Inventory of the lichen flora of the national park of El Kala in northeastern Algeria

Djamel Fadel[1], Rachid Djamaï[1], Aziz Laïfa[1] et Ilhem Boughambouz[2]

[1)] *Laboratoire de Biologie Végétale et Environnement, Faculté des Sciences, Département de Biologie, Université de Badji Mokhtar, Annaba. 23000, Algérie.*
[2)] *Société Canadienne Lavalin, Algérie.*

Accepté le 28/07/2010

ملخص

تتميز الحديقة الوطنية من القالة (شمال الجزائر) عن طريق التنوع الجيني الكبير. كجزء من عملنا، تابعنا تطور النباتات حزاز في ثلاث مناطق مختلفة : الساحلية، وشبه الساحلية والجبلية. استخدمنا طريقة الجمع بين الأسلوب الكلاسيكي lichéno - الاجتماعية على أساس جزئي وكامل. وقد تم تحديد 114 أصناف خاصة مع وفرة في المناطق الجبلية، تميزت الأنواع ممثل جدا Lobaria pulmonaria (لام Hoffm). المناطق التي Quercus subcoastal suber (ل) هو phorophytes الرئيسي الذي يضم النباتات حزاز crustaceous ممثلة في نوع جنس Lecanora. يتم ملؤها أساسا صنوبر pinaster (.Ait) phorophytes الأكثر وفرة في المناطق الساحلية من الأنواع من القشريات Candelariella جنس. في العام، والنباتات حزاز درس له أصل عالمية الثانوية. رصدها المكانية الزمانية وسيلة ثبت في دراسات الأثر والرصد البيولوجي من التلوث.

الكلمات المفتاحية: *التنوع البيولوجي؛ المسطح؛ ش كالا الحديقة الوطنية شمال شرق الجزائر؛ الجزائر*

Résumé

Le parc national d'El Kala (Nord est algérien) est caractérisé par une grande biodiversité génétique. Dans le cadre de nos travaux, nous avons suivi l'évolution de la flore lichénique dans trois zones différentes : côtière, sub-côtière et montagneuse. Nous avons utilisé une méthode combinée lichéno-sociologique basée sur la méthode classique partielle et intégrale. 114 taxa ont été recensés avec une abondance particulière pour les zones montagneuses, marquée par une espèce très représentative *Lobaria pulmonaria* (L. Hoffm.). Les zones sub-côtières où *Quecus suber* (L.) est le principal phorophyte qui abrite une flore lichénique crustacée représentée par le genre *Lecanora Kind*. *Pinus pinaster* (Ait.) phorophyte le plus abondant dans les zones côtières est peuplé principalement par des espèces crustacées du genre *Candelariella*. De manière générale, la flore lichénique étudiée a une origine cosmopolite secondaire. Son suivi spatio temporel est un moyen avéré dans les études d'impacts et de la bioindication de la pollution.

Mots clés*: Biodiversité ;Lichen ; Parc National dEl Kala- nord- est algérien ; Algérie.*

Abstract

The national park of El Kala (Algerian North east) is characterized by its genetic bio-diversity, so our work was carried on the evolution of lichenic flora in the three different zones: coastal, sub-coastal and mountains. We have used licheno-sociological combined method from the partial and integral classic method. 114 taxa have been counted with a particular abundance marked in the mountainous zone (representative species: *Lobaria pulmonaria* (L. Hoffm). Sub-coastal zone where the main phorophyte is *Quercus suber* (L.) is characterised by a crustaceous lichenic flora represented by the *Lecanora kind.* In the coastal zone, the representative phorophyte is *Pinus pinaster* (Ait.) with a dominance of crustaceous species (Candelariella).Of a global manner, lichenic flora in question has sub-cosmopolitan origin; its spatio-temporal follow-up is imperative notably in studies of impact and the bio-indication of the pollution.

Key words: *Bio-diversity; Lichen; National Park of El Kala - northeastern Algeria.*

Auteur correspondant: fadeldjamel@yahoo.fr (Djamel Fadel)

1. INTRODUCTION

The National Park of El Kala has a biodiversity of flora and fauna very important. It contains not only good weather but also provided favorable media phorophytes called for the development of the lichen flora. However, each species has its own requirements and its distribution is influenced by the in the middle .As part of our work we performed a floristic approach based on the inventory of lichen flora. This is the first initiative of its kind in this area of study. It allowed us firstly to know the different lichen species which live in the area and secondly to determine the lichen species most susceptible to pollution than is commonly known species poleophobes.

