Notes on bark beetle fauna in forests of Bursa Province (Marmara Region) of Turkey, with new records for Marmara Region

Worldwide, the Scolytinae subfamily is represented by 9978 species belonging to 288 genera from 33 tribes. In Turkey, Scolytinae consists of Hylesinitae and Scolytitae upper tribes, and various researchers have identified a total of 126 bark beetle species, 47 from the Hylesinitae and 79 from the Scolytitae (Knížek 2011, Sarikaya 2013, Sarikaya & Knížek 2017). Bark beetles are stand-pests or single tree killers depending on the effect of population number. Due to their

damage, the stand's structure is harmed; therefore, the stand's planned workflow is disrupted, and these products are supplied to the market with extraordinary cuttings. Financial losses are also high since the products obtained after the extraordinary cuttings are supplied to the market at lower prices than their value (Can 2005).

Bursa Forest Management Directorate's forests are primarily composed of *Pinus brutia*, *Pinus nigra*, *Abies nordmanniana* subsp. *bornmulleriana*, *Pinus pinea*, as well as *Fagus orientalis*, *Castanea sativa*, and various species of *Quercus*. However, these tree species are susceptible to damage from pest insects belonging to the Scolytinae subfamily, which may cause extensive damage due to abiotic and biotic factors.

Among the bark beetle species, *Orthotomicus erosus* (Wollaston), *Pityokteines curvidens* (Germar), *Ips sexdentatus* (Boerner), *Xyleborinus saxesenii* (Ratzeburg), *Tomicus destruens* (Wollaston), *Tomicus minor* (Hartig) and *Anisandrus dispar* (Fabricius) have been frequently determined in sites (Gencal 2022).

This study aims to determine the Scolytinae fauna and host plant species in the coniferous and deciduous forests situated in the Bursa Forest Management Directorate areas. Our studies were carried out in the year 2021 in the forest areas belonging to the Bursa Province. Previous records of forest pests and field observations were used to select the trial areas for research. In this context, studies were carried out in 10 trial areas, namely Uludağ, Osmangazi, Soğukpınar, Çalı, Mudanya, Arasdere, Yıldırım, Kayapa, Kestel, and Uludağ National Park. The location, coordinates, altitude, and aspect of the study areas are presented in Table 1 and Figure 1.

In order to investigate the Scolytinae fauna, data was collected using weakened trees in the field, trunks in the production areas, pheromone traps, and also trap trees. The collected specimens were prepared, pinned, and labeled, noting the collection method. The insects that were difficult to identify were sent to specialists for diagnosis.

During the study, 39 Scolytinae species from coniferous and deciduous trees were identified. Information on the examined specimens is given below in order. Species were confirmed according to the classifications in Löbl and Smetana (2011) and Schedl (1961). Information on the examined materials is provided in the Supplementary material (available online).

Table 1. Collection sites, stand type, coordinates, altitudes, and aspect.

