The dynamics of the sex ratio index of thrips populations in mountainous meadows

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Abstract: In our researches, the main goal was to dermine the sex ratio index of all the 78 thrips species from different meadows sites on the Gârbova Massive, three consecutive years and later in investigations of the monitoring type, during about 22 years, utilizing two collecting methods, shaking and sweeping. In the case of the dominant species we could notice a different sexual index, depending on the thrips sampling method. The year 1968, considered draughtier year than 1967 and 1969 produced a larger number of males. Also, in the draughtier time of the year 1982, the sex ratio index display lower values for some species, the values rose to 72.82% and 71.43% in 1968 and 1982 and to 94.87% in 1967 and 87.80% in 1998, years considered as "normal".

Introduction

In all the ecological studies, the genetic structure was reduced only to the one of the main aspects of this parameter, represented by the sex structure. The sex ratio index is very important in the knowledge of the biotic potential of the population. Field populations of most species are bisexual, but females often predominate. In some species males are rare or unknown and reproduction is partly or wholly parthenogenetic.

Spurious ratios may also occur in species with flightless males, when plants other than the larval hosts are sampled, when one sex is more active than the other, or when sexes are attracted differentially to trap (Lewis, 1961). In species in which only the females hibernate, the sex ratio changes in spring as new males are gradually produced. Koppa (1969) mentioned that the thrips species with flightless males, the sex ratio point out the suitability of different host plants.

Sex ratio can be influenced by the latitude (Morison, 1957 in Lewis, 1973): *Thrips vulgatissimus* has males in equal number with females in Scotland (57°N) and rare or absent in southern England (52°N). Males of *Aptinothrips rufus* are rare, but in Scotland the ratio is 1♂:150♀♀ (Morison, 1957) and 1♂: 3,000♀♀ in central France (Pusard Radulesco, 1930 in Lewis, 1973).

Arrhenotoky or thelitoky are present on the thrips species. In Netherlands (Vierbergen, 2000) *Thrips tabaci* is normally thelytokous, but the female/male ratio observed on leek was 26: 1 during three research years.

Kirk (1985) has recorded the male-biased adult sex ratio at flowers, suggest that blossoms represent mating sites analogous to leeks. Few data interpretable in terms of sex ratio adaptation are available for fully-winged thrips on grasses and crops. The sex ratio of *Chirothrips manicatus* (Shull, 1914) vary erratically during the breeding season.

Adult sex ration for some Australian gall thrips (Crespi, 1993) varies between 0.05-0.52, depending on the type of galls.

Materials and Methods

The thrips populations were studied during 3 years in 6 sites, all secondary meadows, of 1 ha, in the Gârbova Massif, differentiated altitudinally, through typical vegetal associations and soil.

Şeţu site: 800 m altitude, S-W exhibition, the slope small inclined, brown eubasic meadow soil, characterized by the association *Festuco rubrae-Agrostetum capillaris* Horv. 1951, in fir- beech zone.

We have done the researches and in the following sites on Bogdan Valley:

Site 1: 900 m altitude, S exhibition, the slope 10°-15°, brown acid forest soil, *Festuco rubrae-Agrostetum capillaris* Horv. 1951 association, in beech under zone.

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. In the Şeţu site there had been functioning a meteorological station, during 3 years.

The working method was of the ecological stationary, delimitated on the surface of 1 ha.

In these sites, we have utilised two established methods, recognized on international level: sweep net method and shake of blooming plants method; the thrips were collected twice every month, the number of samples were statistically determined.

The sex ratio was calculated, after standard formula: $Sr = \frac{f}{m+f} x100$

Results and Discussions

The main purpose in our researches was the point out the sex ratio of all 78 thrips species, in 3 consecutive years, in vegetal association and later, in our monitoring studies, in period 1967-1998.

The sex ratio, and the female/male ratio were shown in the Tables 1 and 2, and figures 1-5. The ratio female-male number for each for the first three consecutive years, on the dominant thrips species was: 274 females : 988 males; 393 females : 150 males and 298 females : 362 males, by sweeping method and 25 females : 3 males; 10 females : 0 males and 24 females : 0 males by shake method, on *Chirothrips manicatus* (Vasiliu-Oromulu, 1986).

In order to the sweep net method, the distributions of males wingless are more homogenous, especially between July and October, more abundant in September, in all sites, indifferently on the altitude, or vegetal association.

On the *Aeolothrips intermedius*, the maximal numbers of males were sampled, opposite, by shake method: 112 females : 33 males, 133 females : 46 males and respectively 222 females : 52 males and by sweeping: 120 females : 28 males, 70 females : 12 males and 119 females to 29 males (Tabel.no.1).

