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Full Length Research Paper

Use of pheromone-baited traps for monitoring *Ips sexdentatus* (Boerner) (Coleoptera: Curculionidae) in oriental spruce stands

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The population level and flight periods of *Ips sexdentatus* (Boerner) (Coleoptera: Curculionidae) was determined according to certain stand dynamics, altitude steps and temperatures based on the capture amounts in pheromone traps hung on some spruce stands in the oriental spruce, *Picea orientalis* (L.) Link. Forests of Turkey in 2006 to 2009. Average number of *I. sexdentatus* was statistically different between years and average annual highest number of captured beetles showed differences according to regions. The averages of the numbers of beetles caught in two different altitudes in two separate years are statistically different. In higher altitudes, average number of beetles caught per trap was higher. Provided data showed that *I. sexdentatus* has at least 2 generations in the forests of the region. First adult flight ranged from end of April to mid-June in both altitude steps, while second flight started in mid-June and continued until the mid-September. It was concluded that the beetles that were caught during fourth week of August and first week of September were the adults that would start a third generation. The predator species *Thanasimus formicarius* (L.) (Coleoptera: Cleridae) was caught in the pheromone traps as well as *I. sexdentatus*. In each trap, an average of 43.92 *I. sexdentatus* adults was captured per 1 *T. formicarius* adult. A total of 18 *I. typographus* (L.) (Coleoptera: Curculionidae) adults were captured by 5 traps containing Tryphreon Ipstyp aggregation pheromones. The trapping works in the research region have once again detected the existence of this species, which has densities that cannot be detected by other methods, and which is very dangerous for spruce stands since the first detection 75 years ago.

Key words: *Ips sexdentatus*, pheromone baited traps, monitoring.

INTRODUCTION

Humans and insect pests are the most important biotic factors threatening oriental spruce forest wealth in the Eastern Black Sea region of Turkey (Ozcan and Alkan, 2003). In sensitive nature of the region, spruce forests have an uppermost function expected from forests in water supplying, soil protection and preventing natural destructions (Eroglu et al., 2005). Regional forests are under serious pressure of people that live in mountain villages. This pressure makes forests extremely exposed against the attacks of some bark beetles (Benz, 1984).

Scolytid bark beetles (Coleoptera: Curculionidae) are important forest pests all over the world (Bakke, 1989). Most bark beetle species infest recently dead trees (Wood, 1982); some bark beetle species are known to attack and kill living trees, causing large economic losses (Berryman and Ferrell, 1988; Turchin et al., 1991; Reeve, 1997). Natural distribution of oriental spruce, *Picea orientalis* (L.) Link., in Turkey (approximately 300 thousand ha), in Eastern Black Sea region is generally at the seaside slopes of Black Sea mountain chains between the altitudes of 500 to 2400 m. Optimal distribution is over 1200 m (Saatcioglu, 1976; Demirci, 1991). Oriental spruce stands are under serious threats of *Dendroctonus micans* (Kugelann), a very important pest directly attacking healthy trees; and *Ips sexdentatus*

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(Boerner) and *Ips typographus* (L.) (Coleoptera: Curculionidae), both of which can easily have a primary position and cause a great outbreak. The attacks of *D. micans* in the oriental spruce forests of Turkey first started in 1966 (Acatay, 1968) and extended to the entire spruce stands in early 2000s (Eroglu et al., 2005). *I. typographus* outbreaks that were first discovered in 1984 (Alkan, 1985) have caused major forest losses until 2007 (Gokturk and Eldemir, 2005; Alkan-Akinci et al., 2009). *I. sexdentatus* is one of the most important pests of the forests of Turkey (Oymen, 1992). It has caused death of *Pinus sylvestris* L. and *P. radiate* D. Don. suffering from drought stress in central and Southern France, Northern Spain and Portugal (Goix, 1977; Perrot, 1977; Lieutier et al., 1988; Paiva et al., 1988). Outbreaks have occurred on *P. orientalis* and *P. sylvestris* in Turkey (Schimitschek, 1939; Canakcıoglu, 1983; Schönherr et al., 1983; Oymen and Selmi, 1997). The existence of this beetle in Turkish pine and spruce forests has a very long past and recently, especially the great outbreaks in spruce forests have been recorded as the most outstanding disasters in the country (Bernhard, 1935; Schimitschek, 1953). This beetle has spread to a very wide area; from Japan to Southern Europe and Trans-Caucasia, from the Atlantic to the Pacific. This beetle prefers dead, dying, or weakened trees as its breeding material and is referred to as secondary insects, although it can become primary pest under outbreak conditions. The wood under the gallery is stained blue from fungi transferred by the beetles (Chararas, 1962). As in the case of other conifer bark beetles, *I. sexdentatus* acts as a vector for a blue stain fungus which also damages the tree (Lieutier et al., 1989). This way, hundred hectares of forests can be easily destroyed (Schimitschek, 1953; Keskinalemdar and Ozder, 1995; Oymen and Selmi, 1997; Selmi, 1998, Yuksel and Tozlu, 2000). It prefers trees with thick bark. Moreover, it is observed to attack begining from the top sections of the trees (Canakcioglu, 1983). This beetle kills the trees in spruce forests in masses and thus, causes interruption of canopy in stand canopy closure and serious structural deteriorations within the stand (Ozcan, 2009).

