

NEW CONTRIBUTIONS TO THE KNOWLEDGE OF THE PEST *Lymantria monacha* L. 1758 (LEPIDOPTERA, LYMANTRIIDAE) POPULATIONS BY PHEROMONAL TRAPS WITHIN THE FOREST DISTRICT MIERCUREA SIBIULUI (ROMANIA) DURING THE YEAR 2017

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Abstract. This paper is part of a larger study started in 2011 for monitoring and control the populations of *Lymantria monacha* L., 1758 using pheromone traps. The continuation of the pest population monitoring in 2017 had the purpose of drawing up a plan to improve the control and limitation methods for 2018, as well as the detection of the outbreaks of this pest in the forest perimeter of the Miercurea Sibiu Forest District in Romania.

Keywords: pheromonal traps; *Lymantria monacha* L., 1758; Forest District Miercurea Sibiului (Sibiu county, Romania).

INTRODUCTION

It is known that *Lymantria monacha* L. 1758 (Lepidoptera, Lymantriidae) is the most dangerous defoliator of resinous forests [4-8, 28]. Therefore, the presence, prognosis and warning of the numerical growth of the pest populations is a particularly important activity in the monitoring of the forestry fund of the Miercurea Sibiului Forest District (Sibiu county, Romania). The most effective method to ascertain the presence and the determination of numerical evolution of this insect species is biological control, using pheromone traps. These are provided with adhesive surfaces containing synthetic pheromones specific to this defoliator. According to recent studies, it has been found that Atralymon is the most effective one [9-14, 18-20].

This study is a continuation of a research program developed between the years 2011-2016 which had as purpose the monitoring of the pest, the dynamic of the populations, the efficiency of the males captures and the way to install the pheromone traps in the perimeter of Forest District Miercurea Sibiului, on a wood surface of 14.932, 37 ha.

The study was made in forests of spruce, fir and mixture of spruce, fir and beech tree with ages between 50-125 years through the limitation of the males of the defoliator *Lymantria monacha* L. 1758 attracted by the pheromone traps.

MATERIALS AND METHODS

The study conducted at the Forest District Miercurea Sibiului (Sibiu county, Romania) has included the production units: III Bistra, IV Cibana and V Poda, respectively. In the parcels IV Cibana and V Poda the tree composition is 100% spruce, while in the lot III Bistra the composition is 70% spruce and 30% fir and beech mixture.

For the optimization of studying the pest populations of *Lymantria monacha* L., 1758, the researches have had some targets: the efficiency of the pheromonal traps, the way they are placed in the field,

and on the trees, the dynamic of captures samples which reveals the numeric variations of the populations, and the general tendency to evolution of the populations pest levels within the three production units [1-3, 15-18].

In order to determine the best position on the same tree for the panels with glue and Atralymon, it has been placed only panels identical as size and the pheromonal attractant used, thus resulting in 2017 a number of 81 points of observation, each represented by a pheromonal trap.

They were used standardized pheromone traps, produced by The Raluca Ripan Institute of Chemistry in Cluj Napoca, made of plastic panels with Atralymon synthetic pheromone impregnated in an adhesive to capture the males of *Lymantria monacha* L., 1758.

The distribution of the traps was made using the grid method, to cover the entire monitored area (scale 1:20.000) in the way that every trap must have a capture surface of 200 ha forest. This distance allows every observation point to act independently to others, in what concerns the distance range of the pheromonal lure [26]. To cover all the perimeter of Forest District Miercurea Sibiului it was calculated the total traps number necessary for every year, depending on the attack degree from previous year. Thus, traps were located as follows: 29 in the III Bistra district, 29 in the IV Cibana district and 23 in the V Poda district. They were installed in open zones, at distances of 200-250 m to the edge of the respective forest [27]. In accordance with this distribution, the panels were numbered from 1-81, placed in the lower part of the trees, on the line of the biggest slope and continuing in clockwise direction, on all the three production units.