On the *Frankliniella intonsa* the same shake method must be utilized for obtain the must abundant males number for the three years: 499 females : 116 males, 267 females : 41 males, 194 females : 44 males and for sweep net method the result are scarcer and equally for years: 47 females: 4 males, 39 females : 4 males, 34 females : 2 males; the same results were registered and for *Thrips physapus*, by shake method: 378 females : 112 males, 611 females : 176 males, 436 females : 64 males, the males being present in all the researches month.

Thrips vulgatissimus, in Romania, at 45°N, has a higher number of males as in England. The mean ratio, for 3 years, is 14,83 females : 1 males by sweeping and 11.85 females : 1 males by shake method.

From the Phlaeothripidae Family, *Haplothrips angusticornis* has a high individuals collection, for the three years: 250 females : 32 males, 268 females : 168 males, 324 females : 23 males by shake method and 73 females : 14 males, 210 females : 208 males and 192 females : 78 males, this species having more males number in the second year, draughtlier. The maximal male number characterized the site 4, from 1300 m, with *Scorzonero roseae – Festucetum nigricantis* association, in the second part of July. The same situation, was in the first year, in the same site, and month, but fewer males.

	Sex ratio index values of thrips species from Garbova Massif													
	Sweep net method							Shake method						
	sex ratio			f/m				sex ratio			f/m			
species	1st year	2nd year	3rd year	1st year	2nd year	3rd year		1st year	2nd year	3rd year	1st year	2nd year	3rd year	
Fam. Aeolothripidae														
Aeolothrips albicinctus	80.00	66.67	80.00	4.00	2.00	4.00								
Aeolothrips ericae	66.67	100.00	100.00	2.00	2/o	1/o		66.67	100.00	100.00	2.00	5/o	6/o	
Aeolothrips fasciatus	96.15	100.00	100.00	25.00	19/0	13/o		90.91	91.18	100.00	10.00	10.33	24/o	
Aeolothrips intermedius	81.08	85.37	80.41	4.29	5.83	4.10		77.24	74.30	81.02	3.39	2.89	4.27	
Melanthrips fuscus	80.95	66.67	85.71	4.25	2.00	6.00		50.00	73.33	78.26	1.00	2.75	3.60	
Melanthrips knechteli								100.00			1/o			
Melanthrips pallidior	74.34	65.38	78.21	2.90	1.89	3.59		63.78	68.57	75.68	1.76	2.18	3.11	
Rhipidothrips gratiosus	100.00													
Fam. Thripidae														
Anaphothrips euphorbiae	100.00			1/o				84.62	100.00		5.50	8/o		
Anaphothrips obscurus	100.00	100.00	100.00	4/o	9/o	7/o			100.00			2/o		
Apterothrips secticornis								100.00			1/o			
Aptinothrips elegans	100.00	100.00	100.00	14/o	23/o	17/o		100.00			11/o		14/o	
Aptinothrips rufus	100.00	100.00	100.00	53/o	59/o	61/o		100.00		100.00	33/o	5/o	8/o	
Aptinothrips stylifer	100.00	100.00	100.00	183/o	192/o	190/o		100.00	100.00	100.00				
Chirothrips aculeatus	91.67			11.00										
Chirothrips manicatus	21.71	72.38	45.15	0.28	2.62	0.82		89.29	100.00	100.00	8.33	10/o	24/o	
Firmothrips firmus	24.24	85.71	82.35	0.32	6.00	4.67						0.00		
Frankliniella intonsa	92.16	90.70	94.44	11.75	9.75	17.00		81.14	86.69	81.89	4.30	6.51	4.52	
Frankliniella pallida								100.00	100.00		1/o	1/o		
Frankliniella tenuicornis	100.00			1/o										
Kakothrips dentatus								100.00			1/o			
Kakothrips robustus	75.00	50.00	100.00	3.00	1.00	3/o		93.94	97.06	100.00	15.50	33.00	4/o	
Limothrips denticornis	100.00	100.00	100.00	14/o	2/o	6/o								
Limothrips schmutzi	100.00	100.00	100.00	3/o	1/o	1/o		100.00			1/o			
Mycterothrips annulicornis		100.00												
Neohydatothrips abnormis	100.00	100.00			2/o									
Odontothrips biuncus	100.00	100.00	100.00	4/o	4/o	2/o		100.00	50.00	81.82		1.00	4.50	
Odontothrips confusus	100.00		100.00	1/o		1/o			100.00					
