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PREDATORY INSECTS IN COLLAPSING FOCI OF BARK BEETLES IN SUMY REGION

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The six predator Coleoptera species were found in the declining stage of the outbreak cycle of bark beetles (*Ips acuminatus* and *Ips sexdentatus*) in Sumy region, namely *Aulonium ruficorne* (Olivier, 1790) (Colydiidae), *Platysoma elongatum* (Leach, 1817) (Histeridae); *Rhizophagus depressus* (Fabricius, 1792) (Monotomidae); *Corticeus pini* (Panzer, 1799) (Tenebrionidae); *Thanasimus formicarius* (Linnaeus 1758), and *Thanasimus femoralis* (Zetterstedt, 1828) (Cleridae). *Platysoma elongatum* and *Aulonium ruficorne* were the most frequent in the 2nd decade of May, *Thanasimus formicarius* in the 3rd decade of May, *Corticeus pini* in the 1st decade of June, *Rhizophagus depressus*, *Platysoma elongatum*, and *Aulonium ruficorne* in the 3rd decade of June. The stem fragments with bark beetles for predators' rearing need to be collected from the trees of the 5th category of health condition. It is necessary to collect *Thanasimus formicarius* for rearing in the 3rd decade of May and in the 1st decade of August, and *Rhizophagus depressus*, *Platysoma elongatum*, and *Aulonium ruficorne* in the 3rd decade of June.
K e y w o r d s : frequency of occurrence, entrance holes, nuptial chambers, larval galleries, exit holes.

Introduction. The outbreaks of mass propagation of multivoltine bark beetles *Ips acuminatus* (Gyllenhal, 1827) and *Ips sexdentatus* (Boerner, 1767) (Coleoptera: Curculionidae: Scolytinae), have developed in different European regions in recent years and have begun to collapse (Colombari et al. 2013, Andreieva et al. 2019, Meshkova & Bobrov 2020). These bark beetles had the advantages due to the possibility to develop two main generations and additional sister broods as well as colonizing both living and felled trees and their parts in the conditions of slowly drying of phloem (Meshkova 2019, 2021).

Predators, particularly *Thanasimus formicarius* (Linnaeus 1758), play a considerable role in the control of bark beetles (Kereselidze et al. 2010, Fora et al. 2012, Meshkova et al. 2019, 2021).

After collapsing the population of multivoltine bark beetles, the prevalence of *Tomicus piniperda* (Linnaeus, 1758) and *Tomicus minor* (Hartig, 1834) is beginning to increase (Andreieva et al. 2019). Given that most predatory beetles attack different species of bark beetles (Kenis et al. 2004, Warzee et al. 2006), it remains important to study the occurrence of such predators in the forest stands (Meshkova et al. 2019) and to rear these entomophages for a biological method of forest protection (Meshkova et al. 2021).

Since predators consume bark beetles at different stages during rearing (Reeve 2000), it is also advisable to recognize the features of bark beetles spread in collapsing foci to determine the optimal places and time for their collection.

The aim of this research was to evaluate the occurrence of bark beetles (Coleoptera: Scolytinae) and their predators in collapsing foci depending on some stand characteristics.

Materials and Methods. The study was carried out in collapsing foci of bark beetles in Scots pine (*Pinus sylvestris* L.) stands in Sumy region. Sample trees of the 5th and 6th categories of health condition were analyzed at 30 sample plots in three state forest enterprises of Polissya part of Sumy region and in seven state forest enterprises of the forest-steppe part of Sumy region (9 and 21 forestries, respectively) (Table 1).

Insects were counted on 25 × 25 cm pallets which were located at the parts of the stem with thin, thick, and transitional bark. The assessment was carried out from mid-May to mid-August 2021.