This placement algorithm was applied also during the years 2011-2015 [19-23] within the Forest District Miercurea Sibiului and Forest District Tilișca. The data regarding the captures made by pheromonal traps on the plots, have been useful also to determine the duration and dynamic of the flight of the males [26, 27] and also to ascertain the percentage of butterflies captured in the years 2016 and 2017.

The locations of the traps are presented in Figure 1.



Figure 1. The Forest District Miercurea Sibului map. Red points represent traps position

The traps was placed in the period 3-15 July 2017, before the beginning of the adults' flight, this moment being different from a zone to another, depending on the altitude and location of the monitored forest surface [24, 25, 29].

The traps readings have been made every two weeks, in the period between July 27 and September 12, 2017.

RESULTS

In Tables 1 to 3 there are the results related to: the altitude (that influence the number of captures), the geographical positioning (N, S, E, V) of the panels from the district perimeter, the forest composition in all three districts, the age of trees, the location of trap (lower, middle, upper, massive, and massive margins), the date of installation and the number of insects collected.

Significant captures were noted in the III Bistra production unit (Table 1), where the composition of the forest is mixed, with 70 % spruce and 30 % fir and beech and age ranges from 20 to 150 years. The 29 traps were installed between July 3 and 13, 2017. Within this production facility, the altitude ranges between 700-1600 m. Most of the insects (84) were collected from the trap No. 26, installed in a plot with fir tree mixed with 80% spruce and 20% beech, at 1200

m altitude, in the northwest part of the district, the forest age being 120 years. The total number of specimens collected in July-September in this production unit was 890, with 8 collection points in which the number of collections was between 40 and 84 specimens (Figure 2).

Average captures were found in IV Cibán District (Table 2). Within this production unit, the spruce share is 100 %, the altitude of the forest is between 1200-1600 m and the trees age 15-170 years. In this forest stand, 29 traps were installed between July 1-7, 2017. The readings were made once every two weeks, most of insects (49) being collected under the trap 31 at 1400 m altitude by the southwest of the Forest District, where the age of the forest is 70 years. The total number of captured specimens at all collection points was 480, and captures with values between 20-49 insects were made in 9 panels (Figure 3).

The lowest catches were made in the lot V Poda (Table 3). Here the forest consists of 100% spruce, situated at altitudes between 1300-1600 m. Trees age is between 35-145 years and 23 traps were installed between July 9-15, 2017. Most specimens captured in this parcel of the southern part of the district, where the age of the forest is 105 years old, accounts for 27 insects, at trap number 73, at 1500 m altitude. Total capture was 435 insects, and values between 20-27 specimens were taken from 11 traps (Figure 4).

Table 1. The situation of the pest control of *Lymantria monacha* L., 1758 by means of the Atralymon pheromonal traps by the production unit III Bistra in the year 2017

Nr. crt.	U.a.	Exposition height	Composition	Age	No. trees / ha	Place					The data of installing	Nr. samples captured
						Inferior	Middle	Superior	Massif	Massif edge		
1	16B	SV/700	7Fa3Mo	140	190	x			x		12.07.2017	11
2	20	SV/980	5Fa3Mo2Br	130	230		x		x		12.07.2017	14
3	22/23	SV/920	6Fa4Mo	70	380	x			x		12.07.2017	15
4	34	SV/980	10Mo	75	430		x		x		05.07.2017	27
5	31	SV/980	9Mo1Fa	75	480		x		x		03.07.2017	25
6	36A	SE/1300	10Mo	60	760		x		x		03.07.2017	18
7	40A	S/1300	6Mo3Br1Fa	150	350		x		x		03.07.2017	20
8	45	E/1400	10Mo	45	850		x		x		05.07.2017	19
9	46E	S/1300	10Mo	20	2900		x		x		05.07.2017	13
10	61A	N/1450	10Mo	45	1200		x		x		05.07.2017	10
11	70A	S/1500	10Mo	55	1600	x			x		04.07.2017	5
12	77B	S/1600	10Mo	40	800		x		x		12.07.2017	18
13	85A	N/1550	10Mo	40	1100		x		x		12.07.2017	20
14	107A	E/1600	10Mo	50	1850	x			x		12.07.2017	26
15	110C	NV/1600	10Mo	40	2800	x			x		12.07.2017	23
16	116B	NV/1550	10Mo	35	2300		x		x		13.07.2017	26
17	118C	NE/1500	10Mo	135	560	x			x		13.07.2017	21
18	124A	E/1500	10Mo	70	1700		x		x		13.07.2017	22
19	129A	NE/1500	10Mo	75	920		x		x		11.07.2017	41
20	134A	NE/1500	10Mo	70	810	x			x		11.07.2017	74
21	145	NV/1500	10Mo	55	1420		x		x		11.07.2017	65
22	154A	N/1400	10Mo	70	860		x		x		11.07.2017	40
23	160A	NV/1300	10Mo	95	900	x			x		11.07.2017	75
24	162B	NV/1300	10Mo	95	840		x		x		11.07.2017	58
25	164B	NV/1200	10Mo	100	950		x		x		11.07.2017	61
26	168B	NV/1200	8Mo2Fa	120	650		x		x		11.07.2017	84
27	170	NE/1300	10Mo	130	350			x	x		11.07.2017	20
28	180	N/1051	6Fa2Mo2Br	100	350	x					11.07.2017	18
29	184B	NE/1050	8Fa2Mo	150	280	x			x		11.07.2017	21
TOTAL											890	