Odontothrips loti	84.00	88.31	88.06	5.25	7.56	7.38		71.11	75.73	75.32	2.46	3.12	3.05	
Odontothrips phaleratus	66.67	66.67	85.71	2.00	2.00	6.00								
Oxythrips bicolor	100.00	100.00	100.00	4/o	1/o	1/o								
Parafrankliniella verbasci		100.00			1/o				100.00			4/o		
Prosopothrips vejdovski		100.00	100.00		2/o	1/o								
Sericothrips bicornis	100.00	100.00	100.00	8/o	1/o	1/o								
Sminyothrips biuncatus		100.00			1/o									
Stenothrips graminum									100.00			2/o		
Taeniothrips inconsequens	75.00			3.00										
Taeniothrips picipes	85.09	95.00	100.00	5.71	19.00	56/o		67.73	91.85	93.42	2.10	11.27	14.20	
Tenothrips discolor								100.00			1/o			
Tenothrips frici	77.27	100.00	100.00	3.40	2/o	20/o		83.33	100.00	100.00	5.00	6/o	6/o	
Thrips atratus	79.25	100.00	85.71	3.82	3/o	6.00		97.96	95.35	96.61	48.00	20.50	28.50	
Thrips crassicornis		100.00	100.00		1/o	1/o								
Thrips dilatatus		100.00			1/o									
Thrips euphorbiae								100.00	100.00	100.00	3/o	6/o	4/o	
Thrips flavus	100.00	100.00	100.00	2/o	10/o	23/o		100.00	88.89	85.00		8.00	5.67	
Thrips incognitus									100.00			1/o		
Thrips major	100.00	100.00	100.00	2/o	1/o	4/o		50.00	100.00	100.00	1.00	3/o	3/o	
Thrips minutissimus	100.00	100.00	100.00	2/o	1/o	1/o			100.00	100.00	o/1	3/o	1/o	
Thrips montanus	77.89	93.33	94.12	3.52	14.00	16.00		88.89	88.24	91.14	8.00	7.50	10.29	
Thrips montivagus	50.00	100.00	100.00	1.00	5/o	3/o			85.37	90.00		5.83	9.00	
Thrips nigropilosus		100.00			1/o				96.30	80.00		26.00	4.00	
Thrips pelikani	86.67	83.33	90.91	6.50	5.00	10.00		76.02	82.00	82.24	3.17	4.56	4.63	
Thrips physapus	95.59	93.48	98.68	21.67	14.33	75.00		77.14	79.22	87.20	3.38	3.81	6.81	
Thrips pillichi								100.00	100.00	100.00	9/o	4/o	5/o	
Thrips tabaci	100.00	86.67	100.00	48/o	6.50	37/o		94.61	90.44	99.06	17.56	9.46	105.00	
Thrips trehernei	70.59	100.00	75.00	2.40		3.00		62.86	87.50	86.96	1.69	7.00	6.67	
Thrips trybomi	100.00	100.00	100.00	1/o	2/o	2/o		100.00	90.00	100.00	3/o	9.00	4/o	
Thrips validus	94.12	100.00	100.00	16.00	6/o	11/o		37.50	80.00	81.88	0.60	4.00	4.52	
Thrips vulgatissimus	86.67	100.00	100.00	6.50	20/o	18/0		100.00	82.61	79.17	27/o	4.75	3.80	
Fam. Phlaeothripidae														
Bolothrips bicolor	0.00	0.00		o/1	o/1									
Haplothrips acanthoscelis	85.71	75.00	92.31	6.00	3.00	12.00		82.61	100.00	100.00	4.75	6/o	19/o	
Haplothrips aculeatus	93.62	92.31	89.19	14.67	12.00	8.25		90.00	100.00	100.00	9.00	2/o	11/o	
Haplothrips alpester	92.02	87.88	88.61	11.54	7.25	7.78		92.31	86.11	84.35	12.00	6.20	5.39	
Haplothrips angusticornis	83.91	50.24	71.11	5.21	1.01	2.46		88.65	61.47	93.37	7.81	1.60	14.09	
Haplothrips distinguendus	93.33	100.00	94.74	14.00	7/o	18.00		72.73	91.30	80.00	2.67	10.50	4.00	
Haplothrips kurdjumovi	100.00		100.00	2/o		2/o			0.00			o/1		
Haplothrips leucanthemi	95.35	81.25	100.00	20.50	4.33	27/o		88.58	82.71	78.91	7.76	4.78	3.74	
Haplothrips niger	93.06	90.32	82.98	13.40	9.33	4.88		98.59	96.19	95.68	70.13	25.26	22.13	
Haplothrips phyllophilus									100.00			1/o		
Haplothrips reuteri	91.67	66.67	84.21	11.00	2.00	5.33		75.00	60.34	69.01	3.00	1.52	2.23	
Haplothrips setiger	100.00	100.00	100.00	5/o	3/o	5/o		100.00			2/o			
Haplothrips subtilissimus		66.67	100.00		2.00	2/o		100.00			1/o			
Haplothrips tritici	96.77	100.00	100.00	30.00	4/o	23/o		100.00	100.00	100.00	7/o	5/o	5/o	
Hoplandrothrips bidens	0.00	66.67	0.00	o/1	2.00	o/1								
Liothrips austriacus	100.00		100.00	1/o		1/o								
Liothrips setinodis		100.00			2/o			100.00			1/o			
Phlaeothrips coriaceus	100.00		100.00	1/o		1/o								
Phlaeothrips pillichianus	0.00	66.67	50.00	o/1	2.00	1.00								

