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BIOLOGY OF *BYCTISCUS POPULI* (L.) (COLEOPTERA, ATTELABIDAE). PART II. LEAFROLLS, LARVAE AND THIS YEAR'S IMAGOES.

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Abstract

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In 2007 to 2009, the biology of *Bycticus populi* (L.) was studied on *Populus tremula* in Forest District Bílovice nad Svitavou (former district of Brno-venkov). Females of *B. populi* often stick ends of shoots in addition to petioles in May and in the first half of June. At 38% damaged shoots, they make rolls of more (at the most 4) leaves. From mid-June to the end of July, they bite only into petioles and make rolls of one leaf. The leafrolls are on average 30 mm long and 3 mm wide. With the increase of the number of rolled up leaves their mean size decreases. With the size of leafrolls the number of eggs increases. The development of eggs and larvae in leafrolls takes 26 to 38 days (in the laboratory 17 to 23 days). Larvae of the 1st instar damage on average 0.06 cm^2, larvae of the 2nd instar 0.4 cm^2 and larvae of the 3rd instar 2.1 cm^2. Under favourable conditions, young beetles appear on trees from 15 August to 10 October. Under cold weather (2009), only part of the beetles leaves pupal chambers, namely from 10 September to 8 October. Before the beginning of a winter diapause, beetles damaged about 11 cm^2 leaves of *P. tremula*.[1]

Bycticus populi, Attelabidae, leafrolls, development of larvae, this year's imagoes, damage

The family of Attelabidae is biologically an interesting group of beetles. Their females are characterized by the unusual care of offspring. They make characteristic damage to certain plant organs and lay eggs into wilting tissues or leafrolls. Species developing in young shoots or leafrolls can be occasionally harmful. In the CR, *Bycticus populi* (L.) ranks among the most abundant species rolling up leaves. The species develops mainly on *Populus tremula* L. It resembles a more known polyphagous species *B. betulae* (L.), which is considered to be a pest of vine. Both species do not cut the leaf blade before rolling up the leaves. They achieve wilting and dying the leaves in such a way that they damage petioles or end parts of young non-lignified shoots.

Bycticus populi is a Palaearctic species, which is abundant or even very abundant in Central Europe. It shows mainly diurnal activities being remarkable both by its appearance and specific life manifestations. Numerous publications mention the species. Partial findings on its occurrence and bionomics are given eg by Lengerken (1959), Mellings (2002) and Mellings & Compton (2002). However, the biology of *B. populi* has not been studied in detail yet. The aim of the presented paper is to remove at least this deficiency. Part I (Urban, 2012) deals with the occurrence of last year's imagoes, their feeding and reproduction. Part II describes leafrolls and the development of the new generation of beetles from eggs up to new (this year's) imagoes in more detail.

1 The paper was prepared at the Faculty of Forestry and Wood Technology, Mendel University in Brno within the MSM 6215648902 research project.

MATERIAL AND METHODS

In 2007 to 2009, *Bycticus populi* occurred abundantly in stand 372 E_{12}, Forest District Bílovice nad Svitavou (Training Forest Enterprise Masaryk Forest in Křtiny). It concerns a spruce young-growth stand with the abundant admixture of 3 to 5-year broadleaves (mainly aspen, birch and hazel). Broadleaves were yearly for the most part cut at the end of summer and in the next year, they created numerous shoots. Annual shoots of *P. tremula* were heavily damaged by *B. populi*.

Field studies were carried out in one-week or fourteen-day intervals, namely between 10 a.m. and 15 p.m. From one part of the stand, all newly developed leafrolls were sampled, from the second part of the stand, beetles and where necessary also leafrolls were regularly caught. Leafrolls were also obtained from imagoes reared in the laboratory on *P. tremula*.

On the ground of comparison samples produced from nature and from the laboratory were analysed separately. Among others, the number and dimensions of leafrolls, the number and size of rolled up leaves, the number and health conditions of eggs or larvae were recorded. The course of embryonal and postembryonal development was examined as well as the size of a leaf area damaged by particular instars of larvae. Instars were determined according to the microscopically measured width of a cranium. At young (ie this year's) imagoes, the period of maturation feeding, the size of damaged leaf area and copulation activities were recorded. More detailed data on the examined locality and the course of field and laboratory operations are given in Part I.

RESULTS AND DISCUSSION

Imagoes of *B. populi* leave in the spring wintering grounds and colonize host trees. In Bílovice nad Svitavou, these last year's (mother) imagoes occurred from the 3rd decades of April to the end of July. Females (Fig. 1) live on average 2 months and males 1.5 months. Females damage as many as 19.2 (males up to 15) cm^2 leaves. They create 20 to 30 leafrolls (Fig. 2) and lay 30 to 41 eggs. During 2 to 8 days after the termination of reproduction, imagoes die. In ovaries of died females, 0 to 5 (on average 2.3) non-laid eggs remain.

