Bulletin of the Osaka Museum
of Natural History, No.56
p. 45 – 52; December, 2002

Fauna of the bagworm moth, especially on *Eumeta variegata* (Snellen) in city parts of the Kinki district of Japan (Insecta: Lepidoptera)

Itaru KANAZAWA*, Hiroko YAMAMOTO and Ken'ichi NAKATANI*****

近畿地方都市部におけるオオミノガの現状（昆虫綱：鱗翅目）

金沢　至*・山本博子**・中谷憲一***

抄録：1995年に著者らはオオミノガの幼虫がヤドリバエ類により甚大な被害を受けていることに気づいた．西南日本の都市部のオオミノガが，侵入種と考えられるオオミノガヤドリバエによって壊滅的打撃を受けているという情報を得て，近畿地方都市部のミノムシ相の変化を明らかにするために，野外調査と文献探索を行った．1998年の調査においてミノムシ相の地域差が見られたため，今回の結果からはオオミノガの減少を結論づけることはできなかった．しかし，さまざまな状況証拠から，オオミノガが減少した可能性の高いことが示唆される．

Abstract: We incidentally noticed that the larvae of *Eumeta variegata* were severely parasitized by some flies in 1995. Given an information that *E. variegata* suffered destructive parasitization by an invader species of tachinid fly, *Nealsomyaia rufella*, in the city parts of southwestern Japan around 1995, we carried out field and literature surveys to record the transition of the bagworm funa in Kinki district. Until early 1990s *E. variegata* was the dominant species, but in 1998 *E. minuscula* was most abundant at almost all sites surveyed. It is suggested that *E. minuscula* occupied the blank of ecological niche created by the decrease of *E. variegata*.

Key Words: bagworm fauna, *Eumeta variegata*, Kinki district, Japan, *Eumeta minuscula*, *Nealsomyia rufella*

It was generally observed in the urban area of the Kinki district represented by Osaka city that *Eumeta variegata* (Snellen) was very abundant and predominant among bagworm fauna until early summer of 1994. However Hiroko Yamamoto, one of the present authors, noticed the recent decrease of its occurrence in early autumn of 1994, when she collected larvae of *E. variegata* in order to investigate the development of ovaries in the female larvae and the chromosome number in the male ones. She tried to open the bag and take out the larva, but no living larva was obtained. A wrinkle dead larva and four puparia of tachinid fly were found instead in one of the collected bags.

Contributions from the Osaka Museum of Natural History, No. 376 (Accepted November 21, 2002)

* Osaka Museum of Natural History, Nagai Park, Hisgashi-sumiyoshi-ku, Osaka 546-0034, Japan

** 3-271, Hamadera-suwanomori-cho-nishi, Sakai 592-8347, Japan

***3-8-18, Uchindai-cho, miyakojima-ku, Osaka 534-0013, Japan

It was tried also in the next spring, and again no living larva was obtained.

Mr. Takuji Tachi and Prof. Hiroshi Shima of Kyushu University noticed the incident which happened to the Japanese bagworm fauna in early autumn of 1995 (Tachi and Shima, 1996). They were aware that few bagworms of *E. variegata* were seen in that year in Fukuoka City compared with the average year, and 578 (90%) bags were parasitized as a result of dissecting the total 639 ones captured in 5 points around Kyushu University or the place. It was found to be a tachinid fly, *Nealsomyia rufella* (Bezii) which was not occurring in Japan when adult flies were emerged to trace the parasite. Furthermore, the fly were discovered from even Kumamoto City, Kagoshima City, Okayama City, and it became clear that *E. variegata* did die out in the western area from Kagoshima to Kyoto due to the parasitism of this fly as a result of researching the extent of the domestic distribution. A research result was announced in the Japanese entomology meeting convention held in March, 1996 in the title of "A species of the genus *Nealsomyia* which has not been recorded from Japan and parasitize the larva of *E. variegata*" (Tachi and Shima, 1996).

