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Predatory species of Scolytinae in Bursa province of Turkey

Abstract. Scolytinae, a large group of Coleoptera, are a vital community that causes forest damage. Species such as *Pityokteines curvidens* (Germar), *Orthotomicus erosus* (Wollaston), *Tomicus destruens* (Wollaston), *Tomicus minor* (Hartig) and *Ips sexdentatus* (Boerner) are particularly prevalent in the region. In recent years, the prevalence of bark beetle species causing tree damage in the Bursa province has increased. The purpose of this study was to determine the predator species of bark beetles responsible for causing damage in the forest areas of the Bursa province. Specimens were collected from 8 sites in the study area and identified as belonging to 25 species in 2 orders and 12 families. In study found that species such as *Synuchus vivalis* (Illiger), *Opilo taeniatus* (Klug), *Trichodes apiarius* (Linnaeus), *Anthrenus scrophulariae* (Linnaeus), *Trogoderma angustum* (Solier), *Trogoderma glabrum* (Herbst), *Ampedus cinnaberinus* (Eschscholtz), *Cylister angustatus* (Hoffmann), *Cylister filiformis* (Erichson), *Rhizophagus depressus* (Fabricius), *Rhizophagus dispar* (Paykull), *Ipidia binotata* (Reitter), *Corticeus linearis* (Fabricius), *Corticeus pini* (Panzer), *Nemosoma elongatum* (Linnaeus) and *Dichrostigma flavipes* (Stein) represent new records for both the Marmara Region and the Bursa province. It has been observed that eight species of insects, region *Clerus mutillarius* (Fabricius), *Thanasimus formicarius* (Linnaeus), *Aulonium ruficorne* (Oliver), *Cylister elongatus* (Thunberg), *Hypnogyra angularis* (Ganglbauer), *Megalinus scutellaris* (Fauvel), *Corticeus fraxini* (Kugelann) and *Temnochila caerulea* (Olivier), have set new records for both the Marmara Region and the Bursa province of Turkey. Additionally, the presence of these species in the Bursa province represents a new record for the area. These findings were obtained through extensive studies of the insect populations in these regions.
Key words: Scolytinae, predatory species, Bursa, Turkey, distribution.

Introduction

Forests are an essential part of the global ecosystem, providing a home for countless species of plants and animals and supporting countless vital ecological processes. For centuries, humans have relied on forests for their livelihoods, for building materials, and for many other essential resources. Unfortunately, our forests are under threat. As human populations continue to grow and expand, we are putting increasing pressure on the world's forests, with devastating consequences. Deforestation and habitat destruction are among the greatest threats to forests and the species that depend on them, and these problems are only getting worse [1-2].

One of the major threats to forests is the proliferation of pests and diseases. Many species of insects and other invertebrates are considered pests because they feed on and damage the trees and other plants that make up the forest ecosystem. In many cases, these pests are able to reproduce and spread rapidly, causing significant damage to forests and threatening their continued existence.

One group of insects that is particularly dangerous to forests is the bark beetles. These insects belong to the Scolytinae subfamily of the Coleoptera order, and they are known for their ability to attack and damage trees. In many cases, bark beetles prefer to attack trees that are already weakened by other factors, such as disease or environmental stress. This makes them a secondary pest, as they are able to exploit the vulnerabilities of trees that have already been weakened by other factors [3].

The presence of bark beetles can have serious consequences for forests. When these insects attack a tree, they burrow into the bark and feed on the tissues underneath. This can kill the tree, and in some cases, large numbers of bark beetles can kill entire stands

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of trees. In addition, bark beetles can also transmit diseases and other pathogens, further weakening the trees and making them more susceptible to other pests and diseases.

In order to protect our forests and the biodiversity they support, it is essential that we understand the ecology of bark beetles and the factors that influence their populations. By studying the predatory species of bark beetles in specific regions, we can learn more about the natural mechanisms that keep their populations in check. This information can be used to develop strategies for mitigating the damage caused by bark beetles, and for protecting the forests that are so vital to the health of the planet [4].

The purpose of the study was to identify the predatory species of bark beetles in the Bursa region, in order to better understand the ecological dynamics at play and develop strategies for mitigating the damage caused by these insects. By understanding the natural mechanisms that keep bark beetle populations in check, we can work to protect our forests and the biodiversity they support. The findings of this study will be useful for forest managers and other stakeholders who are working to protect the forests of the Bursa region.

