Temporal and spatial dynamics of thrips populations in mountainous meadows

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Abstract: The work presents the place and the role of the thrips associations in the praticolous biocoenosis from the Gârbova Massif, Southern Carpathians, Romania. The values of some structural indices of thrips populations (the specific presence, dominance, numerical abundance) were studied in relation with the abiotical factors, in researches of the monitoring type.

Keywords: Thysanoptera, structural indices, monitoring.

Introduction

Oettingen (1954) and Knechtel (1956, 1963) have done phenological studies on the thrips populations in Sweden and Romania, in the meadow ecosystems.

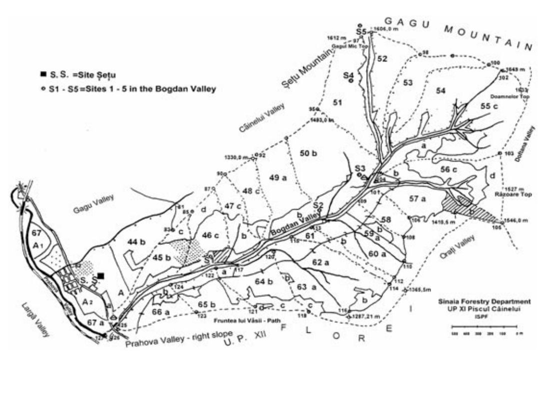
Materials and Methods

The thrips populations were studied during 3 years in 6 different sites, all secondary meadows, of 1 ha each, in the Gârbova Massif, differentiated altitudinally and through typical vegetal associations and soil. *Şeţu site*: 800 m altitude, S-W exhibition, the slope smally inclined, brown eubasic meadow soil, characterized by the association *Festuco rubrae-Agrostetum capillaris* Horv. 1951, in fir-beech zone.

The researches took place in the following sites on Bogdan Valley too: *Site 1*: 900 m altitude, S exhibition, the slope 10°-15°, brown acid forest soil, *Festuco rubrae-Agrostetum capillaris* Horv. 1951 association, in beech underzone. *Site 2*: 1050 m altitude, S-W exhibition, the slope 10°-15°, brown acid forest soil, the vegetal association of *Festuco rubrae-Agrostetum capillaris* Horv. 1951, in beech under zone. *Site 3*: "Hut", 1200 m altitude, S-E exhibition, the slope 10°, brown acid meadow soil, *Festuco rubrae-Agrostetum capillaris* Horv. 1951 vegetal association, in beech under zone. *Site 4*: 1400 m altitude, S exhibition, the slope 15°- 20°, podzol soil, the association *Scorzonero roseae-Festucetum nigricantis* (Puşcaru et all. 56) Coldea 87, in spruce-fir under zone. *Site 5*: "Plateau" 1500 m altitude, W exhibition, the slope 25°-30°, podzol humico-silicatic meadow soil, *Violo declinatae-Nardetum* Simon 66. association, in spruce-fire under zone. All the sites are unmoving and ungrazing meadows. The working method was of the ecological stationary type, limited to a 1 ha surface. In these sites, we have used two different methods, international recognized: the sweep net method and the shake of the blooming plants method; the thrips were collected twice a month, the number of samples was statistically determined.

The abiotical factors

The mechanical and physical factors have been investigated during 3 years on a row, at the Institute's meteorological station, from the Şeţu site; the other climatic values were obtained from another meteorological station.



The Map of the studied sites from the Garbova Massif

Mechanical factors

The influence of the wind is greater in the site 5, because of its location at 1500 m altitude, on the pick of the mountain.

Physical factors

The diurnal, the monthly and the annual temperature varies from one site to another. The thermical differences between the same months in each of the 3 years are significantly great (figure no 1). In the first two years, July was the warmest month, in the third it was August, fact that gives the annual graphic the bell-like shape. In the second year high temperature could be detected 30 days earlier than in the first and the third. In these last two, it was only in May that optimal temperature was reached, for the thrips to come out of over wintering; species, with a higher thermophilous character, come out later, when the air temperature, at 2 meters, rises above 14°C.

Light also plays an important role in the thrips dynamics and ethology; the highest light intensity could be measured in the meadow site on the mountain pick, in site 5, the maximal value reached here being 121,000 lux. It decreases with the altitude, the minimal values being reached in Şeţu.

The annual average values of the air relative humidity were high, 79%, 78% and 77%, in Şeţu, in each of the three years. In the mountain region, because average temperature is very low, the relative humidity has high values.

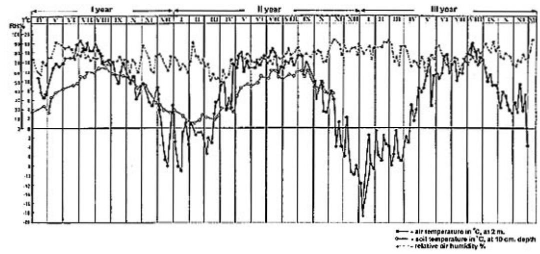


Fig. 1 The variation of the physical factors in the ªeþu site from the Gârbova Massif

The rainfall during these three years, from 800 m – 1300 m altitude, where the researches took place, was represented by average values of 1,033 mm/year, with 285 mm/year amplitude (Table no 1). The months with the highest values were July and January (104.6 and 64.3 mm). The lowest values were recorded in March and November (38.1 mm and 19.9 mm), fact that shows the continental climate of the sites in this research. The values of the potential evapoperspiration indicate an annual overplus of 337.5 mm.

Chemical command factors

The soil presents an acid pH, with values that range between 5.0 and 4.1 depending on the type of soil. **The monitoring researches** show in the last 33 years a great deviation from the normal climatic parameters (figure no 2, 3), especially a long period of drought (about 12 years)

	Annual average temperature °C			Rainfall
Altitude	Positive		Current	annual amounts
m	amounts	currents	general	mm
800	2630	6.2	7.1	860
900	2470	5.7	6.6	900
1000	2310	5.2	6.0	950
1100	2190	4.8	5.5	1010
1200	2060	4.4	5.0	1050
1300	1935	4.0	4.5	1080
1400	1810	3.6	4.0	1125
1500	1715	3.3	3.5	1145
1600	1620	3.0	2.9	1175
Average 1200	**2080**	**4.5**	**5.0**	**1033**
Gradients/100m	**112**	**0.35**	**0.53**	**35**

Table no 1 General climatic values for the altitudinal interval of the studied sites from Gârbova Massif

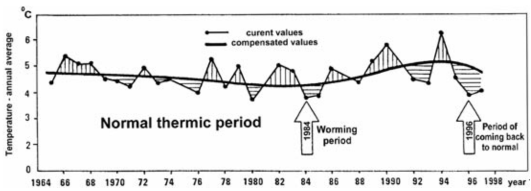


Fig. 2 The dynamics of the annual rainfall averages between 1965 – 1997

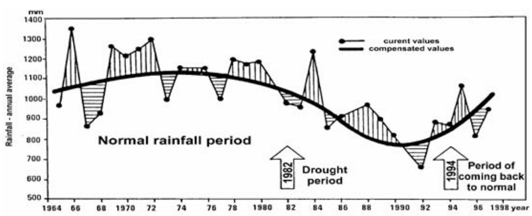


Fig. 3 The dynamics of the annual temperature averages between 1965 – 1997

Results and Discussions

The problem of the estimation of the effective has a special theoretical and practical importance, on this bases information on the respective coenosis's dimension and graduation being obtained.

A large number of exemplars were collected, on the whole 20629 exemplars belonging to 78 species in the consecutive three years of study and 4960 exemplars in the monitoring researchers between 1970-1998 (in July). In the Şeţu site, with the vegetal association *Festuco rubrae-Agrostetum capillaris* we identified 464 exemplars in the first year of research by sweep net method and 903 exemplars in the same year by shake method; in the others sites, in the second and the third year of study, there were identified a different number of exemplars and species; as general rule, the species number is higher by sweep net method, on the other hand the number of individuals is maximum by shake method.

The annual numerical abundance of thrips species from the Gârbova Massif, in each of the six studied sites, collecting by sweeping method, notes in the closed limits, between 1024-1780 individuals, while the annual numerical abundance of thrips populations results from the shake method to join in big limits, from 1089-3178 exemplars.

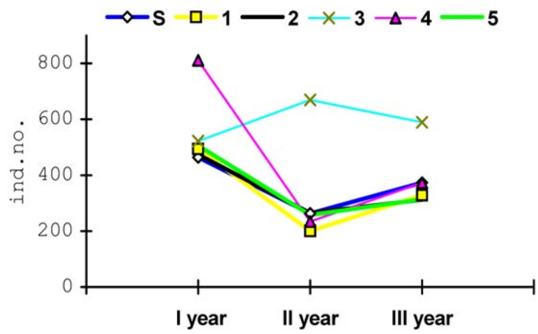


Fig. 4. The annual dynamics of the numerical abundance of thrips populations (1st, 2nd, 3rd year) (sweep net method)

In the frame of different sites (Table no 2) the values of the numerical abundance of different species, vary depending on the physical-chemical and biotic circumstances of the environment.

Comparing the six sites, the maximal numerical abundance obtained by shake method, is situated between 903-1364 in Şeţu site, between 592-831 in the site 1, between 533-981 in the site 2, between 590-1196 in the site 3, between 371-939 in the site 4 and between 281-477 in the site 5 (Table no 2).

