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Diversity and ecology of Pteridophytes in the Skikda region (North East Algeria)

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Abstract

The relative diversity and ecology of ferns the region of Skikda (North-East Algeria) were studied with the aim of documenting the pteridophytic flora and habit in this area. We have identified 25 taxa, one of this list is new to the Numidia sector (Pteris vittata L.). This flora is dominated by the rosale Hemicryptophyte biological type with either 60%. On the biogeographic level, we have 8 dominant subcosmopolite species, representing 32% of the studied flora. The rare flora of the region is presented by 10 taxa, 7 species considered as rare to very rare. According to habitat types, the species can be classified into 4 groups: terrestrials (20 species), lithophytes (11 species), epiphytes (1species) and aquatic plants (1 species).

Keywords: Skikda (North-East Algeria), Pteridophytic flora, Rosale Hemicryptophyte, Subcosmopolite, Rare flora, Habitat types.

Introduction

Pteridophytes are a group of ancient species, characterized as an important plant group in the biography with a large number of relict and endemic taxa. They provide us with much information on the evolution of plants, their components and on the evolutionary aspects of biogeography[1].

This group has a longer evolutionary history than any other vascular plant and as a result, many of the phylogenetically-informative characters may have been lost in the process. They were high in numbers during the carboniferous period (355- 290 million years ago) and dominated part of the vegetation at that time[2].

It well said that ferns are not only curiose taxonomic species, but they are plants characrterized by a dynamic relationship with their environment[3]. As a result, obviously the floristic richness of the Pteridophytes varies according to the changes in abiotic conditions of the environment, explaining why some species are considered as bio-indicators[4,5].

Some 13600 species of pteridophytes are known all around the world[6]. The list Mediterranean Pteridophytes include about one hundred species[7], nearly sixty species are present in Algeria[8,9].

The study area: The study area, Skikda, is located in the north-east of Algeria. Covering an area of 4138 km^2, it is limited from the North by the Mediterranean Sea, to the south by the wilayas (2 states) of Constantine and Guelma, to the east by the wilaya (state) of Annaba and to the west by the wilayas (states) of Jijel and Mila. It extends between the Babors massif in the west and the Edough massif in the east over 150 kilometres along the coast[10]. The plain of Skikda has a triangular shape having as a summit the outlet of the valley of the Saf-Saf[11]. This region is part of the small Kabylie which is part of the alpine chain of the Maghrebides[12].

Methods

The inventory (census) of species was carried out in the years of 2013-2016. The data information of this work is presented in the following order:

The scientific name: our identification and classification of the Pteridophytes species is based on[8,9,13]. The new classification was updated for the species surveyed in the light of recent work compiled in the synonymous and bibliographic index of the North African flora[14].

Bilogical types: Cr. Ch. (Crwling Chamephyte), Hem. ros. (Hemicryptophyte rosale), Hem. Rhiz. (Rhizomatous Hemicryptophyte), Cr. Hem. (Crawling Hemicryptophyte), Ces. Hem. (Cespitose Hemicryptophyte), Rhiz. Geo. (Rhizomatous Geophyte), Th. ros. (Therophyte rosales)[15,16].

Results and discussion

Occurrence and distribution of the Ferns: In this study, a total of 16 species of ferns belonging to 11 genera and 9 families were recorded (Table-1). With a dominance of the Asplenaceae family (7 taxa). This family is the most diversed in Numidia[17].

The majority of the taxa belongs to the rosale haemicryptophyte type with 60%, followed by rhizome geophytes (12%) and cespose hemicryptophytes, rhizome hemicryptophytes and rosales therophytes (8%) for each type, in the last position the crawling Chamephytes with 4% only. These results are comparable to those of[18], in his research on the pteridophytes of the region of Tlemcen (North-West Algeria).

On the biogeographic level, the subcosmopolitan type dominates with 8 species, representing with 32% of the registered pteridologous flora, followed by Mediterranean Atlantic and Mediterranean with 4 species for each type. The other types represent low participation, but contribute to the biogeographic diversity of the studied flora.

The number of rare Pteridophytes consists of 10 taxa (40 %) including 3 quite rare species, 4 rare species and 3 species very rare. These rare species are generally considered to have low abundance and / or a restricted range. The specific habitat, taxonomic originality and temporal persistence of species are also useful criteria in the definition of scarcity[19].