Two bark beetle species (*Ips acuminatus* and *Ips sexdentatus*) were presented at sample trees. *Ips acuminatus* colonized the parts of stems with thin bark, and *Ips sexdentatus* colonized the parts of stems with thick bark. Both bark beetle species could be found at the stem parts with transitional bark, however, it was often difficult to distinguish their entrance or exit holes. Therefore, we considered population parameters of *Ips acuminatus* only by assessment at thin bark, and those of *Ips sexdentatus* only by assessment at thick bark. The width of thick bark was 20–30 mm, transitional bark 5–15 mm, and of thin bark 2–4 mm.

Predatory insects were collected from each pallet to individual Eppendorf tubes, labeled, and later identified in the laboratory using the MBS-9 binocular microscope and special literature (Tarbinsky & Plavilshchikov 1948, Mamaev et al. 1977, Nikitsky 1980, Plavilshchikov 1994, Nikitsky et al. 2005), and were compared with specimens from the collection of the Laboratory of Forest Protection of Ukrainian Research Institute of Forestry and Forest Melioration named after G. M. Vysotsky and Kharkiv Entomological Society. The accuracy of the identification was confirmed by Yu. Skrylnyk.

Table 1

Characteristics of the sample plots

Forest Enterprise	Forestry	Compart-ment	Subcom-partment	Stand composition	Age, years	Relative density of stocking
Krasnopilsky	V. Bobrytske	23	19	10Ps+Qr	92	0.7
Krasnopilsky	Krasnopilske	7	27	10Ps	86	0.7
Krasnopilsky	Osoivske	6	26	10Ps	90	0.7
Lebedynsky	Lebedynske	4	19	10Ps	95	0.7
Lebedynsky	Ukrainske	72	21	10Ps	90	0.7
Lebedynsky	Borovenkivske	21	20	10Ps	83	0.7
Trostyanetsky	Makivske	60	1	10Ps	115	0.7
Trostyanetsky	Lytovske	55	1	9Ps1Qr	75	0.8
Trostyanetsky	Trostyanetske	61	19	10Ps	115	0.7
Romensky	Lypovodolynske	31	1	10Ps	69	0.6
Romensky	Tomashivske	53	16	10Ps	92	0.65
Romensky	Glynske	13	2	10Ps	97	0.65
Svesky	Olynske	6	3	10Ps	82	0.7
Svesky	Chuikivske	33	29	10Ps	78	0.67
Svesky	Sveske	48	7	10Ps	104	0.5
Kroliversky	Gruzchanske	1	7	10Ps	82	0.7
Kroliversky	Krolevetske	11	6	10Ps	82	0.7
Kroliversky	Khreshchatynske	2	11	10Ps	78	0.75
Glukhivsky	Sloutske	15	18	10Ps	84	0.6
Glukhivsky	Chervonyanske	67	4	9Ps1Bp	56	0.8
Glukhivsky	Zemlyankivske	35	17	10Ps	89	0.55
Okhtyrsky	V.-Pysarivske	66	31	10Ps	51	0.6
Okhtyrsky	Okhtyrske	3	11	10Ps	93	0.7
Okhtyrsky	Khukhryanske	42	5	10Ps	83	0.8
Shostkynsky	Myronivske	55	12	10Ps	84	0.7
Shostkynsky	Sobytske	3	20	10Ps	113	0.7
Shostkynsky	Voronizke	55	14	10Ps	84	0.7
Seredino-Budsky	Znob-Novgorodske	25	1	10Ps	86	0.7
Seredino-Budsky	Golubivske	102	15	10Ps	86	0.7
Seredino-Budsky	Kamjamske	22	1	10Ps	81	0.7

Notes: 1. All model trees were felled by selective sanitary felling.
2. Ps – *Pinus sylvestris*; Qr – *Quercus robur*; Bp – *Betula pendula*.

Summary statistics with a significance level of $p < 0.05$ were performed (Atramentova & Utevskaya 2008). Microsoft Excel software and statistical software package PAST: Paleontological Statistics Software Package for Education and Data Analysis (Hammer et al. 2001) were used.