Collection Sites	Status of sites	Coordinate	Altitude (m)	Aspect
Uludağ	Natural *Pinus nigra* forest	40°07′14,116″N / 28°59′59,355″E	933	SW
	Natural *Pinus nigra* forest	40°07′11,204″N / 28°59′53,303″E	934	SW
	Natural *Pinus nigra* forest	40°07′15,63″N / 28°59′46,442″E	721	S
	Natural *Castanea sativa* forest	40°07′9,159″N / 28°59′51,057″E	728	NE
	Natural *Fagus orientalis* forest	40°05′38,703″N / 29°05′3,11″E	920	W
	Natural *Pinus nigra* forest	40°08′5,211″N / 28°59′38,864″E	1256	N
Osmangazi	Natural *Pinus brutia* and *Pinus nigra* mixed forest	40°17′23,347″N / 29°09′19,244″E	313	E
	Natural *Pinus brutia* forest	40°17′20,817″N / 29°09′16,892″E	470	NW
	Natural *Pinus nigra* forest	40°16′41,846″N / 29°08′50,7″E	444	N
	Natural *Pinus brutia* forest	40°17′14,904″N / 29°09′15,069″E	469	E
	Natural *Pinus brutia* forest	40°16′25,549″N / 29°08′32,201″E	404	SE
	Natural *Pinus brutia* forest	40°16′34,303″N / 29°08′44,323″E	424	S
	Natural *Pinus brutia* forest	40°16′26,584″N / 29°08′41,59″E	458	N
	Natural *Pinus brutia* forest	40°16′54,795″N / 29°08′59,597″E	464	S
Soğukpınar	Natural *Pinus nigra* forest	40°05′25,484″N / 29°05′13,408″E	1085	W
	Natural *Pinus nigra* forest	40°02′54,737″N / 29°05′47,698″E	743	W
	Natural *Pinus nigra* forest	40°02′58,857″N / 29°05′17,946″E	765	NW
Çalı	Natural *Pinus brutia* forest	40°11′17,154″N / 28°59′10,756″E	249	SW
	Natural *Pinus brutia* forest	40°11′4,699″N / 28°58′47,821″E	216	E
	Natural *Pinus brutia* forest	40°08′3,413″N / 28°58′9,442″E	286	SW
Mudanya	Natural *Pinus brutia* forest	40°20′34,684″N / 28°56′26,565″E	75	NE
Arasdere	Natural *Pinus nigra* forest	40°03′8,376″N / 29°09′44,392″E	1265	E
	Natural *Pinus nigra* forest	40°02′55,701″N / 29°08′33,729″E	1169	SE
	Natural *Abies nordmanniana* and *Pinus nigra* mixed forest	40°20′37,178″N / 28°56′23,63″E	1329	E
	Natural *Abies nordmanniana* and *Pinus nigra* mixed forest	40°20′34,849″N / 28°56′21,226″E	1312	NE
	Natural *Pinus nigra* forest	40°02′33,454″N / 29°07′34,691″E	1109	NE
Yıldırım	Natural *Fagus orientalis* and *Castanea sativa* mixed forest	40°09′58,704″N / 29°07′50,672″E	794	S
Kayapa	Natural *Pinus brutia* forest	40°07′34,277″N / 28°45′20,154″E	197	SW
	Natural *Quercus cerris* L. forest	40°07′35,118″N / 28°45′17,74″E	488	NW
Kestel	Natural *Quercus cerris* L. forest	40°17′33,677″N / 29°20′23,996″E	587	W
Uludağ National Park	Natural *Abies nordmanniana* and *Pinus nigra* mixed forest	40°08′29,223″N / 29°05′35,594″E	1402	NW

