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Egg parasitoids of the processionary moth *Thaumetopoea pityocampa* (Den. & Schiff.) collected in Albania(*)

Abstract - Egg parasitoids and egg parasitism were studied in 32 egg batches of the pine processionary moth collected near Korca/Albania in heights of 1050-1400 m in August-September 1997, after caterpillars' hatch. In this mountainous region, *Baryscapus servadeii* (Dom.) was most abundant at the higher level, followed by *Ooencyrtus pityocampae* (Mercet) at the lower level. *Trichogramma* sp. was only found at 1400 m a.s.l. Additionally, the hyper-parasitoid *Baryscapus transversalis* Graham was established parasitizing dominantly the eggs placed near the beginning and the end of the batches. The grade of parasitism of the various egg batches varied from zero to 61%. The emergence dynamics of the parasitoids showed a peak of *B. transversalis* in November of the year, in which the host eggs were layed. *B. servadeii* emerged mainly in January of the following year. A high percentage of egg parasitoids died in the eggs, mainly from *O. pityocampae* and the polyembryonic *Trichogramma* sp. (see also Tsankov *et al.*, 1996a); up to 12 pupae were found in one egg.

Riassunto - *Ooparassitoidi di* Thaumetopoea pityocampa *(Den. & Schiff.) raccolti in Albania.*

Sono stati studiati gli ooparassitoidi e la percentuale di parassitizzazione presente in 32 ovature di Processionaria del pino, raccolte presso Korca (Albania) ad una altitudine di 1050-1400 m, in agosto-settembre 1997, dopo la schiusura delle larve. In questa regione montagnosa *Baryscapus servadeii* (Dom.) è risultata la specie più abbondante a 1400 m, seguita da *Ooencyrtus pityocampae* (Mercet) a 1050 m. *Trichogramma* sp. è stato raccolto solo a 1400 m s.l.m. Inoltre si è osservato che *Baryscapus transversalis* Graham parassitizza in modo predominante le uova all'apice ed alla base dell'ovatura. Il grado di parassitizzazione varia da 0 a 61%. Le osservazioni sullo sfarfallamento dei parassitoidi hanno evidenziato un picco per *B. transversalis* nel mese di novembre dello stesso anno in cui sono state deposte. *B. servadeii* sfarfalla per lo più nel gennaio dell'anno successivo. Un'elevata quantità di uova dei parassitoidi muore all'interno delle stesse uova della processionaria; ciò in particolare si verifica in *O. pityocampae* e in *Trichogramma* sp. (Tsankov *et al.*, 1996a); più di 12 pupe ormai morte di un poliembrionale *Trichogramma* sono state trovate in un unico uovo del lepidottero.

(*) Compare FREINA J. & WITT T., 1987: Die Bombyces und Sphinges der Westpalaearktis, Lepidoptera. Forschung & Wissenschaft, München.

Zusammenfassung - *Eiparasitoide des Pinienprocessionsspinners* Thaumetopoea pityocampa *(Den. & Schiff.) Albanien.*

Eiparasitoide und Eiparasitismus wurden bei 32 Gelegen des Pinienprocessionsspinners untersucht; die Gelege wurden im August-September 1997 nach dem Schlupf der Wirtsraupen bei Korca/Albanien zwischen 1050-1400 m NN gesammelt. In dieser montanen Region war *Baryscapus servadeii* (Dom.) am häufigsten in 1400 m NN vertreten, gefolgt von *Ooencyrtus pityocampae* (Mercet) in 1050 m NN. *Trichogramma* sp.wurde nur in 1400 m NN gefunden. Zusätzlich wurde der Hyperparasitoid *Baryscapus transversalis* Graham nachgewiesen, der die Eier bevorzugt am Anfang und am Ende der Gelege parasitierte. Der Parasitierungsgrad der einzelnen Eigelege variierte von Null bis 61% der Eier. *B. transversalis* zeigte ein Schlupfmaximum im November des Jahres der Eiablage, während *B. servadeii* vorwiegend im Januar des Folgejahres schlüpfte. Ein hoher Prozentsatz der Eiparasitoide starb in den Eiern als Larven, Puppen oder fast entwickelte Imagines. Dieser Prozensatz war bei *O. pityocampae* und *Trichogramma* sp. besonders hoch, wie früher auch in Bulgarien festgestellt wurde (Tsankov *et al.*, 1996a). Vom polyembryonalen *Trichogramma* sp. wurden in einem Ei bis zu 12 abgestorbene Puppen gefunden.