Results and Discussion. The mean population density of *Ips sexdentatus* for all model plots and trees was higher than that of *Ips acuminatus* (Table 2). According to Methodical recommendations (2011), the moderate density of nuptial chambers of *Ips acuminatus* is 0.6–1 per dm^2, and that of *Ips sexdentatus* is 0.3–0.5 per dm^2. Thus, by this parameter, the population density of *Ips acuminatus* in our assessment is moderate, near the low limit, and that of *Ips sexdentatus* is high (see Table 2).

Table 2

Population parameters of bark beetles (in the pooled sample)

Parameters	*Ips acuminatus*	*Ips sexdentatus*
Nuptial chambers per dm^2	0.62	0.71
Egg galleries per dm^2	0.84	0.88
Larval galleries per dm^2	1.24	1.42
Mother generation, beetles per dm^2	0.08	0.09
Production, beetles per dm^2	0.05	0.08
The ratio of generations	1.83	1.23
Frequency of occurrence, %	73.0	79.4

According to Methodical recommendations (2011), the moderate density of egg galleries of *Ips acuminatus* is 2.1–5 per dm^2, and that of *Ips sexdentatus* 0.6–1.2 per dm^2. Thus, by this parameter, the population density of *Ips acuminatus* in our assessment is low and that of *Ips sexdentatus* is moderate (see Table 2). The density of the mother generation and production (density of progeny) is low, wherein the production of these species is 1.83 and 1.23 times less than the density of the mother generation. According to Methodical recommendations (2011), the moderate frequency of occurrence makes 21–60 %. However, this parameter exceeded 60 % for both bark beetle species that is remained high (see Table 2).

The analysis shows that the mean frequency of bark beetles' occurrence assessed by the entrance holes, egg galleries, and exit holes in the Polissya part of Sumy region was insignificantly lower than in the Forest-Steppe one (Table 3).

Table 3

Mean frequency of bark beetles' occurrence in model trees by different population parameters in Polissya and forest-steppe parts of Sumy region, %

Occurrence by:	Polissya		Forest-Steppe		*t*
	mean	standard error	mean	standard error	
Entrance holes	74.5	4.3	83.3	2.6	-1.70
Nuptial chambers	67.6	4.6	78.4	2.9	**-1.98**
Egg galleries	72.5	4.4	80.9	2.8	-1.60
Larval galleries	67.6	4.6	78.4	2.9	**-1.98**
Exit holes	72.5	4.4	82.4	2.7	-1.90

Note. $t_{0.05} = 1.96$; significant *t* is bold.

The mean frequency of bark beetles' occurrence assessed by nuptial chambers and larval galleries was significantly higher in the forest-steppe part of Sumy region ($t = 1.98$; $t_{0.05} = 1.97$).

The mean frequency of bark beetles' occurrence tended to increase with a stem diameter (from 74.7 % to 89.2 %) but sharply decreased at a diameter over 42 cm (Fig. 1). It is possible that larger diameter trees were more resistant to bark beetle infestation.

The mean frequency of bark beetles' occurrence assessed by egg galleries varied during the season (Fig. 2). The maximum population density of *Ips acuminatus* occurred in the 2nd decade of

May, the 3rd decade of June, and the 2nd decade of August. The population dynamics of the six-toothed bark beetle changed less sharply, which may be due to the development of sister generations or differences in the dynamics of individual sample plots or trees, which will be analysed in further studies.