The development of mass deaths which appeared suddenly actually was completed in a long process (Yuksel, 1998). In Turkey, at Trabzon Yanbolu Valley - Santa and Degirmendere Valley - Meryemana spruce forests, 250,000 m^3 tree loss caused by I. *sexdentatus* in 1928 (Bernhard, 1935) and had reached approximately one million m^3 in 1930s (Schimitschek, 1953). It was recorded that the total damage of the beetle in 1930 to 1994 was over 1.500.000 m^3 (Keskinalemdar and Ozder, 1995). *I. sexdentatus* is a native species of oriental spruce forests and until very recently when *D. micans* reached these forests and *I. typographus* developed an outbreak, it was the only threatening bark beetle of these forests. Great scale destructions of oriental spruce forests which were especially recorded in the last century and which were told by the public previously requires regular monitoring of population changes and densities of *I. sexdentatus*. The primary purpose of sampling the populations in these types of monitoring programs is to classify the population in terms of being under or over a critical threshold (Wainhouse, 2005). The validity of using pheromones has been proven for monitoring pests (Shorey, 1991). Lindgren funnel traps baited with aggregation pheromones are widely used to monitor and manage populations of economically important bark beetles (Hayes et al., 2008). Funnel traps are especially useful for monitoring the adult stages of beetles if proper attractors are available in the market. Although, they have the disadvantage of catching the natural enemies that react to the pheromone, funnel traps mainly provide "clean" sampling since they are species-specific (Wainhouse, 2005). Hagler (2000) expresses the compatibility of the use of pest-specific pheromones to biological control as stated by Shorey (1991). As with the other parabiologicals, pheromones are designed to be used as one of several components of an overall IPM program (Hagler, 2000). For example, the use of scolytid aggregation pheromones in traps for mass-trapping to reduce the density of local populations in the forest.

Research on the role of semiochemicals in the ecology and behavior of insect pests has provided novel and potentially very powerful techniques for the management of insect populations (Wainhouse, 2005). *I. sexdentatus* is a bark beetle for which aggregation pheromones are important in determining the beetle colonization process (Bouhot et al., 1988). The male beetle initiates the boring and releases an aggregation pheromone consisting mainly of ipsdienol (Vité et al., 1974). Traps can be used in a large scale (Minks, 1977) for monitoring the beetle population (Lindelow and Schroeder, 2001; Wermelinger, 2004). Moreover, monitoring based on pheromone traps can provide information on beetle population density and flight periods, based on yearly changing captured beetle number (Faccoli and Stergulc, 2006). In Turkey, first capturing trials against *I. sexdentatus* with pheromone traps started in 1982 in oriental spruce forests; the control measures against this beetle has continued through mechanical methods, variously designed funnel traps and biological agents (Serez and Eroglu, 1991; Serez, 2001). A total of 6290 pheromone traps were hung in Artvin forests between 2004 to 2009 in 4050 hectare area and 11,482,000 adults were captured (Ozkaya et al., 2010).

In this study that was based on the capture amounts in pheromone traps, the population levels, flight periods, flight durations and the time intervals of most catches of *I. sexdentatus* were determined according to certain stand dynamics, altitude steps and temperatures. With these evaluations, it was aimed to research the opportunities of more efficient utilizations of pheromone traps, in order to provide better monitoring of pest population levels and develop a more comprehensive and economic management strategy against the pest.

Table 1. *Ips sexdentatus* amounts captured in Macka Directorate of Forest Enterprises in 2006 to 2009 by funnel traps.

