Key factors affecting populations of *Schizotetranychus nanjingensis, Aponychus corpuzae* and *Aculus bambusae* in Fujian bamboo forests during different seasons: an analysis using methods of grey sequence

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Abstract

The key factors affecting the population dynamics of mite pests on the moso bamboo (*Phyllostaychs pubescens*) in Fujian, China during different seasons were examined over a two-year cycle of bamboo growth from August 1996 to August 1998 using the methods of the grey sequence. The relative importance of temperature, relative humidity, rainfall and predation by predatory mites varied among species of mite pests, between years, among different seasons in the same year and among different stages of the same species.

Schizotetranychus nanjingensis Ma & Yuan. In spring, when temperature increased, old bamboo leaves fell to the ground and new leaves appeared. The population of *Typhlodromus bambusae* Ehara decreased with many fallen leaves. During this stage, temperature was the most important factor influencing mite population growth in a big harvest year (the year of the two year cycle when bamboo changes leaves), but in a small harvest year when there was no change of leaves, many predatory mites were present on the old leaves and predation was the key factor influencing the population development of this species. In Summer, the raining season brought high relative humidity in the pro-period and the Typhoon often attacked the bamboo forests in the post-period. High temperature and high relative humidity appeared alternately. Relative humidity was most important to the population development of this species in a big harvest year, but in a small harvest year, predation was the key factor (except in 1996 when rainfall was the key factor). In Autumn, temperature decreased slowly from early to late season. Temperature was the key factor for mite population development in a big harvest year, but in a small harvest the key factor was either rainfall or relative humidity. In Winter, temperature and predation were more important than other factors to the population deve-lopment of this species in a big harvest year, but relative humidity was the key factor in a small harvest year.

Aponychus corpuzae Rimando. In Spring, many individuals of this species dropped to the ground with fallen leaves; some of these mites moved onto the leaves again along the culm of the bamboo. The relative humidity was an important factor in a big harvest year, but in a small harvest year, predation was the key factor influencing its population dynamics. In Summer, predation was the key factor in a big harvest year, but in a small harvest year, temperature was the most important factor to its population development. In Autumn, relative humidity was the key factor influencing its population in a big harvest year, but in small harvest year, rainfall was the most important factor. In Winter predation was the key factor in a big harvest year, but rainfall was the most important factor in a small harvest year.

Aculus bambusae Kuang. In Spring, the relative humidity was the key factor influencing its population in a big harvest year, but in a small harvest year, predation was the key factor. In Summer, predation was the key factor influencing its population in both big and small harvest years. In Autumn, relative humidity was the key factor influencing its population development in a small harvest year of 1996 and big harvest year of 1997, but predation was the key factor in the small harvest year of 1998. In Winter, rainfall was the key factor influencing its population in a small harvest year, but predation was the key factor in a big harvest year.

Key words: Pest mites, climatic factors, *Typhlodromus bambusae*, the Grey Sequence.

Introduction

The phytophagous mites *Schizotetranychus nanjingensis* Ma & Yuan, *Aponychus corpuzae* Rimando and *Aculus bambusae* Kuang are regarded as important pests of the moso bamboo (*Phyllostaychs pubescens*) in Fujian province, China. Why do they occur in numbers reaching pest status? Which factor is the key one influencing their population dynamics? How do we analyze the key factor? This paper addresses these problems using the methods of the grey sequence.

The basic methods of the grey system was introduced in analyses of agricultural ecosystems by Deng (1987) in China. The grey sequence was used by Teng (1993) in the analysis of population dynamics of *Panonychus citri* (Koch). Liu *et al.* (1996) applied this method to the analysis of key factors from life table data of insects. Wu *et al.* (1996) applied the methods of the grey relational ordering to the analysis of natural enemies of *Tetranychus cinnabarinus* (Boisduval) in eggplant fields. Recently, the grey model was used to predict the tendency of population changes (Cai 1999). The seasonal population dynamics of *S. nanjingensis* and *A. corpuzae* were analyzed using the methods of the grey sequence (Cai *et al.* 1999, 2000). In this paper, the relational ordering of the grey sequence is applied to analyze the key factors influencing the population dynamics of pest mites in bamboo forests in Fujian, China.

Material and Methods

The population dynamics of *S. nanjingensis*, *A. corpuzae*, *A. bambusae* and *Typhlodromus bambusae* Ehara were investigated for two years in Nanping bamboo forests, Fujian. Samples of five plants were taken every ten days. For each plant, 36 leaves from east, south, west, north, lower, middle, higher, interior, centre, exterior positions were taken and all mites on the leaves were counted under a dissecting microscope. Such ecological factors as temperature, relative humidity and rainfall were also collected from Sep.1996 to Oct.1998 in Nanping, Fujian.

The whole sample period was divided into nine periods according to four seasons (Spring, Summer, Autumn and Winter): (1). Sep. to Nov. 1996, (2). Dec. 1996 to Feb. 1997, (3). Mar. to May, 1997, (4). June to Aug. 1997, (5). Sep. to Nov. 1997, (6). Dec. 1997 to Feb. 1998, (7). Mar. to May, 1998, (8). June to Aug. 1998, and (9). Sep. to Oct. 1998. There were 9 x 13 data for each period. The *X* factors were: x_1 temperature (average of ten days), x_2 relative humidity (%), x_3 rainfall (mm per 10 days) and x_4 *Typhlodromus bambusae* (number per 10 leaves). The *Y* factors were number of mites per 10 leaves: y_1 egg of *S. nanjingensis*, y_2 larva of *S. nanjingensis*, y_3 protonymph, deutonymph and adult of *S. nanjingensis*, y_4 population number of *S. nanjingensis*, y_5 egg of *Ap. corpuzae*, y_6 larva of *A. corpuzae*, y_7 protonymph, deutonymph and adult of *A. corpuzae*, y_8 population number of *A. corpuzae*, and y_9 population number of *Ac. bambusae*. In the first step, the sequences of ecological factors $x_{1\text{-}4}$ were chosen as reference sequences and those of factors $y_{1\text{-}9}$ comparison ones. In the second step, all data were made dimensionless by dividing by the initial datum in the sequence. In the third step, relational coefficients (ξ) between data (k) in the reference sequence j and the comparison sequence i were calculated as the following (Deng 1987):

$$\xi_i = \frac{min(min|y_i(k) - x_j(k)|) + 0.5max(max|y_i(k) - x_j(k)|)}{|y_i(k) - x_j(k)| + 0.5max(max|y_i(k) - x_j(k)|)}$$

In the fourth step, the relational degree (r) among relational coefficients was calculated as the following:

$$r_i = \frac{1}{N}\sum_{1}^{N} \xi_i(k)$$

Key factors had the highest values among four factors.

Results

General description of bamboo development

The moso bamboo changes leaves every two years. The old leaves fall one after another in March. New leaves grow in April. The bamboo plants grow luxuriantly during April to the next April. Many bamboo shoots and plants appear in Winter and Spring. The period from April 1997 to April 1998 in this study site is called a big harvest year. However, from April 1998, all leaves were the old leaves and only a few bamboo shoots and a small number of new bamboo plants appeared in the following Winter and Spring. This period is called a small harvest year, including September 1996 to April 1997, and April to October 1998 in this study.

TABLE 1. Average population densities of mites per 10 leaves on the moso bamboo and four ecological factors in Autumn, 1996, Yongan, Fujian.

Variables	26 Sep.	6 Oct.	16 Oct.	26 Oct.	6 Nov.	16 Nov.	26 Nov.
y_1	226.0	40.9	33.1	31.3	20.9	4.4	0.7
y_2	19.3	20.9	8.4	16.3	18.1	2.6	0.3
y_3	68.4	16.6	12.7	16.7	14.1	15.4	15.9
y_4	313.7	78.4	54.2	64.3	53.1	22.4	16.8
y_5	671.2	123.4	123.8	123.3	148.8	25.3	25.8
y_6	38.3	58.4	28.2	22.0	65.4	13.4	5.3
y_7	82.2	37.2	51.2	40.92	74.6	32.7	20.8
y_8	791.7	219.0	203.2	186.22	288.8	71.4	51.9
y_9	1.0	9.8	0	2.5	39.2	58.5	54.8
x_1	22.9	21.9	21.5	21.5	21.8	16.5	16.3
x_2	83.0	80.0	76.0	77.0	78.0	69.0	72.0
x_3	67.9	17.3	0	0.5	0.9	1.1	0
x_4	3.9	0.3	0.6	0.8	1.0	2.9	0

Explanations: x_1 temperature, x_2 relative humidity, x_3 rainfall and x_4 *T. bambusae* (number per 10 leaf). The *Y* factors are average numbers of mites per 10 leaves: y_1 eggs, y_2 larvae, y_3 protonymphs, deutonymphs and adults, and y_4 all stages of *S. nanjingensis*, y_5 eggs, y_6 larvae, y_7 protonymphs, deutonymphs and adults, and y_8 all stages of *A. corpuzae*, and y_9 all stages of *Ac. bambusae*.

Patterns during Autumn 1996

This was a small harvest year and thus there was no fallen leaves during this season. The densities of both spider mite species (y_4 and y_8) decreased rapidly towards the end of the season, whereas those of the eriophyid *A. bambusae* (y_9) increased (Table 1). Temperature and relatively humidity both decreased with time, whereas rainfall and predatory mites both fluctuated during the period (Table 1).

