paspalum distichum* L." grass is present everywhere around the lake [18]. To the North of the lake there is an alder area Common alder, Black alder, European alder or just Alder "*Alnus glutinosa*(L.) Gaertn." which extends over approximately 37 ha. The nearly tropical climate of this place is particularly favorable for the growth of bald cypress "*Taxodium distichum* (L.) Rich." Cotton wood Eastern cottonwood or Necklace poplar *"Populus deltoids* W.Bartram ex Humphry Marshall ", field elm Wych elm or Scots elm "*Ulmus campestris* L. Mill., Wilkomm" = "*Ulmus glabra*Huds." and *Acacia*, commonly known as the wattles or acacias[19]. The major part of the area of the lake is covered with emergent aquatic vegetation which defines the marshes, this vegetation of *phragmites*, *Typha*, Punks, or Corn dog grass, Bulrushes (*Cyperaceae*) and Willows, also called sallows, and osiers, provides security and nesting sites for several water birds species [12,20,21].

2.2. Sampling methods Tonga Lake (Stations)

Based on the criteria that are related to climate (reference station), geomorphology (surface type, slope, exposure), geology (nature of the parent rock), vegetation (type of plant formation, collection, dominant species), and human influences (remediation, irrigation…), 26 stations were described within five defined strata (Tab.1 and Fig.1).

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Table 1: Geographic coordinates of the sampled stations.

	Stations	**Latitude**	**Longitude**	**Altitude (m)**
1	Douar Brabtiya koudiet deidei	36°52'46.23"N	8°28'39.31"E	90
2	Mechta Tonga	36°52'46.42"N	8°29'41.47"E	5
3	Djebana fed smar	36°52'45.57"N	8°31'2.41"E	9
4	Mechta oum chtoub	36°53'40.91"N	8°32'23.87"E	10
5	Koudiet el arneb	36°53'20.52"N	8°33'29.68"E	16
6	Mechta el khenga	36°53'18.83"N	8°34'44.15"E	117
7	Kef el Assa	36°54'9.29"N	8°34'41.52"E	118
8	Kef el medjouba	36°53'34.26"N	8°36'18.39"E	71
9	Mechta Segleb	36°54'30.33"N	8°36'33.42"E	170
10	Chaaba greiriya	36°53'16.22"N	8°37'33.57"E	406
11	Kef oum Teboul	36°52'39.31"N	8°34'30.96"E	109
12	Friga	36°52'7.70"N	8°35'43.99"E	105
13	Mechta el mzara	36°52'0.42"N	8°33'23.01"E	78
14	Ain bergougaya	36°51'7.38"N	8°35'8.90"E	273
15	Mechta tounsiya	36°50'55.19"N	8°32'23.64"E	67
16	Kef el hammem	36°50'18.90"N	8°33'44.77"E	410
17	Ain eddemna	36°50'10.62"N	8°36'15.04"E	290
18	Djebana sidi saleh	36°49'43.24"N	8°34'57.98"E	265
19	Chabet mrez	36°49'34.61"N	8°32'43.72"E	88
20	Mechta oued el hout	36°49'2.18"N	8°30'37.85"E	78
21	Mechta medjour	36°49'21.66"N	8°29'6.51"E	40
22	koudiat el ouardi	36°48'47.65"N	8°27'36.65"E	70
23	Koudiat chenata	36°49'47.30"N	8°28'10.67"E	7
24	Mechta fed emrad	36°50'14.33"N	8°27'32.10"E	22
25	Koudiat eddoura	36°51'29.36"N	8°27'58.60"E	55
26	Kef mezila	36°52'13.52"N	8°29'26.79"E	16