Our parasite fly was identified as *N. rufella* (Bezii) by Prof. Shima. Given these informations, now, it is important for us to record how much *E. variegata* had lived before the incident and lives now in the city part of the Kinki district under hypothesis that the population of *E. variegata* has been decreased by *N. rufella*.

Materials and Methods

Bags and larvae of the three species, *Eumeta minuscula* Butler, *E. variegata* and *Bambalina* sp. (Fig. 1) among bagworm moths were collected from the city part of the Kinki districts in 1998.

Bagworms were collected from the trees of parks, castles and roadside at the following eight sites such in the city part of the Kinki districts in 1998 (Osaka Pref.: Kyuhoji-ryokuchi Park, Yao City; Oizumi-ryokuchi Park and Hamadera, Sakai City. Shiga Pref.: Nishi-otsu, Otsu City; Hikone Castle, Hikone City. Wakayama Pref.: Nougawa, Musota, and Wakayama Castle, Wakayama City). They were kept in plastic bags with the records of tree species to which they were adhered and preserved at room temperature until examination. The bags were dissected as soon as possible and examined whether living larvae were present or not; if present, the sex and aging were recorded; if not present, they were separated into the six categories shown in Table 2 for *E. variegata*.

As for the past records of the bagworm fauna in the city part of the Kinki district, literature survey was carried out. We include our unpublished record of an educational program of Osaka Museum of Natural History held on February 25, 1990 at Nagai Park. In this program, together with about 10 participants, we tried to collect bagworms as many as possible along trails in a selected part of Nagai Park. Bags were identified and dissected to examine the contents.

Results

Table 1 shows the total numbers of bags and the ratios of those containing living larvae or pupae of the three species of bagworms at eight localities in 1998 and Nagai Park in 1990. These include old bags of preceding seasons, the numbers of which is roughly indicated by those of "old bagworm pupal cases" in Table 2 for *Eumeta variegata*. Table 2 shows the contents of the *E. varigata* bags