Region	Year	Number of traps	Total number of beetles caught in traps	Average number of beetle per trap
Yesiltepe	2006	40	11608	290.20
	2007	65	33390	513.69
	2008	80	19469	243.36
	2009	45	28362	630.27
Macka	2006	35	5165	147.57
	2007	35	5890	168.29
	2008	40	18786	469.65
	2009	40	8354	208.85
Catak	2006	50	8369	167.38
	2007	40	4221	105.53
	2008	40	6049	151.23
	2009	40	4415	110.38
Esiroglu	2006	30	770	25.67
	2007	35	3297	94.20
	2008	35	21500	614.29
	2009	35	31770	907.71
Hamsikoy	2006	30	5079	169.30
	2007	41	11882	289.80
	2008	35	12905	368.71
	2009	35	7810	223.14

MATERIALS AND METHODS

This study was performed in Eastern Black Sea Region of Turkey, at the oriental spruce, *Picea orientalis* (L.) Link. stands with a natural dispersion area of 297,397 ha. The materials of this study are 1652 Triphreon Ipssex and 96 Triphreon Ipstyp commercially branded pheromone preparations, 826 pheromone traps containing these preparations, hung in spruce stands at Trabzon Regional Directorate of Forestry, Macka Directorate of Forest Enterprises, Yesiltepe, Macka, Catak, Esiroglu and Hamsikoy. The dominant tree species is oriental spruce. There are Scotch pine, beech, hornbeam, oak and chestnut in mixed stands in the study area and in the vicinity. Divisions of Forestry between the years 2006 to 2009, and a total of 249,091 *I. sexdentatus,* 18 *I. typographus* adults caught in these traps, and 207 *Thanasimus formicarius* adults only caught in 40 traps in 2006.

For monitoring *I. sexdentatus* flight periods, 75 traps containing Triphreon Ipssex branded pheromone preparations were used in 2006, and 125 of these were used in 2009. For this purpose, the pheromone traps were placed in certain forest areas in 2006 at Yesiltepe and Macka regions, in 2009 at Yesiltepe, Macka and Catak regions, with 100 to 120 m intervals to provide a homogeneous dispersion. Pheromone traps were hung 15 to 20 m to the edge of the stand, inside the openings in the forest and roadsides during mid-April in both years. They were placed between two poles and 1.5 m higher over the ground. The traps were fixed by ropes to the wooden poles both from top and bottom. The traps were numbered with special cards attached. The altitudes and exposures of the points, where the traps were hung were recorded and first pheromone preparations were placed in the traps. First preparations were replaced in mid-June and the traps were kept in the forest until mid-September. The traps were regularly controlled after being placed in the forest; captured beetles were counted and recorded. Additionally, in 2006 a total of 18 traps and in 2009 a total of 30 traps containing Triphreon Ipstyp commercially branded pheromone preparations were used. *T. formicarius* adults caught in the 31 traps between 3 May and 24 August 2006 at Yesiltepe region, and *I. sexdentatus* adults caught during the same period have been assessed together.

Statistical analysis

All statistical analyses were performed using SPSS 13.0 for Windows® software. Logarithmic transformation was applied to the *I. sexdentatus* amounts gathered from capture results that did not show normal dispersions. Independent sample T-test and one way ANOVA were used depending on the variables.

RESULTS

I. sexdentatus amounts captured by a total of 826 funnel traps in the spruce stands of Macka Directorate of Forest Enterprises and Yesiltepe, Macka, Catak, Esiroglu and Hamsikoy forestry divisions in 2006, 2007, 2008 and 2009 are given in Table 1. Without taking the years into account, the average number of beetles per trap has

Table 2. Number of beetles captured at two altitude ranges in 2006 and 2009 at Yesiltepe, Macka and Catak Regions.

Year	Number of traps	Average number of beetles per traps	Altitude range	Number of traps	Total number of beetles caught in traps	Percentage of caught beetles (%)
2006	75	223,76	800 – 1200 m	48	4243	25.24
			1200 m and higher	27	12539	74.76
2009	125	329,05	800 – 1200 m	77	19145	46.55
			1200 m and higher	48	21986	53.45

close values in Macka, Catak and Hamsikoy regions, while it was higher in Yesiltepe and Esiroglu regions. Average number of beetles per trap was higher in Yesiltepe in 2007 and 2009, higher in Macka in 2008, higher in Esiroglu in 2008 and 2009; while Catak and Hamsikoy had the same rates of captures in all years (Table 1).

In Yesiltepe and Macka regions, 61.48% of all beetles captured by the traps in 2006 were received from 10 traps. In these traps, average number of beetles per trap was 1031.2 (436 to 2580), while it was 99.4 in the remaining traps. In Yesiltepe, Macka and Catak regions 59.93% of all beetles captured by the traps in 2009 were received from 12 traps. In these traps, average number of beetles per trap was 2054.33 (920 to 4761) while it was 145.83 in the remaining traps. The higher captures at these two divisions in 2006 and 2009 happened in different compartments. Average highest number of beetles per year has also differed according to divisions (Table 1). In 2009, at a compartment in Yesiltepe region where traps 46, 47 and 48 were located between altitudes of 1200 to 1250 m and an average of 1941.33 beetles were captured per trap; 18 to 20 spruces, with diameters of 30 to 60 cm, were killed in groups due to very severe attacks by *I. sexdentatus* in 2010.