Key words: *Thaumetopoea pityocampa,* egg parasitoids, Albania, hyper-parasitism, mortality of egg parasitoids, phenology.

INTRODUCTION

Androic (1956) showed a map in that *Thaumetopoea pityocampa* (Den. & Schiff.) was distributed around the Mediterranean Sea including the Balkan area. In former Yugoslavia the pine pest inhabited the coastal parts and fed mainly on *Pinus nigra* Arnold. In Greece, it is known from the whole country. Additioinally, Tsankov (1960) reported that the Bulgarian pine forests were highly infested by the processionary moth. No report was presented on the distribution of the pine pest in Albania, except the map published by Androic (1956). Thus, the knowledge of egg parasitoids of the pine pest is also rare from the region. Androic (1956) reported *Ooencyrtus pityocampae* (Mercet) (Encyrtidae) as the most abundant species, followed by *Baryscapus (= Tetrastichus) tibialis* Kurdj. (Eulophidae), *Charitolophus* sp. (Eupelmidae) and *Trichogramma* sp. (Trichogrammatidae) from Jugoslavia. For northern Greece, Bellin *et al.* (1990) established *Baryscapus* (= *Tetrastichus) servadeii* (Dom.) as most abundant egg parasitoid. Mirchev *et al.* (1998a) summarized our knowledge of the ooparasitoids from Bulgaria. Now, we are able to present the first paper on the egg parasitoids of the pine pest found in Albania, near the border to Greece (Fig. 1).

MATERIALS AND METHODS

A number of 32 egg batches were collected near Korca, Southeast Albania, in mountainous regions at Voskopoje in a height of 1400 m and Qarr, 1050 m a.s.l., in