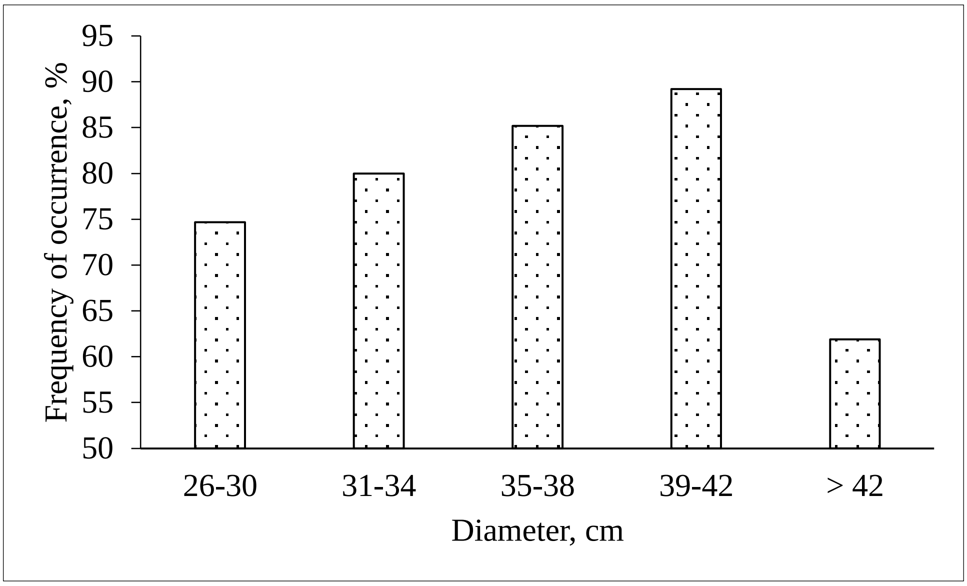

Fig. 1 – Frequency of colonizing the trees of different diameter by bark beetles

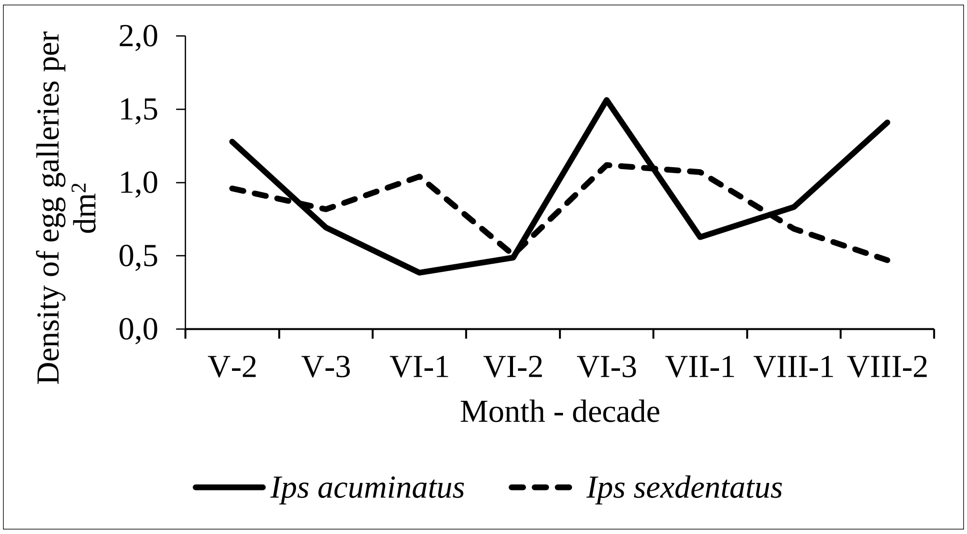

Fig. 2 – Seasonal dynamics of bark beetles' egg galleries

Six predator species from Coleoptera were collected in sample trees: *Aulonium ruficorne* (Olivier, 1790) (Colydiidae), *Platysoma elongatum* (Leach, 1817) (Histeridae), *Rhizophagus depressus* (Fabricius, 1792) (Monotomidae), *Corticeus pini* (Panzer, 1799) (Tenebrionidae), *Thanasimus formicarius* (Linnaeus 1758), and *Thanasimus femoralis* (Zetterstedt, 1828) (Cleridae).

