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Full Length Research Paper

Use of pheromone traps against *Tomicus piniperda* and *Tomicus minor* in the Kazbegi National Park, Georgian Republic

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In the forested lands of Georgia Kazbegi National Park, some kinds of insects have been significantly harming the bark beetle of trees as their population increases. The most harmful species within the 100 ha area of the national park, where *Pinus sylvestris* L. var. *hamata* (Steven) (Scots Pine) trees settle have been identified as *Tomicus piniperda* (L.) and *Tomicus minor* (Hartig) using bio-technic method (pheromone traps), has been implemented against them. The damages of *T. piniperda* and *T. minor* were measured from all the Scots Pine in Kazbegi National Park in 2008. One of the newly developed control methods used in the field with intensive *T. piniperda* and *T. minor* populations is the bio-technic method. Prepared pheromone traps were hung up on trees located in various places and captured insects were counted and the results recorded in 2008. *T. piniperda* and *T. minor* trapped in pheromone traps, hung from the pines of the Scots Pine outbreak area were significantly greater in study area (109.5±2.1 and 118.2±1.8 beetle/trap, both species respectively).

Key words: *Tomicus piniperda, Tomicus minor,* pheromone trials, Kazbegi National Park, Georgia.

INTRODUCTION

Bark beetles are important in natural ecosystems as they attack weakened or dead trees, thus contributing to the decomposition and mineralization in the forest, but some species are tree killers and can cause extensive damage (Berryman and Pienaar, 1973; Christiansen et al., 1987). The subfamily Scolytinae (Coleoptera: Curculionidae), with more than 6000 described species, is one of the largest group of Coleoptera. Scolytinae species typically cause secondary damage, but during occasional outbreaks, they are capable of killing relatively vigorous trees (Borkowski, 2006).

The pine shoot beetles belong to the genus *Tomicus* Latr. (Synonym *Blastophagus* Eichh., synonym *Myelophilus* Eichh.). This is a worldwide genus with 14 species (Ruhm, 1976). The former is called "the common pine shoot beetle" (Bevan, 1962). The pine shoot beetles (*Tomicus* sp.) have been recognized as major forest pests. Hundreds of studies have been carried out on various aspects concerning the life cycle, ecology and economic importance of these beetles. These bark beetles have a major role in the decline of many pine forests growing in both Europe and Mediterranean countries, including Northern Africa (Pfeffer, 1995). This species is widely distributed in the pale arctic region from Europe throughout Siberian to Japan (Browne, 1968; Lekander et al., 1977).

Kazbegi National Park is located on the south of Georgia and 167 km away to Tbilisi. Mount Kazbegi, being one of the highest mountains of the country and the third highest after Mount Shkhara and Janga (5042 m), is included within the National Park property (URL 1). In the field, there are partially forested lands consisting of Scots Pine, Birch, Aspen and Wild rose trees. In recent years, these forested lands have been harmed by the detrimental effects of insect species and some trees have been dried following over nutrition. The existence of many insect species is known to be harmful in forests and cultivated areas and break down the ecosystem. The Pine Shoot Beetle *Tomicus piniperda* (L.) and Lesser Pine Shoot Beetle *Tomicus minor* are two of the most important forest insects of Scots Pine in Kazbegi

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National Park, Georgia.

T. piniperda and *T. minor* are widely distributed in the Pale arctic region, inhabiting different pine species within boundaries of their natural ranges. These insects are the most destructive insect pests, affecting pines in its native range of Europe and Asia (Amezaga, 1997; Langstrom, 1980; Hui, 1991; Langstrom and Hellqvist, 1993; Schroeder and Eidmann, 1987; Poland et al., 1988; Hui, 1991; Eidmann, 1992; Eager et al., 2004). *T. piniperda* was first found in Georgia in the 1940s and its primary host plant is Scots Pine, but it is capable of colonizing, developing and shoot feeding in other pine species, such as Eldari pine (*Pinus eldaric* Medw.), European Black pine (*Pinus nigra*) (Kanchaveli and Supatashvili, 1968).