Leafrolls

Females of *B. populi* roll up growing up and newly fully-grown leaves. They roll the leaf blade from a lateral edge, viz. by an adaxial face outwards, less frequently inward and sporadically both

1: *A female of Bycticus populi. Photo by Z. Chalupa. See: http://www.biolib.cz/image/id7755/.*

2: *A two-leaf roll of B. populi (left), a one-leaf roll (right)*

outwards and inward. The leafrolls are lengthwise, ie in parallel with the main leaf vein. In the basal part (ie at a petiole) and in the apical part, they are opened. Towards the apical end, the leafrolls are often tapered and the blade tip protrudes from an aperture. Their form is usually cylindrical (cigarette-shaped). The leafrolls appear as they would be turned out. Particular layers fit tightly each other and so the leafrolls are rather tough (compact). The leafrolls are loose and irregular only rarely. Their size and form differs from leafrolls of *B. betulae*, which are freely rolled up (soft) and often very opened at their base. Generally, they are created by more leaves including exceptionally also inflorescence. Leafrolls of *B. betulae* are always much wider and often also longer.

According to Shevyrev (1914), leafrolls of *B. populi* are tubular, wide as the straw stalk and long as a petiole. According to the characteristic shape of leafrolls and a host tree the species is termed in Russian "osinovyj (topolevyj) trubkovert". According to Lengerken (1959), the leafrolls are 21 to 37 mm long and 1.5 to 3 mm wide, firm, cylindrical and outward smooth. Mellings (2002) mentions that the leafrolls are cigarette-shaped. They can be easily differentiated from freely rolled up (soft) leafrolls of *Anacampsis* (= *Tachyptilia*) *populella* (Cl.) (Gelechiidae), which are on average 37 mm long and 5.5 mm wide (Fig. 3).

According to our findings, the leafrolls are 15 to 51 (on average 30) mm long and 1.5 to 5.1 (on average 3.0) mm wide. The mean size of leafrolls depends on the number and size of rolled up leaves. In May and in the first half of June (ie in the 1st half of the period of leafroll creation), females also often stick 5 to 10 cm long ends of young non-lignified shoots. Shoots are bent in the place of damage and leaves hang towards the ground. Females then usually roll up the largest leaf, which is placed at the base of the shoot pierced section. On this leaf, one to three smaller neighbouring leaves, which are younger and thus more elastic, are then often rolled. In the initial period of the formation and growth of shoots, females often roll up more leaves (however, at the most four leaves). Outer leaves can be winded on the inside longitudinally rolled up leaf in parallel as well as crossways to the longitudinal axis of the leafroll. Multi-leaf rolls show often a slightly fusiform or irregular form and above-average width. From mid-June to the end of July, females produce always only

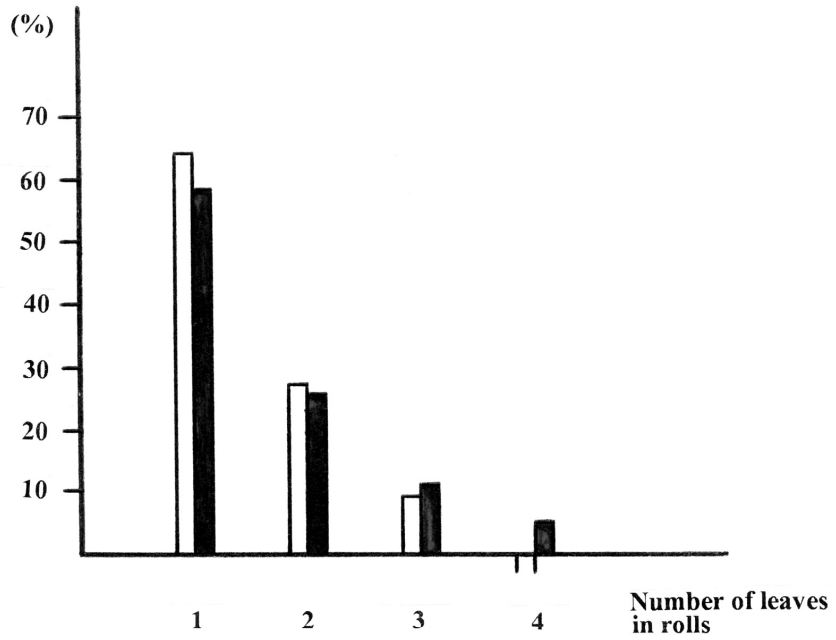
3: *Leafrolls of Anacampsis populella*

I: *Mean dimensions of leafrolls and rolled up leaves (mm) and the mean number of eggs (larvae) in leafrolls (8 May 2007)*

