ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Asarum europaeum L. (Aristolochiaceae) Cenopopulations in Forest: Responses to Climatic Factor.

Svetlana V Fedorova*.

Kazan Federal University, Kremliovskaya str, 18, 420008, Kazan, Russian Federation.

ABSTRACT

Plant adaptation problem to a changing environment is relevant to the regional and global biology. Climatic factor varies throughout the year, causing the seasonal rhythm of plant development. Alternation of wet and dry periods in the seasonal rhythm of the plant causes feedback from plant systems at different levels (organism, population, phytocenosis). Description responses of plant species has a disjunctive area, on the climatic factor is represented in the work. For the first time in the region were obtained results related to the behavior of population systems plants surviving the stress due to climate anomalies (high temperatures and drought). Similar studies have not been conducted before. The climate was more stable, and methods of population analysis did not have wide application. The study was conducted by using the methods of population ecology of plants. This is a description of the seasonal rhythms of individuals of a species under the canopy of broad-leaved forest in different years and comparative population analysis. The latter includes: 1) descriptive statistics morphometric parameters of selected elements of the population of the species in different phytocenoses; 2) an analysis of the distribution curves of the same; 2) analysis of the correlation matrix. Characterize by different population systems; 3) a comparative analysis of similar data obtained at different times at different points of the species range. The research was Asarum europaeum L. (Aristolochiaceae) cenopopulations in the forest. The results showed that in response to climatic factor occurs substantial restructuring within the population of the species. It is reflected as follows: during the complete loss of assimilating organs evergreen herb A. europaeum comes in the middle of the growing season in response to prolonged dry with high air temperature period (climatic anomaly). Resumption of assimilation activity of individuals and restoring projective cover species takes place gradually over several years. The rate of this renewal is largely due phytocenosis factor. Ramet that survived the crisis and restore the activity of assimilation in the second year after anomalies were a number of indicators: 1) a straight plagiotropic shoot length over 26,7-44,9cm; 2) 1-2 pieces assimilative leaves; 3) 13,1-47,3 cm^2 assimilative surface area; 4) the length of 3,1-7,2cm leaf petioles. Ramet have a low level of variation indicators. The distribution pattern of ramet all indicators is not left-modal.

Keywords: population system, polycentric system, morph-structure analysis.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Plants adaptation to changing environment there is actual problem of botanical science, which has to decide on the need for different levels of organization of life by various methods. In this article ecology plants population methods were used. *Asarum europaeum* L. (Aristolochiaceae) is a perennial polycarpous herbaceous plant, which develops an epigeogenous rhizome. This species has a disjunctive area [1] in Western Europe, European part of Russia, in Western Siberia] In the lower herb layer broad-leaved and coniferous-broad-leaved forests *A. europaeum* plants have a feature to grow as a co-dominant or subdominant. The plant has great practical value and put into culture. In the composition of medicines biologically active components *A. europaeum* various organs are taking place. Organic substances in the plant medicinal raw have diverse pharmacological effects. In the food and perfume industries essential oil plants used. In the ontogenesis *A. europaeum* genette (organism that develops from the seed) aboveground shoots decumbent to the substrate, are drawn into the litter, topsoil contractile roots and undergo a series of metamorphoses in connection with the change of function. Epigeogenous rhizome acts as a repository of spare nutrients and organ of renewal plants. In the juvenile ontogenetic state rhizome begins to form as a result of lodging hypocotyl. In the virginal state rhizome acquires the ability to branch. Rhizome able to grow annually, over-ground shoot-formation center has elevated the apical bud and in the axils of scale-like leaves grassroots lateral buds. Bud growth and shoot development genette promotes the formation of a polycentric structure organism, having more soil-supply centers and one or more over-ground shoot-formation centers. This organism represents a polycentric system (Fig. 1). In district of the study is taking place seasonal climate with cold winters and warm summers. Usually summer is periodically rain, winter snow. After the snow melts, in April-May over-ground shoot-formation center is able to continue its development through the formation of assimilative organs and contribute to the widening of a polycentric system. Initially bud is formed plot of shoot having connivent internodes and without-petiole 2-3pcs scale-like leaves. Then one is formed shoot plot, having one elongate (up to 3cm) and one shortened (to 0,5cm) internodes and long-petiole 1-2pcs assimilative leaves. Apical shoot growth ends with the formation of scale-like upland sessile leaves on peduncle having a single apical flower. Fruiting ends in May (early June). Assimilative leaves are able to vegetate calendar year. Grassroots scaly leaves fall off, leaving scars as a result of friction shoot on the soil in the formation of rhizomes. June and July. Elongated internode is 80-90% annual increase shoot. Process of natural adult particulation of polycentric system or mechanical damage rhizomes contribute to the formation of ramet. A ramet is an organism that occurred from a vegetative bud plants. Processes of growth and reproduction of plants polycentric system during several years are responsible for the formation of organism-system species, ie the population system. Population system species native to phytocenosis represents cenopopulation. Studies of *A. europaeum* population structure and organization conducted since 1958 in different parts of the area [1-5]. The history of this research is presented in the present article the author's monograph [5]. Thus, by the time of this study a wealth of factual material has been accumulated and summarized. However, in the history of *A. europaeum* population studies have not paid attention to the climatic anomaly. Perhaps in this period climatic background does not deviate so much from the norm, as it was the summer 2010 on the territory Russian Federation, including Tatarstan Republic. So that natural factors have contributed to the creation of the special situation in the natural habitat of the species, which required non-traditional approach to the study of *A. europaeum* population systems. The presented results will contribute to increased understanding of the mechanism of adaptation *A. europaeum* to the crisis.