The goal of our work consists in a phytosociological and systematic inventory of lichen species through three different zones of the national park of El Kala:

- Coastal zone,
- Sub-coastal zone,
- Mountainous zone.

This inventory permitted us to know the distribution of lichen species according to gradient altitudinal, to the exhibition, to the substratum and the completely distant sites of sources of pollution.

2. MATERIAL AND METHOD

2.1 Material

The material that we used for the realization of this work: altimeter, string, knife, hammer, compass, gnard of land, meter ribbon, rule, sachets and envelopes for the packing of lichens harvested as well as the various specific floras to lichens[1-3] and the chemicals reagents relating of it (KOH to 10%, paraphénylène diamine, bleach, Lugol, Iodine, Blue cotton).

2.2 Survey area

The three zones prospected within the national park of El Kala are as follow:

- The coastal zone constitutes a homogeneous station populated solely by *Pinus pinaster* (Ait.). The mean of the studied three circumferences is 80 to 90 cm; their middle height varies between 25 and 30 m. Absence of undergrowth.
- The sub-coastal zone, organized of a heterogeneous station to two principal groupings: *Quercus suber* (L.) *and Quercus faginea* (Lam.). The undergrowth is very dense and is constitued notably by *Erica arborea* (L.), *Calycotome villosa* (Poir. Link), *Arbustus unedo* (L.), *Myrtus communis* (L.), *etc…*
- Montainous zone, homogeneous zone, formed of *Quercus faginea* (Lam.) (reaching middle height of 20 m about) and located to an altitude of 850 to 1000 m. Arbustiveous and herbaceous strata are very dense and very varied. The prospected zones are represented by different altitudes: the zone I (middle altitude of 100 m); the zone II (middle altitude of 15 m) and the zone III (middle altitude of 900 m), (Fig. 1)