Life forms of the Ferns: Ferns occurring in the study sites were categorized into four different life forms (Figure-2). This was based on their growth habits and classification based on the habitats they occupy namely; terrestrial, epiphytes, lithophytes and hydrophytes. There were 20 taxa terrestrial species, 11 taxa lithophytes, 1 taxa for hydrophytes and epiphytes in all the five sites studied (Figure-1).

Many species have many forms of life. On this subject, the[21] reported that some species had high plasticity and occupied nearly all habitats available and occur in various life forms.

The most widespread terrestrial genera, which include 4 or more terrestrial species, is Asplenium. Many terrestrial genera with one species.

Although only the lithophyte genera Asplenium had reasonably high species diversity (four species) at this site, families with one or more lithophytic species (other than Aspleniaceae of course) included Hemionitidaceae (2 species from 1 genera), Woodwardiaceae (2 species from 1 genera), Polypodiaceae, Adianthaceae, Selaginellaceae (all three with 1 specie from 1 genera).

In addition, wetlands (mare, lake and ripisylve) contain the largest number of listed species. According to Richard et al.[22], high species composition in areas with high moisture, humidity and shaded microhabitats suggests that the species there have adaptation for the environment. The decline of the pteridophytes began. Nevertheless, this interesting group of plants, bridging the non-vascular cryptogams with the seed plants, higher in the evolutionary hierarchy, continues to occupy numerous niches on the land and in marshes and swamps and even in water bodies[23].

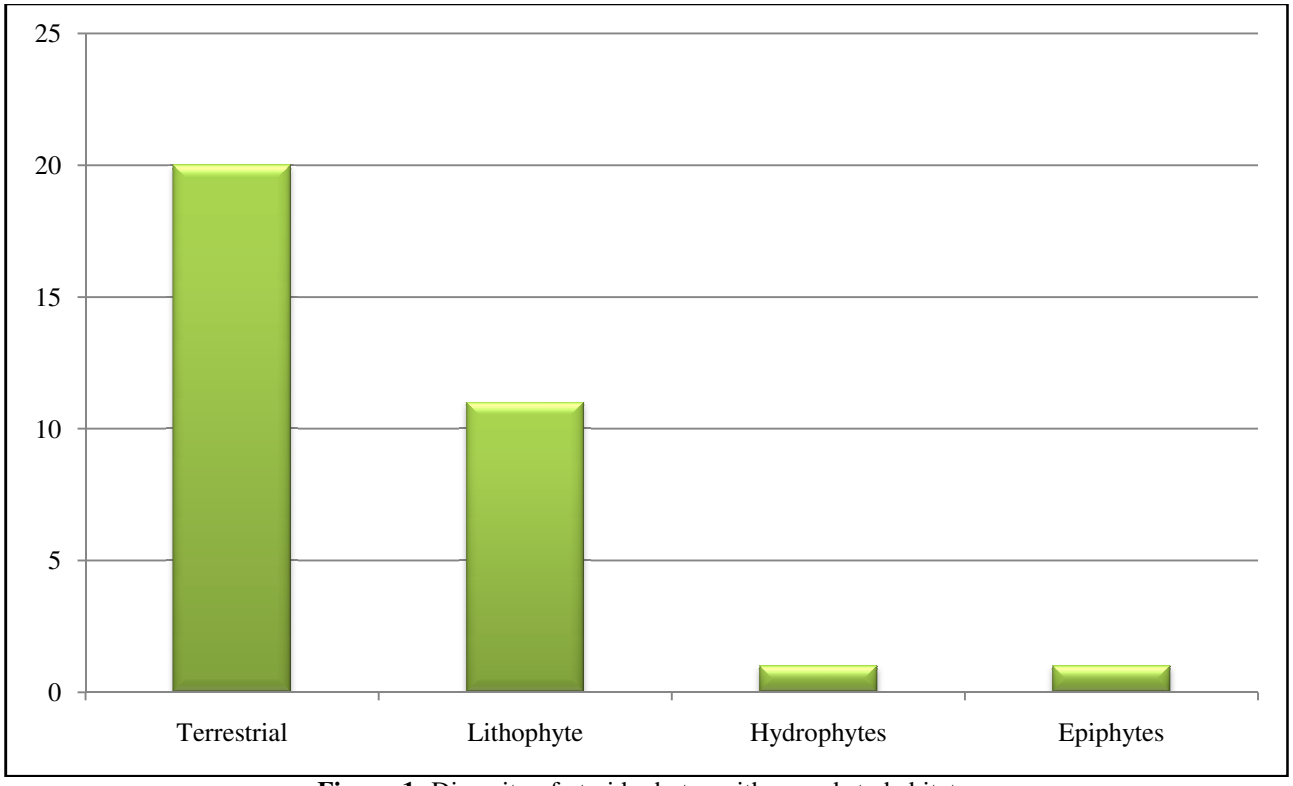

Figure-1: Diversity of pteridophytes with regards to habitats.