The minimal numerical abundance is characteristic to all the sites, in the 2nd year, a dry year, in comparing to the other investigated years (the lowest value 201 exemplars, belongs to the site 1).

In the researches whit the shake method, the spatial analysis reveals the highest value of the numerical abundance of thrips populations, value namely 1364 exemplars, belongs the Şeţu site, in the 2nd year, which although dry, reveals that the shake method is selective, by sampling only from the blooming plants, which cumulate big groups of thrips (fig. 5).

Minimal values of the numerical abundance appear in the site 5 "Plateau" situated at 1500 m altitude, with west exposition, with minimal wind intensity and with lower temperature.

The site 1 and 2, situated in beech area, with the same association *Festuco rubrae-Agrostetum capillaris*, on a brown acid forest soil, present close numerical abundance (2085 exemplars, respectively 2152 exemplars during the three years of researches).

Sweep net method							
Site	1st year		2nd year		3rd year		
	sp n°	ind. n°	sp n°	ind. n°	sp n°	ind. n°	Σ ind. n°
Șețu	38	464	33	263	36	373	1100
1	35	494	29	201	32	329	1024
2	31	474	32	264	33	312	1050
3	39	522	41	669	41	589	1780
4	31	811	30	234	30	373	1418
5	32	506	30	258	29	314	1078
						Total =	7450

Shake method							
Site	1st year		2nd year		3rd year		
	sp n°	ind. n°	sp n°	ind n°	sp n°	ind n°	Σ ind. n°
Șețu	31	903	33	1364	31	911	3178
1	29	831	29	662	30	592	2085
2	23	638	29	981	25	533	2152
3	26	590	35	1196	34	1041	2827
4	30	538	33	939	28	371	1848
5	31	477	21	281	26	331	1089
						Total =	13179

Table no 2. The number of species and the number of individuals of the thrips fauna

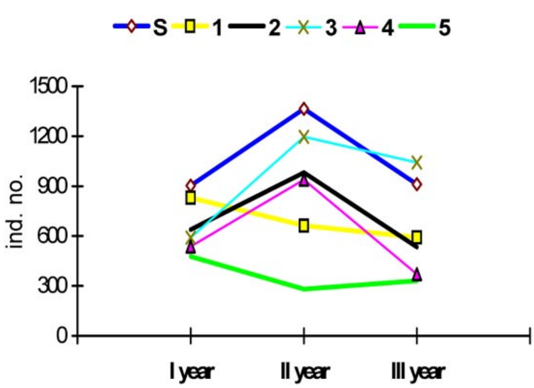


Fig. 5. The annual dynamics of the numerical abundance of thrips populations (1st, 2nd, 3rd year) (shake method)

Both the variation of the temporal and of the spatial category of the thrips population's dimensions is determined by internal factors of the population, and by the oscillations of the ambiental parameters.

The spatial analysis points out the maximal numerical abundance in the site 3 "Hut" (in the 2nd and 3rd year, namely 669 and 589 exemplars) and in the site 4 (1st year with 811 exemplars) by the sweeping method (Table no 2).

The site "Hut" situated at 1200 m altitude, which is characterized by the association *Festuco rubrae-Agrostetum capillaris* is open to the influence of different mechanical, physical factors. In this site, there is a decompression of the fön current, with a liberation of the warmth which determines a specific microclimate of this site, different from the other sites, with the same vegetal association, situated in the same forest beech area.

The site 4 presents the highest values of the numerical abundance due to the very high number of males, apterous, which appear in the first half of September and that can by observed only by the sweep net method.

The dependence of thrips populations on the temperature and humidity is presented in table no 2, the partial determination coefficients show rather small values, for the relative humidity, like independent variables, which explain the small percents of the variables of this dependent variation.

The values of the multiple correlation coefficients (Table no 3) are very significant, by the sweeping method, as compared to the result of the shake method.

These coefficients are more homogenous for the shake method, in all the meadow sites, the amplitude of variation being situated between 0.42-0.72 (in the 1st year); 0.47-0.80 (in the 2nd year) and 0.47-0.88 (in the 3rd year). In opposition, by the sweep method, the variation in higher between sites and years: 0.29-0.97 (1st year); 0.41-0.87 (2nd year); 0.44-0.85 (3rd year).

	Șețu site	1 site	2 site	3 site	4 site	5 site
	sweep net method					
	0.29	**0.91***	**0.97***	**0.86***	**0.03**	**0.30**
I year	0.6100	4.4491	7.695	3.446	0.0577	0.6249
	shake method					
	0.62*	**0.72***	**0.70***	**0.75***	**0.78***	**0.42***
	1.578	2.058	1.941	2.284	2.491	0.9345
	sweep net method					
	0.87*	**0.79***	**0.74***	**0.41**	**0.72***	**0.49***
II year	3.4743	2.6190	2.2254	0.8947	2.0483	1.1294
	shake method					
	0.71*	**0.80***	**0.64***	**0.47***	**0.64***	**0.54***
	2.0355	2.6281	1.6625	1.0728	1.6458	1.2680
	sweep net method					
	0.84*	**0.74***	**0.77***	**0.85***	**0.68***	**0.44**
III year	3.0639	2.2302	2.4416	3.1785	1.8718	0.9894
	shake method					
	0.72*	**0.37**	**0.69***	**0.47***	**0.72***	**0.88***
	2.0601	0.7884	1.8891	1.0622	2.0686	3.6576

Table 3. Multiple correlation coefficients and T Student test

The temporal analysis reveals, in the monthly dynamics of thrips populations, a pick, generally in summer, in June, July, when the age structure becomes complex, the mortality is reduced, the floristical diversity, as trophic substratum for thrips is very rich and the values of some physical factors (temperature, light, humidity), are optimal (Fig. 6-14).

Those numerical maxima is characteristic, all three years, to the thrips populations collected by the shake method, which reflects, closely, the phenology of the plant species.

The shifting of this pick towards autumn, in August or September (fig. 10, 11) could be noticed in the using of the sweep method and it is due to certain species: *Chirothrips manicatus* (after Oettingen, 1942 is bivoltine) and *Haplothrips angusticornis*.

From the ecological point of view, the taxonomical spectrum of the praticolous thrips is varied, formed by graminicolous and floricolous species.

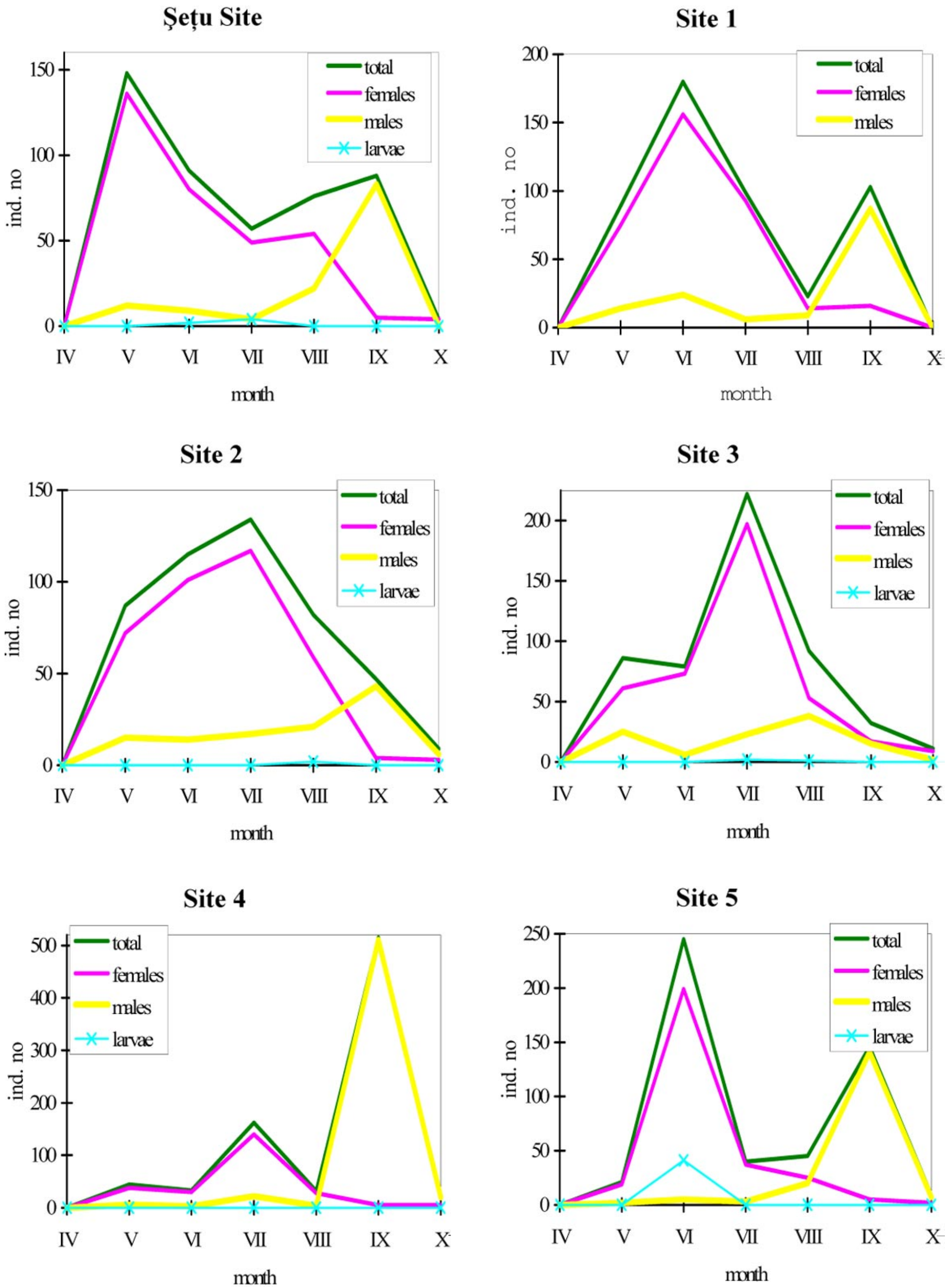


Fig. 6. The monthly dynamics of the numerical abundance of thrips populations (1styear) (sweep net method)

