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CURRENT STATUS OF BARK BEETLES DISTRIBUTION AND IDENTIFICATION IN GEORGIA-TURKEY BORDER AREA

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ABSTRACT:

The transboundary region encompassing forests in Adjara (Georgia) and Turkey is experiencing significant ecological challenges due to bark beetle infestations, particularly by species such as Ips sexdentatus, Dendroctonus micans, and Ips typographus. These infestations are leading to notable biodiversity loss and ecosystem disruption. This study underscores the importance of addressing pest invasions within transboundary areas, where ecological and anthropogenic factors often impede effective management. Given the exacerbating role of climate change on pest proliferation, understanding the dynamics of bark beetle infestations in these forests is crucial for regional biodiversity conservation and forest health maintenance.

Methodologically, the research employed a two-pronged approach: extensive field surveys for real-time data collection and pheromone traps to ascertain the distribution and intensity of bark beetle activity across the Georgia-Turkey border area. Subsequent laboratory analysis facilitated precise pest identification, offering insights into species-specific infestation patterns and population dynamics.

Results from the study reveal a concerning spread of bark beetle populations, with significant implications for the structural integrity and functionality of forest ecosystems. The findings emphasize the need for an integrated pest management strategy that leverages scientific research, community involvement, and cross-border cooperation to mitigate the adverse effects of bark beetle infestations. Ultimately, this research contributes to the broader discourse on sustainable forest management in transboundary contexts. It highlights the critical role of coordinated efforts in preserving ecological balance and ensuring the resilience of forest landscapes in the face of climatic and anthropogenic pressures.

Keywords: Ips typographus, spruce, forest, bark beetle, biology, Georgia-Turkish border area

1. INTRODUCTION

Forests are one of the main sources of life, and the future of forests is intrinsically linked to the future of humanity. Therefore, it is crucial to protect forests and pass them on to future generations. Forests represent the prestige, dignity, and security of a country. The phrase "heaven and homeland" often symbolizes the existence of the green cover called forests. Globally, there are approximately 4 billion hectares of forest area, with 21.7 million hectares in Turkey and 3,420,400 million hectares in Georgia (FAO, 2020).

However, the amount of forested area is decreasing day by day due to negative factors such as fire, pollution, disease, insects, and incorrect planning. Among these insects, bark beetles (Coleoptera: Curculionidae: Scolytinae) cause the most damage. Of the more than 6,000 species of bark beetles identified worldwide, nearly 150 species are distributed in the forests of Turkey. The number of insect species found to be harmful in these forests is 31. Although bark beetles are typically known as secondary pests, in some years, they become primary pests with excessive population growth, leading to significant tree mortality. Bark beetle outbreaks caused an epidemic that dried out approximately 2,000,000 cubic meters of trees between 1980 and 2014.

In contemporary forestry, efforts to control bark beetles are an essential part of forest management activities. Various methods have been used to control bark beetles in

Turkey and Georgia have implemented various control strategies for years, including mechanical, chemical, biotechnical, and biological methods. Following the identification of pheromones for certain species, synthetic pheromones have been widely used for both mass capture and population estimation. Modern control methods also incorporate the use of predators and parasites of harmful species, the installation of bird nests, and the introduction of specific pathogens.

No study has yet examined the distribution and species diversity of bark beetles in the coniferous forests of Turkey and Georgia. Therefore, this research aims to address this gap by investigating the distribution and diversity of bark beetles in the border zone between these two countries.

The Georgia–Turkey border, spanning 273 km, encompasses diverse geographical and ecological characteristics that contribute to its rich biodiversity. According to the 2023 National Forest Census of Georgia, the forested area totals 3,420,400 hectares, with 3,100,500 hectares of woody plants forming forests, constituting 44.5% of the country's territory (Vasadze, 2024). Common coniferous species in Georgia include Oriental Spruce (*Picea orientalis*), pine (*Pinus spp*.), firs (*Abies spp*.), yew (*Taxus baccata*), cypress (*Cupressus spp*.), juniper (*Juniperus spp*.), cedar (*Cedrus spp*.), and larch (*Larix spp*.) (Abashidze, 1959). In Adjara, Oriental Spruce thrives at altitudes from 100 meters in the Machakheli Valley up to 2,400 meters, forming high-productivity forests primarily between 1,500 and 1,800 meters above sea level (Vasadze, 2024).