T. piniperda is the first pine bark beetle to fly in spring within Europe, often flying several weeks before the others (Bakke, 1968; Bouhot et al., 1988). Under favorable weather conditions, the main flight period and the main period of gallery initiation last for only a few days (Bakke, 1968; Eidmann, 1974; Haack et al., 2000). The beetles may be already active in February or March (Amezaga, 1997; Langstrom and Hellquivst, 1985). The beetles reproduce in logs, stumps and pines that are wind broken, wind thrown, or otherwise weakened this species using host volatiles to locate breeding substrate (Kansas et al., 1967; Jordal, 1979). These species hibernate as adults and disperse in the spring as soon as the daily temperature exceeds about 12°C and usually establish galleries in the phloem of wind thrown or otherwise weakened trees. *T. piniperda* and *T. minor* prefer the thicker bark. Females in both species initiate galleries in the bark and are followed by a male. After two to three months, the brood emerges and flies to the shoots of the current year's growth, where they feed and mature. As a result of this feeding, both species cause growth losses and pruning of shoots. Overwintering adults become active in the early spring (Bakke, 1968). Adult females bore individually into the bark of suitable hosts and excavate a nuptial chamber where each female is joined by a single male. Females excavate a gallery and lay eggs in the phloem. Larvae tunnel in the phloem and pupate at the ends of their larval galleries. Most adults emerge in the early summer and feed in the shoots of healthy pine trees. Maturation feeding within shoots continues until temperatures coolsdown in autumn when beetles move down the trunk and construct niches in the outer bark at the base of trees to overwinter (Petrice et al., 2002).

T. piniperda and *T.minor* cause huge growth losses due to the shoot-feeding in the crowns of the pines. However, the attacks on the bole usually kill only weakened trees and do not cause extensive damage. In Europe and North America, the feeding of pine shoot beetles in pine shoots causes losses in the growth of trees (Legowski, 1987; Czokajlo et al., 1997; Borkowski, 2001).

T. piniperda seems to be able to attack and kill healthy trees over large areas. Pine trees contain large amounts of terpenes, a few of which are known to be important for conifer bark beetle interactions. *T. piniperda* is strongly attracted by the host mono terpenes released through an injury on the tree or through the holes made by the Pioneer beetles in the trunk. This can in fact induce a mass attack comparable to that induced by the aggregation pheromones in other species (Byers, 1995).

Control of bark beetles is difficult because of their secluded life. Bark beetles are controlled by means of the trap tree method and biotechnical (pheromone traps), and widely used in recent years (Hui and Lieutier, 1997; Poland et al., 2003). Biological control with the use of predators, parasitoids or pathogens may help curb this problem. There is apparently no practical chemical control for this pest. Cultural practices used in Europe include precise timing of cutting operations and the debarking of cut timber. A predatory beetle, *Thanasimus formicarius* Linnaeus, can eat several pine shoot beetles daily (Czokajlo, 1998; McCullough, 2004).

This paper summarized data obtained from *T. piniperda* and *T. minor* control with pheromone traps in Kazbegi National Park, Georgia in 2008.

MATERIALS AND METHODS

Study area

The research was conducted in the year 2008 in Kazbegi National Park (Georgian). Kazbegi National Park is located on the northern slopes of Main Caucasus range, in the basin of the Tergi River, Kazbegi district; lower marker of its territory is at a height of 1400 m above sea level, and the upper one is within 300 – 4100 m. The establishment of Kazbegi National Park serves the purpose of protecting high mountain ecosystems.

The forests of Kazbegi National Park are located on the steep slopes. 105 species of wood plants can be found in the Strict Nature Reserve, though there are Litvinov's birch (*Betula litwinovi)*, Scots Pine (*Pinus sylvestris* var. *hamata*), junipers (*Juniperus* - 3 species) and Sea-buckthorn (*Hippophae rhamnoides*). The dominant tree species of the study area was 40-140 years old Scots Pine, growing on the southern and southeastern slopes at altitudes ranging from 1970 to 2420 m a.s.l. High hypsometry of the relief and complex morphological conditions are main factors for developing the vertical zonality of the climate. Climate of study area is moderately humid, with relatively cold winter (-8 to 11°C) and short summer (10 to 14°C), the absolute maximum temperature being 30°C. Snow cover remains for 5-7 months (URL 2) (Figure 1).