Table 1

Species with 100 % sex ratio (sweep net method)

	1967	1968	1969	1970	1978	1982	1992	1995	1998
Aeolothrips albicinctus	+			+					
Aeolothrips ericae		+						+	+
Aeolothrips fasciatus	+	+	+	+	+			+	+
Anaphothrips euphorbiae						+		+	
Anaphothrips obscurus				+			+		
Apterothrips secticornis							+		
Aptinothrips elegans		+	+				+	+	+
Aptinothrips rufus	+		+	+					
Aptinothrips stylifer	+	+	+	+	+	+	+	+	+
Bolothrips bicolor							+		
Firmothrips firmus		+	+	+				+	+
Frankliniella intonsa	+	+	+	+	+	+	+	+	+
Haplothrips acanthoscelis		+		+			+	+	+
Haplothrips aculeatus		+	+	+	+	+	+	+	+
Haplothrips alpester				+					
Haplothrips angusticornis						+			+
Haplothrips distinguendus		+	+	+		+	+	+	+
Haplothrips kurdjumovi			+					+	+
Haplothrips leucanthemi			+	+	+		+	+	+
Haplothrips niger						+			
Haplothrips reuteri	+		+	+	+	+	+	+	
Haplothrips setiger							+		
Haplothrips subtilissimus		+					+	+	
Haplothrips tritici			+	+	+	+	+	+	+
Hoplandrothrips bidens					+				
Kakothrips robustus								+	+
Limothrips denticornis								+	
Liothrips austriacus									+
Liothrips setinodis		+							
Melanthrips fuscus			+	+			+	+	+
Melanthrips pallidior					+		+		+
Mycterothrips annulicornis		+					+		
Neohydatothrips abnormis	+								
Odontothrips biuncus	+							+	
Odontothrips phaleratus	+								+
Oxythrips bicolor	+	+		+			+		
Parafrankliniella verbasci		+						+	
Phlaeothrips coriaceus			+		+			+	
Phlaeothrips pillichianus							+		+
Prosopothrips vejdovski		+				+			
Sericothrips bicornis			+	+					+
Smyniothrips biuncatus								+	
Stenothrips graminum						+			
Taeniothrips inconsequens						+			
Taeniothrips picipes		+	+	+	+	+	+	+	+
Tenothrips frici		+	+	+	+	+	+	+	+
Thrips atratus						+			
Thrips crassicornis				+	+				
Thrips dilatatus		+						+	
Thrips flavus	+		+	+	+			+	
Thrips major			+	+			+		
Thrips minutissimus	+		+	+				+	
Thrips montanus			+	+	+	+	+		
Thrips montivagus				+				+	+
Thrips nigropilosus				+				+	
Thrips pelikani			+						
Thrips physapus	+	+	+	+	+	+	+	+	+
Thrips pini							+		
Thrips tabaci	+	+	+	+	+	+	+	+	+
Thrips trehernei	+			+		+			
Thrips trybomi	+	+	+	+	+			+	
Thrips validus	+	+	+	+	+		+	+	+
Thrips vulgatissimus		+	+	+	+			+	+
species number	17	23	27	32	20	19	27	34	27