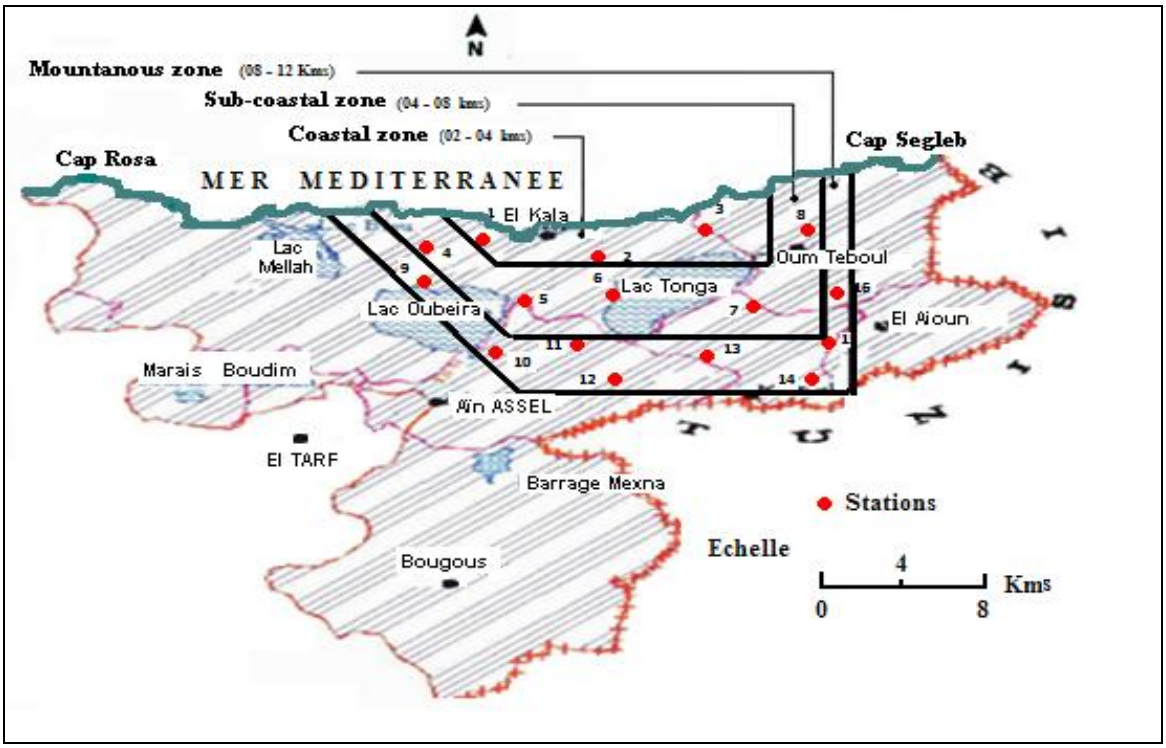

Figure 1. *Situation of the three study zones with their stations of sampling*

2.3 Different types of sampling

2.3.1 *Phytosociological sampling*

On every phorophyte, one defines the most representative face, qualitatively and quantitatively. The surface of sampling is determined by the application of measurements of the minimal area recommended by Roux [4], Roux and al. [5].

Populations to small thalleses crustacean dominants: 150 - 200 cm^2

Populations to big thalleses crustacean dominants: 300 - 500 cm^2

Populations to small thalleses foliaceous dominants: 150 - 200 cm^2

Populations to big thalleses foliaceous dominants: 500 - 800 cm^2

Populations to big thalleses squamuleux dominants: 500 - 1000 cm^2

Every quadrat to study is fixed with the help of nails implanted in the peel and string. Measurements of thalleses of every lichen species are done inside of the quadrat and to which one assigns a coefficient of sociability from 1 to 5.

2.3.2 *Systematic sampling*

On each of the four faces of the phorophyte, one identifies and/or one describes all species marked to the naked eye or the gnarl. A coefficient of recovery in percentage is assigned to every face and every species with regard to the face.

2.3.3 *Plan of sampling (adopted method)*

Several authors have used different methods. We can cite the classic method used by Braun-Blanquet [6]. But this method presents some inconveniences suggested by Roux [7]. The method of the partial taking which looks like the classic method with also some inconveniences because it doesn't permit the survey of stations or, by reason of the ecological condition heterogeneity, population occupy some reduced and dispersed surfaces[4]. A reliable and precise method is currently applicable, named method of entire taking which is based on the method of the coefficient of middle likeness and it consists in the comparison of four quadratses [8]. The advantage of this method, it is that it permits the realization of summaries qualitatively and quantitatively. We tried

to combine the three previous methods to develop a news that permitted us to win the time of it, to limit our means and to get some as reliable results that those brought by the integral method (most precise among methods already quoted). The method that we recommend consists in making a systematic summary qualitatively on the four faces of the phorophyte, a raised phytosociologic that one does on the face of the most representative phorophyte, and quantitatively. Our observations concerned different phorophytes such as *Pinus pinater* (Ait.), *Quercus suber* (L.), *Quercus faginea* (Lam.), *Fraxinus angustifolia* (Vahl.), *Cupressus sempervirens* (L.) and *Casuarina equistifolia (L.).* It is however necessary to notice that these last three species are introduced around orchards and along roadsides. They are localized in several stations of the coastal and sub-coastal zones. The statements of lichens were made at the level of each of three zones according to the presence of porophytes and their accessibility. In every station, we examined between 1 in 10 trees of the same specie which are one diameter included between 0, 30 and 1, 50 meters.

3. RESULTS AND DISCUSSION

The geographical distribution of corticoleses lichens is influenced by three principal factors: nature of the substratum, the climate and the degree of air pollution [9-11].

From the table we try to highlight some conclusions about our work. Initially, we note that some taxes are highly representative in certain zones than others. Indeed, the abundance-dominance of crustaceans, the leafy and fruticulous in the three study zones could be linked to climatic factors independently phorophytes. On the other hand the mountainous zone specific micro-climate (frequent fog) which develops phorophytes Quercus faginea (Lam.) favorable habitat for taxas such as composites, the gelatinous and squamulous. It is known that the geographical distribution of corticoleses lichens is influenced by three principal factors: nature of the substratum, the climate and the degree of air pollution [9-11]. We noticed the variability of a gas to another one as for the specific wealth in lichens and to the degree of recovery following the three prospected zones (Tab.1, Fig. 2a, 2b, 2c).