Pheromone traps and dispensers

Baits releasing synthetic aggregation pheromone of *T. piniperda* and *T. minor* respectively, were used in the present study. TOMPIN ® commercial lure release components of the aggregation pheromone of *T. piniperda* and *T. minor.* 100 traps were setup in Kazbegi National Park. In 2008, multiple funnel traps (8 units : Lingren, 1983) were used, pheromone traps were cylindrical, 122 cm tall, with diameters of 33 cm, made of 6 mm mesh screening material to minimize air damming and silhouette effects. Each trap was hung at a height of 1.5 m. The distance between traps was

Figure 1. Study area.

15 m, while that between rows was 40 m. The traps, which were installed and baited at early April were checked weekly at which time all beetles captured were determined and counted. Traps were set out on the 4th of April and checked every 8 days for a period of 2 months. Differences among traps caught were tested using Student's T-test (Campbell, 1989). The trials lasted until June and data were reported as mean captures all trap.

RESULTS AND DISCUSSION

The pine shoot beetles and lesser pine shoot beetle have for centuries been recognized as one of the most important forest pests in Kazbegi National Park's forest areas. Mechanical and chemical combat methods have some disadvantages, such as application, finance, the topography of the region, prevention of development of parasites and predators of the pest, damage of chemicals to all organisms and the environment. Pheromone traps must be one of the alternative methods. Pheromones are considered as just one among several components in integrated control and can be useful for protecting susceptible stand borders and for monitoring. However, trap catches are not only a measure of the abundance of *T. piniperda* and *T. minor*, but also of the traps' attractiveness related to the nearby natural pheromone. Loyttyniemi et al. (1988) found that pheromone traps offer excellent information for monitoring the population of *T. piniperda* under endemic conditions. A trapping system should be useful for following population trends and for defining situation of low risk. The main target for a monitoring trapping should be to use capture data as the index of the population density. From this point of view, the high correlation between the number of trapped insects and overall population can be deduced.

The study was conducted in the year following the Scots Pine damage. Population levels of pine shoot beetles appeared to be high in the study area. Captures of *T. piniperda* ranged from 109.5±2.1, and *T. minor* 118.2±1.8 beetles per trap in control area (Table 1). It is known that 25-30 insects were trapped during pheromone trials in Europe (Czokajla et al., 2003), and a total 383 insects from 10 pheromone trap were recoded by Inanli and Laz (2001). These numbers are smaller than observations of this study.

Most traps caught several hundreds beetles. The number of bark beetles caught and the average number of insects per trap are summarized in Table 1. The flight activity of *T. piniperda* plus and *T. minor* arent very long

Table 1. Summary of the result number of *T.piniperda* and *T.minor,* average number of these insects per trap in Kazbegi.

Year	Piece trap	Date of control	Captured insects		Catches per trap	
			T. piniperda	*T. minor*	*T. piniperda*	*T. minor*
2008	100	14.04.2008	160	21	1.6	0.2
	100	22.04.2008	910	120	9.1	1.2
	100	30.04.2008	4920	1060	49.2	10.6
	100	08.05.2008	2870	2220	28.7	22.2
	100	16.05.2008	1780	5940	17.8	59.4
	100	24.05.2008	240	1960	2.4	19.6
	100	02.06.2008	60	470	0.6	4.7
	100	10.06.2008	10	30	0.1	0.3
		Total	10.950	11.821	109.5±2.1	118.2±1.8