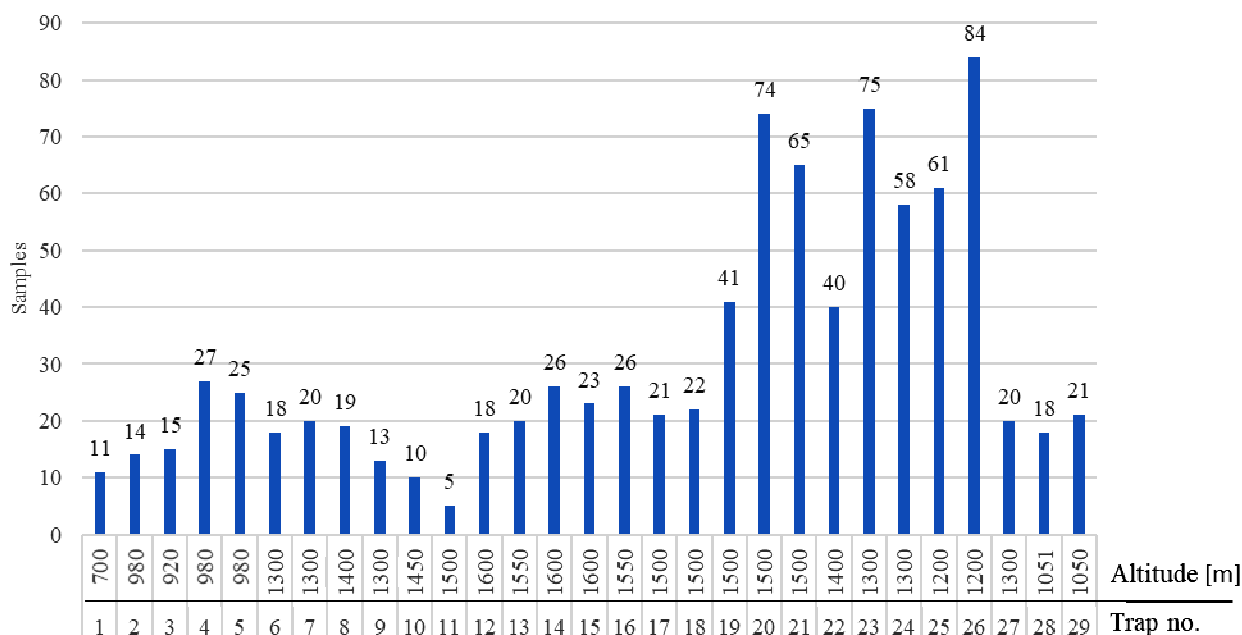


Figure 2. The dynamics of *Lymantria monacha* L., 1758 captures relative to altitude, III Bistra district

Table 2. The situation of the pest control of *Lymantria monacha* L., 1758 by means of the Atralymon pheromonal traps by the production unit IV Cibán in the year 2017