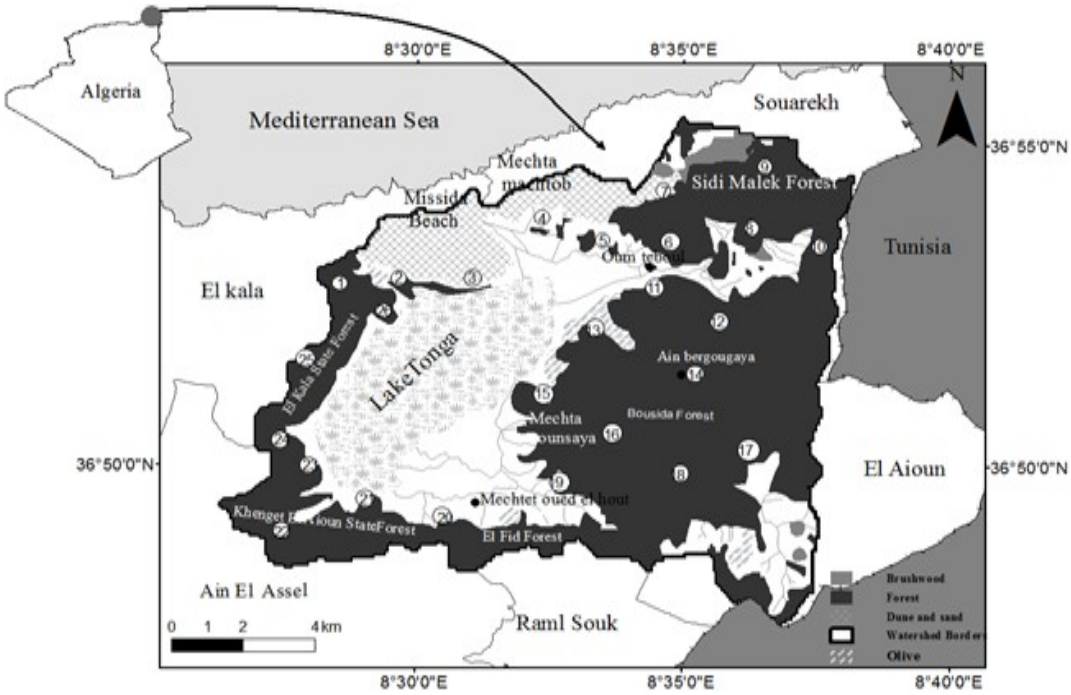

Figure 1: Localization of the survey stations in the Tonga lake watershed.

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3. RESULTS AND DISCUSSION

3.1. Mosses inventory

The inventory conducted in the Tonga lake watershed revealed high specific diversity (153 species).