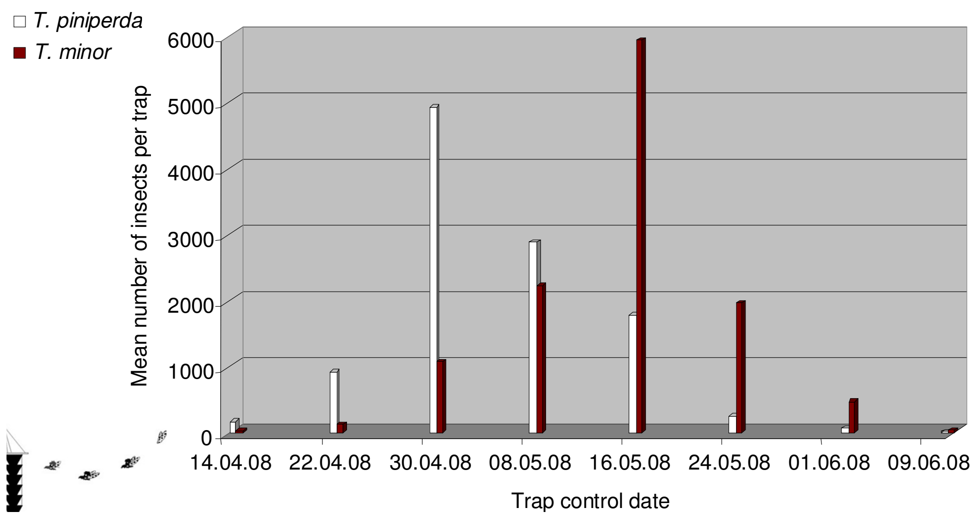

Figure 2. Mean number of *T.piniperda* and *T.minor* per trap and trap control date.

period in lasting only 1-2months. During the control period, it is possible to detect one period of capture of *T. piniperda*, in spring (early April and May). *T. piniperda* has one generation per year. The development of the generation, beginning from early April, takes 6-8 weeks depending on weather conditions. When the mean air temperature is about 12°C, they take flight, looking for suitable Scots Pine trees in order to start generation. Some authors (Amezaga, 1997; Bakke, 1968) have reported that this insect may be active during February and March. However, their numbers in Kazbegi National Park are on the rise.

The males of *T. piniperda*, which were in captured traps, numbered more than females. The percentage of males was 79.6; the percentage of females was 20.4. Similarly, the percentage of males of *T.minor* was 75.8, while the percentage of females was 26.2. Although, in considering only the number of captured adult insects as a mistake, their potential propagation must also be taken into consideration. The trials lasted until May (about 7-8 weeks) and data were reported as mean captures per trap. The flight activity of *T. piniperda* and *T. minor* is limited to smaller period of about 2 months (April-May) (Figure 2).

The flight periods varied greatly during in 2008. The majority of beetles flew during a few days and this main flight varied from mid April to the end of May. Flight activity started when maximum air temperature exceeded 10 to 12°C. The flight culmination was also related to air temperature. The higher the temperature at the beginning of the main flight, the larger the proportion of beetles flying on that day.

In 2008, pine shoot beetles initiated flight in the middle of April. Seasonal periodicity of the bark beetle, which captures the averaged overall levels of defoliation, indicates that peak flight of *T. piniperda* occurred during the last 3 days of April and declined rapidly in May. Unlike these findings, *T. minor's* flight occurred earlier than *T. piniperda.* Peak flight of *T. minor* occurred during the middle of May. *T. piniperda* flight decreased in the last week of May, while *T. minor* flight continued until the first week of June. According to Valenta (2000), in Lithuania, *T.piniperda* is reported to initiate flight in March and *T. minor* begins flight activity few weeks later. However, captures observed of *T.minor* are higher than *T.piniperda*. In 2008, 10950 *T. piniperda* and 11821 *T. minor* adults fall in traps hung in Kazbegi National Park.

In addition, other insect species were captured in the traps. These are more of Cerambycidae and Buprestidae family. Also, the controls seem to fall *Thanasimus formicarius* in traps.

Using pheromone traps alone does not seem to be enough to combat this pest's species. Besides, a clean actuation must be executed in the forest. Spindly trees being knocked down, collapsed and infected must be removed from the forest during cutting operations for maintenance purpose. It is worth keeping in mind that these type of trees left in the area serve as nest trees for insects. If the cut barked trees should be transported to another location, they must be absolutely peeled, otherwise, we may accelerate the diffusion of the insect. To increase the efficiency of pheromone traps and to get the maximum output, times of hang up, control and preparation change must be well defined. Moreover, hang up locations, distances to each other and trees must be well arranged for the traps. Biological combat works must be given importance and developed, and especially, *Thanasimus formicarius* must be grown in the laboratory.