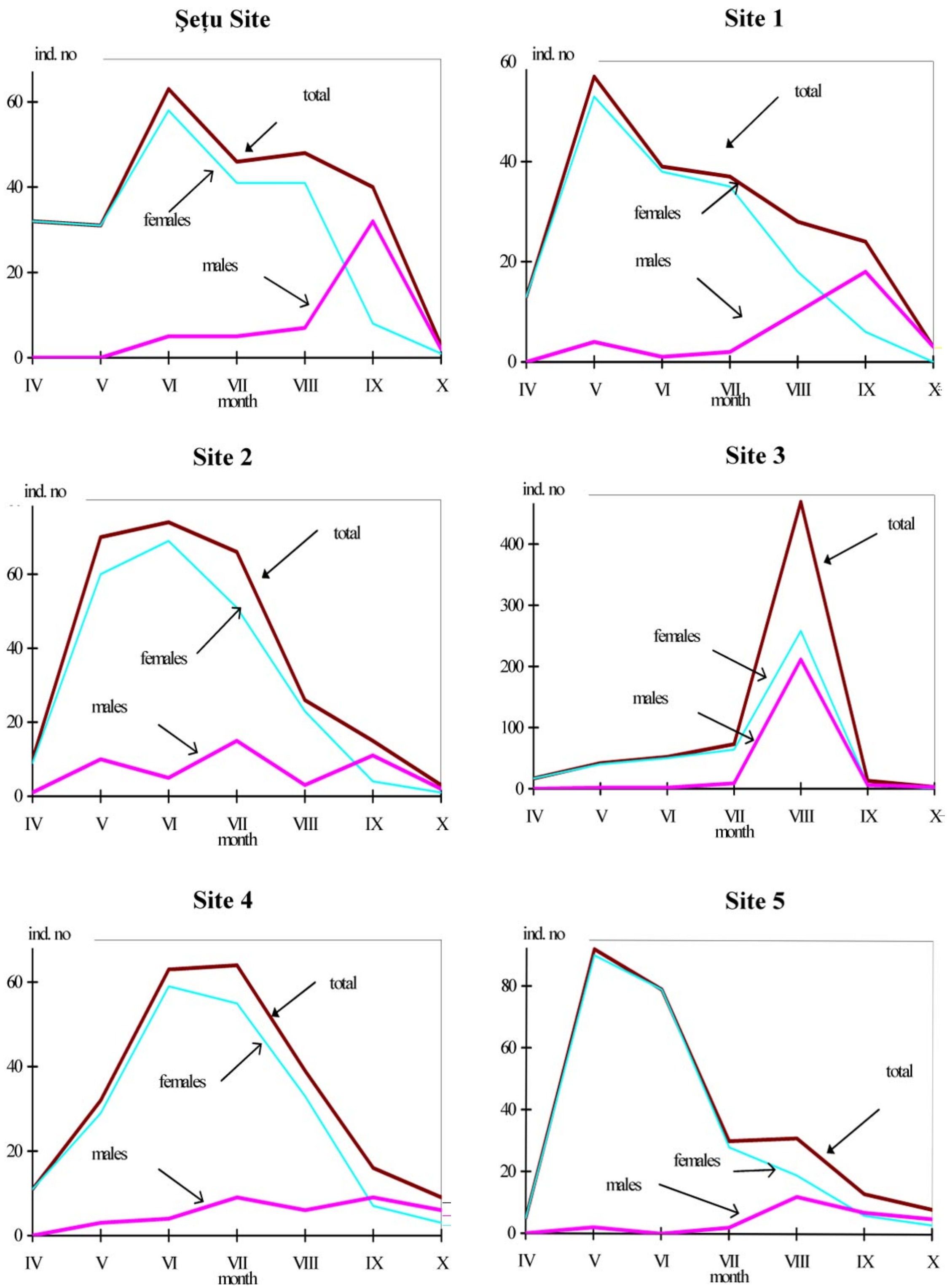


Fig. 7 The monthly dynamics of the numerical abundance of thrips populations (2nd year) (sweep net method)

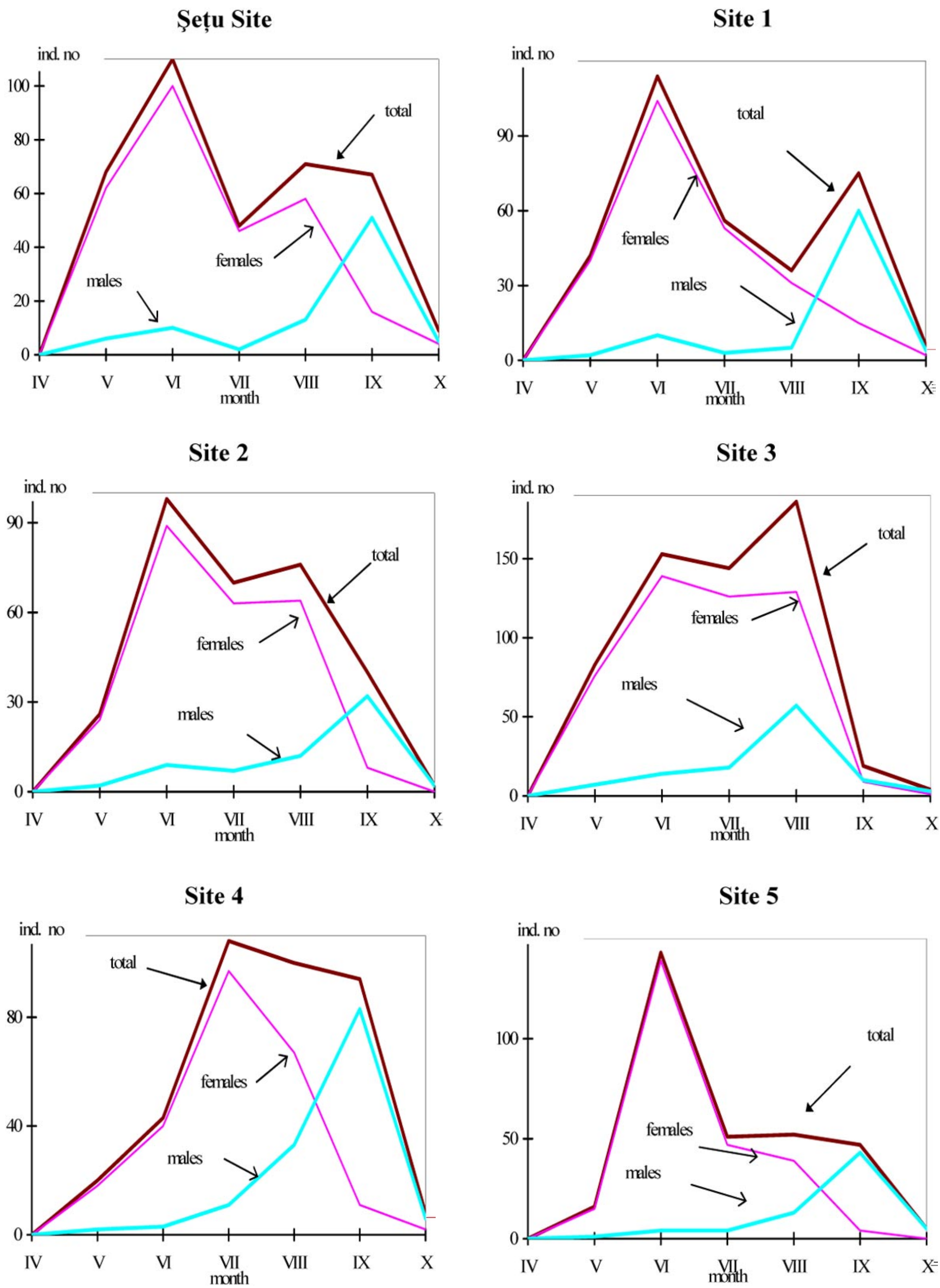


Fig. 8 The monthly dynamics of the numerical abundance of thrips populations (3rd year) (sweep net method)

