ENDEMIC PLANTS FROM ROMANIAN CARPATHIANS – THE FRACTAL ANALYSIS

Nicolescu Anamaria Carmen[1], Andrei Marin[2]

SUMMARY

From morphofractal analyses of the species it result that it have similar morphological characteristics, expressed by similar fractal dimension. Because of analysis of different species it doesn't have similar fractal dimensions. We mention that even in the case of the same species can appear different results between fractal parameter of the studied species the reason being the sozological criteria.

KEY WORDS: *fractal dimensions, fitofractal, box-counting, endemic,taxonomy*

INTRODUCTION

One of biological system general issue is represented by fractal character. Starting from the idea that fractal theory is an instrument dedicated to irregular forms and that the fractal dimension allows the estimation of irregularity grade of an outline, in the present work, is proposed the use of fractal technology as an work instrument in the plants world, in systematic an taxonomic botany.

MATERIALS AND METHODS

The box-counting algorithm requires the determination of fractal dimension depending on the evaluation of the object size in relation with the used scale factor. The algorithm consists in successive covers of the image with 4, 16, 64 etc equalsquaresofside (s) andcounteverytime, of the squares which cover the outline of the object, their number being noted with N(s). Coordinated points (log(N(s), log(l,s)), where (s) is the line of the square cover and N(s) is the square cover number. If this curve is approximately a straight line then its slope will be box-counting fractal dimension.

Determination algorithm of box-counting dimension for outlines binary image is:

- The original image (photography) is read and is processed by computer scanning until its binary form.

- The outline is extracted (footprint image) by removing the object interior points.
- Analysis zone is selected.
- Box-counting dimension is calculated by fixing the side (s) of the square and counting every time the N(s) squares which contain at least one point from the form; the values obtained are logarithmic and graphic represented through a straight line which its slope is the dimension that is searched as box-counting.

THE RESULTS OF RESERCHES

The work has studied 47 endemic taxa from the Romanian Carpatians spontaneously flora. For each taxon has been calculated the fractal parameter of the individual as a whole and the taxa represented by many individuals has been determined the medium fractal value; it has been fractal analyze vegetative organs determining fractal parameter of the leaf; the technique has been applied from histological view analyzing different section of vegetative organs.

To exemplify we choose the *Aconitum moldavicum* Hacq. breed belonging to Ranunculaceaefamily for which implementing the box-counting algorithm for the whole plant we obtained the fractal parameter Df = 1.48.
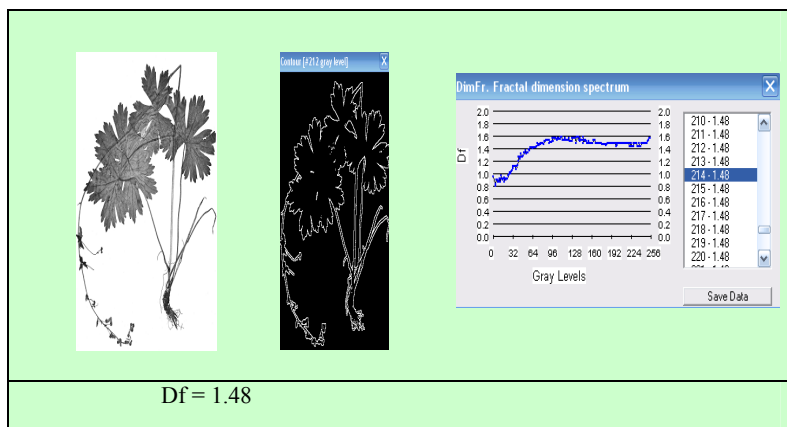

Df = 1.48

*Figure 1 Aconitum moldavicum*Hacq., monofractal size calculation:on the left the general appearance of the plant, in the middle the contour of the plant for the gray threshold 212, on the right the spectrum of the monofractal dimension, resulting the fractal index Df = 1.48

[1]   PhD.University of Bucharest, Faculty of Biology
[2]   Prof. PhD. University of Bucharest, Faculty of Biology

The analyzed leafs have been scanned with no modification of its form or size and have been exposed to the box-counting algorithm.

Grey nuance scale for which have been made the leaf outline wanted to highlight less or not at all the nerves, the accent being put on the properly outline because of the fact that it offers information about the edge and the form of the leaf, very important aspects in taxonomy and species classification.

The research have studied 16 plants family which have been evaluated fitofractal according to the fractal dimension determination algorithm by processing outlines. It has been kept in sight the determination of the affiliation of the species in those 16 studied families according to fractal dimension and also the approaching between studied species, but also of the species that it belongs to.

Nr. crt	Clasa	Family	ValoareDf a familiei
	Magnoliopsida	*Ranunculaceae*	1.36
		Caryophyllaceae	1.28
		Plumbaginaceae	1.40
		Saxifragaceae	1.53
		Rosaceae	1.28
		Fabaceae	1.56
		Apiaceae	1.42
		Brassicaceae	1.38
		Salicaceae	1.31
		Boraginaceae	1.43
		Lamiaceae	1.33
		Scrophulariaceae	1.39
		Campanulaceae	1.34
		Rubiaceae	1.39
		Asteraceae	1.37
	Liliopsida	*Poaceae*	1.46

Table no 1: Valoarea Df a familiilor care cuprind specii de plante endemice în Carpații României

CONCLUSIONS

We consider that the number of each fractal studied species individuals it lead to recognition of an medium fractal dimension for respective species much closer to reality than in the case of an analyses of a smaller number of individuals.

Fractal analyses of the leaf to different endemic species demonstrate that in the same family of the same kind the fractal parameter has similar dimension and sometimes even identical.

Fractal analyses method allow the clear highlight of the species outline, so depending on the chosen grey scale function we can highlight the nerve of the leaf, to insist on a zone which we are interested in but in the first place it offers important data about the plant as a whole.

After the calculation of the fractal dimension it can be obtained the species outline or the analyzed organ which can be considered a primary criteria of taxonomy.

For the fractal characterization of species to a much closer reality is necessary to calculate the fractal dimension of a mature state individual from the same species.

Morphoanatomical characteristics are added to the fractal dimension of species leading to characterization of a species in a specific stage of life.

After the determination of the histofractal dimension for different vegetative organs we can observe a small variation of value, fact which confirms that in the structures with low variability grade the technique meet the expectation.

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