Aim of the study

In forest *A. europaeum* population responses on the climatic factor Tatarstan Republic identify.

Tasks: 1. Climatic background in the study district in 2010-2012 on the basis of meteorological data to characterize; 2. Seasonal rhythm of the development of herbaceous plants under the canopy of broad-leaved forest summer 2010 describe; 3. Character *A. europaeum* cenopopulations renewal under the canopy of broad-leaved forest summer 2011 describe; 4. Comparative morph-structure analysis of two *A. europaeum* cenopopulations summer 2012 spend; 5. The results *A. europaeum* population study received in connection with the climatic anomaly, and out of touch with her associate; 5. Morph-metric feature polycentric system *A. europaeum* cenopopulations describe due to climatic factors.

District, Objects, Methodology

District

This study was conducted in the vicinity of biological station of Kazan Federal University (KFU) ("774km" Gorky railway, Tatarstan Republic, Russian Federation). Growing season here is the lack of snow cover and the presence of air temperatures above 0^0C. Most commonly it lasts from April to October. Continuous assimilation processes taking place in plants is supported by periodic precipitation in the form of rain during the growing season. Detailed specification climatic background growing season 2010-2012 has been given on the basis of meteorological data Climate Observatory KFU. To characterize the two average daily indicators (air temperature and precipitation sum) were used, as well as their statistical parameters calculated for each month.

Objects

These were two *A. europaeum* cenopopulations (CP) under the canopy of broad-leaved forest. CP 1. Location: bottom of the slopes of southern exposure III terrace above the floodplain river Volga. Soil: gray forest, medium loam. Phytoceonosis: "*Acer platanoides* L. – *Carex* sp. *+ A. euro*paeum, *Tilia cordata* Mill.". Crown density was 40%. Indicators of edificatory *A. platanoides*: 1) height limit 15-20 m; 2) trunk circumference at breast height – 62, 65, 67, 70, 75cm; 3) trunk diameter at breast height – 23, 28, 30, 32, 34cm. In herbage as 07.10.2012 forest and meadow plants (capable of forming a polycentric system with over-ground and under-ground shoot-formation centers) soil covered by 80-90%, creating the illusion of a carpet. Formed two species *Carex (C. digitata* L., *C. pillosa* Scop.) compact clones stood out against this carpet were formed a compact clones. CP 2. Location: II terrace above the floodplain river Volga. Soil: gray forest, medium loam. Phytoceonosis: "*Tilia cordata* – mix herb". Crown density was 50 %. Indicators of edificatory *T. cordata*: 1) height limit 15-25m; 2) trunk circumference at breast height 54, 60, 62, 65, 71cm; 3) trunk diameter at breast height 23, 25, 27, 30, 35cm. *Quercus robur* L. and *Tilia cordata*, having a height of 1 m, formed a separate group standing. In herbage as of 07.10.2012 forest and meadow plants (capable of forming a polycentric system with over-ground and under-ground shoot-formation centers) soil covered by 80-90%, creating the illusion of a carpet. *Glechoma hederaceae* L. and *A. europaeum* dominated the herbage composition. Formed *Carex pillosa* compact clones stood out against this carpet were formed a compact clones.