TABLE 2. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Autumn, 1996 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on						r_i
Factor	6 Oct.	16 Oct.	26 Oct.	6 Nov.	16 Nov.	26 Nov.	
Egg							
x_1	0.3827	0.3776	0.3752	0.3354	0.4069	0.4133	0.3819
x_2	0.3804	0.3846	0.3785	0.3619	0.3719	0.3626	0.3733
x_3	0.8710	0.7693	0.7888	0.8626	0.9992	1.0000	0.8818
x_4	0.8255	0.9909	0.8826	0.7490	0.4034	1.0000	0.8086
Larva							
x_1	0.8785	0.6423	0.9071	0.3347	0.6067	0.5643	0.6556
x_2	0.8850	0.6530	0.9174	1.0000	0.5646	0.5142	0.7557
x_3	0.5216	0.6752	0.5189	0.4940	0.8855	0.9863	0.6803
x_4	0.4729	0.7632	0.5855	0.5700	0.6025	0.9863	0.6634
Post-larva							
x_1	0.3565	0.3440	0.3628	0.3463	0.4457	0.4541	0.3849
x_2	0.3540	0.3512	0.3666	0.3501	0.3955	0.3265	0.3573
x_3	1.0000	0.6912	0.6337	0.6826	0.6638	0.6381	0.7182
x_4	0.7166	0.9515	0.9350	0.9105	0.4405	0.6381	0.7654
All stages							
x_1	0.3566	0.3382	0.3479	0.3334	0.3762	0.3730	0.3542
x_2	0.3541	0.3451	0.3514	0.3369	0.3402	0.3207	0.3414
x_3	0.9879	0.6939	0.6647	0.7152	0.8766	0.8798	0.8030
x_4	0.6936	0.9539	1.0000	0.8182	0.3725	0.8798	0.7863

TABLE 3. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Autumn, 1996 in Yongan, Fujian.

Stage / Factor	Relational coefficients (ξ) on						r_i
	6 Oct.	16 Oct.	26 Oct.	6 Nov.	16 Nov.	26 Nov.	
Egg							
x_1	0.3576	0.3633	0.3633	0.3710	0.3874	0.3908	0.3722
x_2	0.3553	0.3707	0.3666	0.3751	0.3513	0.3714	0.3651
x_3	0.8940	0.7195	0.7297	0.6910	0.9998	0.9609	0.8325
x_4	0.8303	0.9785	1.0000	0.9692	0.3837	0.9609	0.8538
Larva							
x_1	0.6962	0.9389	0.8135	0.6149	0.8093	0.6938	0.7611
x_2	0.6999	0.9601	0.8210	0.6103	0.7418	0.6252	0.7431
x_3	0.4655	0.6224	0.6969	0.3878	0.8346	1.0000	0.6679
x_4	0.4294	0.6894	0.8102	0.4288	0.8025	1.0000	0.6934
Post-larva							
x_1	0.5042	0.6283	0.5398	0.9752	0.6228	0.5292	0.6333
x_2	0.5002	0.6479	0.5466	1.0000	0.5444	0.4516	0.6151
x_3	0.7434	0.4455	0.5114	0.3574	0.5785	0.6848	0.5535
x_4	0.5826	0.5232	0.6480	0.4365	0.6145	0.6848	0.5816
All stages							
x_1	0.3912	0.3903	0.3827	0.4278	0.4163	0.3894	0.3996
x_2	0.3885	0.3988	0.3866	0.5048	0.3702	0.3515	0.4001
x_3	1.0000	0.6428	0.6724	0.5618	0.8901	0.9061	0.7789
x_4	0.7048	0.7786	0.9807	0.8300	0.4059	0.9061	0.7677

Schizotetranychus nanjingensis. The relational degrees (r) between grey sequences of mite egg density and the four ecological factors were in the decreasing order of rainfall (x_3=0.88) > predation (x_4=0.81) > temperature (x_1=0.38)> relative humidity (x_2=0.37), indicating that rainfall and predation were two key factors influencing the dynamics of the eggs (Table 2). The relational degrees between grey sequences of mite larval density and the four ecological factors were in the order of relative humidity > rainfall > predation > temperature, indicating that relative humidity was the key factor influencing the dynamics of larvae of this species, whereas those between the density of post-larval stages (i.e. protonymphs, deutonymphs and adults) and ecological factors were in the order of predation > rainfall > temperature > relative humidity, indicating that predation and rainfall were key factors influencing the dynamics of post-larval stages of *S. nanjingensis* (Table 2). The pattern for all life stages combined was the same as that for eggs, indicating that the effects of rainfall and predation on the egg stage were critical for the population and they were key factors influencing the population dynamics of *S. nanjingensis* during this period (Table 2).

Aponychus corpuzae. Predation and rainfall were the key factors affecting the development of eggs in this species as revealed by the order of the relational degrees of the grey sequences of mite egg density and the four ecological factors: predation > rainfall > temperature > relative humidity (Table 3). Similarly, the order of relational degrees in Table 3 reveals that temperature was the key factor influencing the dynamics of the larval and post-larval stages of this mite during this period. Overall, rainfall and predation were key factors influencing the population dynamics of *A. corpuzae* during this period (Table 3) and their effects on the eggs were critical for mite population development during this period.

Aculus bambusae. Relative humidity was slightly more important than the other three factors to the population dynamics of *A. bambusae* during this period (Table 4).

TABLE 4. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density in Autumn, 1996 in Yongan, Fujian.

Factor	Relational coefficients (ξ) on						r_i
	6 Oct.	16 Oct.	26 Oct.	6 Nov.	16 Nov.	26 Nov.	
x_1	0.7678	0.9689	0.9493	0.4333	0.3360	0.3509	0.6344
x_2	0.7679	0.9696	0.9489	0.4332	0.3365	0.3516	0.6346
x_3	0.7539	1.0000	0.9215	0.4273	0.3333	0.3479	0.6307
x_4	0.7505	0.9948	0.9272	0.4289	0.3361	0.3479	0.6309

Patterns during Winter 1996

Temperature, rainfall and relative humidity fluctuated during this season (Table 5). Mite densities were low compared to the last season, except for *A. bambusae*. *Schizotetranychus nanjingensis* were increasing, whereas *A. bambusae* were decreasing (Table 5). The decrease in density of *A. corpuzae* started in Autumn continued in early winter but flattened near the end of the season (Table 5).

TABLE 5. Average population densities of mites per 10 leaves on the moso bamboo and four ecological factors in Winter, 1996 in Yongan, Fujian.

Variables	6 Dec.	16 Dec	26 Dec.	6 Jan.	16 Jan.	26 Jan.	6 Feb.	16 Feb.	26 Feb.
y_1	0.7	0	3.7	5.7	4.0	8.0	15.5	27.9	30.0
y_2	1.0	0	1.5	3.0	2.0	4.0	7.1	4.1	6.0
y_3	15.7	8.9	4.0	8.4	10.8	11.4	8.2	7.2	12.8
y_4	16.4	8.9	9.2	17.1	16.8	23.4	30.8	39.2	48.8
y_5	19.3	11.2	3.5	11.0	9.0	8.0	9.0	10.4	9.2
y_6	7.9	4.7	1.0	3.7	4.0	4.0	3.5	2.7	4.5
y_7	39.0.	16.7	3.5	11.9	13.4	8.4	7.5	4.3	7.9
y_8	66.2	32.6	8.0	26.6	26.4	20.4	20.0	17.4	21.6
y_9	59.0	25.5	27.0	18.0	7.5	4.0	1.0	1.2	0.9
x_1	9.7	10.3	10.2	9.9	11.3	10.2	9.8	9.4	16.7
x_2	72.0	78.0	75.0	72.0	78.0	78.0	89.0	76.0	69.0
x_3	153.0	0	0	22.9	16.0	39.5	87.4	29.0	0
x_4	1.0	1.5	1.8	2.2	2.5	1.8	1.0	1.2	0.8

Schizotetranychus nanjingensis. The relational degrees of the grey sequences between mite egg density and the four ecological factors were in the order of predation > temperature > relative humidity > rainfall (Table 6), indicating that predation was the key factor for mite eggs. The pattern was the same for mite larvae. However, the key factors for post-larval stages were rainfall and relative humidity (Table 6). Overall, relative humidity and temperature were key factors influencing the mite population dynamics and their effects on the post-larval stages were critical for the population development of this species.

TABLE 6. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Winter, 1996 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								
Factor	16 Dec.	26 Dec.	6 Jan.	16 Jan.	26 Jan.	6 Feb.	16 Feb.	26 Feb	r_i
Egg									
x_1	0.9528	0.8350	0.7505	0.8249	0.6737	0.5035	0.3553	0.3425	0.6548
x_2	0.9519	0.8347	0.7480	0.8223	0.6744	0.5062	0.3558	0.3384	0.6540
x_3	1.0000	0.8021	0.7282	0.7925	0.6573	0.4983	0.3507	0.3333	0.6453
x_4	0.9346	0.8601	0.7829	0.8696	0.6889	0.5034	0.3566	0.3373	0.6667
Larva									
x_1	0.7545	0.8792	0.6225	0.7963	0.5254	0.3490	0.5104	0.4328	0.6088
x_2	0.7508	0.8769	0.6201	0.7808	0.5281	0.3576	0.5174	0.3930	0.6031
x_3	1.0000	0.6852	0.5339	0.6327	0.4659	0.3333	0.4550	0.3524	0.5573
x_4	0.6852	0.9158	0.8032	0.8672	0.5920	0.3486	0.5296	0.3834	0.6406
Post-larval									
x_1	0.6815	0.5608	0.6862	0.6905	0.7755	0.6850	0.6742	0.5269	0.6601
x_2	0.6713	0.5641	0.6965	0.7338	0.7559	0.5895	0.6353	0.9103	0.6946
x_3	0.6484	0.8226	0.7395	0.6412	0.6950	1.0000	0.8126	0.5548	0.7393
x_4	0.5192	0.3896	0.3714	0.3513	0.4948	0.6901	0.5797	0.9831	0.5474
Pooled									
x_1	0.7523	0.7632	1.0000	0.9272	0.8104	0.6410	0.5190	0.5507	0.7455
x_2	0.7443	0.7670	0.9865	0.9761	0.8244	0.7089	0.5349	0.4307	0.7466
x_3	0.7436	0.7369	0.6342	0.6271	0.5684	0.5403	0.4093	0.3383	0.5748
x_4	0.6175	0.5537	0.5708	0.5095	0.8337	0.6382	0.5638	0.4066	0.5867

Aponychus corpuzae. Rainfall was more important than the other factors for the population development of this species during this season (Table 7).