Materials and methods

This study was conducted in the forest areas of the Bursa province in Turkey during 2021. Turkey is a country located at the crossroads of Asia, Europe, and North Africa, which gives it a unique combination of temperate and Mediterranean climates. This climatic diversity supports a rich variety of forest ecosystems, with coniferous forests covering approximately 42% of the country's forested areas. Bursa province is located between 40°12 north latitude and 29°04" east longitude, next to Anatolia and in the south of the Marmara Region. Bursa, which connects the Marmara Region to Central Anatolia and Western Anatolia, has the Sea of Marmara in the north, Kütahya in the south, Bilecik in the target and Balıkesir at the end. The study was carried out in eight different experimental areas, including Uludağ, Osmangazi, Soğukpınar, Çalı, Mudanya, Arasdere, Kayapa, and Uludağ National Park. These areas were selected because they were known to have high levels of bark beetle damage. During the course of the study, a total of 25 predatory species of bark beetles were identified in these areas (Figure 1, Table 1).

Figure 1 – Sampling sites and main tree species.

Table 1 – Experimental areas, tree species, altitudes and coordinate of sampling sites

Experimental areas	Tree species	Coordinate	Altitude
Uludağ	*Pinus nigra*	40°07′11,204″N	934
		28°59′53,303″E	
Osmangazi	*Pinus brutia*	40°16′26,584″N	458
		29°08′41,59″E	
Soğukpınar	*Pinus nigra*	40°02′58,857″N	765
		29°05′17,946″E	
Çalı	*Pinus brutia*	40°08′3,413″N	286
		28°58′9,442″E	
Mudanya	*Pinus brutia*	40°20′34,684″N	75
		28°56′26,565″E	
Arasdere	*Abies nordmanniana subsp. bornmulleriana* and *Pinus nigra* mixed	40°20′34,849″N	1312
		28°56′21,226″E	
Kayapa	*Pinus brutia*	40°07′34,277″N	197
		28°45′20,154″E	
Uludağ National Park	*Abies nordmanniana subsp. bornmulleriana*	40°08′29,223″N	1402
		29°05′35,594″E	

Pheromone traps were set in the experimental areas, including Uludağ, Osmangazi, Soğukpınar, Çalı, Mudanya, Arasdere, Kayapa and Uludağ National Park, predators were observed. SMC-PICU containing 150 mg of Ipsenol for ORTERO *P. curvidens* with 1500 mg of methyl butenol + 100 mg of cis-verbanol + 30 mg of Ipsdienol for *O. erosus* in pheromone traps; SMC-BLAMI for *T. minor* containing 700 mg + 20 mg cis-verbanol + 350 mg terpinole; IPSSEX containing ca.60 mg of Ipsdienol for *I. sexdentatus*; For *I. acuminatus*, pheromone dispensers containing 50 mg of ipsenol, 50 mg of ipsdienol and 50 mg of cis-Verbenol were used in each one. In addition to the pheromone traps, trap trees were also installed in the experimental areas. These trees were pruned and treated with the appropriate pheromones to attract bark beetles, and the coordinates of the pruned branches were recorded in order to monitor the traps over time. Throughout the study, specimens of bark beetles were collected from various sources, including damaged trees and turned-down trunks. These specimens were then examined under a stereoscopic microscope and identified by experts. The results of these identifications were used to compile a list of predatory species of bark beetles present in the experimental areas. Controls of the pheromone traps and trap trees were carried out on a weekly basis to ensure that the traps were effective and the data collected was accurate.

Results and discussion

25 species belonging to 2 orders and 12 families were determined in 8 sites taken from Bursa province of Turkey. The list of detected predator species and information on their distribution are given below