Methodology

In the 2010-2011 growing season was held phenology monitoring of the herbage under the canopy of broad-leaved forest. In mid-summer 2012 collection *A. europaeum* control samples was conducted in zones of maximum projective cover CP 1 and CP 2. Continuous selection (for instance of 80 inst.) caused the sample representativeness. Each polycentric system was evaluated on the most important for its functioning morph-metric indicators. These are: 1) plagiotropic shoot length; 2) over-ground shoot-formation centers number; 3) assimilative leaves number; 4) leaf petiole average length; 5) assimilative surface area. The latter figure is calculated by the weight method, when performed weighing the equivalent of paper and paper copies of leaf plate, leaf plate area calculation and summation of the areas of each leaf plates in a polycentric system. Necessary to tell that in the course of this study as an example *A. europaeum* developed a new method of determining the area leaf plate on metric measurements. It is described in detail in the monograph [5]. The methodology put certain “Coefficient of the leaf plate form correct”. Procedure is less time consuming, does not injure the plant or herbarium specimen is universal and preferred to conduct population study of plants. For the calculation of statistical parameters has been used a standard "Package analysis" in Microsoft Excel and software packages: "Descriptive statistics" with a confidence level of 90%; "Doubles two-sample t-test for the average"; "Two-sample F-test for dispersion"; "Correlation". In the process of analysis of the results has been involved a number of parameters that the tables are represented by symbols: *M* – arithmetic mean; *Δ* – confidence interval; C_v,% – variation coefficient; *Lim* – variation limit;