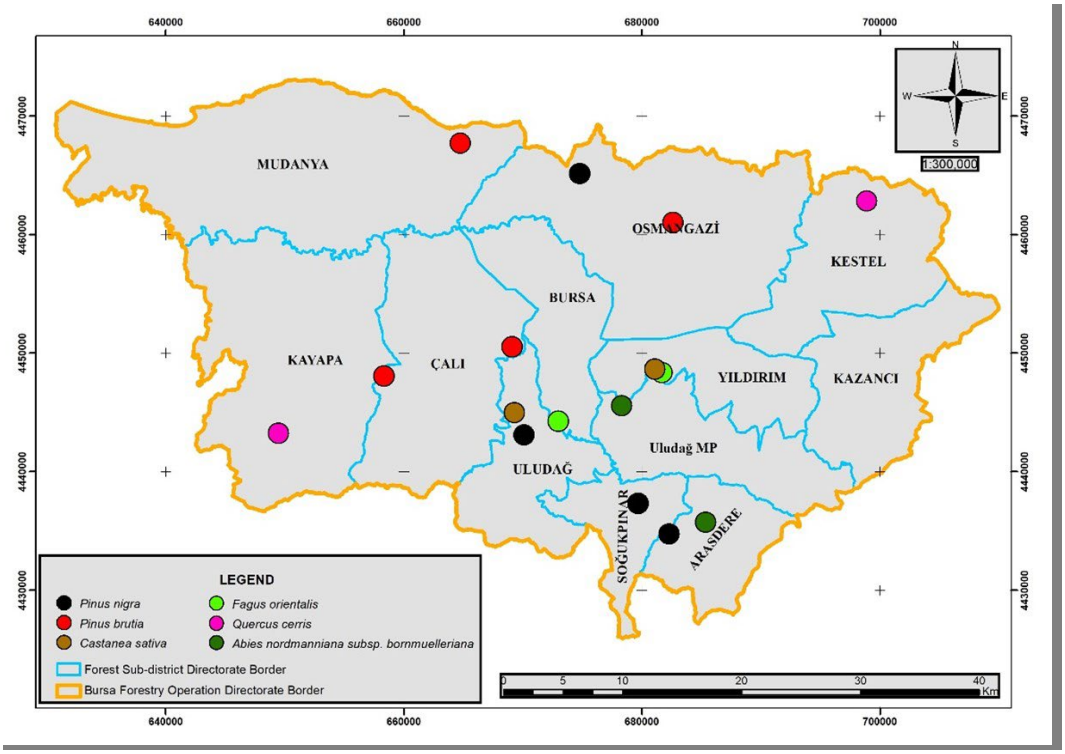

Figure 1. Sampling sites and main tree species.

Two of the 39 Scolytinae species identified in this study were *Scolytus kirschii kirschii* (Skalitzky) and *Ernoporicus fagi* (Fabricius), which are new records for both the Marmara region and Bursa province. *Hylastes angustatus* (Herbst), *Hylastes attenuatus* (Erichson), *Hylurgus micklitzi* Watchtl, *Phloeosinus armatus* (Reitter), *Crypturgus numidicus* (Ferrari), *Taphrorychus ramicola (Reitter), Scolytus amygdali (Guérin-Méneville), S. intricatus (Ratzeburg), S. scolytus (Fabricius), Xyleborinus saxesenii (Ratzeburg)* and *Trypodendron signatum (Fabricius)* species are new records for the Bursa region.

Orthotomicus erosus (Wollaston), *Pityokteines curvidens* (Germar), *Ips sexdentatus* (Boerner), *Xyleborinus saxesenii* (Ratzeburg), *Tomicus destruens* (Wollaston), *T. minor* (Hartig) and *Anisandrus dispar* (Fabricius) were found the most common bark beetle species in the Bursa Province. During the study, a total of 4143 specimens were collected. We have determined the incidence of the collected species: O. *erosus* (8 %), *P. curvidens* (9.4%), *I. sexdentatus* (5.8 %), *X. saxesenii*, (1.8%), *T. minor* (0.8 %), *T. destruens* (0.7 %), *A. dispar* (0.4 %). The highest incidence of *O. erosus* was observed from March to August. Adults of *P. curvidens* were observed between April and August. It has been determined that *Ips sexdentatus* has 3 generations per year in Bursa province. Also, we observed the active flying period of *X. saxesenii* was continued from April to September, with the highest number of adults in the traps being in August. *Tomicus destruens* (Wollaston) gave one generation per year, and the flight period was in mid-November. We have determined that *Tomicus minor* (Hartig) had one generation per year, and the flight period was at the end of March. The adults of *Anisandrus dispar* started to appear in the traps in the middle of April until the end of August; the highest population was recorded in May.

Uludağ was richest stand for diversity of species, with 22 species in 10 areas. Uludağ is followed by Arasdere, Osmangazi, Soğukpınar, Yıldırım, Kayapa, Uludağ National Park, Çalı, Mudanya, and Kestel, respectively. *H. ligniperda* and *H. micklitzi* were detected on 3 host species: *Pinus nigra*, *Pinus brutia,* and *Abies nordmanniana* subsp. *bornmulleriana*. *H. angustatus*, *H. ater,* and *P. bistridentatus* were found on *P. nigra* and *P. brutia*. Also, *T. ramicola* and *S. intricatus* were observed on *F.orientalis,* and *Q. cerris* L. Further investigation revealed that other species were exclusively identified in a single tree species, namely *C. sempervirens*, *F.orientalis*, and *Q. cerris* L. This information is summarized in Table 2.