Aculus bambusae. Rainfall was also the key factor influencing the population dynamics of *A. bambusae* during this season (Table 8).

TABLE 7. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Winter, 1996 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								r_i
Factor	16 Dec.	26 Dec.	6 Jan.	16 Jan.	26 Jan.	6 Feb.	16 Feb.	26 Feb	
Egg									
x_1	0.7486	0.5944	0.7644	0.6539	0.6783	0.7187	0.7751	0.4960	0.6787
x_2	0.7381	0.5975	0.7753	0.6866	0.6655	0.6279	0.7314	0.7486	0.6964
x_3	0.7023	0.9362	0.7806	0.8137	0.9562	1.0000	0.8211	0.7511	0.8452
x_4	0.5793	0.4256	0.4238	0.3677	0.4769	0.7235	0.6685	0.8695	0.5669
Larva									
x_1	0.7647	0.5825	0.7227	0.6762	0.7259	0.7159	0.6893	0.5210	0.6748
x_2	0.7537	0.5855	0.7324	0.7113	0.7113	0.6254	0.6544	0.8079	0.6977
x_3	0.7034	1.0000	0.8509	0.8004	0.8992	0.9950	0.9742	0.7146	0.8672
x_4	0.5885	0.4192	0.4103	0.3743	0.4996	0.7204	0.6035	0.9509	0.5708
Post-larval									
x_1	0.6264	0.5185	0.5954	0.5598	0.5551	0.5608	0.5481	0.4013	0.5457
x_2	0.6179	0.5212	0.6029	0.5869	0.5454	0.4972	0.5230	0.5813	0.5595
x_3	0.7195	0.9545	0.8975	0.8342	1.0000	0.7465	0.9643	0.8608	0.8722
x_4	0.4903	0.3725	0.3483	0.3190	0.3989	0.5641	0.4860	0.6623	0.4477
All stages									
x_1	0.6792	0.5552	0.6591	0.6066	0.6133	0.6256	0.6262	0.4497	0.6019
x_2	0.6703	0.5580	0.6673	0.6352	0.6026	0.5543	0.5968	0.6539	0.6173
x_3	0.7129	0.9395	0.8446	0.8163	1.0000	0.8340	0.9792	0.7991	0.8657
x_4	0.5345	0.5165	0.3861	0.3493	0.4413	0.6292	0.5534	0.7464	0.5196

TABLE 8. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density in Winter, 1996 in Yongan, Fujian.

Factor	Relational coefficients (ξ) on								r_i
	16 Dec.	26 Dec.	6 Jan.	16 Jan.	26 Jan.	6 Feb.	16 Feb.	26 Feb.	
x_1	0.6619	0.6750	0.6319	0.5403	0.5538	0.5513	0.5628	0.4154	0.5741
x_2	0.6540	0.6787	0.5574	0.5609	0.5458	0.4996	0.5409	0.5643	0.5752
x_3	0.7424	0.7310	0.7310	0.8956	0.9940	0.6903	0.8864	1.0000	0.8338
x_4	0.5331	0.4752	0.3906	0.3376	0.4189	0.5539	0.5079	0.6255	0.4803

Patterns during Spring 1997

Temperatures increased with time, but rainfall and relative humidity fluctuated during the season (Table 9). Predatory mites rapidly increased to the highest density from mid-March to early April (Table 9).

TABLE 9. Average population densities of mites per 10 leaves on the moso bamboo and four ecological factors in Spring, 1997 in Yongan, Fujian.

Variables	6 Mar.	16 Mar	26 Mar.	6 Apr.	16 Apr.	26 Apr.	6 May.	16 May	26 May
y_1	31.10	27.30	3.50	18.00	38.10	24.20	15.60	144.00	68.00
y_2	4.30	5.60	1.80	3.80	1.80	15.80	5.60	17.70	12.00
y_3	12.60	18.60	19.80	6.10	6.10	25.20	1.00	48.40	10.00
y_4	48.00	51.50	25.10	27.90	38.00	65.20	23.20	210.10	90.00
y_5	31.10	15.00	19.20	0.01	4.80	0.30	1.00	2.80	2.80
y_6	4.30	20.00	38.50	0.01	0.30	0.50	0.02	2.80	0
y_7	12.20	6.10	7.70	2.00	1.00	0.30	0.60	0.80	1.20
y_8	47.60	41.10	65.40	2.01	6.10	1.10	1.62	6.40	4.00
y_9	0.60	0.40	0	0	0	0	0.33	0	0
x_1	17.00	18.10	14.30	18.70	19.70	20.70	22.40	24.80	22.20
x_2	72.00	82.00	87.00	83.00	82.0	73.00	83.0	81.00	72.00
x_3	10.70	141.00	96.40	50.30	40.5	47.40	55.50	60.30	42.10
x_4	0.30	2.70	5.00	12.20	0	1.00	1.00	0.40	1.20

Schizotetranychus nanjingensis. Temperature and relative humidity were key factors influencing the population dynamics of this species during this Spring and patterns were consistent for egg, larval and post-larval stages (Table 10).

Aponychus corpuzae. Relative humidity and temperature were more important than predation and rainfall to the population development of this species and the results are consistent for egg, larval and post-larval stages (Table 11).

Aculus bambusae. Relative humidity and temperature were key factors influencing the population dynamics of this species (Table 12).

TABLE 10. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Spring, 1997 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								r_i
Factor	16 Mar.	26 Mar.	6 Apr.	16 Apr.	26 Apr.	6 May.	16 May.	26 May	
Egg									
x_1	0.9992	0.9734	0.9831	0.9990	0.9870	0.9688	0.8721	0.9670	0.9687
x_2	0.9956	0.9565	0.9806	1.0000	0.9969	0.9765	0.8598	0.9531	0.9649
x_3	0.6251	0.6987	0.8366	0.8843	0.8532	0.8173	0.9593	0.9273	0.8252
x_4	0.7178	0.5525	0.3363	0.9627	0.8946	0.8835	0.8675	0.9246	0.7674
Larva									
x_1	0.9890	0.9799	0.9900	0.9649	0.8908	1.0000	0.8828	0.9313	0.9536
x_2	0.9926	0.9626	0.9874	0.9658	0.8827	0.9933	0.8699	0.9181	0.9466
x_3	0.6267	0.6989	0.8396	0.8559	0.9641	0.8373	0.9298	0.9464	0.8373
x_4	0.7215	0.5508	0.3336	0.9801	0.9839	0.9081	0.8779	0.9434	0.7874
Post-larva									
x_1	0.9900	0.9748	0.9802	0.9774	0.9724	0.9516	0.9032	0.9852	0.9669
x_2	0.9938	0.9923	0.9777	0.9784	0.9630	0.9590	0.8899	1.0000	0.9693
x_3	0.6384	0.7373	0.8350	0.8677	0.9013	0.8055	0.9274	0.8737	0.8233
x_4	0.7350	0.5769	0.3368	0.9865	0.9474	0.8695	0.8982	0.8712	0.7777
All stages									
x_1	1.0000	0.9848	0.9752	0.9824	0.9934	0.9604	0.9520	0.9728	0.9776
x_2	0.9971	0.9673	0.9728	0.9834	0.9835	0.9681	0.9672	0.9586	0.9742
x_3	0.6237	0.7028	0.8298	0.8704	0.8675	0.8102	0.7944	0.9072	0.8008
x_4	0.7169	0.5541	0.3335	0.9624	0.9107	0.8759	0.9576	0.9045	0.7770

Patterns during Summer 1997

Temperatures continued to increase gradually and rainfall and relative humidity fluctuated during the summer (Table 13). Predatory mites were in reasonable numbers in June and reached very high density in late July, but disappeared in August (Table 13).

Schizotetranychus nanjingensis. Relative humidity and temperature were key factors influencing the population of this species (Table 14).

TABLE 11. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Spring, 1997 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								r_i
Factor	16 Mar.	26 Mar.	6 Apr.	16 Apr.	26 Apr.	6 May.	16 May.	26.May	
Egg									
x_1	0.9795	0.9966	0.9559	0.9602	0.9511	0.9477	0.9440	0.9507	0.9607
x_2	0.9761	0.9791	0.9535	0.9611	0.9602	0.9550	0.9588	0.9644	0.9635
x_3	0.6203	0.7132	0.8184	0.8549	0.8277	0.8038	0.7917	0.8474	0.7847
x_4	0.7101	0.5631	0.3359	1.0000	0.8660	0.8669	0.9495	0.8451	0.7671
Larva									
x_1	0.5502	0.3490	0.8056	0.8070	0.8051	0.7746	0.8517	0.7755	0.7148
x_2	0.5555	0.3597	0.7978	0.8100	0.8369	0.7981	0.9118	0.8206	0.7363
x_3	0.3377	1.0000	0.4819	0.5413	0.5036	0.4573	0.4670	0.5269	0.5395
x_4	0.5015	0.3606	0.0961	0.9968	0.5774	0.5689	0.8734	0.5227	0.5622
Post-larva									
x_1	0.9768	0.9937	0.9597	0.9534	0.9482	0.9449	0.9394	0.9476	0.9580
x_2	0.9733	0.9762	0.9573	0.9542	0.9573	0.9522	0.9541	0.9613	0.9607
x_3	0.6175	0.7102	0.8203	0.8488	0.8247	0.8009	0.7875	0.8441	0.7818
x_4	0.7072	0.5603	0.3347	1.0000	0.8630	0.8639	0.9449	0.8419	0.7645
All stages									
x_1	0.9964	0.9806	0.9565	0.9577	0.9504	0.9465	0.9447	0.9492	0.9603
x_2	0.9928	0.9982	0.9541	0.9586	0.9595	0.9538	0.9595	0.9629	0.9674
x_3	0.6265	0.7314	0.8186	0.8528	0.8269	0.8027	0.7919	0.8459	0.7871
x_4	0.7185	0.5741	0.3354	1.0000	0.8653	0.8657	0.9502	0.8437	0.7691

TABLE 12. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density in Spring, 1997 in Yongan, Fujian.