Nr. crt.	U.a.	Exposition height	Composition	Age	No. trees / ha	Place					The data of installing	Nr. samples captured
						Inferior	Middle	Superior	Massif	Massif edge		
30	15/16	S/1300	10Mo	120	450	x			x		06.07.2017	22
31	17B	SV/1400	10Mo	70	1450	x				x	06.07.2017	49
32	26/27	S/1400	8Mo2Fa	170	980		x		x		06.07.2017	34
33	34B	S/1400	10Mo	75	980		x		x		06.07.2017	18
34	30B	SE/1300	10Mo	75	1100	x			x		06.07.2017	21
35	29B	S/1400	10Mo	75	870			x	x		06.07.2017	26
36	12	S/1200	10Mo	100	634	x			x		06.07.2017	28
37	72	SV/1300	10Mo	100	1470			x	x		07.07.2017	14
38	63	S/1200	10Mo	120	420	x				x	07.07.2017	12
39	48	S/1500	10Mo	120	1250	x				x	07.07.2017	13
40	40A	E/1250	10Mo	80	1150	x				x	07.07.2017	17
41	68	S/1300	10Mo	70	1320	x			x		07.07.2017	23
42	54A	SV/1300	10Mo	100	875			x	x		07.07.2017	13
43	97A	SE/1300	10Mo	15	2400	x			x		01.07.2017	9
44	119A	NV/1400	10Mo	25	2680		x		x		01.07.2017	11
45	85A	NV/1500	10Mo	35	1780		x		x		01.07.2017	11
46	93B	SV/1300	10Mo	80	750		x		x		01.07.2017	7
47	103	SV/1250	10Mo	70	650		x		x		01.07.2017	5
48	127B	V/1500	10Mo	120	475	x			x		01.07.2017	7
49	131B	N/1500	10Mo	100	550		x		x		01.07.2017	6
50	135A	SV/1500	10Mo	35	2600	x			x		07.07.2017	6
51	154A	E/1400	10Mo	30	2400	x			x		07.07.2017	6
52	157C	N/1200	10Mo	45	1823	x			x		07.07.2017	8
53	175A	N/1130	10Mo	55	975		x			x	07.07.2017	33
54	195A	NV/1250	10Mo	100	791		x		x		07.07.2017	25
55	182A	NV/1450	10Mo	115	451		x			x	07.07.2017	13
56	179B	NV/1600	10Mo	110	560			x	x		07.07.2017	19
57	199	NV/1350	10Mo	50	979			x		x	07.07.2017	9
58	158C	V/1300	10Mo	95	560		x		x		07.07.2017	15
TOTAL											480	