Table-1: List of taxa rested in the study area.

Family	Taxa	Bilogical types	Biogeographical types	Ab	Habitat and Ecology
Adianthaceae	*Adiantum capillus-veneris* L.	Rhiz. Hem	Subcosmopolite	VC	Terrestrial or lithophytes, on seasonall on shady places, in rock crevices.
Asplenaceae	*Asplenium adiantum-nigrum* L.	Hem. ros.	Euro Mediterranean	C	Terrestrial, growing under the shade.
	Asplenium obovatum Viv. subsp. *obovatum*	Rhiz. Hem	Mediterranean Atlantic	QR	Terrestrial or lithophytes. Cracks in sheltered and shaded rocks
	Asplenium onopteris L.	Hem. ros.	Euro Mediterranean	C	Terrestrial or lithophytes. Wet rocks, bushes and mountain forests
	Asplenium trichomanes L. subsp. *quadrivalens* D. E. Meyer	Hem. ros.	Circumboreal	C	Terrestrial or lithophytes. Wet forests, Cracks in shaded rocks, old and wet walls of the mountains.
	Athyrium filix-femina (L.) Roth.	Hem. ros.	Holarctic	VC	Terrestrial, grows along the canals in moist places of ripisylve.
	Ceterach officinarum subsp. *officinarum* Will.	Hem. ros.	Eurasien circummediterranean	C	Lithophytes. Old walls and dry mountain rocks.
	Phyllitis scolopendrium (L.) Newman	Hem. ros.	Mediterranean Eurosiberian	QR	Terrestrial, grows along the canals in moist places of ripisylve
Dryopteridaceae	*Polystichum setiferum* (Forsskål) Woynar	Hem. ros.	Mediterranean Atlantic	QR	Terrestrial. In front of streams, wet places of mountain.
Equisetaceae	*Equisetum ramosissimum* Desf. subsp. *ramosissimum*	Ces. Hem.	Subcosmopolite	C	Terrestrial, grows on the floor of field culture and in front of rivers
	Equisetum telmateia Ehrh	Ces. Hem.	Holarctic	AC	Terrestrial, grows on the floor of field culture
Hemionitidaceae	*Anogramma leptophylla* (L.) Link	Th. ros.	Subcosmopolite	C	Terrestrial or lithophytes. Growing in moist and shady places.
	Cosentinia vellea (Aiton) Tod.	Hem. ros.	Mediterranean	QC	Lithophytes. Crack of rocks especially limestone.
Hypolepidaceae	*Pteridium aquilinum* (L.) Kuhn	Rhiz. Geo.	Subcosmopolite	C	Terrestrial. Growing terrestrially at slopes on calcarious soil.
	Pteris vittata L.	Hem. ros.	Subcosmopolite	R	Terrestrial. In front of water and wet ravines
Isoëtaceae	*Isoëtes histrix* Bory	Hem. ros.	Mediterranean Atlantic	QC	Terrestrial.Periodically submerged soils, wet sandy pastures, edges of the plain and mountains mares.
	Isoëtes velata A. Braun subsp. *velata*	Hem. ros.	Mediterranean	VR	Terrestrial. Edges of temporary mares, freshwater lakes on sandy and peaty soil. The only known station in the area still exists has been reported by[20] at Sidi Fritis