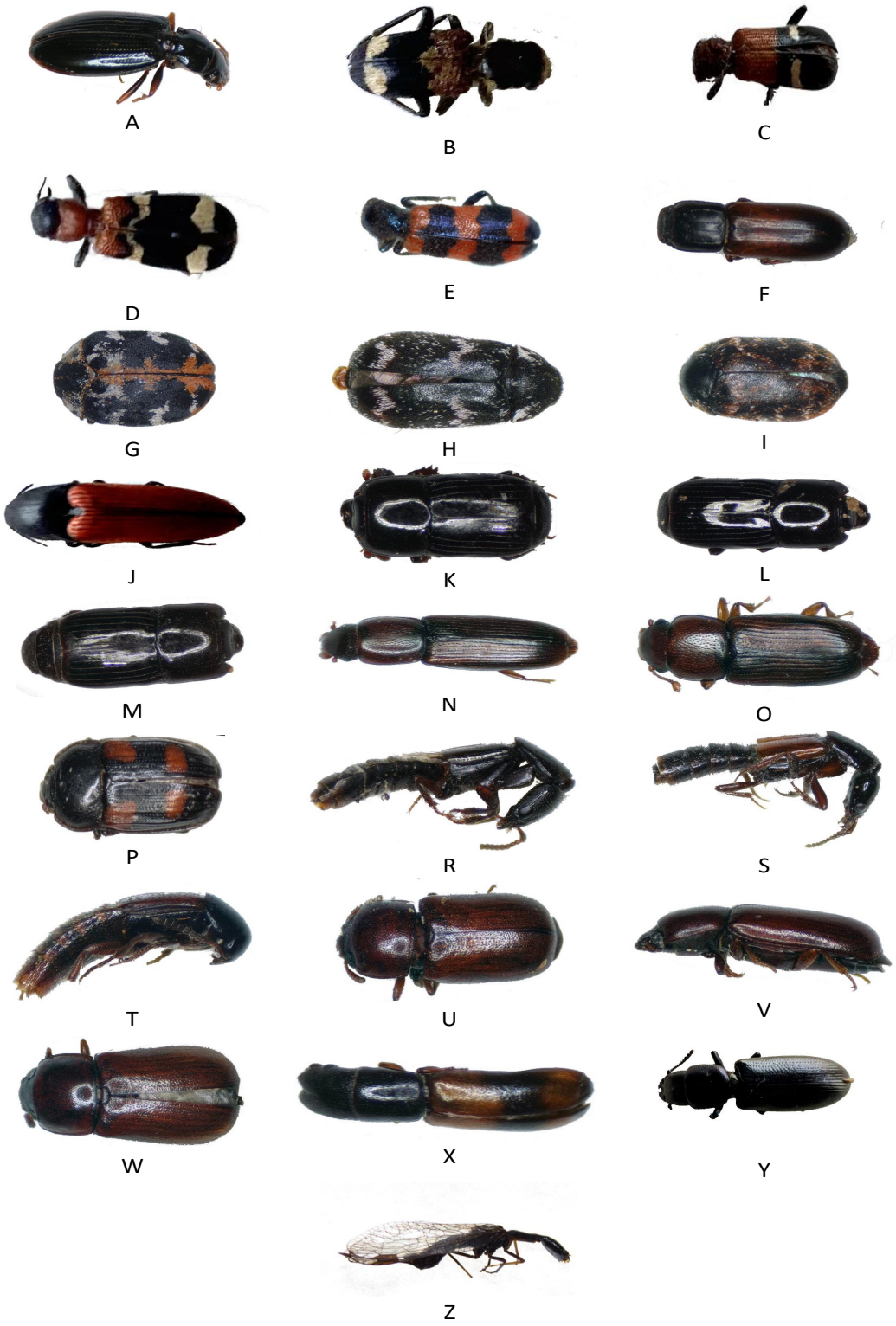

Figure 2 – Predator species collected from Bursa province. **A.** *Synuchus vivalis* **B.** *Clerus mutillarius* **C.** *Opilo taeniatus* ***D.*** *Thanasimus formicarius* ***E.*** *Trichodes apiarius* ***F.*** *Aulonium ruficorne* ***G.*** *Anthrenus scrophulariae* ***H.*** *Trogoderma angustum* ***I.*** *Trogoderma glabrum* ***J.*** *Ampedus cinnaberinus* ***K.*** *Cylister angustatus* ***L.*** *Cylister elongatus* ***M.*** *Cylister filiformis* ***N.*** *Rhizophagus depressus* ***O.*** Rhizophagus dispar, ***P.*** Ipidia binotata ***R.*** Hypnogyra angularis ***S.*** Megalinus scutellaris ***T.*** Tachinus rufipes ***U.*** Corticeus fraxini ***V.*** Corticeus linearis ***W.*** Corticeus pini ***X.*** Nemosoma elongatum ***Y.*** Temnochila caerulea ***Z.*** Dichrostigma flavipes

COLEOPTERA

Carabidae

***Synuchus vivalis* (Illiger, 1798)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Uludağ-Tuzaklı**, 11.v.2021, and **Arasdere**,16.v.2021.

Distribution records: Norway, Netherlands, Sweden, Germany, Finland, Russian, Denmark, Estonia, Switzerland, Austria, Poland, France [5].

Cleridae

***Clerus mutillarius* (Fabricius, 1775)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Uludağ-Tuzaklı**, 18.iv.2021, 18.v.2021, 26.v.2021, 12.vi.2021 and 21.vi.2021; **Arasdere**, 30.v.2021 in *Tomicus minor* galleries: **Soğukpınar-Çaybaşı**, 30.iv.2021. In *Ips acuminatus* galleries: **Arasdere**, 13.vi.2021, 19.vi.2021.