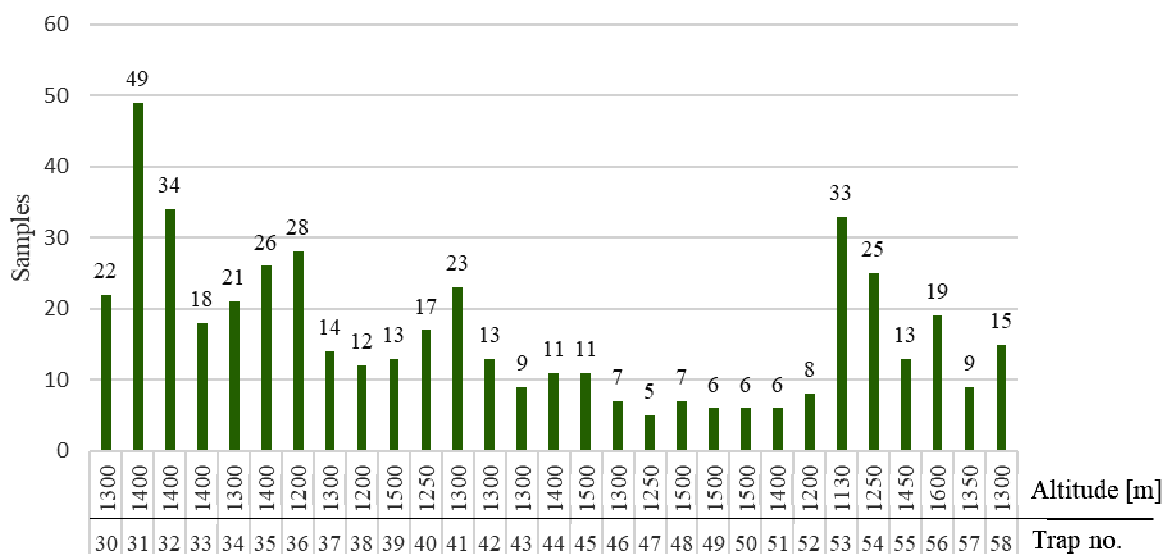


Figure 3. The dynamics of *Lymantria monacha* L. 1758 captures relative to altitude, IV Cibán district

Table 3. The situation of the pest control of *Lymantria monacha* L., 1758 by means of the pheromonal traps atralymon by the production unit V Póde in the year 2017

Nr. crt.	U.a.	Exposition height	Composition	Age	No. trees / ha	Place					The data of installing	Nr. samples captured
						Inferior	Middle	Superior	Massif	Massif edge		
59	6/7	V/1350	10Mo	80	420		x		x		10.07.2017	12
60	14A	SE/1350	10Mo	120	275		x		x		10.07.2017	15
61	20D	N/1500	10Mo	50	1200		x		x		09.07.2017	19
62	22A	NE/1300	10Mo	40	700		x			x	09.07.2017	22
63	25D	NV/1300	10Mo	70	275		x			x	10.07.2017	20
64	183A	N/1300	10Mo	45	420		x		x		10.07.2017	18
65	175A	S/1550	10Mo	80	860		x		x		10.07.2017	13
66	43A	E/1450	10Mo	85	245			x		x	14.07.2017	11
67	63C	N/1550	10Mo	35	1326		x		x		14.07.2017	16
68	75C	V/1450	10Mo	40	1525			x	x		14.07.2017	13
69	95/96	N/1550	10Mo	85	380			x	x		11.07.2017	21
70	82B	S/1550	10Mo	110	245		x		x		14.07.2017	14
71	109B	N/1550	10Mo	80	320			x	x		11.07.2017	25
72	113A	N/1300	10Mo	70	480	x				x	11.07.2017	17
73	126A	S/1500	10Mo	105	450		x		x		11.07.2017	27
74	88A	SE/1500	10Mo	70	1250		x				11.07.2017	27
75	106A	SV/1550	10Mo	100	420		x				11.07.2017	24
76	134B	S/1450	10Mo	75	420		x				15.07.2017	17
77	143E	S/1600	10Mo	55	503		x				15.07.2017	23
78	174A	S/1550	10Mo	145	460		x				15.07.2017	16
79	151B	S/1500	10Mo	125	432		x			x	15.07.2017	21
80	159A	V/1600	10Mo	125	470		x			x	15.07.2017	21
81	169C	S/1600	10Mo	120	452		x		x		15.07.2017	23
TOTAL											435	

In the research period, the majority of the captures were registered in the period between 27 July-12 September, the flight starting mostly in this period. The explanation of this fact is the necessity of a period of exploration and acquaintance, until the adults locate the food source, then it takes place the attack that was continued until to the end of the flight period [29]. The attack was intensified with the increasing of the pest populations density.

Depending on the captures number achieved by pheromonal traps and the attack degree, it was taken into consideration the correlation between the insects' density and the adults and larvar stage, what constituted the prognoses to be used to determine the attack importance and the kind of the protection works required for the year 2018 (Table 4).