More also, in Yesiltepe and Macka regions in 2006, 25.24% of all captured beetles were received from 48 traps between 800 to 1200 m and 74.76% were received from 27 traps at altitudes of 1200 m and higher. At these altitudes, average numbers of beetles per trap were 88.21 and 464.41, respectively (Table 2). In Yesiltepe, Macka and Catak Regions in 2009, 46.55% of all captured beetles were taken from 77 traps between 800 to 1200 m, and 53.45% were taken from 48 traps at altitudes of 1200 m and higher. The average numbers of beetles per trap were 248.64 and 458.04, respectively (Table 2). Average number of beetles captured both years in these two altitude ranges have been statistically different ($p<0.05$). The average number of beetles caught per trap at altitudes of 1200 m is 5.26 times higher in 2006 and 1.84 times higher in 2009 than traps at 800 to 1200 m. However, the average number of beetles captured by traps in stands at different ages in 2006 and 2009 in Yesiltepe and Macka regions were statistically not different from each other ($p>0.05$). In addition, in stands with various closures at Yesiltepe and Macka regions in 2006 and 2009, the average number of beetles captured by traps were statistically not different from each other ($p>0.05$). At the research areas, average number of beetles trapped in stands at different exposures both years, statistically were not different from each other ($p>0.05$). However, average number of captures of the traps with southern exposures (average 384.75) was higher than the traps with other exposures (average 159.83).

The distribution of the number of beetles, trapped between 800 to 1200 m and higher than 1200 m in 2006 and 2009 at Yesiltepe, Macka and Catak regions, are shown in Figures 1 and 2 according to control dates. These data provided showed that *I. sexdentatus* has at least 2 generations in the forests of the region. At Yesiltepe and Macka regions, on May 3, when the first control of the traps at the spruce stands were made in 2006 between 800 to 1200 m and higher than 1200 m; respectively, an average of 2.85 and 0.92 adult beetles were captured per trap. In 2006, it was observed that first flight of *I. sexdentatus* began before 3 May at both altitude steps. It was detected that the over-wintering adults mated and their attacks to the host trees began before May to lay the first eggs that would start the first generation of this year and that it lasted until the third week of June at both altitudes in this flight period. It was also observed that the adults that would start the second generation began to fly at the third week of June. Accordingly, the completion of the first generation that started in early May lasted for 50 to 55 days. On the 24th of August, when the last control of the traps at both altitudes were performed, respectively an average of 0.6 and 2.18 captured adults per trap shows that the adult flights of the beetle in this year continued at least until end of August (Figure 1).

At Yesiltepe, Macka and Catak regions, on 26 April 2009, when the first control of the traps were performed at altitudes of 800 to 1200 m and higher than 1200 m, respectively an average of 0.22 and 0.13 beetles were captured per trap. This shows that in 2009, at both altitude steps, first flight of *I. sexdentatus* started before 26 April. It was detected that the over-wintering adults mated and their attacks to the host trees began at the last week of April to lay the first eggs that would start the first generation in 2009 and that it lasted until the third week of June at both altitudes in this flight period, just like the