1. *Acaulon muticum* (Hedw.) Müll. Hal.
2. *Acaulon triquetrum* (Spruce) Müll. Hal.
3. *Antitrichia californica* Sull.
4. *Archidium alternifolium* (Hedw.) Mitt.
5. *Barbula arcuata* Griff.
6. *Barbula bolleana* (Müll. Hal.) Broth.
7. *Barbula convolute* Hedw.
8. *Barbula indica* (Hook.) Spreng.
9. *Barbula unguiculata* Hedw.
10. *Bartramia pomiformis* Hedw.
11. *Bartramia stricta* Brid.
12. *Brachymenium commutatum* (Müll. Hal.) A. Jaeger
13. *Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen
14. *Brachythecium rivulare* Schimp.
15. *Brachythecium rutabulum* (Hedw.) Schimp.
16. *Brachythecium salebrosum* (Hedw.) Schimp.
17. *Bryoerythrophyllum recurvirostrum* (Hedw.) P.C.Chen
18. *Bryum argenteum* Hedw.
19. *Bryum cellulare* Hook.
20. *Bryum dichotomum* Hedw.
21. *Bryum funkii* Schwägr.
22. *Bryum gemmiparum*De Not.
23. *Bryum kunzei* Hornsch.
24. *Bryum radiculosum* Brid.
25. *Calliergonella cuspidata* (Hedw.) Loeske
26. *Campylopus brevipilus* Bruch & Schimp.
27. *Campylopus flexuosus* (Hedw.) Brid.
28. *Campylopus introflexus* (Hedw.) Brid.
29. *Campylostelium strictum* Solms
30. *Ceratodon purpureus* (Hedw.) Brid.
31. *Cinclidotus aquaticus* (Hedw.) Bruch & Schimp.
32. *Cinclidotus fontinaloides* (Hedw.) P. Beauv.
33. *Cirriphyllum crassinervium* (Taylor) Loeske& M. Fleisch.
34. *Cratoneuron filicinum* (Hedw.) Spruce
35. *Crossidium aberrans* Holz. & E.B. Bartram
36. *Crossidium crassinervium* (De Not.) Jur.
37. *Crossidium laevipilum* Thér. & Trab.
38. *Crossidium squamiferum* (Viv.) Jur.
39. *Cryphaeahete romalla* (Hedw.) D. Mohr
40. *Ctenidium molluscum* (Hedw.) Mitt.
41. *Cynodontium bruntonii* (Sm.) Bruch & Schimp.
42. *Dialytrichia mucronata* (Brid.) Broth.
43. *Dicranella heteromalla* (Hedw.) Schimp.
44. *Dicranella varia* (Hedw.) Schimp.
45. *Dicranoweisia cirrata* (Hedw.) Lindbex. Milde.
46. *Dicranum scoparium* Hedw.
47. *Dicranum tauricum* Sapjegin
48. *Didymodon acutus* (Brid.) K. Saito
49. *Didymodon australasiae* (Hook. & Grev.) R. H. Zander
50. *Didymodon fallax* (Hedw.) R.H. Zander
51. *Didymodon insulanus* (De Not.) M.O. Hill

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52. *Didymodon rigidulus* Hedw.
53. *Ditrichumf lexicaule* (Schwägr.) Hampe
54. *Drepanocladus aduncus* (Hedw.) Warnst.
55. *Encalypta vulgaris* Hedw.
56. *Entosthodon convexus* (Spruce) Brugués
57. *Entosthodon duriaei* Mont.
58. *Epipterygium tozeri* (Grev.) Lindb.
59. *Eucladium verticillatum* (With.) Bruch & Schimp.
60. *Fabronia pusilla* Raddi
61. *Fissidens bryoides* Hedw.
62. *Fissiden scrassipes* Wilson *ex* Bruch & Schimp.
63. *Fissidens crispus* Mont.
64. *Fissiden sdubius* P. Beauv.
65. *Fissidens ovatifolius* R. Ruthe
66. *Fissidens pusillus* (Wilson) Milde
67. *Fissidens taxifolius* Hedw.
68. *Fissidens viridulus* (Sw. *ex* anon.) Wahlenb.
69. *Fontinalis antipyretica* (Hedw.)
70. *Funaria hygrometrica* Hedw.
71. *Funaria microstoma* Bruch *ex* Schimp.
72. *Funariella curviseta* (Schwägr.) Sérgio
73. *Grimmia anodon* Bruch & Schimp.
74. *Grimmia capillata* De Not.
75. *Grimmia crinita* Brid.
76. *Grimmia orbicularis* Bruch *ex* Wilson
77. *Gymnostomum calcareum* Nees & Hornsch.
78. *Gymnostomum viridulum* Brid.
79. *Habrodon perpusillus* (De Not.) LIndb.
80. *Homalia lusitánica* (Hedw.) H.Rob.
81. *Homalia trichomanoides* (Hedw.) Brid.
82. *Homalothecium aureum* (Spruce) H.Rob.
83. *Homalothecium philippeanum* (Spruce) Schimp.
84. *Homalothecium sericeum* (Hedw.) Schimp.
85. *Hygroamblystegium tenax* (Hedw.) Jenn.
86. *Hymenolom acrispulum* (Hedw.) Ochyra
87. *Hypnum cupressiforme* Hedw.
88. *Hypnum imponens* Hedw.
89. *Hypnum jutlandicum* Holmen & E. Warncke
90. *Isothecium alopecuroides* (Lam. *ex* Dubois) Isov.
91. *Kindbergia praelonga* (Hedw.) Ochyra
92. *Leptodon smithii* (Hedw.) F. Weber & D. Mohr
93. *Leucodo nsciuroides* (Hedw.) Schwägr.
94. *Microbryum davallianum* (Sm.) R.H. Zander
95. *Microbryum starckeanum* (Hedw.) R.H. Zander
96. *Mnium stellare* Hedw.
97. *Nogopterium gracile* (Hedw.) Crosby & W.R. Buck
98. *Orthothecium intricatum* (Hartm.) Schimp.
99. *Orthotrichum affine* Schrad. *ex* Brid.
100. *Orthotrichum anomalum* Hedw.
101. *Orthotrichum cupulatum* Hoffm. exBrid.
102. *Orthotrichum lyellii* Hook. & Taylor
103. *Oxyrrhynchium hians* (Hedw.) Loeske
104. *Oxyrrhynchium speciosum* (Brid.) Warnst.
105. *Palustriella falcate* (Brid.) Hedenäs
106. *Philonotis caespitosa* Jur.