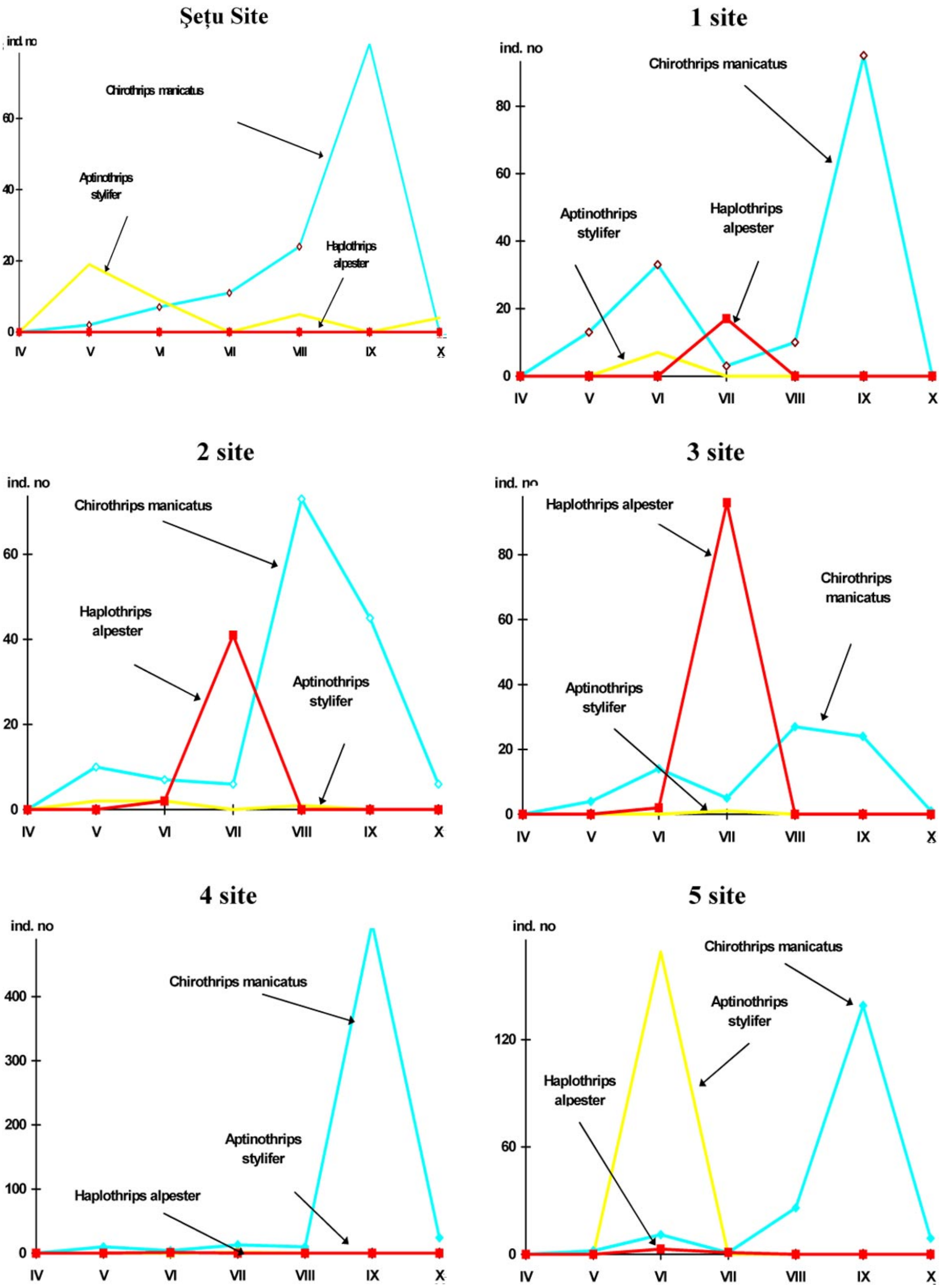


Fig. 9 The monthly dynamics of the numerical abundance of thrips populations (1styear) (sweep net method)

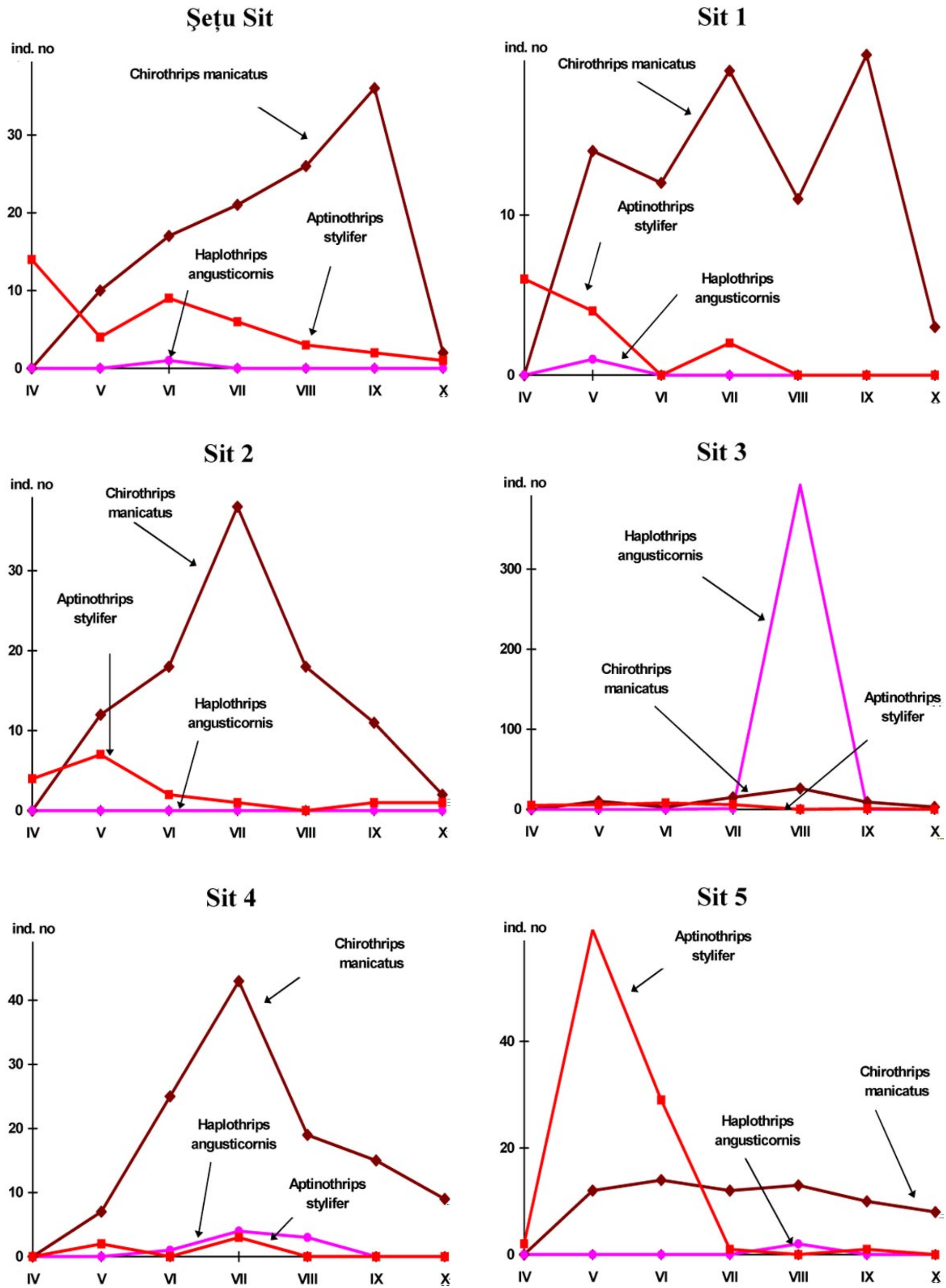


Fig.10 The monthly dynamics of the numerical abundance of thrips populations (2nd year) (sweep net method)