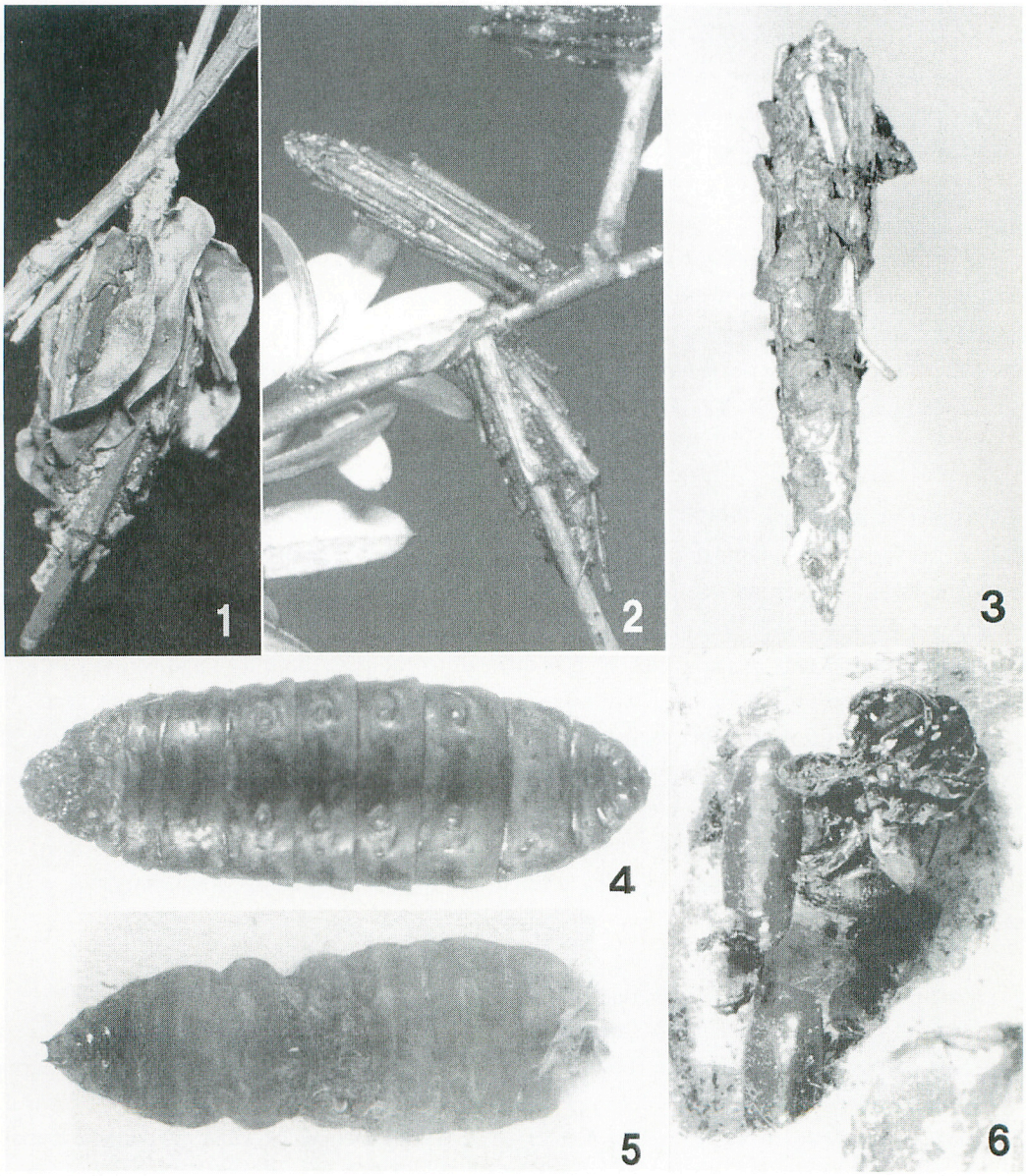

Fig. 1. Bagworm moths in the Kinki district of Japan. 1, *Eumeta variegata*; 2, *Eumeta minuscula*; 3, *Bambalina* sp. 4; Female pupa of *E. variegata*; 5, Female adult of Ditto; 6, Parasitized larva of Ditto by *Nealsomyia rufella*.

which contain no living bagworm.

At Nagai Park in 1998 we could find few bagworms either *E. variegata* or *E. minuscula*.

Observation at Nagai Park in 1990

Many bags of *E. variegata* attached to the trees such as *Quercus phillyraeoides* A. Gray and *Cinnamomum camphora* Sieb. Almost all bags collected were identified as *E. variegata*. There was no bag obviously identified as *E. minuscula*. Among the total 369 bags dissected, 152 were empty ones which contain no living larva, carcass nor fragments (Table 2, "empty bags").

Hamadera in 1994-1998

E. variegata was abundant at Hamadera until early 1990s. In the early autumn in 1994 we found that *E. variegata* bags were abundant, but most bags contained dead larvae parasitized by a tachinid fly species. In the spring of 1995 again no living larva and no pupa was observed in the bags. After the destructive decrease of *E. variegata* outbreaks of *E. minuscula* were seen for several years around the house of H. Yamamoto at Hamadera.

Discussion

Fauna of bagworms in 1998 shows the dominancy of *Eumeta minuscula* except at Musota, where *E. variegata* was abundant. This site is only 5 km distance from Wakayama Castle and this fact suggests that the fauna composition greatly varies among close sites. Fauna in 1978-79 at Nakamozu (Nishida, 1983) and in 1990 at Nagai Park shows the dominancy of *E. variegata*. We have no year to year data in same sites, so it is difficult to compare these data and we only propose two hypothesis, one is that fauna of bagworms varies among sites and possibly among years, the other is that composition of fauna such as species dominancy has been changing from *E. variegata* to *E. minuscula*. *E. variegata* was the dominant species at Nougawa before (Murase, personal comm.). We have only a few data before 1990 but all of them show high abundance of *E. variegata*, so the later hypothesis, as changing fauna in these tens years, is more possibly. In this viewpoint, continuous and long termed study on fauna at Musota, which is rural village near Nougawa, will be greatly important.