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107. *Philonotis capillaris* Lindb.
108. *Philonotis Fontana* (Hedw.) Brid.
109. *Philonotis marchica* (Hedw.) Brid.
110. *Philonotis tomentella* Molendo
111. *Plagiomnium rostratum* (Schrad.) T. J.Kop.
112. *Pleuridium acuminatum* Lindb.
113. *Pogonatum nanum* (Hedw.) P.Beauv.
114. *Polytrichum commune* Hedw.
115. *Polytrichum juniperinum* Hedw.
116. *Polytrichum strictum* Menzies ex Brid.
117. *Pseudocrossidium hornschuchianum* (Schultz) R.H. Zander
118. *Pseudocrossidium revolutum* (Brid.) R.H. Zander
119. *Pterygoneurum ovatum* (Hedw.) Dixon
120. *Ptychostomum capillare* (Hedw.) Holyoak & N. Pedersen
121. *Racomitrium aciculare* (Hedw.) Brid.
122. *Rhizomnium punctatum* (Hedw.) T.J.Kop.
123. *Rhynchostegiella curviseta* (Brid.) Lindb.
124. *Rhynchostegiella litorea* (De Not.) Limpr.
125. *Rhynchostegiella tenella* (Dicks.) Limpr.
126. *Rhynchostegium riparioides* (Hedw.) Cardot
127. *Schistidium agassizii* Sull. & Lesq.
128. *Schistidium crassipilum* H.H. Blom
129. *Schistidium flaccidum* (De Not.) Ochyra
130. *Scleropodium touretii* (Brid.) L.F. Koch
131. *Scorpiurium circinatum* (Bruch) M. Fleisch. & Loeske
132. *Scorpiurium deflexifolium* (Solms) M. Fleisch. & Loeske
133. *Sphagnum auriculatum* Schimp.
134. *Syntrichia handelii* (Schiffn.) S. Agnew & Vondr.
135. *Syntrichia laevipila* Brid.
136. *Syntrichia montana* Nees
137. *Syntrichia papillosissima* (Copp.) Loeske
138. *Syntrichia ruralis* (Hedw.) F. Weber & D. Mohr
139. *Syntrichia virescens* (De Not.) Ochyra
140. *Thamnobryum alopecurum* (Hedw.) Gangulee
141. *Timmiella barbuloides* (Brid.) Mönk.
142. *Tortella flavovirens* (Bruch) Broth.
143. *Tortella humilis* (Hedw.) Jenn.
144. *Tortella nitida* (Lindb.) Broth.
145. *Tortella tortuosa* (Hedw.) Limpr.
146. *Tortula canescens* Mont.
147. *Tortula marginata* (Bruch & Schimp.) Spruce
148. *Trichostomum brachydontium* Bruch
149. *Trichostomum crispulum* Bruch
150. *Weissia brachycarpa* (Nees & Hornsch.) Jur.
151. *Weissia condensa* Lindb.
152. *Weissia rutilans* (Hedw.) Lindb.
153. *Zygodon rupestris* Schimp. *ex* Lorentz