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REFERENCES

Amezaga I (1997). Forest characteristics affecting the rate of shoot pruning by the pine shoot beetle, *Tomicus piniperda* L. (Coleoptera: Scolytidae), in *Pinus radiata* D. Don and *P. sylvestris* L. plantations. Forestry, 70: 129-137.

Bakke A (1968). Ecological studies on bark beetles (Coleoptera: Scolytidae) associated with Scots pine *Pinus sylvestris* L. in Norway with particular reference to the influence of temperature. Med. Nor. Skogsforsoeksves, 21: 443-602.

Berryman AA, Pienaar LV (1973). Simulation of introspect competition and survival of *Scolytus ventralis*broods (Coleoptera: Scolytidae). Environ. Entomol., 2: 447-459.

Bevan D (1962). Pine shoot beetles. Leafl. For. Comm., 3: 8.

Borkowski A (2001). Threats to pine stands by the pine shoot beetles *Tomicus piniperda* (L.) and *T. minor* (Hart.) around a sawmill in southern Poland. J. Appl. Entomol., 125: 489-492.

Borkowski A (2006). Spatial distribution of losses in growth of trees caused by the feeding of pine shoot beetles *Tomicus piniperda* and *T. minor* (Col., Scolytidae) in Scots pine stands growing within range of the influence of a timber yard in southern Poland. J. For. Sci., 52: 130-135.

Bouhot L, Lieutier F, Debouzie D (1988). Spatial and temporal distribution of attacks by *Tomicus piniperda* L. and *Ips sexdentatus* Boern. On *Pinus sylvestris*. Appl. Entomol., 106: 356-371.

Browne FG (1968). Pests and diseases of forest plantation trees. An annotated list of the principal species occurring in the British Commonwealth. Oxford, 1330 pp.

Byers JA (1995). Host tree chemistry affecting colonization in bark beetles. In: Chemical Ecology of Insects (Carde R. T. and Bell W. J., eds.). Chapman and Hall, New York, pp. 154-213.

Campbell RC (1989). Statistics for biologists. Third edition. Cambridge University Press, p. 446.

Christiansen E, Waring RH, Berryman AA (1987). Resistance of conifers to bark beetle attack: Searching for general relationships. For. Ecol. Manage., 22: 89-106.

Czokajlo D (1998). Semi chemicals for the larger pine shoot beetle, *Tomicus piniperda* L. and its clerid predators. Ph.D. Dissertation. State University of New York. Coll. Environ. Sci. For., p. 164.

Czokajlo D, Wink R, Warren J, Teal S (1997). Growth reduction of Scots pine, *Pinus sylvestris*, caused by the larger pine shoot beetle, *Tomicus piniperda* (Coleoptera, Scolytidae), in New York State. Can. J. For. Res., 27: 1394-1397.

Eager T, Beresford C, Dalusky M, Nielsen D, Brewer J, Hilty S, Haack KR (2004). Suitability of some southern and western pines as hosts for the pine shoot beetle, *Tomicus piniperda* (Coleoptera: Scolytidae). J. Econ. Entomol., 2: 460-467.

Eidmann HH (1974). Versuche über den Verlauf des Schwärmens von Borkenkäfern und des insektenbefalls an Kiefernholz in Mittelschweden. Stud. For. Suec., 113: 1-26.

Eidmann HH (1992). Impact of bark beetles on forests and forestry in Sweden. J. Appl. Entomol., 114: 193-200.

Haack RA, Lawrence RK, Heaton GC (2000). Seasonal shoot-feeding by *Tomicus piniperda* (Coleoptera: Scolytidae) in Michigan. Great Lakes Entomol., 33: 1-8.

Hui Y, Lieutier F (1997). Shoot aggregation by *Tomicus piniperda* L. (Coleoptera: Scolytidae) in Yunnan, southwestern China. Ann. Sci. For., 54: 635-641.

Hui Y (1991). On the bionomy of *Tomicus piniperda* (L.) (Col., Scolytidae) in the Kunming region of China. I. Appl. Ent., 112(4): 366-369.