Number of leaves in rolls	Number/% of analysed leafrolls	Mean length/width			Mean number of eggs (larvae)
		of leafrolls (according to the order of rolling)	of leaves (according to the order of rolling)	leaves in total	
1	72/64.3	30.9/2.6	30.9/24.6	30.9/24.6	1.0
2	30/26.8	26.3/2.5	26.3/19.1	25.5/18.4	1.2
		30.5/3.5	24.6/17.7		
3	10/8.9	24.4/2.1	24.4/17.6	21.2/16.1	1.3
		25.5/3.1	20.0/15.6		
		26.6/3.7	19.2/15.0		
Total	112/100.0	30.4/2.9	27.1/20.7	27.1/20.7	1.1

II: *Mean dimensions of leafrolls and rolled up leaves (mm) and the mean number of eggs (larvae) in leafrolls (14 May 2007)*

Number of leaves in rolls	Number/% of analysed leafrolls	Mean length/width			Mean number of eggs (larvae
		of leafrolls (according to the order of rolling)	of leaves (according to the order of rolling)	leaves in total	
1	81/58.7	28.7/2.5	28.7/22.8	28.7/22.8	1.1
2	36/26.1	25.8/2.3	25.8/20.2	24.4/19.1	1.2
		28.4/3.5	23.0/17.9		
3	15/10.9	24.1/2.1	24.1/18.7	20.7/15.7	1.6
		27.4/2.9	19.1/14.1		
		30.9/4.1	19.0/14.4		
4	6/4.3	20.3/2.0	20.3/18.0	20.5/15.6	2.2
		24.3/3.3	22.7/16.3		
		28.6/4.2	19.0/14.0		
		32.7/5.0	20.0/14.3		
Total	138/100.0	29.0/3.0	24.8/19.4	24.8/19.4	1.2



4: *The percentage of rolls according to the number of rolled up leaves. 8 May 2007 (light columns), 14 May 2007 (dark columns).*

one-leaf rolls. Within this period, females do not damage shoots and induce leaf wilting only by sticking (piercing) petioles. This change described in the behaviour of females is caused particularly by the gradual lignifications of shoots.

At the beginning of the growing season, leafrolls are most often (on average in 61.5%) one-leaf (Tabs. I and II, Fig. 4). At the majority of one-leaf rolls, petioles are bitten (shoots only rarely). On average, 26.5% leafrolls are created by two leaves, 9.9% by three leaves and 2.1% by four leaves. It is characteristic that at multi-leaf rolls, usually shoots and sometimes also petioles (particularly of inner leaves) are damaged. The mean length of one-leaf and multi-leaf rolls is in principle the same. With the increasing number of leaves, however, the mean size of the leafroll width significantly enlarges. In one-leaf rolls, the mean size of a leaf blade is largest, in four-leaf ones smallest. In more-leaf rolls, inner leaves (ie leaves rolled up first) are usually largest. The mean size of leaves rolled up later gradually decreases and, as a rule, peripheral leaves are smallest (Tabs. I and II). This finding is related to the dynamics of the growth of shoots and suitability of leaves for the creation of leafrolls and development of larvae.

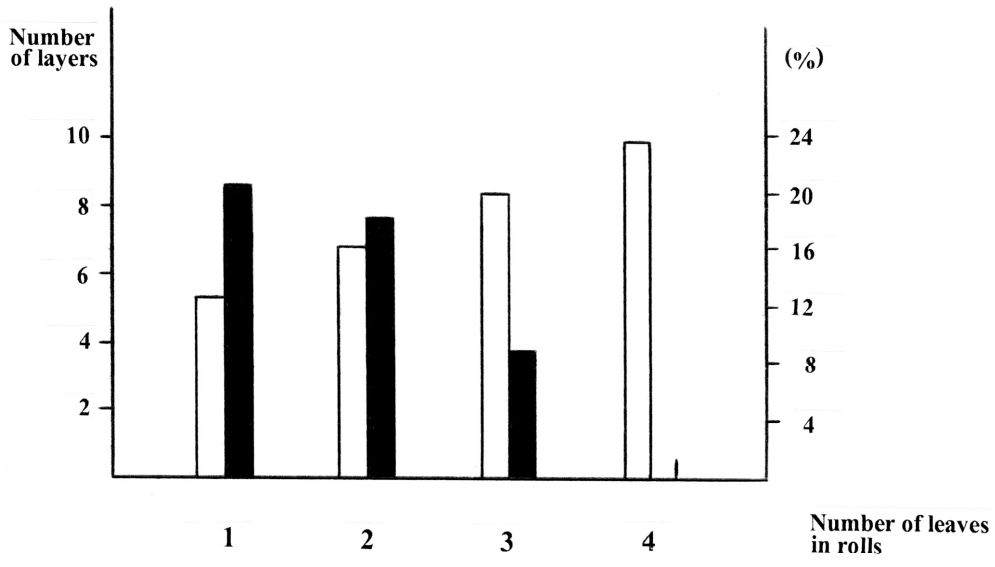
According to Escherich (1923), Francke-Grosmann (1974), Mellings & Compton (2002) etc. females usually roll only one leaf and rarely two leaves. For example, Ter-Minasjan (1950), Schimitschek (1955), Vasiljev *et al.* (1974), Freude, Harde & Lohse (1981), Tillesse *et al.* (1997) and Legalov (2007) mention one-leaf rolls. According to our findings, leafrolls made in the 1st half of the period of reproduction (ie in May and the 1st half of June) are 1 to 4-leaf (on average 1.6-leaf). Leafrolls produced in the 2nd half of the period of reproduction (ie in the 2nd half of June and in July) are always one-leaf.