ISSN: 0975-8585

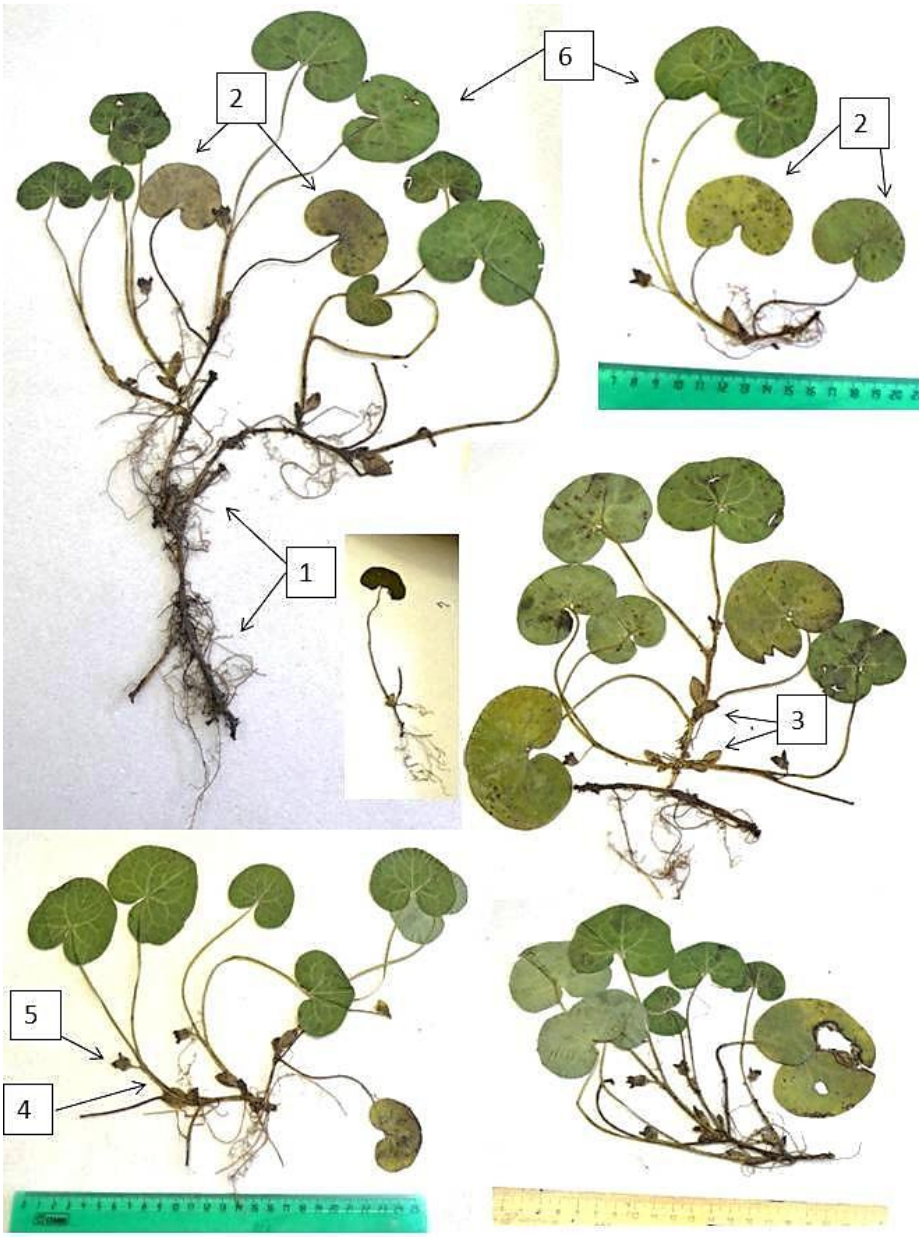

Figure 1: *Asarum europaeum* polycentric system collected from phytocenosis "*Pinus sylvestris* L. + *Tilia cordata* – mix herba". Herbarium 05.18.2013:

1 – plagiotropic shoot perennial plot (epigeogenous rhizome); 2 – long-petiole assimilation last year's leaf (yeas of formation 2012); 3 – without-petiole scale-like leaf (yeas of formation 2013); 4 – plagiotropic shoot annual plot (over-ground shoot-formation center); 5 – flowering shoot; 6 – long-petiole assimilation leaf (yeas of formation 2013)

n – sample size; Σx_i – option sum number; k – freedom degrees; t_d – Student criterion validity of the difference; F – R. Fischer criterion compliance of (consent). Estimations of character *A. europaeum* polycentric distribution systems in CP 1 and CP 2 to morph-metric indicators were carried out graphically. Histograms were constructed using the software package "Chart Wizard" in Microsoft Excel. 5 classes in between the minimum and maximum values of a sample indicators and empirical frequency option in the aggregate sample (f,%) reflected on the corresponding figure. Calculation of matching K. Pearson criterion (χ^2-distribution) to identify similarities between the distributions was performed using the formula: $\chi^2 = 4(\sum f_1^2/(f_1^2 + f_2^2)) - (\sum f_1 + \sum f_2)$ [6], when f_1 and f_2 – frequency compared distributions The number of degrees of freedom equal to the number of classes distribution. Several receptions have been used to improve the perception results. 1. Criteria value he differences and similarities between the sampling of indicators were identified at 4 levels of

significance (90; 95; 99; 99,9%). It is noted in the following table. It empirical values of criteria exceeds a certain level of significance, were labeled corresponding number of asterisks (*; **; ***; ****).

RESULTS

Tab. 1 shows the statistical parameters characterizing the climatic background of summer months in 2010-2012. The growing season 2010 was characterized by very high air temperatures and cloudless atmosphere. 37 days precipitation was observed (with 12 July 2010 on 18 August 2010). At the same time average daily air temperatures ranged from +21,1^{0}C to +32,6^{0}C. Daily maximum air temperature rose to 51^{0}C. This phenomenon is not typical for the study district. Fires of a number of nearby districts (including forests) contributed to the smog which was held in the study district for three weeks. Perennial plants in such circumstances have changed their seasonal rhythm of development: generating plants quickly finished fruiting and together with other vegetating plants in mid-July, went into resting state. This fully applies to *A. europaeum* in surveyed phytocenoses. Under the forest canopy was a "dead zone." Consequence of the anomaly was the enrichment of soil minerals that have come out of the air with precipitation. Rapid dehydration of plants and animals, have created a rich supply of organic matter, which provoked the activity of soil bacteria.