Among predators, in the Polissya part of Sumy region, the highest was the frequency of occurrence of *Aulonium ruficorne* and *Thanasimus formicarius* (10.8 % for each), and in the Forest-Steppe zone that of *Aulonium ruficorne* and *Platysoma elongatum* (14.2 and 13.2 %, respectively). The significant differences in the frequency of occurrence in the two natural zones were proved only for *Corticeus pini* (2 ± 1.4 % and 7.4 ± 1.8 %, respectively; $t = 2.4$; $t_{0.05} = 1.97$).

The frequency of *Corticeus pini* occurrence in the trees of the 5th category of health condition was significantly higher than in the trees of the 6th health condition category (10.8 ± 2.84 % and 2.2 ± 1.06 %, respectively; $t = 2.9$; $t_{0.05} = 1.97$). The difference in the frequency of *Corticeus pini* occurrence in the stem parts with thick and transition bark was also significant (7.8 ± 2.0 % and 1.6 ± 1.57 %; $t = 2.4$; $t_{0.05} = 1.97$).

The difference in the frequency of *Aulonium ruficorne* occurrence in the stem parts with thick and transition bark was also significant (22.2 ± 5.24 % and 6.5 ± 3.12 %; $t = 2.6$; $t_{0.05} = 1.97$). The frequency of other predators' occurrence in certain stem parts had not differed significantly.

Corticeus pini, *Rhizophagus depressus* and *Aulonium ruficorne* preferred the stands of 71–80 years old (22.2 %, 29.6 %, and 25.9 % of colonized samples). *Platysoma elongatum* colonizes the stands of 51–90 years old almost equally (11.1–16.7 % of colonized samples), and only 4.8 % of the colonized samples in the stands are over 100 years old. *Thanasimus formicarius* prefers the stands of 51– 60 years old (38.9 %), and with age, the frequency of its occurrence decreases to 4.8 % in the stands of 91–100 years old (Table 4).

Thanasimus femoralis was not found in the trees younger than 81 years old; however, the frequency of its occurrence increased from 1.8 to 4.8 % in those 100 years old (see Table 4).

Table 4

Frequency of predators' occurrence in the stands of different age, %

Age, years	*Corticeus pini*	*Rhizophagus depressus*	*Platysoma elongatum*	*Aulonium ruficorne*	*Thanasimus formicarius*	*Thanasimus femoralis*
51–60	0.0 ± 0.00	0.0 ± 0.00	11.1 ± 7.41	5.6 ± 5.40	38.9 ± 11.49	0.0 ± 0.00
61–70	16.7 ± 15.21	0.0 ± 0.00	16.7 ± 15.21	0.0 ± 0.00	16.7 ± 15.21	0.0 ± 0.00
71–80	22.2 ± 8.00	29.6 ± 8.79	11.1 ± 6.05	25.9 ± 8.43	0.0 ± 0.00	0.0 ± 0.00
81–90	3.0 ± 1.31	8.3 ± 2.13	15.5 ± 2.79	13.1 ± 2.60	11.3 ± 2.44	1.8 ± 1.02
91–100	2.4 ± 2.35	14.3 ± 5.40	4.8 ± 3.29	14.3 ± 5.40	4.8 ± 3.29	4.8 ± 3.29
> 100	8.9 ± 4.24	4.4 ± 3.07	4.4 ± 3.07	8.9 ± 4.24	6.7 ± 3.72	4.4 ± 3.07

The trend to increase the frequency of its occurrence with a relative density of stocking was recorded for *Aulonium ruficorne* (from 0 at 0.5 relative density of stocking to 16.7 % at 0.8 relative density of stocking) and *Thanasimus formicarius* (from 0 at 0.5 relative density of stocking to 19.4 % at 0.8 relative density of stocking) (Table 5). The frequency of *Platysoma elongatum* occurrence did not depend on the relative density of stocking (11.1–13.9 %) (see Table 5).