On a cross-section, leafrolls are closely spiral, 4 to 11 layers. The mean number of layers increases with number of rolled up leaves (Fig. 5). At one-leaf rolls, there are 4 to 7 (on average 5.3) layers, at two-leaf rolls 8 to 11 (on average 6.8) layers, at three-layer rolls 6 to 10 (on average 8.3) layers and at four-layer rolls 8 to 11 (on average 9.8) layers.

The number of eggs in leafrolls

Eggs of *B. populi* are regularly oval, slightly yellowish, lustrous and slightly sticky. Their length is 0.71 to 0.93 (on average 0.84) mm and width 0.57 to 0.68 (on average 0.63) mm. In ovaries of females, eggs are created during the whole period of reproduction. The eggs are always laid between leaf layers near the centre of a future leafroll. In 2007, females laid only one egg into 76.4% rolls, two eggs into 16.8% rolls and three eggs into 2.0% rolls. In 4.8% leafrolls, no egg was found. The mean number of eggs increased with the increasing number of leaves in rolls (Tab. III, Fig. 6). According to analyses carried out in 2007 to 2009, females laid 0 to 4 (on average 1.3) eggs into one roll, in the laboratory 0 to 8 (on average 2.2) eggs (see Part I.). Eggs are laid into the central part of leafrolls (at least 5 mm from both ends), namely individually (at least 4 mm apart). The mean number of eggs in leafrolls significantly increases with the length and width of rolls (Tabs. IV and V, Fig. 7). Also Evans (2001) noticed the higher number of eggs in longer rolls.

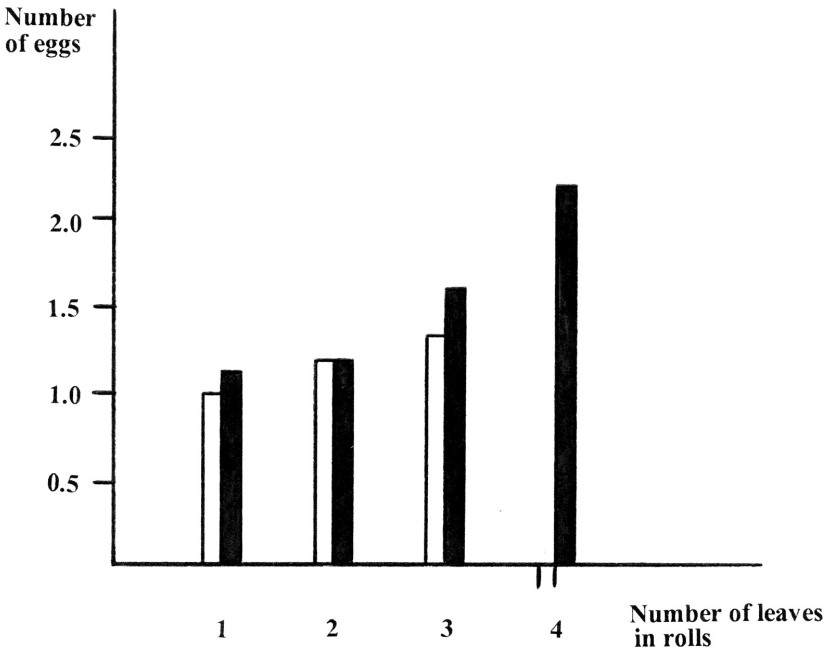
According to Dosse (1954), Lengerken (1959) and Francke-Grosmann (1974), there is only one egg in leafrolls. Freude, Harde & Lohse (1981) mention at the most three eggs and Shevyrev (1914) and Mellings & Compton (2002) four eggs. As many as three females participate sometimes in the creation



5: *The mean number of the leaf layers in rolls rolled up of one to four leaves (light columns). Mortality of eggs in leafrolls (%) (dark columns). 14 May 2007.*

III: *The number of eggs and larvae in rolls made of one up to four leaves (2007)*