Table 1: Change in daily average air temperature (^{0}C) and precipitation sum (mm) during the summer months in the study district 2010-2012

Mans	Para-meter	2010		2011		2012	
		^{0}C	mm	^{0}C	mm	^{0}C	mm
June	*M±Δ*	22,3±1,4	0,39±0,3	18,14±1,0	4,30±2,0	20,6±0,9	1,09±0,8
	Lim	14,9-30,1	0-4,8	12-24,4	0-21,9	14,1-26,3	0-11
	∑xi	669,27	11,7	544,1	128,9	618	32,8
July	*M±Δ*	26,6±1,1	0,30±0,32	24,26±0,7	1,46±1,3	22,30±1,1	1,39±1,2
	Lim	18,2-32,2	0-5,5	18,7-28,7	0-22,9	16,7-29,2	0-16,1
	∑x_i	824,6	9,2	752	45,2	691,4	43,2
August	*M±Δ*	23,25±2,2	1,28±0,7	19,52±1,4	0,71±0,6	20,29±1,2	17±1,3
	Lim	9,8-32,6	0-9,6	11,5-28,2	0-9,9	12,5-26,8	0-22,7
	∑xi	720,7	39,8	605,2	22	628,9	53

In the growing season 2011 climatic background close to normal. In mid-July cover *A. europaeu m*in zones of maximum projective cover on CP 1 and CP 2 reached 40 and 50%, respectively. Over-ground shoot-formation centers on the background of forest litter were arranged in groups of varying density. In some groups, the leaf plates assimilative leaves overlap. The impression was that the composition of CP 1 and CP 2 are mono-centric and polycentric systems having multiple over-ground shoot-formation centers. However, mono-centric systems were not detected. In this polycentric system had: 1) plagiotropic shoot length more than 26,7cm; 2) 1pcs over-ground soot-formation center; 3) 1-2pcs assimilative leaves having leaf petiole average length 3,1-7,2cm and assimilative surface area 13,1-47,3cm^2. Analysis the morph-metric indicators polycentric system of CP 1 and CP 2 (Tab. 2) showed that the coefficient of variation for them no more than 24%. For the population system of this variation level is considered negligible [6]. One of the indicators vegetative mobility polycentric system “plagiotropic shoot length” varied at a low level (C_V=8 and 12%, of CP 1 and CP 2, respectively). In CP 1 and CP 2 morph-structure, have been identified and marked differences statistically confirmed Student t_d-criterion and Fisher F-criterion (Tab. 3). The average polycentric system *A. europaeum* in CP 2 compared with the CP 1 had: 1) longer plagiotropic shoot length; 2) broader assimilative surface area; 3) longer leaf petiole average length. Variation series of data indicators CP 1 and CP 2 differed in the level of dispersion. Analysis of the distribution curves of polycentric systems for CP 1 and CP 2 using Pearson χ^2 criterion (Tab. 3) revealed similarities and differences in the variation series. Thus, 90 % of polycentric systems CP 1 and CP 2 had 2pcs assimilative leaves (Fig. 2A), which led to the first similarity. Distribution curve by assimilative surface area for CP 1 *и* CP 2 was right-modal (Fig. 2D), which led to the second similarity. Distribution curve of polycentric systems by leaf petiole average length for CP 1 approaching normal with a maximum of 30%, for CP 2 was the right-modal, with a maximum of 45% (Fig. 3B). This led to the first difference. Distribution curve by plagiotropic shoot length for CP 1 to a greater extent was similar to the