In Turkey, the Shavşat Forest Enterprise Directorate manages 68,203.90 hectares of forest, with 28,286.80 hectares degraded and 39,917.10 hectares in good condition. Artvin Şavşat forests primarily consist of pure and mixed coniferous forests, with Eastern Spruce (Picea orientalis) being the most widespread species, followed by Scots Pine (*Pinus sylvestris*) and Eastern Black Sea Fir (*Abies nordmanniana*) (General Directorate of Forestry, Ankara).

In the coniferous forests of Georgia and Turkey, various harmful insect species have been recorded and studied by different scientists and experts over time (Vinogradov-Nikitin, Zaitsev, 1926, Schimitschek, 1953, Goginashvili et.al. 2021, Vasadze, 2023, 2024, Gokturk et al, Unal 2005, 2010, 2012, 2015, Aksu et. al, 2014, Tavadze, 2003). Some of these species are present in such small numbers that they do not cause significant economic damage. However, others can multiply rapidly, leading to the wilting of individual trees or entire groves. This results in group-type foci of wilting as well as scattered wilting in the form of single trees.

The rapid increase in the distribution area of these harmful insects makes it crucial to detect, recognize, and analyze the potential outcomes promptly. Proper and timely planning of control measures against these pests is of significant practical and economic importance.

2. METHODS

To assess the spread of harmful bark beetles, reconnaissance studies were conducted in the border zone of Turkey and Georgia, specifically in Mountain Chirukh within the Shuakhevi Municipality (Georgia) and in the vicinity of Mt. Shavsheti (Artvin, Turkey).

Insect identification and taxonomic research were conducted using standard entomological methodologies (Busarova & Negrobov, 2020). Pheromone traps were used to monitor bark beetle populations and study their flight dynamics, with two traps per hectare placed in Chirukh (Georgia) and Shavsheti (Turkey).

In the first stage of the research, the selection of the study area was conducted in the Georgia-Turkey border regions, considering geographical and ecological features using geographic information system (GIS) analysis.

The research area in Georgia was Shuakhevi Municipality, specifically Mt. of Chirukhi. The exact location of the study area is between the coordinates 41.491167, 42.410722, and 41.476026, 42.451837. The research area in Turkey was Shavsheti, located within the following coordinates: 41.451229, 42.382543, and 41.432024, 42.449244.

The mountainous region along the Adjara-Turkish border in the Shuakhevi area is characterized by remarkable ecological and geographical diversity. This area, part of the Lesser Caucasus mountain range, features unique landscapes and diverse ecosystems, making it significant for the pheromone traps placed in 2021 Chirukhi (Georgia) across various blocks (locations) to provide critical insights into the seasonal dynamics and distribution of bark beetles in the Georgia-Turkey border region. The data reveals the following key points:

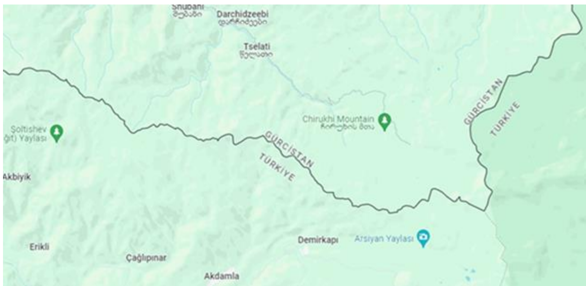
Blocks 1-3(Table 1): Traps were placed on 7th May, and pest removal data was collected from 15th May to 2nd July. The average number of pests removed from one trap varied significantly, from 85.52 on 15th May to 167.13 on 2nd July. The total number of pests captured increased steadily over time, indicating a rising pest population throughout the monitoring period. The peak capture period was in early to mid-June, highlighting this as a critical period for intensified pest control efforts.

Blocks 4-8: Traps were placed on 31st May, with pest removal data collected from 8th June to 26th July. The average number of pests removed from one trap ranged from 145.50 to 198.72. The pest captures showed a significant rise, peaking around late June and early July. This suggests a slightly later peak in pest activity compared to Blocks 1-3, possibly due to environmental or geographical differences.