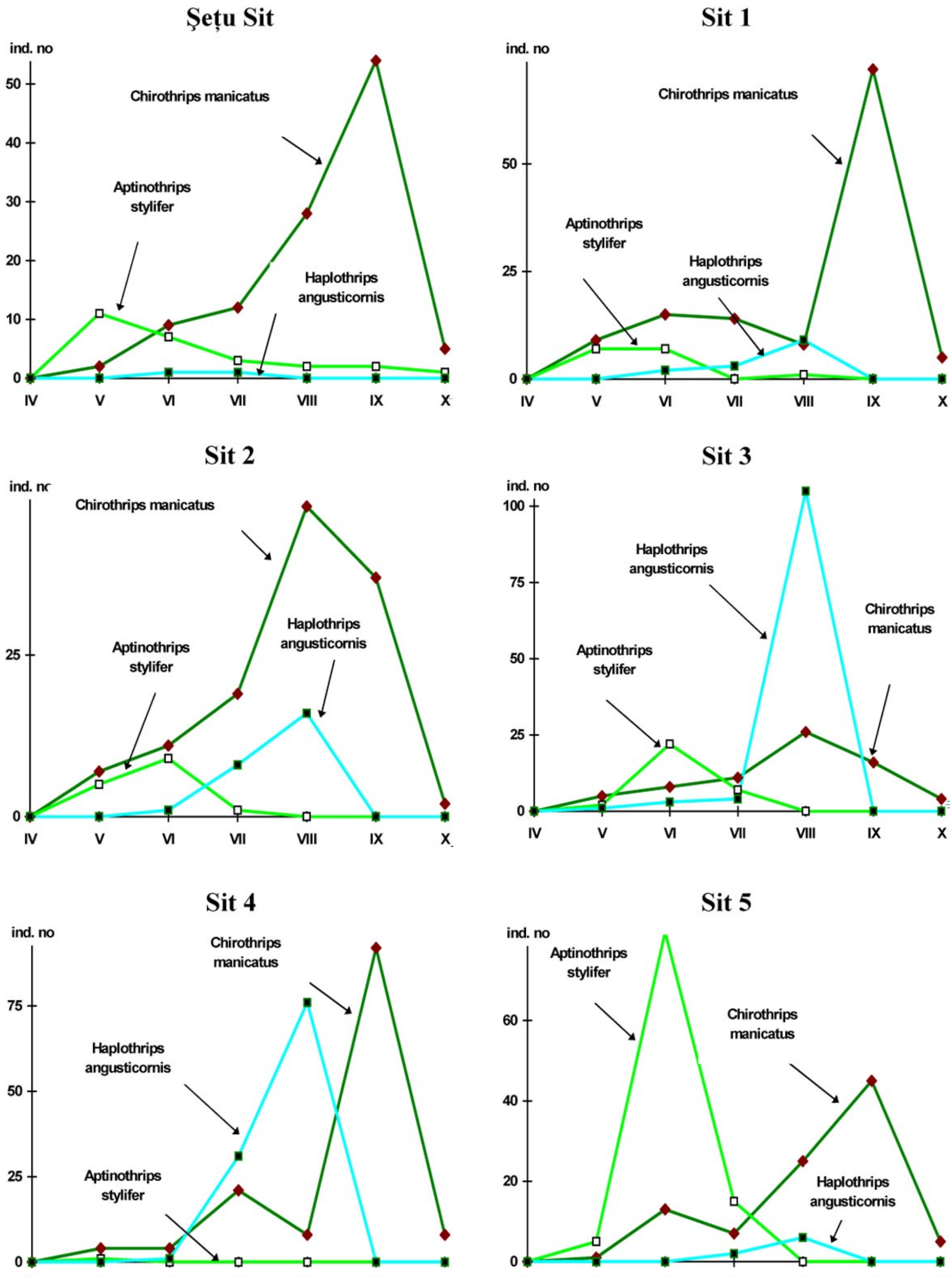


Fig. 11 The monthly dynamics of the numerical abundance of thrips populations (3rdyear) (sweep net method)

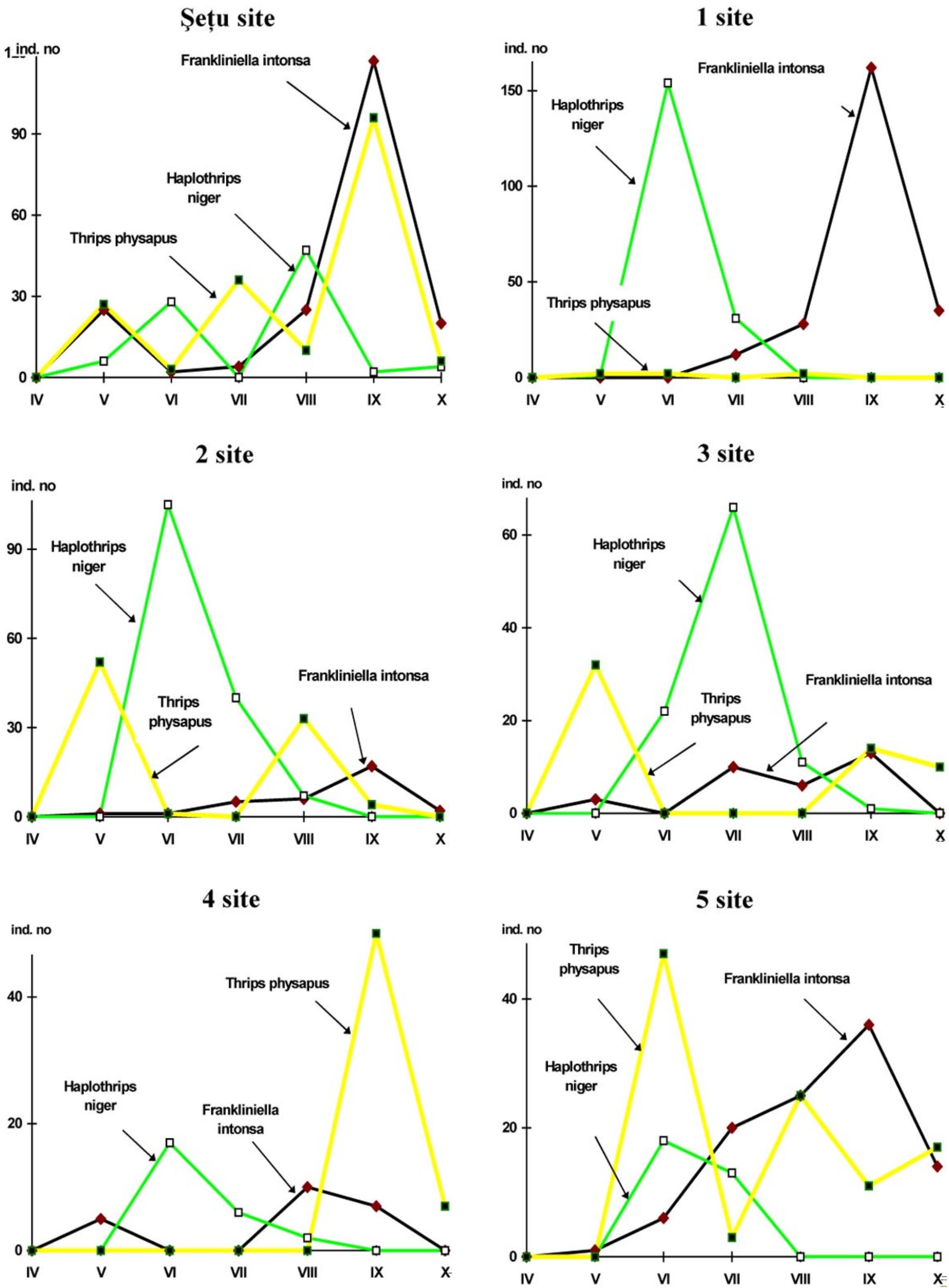


Fig.12 The monthly dynamics of the numerical abundance of thrips populations (1styear) (shake method)

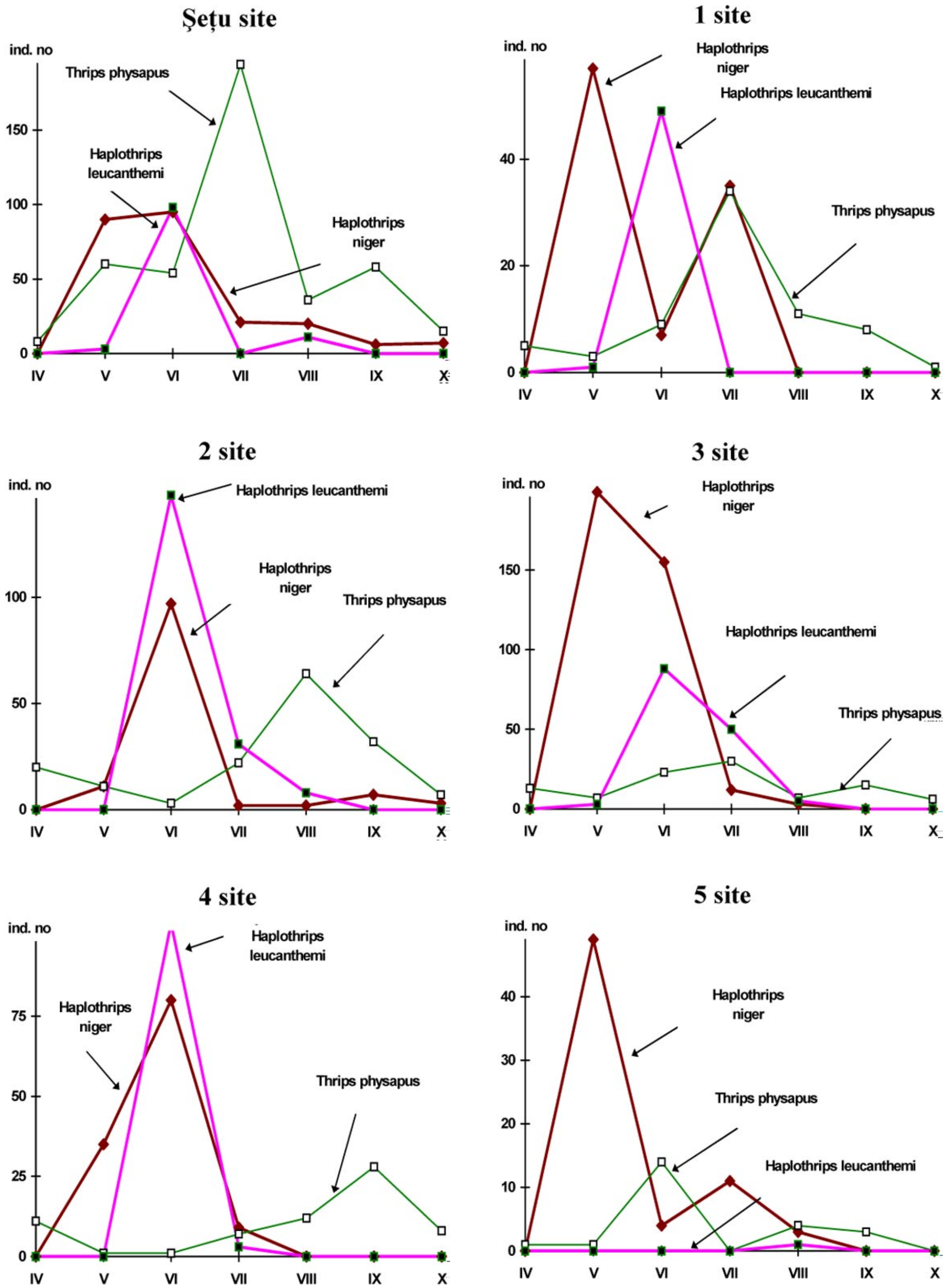
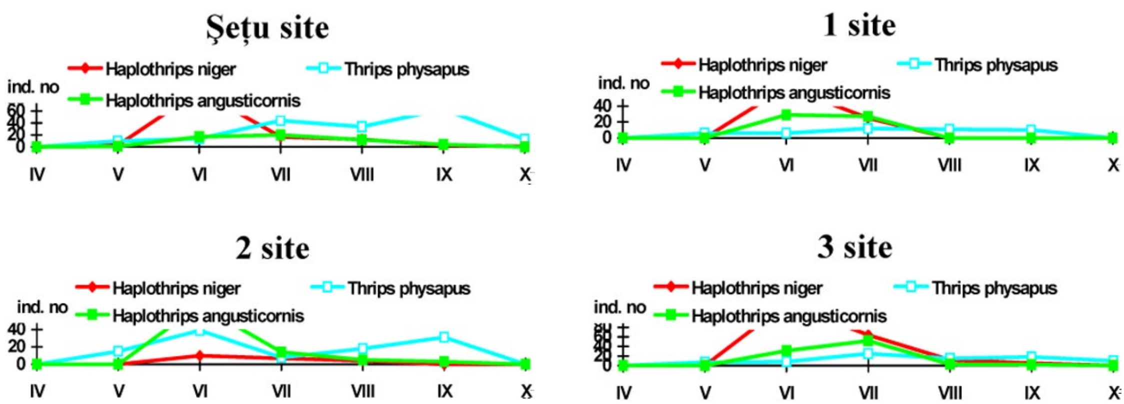
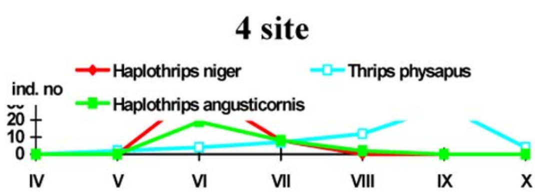