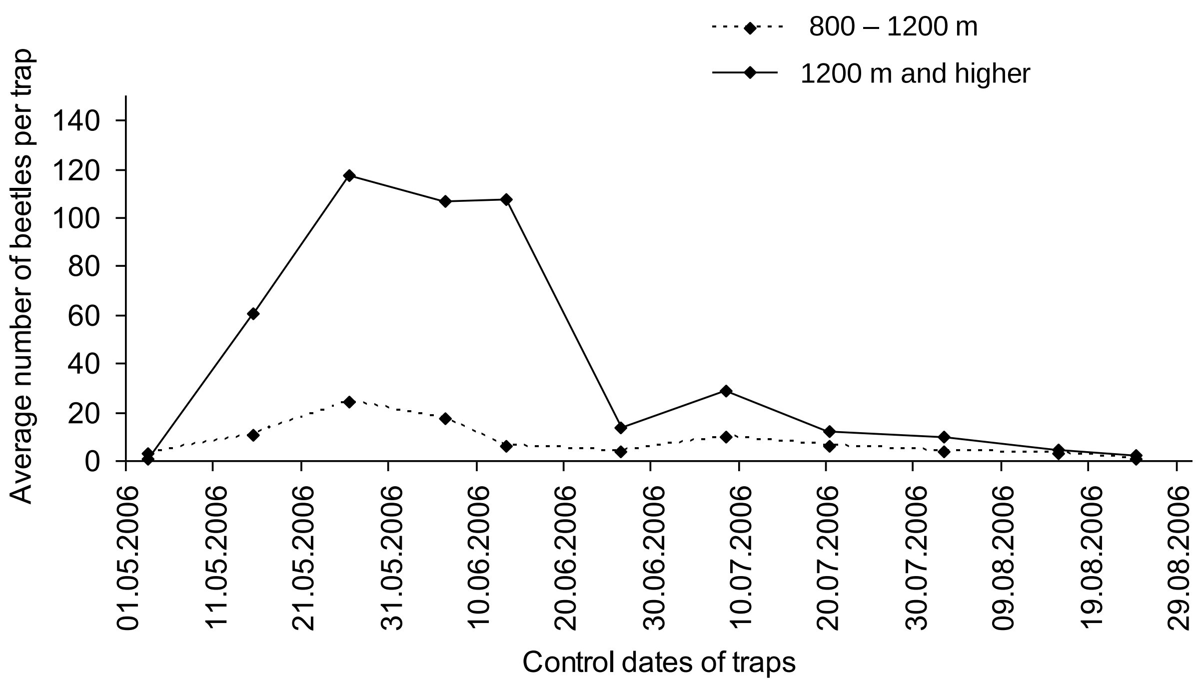

Figure 1. Number of *Ips sexdentatus* caught in traps on the control dates at two different altitudes in 2006 at Yesiltepe and Macka Regions.

previous year.

Furthermore, it was observed that the adults that would start the second generation of the beetle began to fly in third week of June. Accordingly, in this year the completion of the first generation that started in last week of April continued approximately for 55 to 60 days. On the 4th of September when the last control of the traps at both altitudes were performed respectively, an average of 2.84 and 3.38 captured adults per trap shows that the adult flights of the beetle in this year continued at least until the second week of September (Figure 2). In the research region, it was seen that the first adult flight observed in early May and end-April in 2006 and 2009, reached its highest number after approximately 20 days after the first flight at both altitude steps and that this high flight activity continued for approximately 20 days. In 2006, 69.51 and 84.76% of all beetles trapped in the first and second altitude steps respectively, were captured in the first flight period; these numbers were 78.37 and 71.27% in 2009 (Figures 1 and 2). In 2006, average number of beetles caught per trap in the first and second flight periods was respectively 12.26 and 4.48 at first altitude step, and respectively 78.72 and 11.79 at the second altitude step. In 2009, these amounts were respectively 39.15 and 18.01 at the first altitude step and respectively 72.78 and 44.79 at the second altitude step.

The predator species *T. formicarius* was also caught by the pheromone traps together with *I. sexdentatus*. During the control of the traps, the predators, almost all being alive, were released. Number of *I. sexdentatus* and *T. formicarius* captured in 40 traps in Yesiltepe region between 3 May and 24 August 2006 are given in Table 3. All lively 207 *T. formicarius* adults were taken from 31 of 40 traps (77.5%). In each of the eleven different control dates, an average of 9.36 (1 to 19) *T. formicarius* was found in these 31 traps. During the whole trapping season, these 31 traps averaged 293.42 *I. sexdentatus* and 6.68 *T. formicarius* adults. Each trap averaged 1 *T. formicarius* adult against 43.92 *I. sexdentatus* adults. Additionally, in 8 different controls; 1 to 6 *T. formicarius* adults were found in traps where no *I. sexdentatus* were found. Additionally, in 2006, only *I. typographus* adults were captured in traps containing *I. typographus* aggregation pheromones, using 5 Tryphreon Ipstyp commercially branded pheromone preparations. In these traps, on controls dated 3rd May, 26th May and 13th June; 2, 11 and 5 *I. typographus* adults were found. In 2009, 13 traps with the same pheromone preparations were hung but no *I. typographus* could be captured.

DISCUSSION

In Yesiltepe, Macka and Catak regions, the average number of *I. sexdentatus* trapped in two different years were found to be statistically different and the average number of beetles trapped in 2009 was 46.9% more than that of 2006. In 2006 and 2009, 61.48 and 59.93% of the total captured beetles were respectively taken from 10 and 12 traps. In these traps, the average number of