Jordal JB (1979). Responsible luktstimuli hosliten og stor margborar *Tomicus minor* og *T. piniperda* under versverminga. Mimeographed thesis. Department of Zoology, University of Trendheim, p. 105.

Kanchaveli G, Supatashvili Sh (1968). Forest entomology, 374 pp. (in Georgian).

Kansas E, Perttunen V, Oksanen H, Rinne M (1967). Laboratory experiments on the olfactory orientation of *Blastophagus piniperda* L. (Coleoptera, Scolytidae) to substances isolated from pine rind. Acta Entomol. Fenn., 22: 87.

Langstrom B, Hellquivst C (1985). *Pinus contorta* as a potential host for *Tomicus piniperda* L. and *T. minor* Hart, in Sweden Zeitschrift fur Angenandte Entomologie, 99: 174-181.

Langstrom B, Hellqvist C (1993). Induced and spontaneous attacks by pine shoot beetles on young Scots pine trees: Tree mortality and beetle performance. J. Appl. Entomol., 115: 25-36.

Langstrom B (1980). Distribution of pine shoot beetle attacks within the crown of Scots pine. Studia For. Suecica No. 154.

Legowsk D (1987). Observations on the fall of twigs in forest district Niedźwiady in the years 1977–1983. Sylwan, 9: 39-46.

Lekander B, Petersen B, Kangas E, Bakke A (1977). The distribution of bark beetles in the Nordic countries. Acta Entomol. Fenn., 32: 1-36.

Lingren BS (1983). A multiple funnel trap for Scolytid beetles (Coleoptera). Can. Entomol., 115: 299-302.

Loyttyniemi K, Heliovaara K, Repo S (1988). No evidence of population pheromone in *Tomicus piniperda* (Coleoptera, Scolytidae): A field experiment. Ann. Entomol. Fenn., 54:93-95.

McCullough DG (2004). Pine shoot beetle compliance management program. http://www.michigan.gov/mda/0,1607,7-125-1568_2390_5974- 11726--,00.html (15 October 2010).

Petrice TR, Haack RA, Poland TM (2002). Selection of overwintering sites by *Tomicus piniperda* (Coleoptera: Scolytidae) during fall shoot departure. J. Entomol. Sci., 37: 48-59.

Pfeffer A (1995). Zentral und Westpalaarktische Borken und Kernkäfer (Coleoptera: Scolytidae, Platypodidae), Pro Entomologica: Naturhistorisches Museum Basel, p. 310.

Poland TM, Borden JH, Stock AJ, Chong LJ (1998). Green leaf volatiles disrupt responses by the spruce beetle, *Dendroctonus rufipennis,* and the western pine beetle, *Dendroctonus brevicomis* (Coleoptera: Scolytidae) to attractant baited traps. J. Entomol. Soc. B. C., 95: 17-24.

Poland TM, Groot P, Burke S, Wakarchuk D, Haack RA, Nott R, Scarr T (2003). Development of an improved attractive lure for the pine shoot beetle, *Tomicus piniperda* (Coleoptera: Scolytidae). Agr. For. Entomol., 5: 293-300.

Ruhm W (1976). *Blastophagus antipodus* Egg. und *Blastophagus porteri* Breth. (Scolytidae, Col.) an der Araukarie (*Araucaria araucana* (Mol.) Koch) in Chile. Zeitschr. fur Pfanzenkrankheiten und Pfanzenschutz, 83: 137-145.

Schroeder LM, Eidmann HH (1987). Gallery initiation by *Tomicus piniperda* (Coleoptera, Scolytidae) on Scots pine trees baited with host volatiles. J. Chem. Ecol., 13: 1591-1599.

URL 1 (2010). http://www.kazbegi.org.

URL 2 (2010). http://www.aroundtheglobe.eu/georgia-kazbegi-national-park/.

Valenta V (2000). Bark beetles. In: Manual of forest protection (ed. A. Ziogas). Kaunas, Lutute, pp. 135-163.

Ye H (1991). On the bionomy of *Tomicus piniperda* (L.) (Col., Scolytidae) in the Kunming region of China. J. Appl. Ent., 112: 366-369.