Fig. 13 The monthly dynamics of the numerical abundance of thrips populations (2ndyear) (shake method)





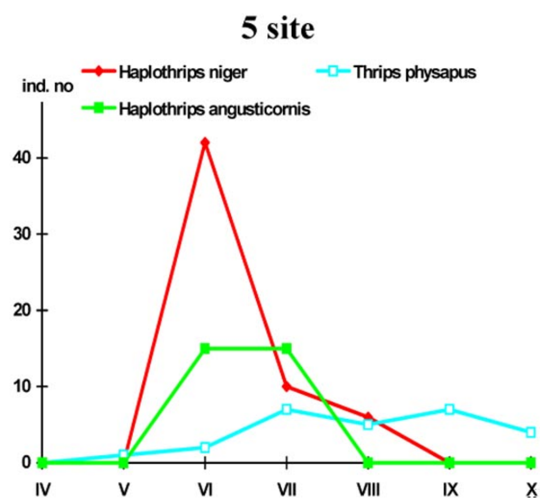


Fig. 14 The monthly dynamics of the numerical abundance of thrips populations (3rdyear) (shake method)

Among graminicolous species, the most frequent are *Chirothrips manicatus, Aptinothrips stylifer, Aptinothrips rufus, Limothrips denticornis, Haplothrips tritic* and *Haplothrips aculeatus*, which develops mostly on Poaceae plants.

The floricolous species have a large habitat, in the inflorescences of different plants species; the most specific are: *Frankliniella intonsa, Haplothrips alpester, Haplothrips leucanthemi, Haplothrips niger, Thrips physapus,* etc.

Depending on the collecting method, the graminicolous thrips (by sweep net) or floricolous (by shake net), thrips species, becomes dominant.

The spatial and temporal dynamics were analysed at the dominant species, by sweep net method: *Chirothrips manicatus, Aptinothrips stylifer, Haplothrips angusticornis, Haplothrips alpester* and by shake method: *Frankliniella intonsa, Haplothrips niger, Haplothrips leucanthemi, Thrips physapus*.

The species as the following: *Aeolothrips intermedius, Chirothrips manicatus, Melanthrips pallidior, Aptinothrips rufus, Aptinothrips stylifer, Haplothrips alpester, Haplothrips angusticornis* with high numerical abundance, have a high ecological plasticity, each occupying an important ecological niche in the structural net of the whole meadow ecosystem.

The site 5 „Plateau", at the 1500 m altitude, the only one with west exhibition, exposed to the strong winds, is dominated by the graminicolous thrips *Aptinothrips stylifer*. This species together with *Aptinothrips rufus* are the only ones which reach the highest altitude from Austrian Alps (Pelikán, 1995).

The temporal dynamics reveals a maximum of the numerical abundance in June in the 1st and 3rd year and in Mai in the 2nd, the driest, when the spring came one month earlier (by the sweep net method) (figure no 1).

By the shake method, the spatial and temporal dynamics of the dominant species: *Frankliniella intonsa, Haplothrips niger, Haplothrips leucanthemi, Haplothrips angusticornis* and

Thrips physapus has a specific character, belonging to the site and year .They used the most efficiently the resources of the meadow sites, having the largest influence on the other thrips from these coenosis., due to their ecological wide valances.

The values of the multiple correlations have been calculated for determined at some of the thrips species, the dominants ones are: *Aeolothrips intermedius, Chirothrips manicatus* and *Haplothrips angusticornis* (Table no.4), for both collecting methods, for the first 3 years of researches.

Survival and breeding of thrips in hot or dry places depends on their tolerance of low humidity which is closely linked to temperature. (Lewis, 1973)

The values of the coefficients are higher in the case of the sweep net method for *Aeolothrips intermedius* and *Haplothrips angusticornis* and lower for *Chirothrips manicatus.*(Tabel.no.4)

The correlation shows ecological significance between the thrips number and some abiotical factors.

The distribution of thrips middle mountainous level in beech zone, in the vegetal association *Festuco rubrae-Agrostetum capillaris* installed on the brown forest acid soil, is similar with the one at the altitude of 900 m and 1050 m. The percentage is of 15.97% respectively 15.52% from the total collected members.

In the same vegetal association, *Festuco rubrae-Agrostetum capillaris*, at 800 m, in fire-beech zone and at 1200 m in beech under zone, but installed on the brown meadow acid soil, the percentage of the thrips is much higher, 20.74% and respectively 22.33%.

In the superior mountainous level, on the pick, at 1500 m characterized by the association *Violo declinatae-Nardetum*, on the podzol humico-silicatic meadow soil, the percentage of the thrips is the lowest, 10.51%.

Monitoring study

The aim of the biological monitoring is to evaluate the present state and to find the tendencies of the biocoenosis modifications on the whole and of its most important components: species with mass reproduction between phytophagous indicators.

Detailed quantitative studies on thrips populations are rare and have seldom lasted more than a few years, so the causes of long-term changes in abundance are little understood (Lewis, 1973).

Thrips reaches on the mentioned criteria, for that, between 1970-1998 would present the particular structural aspects of thysanoptera from the same mountainous meadows. The collecting, every July during several years is added to the same period of the years 1967-1969.