Table 2

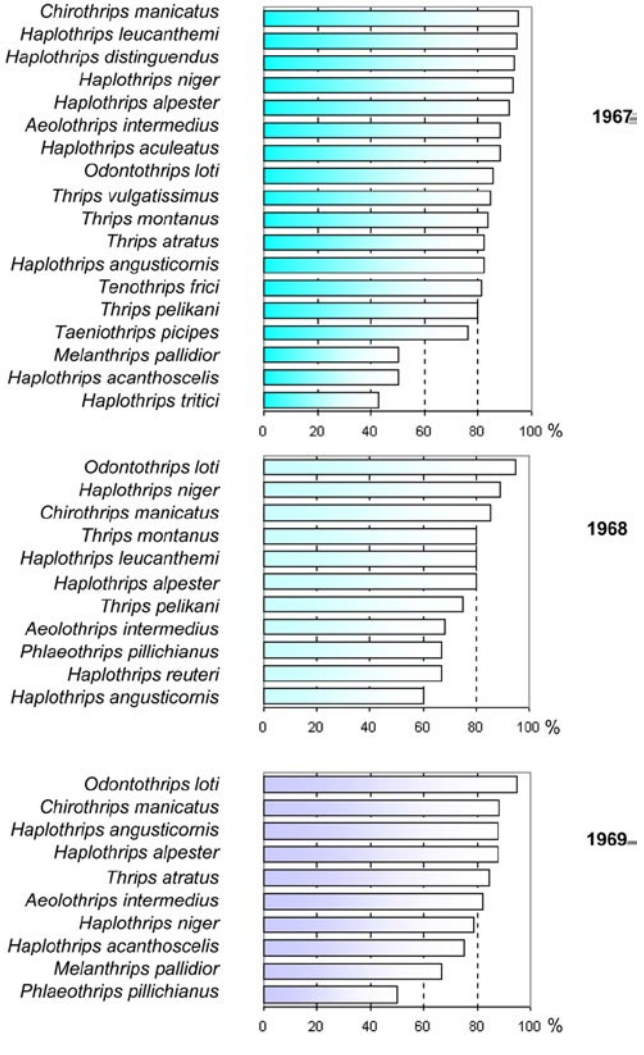

Figure 1: Annual dynamics of sex ratio (sweep net method)

Species with 100 % sex ratio (shake method)

	1967	1968	1969	1970	1978	1982	1992	1995	1998
Aeolothrips ericae		*	*	*					*
Aeolothrips fasciatus	*	*	*	*	*	*	*	*	*
Anaphothrips euphorbiae							*		
Anaphothrips obscurus				*					
Apterothrips secticornis							*		
Aptinothrips elegans							*		
Aptinothrips rufus			*	*	*				
Aptinothrips stylifer			*	*	*		*	*	*
Chirothrips manicatus	*	*	*	*	*		*	*	*
Frankliniella pallida		*					*		
Haplothrips acanthoscelis			*	*	*	*	*	*	*
Haplothrips aculeatus	*		*	*	*		*	*	*
Haplothrips distinguendus	*	*		*	*	*	*	*	*
Haplothrips reuteri	*				*	*	*		
Haplothrips tritici	*	*	*		*			*	*
Kakothrips robustus		*		*					
Liothrips setinodis	*							*	
Melanthrips knechteli								*	
Melanthrips pallidior	*		*	*					*
Odontothrips biuncus	*			*			*	*	
Odontothrips confusus				*				*	
Odontothrips loti	*								
Taeniothrips picipes		*			*	*	*		*
Tenothrips frici	*	*	*	*	*		*	*	*
Thrips atratus	*	*		*	*	*			*
Thrips flavus		*	*	*			*	*	*
Thrips major				*				*	*
Thrips minutissimus		*	*	*				*	
Thrips montanus	*					*	*		*
Thrips montivagus					*		*	*	*
Thrips nigropilosus					*	*	*		*
Thrips pelikani	*				*	*			*
Thrips pillichi	*	*	*	*				*	
Thrips tabaci	*		*	*	*	*	*	*	*
Thrips trehernei	*	*	*	*	*		*	*	*
Thrips trybomi		*		*	*		*	*	*
Thrips validus	*					*			
Thrips vulgatissimus	*	*	*	*	*		*	*	*
Species number	19	16	16	23	19	11	22	21	22

Table 2 (cont.)