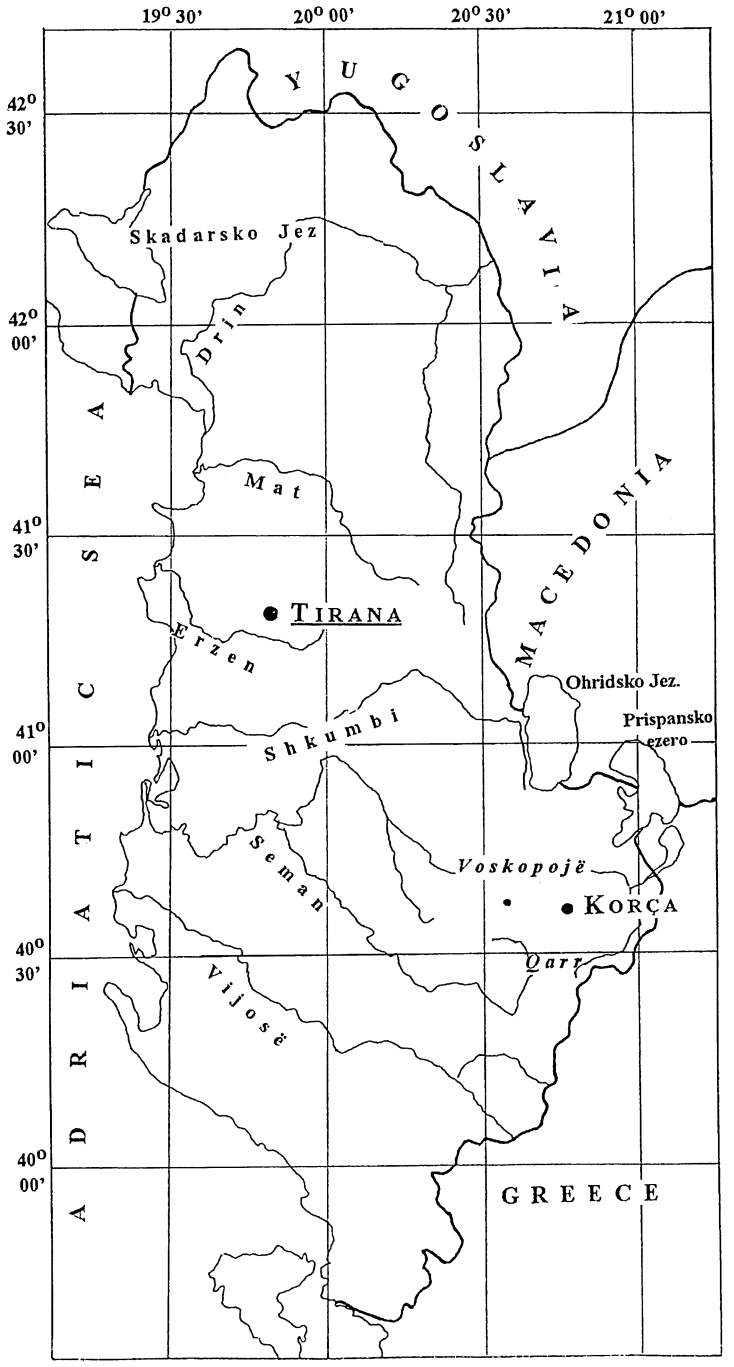

Fig. 1 - Map of Albania showing the sites near Korca (Voskopoje and Qarr) where the egg batches were sampled.

August-September 1997 from *Pinus nigra* Arnold and sent to the Forest Research Institute in Sofia on 13.10.1997 by the Albanian colleague. The batches were preserved about one month at Korca under laboratory conditions. The scale cover of the egg batches were removed between 16-21.10.1997 and thereafter the batches were put singly in test tubes with cotton stoppers. Laboratory studies were performed at room temperature (20-22°C). The emergence of parasitoids was daily observed from 21.10.1997 to 20.09.1998. The emerged Insects were transferred to smaller tubes for determination. The data obtained were combined for ten days and tabled.

Parasitoids emerged before collection and sending the batches to Sofia were determined by their meconia and remains after Schmidt & Kitt (1994), Tanzen & Schmidt (1995), and Schmidt *et al.* (1997a).

RESULTS

Characterization of the egg batches

A total of 32 egg batches were studied, from which 18 batches were collected at Voskopoje and 14 at Qarr near Korca at the end of August and the beginning of September 1997 after the pest larvae had hatched. The characterization of the egg batches were presented in Table 1. In all cases, oviposition occurred from base to tip of the needles. The mean number of eggs per batch was calculated to 209 at Voskopoje and 184 at Qarr.

Species of egg parasitoids established

Table 2 shows the results obtained by the analysis of the parasitoids emerged or died as developing stages in the eggs.

Table 1 - Structure of egg batches of Thaumetopoea pityocampa *from Korca district, Albania.*

Site of collection	Voskopojë, 1400 m a. s. l.	Qarr, 1050 m a. s. l.
Date of collection	10. 09. 1997	28. 08. 1997
Number of egg batches	18	14
Length of needles (*Pinus nigra*)	86.4 mm (min 50 mm - max 105 mm)	69.4 mm (min 40 mm - max 85 mm)
Length of egg batches	25.6 mm (min 9 mm - max 34 mm)	23.1 mm (min 15 mm - max 30mm)
Diameter of egg batches	3.3 mm (min 3.0 mm - max 3.8 mm)	3.3 mm (min 2.8 mm - max 3.5 mm)
Number of egg rows per batch	8.8 (min 8 - max 10)	8.7 (min 8 - max 10)
Distance of egg batches to base of needles	3.6 mm (min 0 mm - max 7 mm)	4.9 mm (min 0 mm - max 10 mm)
Orientation of scales	in all cases from base to tip of needles	in all cases from base to tip of needles
Number of eggs per batch	88 - 266	115 - 228
Total number of eggs	3762	2580
Mean per batch	209	184

Table 2 - Parasitoids of the egg batches of Thaumetopoea pityocampa *from Korca district, Albania.*