Number of eggs and larvae in leafrolls	Number/% of rolls rolled up of				
	one leaf	two leaves	three leaves	four leaves	leaves (mean)
0	12/7.8	-	-	-	12/4.8
1	123/80.4	54/81.8	13/52.0	1/16.7	191/76.4
2	16/10.5	11/16.7	12/48.0	3/50.0	42/16.8
3	2/1.3	1/1.5	-	2/33.3	5/2.0
Total	153/100.0	66/100.0	25/100.0	6/100.0	250/100.0
%	61.2	26.4	10.0	2.4	100.0
Mean number	1.1	1.2	1.5	2.2	1.2



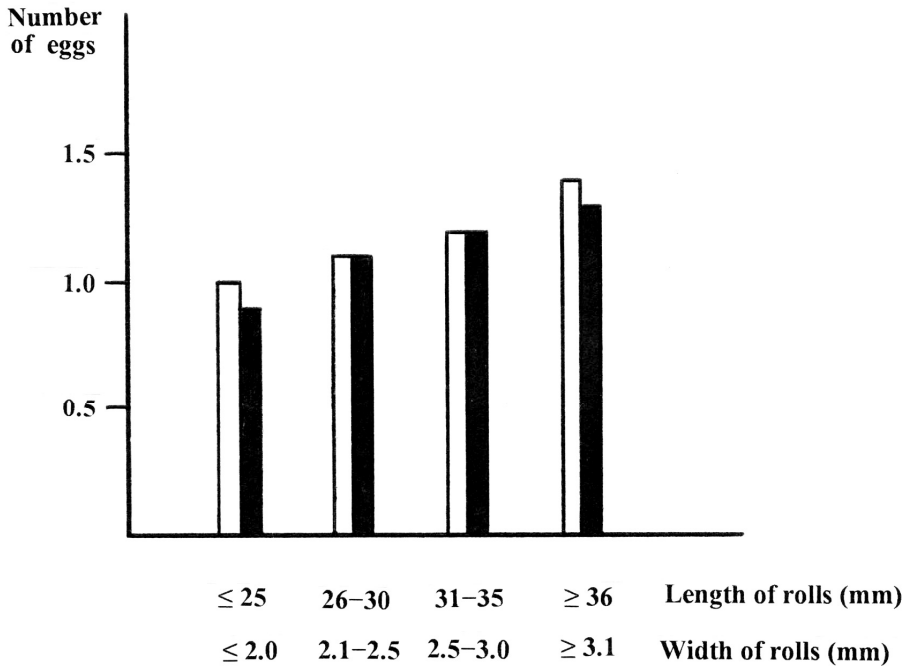
6: *The mean number of eggs in rolls according to the number of leaves in rolls. 8 May 2007 (light columns), 14 May 2007 (dark columns).*

IV: *The number of eggs and larvae in leafrolls of various lengths (2007)*

Leafroll length (mm)	Number/% of leafrolls	Number/% of eggs (larvae)	Mean number of eggs (larvae) in leafrolls
≤ 25	73/29.2	77/26.4	1.0
26–30	89/35.6	102/35.1	1.1
31–35	50/20.0	58/19.9	1.2
≥ 36	38/15.2	54/18.6	1.4
Total	250/100.0	291/100.0	1.2

V: *The number of eggs and larvae in leafrolls of various widths (2007)*

Leafroll width (mm)	Number/% of leafrolls	Number/% of eggs (larvae)	Mean number of eggs (larvae) in leafrolls
≥ 2.0	41/16.4	38/13.1	0.9
2.1–2.5	59/23.6	63/21.6	1.1
2.6–3.0	80/32.0	96/33.0	1.2
≥ 3.1	70/28.0	94/32.3	1.3
Total	250/100.0	291/100.0	1.2



7: *The mean number of eggs in leafrolls of various lengths (light columns) and width (dark columns) (2007)*

8: *An egg parasitized by Poropoea sp. (Trichogrammatidae). Larvae of the 1st to 3rd instars of B. populi.*

of leafrolls. Therefore, it is possible that eggs in some leafrolls come from more females. On the other hand, females of *B. betulae* lay 5 to 8 eggs (Schaufuss, 1916; Vasiljev *et al.*, 1974) into one leafroll and at the cooperation of females even 14 eggs (Francke-Grosmann, 1974; Mellings & Compton, 2002).

Preimaginal development

Bycticus populi develops in leafrolls, which persist on trees for a certain time or immediately after creation fall to the ground. In consequence of the interruption of vascular bundles, the leafrolls dry up, become brown and grow black. A secret, which serves for sticking the leaf dents at the blade edge to leafrolls, loses gradually its reinforcing function. Dry leafrolls preserve their form even on the soil surface where they usually moisten and become rot.