Factor	Relational coefficients (ξ) on								r_i
	16 Mar.	26 Mar.	6 Apr.	16 Apr.	26 Apr.	6 May	16 May	2 6May	
x_1	0.9808	0.9603	0.9487	0.9461	0.9435	0.9519	0.9331	0.9365	0.9501
x_2	0.9773	0.9439	0.9463	0.9470	0.9525	0.9712	0.9476	0.9531	0.9549
x_3	0.6254	0.6930	0.8122	0.8431	0.8211	0.8143	0.7830	0.8379	0.7788
x_4	0.7093	0.5495	0.3333	1.0000	0.9839	0.8796	0.9385	0.8356	0.7787

TABLE 13. Average population densities of mites per 10 leaves on the moso bamboo and four ecological factors in Summer, 1997 in Yongan, Fujian.

Variables	6 Jun.	16 Jun	26 Jun.	6 Jul.	16 Jul.	26 Jul.	6 Aug.	16 Aug	26 Aug
y_1	32.0	14.0	10.9	7.6	1.9	2.0	15.8	29.7	228.2
y_2	13.8	5.7	4.3	2.8	0.9	0	9.1	18.1	59.7
y_3	18.4	7.4	5.4	2.4	1.5	2.5	14.2	28.1	134.7
y_4	64.2	27.1	20.6	12.8	4.3	4.5	39.1	75.9	422.6
y_5	2.0	2.1	15.6	30.2	54.7	72.0	56.0	39.6	10.4
y_6	2.0	2.3	5.2	10.2	10.2	40.0	32.0	23.9	12.1
y_7	2.5	2.9	6.5	1.7	30.6	27.2	29.0	30.0	13.0
y_8	6.5	7.3	27.3	42.1	95.5	139.2	117.0	93.5	35.5
y_9	1.0	0	14.0	27.0	58.3	139.2	130.3	171.0	199.2
x_1	25.6	24.6	26.7	26.3	27.1	27.8	27.4	27.2	27.2
x_2	82.0	71.0	83.0	87.0	84.0	79.0	86.0	81.0	82.0
x_3	112.1	16.9	242.7	113.3	77.5	73.2	149.6	65.2	94.4
x_4	3.0	3.7	7.0	2.7	1.4	89.5	0	0	0

TABLE 14. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Summer, 1997 in Yongan, Fujian

Stage	Relational coefficients (ξ) on								r_i
Factor	16Jun.	26Jun.	6Jul.	16Jul.	26Jul.	6Aug.	16Aug.	26Aug	
Egg									
x_1	0.9699	0.9588	0.9534	0.9409	0.9394	0.9666	0.9950	0.7134	0.9297
x_2	0.9759	0.9607	0.9514	0.9429	0.9467	0.9679	1.0000	0.7113	0.9321
x_3	0.9850	0.8944	0.9544	0.9631	0.9657	0.9503	0.9812	0.7060	0.9250
x_4	0.9531	0.8855	0.9612	0.9773	0.3347	0.9718	0.9451	0.6790	0.8385
Larva									
x_1	0.9807	0.9692	0.9635	0.9532	0.9477	0.9894	1.0000	0.8342	0.9547
x_2	0.9867	0.9711	0.9614	0.9553	0.9550	0.9908	0.9951	0.8313	0.9558
x_3	0.9991	0.9043	0.9645	0.9757	0.9741	0.9727	0.9693	0.8242	0.9480
x_4	0.9637	0.8953	0.9713	0.9901	0.3389	0.9737	0.9345	0.7881	0.8570

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TABLE 14. Continued from last page.

Stage	Relational coefficients (ξ) on								r_i
Factor	16Jun.	26Jun.	6Jul.	16Jul.	26Jul.	6Aug.	16Aug.	26Aug	
Post-larva									
x_1	0.9801	0.9681	0.9590	0.9541	0.9558	0.9969	0.9861	0.7154	0.9394
x_2	0.9861	0.9700	0.9570	0.9562	0.9633	0.9983	0.9813	0.7133	0.9407
x_3	1.0000	0.9031	0.9600	0.9768	0.9827	0.9798	0.9560	0.7080	0.9333
x_4	0.9630	0.8941	0.9668	0.9912	0.3390	0.9667	0.9221	0.6811	0.8405
All stages									
x_1	0.9728	0.9614	0.9549	0.9451	0.9436	0.9777	1.0000	0.7353	0.9364
x_2	0.9789	0.9633	0.9529	0.9471	0.9510	0.9791	0.9950	0.7331	0.9376
x_3	0.9900	0.7312	0.5178	0.3611	0.2987	0.3611	0.4399	0.7797	0.5599
x_4	0.9958	0.7372	0.5158	0.3592	0.9969	0.3498	0.4325	0.7470	0.6418

Aponychus corpuzae. Predation was the key factors influencing mite egg and larva densities, whereas temperature and rainfall were more important to the post-larval stages (Table 15). Overall, predation was the key factor influencing the population dynamics of this species during this period and its effect on spider mite eggs and larvae was critical for the population development of this species.

TABLE 15. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Summer, 1997 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								r_i
Factor	16Jun.	26Jun.	6Jul.	16Jul.	26Jul.	6Aug.	16Aug.	26Aug	
Egg									
x_1	1.0000	0.7271	0.5595	0.4040	0.3378	0.3982	0.4878	0.8144	0.5911
x_2	0.9947	0.7262	0.5601	0.4037	0.3370	0.3980	0.4868	0.8121	0.5898
x_3	0.9564	0.7621	0.5592	0.4007	0.3350	0.4006	0.4815	0.8062	0.5877
x_4	0.9947	0.7676	0.5573	0.3987	0.7451	0.3889	0.4740	0.7766	0.6378

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TABLE 15. Continued from last page.

Stage / Factor	Relational coefficients (ξ) on								r_i
	16Jun.	26Jun.	6Jul.	16Jul.	26Jul.	6Aug.	16Aug.	26Aug	
Larva									
x_1	0.9891	0.8669	0.7065	0.7081	0.3377	0.3927	0.4705	0.6619	0.6417
x_2	0.9795	0.8645	0.7082	0.7063	0.3363	0.3924	0.4688	0.6591	0.6394
x_3	0.9129	0.9647	0.7056	0.6894	0.3326	0.3970	0.4597	0.6520	0.6392
x_4	1.0000	0.9813	0.6999	0.6785	0.4962	0.3763	0.4472	0.6167	0.6620
Post-larva									
x_1	0.9871	0.8660	0.9722	0.4633	0.4987	0.4784	0.9671	0.7023	0.7419
x_2	0.9775	0.8636	0.9689	0.4626	0.4955	0.4779	0.4764	0.6991	0.6777
x_3	0.9111	0.9637	0.9735	0.8304	0.4877	0.4848	0.4670	0.6912	0.7262
x_4	1.0000	0.9802	0.9849	0.4504	0.3359	0.4541	0.4457	0.6516	0.6629
All stages									
x_1	0.9951	0.7749	0.6627	0.4369	0.3416	0.3841	0.4426	0.7098	0.5935
x_2	0.9862	0.7732	0.6641	0.4362	0.3403	0.3838	0.4412	0.7068	0.5865
x_3	0.9241	0.8362	0.6620	0.4303	0.3369	0.3879	0.4338	0.6994	0.5888
x_4	1.0000	0.8566	0.6574	0.4264	0.5581	0.3697	0.4236	0.6622	0.6193

Aculus bambusae. Similarly, predation was also the key factor influencing the population dynamics of *A. bambusae* in Summer, 1997 (Table 16).

TABLE 16. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density Summer, 1997 in Yongan, Fujian.

Factor	Relational coefficients (ξ) on								r_i
	16 Jun.	26 Jun.	6 Jul.	16 Jul.	26 Jul.	6 Aug.	16 Aug	26 Aug	
x_1	0.9919	0.8862	0.7944	0.6360	0.4196	0.4359	0.3701	0.3350	0.6086
x_2	0.9929	0.8860	0.7946	0.6359	0.4194	0.4359	0.3700	0.3350	0.6087
x_3	1.0000	0.8952	0.7943	0.6345	0.4189	0.4364	0.3694	0.3348	0.6104
x_4	0.9893	0.8965	0.7936	0.6336	0.4774	0.4339	0.3686	0.3338	0.6158

Patterns during Autumn 1997

Temperature gradually decreased but the number of predators peaked in late October and then rapidly decreased (table 17). Rainfall and relative humidity fluctuated during the season. The density of *S. nanjingensis* remained high in September-October but suddenly dropped to low levels in November. The density of *A. corpuzae* peaked in early November, whereas that of *A. bambuzae* fluctuated during the season (Table 17).

TABLE 17. Average population densities of mites 10 leaves on the moso bamboo and four ecological factors in Autumn 1997 in Yongan, Fujian.