Site of collection	Voskopojë, 1400 m a. s. l.	Qarr, 1050 m a. s. l.
Date of collection	10. 09. 1997	28. 08. 1997
Ooencyrtus pityocampae (Mercet)	**54**	**155**
emerged before collection of egg batches	18	38 (1 of them with dark meconium)
emerged after collection of egg batches	6♀♀	3♀♀ (2 of them with dark meconium)
adults died in eggs without opening	1♀	5♀♀
pupae died inside the eggs	-	12
larvae of different stages died in the eggs	29	97
Baryscapus servadeii (Dom.)	**691**	**129**
emerged before collection of egg batches	162 (1 of them with remains of the caterpillar)	44 (1 of them with remains of the caterpillar)
emerged after collection of egg batches	489 (488♀♀,1♂) (9 of them with remains of caterpillars)	59 (55♀♀, 4♂♂) (5 of them with remains of caterpillars)
adults died in eggs without opening	8♀♀	8 (7♀♀ ,1♂)
pupae died inside the eggs	4 (1 of them with remains of the caterpillar)	1
larvae of different stages died in the eggs	28	17
Baryscapus transversalis Graham 1991	**12**	**67**
emerged before collection of egg batches	-	6
emerged after collection of egg batches	12 (6♀♀, 6♂♂)	43 (29♀♀, 14♂♂)
adults died in eggs without opening	-	10 (1♀ , 9♂♂)
pupae died in the eggs	-	4
larvae of different stages died in the eggs	-	4
Trichogramma sp.	**from 55 eggs**	-
emerged before collection of egg batches	from 7 eggs	-
emerged after collection of egg batches	1	-
eggs with dead pupae	17	-
eggs with dead larvae	30	-
undetermined dead larvae of parasitoids	11	-
eggs destroyed by predators	51	40

Ooencyrtus pityocampae (Mercet), *Baryscapus servadeii* (Dom.), *B. transversalis* Graham and *Trichogramma* sp. were established. At Voskopoje *B. servadeii* was much more abundant than *O. pityocampae*. At Qarr more individuals of the latter were found than of the former. The other two species were present in minor numbers.

O. pityocampae emerged mainly before collection of the batches. After collection very few adults appeared. Most of the individuals died as larvae on different stages.

B. servadeii emerged mainly after collection of the egg batches, but very early in the following year and many individuals of the species left the eggs before sampling. Very few males appeared. Some larvae of the eulophid did not reach the adult stage.

From the hyper-parasitoid *B. transversalis,* most of the individuals appeared in November after collection of the egg batches. The species was more numerous at Qarr than at Voskopoje. Females and males were found with about equal numbers. Some individuals of this species died on larval and pupal stages, ten adults could not make a hole for emergence.

Trichogramma sp. was found only at Voskopoje in relatively high numbers of eggs, but very few emerged, mainly before sampling of the egg batches; one adult only appeared after sampling. Cutting the eggs we found 3 pupae in two eggs, 4 pupae in one egg, 6 pupae in three eggs, 7 pupae in five eggs, 8 pupae in four eggs, 9 and 12 pupae in one egg each.

The first egg parasitoid emerged on 01.11.1997 and the last one was found alive on 08.09.1998. The undeveloped larvae did not survive.

Hatching rate of caterpillars, impact of parasitoids, and predator effects

The hatching rate of caterpillars was relatively high (73.6% at Voskopoje and 77.5% at Qarr), that means a low impact of parasitoids, including predator effects (23% at Voskopoje and only 15.2% at Qarr). Some eggs were totally empty, others contained dried up yolk. Some caterpillars did not hatch , although they developed to small larvae. The data concerning the pest larvae died without hatching are presented in Table 3.

Distribution of egg parasitoids in different parts of the egg batches

Normally unscaled eggs are more frequently attacked by egg parasitoids than scaled ones. The majority of unscaled eggs are located at the base and top of the batches. Therefore, parasitism in these parts is normally higher than in the middle of the batch. To prove this hypothesis, the egg batches were divided in five equal parts and the parasitized eggs were counted for each parasitoid (Table 4).

Considering the different species of parasitoids and their distribution at both collection sites, *B. servadeii* was equally distributed at Voskopoje, whilst at Qarr the eulophid was found more frequently on both ends of the egg batches. *O. pityocampae* attacked more frequently the base part at Voskopoje, whilst at Qarr more adults

Table 3 - Hatching rates and mortality of caterpillars of Thaumetopoea pityocampa *(Den. & Schiff.) from egg batches sampled near Korca/Albania.*

Site of collection	Voskopojë, 1400 m a. s. l.	Qarr, 1050 m a.s.l.
Date of collection	10. 09. 1997	28. 08. 1997
Caterpillars died without opening	39	53
undeveloped caterpillars died without opening	4	48
caterpillars died with opening	3	7
caterpillars hatched	2766 (73.6%)	2000 (77.5%)
undeveloped eggs with dried-up yolk	63	52
eggs totally empty, without any remains	13	29
Total number of eggs from which no caterpillar hatched without influence of parasitoids	122 (3.2%)	189 (7.3%)
Impact of egg parasitoids and predators	874 (23.2 %)	391 (15.2%)

emerged from the first and last (5th) parts . The hyper-parasitoid *B. transversalis* was found on both ends of the batches at Voskopoje, the eggs of the middle part were not hyperparasitized. At Qarr, *B. transversalis* was established more frequently on the top (4th-5th) part. In the latter site, hyperparasitism was relatively high. *Trichogramma* sp. parasitized both ends of the batches much more frequently than the middle part, but it was only found at Voskopoje.