Distribution records: Russia, Turkey, Portekiz, İspanya, Romanya, Ukrayna ve Rusya Fas, Cezayir, Tunus, Almanya, Avusturya, Polonya, Çek Cumhuriyeti [6-7-8-9].

***Opilo taeniatus* (Klug, 1842)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Çalı**, 15.v.2021; **Mudanya**, 29.v.2021.

Distribution records: Caucasus, Czechoslovakia, Crete, Cyprus, Syria, Turkey, Greece and Libya [5].

***Thanasimus formicarius* (Linnaeus, 1758)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Uludağ-Tuzaklı**, 30.iv.2021, 30.v.2021, 13.vi.2021, 15.v.2021; Soğukpınar-Çaybaşı, 18.v.2021. In *Pinus brutia* on *Orthotomicus erosus* galleries: **Osmangazi-Avdancık**, 18.v.2021.

Distribution records: Albania, Armenia, Austria, Belarus, Belgium, Bulgaria, Croatia, Czechia, Denmark, England, Estonia, Finland, France, Germany, Hungary, İreland, İtaly, Mongolia, Morocco, Latvia, Lichtenstein, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, Tunusia, Turkey [10-11].

***Trichodes apiarius* (Linnaeus, 1758)**

Material examined: On *Pinus nigra* in *Ips acuminatus* galleries: **Uludağ-Tuzaklı**, 30.v.2021 in *Ips sexdentatus* galleries, **Uludağ-Tuzaklı**, 23.vii.2021; **Arasdere**, 21.vii.2021.

Distribution records: Austria, Italy, Germany, France, Switzerland, Slovakia, Ukraine, Spain, Lithuania, Netherlands, Hungary, Russian Federation, Czechia, Belarus, Poland, Serbia, Croatia and Turkey [5-12].

Colydiidae

***Aulonium ruficorne* (Oliver, 1790)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Osmangazi-Avdancık**, 15.v.2021, 07.vi.2021, 24.vi.2021 and 06.viii.2021. On *Pinus nigra* in *Ips sexdentatus* galleries: **Soğukpınar-Çaybaşı**, 23.vii.2021.

Distribution records: Bulgaria, France, Greece, Hungary, Italy, Portugal, Serbia, Spain, Turkey, Ukraine [11-13-14].

Dermestidae

***Anthrenus scrophulariae* (Linnaeus, 1758)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Soğukpınar-Çaybaşı**, 01.vi.2021. On *Abies nordmanniana* subsp. *bornmulleriana* in *Pityokteines curvidens* galleries: **Arasdere**, 03.vi.2021.

Distribution records: Finland, N. America, Australia, Canada, Sweden, Lithuania, Czechia and Tasmania [5].

***Trogoderma angustum* (Solier, 1849)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Uludağ-Tuzaklı**, 31.iv.2021; **Osmangazi-Gündoğdu**, 11.v.2021.

Distribution records: Sweden, Norway, Germany, Lithuania, Netherlands, Denmark, Switzerland, Australia, Argentina and Ireland [5].

***Trogoderma glabrum* (Herbst,1783)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Soğukpınar**, 17.v.2021; **Osmangazi-Avdancık**, 30.v.2021.

Distribution records: Canada, Russian, Switzerland, Germany, Finland, Sweden, France and Estonia [5].

Elateridae

***Ampedus cinnaberinus* (Eschscholtz, 1829)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Osmangazi-Avdancık**, 16.iv.2021 and 08.v.2021; **Arasdere**, 30.iv.2021, 18.v.2021, 13.vi.2021; **Uludağ-Tuzaklı**, 18.v.2021. On *Pinus brutia* in *Orthotomicus erosus* galleries: **Osmangazi-Avdancık**, 28.v.2021. 30.v.2021. On *Abies nordmanniana* subsp. *bornmulleriana* galleries: **Arasdere**, 13.vi.2021.

Distribution records: Albania, Armenia, Austria, Azerbaijan, Belgium, Belarus, Bosnia&Herzegovina, Bulgaria, Croatia, Czechia, Denmark, Estonia, England, Finland, France, Germany, Greeece, Gürcistan, Hungary, Iran, Italy, Kazakishtan, Latvia, Lithuania, Moldova, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey [15- 16].

Histeridae

***Cylister angustatus* (Hoffmann, 1803)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Çalı**, 31.iv.2021.

Distribution records: Austria, Belarus, Belgium, Bulgaria, Czechia, Denmark, Finland,

France, Germany, Hungary, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Russia, Slovakia, Slovenia, Switzerland, Turkey, Ukraine [16-17].

***Cylister elongatus* (Thunberg, 1787)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Osmangazi-Avdancık**, 24.iv.2021 and 07.v.2021.