horizontal line. Curve for CP 2 was normal, with a maximum of 60% (Fig. 2C). This led to a second difference. Common feature for CP 1 and CP 2 was that among poorly differentiated polycentric systems dominated by those who had the following characteristics: 1) plagiotropic shoot length longer 35cm; 2) 2pcs assimilative leaves number; 3) assimilative surface area broader 27cm^2. This led to the fact that often the character the distribution of polycentric systems by morph-metric indicators was right-modal, rarely approaching the norm. This was due to the ontogenetic and morphological differentiation of polycentric systems in CP 3 and CP 4. Despite the significant difference in the variation series CP 3 and CP 4 for these indicators, their distribution was often left-modal, rarely approaching the norm. Let us turn to an earlier study in Tatarstan Republic [5]. Under the canopy of broad-leaved forest with *Tilia cordata, Acer platanoides* and *Quercus robur* in forest carbonate soil in 1961-1963 on series CP was carried out to collect control samples *A. europaeum* by regular selection. In the composition of CP were identified mono-centric and polycentric systems. They had plagiotropic shoot length in limit of 4,5-28,6cm, over-ground shoot-formation centers number in limit of 1-5pcs. Polycentric character of distribution systems by morph-metric indicators was often left-modal, rarely approaching normal. In the period of 1958-1980 [3] and later study was conducted in a row of *A. europaeum* CP under the canopy of coniferous, broad- leaved, small-leaved forests and mixed forests in different points of the area. As a part of all surveyed CP were identified as mono-centric and polycentric systems having a

Table 2: Morph-metric indicator parameters of polycentric system *Asarum europaeum* cenopopulations in the second year after the climatic anomaly. Data 10 July 2012

Indicator (n = 80)	№ CP	Parameter			
		$M\pm\Delta$	C_v,%	*Lim*	$\sum x_i$
Assimilative surface area, cm ²	1	26,97±1,04	21	14,9-36,5	2158,2
	2	31,95±1,46	24	13,1-47,3	2556,7
Leaf petiole average length, cm	1	4,94±0,37	13	3,7-6,3	754,7
	2	5,59±0,41	14	3,1-7,2	835,7
Plagiotropic shoot length, cm	1	34,68±0,78	12	26,7-42,1	2774,4
	2	36,9±0,55	8	29,5-44,9	2952,5
Assimilative leaves number, pcs	1	1,9±0,06	16	1-2	152
	2	1,87±0,06	18	1-2	150

different quantity over-ground shoot-formation centers, and a high level of variation of morph-metric indicators. This was a consequence of ontogenetic differentiation and morphological heterogeneity. Thus, the results, the study population system of *A. europaeum* in 2012 were significantly different from all the previous results on a number of characteristics: 1) the composition of the population system; 2) the nature of the distribution of functionally Extension of the significant morph-metric indicators; 3) parameter of polycetric system morph-metric indicators; 4) the level of variation morph-metric indicators. assimilation leaf (yeas of formation 2013). This allows us to conclude that in response to climatic anomaly have been major changes in the structure and organization *A. europaeum* population, which led to the development of particular elements. Indicators of development *A. europaeum* in CP 1 and CP 2 in summer 2012 were conditioned by a number of physiological processes:

1. Elimination mono-centric and polycentric system of low vitality;
2. Particulation of the polycentric systems in which stocks of plastic substances have been spent on the operation of the most powerful ramet (they were at the time control polycentric systems); 3. Extension of the period of rest of polycentric systems (such systems were not included in the sample because they were not above-ground organs). As overcoming the consequences of the crisis on the norm climatic background, assimilative fraction of the population system will change due to the activation of physiological processes in the bud regeneration and adventitious buds on the vegetative

Table 3: Differences criteria for morph-metric indicators *Asarum europaeum* in cenopopulations. Data 10 July 2012

Indicator	Criterion	Value
Assimilative surface area, cm ²	$F\ (k=38)$	1,97***
	$t_d\ (k=38)$	4,25****
	$\chi^2(k=4)$	8,5*
Leaf petiole average length, cm	$F\ (k=38)$	2,04****
	$t_d\ (k=38)$	4,003****
	$\chi^2(k=4)$	31,1****
Plagiotropic shoot length, cm	$F\ (k=38)$	1,55**
	$t_d\ (k=38)$	6,37****
	$\chi^2\ (k=4)$	18,2***
Assimilative leaves number, pcs	$F\ (k=38)$	1,21
	$t_d\ (k=38)$	0,46

ISSN: 0975-8585

embryo. This will contribute to the formation of several over-ground shoot-formation centers in a polycentric system, stronger differentiation polycentric systems rhythms of development and, as a consequence, lead to a distribution of polycentric systems as a part of the population system. This, in tun, will contribute to the manifestation of the indicators that have been identified in an earlier study of *A. europaeum*. In support of this assumption in Fig. 1 (bottom left) is represented by a herbarium specimen collected in June 2013 It is a polycentric systemsб having 3pcs over-ground shoot-formation centers. Moreover, the number of assimilative leaves formed them in 2012 is 2pcs (one leaf is damaged and has only the petiole). This clearly demonstrates the process of renewal of vegetative activity of polycentric system after the crisis.