Variables	6Sep.	16Sep	26Sep.	6Oct.	16Oct.	26Oct.	6Nov.	16Nov	26Nov
y_1	101.2	120.0	201.0	115.0	92.0	130.0	0.6	4.6	13.6
y_2	70.0	85.0	20.0	15.0	87.0	98.0	0	0.8	0
y_3	60.0	57.0	90.0	62.0	98.0	137.0	0	2.4	8.0
y_4	231.2	262.0	311.0	192.0	277.0	365.0	0.6	7.8	21.6
y_5	10.0	5.0	7.0	5.0	5.0	20.0	45.8	36.0	27.8
y_6	5.0	5.0	10.0	7.0	10.0	7.0	15.4	11.6	8.0
y_7	10.0	19.0	5.0	5.0	19.0	34.0	16.2	19.4	15.0
y_8	25.0	29.0	22.0	17.0	34.0	61.0	77.4	67.0	50.8
y_9	127.9	56.5	73.0	64.5	30.0	0	298.4	246.0	234.4
x_1	26.4	25.3	19.9	22.2	21.8	18.7	15.8	17.1	17.6
x_2	85.0	76.0	82.0	87.0	82.0	77.0	73.0	80.0	86.0
x_3	92.2	0.2	50.7	33.7	76.5	0.8	0	11.2	7.4
x_4	0.3	0.6	2.0	2.2	6.0	13.3	0	0.4	0.4

Schizotetranychus nanjingensis. Temperature was the key factor for eggs and post-larval stages, whereas rainfall was the key factor for the larval stage (Table 18). Overall, temperature was the key factor for this species during Autumn, 1997.

Aponychus corpuzae. Relative humidity was slightly more important than temperature and rainfall to the development of this species, whereas predation was the weakest factor among the four (Table 19). The pattern was consistent for the egg, larval and post-larval stages.

Aculus bambusae. Relative humidity was more important than temperature and rainfall in influencing the population of this species in Autumn, 1997 (Table 20). The role of predation was much weaker than the other three factors.

TABLE 18. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Autumn, 1997 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								r_i
Factor	16 Sep.	26 Sep.	6 Oct.	16 Oct.	26 Oct.	4 Nov.	14 Nov.	24 Nov	
Egg									
x_1	0.9898	0.9461	0.9867	0.9964	0.9742	0.9735	0.9731	0.9761	0.9770
x_2	0.9869	0.9550	0.9951	0.9977	0.9830	0.9621	0.9603	0.9611	0.9752
x_3	0.9481	0.9377	0.9657	0.9966	0.9443	1.0000	0.9968	0.9978	0.9734
x_4	0.9638	0.8409	0.7767	0.5301	0.3334	1.0000	0.9383	0.9475	0.7913
Larva									
x_1	0.9882	0.9787	0.9716	0.9809	0.9688	0.9729	0.9712	0.9699	0.9753
x_2	0.9853	0.9693	0.9637	0.9872	0.9775	0.9615	0.9585	0.9537	0.9696
x_3	0.9466	0.9878	0.9930	0.9811	0.9391	1.0000	0.9949	0.9963	0.9799
x_4	0.9647	0.7709	0.7510	0.5337	0.3333	1.0000	0.9365	0.9415	0.7790
Post-larva									
x_1	0.9996	0.9657	0.9909	0.9630	0.9303	0.9723	0.9719	0.9753	0.9711
x_2	0.9973	0.9752	0.9995	.0.9692	0.9385	0.9608	0.9589	0.9599	0.9699
x_3	0.9569	0.9568	0.9692	0.9632	0.9024	1.0000	9.9961	0.9975	0.9678
x_4	0.9524	0.8028	0.7695	0.5338	0.3333	1.0000	0.9365	0.9460	0.7843
All stages									
x_1	0.9920	0.9732	0.9996	0.9830	0.9610	0.9730	0.9722	0.9740	0.9785
x_2	0.9890	0.9826	0.9912	0.9893	0.9696	0.9616	0.9594	0.9589	0.9752
x_3	0.9499	0.9642	0.9788	0.9832	0.9317	1.0000	0.9960	0.9995	0.9754
x_4	0.9611	0.8008	0.7668	0.5321	0.3334	1.0000	0.9373	0.9453	0.7846

TABLE 19. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Autumn, 1997 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								r_i
Factor	16 Sep.	26 Sep.	6 Oct.	16 Oct.	26 Oct.	4 Nov.	14 Nov.	24 Nov	
Egg									
x_1	0.9813	1.0000	0.9867	0.9873	0.9449	0.8438	0.8798	0.9115	0.9419
x_2	0.9842	0.9902	0.9783	0.9810	0.9533	0.8526	0.8907	0.9252	0.9444
x_3	0.9795	0.9955	0.9962	0.9872	0.9163	0.8242	0.8610	0.8891	0.9311
x_4	0.9362	0.7821	0.7579	0.5218	0.3342	0.8242	0.9108	0.9384	0.7507
Larva									
x_1	1.0000	0.9470	0.9765	0.9500	0.9707	0.8981	0.9295	0.9602	0.9540
x_2	0.9970	0.9558	0.9847	0.9558	0.9794	0.9080	0.9415	0.9752	0.9622
x_3	0.9574	0.9385	0.9559	0.9501	0.9410	0.8762	0.9089	0.9357	0.9330
x_4	0.9573	0.8230	0.7850	0.5450	0.3340	0.8762	0.9636	0.9896	0.7842
Post-larva									
x_1	0.9583	0.9902	0.9860	0.9524	0.8859	0.9548	0.9429	0.9632	0.9542
x_2	0.9555	0.9802	0.9774	0.9586	0.8935	0.9665	0.9558	0.9791	0.9583
x_3	0.9174	1.0000	0.9959	0.9526	0.8599	0.9289	0.9206	0.9374	0.9391
x_4	0.9976	0.7703	0.7515	0.5320	0.3341	0.9289	0.9798	0.9943	0.7861
All stages									
x_1	0.9945	0.9980	0.9964	0.9791	0.9274	0.8971	0.9152	0.9426	0.9563
x_2	0.9915	1.0000	0.9878	0.9854	0.9355	0.9072	0.9271	0.9574	0.9615
x_3	0.9515	0.9885	0.9892	0.9793	0.8996	0.8748	0.8948	0.9185	0.9370
x_4	0.9653	0.7867	0.7620	0.5313	0.3347	0.8748	0.9491	0.9716	0.7719

TABLE 20. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density in Autumn, 1997 in Yongan, Fujian

Factor	Relational coefficients (ξ) on								r_i
	16 Sep.	26 Sep.	6 Oct.	16 Oct.	26 Oct.	4 Nov.	14 Nov	24 Nov	
x_1	0.9776	0.9922	0.9854	0.9744	0.9694	0.9278	0.9460	0.9504	0.9654
x_2	0.9804	0.9829	0.9775	0.9685	0.9611	0.9380	0.9579	0.9647	0.9664
x_3	0.9809	0.9995	0.9942	0.9742	1.0000	0.9051	0.9252	0.9271	0.9633
x_4	0.9347	0.7846	0.7648	0.5288	0.3335	0.9051	0.9802	0.9784	0.7763

Patterns during Winter 1997

Temperature, rainfall and relative humidity fluctuated during the season (Table 21). Predatory mites were active in early December and Mid-January to early February (Table 21).

TABLE 21. Average population densities of mites per 10 leaves on the moso bamboo and four ecological factors in Winter 1997 in Yongan, Fujian.

Variables	4 Dec.	14 Dec	24 Dec.	4 Jan.	14 Jan.	24 Jan.	4 Feb.	14 Feb.	24 Feb.
y_1	4.0	4.0	0	0	0	0	0	2.2	0
y_2	0.4	0.8	0.8	0	2.2	0	0	1.2	0
y_3	2.2	2.8	3.0	0	8.4	0	1.4	6.8	0
y_4	6.6	7.6	3.8	0	10.6	0	1.4	10.2	0
y_5	27.4	25.0	4.8	0	1.6	0	6.6	5.6	5.4
y_6	4.0	18.0	0	0	0	0	1.4	0	5.4
y_7	28.8	15.0	3.8	0	0	0	2.6	8.6	1.0
y_8	60.2	58.0	8.6	0	1.6	0	10.6	14.2	11.8
y_9	277.6	167.2	70.0	0	0	6.0	0	0	0
x_1	10.9	12.7	13.7	13.0	9.2	7.3	9.6	15.4	12.1
x_2	80.0	82.0	88.0	84.0	83.0	91.0	82.0	87.0	82.0
x_3	20.5	4.8	6.5	16.2	69.5	68.0	49.3	222.7	33.6
x_4	1.0	0	0	0	0.4	0.2	1.0	0	0

TABLE 22. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Winter, 1997 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								r_i
Factor	14 Dec	24 Dec	4 Jan.	14 Jan.	24 Jan.	4 Feb.	14 Feb.	24 Feb	
Egg									
x_1	0.9690	0.8040	0.8122	0.8590	0.8851	0.8541	0.8567	0.8229	0.8579
x_2	0.9952	0.8242	0.8308	0.8325	0.8193	0.8342	0.9056	0.8342	0.8595
x_3	0.8909	0.9422	0.8671	0.6033	0.6085	0.6820	0.3333	0.7588	0.7082
x_4	0.8376	1.0000	1.0000	0.9280	0.9627	0.8376	0.9036	1.0000	0.9337

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TABLE 22. Continued from last page.

Stage	Relational coefficients (ξ) on								r_i
Factor	14 Dec	24 Dec	4 Jan.	14 Jan.	24 Jan.	4 Feb.	14 Feb.	24 Feb	
Larva									
x_1	0.8146	0.8410	0.7673	0.4578	0.8545	0.8170	0.7124	0.7798	0.7556
x_2	0.8013	0.8137	0.7892	0.4684	0.7756	0.7932	0.6728	0.7932	0.7384
x_3	0.6901	0.7001	0.8327	0.6508	0.5424	0.6205	0.3333	0.7058	0.6345
x_4	0.6628	0.6628	1.0000	0.4353	0.9516	0.7972	0.5672	1.0000	0.7596
Post-larva									
x_1	0.9731	0.9733	0.7652	0.5665	0.8530	0.9409	0.6984	0.7778	0.8185
x_2	0.9401	0.9365	0.7873	0.5829	0.7736	0.9091	0.6598	0.7913	0.7976
x_3	0.7891	0.7877	0.8310	0.9008	0.5395	0.6873	0.3333	0.7034	0.6965
x_4	0.7533	0.7403	1.0000	0.5320	0.9511	0.9144	0.5570	1.0000	0.8060
All stages									
x_1	0.9971	0.8725	0.8233	0.8594	0.8743	0.8745	0.9723	0.8076	0.8851
x_2	0.9736	0.8989	0.8161	0.8912	0.7986	0.8514	0.9105	0.8197	0.8700
x_3	0.8355	0.9472	0.8550	0.7231	0.5841	0.6800	0.3333	0.7398	0.7123
x_4	0.8018	0.8900	1.0000	0.7944	0.9588	0.8553	0.7509	1.0000	0.8814

Schizotetranychus nanjingensis. Predation was the key factor for the egg and larval stages, whereas temperature was the key factor for the post-larval stages (Table 22). Overall, temperature was the key factor for this species during Autumn, 1997 and its effects on the post-larval stages were critical for the population development.