Emergence dynamics of the parasitoid species

The phenology of the egg parasitoids was studied under laboratory conditions. The results are presented in Table 5. In egg batches collected at both sites, *B. servadeii* showed a peak of emergence between 1st and 20th of January of the year after

Table 4 - Location of the the parasitoids in the egg batches; each batch was divided in five equal parts.

Site	Parasitoids	Number of parasitized eggs	Distribution of egg parasitoids on the egg batches in %				
			base		Π		top
			1/5	2/5	3/5	4/5	5/5
	B. servadeii	691	22.9	17.5	20.5	18.8	20.3
Voskopojâ	*O. pityocampae*	54	29.6	22.2	11.1	16.7	20.4
	B. transversalis	12	16.7	-	-	50.0	33.3
	Trichogramma sp.	55	32.8	12.7	3.6	12.7	38.2
	B. servadeii	129	24.0	13.2	12.4	20.2	30.2
Qarr	*O. pityocampae*	155	19.4	12.9	12.9	25.8	29.0
	B. transversalis	67	12.0	12.0	12.0	35.8	28.2

Table 5 - Emergence dynamics of parasitoids from egg batches under laboratory conditions (20-22°C).

Site	Species	Numbers of parasitoids emerged															
		November '97			December '97			January '98			February '98			March	April	August	Sept.
		1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-28	21-31	11-20	1-10	1-10
Voskopoje	*B. servadeii*	2	-	-	1	5	22	290	166	1	1	-	-	-	-	1	-
	B. transversalis	4	2	2	2	-	-	-	1	1	-	-	-	-	-	-	-
	O. pityocampae	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	2
Qarr	*B. servadeii*	1	3	2	1	1	9	18	21	2	-	-	-	-	-	-	1
	B. transversalis	-	5	33	5	-	-	-	-	-	-	-	-	-	-	-	-
	O. pityocampae	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-

host oviposition. At both sites of sampling, almost all individuals of the species emerged within a period of one month. independent of the number of individuals emerged.

The hyper-parasitoid *B. transversalis* was found mainly at Qarr, where the period of emergence had a peak already at the end of November after oviposition.

From *O. pityocampae* only few individuals were found as adults which emerged from February to September of the following year. Most of the specimens emerged before collection of the egg batches, before or shortly after caterpillars' hatch.

DISCUSSION

Structure of egg batches and number of eggs

The egg batches collected at both sites of sampling were similar arranged as found in Bulgaria (Tsankov *et al.*, 1996a, 1998). In contrast to southern Greece (Schmidt, 1990), all egg batches were layed from base to tip of the needles. and were wrapped around two needles. The distance from the base of the needles varied from zero to 10 mm, as known from other sites studied. The mean number of eggs was lower than in Bulgaria at Marikostino (Tsankov *et al.*, 1996a,1998) and more similar to the numbers found in the Rhodopes (Mirchev *et al.*, 1998b) and in Greece (Bellin *et al.*, 1990, Schmidt, 1990). In Albania, as in many other European sites, some eggs of the batches were destroyed by predators.

Parasitoid impact

In eggs of *T. pityocampa*, parasitism started directly after oviposition and maintained almost until termination of the embryogenesis of the host (Kitt & Schmidt, 1993). The probability of the parasitoid to find and parasitize egg batches will increase with the abundance of the species of parasitoids and the time of exposure. If the abun-

dance is low the impact of the species will also be low and not all egg batches are parasitized, as it was shown in the Eastern Rhodopes (Mirchev *et al.*, 1998b). Also in the Korca district, some egg batches were not parasitized. The rate of parasitism of the various egg batches varied from zero to 61%. resulting in mean impact and predator effects of about 15% at Qarr and 23% at Voskopoje. A high percentage of caterpillars hatched (73 to 77%), although the exposure time could be fully used by the parasitoids.