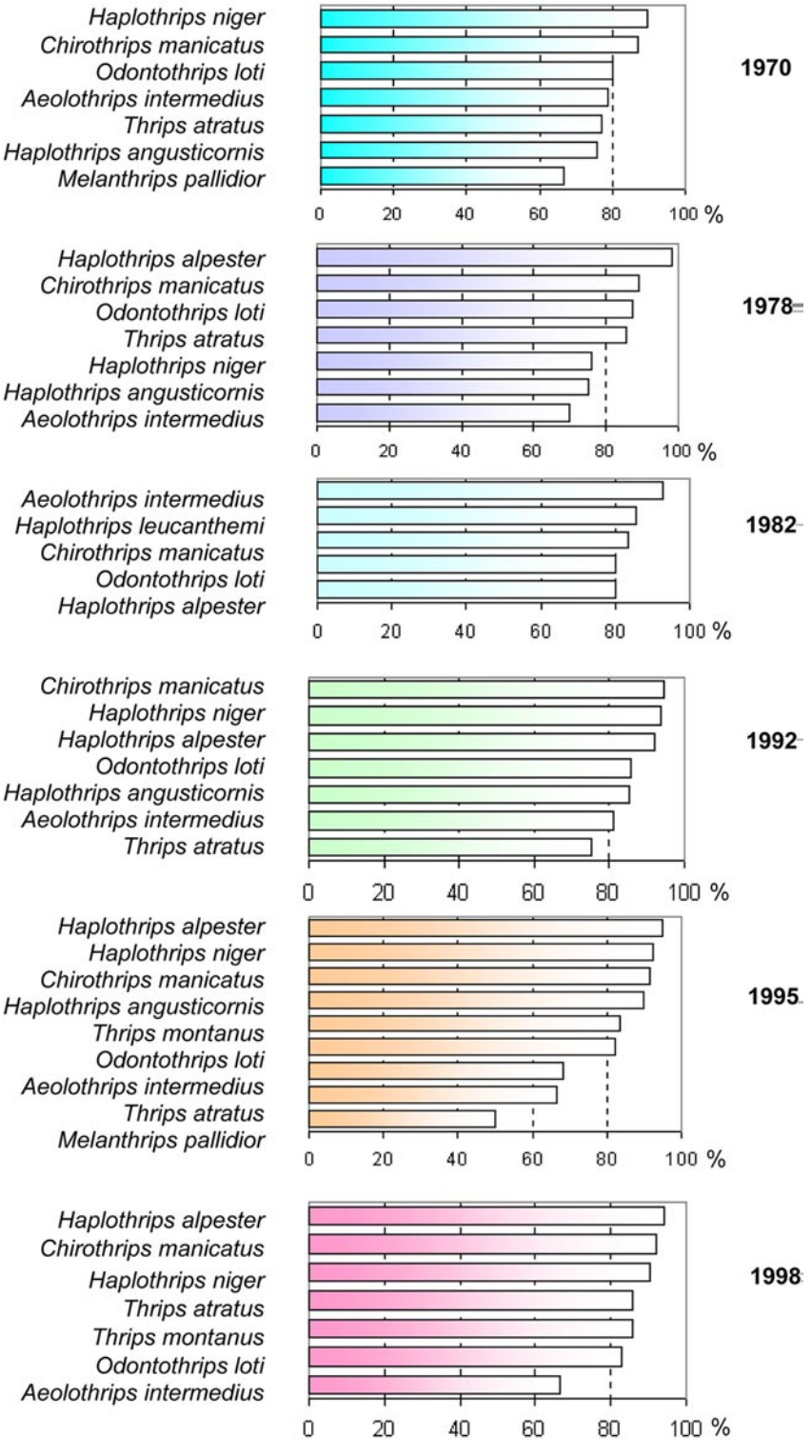

Figure 2: Annual dynamics of sex ratio (sweep net method)