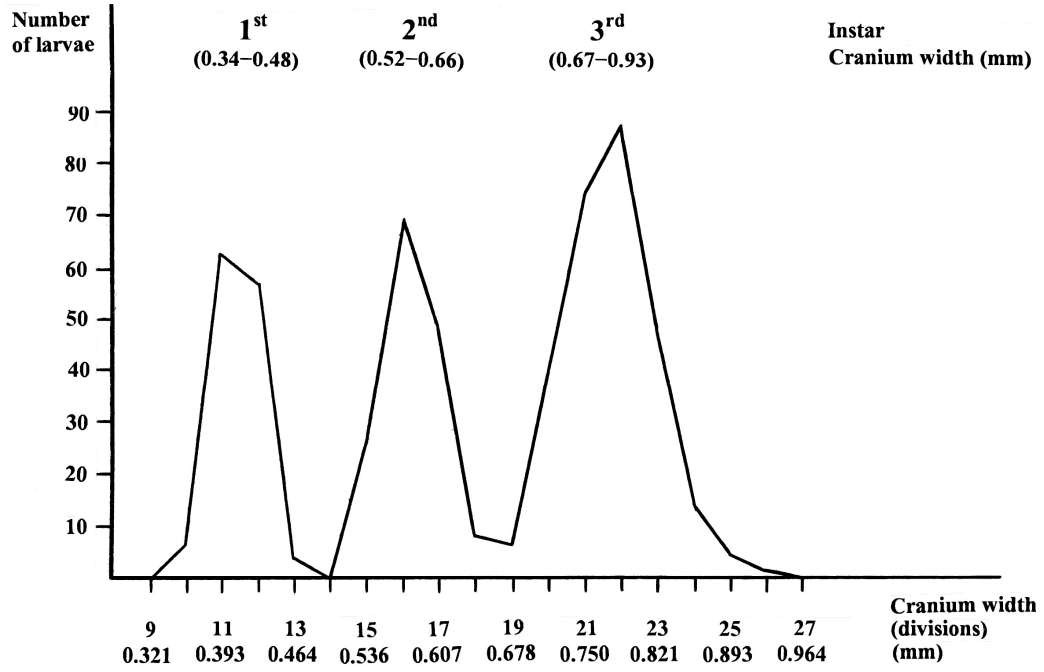
The embryonic development takes 6 to 10 days, under laboratory conditions 4 to 5 days. Part of eggs dies under unfavourable weather conditions (particularly during an excessively warm and dry period). In the course of the 1st half of May 2007, on average 16.7% eggs died. The highest mortality (about 20.5%) was in one-leaf rolls, 0% mortality was in four-leaf rolls (Fig. 5).

Larvae feed on inner parts of rotting leafrolls. Inside the rolls, they moult twice (thus, they have three instars) (Fig. 8). Larvae of the 1st instar develop for 6 to 8 days (in the laboratory 4 to 5 days) and

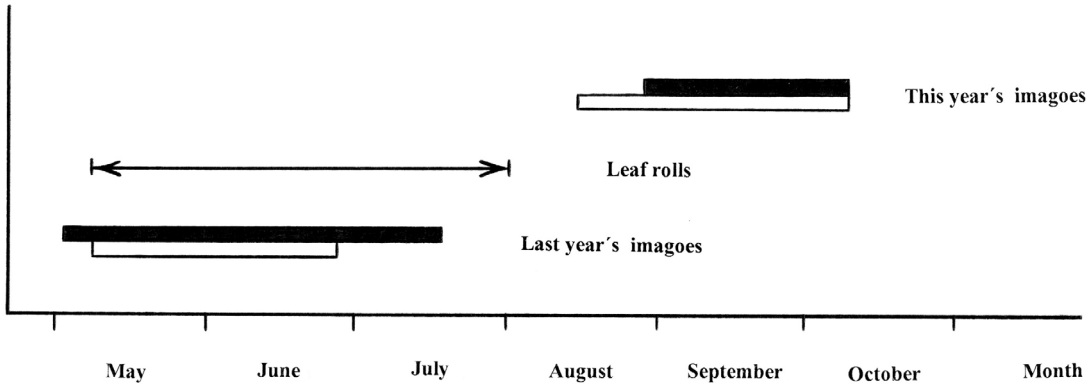
damage on average 0.06 cm² leaves. Larvae of the 2nd instar develop 6 to 8 days (in the laboratory 4 to 5 days) damaging on average 0.4 cm² leaves. Larvae of the 3rd instar feed 8 to 12 days (in the laboratory 5 to 8 days) and on average damage 2.1 cm². The development of eggs and larvae in rolls takes 26 to 38 days (in the laboratory 17 to 23 days). Under cold weather, the development can draw out to 1.5 months. Larvae of all three instars damage on average 2.56 cm² leaves. In this damage, larvae of the 1st, 2nd and 3rd instars damage 2.4%, 15.6% and 82.0% leaves, respectively.