Table 5

Frequency of predators' occurrence in the stands of different relative density of stocking, %

Relative density of stocking	*Corticeus pini*	*Rhizophagus depressus*	*Platysoma elongatum*	*Aulonium ruficorne*	*Thanasimus formicarius*	*Thanasimus femoralis*
0.5	11.1 ± 10.48	11.1 ± 10.48	11.1 ± 10.48	0.0 ± 0.00	0.0 ± 0.00	22.2 ± 13.86
0.6	7.1 ± 3.97	4.8 ± 3.29	11.9 ± 5.00	9.5 ± 4.53	4.8 ± 3.29	4.8 ± 3.29
0.7	3.2 ± 1.19	8.2 ± 1.86	11.4 ± 2.15	13.7 ± 2.32	10.5 ± 2.07	1.4 ± 0.79
0.8	16.7 ± 6.21	25.0 ± 7.22	13.9 ± 5.76	16.7 ± 6.21	19.4 ± 6.60	0.0 ± 0.00

With a relative density of stocking from 0.5 to 0.8, the frequency of *Thanasimus femoralis* occurrence decreased from 22.2 % to 0 %. The frequency of *Corticeus pini* and *Rhizophagus depressus* occurrence was the highest at 0.5 relative density of stocking, decreased at 0.6–0.7 relative density of stocking, and considerably increased (from 16.7 to 25 %) at 0.8 relative density of stocking (see Table 5).

Corticeus pini, *Rhizophagus depressus*, and *Aulonium ruficorne* preferred the trees with a larger diameter (Table 6).

Table 6

Frequency of predators' occurrence in the stands of different diameter, %

Diameter of stand, cm	*Corticeus pini*	*Rhizophagus depressus*	*Platysoma elongatum*	*Aulonium ruficorne*	*Thanasimus formicarius*	*Thanasimus femoralis*
26–30	2.7 ± 1.86	8.0 ± 3.13	14.7 ± 4.09	12.0 ± 3.75	16.0 ± 4.23	0.0 ± 0.00
31–34	6.2 ± 2.98	9.2 ± 3.59	10.8 ± 3.84	10.8 ± 3.84	18.5 ± 4.81	0.0 ± 0.00
35–38	6.5 ± 2.37	9.3 ± 2.79	13.9 ± 3.33	13.9 ± 3.33	7.4 ± 2.52	3.7 ± 1.82
39–42	10.8 ± 5.10	18.9 ± 6.44	8.1 ± 4.49	16.2 ± 6.06	0.0 ± 0.00	8.1 ± 4.49
> 42	0.0 ± 0.00	4.8 ± 4.65	0.0 ± 0.00	14.3 ± 7.64	0.0 ± 0.00	0.0 ± 0.00

Maximal frequency of these species occurrence was found in the stands with a diameter of 39–42 cm (10.8 %, 18.9 %, and 16.2 % of the colonized samples, respectively). The frequency of *Platysoma elongatum* occurrence in the stands with a diameter of 26–38 cm was 10.8–14.7 %; however, it decreased to 8.1 % in the trees of a larger diameter. *Thanasimus formicarius* preferred the trees with a diameter under 34 cm (16–18.5 %), and *Thanasimus femoralis* – with a diameter of 39–42 cm (8.1 %) (see Table 6).

Analysis of stem diameter in the place of assessment shows similar patterns (Table 7). *Corticeus pini*, *Rhizophagus depressus*, and *Aulonium ruficorne* preferred the trees with a larger diameter in the place of pallets location (frequency of occurrence was 8.3 %, 13.9 %, and 19.4 % in the stem fragments with a diameter of 37–40 cm). *Platysoma elongatum* colonized only 4.3 % of the stem fragments with a diameter of 20–24 cm and 11.9 % in the fragments with a diameter over 25 cm. The frequency of *Thanasimus formicarius* occurrence decreased from 26.1 % in the fragments with diameters of 20–24 cm to 5.3 % in the fragments with diameters of 33–36 cm. The maximal frequency of occurrence for *Thanasimus femoralis* (8.3 %) was recorded for the fragments with diameters of 37–40 cm (see Table 7).