Table 4: Correlation coefficient for *Asarum europaeum* cenopopulations. Data 10 July 2012

Indicator (*n*=80)	1	2	3	4
CP 2				
1 – Assimilative surface area, cm ²		+0,05	-0,04	+0,62****
2 – Leaf petiole average length, cm	+0,03		-0,22***	-0,20**
3 – Plagiotropic shoot length, cm	-0,16**	+0,009		+0,16**
4 – Assimilative leaves number, pcs	+0,62****	+0,12	-0,22***	
CP 1				

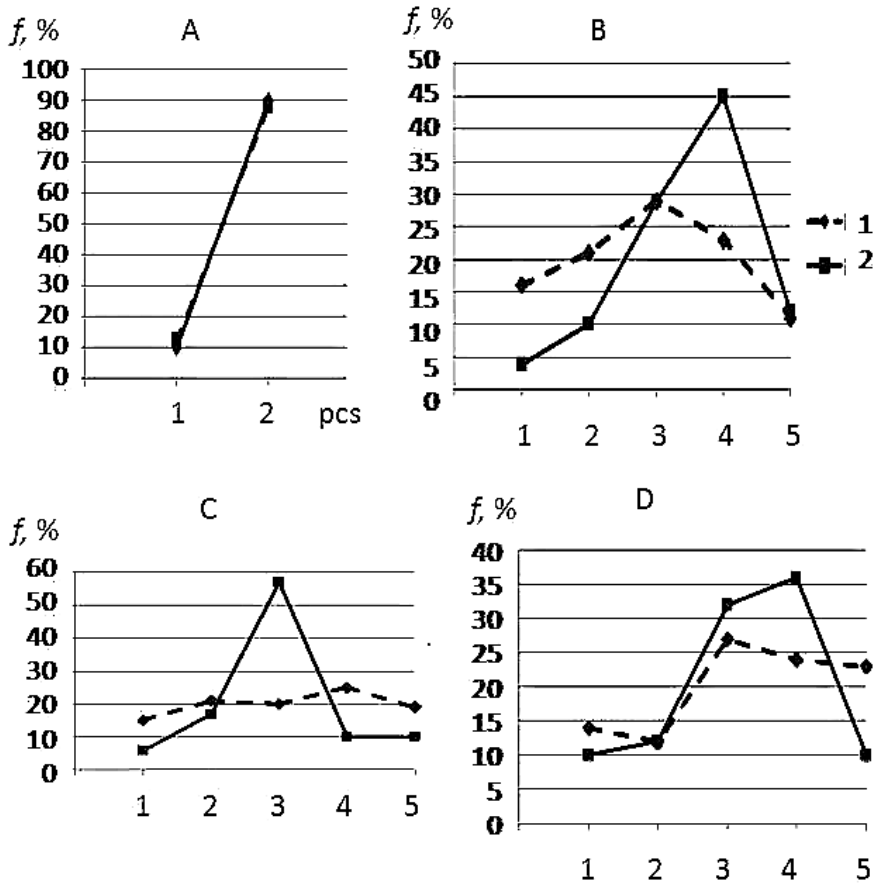

Figure 2: Change distribution curves of morph-metric indicators polycentric system *Asarum europaeum* cenopopulation (n=80) of second year after climatic anomaly. Data 07.10.2012:

1 and 2 – № CP. Vertical – the incidence of indicators: A) assimilation leaf number, pcs; B) leaf petiole average length, cm; C) plagiotropic shoot length, cm; D) assimilative surface area, cm². Horizontal: A) number, pcs; B, C, D) № class