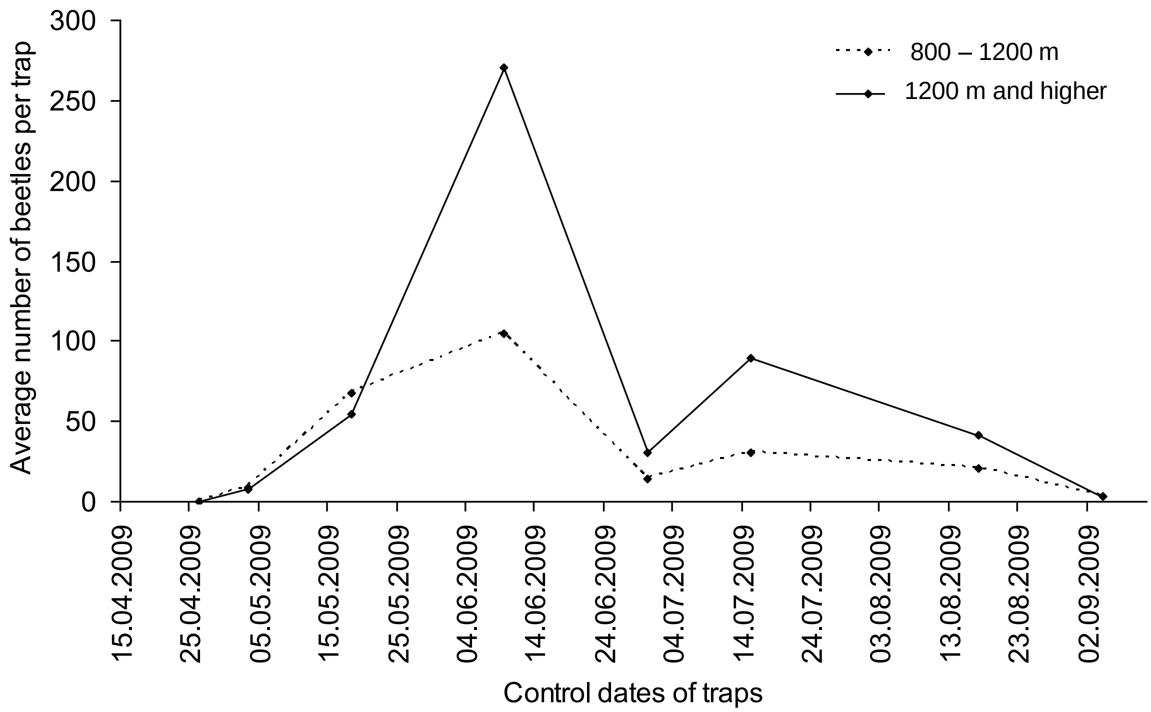

Figure 2. Number of *Ips sexdentatus* caught in traps on the control dates at two different altitudes in 2009 at Yesiltepe, Macka and Catak regions.

Table 3. Numbers of *Ips sexdentatus* and *Thanasimus formicarius*, counted in the traps according to control dates.

Trap control dates	Number of traps with captured *Thanasimus formicarius*	Number of *Ips sexdentatus* caught in traps	Number of *Thanasimus formicarius* caught in traps	Average number of predator per capture
03.05.2006	1	8	1	1
15.05.2006	9	1579	26	2.89
26.05.2006	15	2486	58	3.87
06.06.2006	8	1707	10	1.25
13.06.2006	19	1794	45	2.37
26.06.2006	3	133	3	1
08.07.2006	12	664	22	1.83
20.07.2006	6	298	9	1.5
02.08.2006	9	258	14	1.56
15.08.2006	6	111	12	2
24.08.2006	5	58	7	1.4
Total	93	9096	207	1.88

beetles per trap was 1031.2 and 2054.33, and 99.4 and 145.83 in the remaining traps. The higher captures at Yesiltepe and Macka regions in 2006 and 2009 occurred in different compartments. The highest average number of beetles captured per year differed according to forestry divisions (Table 1). At a compartment in Yesiltepe region where an average of 1941.33 beetles were captured per trap in 2009, 18 to 20 spruces with 30 to 60 cm diameters were killed in groups due to very severe attacks by *I. sexdentatus* in 2010. Similarly, the increase of average 25.67 and 94.20 captures per trap in Esiroglu region in 2006 and 2007 to 614.29 and 907.71 in 2008 and 2009 may be the precursor of a similar damage impact at this certain areas in this region. Depending on the beetle's population density in the distribution range, the amount caught by the pheromone traps differ from year to year and from region to region.