Only four species of egg parasitoids were established near Korca. As in other mountainous regions (Bellin *et al.*, 1990; Tsankov *et al.*, 1995; Schmidt *et al.*, 1997b; Mirchev *et al.*, 1998b), *B. servadeii* was most abundant, mainly in the higher parts of the Korca district at Voskopoje. At Qarr, *O. pityocampae* was the main parasitoid attacking the eggs of the pine processionary moth. Almost all parasitized eggs were attacked in an early developing stage, because no remains of the caterpillars were found, except in very few eggs.

The polyembryonic *Trichogramma* sp. was found only at Voskopoje and there in few eggs. Very few individuals left the eggs before sampling of the batches and only one individual appeared alive in the laboratory, thus the species could not be determined definitely. Most of the individuals died as larvae and pupae.

As observed in other regions, the parasitoids mainly attacked the egg batches from the beginning and/or the end, but no rule exists (Tsankov *et al.*, 1995; Tsankov *et al.*, 1996a,b, Schmidt *et al.*, 1997b, Mirchev *et al.*, 1998b), except the hyper-parasitoid *B. transversalis* was found more on the endparts (Schmidt *et al.*, 1997a), as also observed near Korca.

Hyperparasitism

As in Greece and Bulgaria, *B. transversalis* was also established in Albania. But only a low percentage of eggs was attacked by the hyper-parasitoid, which appeared in both sexes, like in other regions (Bellin *et al.*, 1990; Tsankov *et al.*, 1996a,b, 1998; Schmidt *et al.*, 1997a; Mirchev *et al.*, 1998b).

The species appeared very early after parasitism of the primary parasitoids to establish further generations (Bellin, 1995).

Host egg mortality and sterile host eggs

The mortality of the host eggs depends mainly on the abundance of egg parasitoids and factors influencing the embryonic development of the host. Additioinally, in all egg batches studied a small number of eggs could be established which were totally empty (Tsankov *et al.*, 1996a,b, 1998; Schmidt *et al.*, 1997a,b; Mirchev *et al.*, 1998b). Such eggs were also found in Albania together with a low percentage of eggs containing dried up yolk, which were persumably unfertilized. For all sites studied these percentages together hold less than 10% of the total eggs, from that no caterpillar hatched without the influence of parasitoids.

Phenology of egg parasitoids

Basing on the emerging period, which can be studied easily under laboratory conditions, the species of egg parasitoids appeared in various periods. In general, *B. servadeii* appeared when the host eggs were deposited for the next generation (Halperin, 1990b). So far as known, no other host eggs are accepted by the egg parasitoid those from the pine processionary moth (Halperin, 1990a). Thus, in most cases very few individuals of *B. servadeii* emerged at spring time, when no possibility exists to parasitize host eggs. At Marrakech/Morocco, Schmidt *et al.* (1997b) found a percentage of 50% emerging in spring, which may be able to parasitize the eggs of *T. bonjeani* having an egg diapause in winter (Demolin, 1988). Therefore, in this study it was surprising that all parasitoids of *B. servadeii* emerged in December-January, when no possibility exists to find eggs for parasitization. In Albania, an alternative host is unknown. It seems that the Albanian population of the eulophid is not genetically adapted to the oviposition period of the host. This means that the larval development of the egg parasitization is strongly influenced by the natural conditions to reach the next host generation after winter without diapause, as it was established for *Gomphocerus rufus* (L.) (Caelifera, Acrididae) from Norway (Schmidt 1987). In the southern part of the country this grasshopper has a facultative egg diapause and some nymphs hatched in autumn, when the temperature increased under laboratory conditions. In nature, the temperature must be low enough in winter that no hatching takes place. Compared with the Albanian population of *B. servadeii*, the latter needs mountainous conditions with long low periods of temperature to stay in the host eggs, until the next oviposition of the host takes place.

The hyper-parasitoid *B. transversalis* emerged very early in Autumn to find again host eggs with primary parasitoids for hyper-parasitism (Bellin 1995).

O. pityocampae was found in very few numbers emerging throughout the year following host oviposition. The main part of the encyrtid emerged in September or earlier, before sampling of the egg batches. This was the case at most of the sites studied (Tsankov *et al.*, 1996a,b, 1998; Schmidt *et al.*, 1997a,b; Mirchev *et al.*, 1998b).

For comparison , the periods were shown in Table 6, in which the main egg parasitoids appeared from egg batches under laboratory conditions.

Table 6 - The phenology of primary egg parasitoids in various regions studied under laboratory conditions (20-22°C).