The total pests captured from all blocks in 2021 amounted to 774,629, reflecting a substantial bark beetle distribution in the region. Environmental studies and conservation efforts. The region includes sections of the Lesser Caucasus Mountains, which transition into the Pontic Mountains in Turkey. The terrain is rugged, with steep slopes and high peaks reaching elevations of over 2,400 meters.

Artvin, in Turkey, encompasses a total forest area of 404,208 hectares, with an estimated timber volume of approximately 54.54 million m³, an annual increment of 973,914 m³, and an annual production of 150,575 m³, positioning it as a significant region (Turkish General Directorate of Forestry, 2020). Artvin is also notable for its biodiversity, hosting 137 families, 761 genera, and a total of 2,727 natural plant taxa with vascular bundles, making it Turkey's richest region in terms of flora. There are 500 species at risk, of which 198 are endemic and 302 are non-endemic but rare. In terms of forest assets, Artvin contributes 2% of Turkey's forested areas and 6% of its timber wealth. The Şavşat Forest Management Directorate oversees a total forest area of 68,203.90 hectares, comprising 39,917.10 hectares of normal forest and 28,286.80 hectares of degraded forest. Most of the forests in Artvin Şavşat are pure and coniferous, forming mixed forests. The species with the widest distribution is Eastern Spruce (*Picea orientalis*), followed by Scots Pine

(*Pinus sylvestris*) and Eastern Black Sea Fir (*Abies nordmanniana*).



Picture 1. The research area

3. RESULTS AND DISCUSS

In the coniferous forests of Georgia and Turkey, various harmful insect species have been recorded and studied by scientists and experts over time. Some of these species are present in such small numbers that they do not cause significant economic damage. However, others can multiply rapidly, leading to the wilting of individual trees or entire groves. This results in group-type foci of wilting and scattered wilting in the form of single trees.

The rapid increase in the distribution area of these harmful insects makes it crucial to detect, recognize, and analyze the potential outcomes promptly. Proper and timely planning of control measures against these pests is of significant practical and economic importance. During the registration of harmful bark beetles, special attention was given to trunk pests belonging to the *Ipidae* family, specifically the large spruce bark beetle (*Dendroctonus micans Kug*.), the printing bark beetle (*Ips typographus L*.), and the pine bark beetle (*Ips acuminatus Eichn.)*

Table 1. Bark beetle's quantity in Chirukhi (Georgia), 2021.

Block	Pheromone traps	Traps placement time	Pests (IPSTYP+ IPSSEX) removal data in 2021.						
			15.05.	**23.05.**	**31.05.**	**08.06.**	**16.06.**	**24.06.**	**02.07.**
1	131	07.05.	8 228	14 960	14 025	19 635	12 155	12 903	14 025
2	89	07.05.	9350	14 025	19 635	21 131	22 440	22 253	22 627
3	100	07.05.	8789	12 155	14 399	12,155	14 025	14 960	16 830
The total quantity of pests in stages			**27 367**	**41 140**	**48 059**	**52 921**	**48 620**	**50 116**	**53 482**
The average number of pests removed from one trap			**85,52**	**128,56**	**150,18**	**165,37**	**151,93**	**156,61**	**167,13**
Time of pest **removal**			**08.06**	**16.06**	**24.06**	**02.07**	**10.07**	**18.07**	**26.07**
4	44	31.05.	6 919	8 415	8 789	9 537	10 098	9 163	8 789
5	34	31.05.	9 163	14 025	14 960	15 895	16 643	14 212	14 025
6	65	31.05.	10 846	11 220	12,155	14 399	15 334	14 025	12 903
7	60	31.05.	10 098	12 155	13 277	13 651	14 586	12 529	11 033
8	180	07.05.	18 700	7285	13 090	22 627	14 960	17 765	18 139
The total quantity of pests in sages			**55 725**	**54 604**	**62 271**	**76 109**	**71 621**	**67 694**	**64 889**
The average number			**145,50**	**142,57**	**162,59**	**198,72**	**187,00**	**176,75**	**169,42**
Total Quantity of pests in the year			**321 725+452 904=774 629**						

Block 1-3 Data: Total number of traps in Blocks 1-3: 131 (Block 1) + 89 (Block 2) + 100 (Block 3) = 320 traps

Block 4-8 Data: Total number of traps in Blocks 4-8: 44 (Block 4) + 34 (Block 5) + 65 (Block 6) + 60 (Block 7) + 180 (Block 8) = 383 traps.