Table 1. *Physionomical spectrum of corticoleses lichens of the national park of El Kala*

Zones et Stations	Coastal			Sub-coastal					Mountainous								origin
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Taxa	Abundance — Dominance																
Crustacean	2	2	3	2	2	1	1	3	1	3	+	2	+	2	1	1	65 % Su, 30 % Co and 5% Uo
Foliaceous	1	1	3	1	2	2	2	3	1	+	1	1	2	1	3	3	40 % Su, 30 % Co and 30% Eu
Fruticulous	1	+	2	3	2	1	1	+	2	2	1	+		3	2	2	60 % Co, 30 % Su and 10 % Uo
Composite	1	+	1	2	1	1	+	1	+	+	2	1	2	+	1	1	70 % Eu and 30 % Uo
Gelatinous			+					+	+	2		1		1		1	60 % Eu and 40 % Uo
Squamulous											+			1	1	+	100 % Uo

Su: Subcosmopolite ; **Co:** Cosmopolite ; **Eu:** European ; **Me:** Mediterranean; **Uo:** Unknown origin

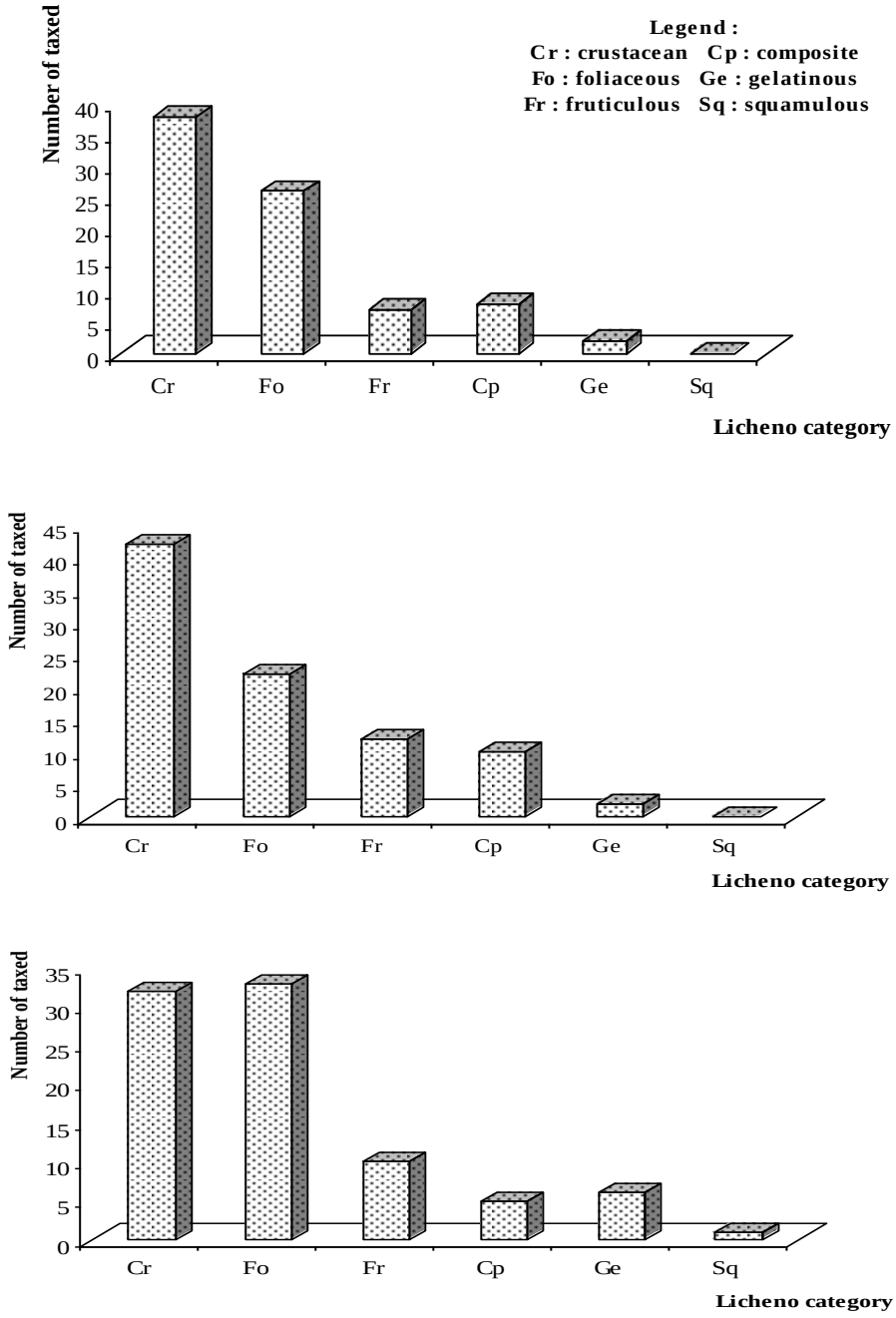

Figure 2. *Physionomical spectrum of corticoleses lichens in the three study zones*

It is bound to wealth and the specific diversity of course in our survey region [14].

Quercus faginea (Lam.) *that* is the hygrophile and ombrophile specie of altitude, regroup a flora very rich and very varied lichens (foliaceous lichens, crustacean, fruticulous, gelatinous, composite and squamulous). This phorophyte represents itself only 71% of the total number of taxed to those inventoried of where it big affinity for epiphyteses.