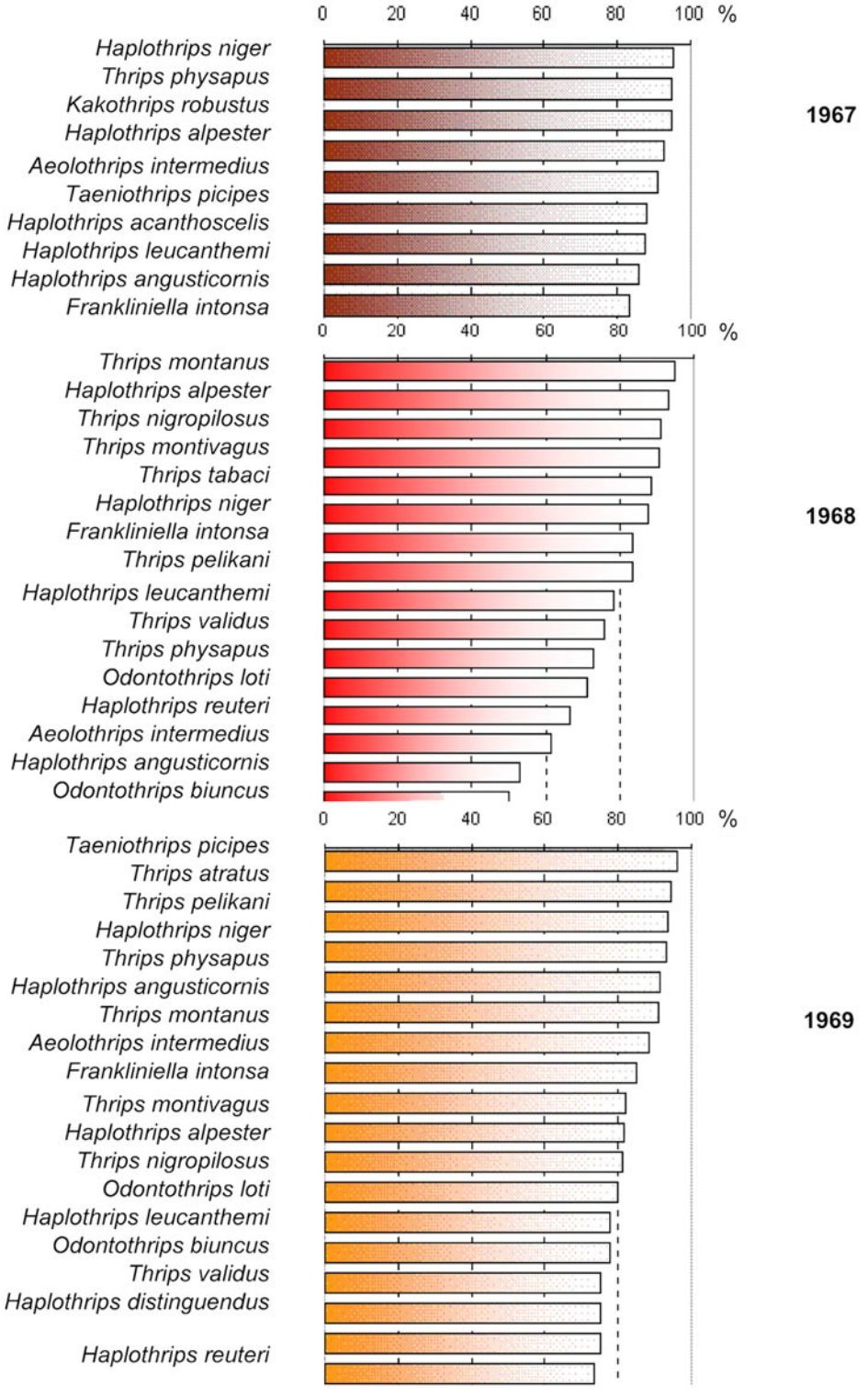

Figure 3: Annual dynamics of sex ratio (shake method)

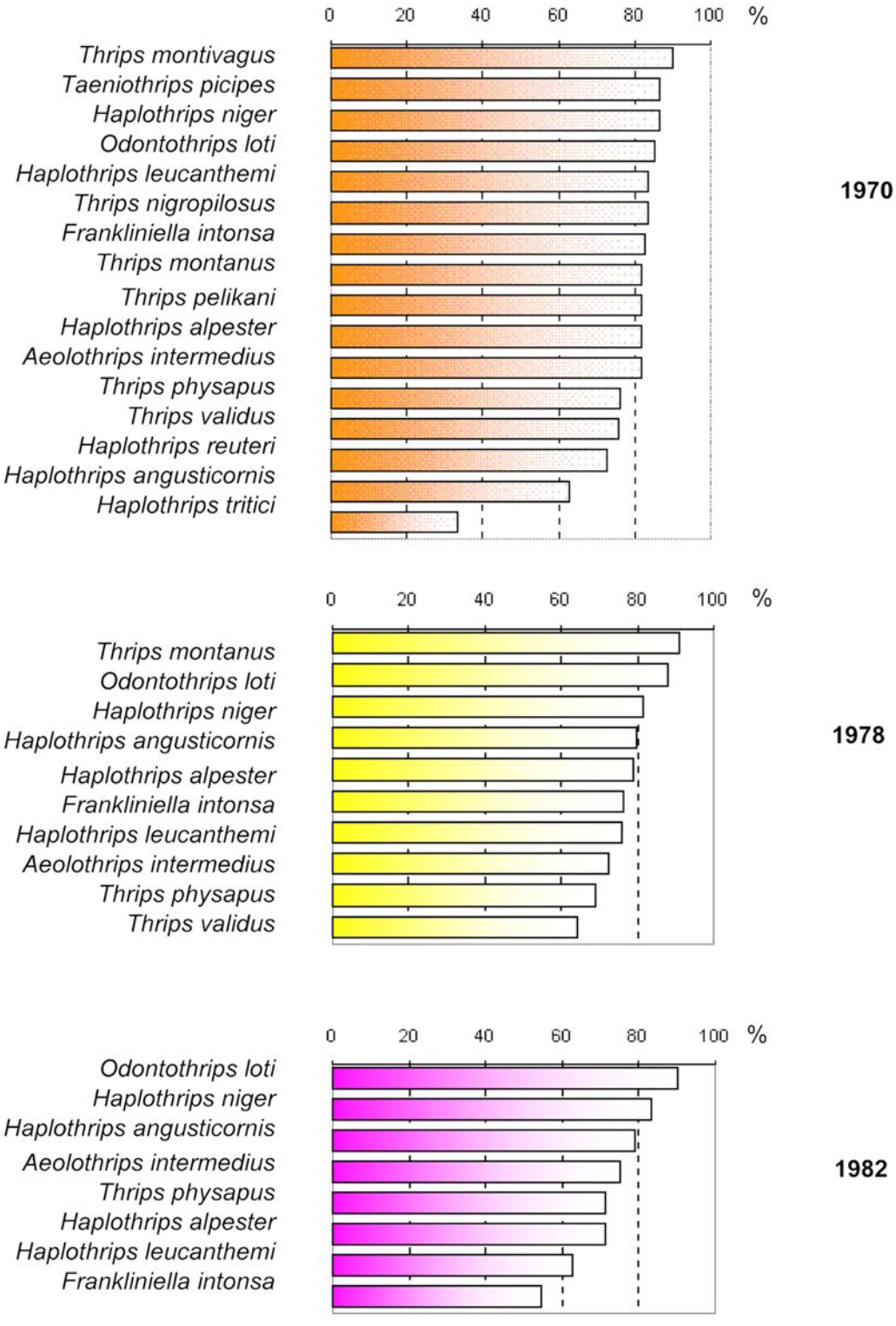

Figure 4: Annual dynamics of sex ratio (shake method)