In 2021, pheromone traps were placed in Chirukhi (Georgia) across various blocks to provide critical insights into the seasonal dynamics and distribution of bark beetles in the Georgia-Turkey border region. The data reveals several key points:

Traps were placed in Blocks 1-3 on 7th May, with pest removal data collected from 15th May to 2nd July. The average number of pests removed per trap varied significantly, from 85.52 on 15th

May to 167.13 on 2nd July. The total number of pests captured increased steadily over time, indicating a rising pest population throughout the monitoring period. The peak capture period was in early to mid-June, highlighting this as a critical period for intensified pest control efforts.
In Blocks 4-8, traps were placed on 31st May, with pest removal data collected from 8th June to 26th July. The average number of pests removed per trap ranged from 145.50 to 198.72. The pest captures showed a significant rise, peaking around late June and early July. This suggests a slightly later peak in pest activity compared to Blocks 1-3, possibly due to environmental or geographical differences.
Data collected in 2023 from Chirukhi (Georgia), presents a detailed view of the pest dynamics. Traps were placed on 14th June, with pest removal data collected from 21st June to 8th August. The average number of pests removed per trap ranged from 211.0 on 21st June to 35.06 on 8th August. A notable peak in pest captures occurred in late June and early July, followed by a decline towards the end of the monitoring period. Traps placed on 14th June: Pest removal data was collected from 21st June to 8th August.

Table 2. The Bark beetle's quantity in Chirukhi (Georgia), 2023

Block	Pheromone traps	Traps placement time	Pests (IPSTYP+ IPSSEX.) removal data in 2023.						
			21.06	29.06	07.07	15.07	23.07	31.07	08.08
1	100	14.06.	20 757	23 375	22 814	4 310	6 545	5 797	3 366
2	100	14.06	18 887	34 595	31 790	30 855	7 480	6 171	3 927
3	100	14.06.	22 066	23 936	21 505	29 546	7 667	7 106	3 740
4	100	14.06.	22 814	24 497	23 936	27 115	8 415	6 732	2 992
Total quantity in stages			84 524	106 403	100 045	111 826	30 107	25 806	14 025
The average number of pests removed from one trap			211,0	266,0	250,1	279,6	75,3	64,5	35,06
Total quantity in the year			472 736 pests						

The average number of pests removed from one trap ranged from 211.0 on 21st June to 35.06 on 8th August. A notable peak in pest captures occurred in late June and early July, followed by a decline towards the end of the monitoring period.
In Shavsheti, Turkey, the 2023 data analyses two species of bark beetles: *Ips typographus* (IPS TYP) and *Ips sexdentatus (*IPS SEX). The average number of pests removed per trap for IPS TYP ranged from 110.13 to 229.5, while for IPS SEX, it ranged from 158.0 to 278.53. Significant fluctuations in pest captures were observed, with notable peaks in late June and mid-July Table 3). It should be noted that the study area for pest monitoring in Shavsheti was only 20% of the size of the study area in Georgia. Consequently, the concentration of both types of pests in Shavsheti could be five times higher. This high pest concentration has had a significant impact on the region, with over 15,000 conifers withering in the study area over the past three years.

Table 3.The Bark beetle's quantity in Shavsheti (Turkey), 2023.

Pheromone Traps	Pests Species	Pests (IPSTYP+ IPSSEX) removal data in 2023.										
		17.05	23.05	02.06	10.06	19.06	28.06	7.07	17.07	26.08	06.08	Total
75	IPS TYP	8260	11080	13550	9900	6600	9500	14500	17210	7900	4500	103000
The average number of pests removed from one trap		110,13	147,7	180,67	132,0	88,0	126,7	193,3	229,5	105,3	60	
75	IP SSEX	11850	13480	15750	12150	8950	10500	17230	20890	9250	6950	127.000
The average number of pests removed from one trap		158,0	179,73	210	162,0	119,3	140,0	229,73	278,5	123,3	92,7	
Total pests quantity		20110	24560	29300	22050	15500	20000	31730	38100	17150	11450	

Both 2021 and 2023 data in Georgia show peak pest activity in June and July, emphasizing this period as critical for pest control measures. The slight variation in peak times between the two years and regions may be attributed to climatic differences or local environmental factors.