Quercus suber (L.) that is a gas Mediterranean photophile, to obstinate peel (except in case of demasclage every 10 years), constitute also with its 74% of the whole of taxed inventoried, a good phorophyte especially for crustaceous species.

Pinus pinaster (Ait.) that is a gas heliophile, to scaly and crumbly peel making of it a bad phorophyte (a recovery

in lichens of 25%), nevertheless, we noticed in abundance, of foliaceous and fruticolous species covering branches of

this phorophyte completely. It is influenced by the stong exhibition to light and rains.

Fraxinus angustifolia (Vahl.) especially develops itself to the humid surrounding level, it represents 24% of the whole of taxed to them; its peel has rugous aspect, of where the maintenance of a strong humidity to in the anfractuosities, preferential habitats of certain types of lichens, case of the gelatinous lichens *Collema nigrescens* (Huds. D.C) and *Collema furfuraceum* (Arnold Du Rietz) that present a strong indication of abundance-dominance, what agrees with the observation that noted that the peel situated on the opposite superior face to the dominant winds [15]. On *Casuarina equisetifolia* (L.) one records 22% of lichenic flora inventoried and 21% on *Cupressus sempervirens* (L.) In general, these last two phorophyteses are associated in the space and present opposite in general the same behaviour of groupings licheniqueses that they shelter.