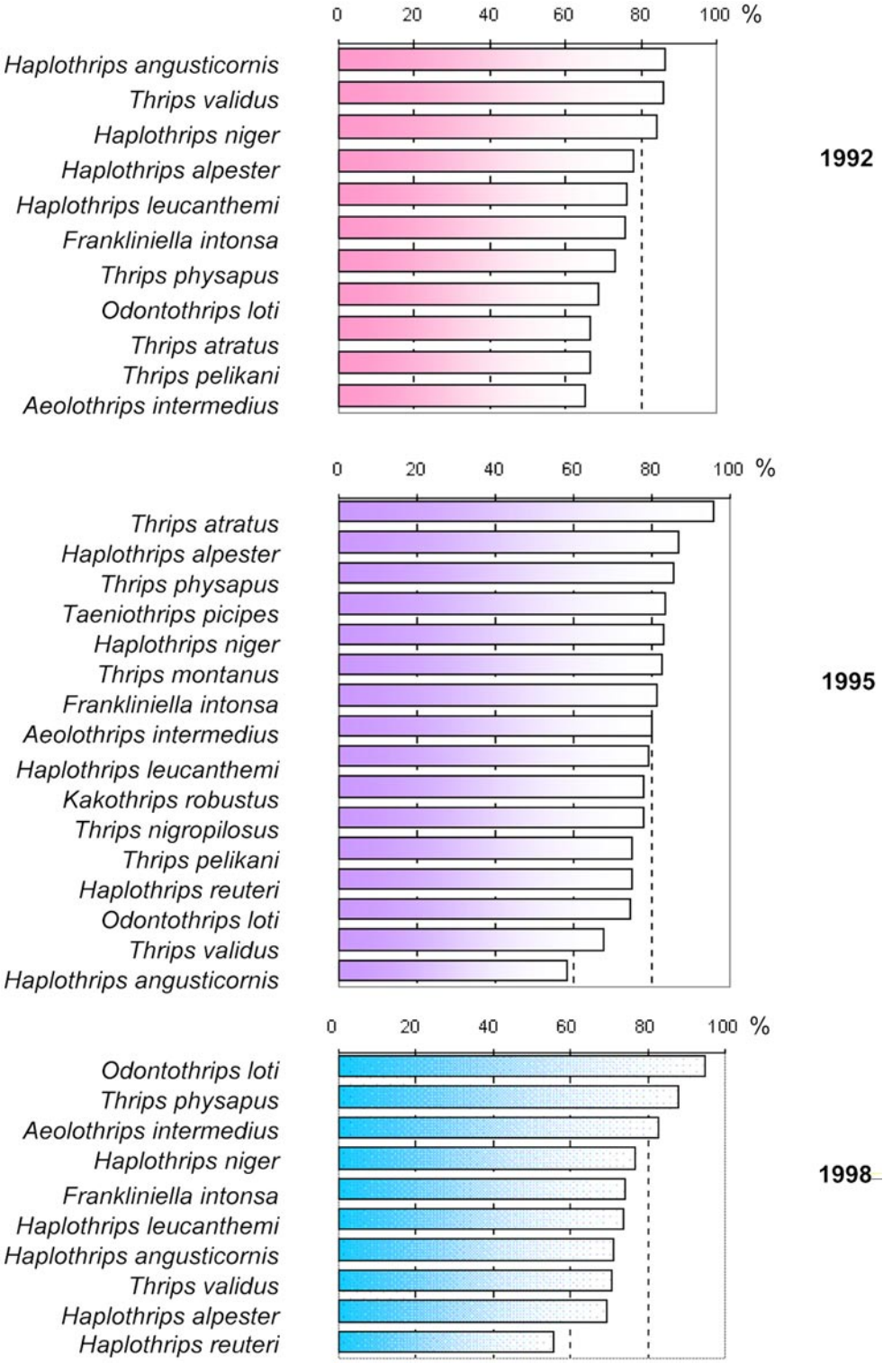

Figure 5: Annual dynamics of sex ratio (shake method)

Conclusions

The sex ratio index of the thrips species depending on the collecting method and sites, points out characteristical values for each species. For *Aptinothrips stylifer*, *Aptinothrips rufus* and *Aptinothrips elegans*, have never been found males, for *Taeniothrips inconsequens* and for *Firmothrips firmus* the ratio 1 males : 3 females is very rare.

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