Aponychus corpuzae. Predation was more important than other factors to the development of this species (Table 23). The pattern was consistent for the egg, larval and post-larval stages.

Aculus bambusae. Predation was also the key factor influencing the population development of this species (Table 24).

TABLE 23. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Winter, 1997 in Yongan, Fujian.

Stage / Factor	Relational coefficients (ξ) on								r_i
	14 Dec.	24 Dec.	4 Jan.	14 Jan.	24 Jan.	4 Feb.	14 Feb.	24 Feb	
Egg									
x_1	0.9547	0.8313	0.8171	0.8715	0.8884	0.8928	0.8152	0.8537	0.8656
x_2	0.9793	0.8521	0.8354	0.8448	0.8241	0.8677	0.8579	0.8655	0.8659
x_3	0.8871	0.9742	0.8708	0.6153	0.6164	0.7085	0.3333	0.7871	0.7241
x_4	0.8538	0.9682	1.0000	0.9398	0.9638	0.8712	0.9631	0.9643	0.9405
Larva									
x_1	0.6196	0.8121	0.8200	0.8655	0.8902	0.9110	0.7936	0.9577	0.8337
x_2	0.6098	0.8316	0.8380	0.8396	0.8268	0.8895	0.8332	0.9435	0.8265
x_3	0.5599	0.9450	0.8730	0.6157	0.6209	0.7255	0.3333	0.9495	0.7029
x_4	0.5469	1.0000	1.0000	0.9314	0.9645	0.8931	1.0000	0.8009	0.8921
Post-larva									
x_1	0.8913	0.8244	0.8158	0.8622	0.8875	0.8698	0.8258	0.8309	0.8510
x_2	0.9129	0.8465	0.8342	0.8358	0.8228	0.8497	0.8701	0.8421	0.8518
x_3	0.9485	0.9663	0.8699	0.6091	0.6143	0.6953	0.3333	0.7670	0.7255
x_4	0.9103	0.9756	1.0000	0.9296	0.9635	0.8531	0.9465	0.9935	0.9465
All stages									
x_1	0.9634	0.8267	0.8167	0.8583	0.8881	0.8829	0.8187	0.8532	0.8635
x_2	0.9886	0.8474	0.8350	0.8402	0.8237	0.8623	0.8619	0.8650	0.8655
x_3	0.8793	0.9684	0.8705	0.6124	0.6157	0.7045	0.3333	0.7864	0.7213
x_4	0.8465	0.9738	1.0000	0.9343	0.9637	0.8658	0.9575	0.9644	0.9383

TABLE 24. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density in Winter, 1997 in Yongan, Fujian.

Factors	Relational coefficients (ξ) on								r_i
	14 Dec.	24 Dec.	4 Jan.	14 Jan.	24 Jan.	4 Feb.	14 Feb.	24 Feb	
x_1	0.9061	0.8439	0.8200	0.8655	0.8934	0.8605	0.7936	0.8303	0.8517
x_2	0.9278	0.8650	0.8380	0.8396	0.8296	0.8413	0.8332	0.8413	0.8520
x_3	0.9365	0.9884	0.8730	0.6153	0.6224	0.6931	0.3333	0.7682	0.7288
x_4	0.9002	0.9556	1.0000	0.9314	0.9682	0.8445	1.0000	1.0000	0.9500

Patterns during Spring 1998

Temperature gradually increased from mid-teens to mid-twenties but rainfall and relative humidity fluctuated during the season (Table 25). Predators were higher in density at the two ends than in the middle of the season.

TABLE 25. Average population densities of mites per 10 leaves on the moso bamboo and four ecological factors in Spring in 1998 in Yongan, Fujian.

Variables	19 Mar.	29 Mar.	9 Apr.	19 Apr.	29 Apr.	9 May	19 May	29 May	19 Mar.
y_1	1.0	2.0	0	0	0	0	0	15.6	20.2
y_2	1.0	1.0	0	0	0	0	0	7.0	0.6
y_3	1.0	1.0	0	0	0	0	0	7.6	10.4
y_4	1.0	4.0	0	0	0	0	0	30.2	31.2
y_5	10.0	10.4	17.2	0	0	0	0	5.0	24.0
y_6	1.2	0	3.6	0	0	0	0	0	8.0
y_7	1.6	2.4	4.8	0	0	0	0	1.0	12.8
y_8	12.8	12.8	25.6	0	0	0	0	6.0	44.8
y_9	1.0	0	0	0	0	0	0	4.6	0
x_1	13.6	15.0	17.5	22.4	22.7	23.7	25.0	25.3	23.9
x_2	87.0	90.0	82.0	73.0	68.0	83.0	82.0	82.0	77.0
x_3	157.5	70.1	53.6	7.7	5.7	151.9	149.1	75.6	27.0
x_4	1.0	0.2	0	0	0	0	0.2	1.0	1.0

Schizotetranychus nanjingensis. Predation was the key factor influencing the population dynamics of this species (Table 26). The pattern was consistent for egg, larval and post-larval stages.

Aponychus corpuzae. Predation was more important than other factors to the development of this species and this pattern was true for egg, larval and post-larval stages (Table 27).

TABLE 26. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Spring 1998 in Yongan, Fujian.

Stage	Relational coefficients (ξ) on								r_i
Factor	19 Mar.	29 Mar.	9 Apr.	19 Apr.	29 Apr.	9 May	19 May	29 May	
Egg									
x_1	0.9178	0.8861	0.8588	0.8571	0.8518	0.8449	0.4216	0.3519	0.7488
x_2	0.9121	0.9140	0.9234	0.9276	0.9130	0.9140	0.4059	0.3414	0.7814
x_3	0.8656	0.9672	0.9951	0.9964	0.9122	0.9136	0.3984	0.3333	0.7977
x_4	0.8476	1.0000	1.0000	1.0000	1.0000	0.9804	0.9092	0.9092	0.9558
Larva									
x_1	0.9694	0.7170	0.6643	0.6614	0.6517	0.6394	0.3881	0.7380	0.6786
x_2	0.9895	0.7757	0.7969	0.8066	0.7736	0.7757	0.3499	0.9196	0.7734
x_3	0.8545	0.9055	0.9852	0.9890	0.7717	0.7750	0.3333	0.8838	0.8123
x_4	0.8030	1.0000	1.0000	1.0000	1.0000	0.9422	0.3521	0.8907	0.8735
Post-larva									
x_1	0.9803	0.7990	0.7564	0.7539	0.7459	0.7356	0.4712	0.3718	0.7018
x_2	0.9933	0.8444	0.8602	0.8674	0.8428	0.8444	0.4345	0.3496	0.7546
x_3	0.9021	0.9376	0.9905	0.9930	0.8413	0.8438	0.4180	0.3333	0.7825
x_4	0.8647	1.0000	1.0000	1.0000	1.0000	0.9624	0.4366	0.3524	0.8270
All stages									
x_1	0.8426	0.9234	0.9040	0.9029	0.8990	0.8941	0.3538	0.3451	0.7581
x_2	0.8395	0.9427	0.9492	0.9520	0.9421	0.9427	0.3465	0.3385	0.7817
x_3	0.8136	0.9785	0.9969	0.9977	0.9415	0.9425	0.3407	0.3333	0.7931
x_4	0.8033	1.0000	1.0000	1.0000	1.0000	0.9873	0.3470	0.3394	0.8096

Aculus bambusae. Predation was also the key factor influencing the population development of this species (Table 28).

It should be noted that the patterns during this season were the same as those in the last season.

TABLE 27. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Spring 1998 in Yongan, Fujian.

Stage / Factor	Relational coefficients (ξ) on								r_i
	19 Mar.	29 Mar.	9 Apr.	19 Apr.	29 Apr.	9 May	19 May	29 May	
Egg									
x_1	0.9466	0.7201	0.4035	0.4003	0.3900	0.3774	0.4503	0.6342	0.5403
x_2	0.9951	0.5890	0.5725	0.5817	0.5388	0.5418	0.7158	0.4238	0.6206
x_3	0.6519	0.4468	0.9580	0.9685	0.5371	0.5407	0.9824	0.3333	0.6773
x_4	0.8478	0.3931	1.0000	1.0000	1.0000	0.8478	0.6903	0.4432	0.7773
Larva									
x_1	0.7802	0.6956	0.7038	0.7011	0.6920	0.6805	0.6778	0.3854	0.6646
x_2	0.7910	0.6555	0.8249	0.8336	0.8040	0.8059	0.8059	0.3549	0.7345
x_3	0.8979	0.5954	0.9884	0.9908	0.8023	0.8052	0.8908	0.3333	0.7880
x_4	0.9514	0.5661	1.0000	1.0000	1.0000	0.9514	0.7965	0.3586	0.8280
Post-larva									
x_1	0.9079	0.6956	0.7038	0.7011	0.6920	0.6805	0.7601	0.3854	0.6908
x_2	0.8937	0.6555	0.8249	0.8336	0.8040	0.8059	0.9250	0.3549	0.7622
x_3	0.7877	0.5954	0.9877	0.9908	0.8023	0.8052	0.9643	0.3333	0.7833
x_4	0.7507	0.5661	1.0000	1.0000	1.0000	0.9514	0.9126	0.3586	0.8174
All stages									
x_1	0.9418	0.7000	0.5026	0.4993	0.4885	0.4752	0.5447	0.4885	0.5801
x_2	0.9797	0.6115	0.6670	0.6804	0.6356	0.6384	0.7784	0.3889	0.6725
x_3	0.7500	0.5007	0.9715	0.9787	0.6331	0.6374	0.9933	0.3333	0.7248
x_4	0.6754	0.4542	1.0000	1.0000	1.0000	0.8927	0.7581	0.3997	0.7725

TABLE 28. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density in Spring, 1998 in Yongan, Fujian.