Region, Site	*B. servadeii*	O. *pityocampae*	References
Greece: Kassandra	September-October	February-May, September	Bellin *et al.* (1990)
Greece: Hydra Island	September	May	Schmidt *et al.* (1997a)
Bulgaria: Marikostino		May-August	Tsankov *et al.* (1996a)
Bulgaria: Ploski	April, June-July	May-June	Tsankov *et al.* (1996a)
Bulgaria: Banya		April-May	Tsankov *et al.* (1996b)
Isreal	September-November	April-June, September-November	Halperin (1990b)
Morocco: Marrakech	May, August-September	April-July	Schmidt *et al.* (1997b)

Generally, the egg parasitoids appear earlier of the year in mountainous regions than at sea-level, well adapted to the differences of host oviposition. Due to the earlier beginning of the frost period in the former, deposition of host eggs takes place earlier at higher regions than near the sea (Demolin, 1969; Masutti & Battisti, 1990; Schmidt *et al.*, 1990). *O. pityocampae* shows two main emerging periods. The adults of the same generation appeared partly in September to December to parasitize eggs of the same host-generation, and partly in April-May to July, after a winter diapause, to reach the next host generation. *B. servadeii* emerged normally, after a prolonged winter diapause, in April-May and August-September to November, depending on the climated conditions, to parasitize the host eggs of the next generation; only few individuals of the eulophid emerged before the winter season. This contrasts the situation in mountainous regions, where about one third and more individuals can emerge in autumn, before sampling of the batches to parasitize further eggs of the same host generation (Tsankov *et al.*, 1995; Schmidt *et al.*, 1997b; Mirchev *et al.*, 1998b)

Mortality of egg parasitoids

As in other countries, the percentage of *O. pityocampae* which died in host eggs was very high in Albania. This may due to the high temperatures in Balkanian countries, in that the encyrtid has to survive. *O. pityocampae* is more sensitive to temperatures above 32°C than *B. servadeii* (Halperin 1990b). Insolation can increase the temperature effect. Under the scale cover the temperature can raise up to 8°C above air temperature (Milani, 1990). For the egg batches obtained from Korca, it is unknown

Table 7 - Mortality numbers of O. pityocampae *found in* T. pityocampa *eggs.*

Site	Date of collection	Total number of *O. pityocampae* counted	*O. pityocampae* died in eggs as			Total *O. pityocampae* died in eggs		References
			adults	pupae	larvae	n	%	
Voskopoje	10.09.97	54	1	0	29	30	55.6	present paper
Qarr	28.08.97	155	5	12	97	114	73.5	present paper
Janino	23.08.95	88	4	12	11	27	30.7	Mirchev *et al.* (1998b)
Banja	12.08.92	1039	194	60	185	439	42.3	Tsankov *et al.* (1996b)
Banja	07.09.93	585	76	36	54	166	28.4	Tsankov *et al.* (1996b)
Marikostino	22.10.91	2638	275	108	119	502	19.0	Tsankov *et al.* (1998)
Marikostino	08.08.92	700	25	45	53	123	17.6	Tsankov *et al.* (1998)
Marikostino	10.09.92	2525	110	502	501	1113	44.1	Tsankov *et al.* (1998)
Kurtovo	25.09.91	1434	237	327	57	621	43.3	Tsankov *et al.* (1996a)
Lahav/Isreal	Sept:-Nov: 1989	1622	276	279	523	1078	66.5	Kitt & Schmidt (1993)
Marrakech/ Morocco	29.11.95	21	5	11	5	167	11.2	SCHMIDT *et al.* (1997b)

wheather climatic factors are the reason for the high mortality of the developing stages. In Bulgaria and other regions, the egg batches were directly transported to the laboratory without storage everywhere. If a temperature effect is responsible for the high mortality, then the natural conditions, in which the host is living, are not suitable for *O. pityocampae*; the encyrtid has to survive near the border of its possibilities. For comparison, Table 7 presents the places, in which high mortalities, especially for *O. pityocampae,* were recorded.

In Bulgaria, a high percentage of parasitoid mortality was found in various regions. On the other hand, different mortalities of the encyrtid were found at Marikostino in the same biotope. It remains an open question why the mortality of the parasitoid varies in so high percent numbers, independent of the abundance of the species.

Different from *B. servadeii*, the conditions may be also limited for surviving of *Trichogramma* sp. in the Albanian region, as found in Bulgaria near Banya (Tsankov *et al.*, 1996b).

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