The average number of pests per trap was generally higher in 2023 compared to 2021, indicating either a larger pest population or more effective trapping methods in 2023.

In Shavsheti, the pest density was higher for the IPS SEX species compared to IPS TYP, reflecting species-specific population dynamics and habitat preferences.

Studies on the growth and development of different stages of the bark beetle (egg, larva, pupa, and adult) were conducted under laboratory and field conditions using internationally recognized forestry methods. Research in the Adjara forests has shown that mass reproduction of pests is promoted by high fertility rates, rapid development, high generation rates, biotic factors, resistance to climatic factors, improper agricultural practices, and reduced forest density.

In winter, 80% of the pest population is found within the snow cover, from the root collar to a height of up to 2 meters on the stem, with a smaller number above the snow cover. The pest population is also found in the soil layer 6-8 cm deep and in the fallen tree bark at a distance of 2.5-3.0 meters from the trunk, where thousands of insects gather. This location presents an effective opportunity for chemical control methods (insecticides).

The egg stage of the pest lasts 10-20 days, the larval stage 20-30 days, and the pupal stage 7-15 days. The complete development of a new generation takes approximately 35-65 days. At a temperature of 0°C, the growth and development of the pest in all its stages (larva, pupa, and immature beetles) is very slow. However, as the temperature increases, the growth rate accelerates. At 0°C, the spruce bark beetle moves very slowly, and no flight or adverse effects are observed. However, at 20-25°C, constant flight and strong activity occur. In different environments of the study area, adult male beetles reach up to 5.5 mm in length, while females reach up to 5.9 mm.

Timely and appropriate forestry management measures are needed to minimize the pest population.

Major Pests of Coniferous in the Georgia-Turkey Border Area

Of the more than 6,000 species of bark beetles identified worldwide, nearly 150 species are distributed in the forests (Raffa et al. 2008). The number of insect species found to be harmful in the Ajara-Shavsheti border area forests is 31 (Sertkaya, 2010). Many coniferous pests in the Georgia-Turkey border area infest different parts of the spruce trunk with varying intensity and harmful effects. These pests generally settle at a height of 1-2 meters near the root collar (root neck), at different heights of the trunk, on the trunk, branches, and roots (bark eaters). Currently, the numbers and damage caused by some pests are so low that they do not have significant economic value and do not pose a threat. However, their impact is expected to increase with climate change, necessitating constant monitoring and control (Vasadze, 2024).

Special attention should be paid to the harmful diseases caused by the European spruce bark beetle *(Ips typographus L.)*, which requires constant monitoring, as well as the spined spruce bark beetle (*Ips acuminatus Eichn.),* the spruce bark beetle (*Dendroctonus micans Kugel.),* the six-toothed bark beetle (*Ips sexdentatus Boern.),* the two-toothed bark beetle (*Pityogenes bidentatus Fabr.),* and the four-toothed bark beetle (Pityogenes quadridens Hert.).

Due to the anticipated impact of climate change, the numbers and damage caused by these pests are expected to increase, necessitating ongoing monitoring and effective control measures to protect forest health and maintain ecological balance.

In 2023-2024, during the research process, the following species of bark beetles were identified in the border zone of Adjara-Shavsheti:

1. Ips. Typographus (Linnaeus, 1758)

Tree species detected: *Picea orientalis*.

Distribution in the world: Europe, Palestine, Georgia, Japan, Caucasus, Cyprus, North America, North Africa, Jordan, and Turkiye (Selmi, 1998; Yüksel, 1998; Gokturk, 2002; Vasadze, 2023).

The adult is 4-6 mm in size, cylindrical, dark brown or black, with yellow feathers on the sides of the body and the front of the head. The antenna legs are yellowish-light brown.

It is a secondary harmful species and prefers physiologically weakened old trees as hosts. The damage of this bark beetle, which prefers trees with thick bark and generally damaged and broken cover, starts from the top of the tree. The main paths cause destruction parallel to the wood fibers of the tree, while the larval paths are perpendicular. Although the main path usually has 2 arms depending on the number of females, sometimes it may have 1 or 3 and rarely 7 arms.