Table 7

Frequency of predators' occurrence in the samples of different diameter, %

Diameter of sample, cm	*Corticeus pini*	*Rhizophagus depressus*	*Platysoma elongatum*	*Aulonium ruficorne*	*Thanasimus formicarius*	*Thanasimus femoralis*
20–24	0.0 ± 0.00	4.3 ± 4.25	4.3 ± 4.25	4.3 ± 4.25	26.1 ± 9.16	0.0 ± 0.00
25–28	4.8 ± 3.29	7.1 ± 3.97	11.9 ± 5.00	9.5 ± 4.53	19.0 ± 6.06	0.0 ± 0.00
29–32	5.6 ± 2.44	9.0 ± 3.03	18.0 ± 4.07	11.2 ± 3.35	14.6 ± 3.74	0.0 ± 0.00
33–36	7.4 ± 2.68	8.4 ± 2.85	10.5 ± 3.15	11.6 ± 3.28	5.3 ± 2.29	4.2 ± 2.06
37–40	8.3 ± 4.61	13.9 ± 5.76	11.1 ± 5.24	19.4 ± 6.60	0.0 ± 0.00	8.3 ± 4.61
41–44	0.0 ± 0.00	23.8 ± 9.29	0.0 ± 0.00	33.3 ± 10.29	0.0 ± 0.00	0.0 ± 0.00

The frequency of predators' occurrence also depended on the date of assessment (Table 8). Thus, in the 2nd decade of May, the frequency of occurrence was the highest for *Platysoma elongatum* (9.6 %) and *Aulonium ruficorne* (7.6 %), while the one for the other predators was 4–5 %. In the 3rd decade of May, the frequency of occurrence of *Thanasimus formicarius* increases from 4.1 to 8.1 %. In the 1st decade of June, *Corticeus pini* had the highest frequency of occurrence (5 %) both among all predator species and during the seasonal dynamics of this species. Maximal frequency of *Rhizophagus depressus* (6.8 %), *Platysoma elongatum* (8.4 %), and *Aulonium ruficorne* (7.7 %) occurrence was found in the 3rd decade of June. *Thanasimus femoralis* showed the second maximum occurrence in the 1st decade of August (6.1 %). The frequency of *Thanasimus femoralis* occurrence varied during the season within 2.3–4.6 % (see Table 8).

Table 8

Frequency of predators' occurrence (%) depending on sampling date

Month–decade	*Corticeus pini*	*Rhizophagus depressus*	*Platysoma elongatum*	*Aulonium ruficorne*	*Thanasimus formicarius*	*Thanasimus femoralis*
V-2	4.2 ± 4,08	8.3 ± 5,64	33.3 ± 9,62	16.7 ± 7,61	4.2 ± 4,08	8.3 ± 5,64
V-3	0.0 ± 0,00	10.0 ± 5,48	6.7 ± 4,55	16.7 ± 6,80	26.7 ± 8,07	0.0 ± 0,00
VI-1	18.3 ± 5,00	10.0 ± 3,87	1.7 ± 1,65	8.3 ± 3,57	5.0 ± 2,81	0.0 ± 0,00
VI-2	6.7 ± 4,55	6.7 ± 4,55	6.7 ± 4,55	10.0 ± 5,48	6.7 ± 4,55	6.7 ± 4,55
VI-3	3.3 ± 3,28	16.7 ± 6,80	30.0 ± 8,37	23.3 ± 7,72	3.3 ± 3,28	0.0 ± 0,00
VII-1	3.3 ± 2,32	10.0 ± 3,87	11.7 ± 4,14	13.3 ± 4,39	13.3 ± 4,39	3.3 ± 2,32
VIII-1	0.0 ± 0,00	7.1 ± 3,97	11.9 ± 5,00	11.9 ± 5,00	19.0 ± 6,06	0.0 ± 0,00
VIII-2	0.0 ± 0,00	10.0 ± 5,48	6.7 ± 4,55	10.0 ± 5,48	3.3 ± 3,28	3.3 ± 3,28

The mean population density of predators is 5.92 beetles per dm^2, which is high and characteristic of outbreak decline. The mean population density of *Thanasimus formicarius* is 1.44 beetles per dm^2, which is also high (Methodical recommendations, 2011).