Family	Taxa	Bilogical types	Biogeographical types	Ab	Habitat and Ecology
					Lake (15m) (036°54′04.58″N ; 007°17′23.86″E).
Ophioglossaceae	*Ophioglossum lusitanicum* L.	Rhiz. Geo.	Mediterranean	R	Terrestrial. Wet shady forests of *Pinus pinaster* Aiton
Osmundaceae	*Osmunda regalis* L.	Hem. ros.	Subcosmopolite	C	Terrestrial. Edges of rivers and streams of well-rained mountains.
Polypodiaceae	*Polypodium cambricum* L. subsp. *cambricum*	Rhiz. Geo	Mediterranean Atlantic	VC	Epiphytes or lithophytes living on shady rocks, ravines and to climbing on shade trees.
Salvinaceae	*Salvinia natans* (L.) All.	Th. ros.	Paleotempere	VR	Hydrophytes. It is floating in stagnant waters (ponds or mares and lakes)
Selaginellaceae	*Selaginella denticulata* (L.) Spring	Cr. Ch.	Mediterranean	VC	Terrestrial or lithophytes. Frequent on rocks, damp and shady ravines of the plain and mountain.
Thelypteridaceae	*Thelypteris palustris* Schott	Hem. ros.	Subcosmopolite	VR	Terrestrial. The only station already known in Aulnaie de Damnet Ataoua on a peat environment according to de Bélair and Véla (unpublished).
Woodwardiaceae	*Cystopteris diaphana* auct. non Bory	Hem. ros.	Subtropical	R	Terrestrial or lithophytes. Riverbanks and cracks of wet mountain rocks
	Cystopteris fragilis subsp. (L.) Bernh. *fragilis*	Hem. ros.	Subcosmopolite	R	Terrestrial or lithophytes. Fissures des roches ombragées de maquis et surtout des montagnes.

C : Common, Q : Quite, R : Rare, V: Very

New records: It was found that one specie each is new records for sector Numidia K3 (According to the subdivision proposed by[9]):

Pteris vittata L. It is important to note that this newly recorded species were found only once at one location and in rather small numbers (Figure-2).

However, this species is presented in the flora of[8] and[9] in the area of K2, A2, O1 (the Andalusians). It should be noted that the preferred habitats of this species are wet ravines and oozing rocks on the coast and in the mountains up to 800 m, in limestone and siliceous soil.

This species is new described for the area of Skikda and Numidia in a ripisylve at the Beach Saint Louis (15m) (036 ° 54'24.2"N; 007 ° 07'11.7"E).

Moreover, the flora of[24] indicates a station on Numidia (Figure-3), and this confirms a revision of the flora of[9].

Figure-2: Photo of *Pteris vittata* L. Beach Saint Louis 19-02-2016

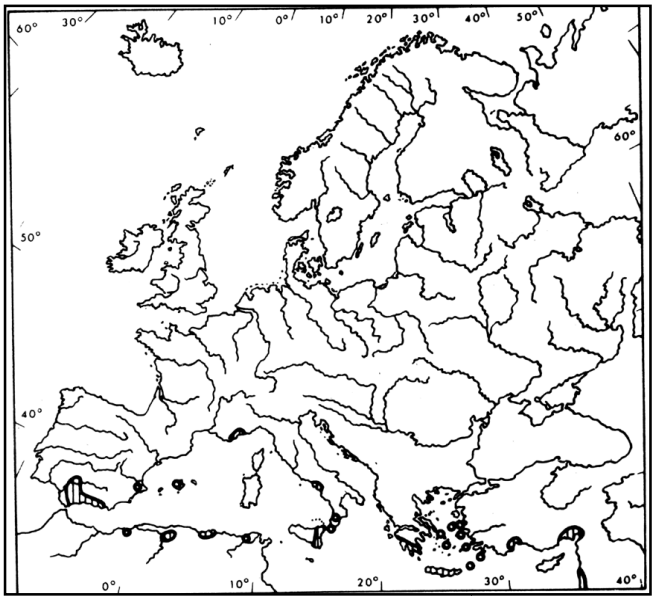

Figure-3: Distribution area of *Pteris vittata* L.

Conclusion

Our study highlighted the very rich biological and ecological richness of Skikda which is located in the center of the "Hotspots" Kabylie-Numidie-Kroumirie[25]. This location, close to the Mediterranean coast, benefits from a humid climate promote maintain with luxuriant vegetation.

The study area has more than 25 species of pteridophytes, especially considering that for the North of Algeria the total number is estimated at 58 species[14].

The many field work that we made in this area allowed us to identify plants of very rare species, serving in the process of disappearance such as: *Isoëtes velata* A. Braun subsp. *velata*, *Salvinia natans* (L.) All., *Thelypteris palustris* Schott. In this regards it is necessary to make the people aware of attendance problem and the development of the littoral.

Today, we are heading towards a botanical bank data to control this floristic cover that is close to ecological rupture (environmental stress).

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