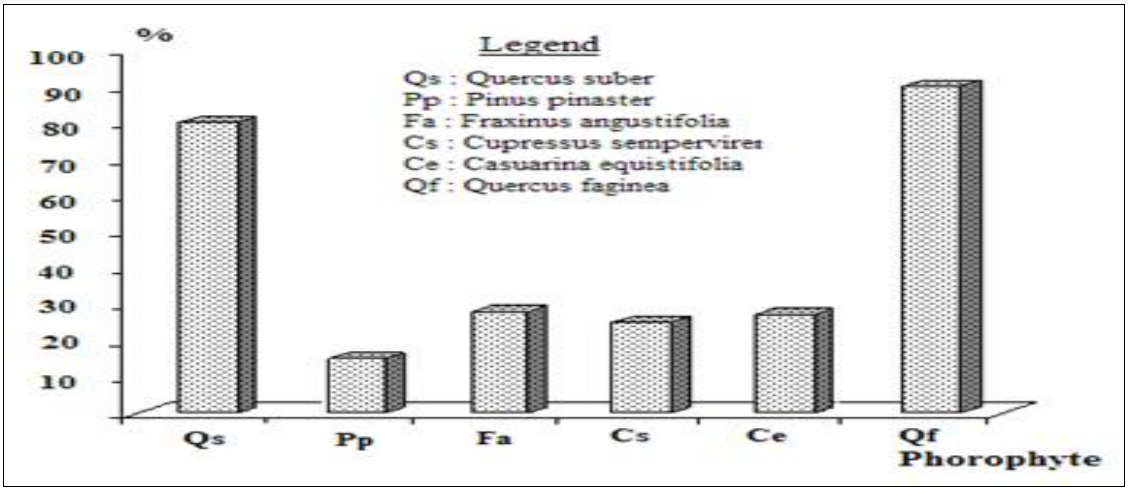

Figure 3. *Peopling of lichenic flora depending on the nature of phorophyte*

Of the fact of the number limited of lichen species and the frequency of crustaceous species, we can give out the hypothesis that the weak degree of lichenic species recovery on these two gases can be bound to the weak retention in water (limited local microclimate). Numerous hypothese have been formulated as for the variation of epiphytic flora according to the nature of the phorophyte: some authors take in consideration the relief of the peel, the habitat of trees, of others assign the difference to the toughness and the speed of peeling of the peel, and other assigns the differences floristiqueses to the relief, to the toughness, to the capacity of retention in water and to the power of condensation of the steam of water of the peel [16]. From de table, it also emerges that the altitudinal factor in three studied zones had an evident influence on the biogeographical spectre of the flora lichénique. For example, to the level of the III zone one notes 49 species subcosmopoliteses and 11 European species. The presence of these last is linked to the climatic conditions of this zone encouraged by the altitude, however species of Mediterraneen origin seem to be rare (Fig. 4). According to the table, it appears that the lichen flora of the national park of El Kala is globally homogeneous as to its origin biogeographic.

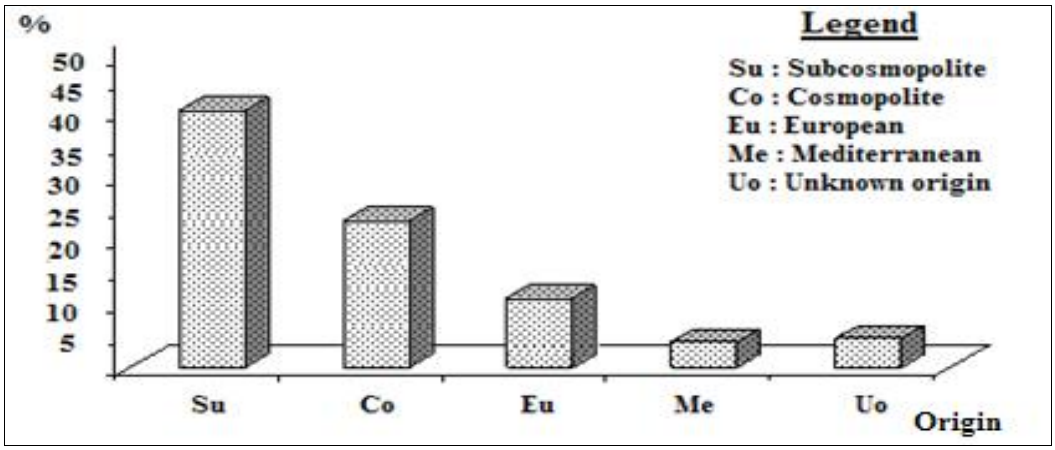

Figure 4. *Global biogeographical spectrum of corticoleses lichens of the national park of el Kala*

After having studied the spatial distribution of taxed licheniques through the three zones

of survey, we judged useful to appreciate terracings of these species according to altitudinal gradient. Among folaceous species, one signals to low altitude the dominance of *Xanthoria parietina* (L. Th.Fr.), of *Physcia adscendens (*Fr. Oliv.), *Physcia tenella* (Scop.D.C.) and *Physconia grisea* (Lamk. Poelt) and to high altitude, the dominance of the *Parmelia caperata* (L.Ach.), *Parmeli perlata* (Huds. Vain), *Parmelia dubosqui* (sp), *Parmelia sataxilis* (L.), *etc…*).We noted a meaningful interrelationship between the number of called to licheniques crustacean and the altitude, otherwise said, more one brings up in altitude and more the number of lichens crustacean increases (r = 0.394 *): for example, to 100 m of altitude one records 10 crustaceous species represented by the *Lecanora* kinds and *Lecidea* and to 35 m, 04 species in average. In the III zone (mountainous zone) that conceals an important population of *Quercus faginea* (Lam.), very important phorophyte as for lichenic recovery (91 taxa inventoried between 850 m and 1000 m).The dominant species are the follow-up foliaceous of crustaceous, then of fruticulous. However we note a very highly meaningful interrelationship between crustaceous and fructiculous species (r = 0.691).In high altitude, foliaceous species are representated by *Lobaria pulmonaria* (L. Hoffm) and *Parmelia perlata* (Huds. Vain), species crustaceous by the *Pertusaria,* as for fructicolous species, they are marked by *Evernia prunasti* (L. Auch) (Fig.5).