The cause of the mortality of E. variegata

In the survey of 1998 only a few *E. variegata* had received parasitism by tachinid flies in urban area of the Kinki district. On the other hand, about 16 percent bags contained dead larvae parasitized by wasps. However, this does not necessarily mean that the parasitism by wasps was the main cause of the destructive decrease of *E. variegata*. We must consider about the parasite damage on not only pupae stage but also larvae stage. Nishida (1983) reports that wasps attack on *E. variegata* pupae ca. 80 times more intensive rate than larvae. It is necessary to clear the parasite pressure in larva stage by tachinid fly.

At Hamadera in 1995 most bags of *E. variegata* contained dead larvae or pupae accompanied

Table 1. Number of *Eumeta variegata* found alive, including comparison with the other species

Site	Date	*Eumeta variegata*							*Eumeta minuscula*		*Bambalina* sp.		Undetermined		Total bags	Total alive
		Bags	alive	Total alive %	larvae Male	larvae Female	pupae Male	pupae Female	Bags	alive	Bags	alive	Bags	alive		
Nagai Park	Feb.25,1990	369	98	26.6	59	38		1	0	0	0	0	0	0	369	98
Kyuhoji-ryokuchi	Jan.12,1998	11	1	9.1		1			392	297	0	0	0	0	403	298
Oizumi-ryokuchi	Jan.12,1998	13	0	0.0					127	93	0	0	0	0	140	93
Hamadera	Feb.9,1998	0	0	-					224	185	0	0	0	0	224	185
Nishi-otsu	Jan.31,1998	1	0	0.0					15	5	2	0	0	0	18	5
Hikone Castle	Feb.1,1998	3	1	33.3		1			227	119	19	2	0	0	249	122
Nougawa	Apr.27/May.11,1998	29	10	34.5	1	1	8		134	50	0	0	4	0	167	60
Musota	Apr.27,1998	13	9	69.2			6	3	1	1	0	0	0	0	14	10
Wakayama Castle	May.11,1998	0	0	-					95	82	0	0	0	0	95	82
	Total (1998)	70	21	30.0	1	3	14	3	1215	832	21	2	4	0	1310	855

Table 2. Contents of bags which contained no living *Eumeta variegata*.

Site	Date	Bags collected	Bags with no living bagworms (BNW)	Empty bags	Old bagworm pupal cases	Bagworm parasited by wasps	Bagworm parasited by flies	Dead larvae only	Dead pupae only
Nagai Park	Feb.25,1990	369	271	152	29			88	2
			% of BNW (1990)	56.1	10.7	0.0	0.0	32.5	0.7
Kyuhoji-ryokuchi	Jan.12,1998	11	10		10				
Oizumi-ryokuchi	Jan.12,1998	13	13		7	2		4	
Nishi-otsu	Jan.31,1998	1	1		1				
Hikone Castle	Feb.1,1998	3	2			2			
Nougawa	Apr.27/May.11,1998	29	19	6	2	5	3	1	2
Musota	Apr.27,1998	13	4		2	2			
	Total (1998)	70	49	6	22	11	3	5	2
			% of BNW (1998)	12.2	44.9	22.4	6.1	10.2	4.1