Sweep net method

	AEOLOTHRIPS INTERMEDIUS						***CHIROTHRIPS MANICATUS***						***HAPLOTHRIPS ANGUSTICORNIS***						
	Setu site	**1 site**	**2 site**	**3 site**	**4 site**	**5 site**	**Setu site**	**1 site**	**2 site**	**3 site**	**4 site**	**5 site**	**Setu site**	**1 site**	**2 site**	**3 site**	**4 site**	**5 site**	
I year	**0.37**	**0.84***	**0.72***	**0.91***	**0.35**	**0.58***	**0.47***	**0.16**	**0.68***	**0.63***	**0.16**	**0.58***		**0.94***	**0.76***	**0.89***	**0.73***	**0.76***	
	0.7965	3.0540	2.0462	4.4732	0.7392	1.4329	1.0594	0.3226	1.8575	1.6345	0.3148	1.4409		5.6353	2.3310	3.9281	2.1205	2.3433	T
II year	**0.57***	**0.46***	**0.89***	**0.45***	**0.78***	**0.39**	**0.94***	**0.81***	**0.80***	**0.65***	**0.70***	**0.71***	**0.69***	**0.65***	**0.41**	**0.21**	**0.36**	**0.44***	
	1.3764	1.0357	3.8196	1.0088	2.5043	0.8495	5.5827	2.7774	2.6319	1.7245	1.9626	2.0234	1.9172	1.7277	0.9037	0.4215	0.7682	0.9787	T
III year	**0.27**	**0.14**	**0.13**	**0.57***	**0.94***	**0.94***	**0.19**	**0.56***	**0.61***	**0.78***	**0.53***	**0.55***	**0.41**	**0.98***	**0.94***	**0.70***	**0.91***	**0.95***	
	0.5618	0.2811	0.2621	1.3983	5.2865	5.3555	0.3828	1.3366	1.5407	2.5177	1.2662	1.3190	0.8954	11.0216	5.6345	1.9734	4.3165	5.9594	T
I year	**0.38**	**0.38**	**0.83***	**0.88***	**0.33**	**0.38**	**0.45***	**0.95***	**0.76***	**0.76***	**0.90***	**0.82***	**0.32**	**0.94**	**0.97**	**0.90**	**0.70***	**0.35**	
	0.8269	0.8245	2.9688	3.6819	0.7073	0.8171	1.0164	5.8139	2.3359	2.3095	4.0246	2.8529	0.6643	5.5357	8.3251	4.0221	1.9401	0.7357	T
II year	**0.54***	**0.70***	**0.57***	**0.60***	**0.53***	**0.43***				**0.93***	**0.82***		**0.69***	**0.65***	**0.41**	**0.21**	**0.36**	**0.44**	
	1.2845	1.9605	1.3773	1.5040	1.2463	0.9490*				5.0058	2.8503		1.9172	1.7277	0.9037	0.4215	0.7682	0.9787	T
III year	**0.45***	**0.12**	**0.74***	**0.69***	**0.76***	**0.76***	**0.43***	**0.89***	**0.72***	**0.93***	**0.38**	**0.42***	**0.45***	**0.10**	**0.18**	**0.16**	**0.60***	**0.88**	
	1.0070	0.2346	2.1917	1.8948	2.3219	2.3127	0.9620	3.8026	2.0977	4.9545	0.8252	0.9251	1.0144	0.2022	0.3660	0.3268	1.5136	3.7703	T

* significant p<0.001

Table 4. Multiple correlation coefficients and T Student test

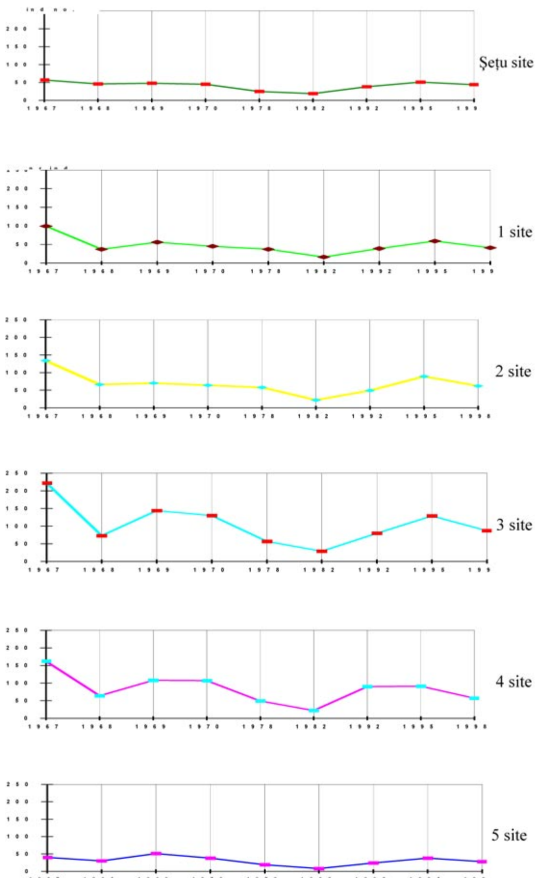


Fig. 15 The multiannual dynamics of the numerical abundance of thrips populations (sweep net method, July)

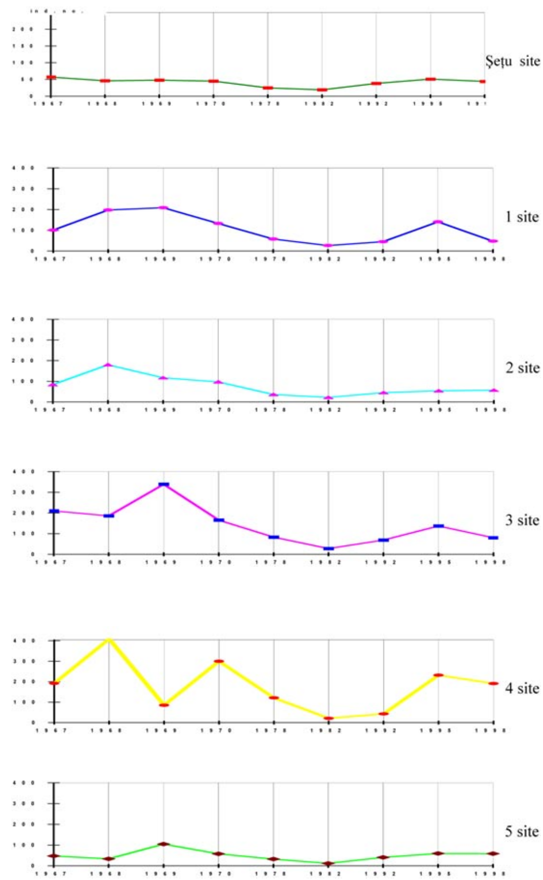


Fig. 16 The multiannual dynamics of the numerical abundance of thrips populations (shake method, July)

The climatic data shows that between 1965-1998 there was a high deviation compared to the normal climatic parameters; that was represented by a continuous of draught ness (about 12 years), beginning in 1981 and ending in 1994 (figure no. 15, 16).The maximal observed deficit between the extremes, against the mean compensated curve, was of 300 mm. As average, this deficit represents about 200 mm precipitation/year. Contrary to the case of the precipitations, the average air temperature, increased, but the period of this rise, doesn't coincide with the rainfall deficit's one; it moves again to the right with three years, between 1985-1996. The differences between the extremities are of 0.9°C and the differences between the against the mean period expressed by the compensate curve is of 0.6°C/year.

Translated into the De Martonne aridity index this climatic deviation is equal to a minus of 28 in the case of the extremities and with a minus of 33 in the case of the averages, that means the normal De Martonne index of the researched area, diminishes with about 60% (42%); 30 instead of 69 (70.8) like the normal values.

The deficitary value of the De Martonne index puts the investigated territory, in the beech forest plain at the interference with the oak, being known that the steppe begins at De Martonne index values smaller than 24.

The temporal analysis of the taxonomical structure of thrips reveals two distinct periods in its dynamics: the first is characteristic for the period 1967-1982 and the second for 1982-1998. In the year 1982, the thrips suffer a great reduction of the species, regardless the collecting methods or the investigated sites (with 57.10%) fact due to the impact of the ambiental modification (the beginning of highly draughty period) (figure no 2, 3).

The thrips diversity and numerical abundance of populations shows a time-back tendency of the first specific complexity only after the year 1995. The whole diversity analysis of thrips from investigated sites from Gârbova Massif, reveals a reach taxonomical spectrum organized on two trophic modules, of the phytophagous (65-82%) and of the zoophagous (18-35%) by both methods.

Table no. 5 shows characteristic for the spatial and temporal dynamics of the species and their individuals' numbers.

In order to justify, we have chosen as example, the shake method of whose results are less affected by the dryness.

In the Şeţu site the diminishing of the numerical abundance in 1982, comparatively with the maximum (obtained in 1968) had values of 10.93 times, in site 3 "Hut", 12.11 times, in the site 4, 19.48 times and at 1500 m, in the site 5 "Plateau" 8.75 times.

By the sweep net method, the ratio between that maximal values of the numerical abundance was reached in 1967 and the minimal values from 1982, is rather diminished comparing to those reached by shake method: in Şeţu site 3 times, in site 3 and 4, of 7.66 times and respectively 7.36 times are in the site 5, only 5 times.