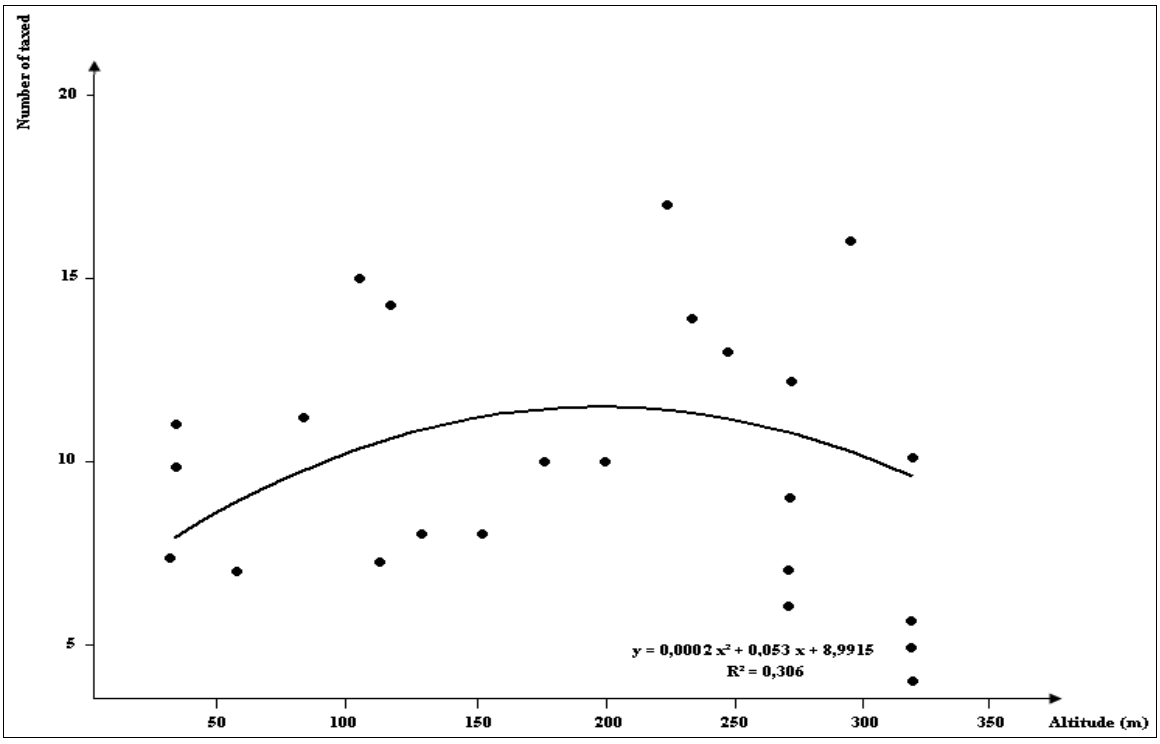

Figure 5. *Curve regression in the number of taxed in relation to altitude in the II zone*

4. CONCLUSION

The survey that we took in the National Park of Kala is the first inventoty. It followed us to raise a list of 114 lichenic taxa distributed like this: 45 crustaceous species, 35 foliaceous, 15 fruticulous, 11 gelatinous, 07 composite and 01 squamulous. We record a spatial variation in lichenic distribution; the biggest number of taxed, in the mountainous zone and subcoastal zone although the mountainous zone has been under-sampled with regard to others. Crustaceous species are marked by the *Pertusaria*, foliaceous species by the *Parmelia* and fruticulous by the *Ramalina*.