As a result, among the bark beetles detected in the forests, *O. erosus*, *I. sexdentatus*, *T. destruens,* and *P. curvidens* pose a significant danger to the forests. Considering this, if favorable climatic conditions appear, these species can cause epidemics in the studied areas. Therefore, it is essential to take precaution methods against these bark beetles.

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Table 2. Scolytinae distribution and hosts in Bursa Forest Management Directorate areas (● *Pinus nigra*, ♦ *Pinus brutia*, ■ *Abies nordmanniana* subsp. *bornmulleriana*, ◘ *Cupressus sempervirens*, ◙ *Fagus orientalis*, ▲ *Castanea sativa*, ▬ *Quercus cerris*)

Collected species \ Collection sites	Uludağ	Osmangazi	Soğukpınar	Çalı	Mudanya	Arasdere	Yıldırım	Kayapa	Kestel	Uludağ National Park
Hylastes angustatus	●	♦				●				
Hylastes ater	●		●	♦		●				
Hylastes attenuatus			●			●				
Hylastes linearis			●							
Hylurgops palliatus	●									
Hylurgus ligniperda	●	♦	●	♦	♦	■		♦		■
Hylurgus micklitzi	●	♦		♦	♦	■		♦		■
Tomicus destruens		♦						♦		
Tomicus minor	●	●	●							
Tomicus piniperda	●									
Phloeosinus armatus		◘								
Carphoborus minimus	●	●				●				
Cryphalus piceae						■				■
Ernoporicus fagi	◙									
Crypturgus numidicus	●		●							
Dryocoetes villosus							▲			
Taphrorychus ramicola	◙								▬	
Taphrorychus villifrons								▬		
Ips acuminatus	●	●								
Ips mannsfeldi	●	●				●				
Ips sexdentatus	●		●			●				
Orthotomicus erosus		♦		♦	♦					
Orthotomicus longicollis	●					●				
Orthotomicus pinivorus	●									
Pityogenes bistridentatus	●			♦						
Pityogenes calcaratus			♦							
Pityokteines curvidens						■				■
Pityokteines vorontzowi						■				■
Scolytus amygdali	▲						▲			
Scolytus intricatus							◙	▬		
Scolytus kirschii kirschii	▲									
Scolytus rugulosus								▬		
Scolytus scolytus									▬	
Anisandrus dispar								▬	▬	
Xyleborinus saxesenii	◙						◙			
Xyleborus eurygraphus			●			●				
Xyleborus monographus	◙						◙			
Trypodendron lineatum		●	●							
Trypodendron signatum	◙						◙			

References

Can, P. (2005): An evaluation on the problem of bark beetles (Coleoptera, Scolytidae) seen in the forests of Turkey in recent years. Forest and Game Magazine 4: 4–11.

Gencal, T. (2022): Observations on Scolytinae (Col.: Curculionidae) species in the fields of Bursa Forest Management Directorate (Master's Thesis). Bursa Technical University, Graduate School of Education, Bursa.

Knížek, M. (2011): Scolytinae, pp. 86-87, 204-251. In: Löbl, I., Smetana, A. (eds.), Catalogue of Palaearctic Coleoptera, Vol. 7., Apollo Books, Stenstrup.

Löbl, I., Smetana, A. (2011): Catalogue of Palaearctic Coleoptera. Volume 7: Curculionoidea I. Apollo Books.

Sarıkaya, O., Knizek, M. (2017): *Scolytus koenigi* Schevyrew, 1890: A new record for Turkish Scolytinae (Coleoptera: Curculionidae) fauna. Journal of the Entomological Research Society 19(1): 95-99.

Sarıkaya, O. (2013): Notes on Bark and wood-boring beetles (Coleoptera: Bostrichidae; Curculionidae: Platypodinae and Scolytinae) of the Sweetgum (*Liquidambar orientalis* Mill.) Forest Nature Protection Area, with a new record for Turkish fauna. Journal of Food, Agriculture, and Environment 11 (3&4): 2178-2185.

Schedl, K.E. (1961): Bark beetles from Turkey, II. Part 190. Contribution to the morphology and systematics of the Scolytoidea 34(12): 184-188.

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