Distribution records: Albania, Belarus, Bulgaria, Czechia, Denmark, England, Finland, France, Germany, Greece, Hungary, Japan, Italy, Latvia, Lithuania, Malaysia Norway, Poland, Portugal, Russia, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine [5-16-18].

***Cylister filiformis* (Erichson, 1834)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Çalı**, 31.iv.2021 **Mudanya**, 08.v.2021.

Distribution records: Spain, Germany, Costa Rica, Finland, France, Poland, Hungary, Japan, Estonia, Turkey, Portugal and Australia [5].

Monotomidae

***Rhizophagus depressus* (Fabricius, 1792)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Osmangazi-Avdancık**, 06.v.2021. On *Abies nordmanniana* subsp. *bornmulleriana* in *Pityokteines curvidens* galleries: **Arasdere,** 10.vi.2021.

Distribution records: Norway, Sweden, Germany, France, Finland, Netherlands and Turkey [5].

***Rhizophagus dispar* (Paykull, 1800)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Mudanya**, 17.iv.2021 and 07.v.2021

Distribution records: Germany, Denmark, Sweden, Switzerland, Russian, Finland and Turkey [5].

Nitidulidae

***Ipidia binotata* (Reitter, 1875)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Osmangazi-Avdancık**, 08.v.2021. **Uludağ National Park**, 16.v.2021.

Distribution records: Albania, Austria, Belarus, Belgium, Bosnia&Herzegovina, Bulgaria, Croatia, Czechia, Denmark, England, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, , Italy, Latvia, Lichtenstein Lithuania, Macedonia, Montenegro, the Netherlands, Norway, Poland, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine [16-18].

Staphylininae

***Hypnogyra angularis* (Ganglbauer, 1895)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Uludağ-Tuzaklı**, 10.vii.2021.

Distribution records: Sweden, Germany, Netherlands, Estonia, Austria, Finland, France, Belgium, Romania, Italy, Poland, Israel and Turkey [5].

***Megalinus scutellaris* (Fauvel, 1900)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Soğukpınar-Çaybaşı**, 08.ix.2021.

Distribution records: Turkey [20].

***Tachinus rufipes* (Linnaeus, 1758)**

Material examined: On *Pinus nigra* in *Ips sexdentatus* galleries: **Arasdere**, 03.vii.2021.

Distribution records: Sweden, Norway, Netherlands, Denmark, Germany, Finland, Estonia, France, Canada, Spain, Netherlans [5].

Tenebrionidae

***Corticeus fraxini* (Kugelann, 1794)**

Material examined: On *Abies nordmanniana* subsp. *bornmulleriana* in *Pityokteines curvidens* galleries: **Arasdere**, 20.iii.2021, 03.v.2021. On *Pinus nigra* in *Ips sexdentatus* galleries: Uludağ**-Tuzaklı,** 10.v.2021.

Distribution records: Austria, Belarus, Belgium, Bulgaria, Croatia, Cyprus, Czechia, England, Estonia, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine [11-14-16-21].

***Corticeus linearis* (Fabricius, 1790)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Çalı,** 31.iv.2021.

Distribution records: Austria, Belarus, Belgium, Czechia, Denmark, England, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Tunusia, Turkey [16-21].

***Corticeus pini* (Panzer, 1799)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Osmangazi-Avdancık**, 31.iv.2021; **Mudanya**, 23.vii.2021.

Distribution records: Austria, Belarus, Belgium, Croatia, Czechia, Estonia, France, Germany, Greece, Hungary, Israel, Italy, Lebanon, Lichtenstein, Mongolia, Poland, Romania, Russia, Slovakia, Spain, Switzerland, Syria, Tunusia, Turkey, Ukraine [11-16-21].

Trogossitidae

***Nemosoma elongatum* (Linnaeus, 1761)**

Material examined: On *Abies nordmanniana* subsp. *bornmulleriana* in *Pityokteines curvidens* galleries: **Uludağ National Park**, 30.v.2021.

Distribution records: Germany, Russian, France, Netherlands, Belgium, Poland, Italy, Austria and Turkey [5-12].

***Temnochila caerulea* (Olivier, 1790)**

Material examined: On *Pinus nigra* in *Tomicus minor* galleries: **Soğukpınar-Çaybaşı**, 30.iv.2021. On *Pinus nigra* in *Ips acuminatus* galleries: **Osmangazi-Avdancık**, 01.v.2021 and 15.v.2021. **Uludağ-Tuzaklı**, 30.v.2021. On *Pinus nigra* in *Ips sexdentatus* galleries: **Arasdere**, 07.vi.2021. On *Pinus brutia* in *Orthotomicus erosus* galleries: **Osmangazi-Avdancık**, 21.vi.2021.