The impact of those ambiental modifications can be reflected both in the taxonomical diversity and in the values of structural indices. The resistent species are: *Thrips tabaci, Aptinothrips stylifer, Chirothrips manicatus, Frankliniella intonsa, Odontothrips loti, Thrips validus, Haplothrips alpester, Haplothrips angusticornis, Haplothrips niger, Haplothrips reuteri*

By both methods of sampling, the highest number of exemplars were collected in the association *Festuco rubrae-Agrostetum capillaris*; with the sweep net, in the site 3, and by

Site 4 (sweep net method)																		
	1967		1968		1969		1970		1978		1982		1992		1995		1998	
species	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**
Fam. Aeolothripidae																		
Aeolothrips fasciatus	1	0.45	1	1.37			1	0.77									1	1.15
Aeolothrips intermedius	6	2.70	3	4.11	8	5.56	6	4.62	3	5.26			2	2.50	5	3.88	5	5.75
Melanthrips fuscus							1	0.77					1	1.25	2	1.55		
Melanthrips pallidior					1	0.69			2	3.51							1	1.15
Fam. Thripidae																		
Anaphothrips obscurus													1	1.25				
Aptinothrips elegans			2	2.74	1	0.69											1	1.15
Aptinothrips rufus	4	1.80			5	3.47	2	1.54										
Aptinothrips stylifer	1	0.45	6	8.22	7	4.86	4	3.08	5	8.77	1	3.45	3	3.75	6	4.65	8	9.20
Chirothrips manicatus	5	2.25	15	20.55	11	7.64	10	7.69	6	10.53	4	13.79	8	10.00	6	4.65	12	13.79
Firmothrips firmus			1	1.37			1	0.77									1	1.15
Frankliniella intonsa					2	1.39	3	2.31			1	3.45	1	1.25	4	3.10	5	5.75
Odontothrips biuncus															1	0.78		
Odontothrips loti	3	1.35	10	13.70	5	3.47	3	2.31	2	3.51	3	10.34	4	5.00	1	0.78	2	2.30
Odontothrips phaleratus	1	0.45															3	3.45
Oxythrips bicolor			1	1.37			1	0.77										
Parafrankliniella verbasci			1	1.37											1	0.78		
Stenothrips graminum											1	3.45						
Taeniothrips picipes			1	1.37	1	0.69	2	1.54			1	3.45						
Tenothrips frici	1	0.45	1	1.37	3	2.08	2	1.54							1	0.78		
Thrips atratus	1	0.45			1	0.69	2	1.54	3	5.26			3	3.75	2	1.55		
Thrips flavus	1	0.45			4	2.78	2	1.54	1	1.75					1	0.78		
Thrips montanus	8	3.60			4	2.78	2	1.54	1	1.75								
Thrips montivagus							1	0.77										
Thrips nigropilosus							1	0.77							1	0.78		
Thrips pelikani					2	1.39												
Thrips physapus	1	0.45	1	1.37	3	2.08	3	2.31	2	3.51					2	1.55		
Thrips tabaci	1	0.45			1	0.69	3	2.31	2	3.51	8	27.59	2	2.50				
Thrips trehernei											1	3.45						
Thrips trybomi			1	1.37	1	0.69	1	0.77							1	0.78		
Thrips validus					1	0.69	1	0.77							2	1.55		
Thrips vulgatissimus	9	4.05	2	2.74	3	2.08	2	1.54	1	1.75					1	0.78	2	2.30

Table 5. Numerical and relative abundance of the thirps populations from the site 4 (sweep net method) and from the site 1 (shake method) July, 1967-1998

Fam. Phlaeothripidae																		
Haplothrips acanthoscelis															1	0.78	1	1.15
Haplothrips aculeatus	16	7.21	1	1.37	3	2.08	2	1.54	5	8.77	1	3.45	3	3.75	6	4.65	2	2.30
Haplothrips alpester	96	43.24			37	25.69	31	23.85	13	22,81	5	17.24	15	18.75	33	25.58	25	28.74
Haplothrips angusticornis	4	1.80	1	1.37	4	2.78	8	6.15	4	7.02	1	3.45	6	7.50	11	8.53	1	1.15
Haplothrips distinguendus	2	0.90	1	1.37			1	0.77					2	2.50	3	2.33		
Haplothrips leucanthemi	25	11.26	3	4.11	11	7.64	8	6.15	1	1.75	1	3.45	13	16.25	7	5.43	4	4.60
Haplothrips niger	34	15.32	18	24.66	24	16.67	20	15.38	4	7.02			12	15.00	23	17.83	7	8.05
Haplothrips reuteri	1	0,45	3	4.11	1	0.69	2	1.54	1	1.75			2	2.50	4	3.10		
Haplothrips subtilissimus													1	1.25				
Haplothrips tritici	1	0.45					3	2.31	1	1.75	1	3.45	1	1.25	3	2.33		
Kakothrips robustus							1	0.77									1	1.15
Limothrips denticornis															1	0.78		
Total	**222**	**100**	**73**	**100**	**144**	**100**	**130**	**100**	**57**	**100**	**29**	**100**	**80**	**100**	**129**	**100**	**82**	**100**

										Site 1			(shake method)					
	1967		1968		1969		1970		1978		1982		1992		1995		1998	
species	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**
Fam. Aeolothripidae																		
Aeolothrips ericae																	1	2.08
Aeolothrips fasciatus			1	0.51	3	1.44	2	1.50	1	1.72	2	7.41			2	1.42	1	2.08
Aeolothrips intermedius			9	4.55	21	10.05	9	6.77	5	8.62	2	7.41	5	11.11	5	3.55	2	4.17
Melanthrips knechteli															1	0.71		
Fam. Thripidae																		
Aptinothrips stylifer			1	0.51														
Chirothrips manicatus	2	1.98			1	0.48	2	1.50							1	0.71		
Frankliniella intonsa	12	11.88	39	19.70	25	11.96	9	6.77	6	10.34	4	14.81	5	11.11	20	14.18	3	6.25
Kakothrips robustus	18	17.82													8	5.67		
Odontothrips biuncus			1	0.51														
Odontothrips loti	7	6.93	4	2.02	7	3.35	1	0.75	3	5.17			9	20.00	13	9.22	6	12.50
Taeniothrips picipes	5	4.95			5	2.39	3	2.26					1	2.22	1	0.71		
Tenothrips frici	1	0.99	1	0.51	2	0.96	1	0.75	1	1.72					2	1.42	2	4.17
Thrips atratus	1	0.99			7	3.35					1	3.70	1	2.22	3	2.13	2	4.17
Thrips minutissimus					1	0.48	1	0.75							1	0.71		
Thrips montanus			2	1.01	5	2.39	3	2.26					2	4.44	4	2.84	1	2.08
Thrips montivagus			15	7.58	9	4.31	7	5.26	4	6.90			2	4.44	4	2.84		
Thrips nigropilosus			8	4.04	4	1.91									3	2.13	1	2.08
Thrips pelikani			1	0.51	1	0.48	1	0.75									1	2.08
Thrips physapus			34	17.17	12	5.74	15	11.28			1	3.70	7	15.56	7	4.96	1	2.08
Thrips tabaci	7	6.93	32	16.16	12	5.74	8	6.02							15	10.64	7	14.58
Thrips trybomi			2	1.01			1	0.75							2	1.42		
Thrips validus			5	2.53	7	3.35	4	3.01	2	3.45			1	2.22	3	2.13	2	4.17
Thrips vulgatissimus	1	0.99	1	0.51	1	0.48							1	2.22	1	0.71		
Fam. Phlaeothripidae																		
Haplothrips acanthoscelis	6	5.94			1	0.48	2	1.50					1	2.22	1	0.71	1	2.08
Haplothrips aculeatus	2	1.98			3	1.44	2	1.50	1	1.72			1	2.22	3	2.13	1	2.08
Haplothrips alpester															1	0.71		
Haplothrips angusticornis	5	4.95	2	1.01	27	12.92	12	9.02	6	10.34	7	25.93	1	2.22	2	1.42	2	4.17
Haplothrips distinguendus			1	0.51	5	2.39	2	1.50	1	1.72			1	2.22	2	1.42	2	4.17
Haplothrips kurdjumovi			1	0.51														
Haplothrips leucanthemi	2	1.98			19	9.09	12	9.02	8	13.79	1	3.70	6	13.33	9	6.38	6	12.50
Haplothrips niger	31	30.69	35	17.68	25	11.96	32	24.06	18	31.03	9	33.33			22	15.60	5	10.42
Haplothrips reuteri			3	1.52	4	1.91	3	2.26	2	3.45			1	2.22	2	1.42	1	2.08
Haplothrips tritici					2	0.96	1	0.75							2	1.42		
Liothrips setinodis	1	0.99													1	0.71		
Total	**101**	**100**	**198**	**100**	**209**	**100**	**133**	**100**	**58**	**100**	**27**	**100**	**45**	**100**	**141**	**100**	**48**	**100**

Table 5. (cont.) Numerical and relative abundance of the thirps populations from the site 4 (sweep net method) and from the site 1 (shake method) July, 1967-1998

shaking, in the Şețu site, and the lowest number of exemplars, by both methods, generally, in the association *Violo declinatae-Nardetum*, at 1500 m where the environmental conditions are less favourable to thrips populations.

The values of the effectives vary from a coenosis to another, depending on the vegetal association, the curve having oscillations with a constant character for the second year, a dry year in comparison with the third year. A certain reduction of the individual's sampling by sweep method is relevant, also reflecting the dry ness degree of the respective vegetation.

The shake method reveals the degree of the thrips aggregation on the blooming plants; they can change numerous hosts, because of their polyphagy.

We consider both methods very useful, the sweeping taking an important contribution of species, and the shaking of exemplars, both realizing a complete sampling of the thrips fauna from the mountainous meadows.

Conclusions

The ecological study of the thrips associations structure was conducted in 6 sites of secondary meadows, differentiated by the vegetal associations and by altitudes between 800 m – 1500 m in the Gârbova Massif, Southern Carpathians, Romania. The general analysis of the thysanoptera diversity showed a large number of species: namely 78; by the sweep net method - 68 species, by the shake method - 58 species ;

The temporal and spatial dynamics of the thrips populations show the richest structural net in the vegetal association *Festuco rubrae-Agrostetum capillaries***.** A species and individual decrease was observed in all sites, in the draughty 1982 year, with the tendency to came back, to the 1967-1970 normal values, towards 1995.

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