Factors	Relational coefficients (ξ) on								r_i
	19 Mar.	29 Mar.	9Apr.	19 Apr.	29 Apr.	9 May	19 May	29 May	
x_1	0.6513	0.6155	0.5557	0.5524	0.5417	0.5284	0.4292	0.5396	0.5517
x_2	0.6657	0.6861	0.7126	0.7249	0.6835	0.6861	0.3603	0.6995	0.6523
x_3	0.8223	0.8583	0.9768	0.9827	0.6811	0.6851	0.3333	0.9232	0.7829
x_4	0.9115	1.0000	1.0000	1.0000	1.0000	0.9115	0.3640	0.6821	0.8586

Patterns during Summer 1998

All four ecological factors fluctuated during the season (Table 29). Predatory mites were nearly 10 times as many as the last season.

TABLE 29 Average population densities of mites per 10 leaves on the moso bamboo and four ecological factors in Summer, 1998 in Yongan, Fujian.

Variables	6 Jun.	16 Jun.	26 Jun.	6 Jul.	16 Jul.	26 Jul.	6 Aug.	16 Aug	26 Aug
y_1	48.4	28.0	8.6	2.0	0	4.0	83.4	12.7	15.0
y_2	24.2	11.6	1.4	1.0	0	1.4	50.6	5.7	9.0
y_3	24.4	15.0	6.2	6.0	0	3.6	86.4	5.7	50.4
y_4	97.0	54.6	16.2	9.0	0	9.0	220.4	24.1	74.4
y_5	28.2	60.8	238.8	138.6	73.6	222.0	81.6	160.0	171.0
y_6	9.2	29.2	31.4	53.0	31.4	60.4	44.8	38.5	42.0
y_7	6.8	19.0	52.3	72.2	35.4	65.6	32.8	54.3	49.2
y_8	44.2	109.0	322.5	263.8	140.4	348.0	159.2	252.8	262.2
y_9	1.0	0	76.0	0	0	4.8	197.2	0	22.0
x_1	25.4	26.5	26.3	28.3	30.1	29.0	29.6	30.5	28.0
x_2	77.0	89.0	87.0	76.0	74.0	78.0	75.0	70.0	78.0
x_3	122.0	160.2	207.9	105.8	8.4	41.3	102.8	1.7	73.2
x_4	11.6	4.4	4.8	2.0	0.4	2.0	6.6	1.0	0.2

Schizotetranychus nanjingensis. Predation was the key factor influencing the population dynamics of this species in summer 1998 (Table 29). The pattern was consistent for egg, larval and post-larval stages.

Aponychus corpuzae. Temperature was more important than other factors to the development of this species and this pattern was true for egg, larval and post-larval stages (Table 27).

TABLE 30. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Summer 1998 in Yongan, Fujian.

Stage / Factor	Relational coefficients (ξ) on								r_i
	19 Jun.	29 Jun.	9 Jul.	19 Jul.	29 Jul.	9 Aug.	19 Aug.	29 Aug	
Egg									
x_1	0.6484	0.4908	0.4332	0.4146	0.4365	0.4529	0.4675	0.5115	0.4819
x_2	0.5938	0.4638	0.4655	0.4014	0.4697	0.5084	0.5645	0.5427	0.5087
x_3	0.5336	0.3485	0.5020	0.9589	0.7831	0.5568	0.7876	0.7585	0.6536
x_4	0.8281	0.7974	0.8915	1.0000	0.9349	0.6866	0.8485	0.7545	0.8427
Larva									
x_1	0.6171	0.4751	0.4511	0.4324	0.4485	0.4892	0.4783	0.5501	0.4927
x_2	0.5707	0.4514	0.4836	0.4795	0.4811	0.4409	0.5718	0.5845	0.5079
x_3	0.5183	0.3474	0.5202	0.9617	0.7773	0.4120	0.8202	0.8174	0.6468
x_4	0.9287	0.7264	0.8983	1.0000	0.9143	0.3646	0.8814	0.7272	0.8050
Post-larva									
x_1	0.7892	0.6664	0.6418	0.5721	0.6092	0.3913	0.6159	0.6169	0.6129
x_2	0.7454	0.6397	0.6784	0.6174	0.6425	0.3728	0.6990	0.5952	0.6238
x_3	0.6937	0.5161	0.7182	0.9720	0.9018	0.3607	0.8858	0.5114	0.6950
x_4	0.8777	0.9181	0.9688	0.9937	1.0000	0.3389	0.9250	0.4275	0.8062
All stages									
x_1	0.6652	0.5152	0.4731	0.3690	0.4662	0.4525	0.4912	0.7465	0.5224
x_2	0.6134	0.4883	0.5076	0.4889	0.5001	0.4122	0.5860	0.8073	0.5505
x_3	0.5554	0.3722	0.5464	0.9630	0.8087	0.3877	0.8158	0.8674	0.6646
x_4	0.8560	0.8067	0.9522	1.0000	0.9516	0.3468	0.8740	0.5533	0.7926

Aculus bambusae. Predation was the key factor influencing the population development of this species (Table 28).

It should be noted that predation was the key factor for both *S. nanjingensis* and *A. bambusae* for the last three seasons, all of the big harvest year.

TABLE 31. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Summer 1998 in Yongan, Fujian.

Stage / Factor	Relational coefficients (ξ) on								r_i
	19 Jun.	29 Jun.	9 Jul.	19 Jul.	29 Jul.	9 Aug.	19 Aug.	29.Aug	
Egg									
x_1	0.9488	0.4255	0.6230	0.8895	0.4533	0.8473	0.5737	0.5425	0.6630
x_2	0.9700	0.4291	0.6130	0.8591	0.4479	0.8200	0.5547	0.5372	0.6539
x_3	1.0000	0.4515	0.6036	0.7424	0.4217	0.8018	0.5034	0.5136	0.6298
x_4	0.8402	0.4036	0.5561	0.7386	0.4158	0.7677	0.5072	0.4841	0.5892
Larva									
x_1	0.9224	0.8815	0.6265	0.9009	0.5700	0.7121	0.7950	0.7379	0.7689
x_2	0.9423	0.8967	0.6165	0.8699	0.5616	0.6928	0.7592	0.7281	0.7584
x_3	0.9704	1.0000	0.6070	0.3582	0.5214	0.6798	0.6669	0.6858	0.6862
x_4	0.8202	0.7931	0.5593	0.7473	0.5124	0.6554	0.6736	0.6345	0.6745
Post-larva									
x_1	0.9622	0.5649	0.4557	0.7236	0.4888	0.7556	0.5588	0.5909	0.6376
x_2	0.9780	0.5694	0.4518	0.7087	0.4842	0.7396	0.5456	0.5863	0.6330
x_3	1.0000	0.5981	0.4480	0.6477	0.4617	0.7287	0.5086	0.5657	0.6198
x_4	0.8786	0.5368	0.4283	0.6456	0.4565	0.7080	0.5114	0.5394	0.5881
All stages									
x_1	0.9500	0.4955	0.5755	0.8532	0.4734	0.7969	0.5986	0.5772	0.6650
x_2	0.9708	0.5001	0.5673	0.8259	0.4677	0.7733	0.5784	0.5113	0.6569
x_3	1.0000	0.5301	0.5594	0.7200	0.4400	0.7574	0.5243	0.5454	0.6346
x_4	0.8481	0.4668	0.5194	0.7165	0.4338	0.7279	0.5283	0.5130	0.5942

TABLE 32. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density in Summer, 1998 in Yongan, Fujian.

Date	Relational coefficients (ξ) on								r_i
	19 Jun.	29 Jun.	9 Jul.	19 Jul.	29 Jul.	9 Aug.	19 Aug.	29 Aug.	
x_1	0.9896	0.5675	0.9889	0.9885	0.9643	0.3341	0.9881	0.8248	0.8307
x_2	0.9885	0.5678	0.9902	0.9905	0.9630	0.3338	0.9910	0.8242	0.8311
x_3	0.9870	0.5696	0.9914	0.9994	0.9567	0.3337	1.0000	0.8213	0.8324
x_4	0.9963	0.5654	0.9984	0.9998	0.9552	0.3334	0.9993	0.8174	0.8332

Patterns during Autumn 1998

Temperature gradually decreased from mid-twenties to 20^{o}C, whereas rainfall was less and relative humidity was low in the middle of the season (Table 33). Predatory mites were more abundant in mid-September than the rest of the season but were seven times less than last season.

TABLE 33. Average population densities of mites per 10 leaves on the moso bamboo and four ecological factors in Autumn, 1998 in Yongan, Fujian.