Distribution records: Austria, Bosnia&Herzegovina, Bulgaria, Croatia, Cyprus, France, Germany, Greece, Italy, Romania, Russia, Slovakia, Spain, Turkey [11-16-22].

Raphidiidae

***Dichrostigma flavipes* (Stein, 1863)**

Material examined: On *Pinus brutia* in *Orthotomicus erosus* galleries: **Çalı**, 07.v.2021; **Mudanya-Güzelyalı**, 13.v.2021.

Distribution records: Italy, Austria, Germany, Croatia, Hungary, Montenegro, Ukraine, Czechia, Russian, Albania, Slovakia, Greece, Poland, Kosovo, North Macedonia, Montenegro, Bulgaria, Switzerland [5].

Thanasimus formicarius (Linnaeus) is a predatory species of bark beetle that was found extensively in the study area. This species was observed in the main and larval galleries of *Ips sexdentatus*, *Orthotomicus erosus* and *Ips sexdentatus* pheromone traps. Previous studies have also found *Thanasimus formicarius* in the main and larval galleries of various bark beetle species, as well as in pheromone traps hung for these species. For example, [23] found the larvae and adults of *Thanasimus formicarius* in the main and larval galleries of *Ips sexdentatus*, *Tomicus destruens*, *T. minor*, *Orthotomicus erosus* and *O. tridentatus*, as well as in pheromone traps hung for these species. [12] found the predator in the main and larval galleries of *Pityokteines curvidens* and *Ips sexdentatus*, as well as in pheromone traps, in the forests of Bartın and Karabük. [24] detected the predator in *Orthotomicus erosus* and *Ips sexdentatus* pheromone traps and trap woods in the forests of İzmir. [25] found a large number of predators in the pheromone traps and trap woods installed in the Balıkesir Directorate of Forestry Operations Taşköy, Sarıbeyler, Domuzharmanı and Balya sites. [26] reported that he encountering the hunter in *P. nigra*, *P. pinaster* and *P. sylvestris* in the forests of Bahçeköy Forestry Management Directorate.

[27] found the larvae and adults of *Thanasimus formicarius* (Linnaeus) in the main and larval galleries of *Pityokteines curvidens*, *P. spinidens*, *P. vorontzowi*, *C. piceae* and *Pissodes piceae* species in Bolu and Aladağ. [28] detected the predator in the main and larval galleries of *Ips mannsfeldi* and *Tomicus minor* in larch forests, in the main galleries of *I. sexdentatus*,and in the larval galleries of *Orthotomicus erosus* in stone pine and red pine forests in the Mediterranean Region. In Bucak, Tosun found the larvae of the predator in the larval galleries of *Pityokteines curvidens*. In eastern spruce forests, the predator was observed in the main and larval galleries of *Orthotomicus erosus*, *Pityokteines spinidens*, *Cryphalus piceae*, *Pityogenes bidentatus*, *Dendroctonus micans*, *Ips sexdentatus*, *Pityophthorus pityographus, Ips acuminatus* and *Ips typographus*. [29- 30].

The adults of *Temnochila coerulea* (Olivier) were frequently found in the study area, were detected in the pheromone trap established for *Tomicus minor*, *Ips acuminatus*, *Ips sexdentatus*, *Orthotomicus erosus* and *Pityokteines curvidens*. Previous studies have also found this species in the main and larval galleries of various bark beetle species. For example, [23] reported that primarily *Orthotomicus erosus*, *Pityokteines curvidens*, *Tomicus destruens*, *Ips sexdentatus* and *Tomicus m*inor are encountered in the main and larval galleries in the Western Mediterranean Region. [12], in his study in Karabük and Bartın forests, reported that he encountered the adults of the hunter in the pheromone trap established for *Pityokteines curvidens* in Safranbolu-Gölyaylası and Cubullu-Karaman.

[24] detected the adults of *Temnochila coerulea* in the pheromone trap established for *Ips sexdentatus* (Boerner) and *Orthotomicus erosus* in his study conducted in İzmir at sites. [25] reported that *Temnochila coerulea* adults were encountered in pheromone traps and trap woods in the forests of Balıkesir Directorate of Forestry.

Ampedus cinnaberinus (Eschscholtz) adults were found in pheromone traps for *Tomicus minor*, *Ips sexdentatus*, *Ips acuminatus*, *Orthotomicus erosus* and *Pityokteines curvidens*. [24] reported that *Ampedus cinnaberinus* is a new record for the Aegean Region and was encountered in *Ips sexdentatus* pheromone traps in *Pinus nigra* areas at an altitude of 880-1012 m. [31] detected the adults of the hunter in *Ips sexdentatus* pheromone traps in Artvin-Madenler and Erzurum-Oltu.