Larvae of particular instars can be determined according to their cranium width (Fig. 9). In natural (ie slightly bent) shape, larvae of the 1st instar are 1.3 to 2.5 mm long, larvae of the 2nd instar 1.8 to 3,5 mm and larvae of the 3rd instar 2.5 to 7.0 mm. Grown up larvae are 4 to 7 mm long (4 to 6 mm according to Mellings, 2002).

Larvae of the 1st instar eat away very small openings into the first two inner layers of rolls. Tissues in the inner part of a roll are also irregularly eaten away by larvae of the 2nd and 3rd instars. Larvae never damage peripheral layers of leafrolls. During feeding, they are orientated in parallel with the lengthwise axis of rolls. The inner eaten out part shows lengthwise form 10 to 25 × 1.5 to 3 mm in size. The total consumption of food is surprisingly low. Gallery systems are filled up by the large amount of black and lustrous funicular frass pellets. Frass pellets of all three instars are roughly of the same length (0.17 to 0.7 mm). Frass pellets of the 1st instar are 0.036 mm wide, of the 2nd instar 0.07 mm and of the 3rd instar 0.11 mm. Larvae (similarly as eggs)



9: *The width of the cranium of larvae of the 1st to the 3rd instar of B. populi. Some 553 larvae were measured.*



10: *A period of the occurrence of imagoes and leafrolls of B. populi (2008)*

suffer from unfavourable weather (particularly long heat and drought).

Grown up larvae leave the leafrolls and hide in soil to pupate. According to Arnoldi *et al.* (1974), they create pupal changers at a depth of 3 to 6 cm, according to Mellings & Compton (2002) at a depth of 0.5 to 6 cm. In soil, the larvae change to prepupae, which survive on average one month. In July and in the first half of August, the larvae pupate. The stage of a pupa takes one to two weeks.

Young (this year's) imagoes

Under favourable conditions, newly hatched beetles leave pupal chambers after several days and appear on host trees. At the studied locality, they were found from 15/8 to 10/10 (Fig. 10). In the climatically unfavourable year 2009, only small part of imagoes left their pupal chambers, viz. from 10/9 to 8/10. Larger part of imagoes in pupal chambers diapaused until the spring of the next year.

Arnoldi *et al.* (1974) mention that only part of imagoes leaves pupal chambers in the autumn. According to Vasiljev *et al.* (1974), beetles appear on the soil surface in the 2nd half of August and in September. Tillesse *et al.* (1997) mention the August occurrence of young imagoes on trees. At rearing carried out by Mellings (2002), imagoes occurred in August. At the end of October, they entered the diapause.

A period of the occurrence of this year's imagoes on trees is of various length (at the most, however, two-month). The actual period of feeding takes only 2 to 4 weeks. Under laboratory conditions, the feeding took 2 to 3 weeks and individuals of both sexes damaged about 11 cm^2 leaves *P. tremula* (Tabs. VI and VII). At the end of the growing season, beetles consumed older leaves of aspen 10.5 times less than fine suckers of *P. nigra* var. *italica*. The beetles were most active between 1 p.m. and 5 p.m. when they also often copulated. Every day, they copulated 0 to 3 times (on average 1.7 times) for the period of 3 to 15 (on average 9) minutes. Males tried to copulate unsuccessfully on average 10 times a day on average for the period of 40 seconds. In the course of night, imagoes were little active and mostly hid under leaves.

Importance

Bycticus populi is rather an interesting than dangerous species. According to Lengerken (1959), the species occurs on 70 to 100 cm tall root suckers and never on trees. It is related mainly to well insolated advance growth and young-growth stands *P. tremula* (Mellings, 2002). The priority damage to aspen is related to the low content of phenolic compounds, which show antiherbivorous effects (Gruppe, Fusseder & Schopf, 1999).

Last year's beetles band-shaped skeletonize leaves up to the lower epidermis from the end of April to mid-July. After wintering, males live on average 1.5 (females 2) months and damage even 15 (females 19.2) cm^2 leaves *P. tremula*. Trough this maturation and regeneration feeding, trees are damaged only minimally. Damage to leaf petioles can be more important, particularly of end parts of young shoots. They damage the shoots in May and in the first half of June (ie in the period of intensive growth of trees). Trough out their life, females produce 20

VI: *One-week area and total area of leaves damaged by this year's male imagoes (cm^2/%). Laboratory examination, 2008.*