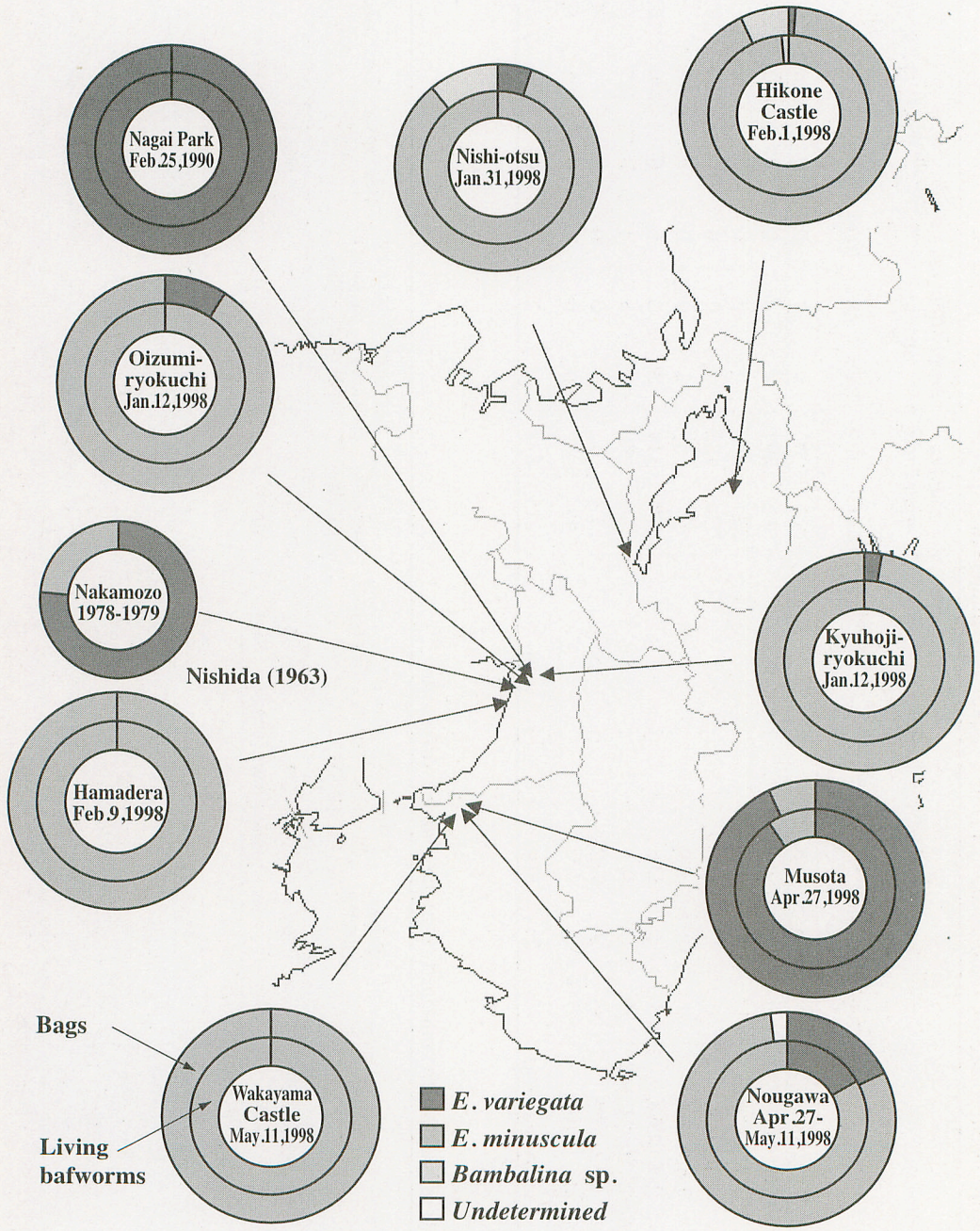

Fig. 2. Distribution map and formation of three species of bagworm moths in the Kinki district of Japan. Outer parts show the formation in bags, inner ones show the formation in larvae of bagworm moths.

with pupal skins of the tachinid fly. The situation and timing agrees with the report by Tate and Shima (1996) that *E. variegata* had destructively decreased in the city parts of southwestern Japan due to the parasitism by *Nealsomyia rufella*. It seems likely that *N. rufella* was the main cause of the destructive decrease of *E. variegata* in the Kinki district also.