The data on the spread of predators are yet to be analysed by individual state forest enterprises and in relation to the prevalence of bark beetles.

The preliminary conclusion is that stem fragments with bark beetles for rearing the predators should be taken from the trees of the 5th category of health condition. *Thanasimus formicarius* should be collected for rearing in the 3rd decade of May and in the 1st decade of August, and *Rhizophagus depressus*, *Platysoma elongatum,* and *Aulonium ruficorne* – in the 3rd decade of June.

Conclusions. The six predator Coleoptera species were found in the declining stage of the outbreak cycle of bark beetles *Ips acuminatus* (Gyllenhal, 1827) and *Ips sexdentatus* (Boerner, 1767), namely *Aulonium ruficorne* (Olivier, 1790) (Colydiidae), *Platysoma elongatum* (Leach, 1817) (Histeridae); *Rhizophagus depressus* (Fabricius, 1792) (Monotomidae); *Corticeus pini* (Panzer, 1799) (Tenebrionidae); *Thanasimus formicarius* (Linnaeus 1758), and *Thanasimus femoralis* (Zetterstedt, 1828) (Cleridae).

Platysoma elongatum and *Aulonium ruficorne* had the highest frequency of occurrence in the 2nd decade of May, *Thanasimus formicarius* in the 3rd decade of May, *Corticeus pini* in the 1st decade of June, *Rhizophagus depressus*, *Platysoma elongatum*, and *Aulonium ruficorne* in the 3rd decade of June.

The fragments of the stem with bark beetles for predators' rearing have to be collected from the trees of the 5th category of health condition. It is necessary to collect *Thanasimus formicarius* for rearing in the 3rd decade of May and in the 1st decade of August, and *Rhizophagus depressus*, *Platysoma elongatum*, and *Aulonium ruficorne* – in the 3rd decade of June.

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ХИЖІ КОМАХИ В ОСЕРЕДКАХ, ЩО ЗГАСАЮТЬ, У СУМСЬКІЙ ОБЛАСТІ

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В осередках короїдів (*Ips acuminatus* and *Ips sexdentatus*), що згасають, у Сумській області виявлено шість видів хижаків із ряду Coleoptera: *Aulonium ruficorne* (Olivier, 1790) (Colydiidae), *Platysoma elongatum* (Leach, 1817) (Histeridae), *Rhizophagus depressus* (Fabricius, 1792) (Monotomidae), *Corticeus pini* (Panzer, 1799) (Tenebrionidae), *Thanasimus formicarius* (Linnaeus 1758) та *Thanasimus femoralis* (Zetterstedt, 1828) (Cleridae). *Platysoma elongatum* та *Aulonium ruficorne* були найбільш поширені у другій декаді травня, *Thanasimus formicarius* – у третій декаді травня, *Corticeus pini* – у першій декаді червня, *Rhizophagus depressus*, *Platysoma elongatum* та *Aulonium ruficorne* – у третій декаді червня. Фрагменти стовбурів із короїдами для розведення хижаків слід відбирати з дерев V категорії санітарного стану. Необхідно збирати *Thanasimus formicarius* для розведення у третій декаді травня та першій декаді серпня, а *Rhizophagus depressus*, *Platysoma elongatum* та *Aulonium ruficorne* – у третій декаді червня.

Ключові слова: частота трапляння, вхідні отвори, шлюбні камери, личинкові ходи, льотні отвори.

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