2. Ips sexdentatus (Boerner, 1776)

Tree species detected: Abies nordmanniana, Picea orientalis, Pinus sylvestris.

Distribution in the world: Europe, Japan, Caucasus, Korea, Northern China, Türkiye (Yüksel, 1998; Gokturk, 2002; Pfeffer, 1995, Vasadze, 2024).

The adult is 5.5-8 mm in size, shiny brown-black, and has long hair. They have twelve teeth in total, six on each side of their rump. The fourth tooth from the top is the largest and its tip looks like a button.

It is a secondary harmful species. The damage of this bark beetle, which prefers trees with thick bark and generally damaged and broken cover, starts from the top of the tree. The main paths cause destruction parallel to the wood fibers of the tree, while the larval paths are perpendicular. Rapid and massive drying is observed in trees whose cambium layer is damaged. Although the main tract can have 1 to 9 arms depending on the female size, it is usually 3-armed.

3. Dendroctonus micans (Kugelann 1794)

Hosts: Picea orientalis.

Distribution in the world: All Europe, Georgia, Japan, Caucasus, Korea, North America, Turkey (Sekendiz, 1981, Çanakcıoğlu, 1998, Yüksel, 1998; Gokturk, 2002, Vasadze, 2024).

Description and Biology: The adult is 5.5-9 mm in size and is known as the largest of the bark beetles. In adults, the body is cylindrical, dark brown or blackish, and the antennae and legs are reddish brown. Young adults are yellow or light brown.

Harm: It is primarily harmful. The larvae that emerge from the eggs laid collectively by the female feed on the cambium, causing the moth to dry out. Abundant amounts of resin in trees exposed to D.micans attack.

4. Tomicus piniperda (Linnaeus 1758)

Tree species identified: Pinus sylvestris

Hosts: Picea orientalis, Pinus brutia P. nigra, P. pinea, P. sylvestris

Distribution in the world: Europe, Palestine, Georgia, Japan, Caucasus, Cyprus, North America, North Africa, Jordan, Turkey (Tosun, 1977; Acatay, 1969).

Description and Biology: The adult is 3-5 mm in size, blackish-yellowish red, and the head and thorax are black. The antennae and feet are yellowish-red. There are two pits on the rump.

Harm: It is a secondary pest and is harmful to fallen and sometimes planted trees that have lost their resistance. The adult paths it creates in the tree are seen as two branched paths in the bark. It spends the winter in its adult stage.

5. Tomicus Minor (Hartig 1834)

Tree species detected: Picea orientalis, Pinus sylvestris

Distribution in the world: Europe, Japan, Caucasus, Corsica, Northern China, Türkiye (Çanakcıoğlu, 1998; Yüksel, 1998; Pfeffer, 1995, Vasadze, 2024).

Distribution in Turkey: Adana, Ankara, Antalya, Ardahan, Artvin, Balıkesir, Bartın.

Description and Biology: Adult size is 3.4-4 mm, the width of the neck shield is longer than the neck. The insect's rump is pitless and its wing coverts are reddish brown. The head and thorax are black. There is no depression on the rump.

Harm: It can also damage healthy trees. The insect causes two types of damage to trees. First; The main paths opened by the insect can cut the wood fibers vertically, causing the tree to dry out.

6. Ips acuminatus (Gyllenhal 1827)

Tree species detected: Picea orientalis, Pinus sylvestris.

Distribution in Turkey: Antalya, Artvin, Bartın, Bolu, Denizli, Eskişehir (Çanakcıoğlu, 1998; Yüksel, 1998; Vasadze, 2024; Gokturk, 2002).

Description and Biology: Adults are 2.8-3.8 mm in size, young adults are light brown, old adults are dark brown to reddish brown, and have 3 tooth-shaped protrusions on both sides of their body. The third tooth from above is flat, expanded, and two-pronged in males, and simple single-pronged in females.

Harm: It is a secondary harmful species and damages thin-barked trees that have previously been weakened. For this reason, it mostly affects the tops, branches, and pole-aged trunks of trees. The adult paths formed in the tree are generally seen as 3-5 branches, although the main path in the bark may have 3-12 branches.