Among the different studied phorophyteses, *Quercus faginea* (Lam.) is in head as for lichenic recovery. We raised a variation as good according to altitudinal gradient are most representative. What is astonishing, it is that the European species (15) are according to the nature of the phorophyte. Among the sampled species and identified, it comes out again that species subcosmopoliteses more important times that the Mediterranean. The dynamics and the distribution of corticoleses lichens are bound closely to several factors (local climatic conditions, knowing that the region of El Kala is classifed to the international ladder among the protected humid zones), the diversity of phorophytes and the topography of the land. We consider that this draft of survey is going to be a big contribution for algerian lichenic research and will contribute to the enrichment of the Maghreb flora thus in particular and Mediterranean in general.

References

[1] P. Ozenda P et G. Clauzade, *Les lichens, étude biologique et flore illustée*, Ed. Masson, CIE, Paris, 1970, 801 p.

[2] G. Clauzade et C. Roux, *Likenoj de Okcidenta Europo. Ilustrita determinlibro*, Ed.Bull. Soc. Bot. Centre-Ouest, Royan, 1985.

[3] C. Roux et C. Gueidanc, *Flore et végétation des lichens et champignons lichenicoles et non lichénisés du massif de la Sainte Baume (Var, Provence, France)*, Bull. Soc. Linn. Provence, Vol. 53, 2002, p.123-150.

[4] C. Roux, *Echantillonnage de la végétation lichénique et approche critique des méthodes de relevés*, Cryptogamie, bryol. Lichenol., Vol. 11, Issue 2, 1990, p.95-108.

[5] C. Roux, C. Coste, D. Masson et C. Bauvet, *Lichens et champignons lichenicoles du parc national des Cevennes.3-Les basses Cévennes*, Bull. Soc. Linn. Provence, Vol. 57,2006, p.59-84.

[6] J. Braun-Blanquet, *Pflanzensoziologie*, Ed. Springer Verlag, Vienne, 1964.

[7] C. Roux, C. Coste, O. Bricaud et D. Masson, *Catalogue des lichens et des champignons lichénicoles de la région Languedoc - Roussilon (France méridionale)*, Bull. Soc. Linn. Provence, Vol. 57, 2006, p.85-200.

[8] J.M. Houmeau et C. Roux, *Lichens et groupements lichéniques observés lors de la 7ème session extraordinaire de la S.B.C.O. dans le Cantal*, Bull. Soc.bot. Centre-Ouest, Vol. 11, 1980, p.87-103.

[9] T.H. Nash et L. Sigal, *Sensitivity of lichens to air pollution with air emphasis on oxidant air pollutants*, Proceeding of the symposium on effects of air pollutants on mediterranean and temperate forest ecosystem, Riverside, California, 1980, p.22-27.

[10] A. Semadi, *Incidence de la pollution fluorée d'origine industrielle sur la végétation de la région d'Annaba*, Thèse de Doctorat, Paris VII, 1983.

[11] P. Lebrun, *L'usage de bio-indicateurs dans le diagnostic sur la qualité du milieu de vie*, Journées d'étude de l'A.F.I.E, Ecologie appliquée : indicateurs biologiques et techniques d'études, 1990, p.167-174.

[12] C. Roux, *Les lichens indicateurs de pollution.1ère partie : la pollution atmosphérique dans le bassin d'Aix*, Bull. Soc. Linn. Provence, Vol. 44, 1993, p.12-19.

[13] D. Fadel, I. Boughambouz, A. Laifa et R. Djemai, *Bioindication the air pollution by total hydrocarbons by using a lichenic specie in the area of Skikda*, Algeria. Phys. Chem. News., Vol. 34, 2007, p.126-130.

[14] G. De Belair, *Structure, fonctionnement et perspective de gestion de quatre écocomplexes: lacustres et marécageux (El Kala, Est algérien)*, Thèse de Doctorat, Université Lyon, 1990.

[15] J.J. Barkman, *Phytosociology and ecology of cryptogamic epiphytes, Vol.* 2, Ed.Van Gorcum &Co, Assen, 1958.

[16] A. Semadi, *Effet de la pollution atmosphérique (pollution globale, fluorée et plombique) sur la végétation dans la région d'Annaba (Algérie)*, Thèse de Doctorat Paris VI, 1989.