Week after catching	Date of catching				
	15/8	22/8	22/8	3/10	10/10
1st	5.1/32.9	6.5/36.1	5.1/49.5	1.5/23.8	1.9/14.0
2nd	4.1/26.5	4.2/23.3	3.0/29.1	0	1.8/13.2
3rd	2.1/13.5	2.0/11.1	1.7/16.5	0	3.1/22.8
4th	0.5/3.2	1.4/7.8	0.3/2.9	2.6/41.3	1.3/9.6
5th	0.2/1.3	1.5/8.3	0.2/2.0	2.2/34.9	0
6th	0.1/0.7	1.1/6.1	(† 28.9.)	(†10.11.)	0
7th	0	0.7/3.9	-	-	0
8th	0	0.6/3.4	-	-	0.7/5.1
9th	0	(† 22.10.)	-	-	1.7/12.5
10th	0	-	-	-	1.4/10.3
11th	1.1/7.1	-	-	-	1.0/7.4
12th	2.1/13.5	-	-	-	0.7/5.1
13th	0.2/1.3	-	-	-	(† 5.1.)
14th	(† 17.11.)	-	-	-	-
Damage in total	15.5/100.0	18.0/100.0	10.3/100.0	6.3/100.0	13.6/100.0
Before diapause	12.1/78.1	18.0/100.0	10.3/100.0	1.5/23.8	8.1/59.6
After diapause	3.4/21.9	-	-	4.8/76.2	5.5/40.4
Period of life (days)	95	62	38	39	87

VII: *One-week area and total area of leaves damaged by this year's female imagoes (cm²/%). Laboratory examination, 2008.*

Week after catching	Date of catching				
	28/8	**5/9**	**19/9**	**3/10**	**3/10**
1st	3.0/27.0	3.5/27.8	0.7/13.0	0.1/0.5	2.4/54.5
2nd	5.4/48.7	0.8/6.3	1.2/22.2	1.7/8.2	0
3rd	0.2/1.8	0.3/2.4	0.4/7.4	1.4/6.7	0
4th	0.3/2.7	0.7/5.6	0	2.0/9.7	0
5th	0.7/6.3	1.9/15.1	0	2.8/13.5	0.4/9.1
6th	0.1/0.9	0.2/1.6	0	1.0/4.8	0
7th	1.1/9.9	0	0.5/9.3	1.4/6.8	0
8th	0.3/2.7	0	0.6/11.1	1.1/5.3	0
9th	0	0	0.4/7.4	2.6/12.6	0
10th	0	1.0/7.9	0.4/7.4	1.0/4.8	1.0/22.7
11th	0	2.0/15.9	0.4/7.4	1.5/7.2	0.6/13.7
12th	0	0.9/7.1	0.6/11.1	1.9/9.2	0
13th	0	1.3/10.3	0.1/1.8	2.0/9.7	0
14th	(† 1.12.)	0	0.1/1.9	0.2/1.0	(† 1.1.)
15th	-	0	0	(† 13.1.)	-
16th	-	0	(† 1.1.)	-	-
17th	-	(† 1.1.)	-	-	-
Damage in total	11.1/100.0	12.6/100.0	5.4/100.0	20.7/100.0	4.4/100.0
out of this before diapause	11.1/100.0	7.4/58.7	2.3/42.6	?	2.4/54.5
after diapause	-	5.2/41.3	3.1/57.4	?	2.0/45.5
Period of life (days)	95	118	104	102	90

to 30 leafrolls, however, they bite into much more (two times) petioles and shoots. Ends of shoot die and trees branch, exceptionally even die. Apical parts of shoots usually persist on trees for a long time. In consequence, the growth and quality of trees decreases similarly as at the attack of a fungus *Venturia tremulae* Aderh. (= *Pollaccia radiosa* /Lib./E. Bald. & Cif.). *B. populi* damages mainly in forest nurseries.

Protection and defensive measures

Collection and burning leafrolls or using a longer rotation is recommended (Tillesse *et al.*, 1997). Population density of *B. populi* is reputedly decreased trough the fertilization by N, P, K and Mg (Gruppe, Fusseder & Schopf, 1999). The collection of the remarkable beetles and mainly the mechanical processing of site/soil after the fall of leafrolls shows control effects.

SUMMARY

In 2007 to 2009, the biology of *Byctiscus populi* (L.) was studied on *Populus tremula* in Forest District Bílovice nad Svitavou (former district of Brno-venkov). Females of *B. populi* often stick ends of shoots in addition to petioles in May and in the first half of June. At 38% damaged shoots, they make rolls of more (at the most 4) leaves. From mid-June to the end of July, they bite only into petioles and make rolls of one leaf. The leafrolls are on average 30 mm long and 3 mm wide. With the increase of the number of rolled up leaves their mean size decreases. With the size of leafrolls the number of eggs increases. The development of eggs and larvae in leafrolls takes 26 to 38 days (in the laboratory 17 to 23 days). Larvae of the 1st instar damage on average 0.06 cm², larvae of the 2nd instar 0.4 cm² and larvae of the 3rd instar 2.1 cm². Under favourable conditions, young beetles appear on trees from 15 August to 10 October. Under cold weather (2009), only part of the beetles leaves pupal chambers, namely from 10 September to 8 October. Before the beginning of a winter diapause, beetles damaged about 11 cm² leaves of *P. tremula*.

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