In Black Sea Region, population of *I. sexdentatus* is fluctuated at high densities (Oymen, 1992). Capture capacities of traps are affected by many factors such as their being hung to locations where there are suitable trees for the reproduction of the beetle, the attacks being near the trees, stand density and wind direction (Safranyik et al., 2004). The number of the bark beetles captured in the pheromone traps depends on environmental and local conditions (Lobinger, 1995). Beetles can only find the source of the pheromone under average weather and climate conditions. Having a small number of flying beetles, or short flight period affects the capturing efficiency of the traps. Additionally, the position of the location of the pheromone trap also has a different effect on capturing efficiency. If traps are hung close to each other, both affect the other mutually. Traps must be at least 10 m to the closest tree otherwise some beetles could attack trees near the trap and damage them (Serez, 1987). It is estimated that *I. sexdentatus* are attracted to pheromone traps from a maximum of 80 m (Jactel, 1991). In an assessment with 38 adult individuals, 98% of *I. sexdentatus* adults have flown more than 5 km, 50% have flown more than 20 km, and 10% have flown more than 45 km (Jactel and Gaillard, 1991). Beetles have been found in the stomach of trout in lakes 35 km from the nearest spruce forest (Nilssen, 1978). Dispersal over longer distances depends on transportation under the bark of logs. Stinking smell caused by rotten beetles can decrease the capturing efficiency of the traps (Kretschmer, 1990). Therefore, traps must be controlled with brief intervals and their being cleaned after each control, especially after rain and snow, is essential.

In Yesiltepe, Macka and Catak regions during 2006 and 2009, the average number of beetles trapped bet-ween 800 to 1200 m and at 1200 m and higher altitudes were statistically different. Average beetle amount captured per trap at 1200 m was 5.26 times higher in 2006 and 1.84 times higher in 2009, than those in traps at 800 to 1200 m. At altitudes where spruce has optimum distribution, namely 1200 m and higher, higher amount of trapped beetles can be explained by having a higher beetle population. However, number of trapped beetle may change due to regional differences dependent on stand characteristics influencing density increase and outbreak development, ecologic factors such as water economy and relative humidity, and the features of growing environment based on bedrock and soil structures.

Captured beetle data gathered from Yesiltepe, Macka and Catak regions in 2006 and 2009 at two different altitude steps reveal that *I. sexdentatus* has at least 2 generations in the forests of these regions. This result is directly supported by other researches based on field findings. The species has only two generations in central areas of Eurasia and four to five generations in the Mediterranean area and in other areas with a long, warm summer season (Vité et al., 1974). It is known that in this region, first flight occurs during early April (Besceli and Ekici, 1969; Serez, 1983) and mid-May and second flight occurs between mid-June and end-August (Besceli and Ekici, 1969). It is observed that *I. sexdentatus* usually completes 2 generations a year in oriental spruce forests and that the adults, who could only start the third generation in suitable weather conditions (Sekendiz, 1991), mate at the end of August and early-September and lay eggs (Yuksel, 1998). The flight time of the first generation in the pine forests of the Mediterranean Region occurs in May, and the second generation's flight occurs in August (Tosun, 1977). Under the conditions in Turkey, usually 2 generations a year is seen; however, a third generation can be seen under suitable climate conditions. (Sarıkaya, 2008)

In 2006, at both altitude steps, *I. sexdentatus*'s first flight started before 3rd May and continued until the third week of June. The flight of the adults that would start the second generation started in the third week of June and continued until the end of August. In 2009, at both altitude steps, the first flight started before 26 April and continued until the third week of June. The second flight again started in third week of June and continued until the end of second week of September. It was seen in 2006 and 2009 that there were no differences between the first adult flight dates at two altitude steps. Average temperatures of January, February, March and April in 2006 and 2009 at 1000 m were 3.3 and 4.1°C. Average temperatures of these months at 1500 m were 0.8 and 1.57°C. In both years, average temperatures of April, according to altitude steps, were respectively 6.3 and 3.8°C, and 5.2 and 2.7°C. The spring flight starts when the temperature exceeds about 20°C; in the north- this is in May/June, in southern areas in March/April (Vité et al., 1974; Sarıkaya, 2008). In this case, it was understood that the highest temperatures reached in late-April and early-May and their durations have been effective on these flights, rather than the monthly average temperatures. Temperature has a role of a limiting factor on the daily amounts of trapped beetles and captured beetle amounts depend on the daily duration of a temperature over a threshold that allows the beetles' flight, and on the daily highest temperature (Bakke, 1968).

In the assessment made according to the results of these captures; the flight times of the adults who flew last in the first flight in very little numbers, and of the adults who flew first in the second flight cannot be distinguished and thus; the ending dates of the first flight and the starting dates of the second flight coincide. It was detected that the first flight of this beetle begins in March, April and May in the forests of the region depending on the altitude, and consequently they laid eggs in April, May and June (Yuksel, 1998). The second flight that began in the third week of June continued until the end of August in 2006 and until the second week of September in 2009. Laying period of the second generation continues from June to first week of August depending on the altitude.

According to these results, it can be understood that the adults trapped in late August in 2006 and early September in 2009 are the adults who would start the third generation observed in late August and early September according to lower and higher altitude steps (Yuksel, 1998).