Variables	9 Sep.	19 Sep.	29 Sep.	9 Oct.	19 ct.	29 Oct.
y_1	1.0	32.0	10.4	2.8	50.0	11.0
y_2	1.0	12.2	10.0	1.0	5.4	5.4
y_3	1.0	19.0	17.2	4.0	10.0	9.4
y_4	1.0	63.2	37.6	7.8	65.4	25.8
y_5	22.4	166.4	86.8	103.7	79.4	52.2
y_6	4.2	32.0	19.7	24.4	25.6	58.6
y_7	9.2	37.6	26.2	34.0	40.6	20.4
y_8	35.8	236.0	132.7	162.1	145.6	131.2
y_9	1.0	174.6	88.0	119.0	0	0
x_1	25.2	26.1	25.2	24.6	23.6	20.1
x_2	84.0	77.0	69.0	70.0	69.0	80.0
x_3	21.5	16.5	0	0	1.5	64.7
x_4	1.0	2.4	0.4	0.2	0.3	0.1

Schizotetranychus nanjingensis. Temperature was slightly more important than the other factors to the population development of this species (Table 34). This pattern was consistent for egg, larval and post-larval stages.

Aponychus corpuzae. Temperature was the key factor affecting the dynamics of the egg, larval and post-larval stages of this mite (Table 35). Rainfall was the key factor influencing the population dynamics of this species (Table 35).

TABLE 34. Relational coefficients and relational degrees between grey sequences of ecological factors and that of *Schizotetranychus nanjingensis* densities in Autumn, 1998 in Yongan, Fujian.

Stage / Factor	Relational coefficients (ξ) on					r_i
	19 Sep.	29 Sep.	9 Oct.	19 Oct.	29 Oct.	
Egg						
x_1	0.4790	0.7795	1.0000	0.3619	0.7618	0.6764
x_2	0.4780	0.7755	0.9947	0.3613	0.7651	0.6749
x_3	0.4767	0.7575	0.9648	0.3577	0.8129	0.6739
x_4	0.4910	0.7662	0.9718	0.3588	0.7469	0.6669
Larva						
x_1	0.3400	0.3901	1.0000	0.5639	0.5563	0.5701
x_2	0.3377	0.3854	0.9757	0.5576	0.5648	0.5642
x_3	0.3347	0.3652	0.8547	0.5196	0.7080	0.5564
x_4	0.3699	0.3748	0.8809	0.5307	0.5211	0.5355
Post-larva						
x_1	0.4483	0.4795	1.0000	0.6678	0.6852	0.6562
x_2	0.4463	0.4762	0.9884	0.6636	0.6912	0.6531
x_3	0.4439	0.4613	0.9256	0.6374	0.7829	0.6502
x_4	0.4721	0.4684	0.9399	0.6452	0.6592	0.6370
All stages						
x_1	0.4164	0.5701	1.0000	0.4066	0.6848	0.6156
x_2	0.4159	0.6874	0.9964	0.4061	0.6866	0.6385
x_3	0.4152	0.5620	0.9759	0.4030	0.7121	0.6136
x_4	0.4225	0.5652	0.9807	0.4039	0.6766	0.6098

Aculus bambusae. Predation was the key factor influencing the population dynamics of this species (Table 36).

TABLE 35. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aponychus corpuzae* density in Autumn, 1998 in Yongan, Fujian.

Stage Factor	Relational coefficients (ξ) on					r_i
	19 Sep.	29 Sep.	9 Oct.	19 Oct.	29 Oct.	
Egg						
x_1	0.4124	0.6461	0.5741	0.6751	0.8244	0.6264
x_2	0.4074	0.6280	0.5626	0.6623	0.8515	0.6224
x_3	0.4013	0.5564	0.5037	0.5892	1.0000	0.6101
x_4	0.4797	0.5891	0.5167	0.6098	0.7210	0.5833
Larva						
x_1	0.7859	1.0000	0.9028	0.8785	0.5287	0.8192
x_2	0.7790	0.9835	0.8920	0.8702	0.5328	0.8115
x_3	0.7706	0.9139	0.8336	0.8197	0.5938	0.7863
x_4	0.8741	0.9465	0.8469	0.8346	0.5109	0.8026
Post-larva						
x_1	0.5674	0.7373	0.6059	0.5247	0.8252	0.6521
x_2	0.5548	0.7059	0.5887	0.5142	0.8623	0.6452
x_3	0.5397	0.5904	0.5051	0.4549	1.0000	0.6180
x_4	0.7680	0.6415	0.5229	0.4715	0.6910	0.6190
All stages						
x_1	0.4213	0.6350	0.5520	0.5904	0.6173	0.5632
x_2	0.4155	0.6154	0.5400	0.5794	0.6343	0.5569
x_3	0.4084	0.5390	0.4795	0.5164	1.0000	0.5887
x_4	0.5022	0.5737	0.4928	0.5342	0.5508	0.5307

TABLE 36. Relational coefficients and relational degrees between the grey sequences of ecological factors and that of *Aculus bambusae* density in Autumn, 1998 in Yongan, Fujian.

Factors	Relational coefficients (ξ) on					r_i
	19 Sep.	29 Sep.	9 Oct.	19 Oct.	29 Oct.	
x_1	0.3339	0.5002	0.4244	0.9901	0.9917	0.6481
x_2	0.3338	0.4996	0.4242	0.9914	0.9900	0.6478
x_3	0.3336	0.4973	0.4224	1.0000	0.9673	0.6441
x_4	0.3357	0.4984	0.4228	0.9974	0.9997	0.6508

Discussion

In this study, we followed the population dynamics of *S. nanjingensis*, *A. corpuzae* and *A. bambusae* through a two-year cycle of bamboo growth and monitored four ecological factors. We showed that key factors affecting the population development of these mites displayed variation among different seasons of the same year and between the same season in different years. The latter observation is particularly important as our results showed that key factors for a species could be different for the same season in a big harvest year (e.g. Spring 1997) and small harvest year (e.g. Spring 1998). Thus, studies by Cai *et al.* (1999, 2000) on the dynamics of *S. nanjingensis* and *A. corpuzae* for a single season in a single year is of limited value in understanding key factors influencing the population development of these mites.

This study also showed variation in the relative importance of the four ecological factors to the population dynamics of the three species. *Aponychus corpuzae* and *A. bambusae* shared key factors between each other in more seasons (5 of 9) than did any of them with *S. nanjingensis* (1 of 9 each). Only in one season did all three species shared the key factor (predation in Spring 1998) or had completely different key factors (Autumn 1998). It is interesting to know that *A. corpuzae* and *A. bambusae* both live on the surface of the bamboo leave and they are therefore similarly more susceptible to predation, relative humidity or rainfall than *S. nanjingensis*, which lives in the shelter of the web-nests. It is not surprising that predation, relative humidity or rainfall were key factors affecting the population development of *A. corpuzae* and *A. bambusae* and temperature was relatively not important (key factor for *A. corpuzae* in Summer 1998 only).

For *S. nanjingensis* and *A. corpusae*, we showed that the relative importance of the four ecological factors to mite population development showed variation among different life stages and the extent of this variation were different in different seasons. For example, in Winter 1997, the relative importance of the four factors were in the order predation > temperature > relative humidity > rainfall for the eggs and larvae of *S. nanjingensis* but in the order of temperature > predation > relative humidity > rainfall for the post-larval stages. In Spring 1998, however, the pattern was consistently predation > rainfall > relative humidity > temperature for the all stages of the same species.

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Abstract in Chinese

利用灰色关联法分析影响福建毛竹林不同季节南京裂爪螨、竹缺爪螨、竹刺瘿螨种群的关键因子

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摘要 应用灰色关联分析的方法，了解 1996 年秋天至 1998 年秋天，在毛竹生长的不同季节影响害螨种群发生的关键因子：温度、相对湿度、降雨量和竹盲走螨的捕食作用在同年或同种不同季节、年间，引起种群数量变化的相对重要性。

南京裂爪螨 *Schizotetranychus nanjingensis* Ma & Yuan：春季温度上升，毛竹老叶落到地面，新叶长出，随着落叶竹盲走螨在毛竹上种群下降。这个时期大年毛竹（换叶的那一年，毛竹两年换叶一次）温度是影响该螨种群消长的重要因素；但小年毛竹，没有换叶，许多捕食螨在老叶上，因此捕食螨的捕食作用是影响该螨种群变动的重要因素，夏季前期雨季带来高湿，后期有台风袭击竹林，高温和高湿交替出现，大年毛竹相对湿度对该螨发生是最重要的因素，而小年毛竹，捕食螨的捕食作用是关键因子（1996 年雨量是关键因子例外）。秋季温度逐渐下

降，大年毛竹温度是影响该螨种群消长的关键因子，而小年毛竹关键因子不是降雨量就是相对湿度。冬季大年毛竹温度和捕食作用影响该种群变动比其它因素更为重要，但小年毛竹关键因子是相对湿度。

竹缺爪螨 *Aponychus corpuzae* Rimando：春季该螨种群随着落叶落到地面，其中一些个体沿着竹杆爬回竹叶，大年毛竹相对湿度是影响该螨发生的重要因素，但小年毛竹捕食螨的捕食作用是影响该螨种群消长的关键因子。夏季大年毛竹捕食螨的捕食作用是关键因素，但小年毛竹温度对种群消长是重要因素。秋季相对湿度是影响大年毛竹该螨种群的关键因子，而小年毛竹降雨量是重要的因素。冬季大年毛竹捕食作用是关键因子，但小年毛竹降雨量是影响该螨种群消长的最重要因素。

竹刺瘿螨 *Aculus bambusae* Kuang：春季相对湿度是影响大年毛竹该螨发生的关键因子，而小年毛竹捕食螨的捕食作用是其关键因子。夏季不论毛竹的大小年，捕食螨的捕食作用都是影响该螨种群变动的重要因素。秋季 1996 年小年毛竹和 1997 年大年毛竹相对湿度是影响其种群增长的重要因素，而在 1998 年小年毛竹捕食螨的捕食作用是关键因子。冬季小年毛竹降雨量是影响该螨种群的关键因子，但大年毛竹捕食螨的捕食作用是影响该螨种群变动的关键因子。

关键词： 害螨，气候因子，竹盲走螨，关联分析

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