3.2.Physiognomic spectrum of mosses taxa sampled in the study area

The physiognomic examination of the mosses species list reveals that the category of acrocarpous is larger with 107 species. Species while for the category of pleurocarpous, there are only 46 species (Fig. 2).

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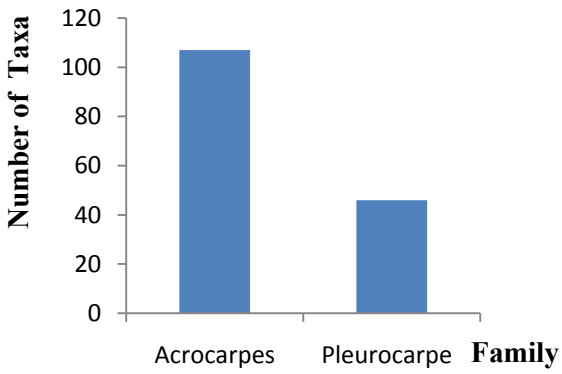

Figure 2: Physiognomic spectrum of mosses taxa observed in the watershed of lake Tonga.

3.3. Systematic spectrum of Mosses taxa sampled in the study area

The 153 species belong to 29 families, the most dominant are the *Pottiaceae* with 46 species, *Brachytheciaceae* with 18 species, *Bryaceae*, *Hypnaceae* and *Grummiaceae* with 9 species for each one (Fig. 3).

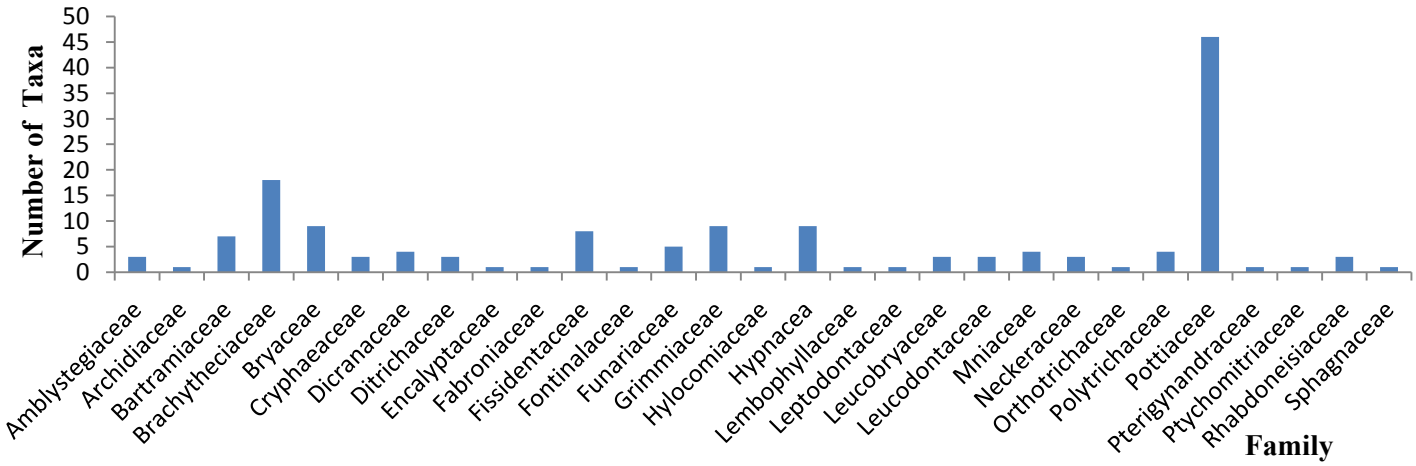

Figure 3: Systematic spectrum of mosses taxa observed in the lake Tonga watershed.