In 2006 and 2009, the completion of the first generation, which started in early May and last week of April, has taken approximately 50 to 60 days. The completion of the second generation between last week of June and last week of August was approximately 60 to 65 days. It is reported that the period of development from *I. sexdentatus* eggs laid in the first generation to the emergence of young adults is 40 days (Bonnemasion, 1962). However, it is also reported that this period can increase to 78 days in nature, due to larval development phases being affected by climate conditions (Chararas, 1962). A total of 40 days period of a generation of this beetle (Ozder, 1978) was detected as 60 days in Artvin (Ataman, 1967). Brood development from the start of gallery construction until the emergence of the new generation adults may take 2 to 3 weeks at a constant laboratory temperature of 27°C and 3 to 4 weeks at 22°C. No gallery construction and brood production succeeds at a constant temperature of 12°C. Overwintering is in the adult stage. The super-cooling point in hibernating adults is about -19°C, whereas in larvae it is only -9°C (Bakke, 1968). At both altitude steps, the numbers of beetles trapped in the first flight are higher than those in the second flight. Average capture rates per trap in 2006 and 2009 are respectively 2.74 and 2.17 times higher in the first flight periods than the second flight periods at the first altitude steps and respectively 6.68 and 1.62 times higher in the second altitude steps. Highest catches in the first flight happened between 15th May and 13th June. The orientations of the over-wintering adults to dead and felled trees in the second flight might have caused them to react less to the aggregation pheromone used. In this case, it can be more valid to take into account the capture amounts for sampling the populations in the monitoring programs. Although pheromone preparations in the traps are replaced before the second flight, the capture efficiency decrease in this flight period may require a research on the format of the chemical compound of the pheromone preparations to be used for this flight. Most of the pheromone traps caught the predator species *T. formicarius* as well as *I. sexdentatus*. In 2006, at Yesiltepe region, between 3rd May and 24th August, all lively 207 *T. formicarius* adults were taken from 31 of 40 traps. In each trap 1 *T. formicarius* adult was captured against an average of 43.92 *I. sexdentatus* adults. Additionally, in eight different controls, 1 to 6 *T. formicarius* adults were found in traps where no *I. sexdentatus* adults existed. *T. formicarius* is an abundant and voracious predator of bark beetles. It is attracted by bark beetle pheromones and host tree substances (Schroeder, 1997). Serez (1983) states that next to *I. sexdentatus*, parasitoid species are also caught by pheromone traps as well as predator species *T. formicarius*. Clerid beetles react to the same pheromones with their preys (Aukema et al., 2000). In the mechanical control against *I. sexdentatus* in Murgul in 1985, plenty of predators (*Rhizophagus dispar*, *T. formicarius*, *Raphidia* sp.) were found in beetle galleries (Alkan and Aksu, 1990). The assessments based on fresh *I. sexdentatus* galleries in the Eastern Black Sea Region between 1992 and 1996, *T. formicarius, Cylister oblongum*, *Paraphloeus longulus*, *Rhizophagus depressus*, *Rhizophagus dispar* and *Hypophloeus unicolor* were found to be the most effective predators (Yuksel 1998). In the experiments, it was observed that *T. formicarius* reduced *T. piniperda*'s (L.) (Coleoptera: Scolytidae) reproduction efficiency as much as 81 to 92% (Schroeder, 1996; Schroeder and Weslien, 1994). Therefore, having this many *T. formicarius* adults in the traps comes out as a disadvantage of pheromone traps. Furthermore, in 2006, 18 *I. typographus* adults were captured by 5 traps containing Tryphreon Ipstyp aggregation pheromone. In 2009, *I. typographus* was not caught in any traps other than these, including the 13 traps containing the same pheromone preparation. Also, *I. typographus* was not found among the beetles captured by traps with *I. sexdentatus* preparations, where *I. typographus* had been caught previously. This situation may be an indication of the selectivity of the used pheromone preparations against species.

The existence of *I. typographus* in Turkish oriental spruce forests has been known for 75 years (Berker, 1936; Alkan, 1964). However, *I. typographus* has developed a very severe outbreak effective in a 15,000 ha area, in 1984 in Artvin (Alkan, 1985), the first infested region after the great scale outbreak first caused by *D. micans* in the spruce forests (Eroglu et al., 2005). The results of these captures by pheromone traps, which were made after the first detection of *I. typographus* in Trabzon-Macka spruce forests, were a second finding of this beetle in these forests. The second big outbreak of *I. typographus* occurred in the spruce stands of Giresun where *D. micans* infested after Artvin. These pheromone traps, which were mostly used to support pressuring of low-intensity populations and to gather data on population fluctuations, made it available to detect the existence of a very dangerous species, *I. typographus,* in the region, a species which stayed under such low densities that could not be detected with other methods for long.

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