Some reasons are suspected to resolve the inconsistency between the situations around 1995 and in 1998. First, *N. rufella* may not have been an effective parasite at the investigation moment in 1998, when *E. variegata* had already decreased and the density was low. *N. rufella* may become a destructive parasite only where the density of *E. variegata* is high. Second, we could not exactly determine how old the bag was when no living bagworm was present within, thus old bags were included in our samples without discrimination. This factor may act ambiguously. The rate of bags containing living larvae is estimated lower than the actual situation. On the other hand, the rate of bagworms safely emerged may be estimated higher, if the bags containing old pupal cases are regarded as those of the current season. It is not certain how long do bags remain on the tree.

There are no quantitative comparative data showing whether the population sizes of *E. minuscula* explosively increased or not after the destructive decrease of *E. variegata*. At least at Hamadera, however, outbreaks of *E. minuscula* was observed just after the decrease of *E. variegata*. At Musota, where the most natural environment was seen among our study sites, we could not find any sign of parasitism by *N. rufella* and the dominant species was still *E. variegata*, although the density was not so high. The population size of *E. minuscula* was very small. We suspect that *E. minuscula* occupied the blank of ecological niche created by the decrease of *E. variegata* in urban area of the Kinki district.

We may also have to consider a possibility that the outbreaks of *E. variegata* in urban parks such as Nagai in 1990 were unusual cases rather than normal bagworm faunas. Among 271 bags collected, there were 152 bags with no content, 88 ones with dead larvae by unknown cause, and few ones parasitized by wasps or flies. It is remarkable that there were few parasites contrast to the situation at Nakamozu or Nougawa. The lack of rich parasite fauna may have allowed outbreaks of *E. variegata*. In this context, the situations in urban parks now are thought to have returned to a stable condition of host-parasite relationships. To our present knowledge the invader species, *N. rufella*, is known to parasitize only to *E. variegata*, therefore the two species may have had long history of coexistence elsewhere. It is important for us to watch the process of recovery of the *E. variegata* population in urban parks at the situation that a specific parasite is present. This may give us insight to clarify how the past outbreaks of *E. variegata* at urban parks in southwestern Japan were brought about.

Acknowledgments

We wish to express our sincere gratitude to Dr. Hiroshi Shima of the Kyushu University for identifying the tachinid species and for providing us with many valuable suggestions about the parasites of Psychidae. We thank the following persons for giving helpful advice regarding our study: Dr. Yasuyuki Sakuradani of the Kinki University, Dr. Akito Kawazoe, Messrs. Fumihiro

Sugahara and Masasuke Sugimura of the Central Park of Osaka Pref., Mr. Hisatugu Higashio of the Western Park Office of Osaka Pref., Mr. Ko Seto, a ret. reseacher of O.M.N.H., and Mr. Shinji Fujii of O.M.N.H. Our thanks are extended to Prof. Yorio Miyatake of the Aoyama Junior College for supplying information about the bagworms graciously from his research field. Our thanks also go to the following persons who assisted us with carrying out the indoor work at the O.M.N.H.: Ms. Noriko Izumimoto, Mr. Masatoshi Osafune, Mr. Shouzou Kitagawa, Mr. Kiyoshi Tabuchi, Ms. Tomoko Nishino, Mr. Yutaka Nishimoto, Ms. Tomoko Fujimoto, and Mr. Hirofumi Yanamoto.

Literature Cited

Tachi, T. and Shima, H. 1996. A species of the genus *Nealsomyia* which has not been recorded from Japan and parasitize the larva of *Eumeta variegata* (Diptera: Tachinidae). The collection of lecture summaries of the joint convention of the 56th one of the Entomological Society of Japan and the 40th one of The Japanese Society of Applied Entomology and Zoology, P.193. (in Japanese).

Nishida, E. 1983. Biologies Parasite Complexes of Two Bagworms, *Eumeta japonica* and *Eumeta minuscula* (Lepidoptera, Psychidae). Kontyu. 51 (3): 394-411.