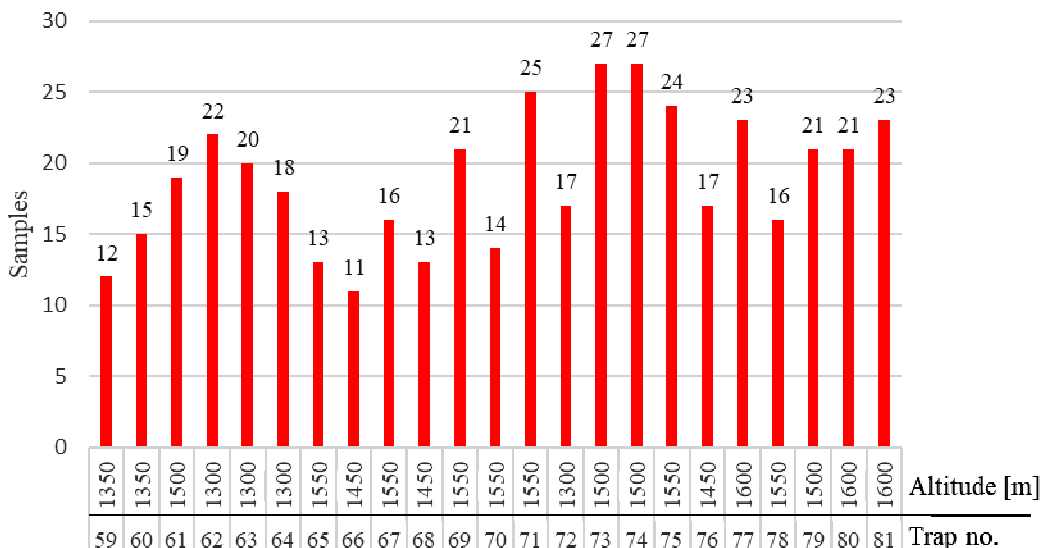


Figure 4. The dynamics of *Lymantria monacha* L., 1758 captures relative to altitude, V PODE district

Table 4. The situation of the infestation with *Lymantria monacha* L., 1758 in the resinous forests and the measures for control stipulated for the year 2018

No. crt.	Forest District Miercurea Sibiului	The surface of the resinous forests where was recorded the pest/ha year 2017	Nr. of pheromonal traps stipulated for the year 2018
1	U.P. III. BISTRA	4300	29
2	U.P. IV. CIBAN	2400	29
3	U.P.V. PODE	2000	23
TOTAL		8700	81

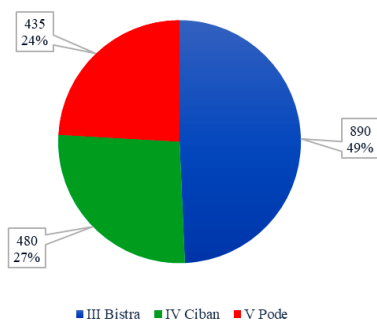


Figure 5. Samples number of captured *Lymantria monacha* L. from all three areas

DISCUSSION

The research using panel pheromonal traps during in the year 2017, within the Forest District Miercurea Sibiului has intended the monitoring of the evolution and tracing out of the attack degree of the pest *Lymantria monacha* L., 1758 in order to implement the forest protection plan for the year 2018.

The studies conducted every year since 2011 [24-27] within the Forest District Miercurea Sibiului have confirmed in 2017 the existence of this pest in all the three lots of this Forest District, capturing a total of 1805 insects. The annual record of butterfly captures in

pheromone traps has allowed to trace the evolution of *Lymantria monacha* L., 1758 populations level over the last 7 years within the Forest District of Miercurea Sibiului.

In 2017 the capture recorded different values depending on their location, altitude, tree composition and butterfly flight which was reported after 27 July and until 12 September. Following the observations we made, we found a correlation between the altitude and the number of the captured specimens. The most specimens were captured on traps located at altitudes between 1200-1600 m, even if the attacked areas are mixed with spruce, fir tree and beech. One more possible explanation would be the microclimate created by this mixture of tree species. As a result, the most affected area of the *Lymantria monacha* L., 1758 pest attack in 2017 was the III Bistra production unit, where 890 specimens were captured, representing 49% of the total collected specimens (Figure 5).

A moderate defoliator attack was found in the IV Cibani parcel, where 480 samples were captured, i.e. 27 % of total captures.

At the parcel V PODE, 435 specimens were captured, representing 24 % of the total capture recorded in 2017 within the Forest District Miercurea Sibiului.

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