7. Hylurgops palliatus (Gyllenhal 1813)

Tree species detected: Picea orientalis, Pinus sylvestris

Distribution in the world: Germany, USA, Belgium, Finland, France, Georgia, England, Italy, Japan, Caucasus, Corsica, North Africa, Siberia, and Turkey (Selmi, 1998; Çanakcıoğlu, 1998; Yüksel, 1998; Vasadze, 2024).

Description and Biology: The adult is 2.5-4 mm in size, blackish brown or dark brown reddish. The lateral edges of the wing coverts are generally black except for young adults. The wing covert is grained in rows so that the dot stripes can be recognized towards the front.

The antennae and feet are brown-red.

Harm: It is a secondary pest and is harmful to the thick-barked parts of fallen and sometimes standing trees that have lost their resistance. The adult paths it creates in the tree are seen as a branched vertical path in the bark. It spends the winter in its adult stage.

8. Hylastes ater (Paykull, 1800)

Tree species detected: Picea orientalis

Distribution in the world: Europe, Caucasus, Japan, Türkiye (Bevan, 1987; Grune, 1979; Kobakhidze, 1967).

Description and Biology: In adults, its body color is matte black and dark brown, its antennae and legs are reddish, and it is 3-3.5 mm in size, with rows of large circular, equidistant points on the wing coverts. The neck shield is glossy black and is noticeably longer than it is wide.

Harm: This insect, which is a secondary pest, is mostly harmful to trees that have lost their resistance, are diseased, fallen, and sometimes planted. The main road is a branched vertical road type. It spends the winter in the adult period.

9. Pityogenes bidentatus (Herbst 1783)

Tree species detected: Picea orientalis

Distribution in the world: Georgia, Israel, Northern and Central Europe, Caucasus, Russia, Türkiye (Selmi,1998; Çanakcıoğlu, 1998; Yüksel, 1998).

Description and Biology: The adult is 1.5-2.8 mm in size, cylindrical, light brown, reddish brown or black in color. It is a large tooth bent downwards in the form of a hook on the upper side of the

insect's rump and appears to have two hook-shaped ends.
Harm: It is a secondary harmful species and prefers thin-barked trees that have suffered physiological damage. It forms a main road in a star-like shape.

Species: 10. Pityokteines curvidens (Germar 1824)

Tree species detected: Picea orientalis, Abies nordmanniana
Distribution in the world: Europe, Caucasus, Japan, Türkiye (Baş, Selmi, 1985; Pfeffer, 1995).
Description and Biology: The adult is 2.5-3.2 mm in size, cylindrical, brown-black, and has yellowish-brown hairs on it. The antenna legs are light brown. The rump is upright, sloping, and shiny and has three teeth on each side. The first of these three teeth is curved upwards, and the second, the largest, is curved downwards in a hook shape. In female insects, the teeth on the rump are small and blunt.
Harm: Although it is a secondary pest, it can become a primary pest under suitable conditions. It generally prefers thick-barked trees, especially weakened trees close to the physiological age limit, as hosts. It causes damage to the same tree together with *Pissodes* P*iceae* and *Cryphalus*
Picea species.

2. CONCLUSION

The study's data underscores the critical importance of continuous and timely pest monitoring to effectively manage bark beetle populations. By focusing on the peak activity periods and employing an integrated pest management approach, it is possible to mitigate the adverse effects of bark beetle infestations on forest ecosystems along the Georgia-Turkey border. The cooperation between the two regions, sharing data and coordinating pest management efforts, is essential for preserving ecological balance and ensuring the resilience of these forest landscapes.
The study highlights the need for continuous and timely pest monitoring to manage bark beetle populations effectively. By focusing on the peak activity periods and employing integrated pest management strategies, it is possible to mitigate the adverse effects of bark beetle infestations on forest ecosystems along the Georgia-Turkey border. This research emphasizes the importance of regional cooperation in preserving ecological balance and ensuring the resilience of forest landscapes.
In 2021 and 2023 both regions (Chirukhi, Shavsheti) were effective in capturing pests, with the average captures providing valuable data for monitoring and control strategies. The highest average capture rates were observed during the peak activity periods, underscoring the importance of timely interventions.

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