Adults of *Rhizophagus depressus* (Fabricius) were encountered in the main and larval galleries of *Orthotomicus erosus*, and in pheromone traps set up for *Pityokteines curvidens*. [24] detected the adults of the hunter on the main roads of *Orthotomicus erosus* and *Ips sexdentatus*. It has been reported

that the predator has encountered its adults in the main and larval galleries of *Tomicus destruens*, *Orthotomicus erosus* and *Pityogenes pennidens* in the Western Mediterranean Region [23]. [12] reported that he detected *Rhizophagus depressus* in *Pityokteines curvidens* main roads and pheromone traps in his study. [30] reported that *Ips typographus* is a predator in eastern spruce fields. [27] reported that *Rhizophagus depressus* was encountered in the main and larval galleries of *Pityokteines curvidens*, *P. vorontzovi* and *Pityophthorus pityographus*. However it was primarily detected in the nest of *C. picea*.

Adults of *Rhizophagus dispar* (Paykull) were found in red pine trap trees and on the main roads of *Orthotomicus erosus*. [24] reported in his study that the predator is a new record for the Aegean region and it was encountered in the main roads of *Orthotomicus erosus* and larval galleries.

In our study, adults of Ipidia binotata (Reitter) were found in pheromone traps set up for *Orthotomicus erosus* and *Pityokteines curvidens*. [24] reported that the hunter was a new record for the Aegean region and that he encountered the hunter in the pheromone traps set up for *Orthotomicus erosus* in his study conducted in the Izmir region.

In our study, adults of *Clerus mutillarius* Fabricius were found in *Ips sexdentatus*, *Tomicus minor* and *Ips acuminatus* pheromone traps. [25] reported in his study that he detected the predator in the pheromone trap installed in the sites, in the trap woods and the property shells in the production compartment. [12] detected *Clerus mutillarius* Fabricius in the pheromone trap established for *Pityokteines curvidens*. [23], *Orthotomicus erosus*, *Tomicus destruens*, and *Ips sexdentatus* in the main and larval tract, and in the pheromone traps set up for *O. erosus* adults, were detected. [26] detected the predator in *Pinus nigra* and *P. sylvestris* in the study she carried out at Bahçeköy Forestry Management Directorate.

Adults of *Trichodes apiarius* (Linnaeus) were detected in *Ips acuminatus* and *Ips sexdentatus* pheromone traps in our study area. [12] reported that he encountered the adults of the predator in the pheromone trap established for *Pityokteines curvidens* in Ovacuma-Cubulludere.

In our study area, *Opilo taeniatus* (Klug.) adults were detected in pheromone traps set up for *Orthotomicus erosus* in Çalı region and *Pinus brutia* trunks waiting in the field in Mudanya. [28] reported in his study that he encountered the adults of *Opilo taeniatus* (Klug.) predators on the main insect galleries in cedar trees in Elmalı-Avlanbeli (1300 m).

Aulonium ruficorne (Oliver) adults were detected in *Orthotomicus erosus* and *Ips sexdentatus* pheromone traps in our study area. [23] reported that *Orthotomicus tridentatus* Eggers, *Orthotomicus erosus* (Wollaston), *Ips sexdentatus*, *Tomicus destruens*, T. minor and *Pityokteines curvidens* in their nests frequently encountered the adults of the hunter in the Western Mediterranean Region. [12] detected the predator in the pheromone trap for *Ips sexdentatus* and *Pityokteines curvidens*. [25] reported that predators are widespread in pheromone traps, trap woods and sterling wares installed in the study area. [24] detected *Aulonium ruficorne* adults in *Orthotomicus erosus* and *Ips sexdentatus* pheromone traps and trap woods in the forest areas of İzmir region. In studies carried out to date, *Ips acuminatus*, *Phloesinus aubei*, *Pityogenes bidentatus*, *Orthotomicus erosus* and *Ips sexdentatus* species have been reported as predator hosts [4-28-29-32].

In the study area, adults of *Cylister angustatus* (Hoffmann) were found in *Pinus brutia* trunks waiting in the field in the production section. [24] reported that he encountered the hunter in the red pine trapwoods established for *Orthotomicus erosus* in Menderes-Çatalca.

In the study area, *Cylister elongatus* (Thunberg) adults were detected on the main roads of *Orthotomicus erosus*. [33] reported encountering *Orthotomicus erosus* the hunter in the pupal cradles and main roads in Menderes-Çatalca, a new record for the Aegean region. [23] reported that it encountered the predator in the main and larval galleries of *Orthotomicus erosus* and *Tomicus destruens* in Aşağıgökdere, Antalya-Çakırıllar and Alanya-Avsallar red pine fields.