3.4. Discussion

The North-east of Algeria contains several hundreds of mosses species (153 species), which occupy both terrestrial and aquatic biotopes (freshwater to slightly brackish waters), the species presented in this work relate only to the forestal environments in the watershed of lake Tonga [22].

Barbulas are a part of the numerous species these genera has in the area, this explains the attraction those species have to temperate climates and even to the hot one. This genus has a wide distribution worldwide, From the East and Central Asia to the South-west (Turkey), passing by North Africa, Central America, North America and Australia [23], five species were counted: *B. arcuata, B. bolleana, B. convoluta, B. indica, et B. unguiculata.Epipterygiums* and *Negopterium* grow exclusively on trees or on rocks; the species of these two related genera are not many. *Fissidens* are relatively small mosses compared to other mosses in the region [24];they are represented by eight species: *F. bryoides*, *F. crassipes*, *F. crispus*, *F. dubius*, *F. ovatifolius*, *F. pusillus*, *F. taxifolius* and *F. viridulus*. The watershed oflake Tonga is rich in species from *Grimmia* genus but many of them are rare [25], such as: *G. anodon*, *G. capillata*, *G. crinite* and *G. orbicularis*. Two species of *Orthotrichum* genus are strongly represented: *O. affine* and *O. lyellii*. The *Phascaceae*, which live in cultivated fields, are totally lacked in the explored territory and disappear near to high mountains [5]. The *Sphagnaceae* are very rare, we only found one species of this group, that is: *Sphagnum auriculatum*. *Polytrichum* genus, which is hugely expanded in the Algerian North-east, is represented by: *P. commune*, *P. juniperinum* and *P. strictum*. *Scorpiurium*and *Bryumfenera* are much alike in all regions, many representatives, yet this

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second genus is not as widespread as it is supposed to be. *Syntrichia* genus has two distinctive habitats;*S. ruralis* grows on wet rocks,while dry rocks give shelterto: *S. handelii*, *S. laevipila*, *S. papillosissima*, *S. virescens* and *S. montana*, the latter prefers sandy soils[26].*Weissiaceae* are represented by a lot of species, like *W. brachycarpa*, *W. condensa* and *W. rutilans*. Pleurocarpous mosses with forty-six species often overlap the edge of streams in shady places or form small green islets around trees. In wet meadows, some cling to the oaks trunks, others like orchards and hedges, some species do not leave marshes; they live in running water or on stones and rocks that are constantly inundated [27]. Specific species are found in exposed soils, whereas the majority look for the forest's umbrage. However, we found species that are hard to spot and that rise in various habitats, such as *Hypnum cupressi forme*, but the number of these mosses has enormously reduced.Pleurocarpous species that are most spread in the watershed are those of Brachythecium genus with three species: *B. rutabulum*, *B. salebrosum*, and *B. Rivulare*,the latter exists in almost all regions, it also appears on the borders of *Spermatophytes* (Phanerogams) vegetation, it grows much more on high mountains rather than the grounds of rural areas [28].
This prompts us to value and protect this heritage and this bryophytic richness that was always neglected despite its importance in many fields.

4. CONCLUSION

The inventory of mosses in the North-east of Algeria is an important contribution to the knowledge of Mediterranean mosses, from a floristic point of view; one hundred fifty-three taxa were identified, reflecting the biodiversity of the Tonga lake
watershed. This floristic richness, confirmed by the number of identified species, is to be compared with inventories from other Mediterranean countries (Italy, Spain, Greece, and Turkey).
There should be more such studies on the three branches of bryophytes (Mosses, liverworts and hornworts) in all the regions of the Maghreb, in order to define the forestal wealth and enrich the list of specific bryophytes in sub-humid climate.

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