CONCLUSION

- Climatic anomaly in the study district in 2010 has the following characteristics: 1) June-July, the average daily air temperature for 11 days exceed the threshold of 29^{0}C; 2) the precipitation sum reaches 29,9mm; 3) the interval between rains more than 14 days. In response to the anomaly, herbaceous plants under the canopy of broad-leaved forest move to a standstill in mid-July.
- Climatic norm in the study district in 2011 has the following characteristics: 1) June-July, the average daily air temperature exceed the threshold of +28,7^{0}C; 2) precipitation sum reaches the precipitation sum reaches 174,1 mm; 3) interval between rains no more than 7 days. In response to the norm, *A. europaeum* polycentric systems under the canopy of broad-leaved forest assimilative process resumed, that contributes to the development of the population system and increase its projective cover. Assimilative organs formed by plants during the growing season, go under the snow.
- Climatic norm in the study district in 2012 has the following characteristics: 1) June-July, the average daily air temperature for 2 days, exceed the threshold of +29^{0}C; 2) precipitation sum reaches 76mm; 3) interval between rains no more than 14 days. In response to the norm, *A. europaeum* polycentric systems under the canopy of broad-leaved forest assimilative process continues without interruption, which contributes to sprawl a polycentric system and increase *A. europaeum* projective cover up to 40-50%. Assimilative organs formed by plants during the growing season, go under the snow.
- Resumption of population systems *A. europaeum* after the crisis in phytocenoses "*Acer platanoides – Carex sp. + A. europaeum, Tilia cordata*" and "*Tilia cordata*– mix herb" is due to the activity of polycentric systems having row morph-metric parameters:1) presence of one over-head shoot-formation center; 2) plagiotropic shoot length 26,7-44,9cm; 3) assimilative leaves number 1-2pcs, having petiole average length 3,1-7,2cm; 4) assimilative surface area 13,1-47,3cm^2.
- In response to changing eco-phytocenosis factors *A. europaeum* population system changes: 1) rate of rise of a polycentric system. In phytocenosis "*Acer platanoides – Carex sp. + A. europaeum, Tilia* cordata" it is lower than in phytocenosis "*Tilia cordata*– mix herb "; 2) character of distribution polycentric systems for morphometric indicators. In the composition of *A. europaeum* cenopopulation in phytocenosis "*Acer platanoides – Carex* sp. + *A. europaeum, Tilia cordata*" dominated polycentric system having plagiotropic shoot length 35,94-42,1 cm, assimilative surface area 26,97-36,5 cm^2, and length petioles 4,94-6,3 cm. In the composition of *A. europaeum* cenopopulation in phytocenosis "*Tilia cordata* – mix herb" dominated polycentric system having length plagiotropic shoot 36,66-44,9cm, assimilative surface area 31,95-47,3cm^2, and petiole average length 5,59-7,2cm.

ACKNOWLEDGEMENT

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

Conflict of Interest

The author confirms that the data do not contain any conflict of interest.

REFERENCES

[1] Smirnova O.V., Zworykina K.V.(1974).*Asarum europaeum //* Biological flora Skye Moscow region, Moscow Fl: PH Mos. Univ., Vol. I, Pp. 1-51.
[2] Lyubarsky E.L., Poluyanova V.I. (1984) Vegetative-mobile plants population structure, Kazan Fl: PH Kazan. Univ.
[3] Smirnova O.V. (1987) Sward structure of broad-leaved forests. Moscow Fl: Nauka.
[4] Fedorova S.V. (2011) *Asarum europaeum* L. (Aristolochiaceae) population responses to replace eco-phytocenosis factors. In Questions of general botany. Kazan Fl: PH Kazan. Univ. Pp. 139-148. DOI http://kpf.ru/publication?p_id=29710.
[5] Fedorova S. (2013) Population organization of herbaceous plants in forest phytocenoses: *Asarum europaeum* L. (Aristolochiaceae) and Convallaria majalis L. (Convallariaceae). LAP LAMBERT Acad. Pab. DOI http://kpfu.ru/publication?p_id=71900.
[6] Lakin G.F. (1990) Biometrics: Textbook allowance, Moscow Fl: Higher School.