[4], states that *T. piniperda* and *O. erosus* species are the hosts of the predator. [25] reported in his study that he encountered the adults of the hunter in pheromone traps and trapped woods in Taşköy, Sarıbeyler and Domuzharmanı localities.

Nemosoma elongatum (Linnaeus) adults were detected in the pheromone trap for *Pityokteines curvidens* in the study area. [26] reported that they encountered the adults and larvae of the predator in the nests of *Cryphalus piceae* and *Pityokteines curvidens*, but their number was relatively low. [12] reported that *Nemosoma elongatum* (Linnaeus) was encountered in pheromone traps set up for *Pityokteines curvidens*, and trapped trees prepared for *P. curvidens* and *Cryphalus piceae*, and in *Pityophthorus pityographus* nests.

In the study area, adults of *Corticeus fraxini* were found in *Pityokteines curvidens* pheromone trap, *Ips sexdentatus* main galleries and *Orhotomicus erosus* main and larval galleries. [23], in his study in the Western Mediterranean Region, reported that the hunter encountered its adults on the main roads of *Pityokteines curvidens*, *Orthotomicus erosus*, *O. tridentatus*, *Tomicus destruens*, *T. minor* and *Ips sexdentatus*. [34] reported that they detected the predator in the main and larval galleries of *Tomicus piniperda*, *T. minor*, *Ips sexdentatus* and *I. acuminatus* in Sarıkamış forest areas. [24] reported in his study that the hunter is a new record for the Aegean region and that he detected the adults of *Orthotomicus erosus* on the main road. [26] reported that he detected the predator in *P. nigra* and P. *sylvestris* species on 20.05.2018 and 28.05.2018.

Adults of *Corticeus linearis* (Fabricius) were found in the study area in *Pinus brutia* trunks. [12] reported that the hunter detected its adults in *Pityokteines curvidens* pheromone traps in Safranbolu. [23] reported that they encountered predators in the main and larval galleries of *Tomicus destruens* and *Orthotomicus erosus* in the Western Mediterranean Region. [24], in his study in İzmir, reported that *Corticeus linearis* is a new record for the Aegean region and has encountered the predator in *Ips sexdentatus* and *Orthotomicus erosus* pheromone traps.

Corticeus pini (Panzer) adults were detected in the red pine trap trees and *Pinus brutia* trunks in the study area. [28] reported that *Orthotomicus erosus* encountered predators on the main and larval galleries of cedar in Elmalı-Bucak and stone pine in Serik-Belek. [23] reported that *Tomicus destruens* adults were encountered in the main and larval galleries in Aşağıgökdere-Bozkal. [24], on the other hand, reported in his study that the hunter was a new record for the Aegean region, and he detected it on the main road of *Orthotomicus erosus*.

Conclusion

This study identified 25 species of predatory bark beetles in the forest areas of Bursa Forestry Management Directorate. These species included *Synuchus vivalis* (Illiger), *Opilo taeniatus* (Klug), *Trichodes apiarius* (Linnaeus), *Anthrenus scrophulariae* (Linnaeus), *Trogoderma angustum* (Solier), *Trogoderma glabrum* (Herbst), *Ampedus cinnaberinus* (Eschscholtz), *Cylister angustatus* (Hoffmann), *Cylister filiformis* (Erichson), *Rhizophagus depressus* (Fabricius), *Rhizophagus dispar* (Paykull), *Ipidia binotata* (Reitter), *Corticeus linearis* (Fabricius), *Corticeus pini* (Panzer), *Nemosoma elongatum* (Linnaeus) and *Dichrostigma flavipes* (Stein). These findings are significant because they represent a new record for both the Marmara Region and the Bursa province for certain species, including *Clerus mutillarius* (Fabricius), *Thanasimus formicarius* (Linnaeus), *Aulonium ruficorne* (Oliver), *Cylister elongatus* (Thunberg), *Hypnogyra angularis* (Ganglbauer), *Megalinus scutellaris* (Fauvel), *Corticeus fraxini* (Kugelulean).

In this study, the richness of the species that are the natural enemies of bark beetles in the forests of Bursa province has been determined, and it is important to take the necessary precautions for the protection and development of the populations of these species and to reduce the share of chemical control studies in control. Additionally, the presence of these species in the Bursa province is a new record for the area. These discoveries will be useful for understanding the ecology of predatory bark beetles in the region and developing strategies for protecting forests from the damage caused by these insects.

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