



The management of the control against forest pests in protected areas: Kackar Mountains National Park

Sevim İnanç Özkan¹

Received: 15 November 2021 / Accepted: 29 August 2023 / Published online: 13 September 2023
© African Association of Insect Scientists 2023

Abstract

Pests are among the most important dangers threatening the existence and continuity of forests. Harmful insects cause great destruction in forests. The forestry organization performs chemical, mechanical, biotechnical, and biological control activities against pests and diseases in forests. Harmful insects are not as prominent and even ignored as forest fires in public sphere because their activities and damages do not appear suddenly, but the destruction caused by pests is understood after it becomes an epidemic. For this reason, it is vital to be informed about threats such as fires, insect epidemics, etc. that occur in forest areas as soon as possible and to fight with the support of the public. Kackar National Park is one of the areas with the richest ecotourism potential in Turkey. Forest pests are spread around the national park, causing serious damage to the forest and areas of cultural importance. Detection of forest pests that threaten the national park forests, which are the national treasure, is of critical importance for the sustainability of the area. There is a need to increase the knowledge and awareness levels of all segments of society in this respect. It was determined that only half of people who live in rural areas of Kackar Mountain National Park, which is located in the Eastern Black Sea Region, where intense insect damage was experienced for more than 60 years, have knowledge about forest pests. Also, 285.000 *Rhizophagus grandis* were reproduced and placed in forest trees in the scope of combating forest pests in the area, and 310 pheromone traps were placed in forest areas to determine the insect population and the management of the control. The 2.769.521 m³ *Picea orientalis* that was damaged was removed from the area.

Keywords National Park · Spruce forest · Forest pest management · Insect damage

Introduction

Protected areas are rare areas which include biological diversity, cultural heritage and natural values. Protecting the values in these areas is very important in terms of sustainability (Brilha 2002; Watson et al. 2014; Bruno et al. 2018). These areas are priority areas for protection. Insect damage experienced around the national park is among the most important causes of damage for biodiversity (Saout et al. 2013; Inanc Ozkan 2021; Inanc and Ayaz 2019). Forest pests pose a great danger to Kackar Mountains National Park, which hosts 756 taxa plant species, 54 of which are endemic, 149 taxa invertebrate animals, 6 of which are endemic, and 178 taxa vertebrate animals. Pest control

survey and studies are conducted to minimize the damage experienced in this area (Tilki et al. 2005; Temizkan and Yıldırım 2014).

Species such as “*Ips sexdentatus*” i.e. twelve-teeth pine bark beetle, “*Ips typographus*” i.e. eight-teeth giant bark beetle and the giant bark beetle “*Dendroctonus micans*” spread around the national park causing serious damage to coniferous forest and culturally important areas (Müller et al. 2008). These species that damage the forest spread in the area rapidly since they have high reproduction rates and pose a great danger to the existence of trees in the area where they exist. Managing the effects of pests is an issue that has great importance for all land use rights managers. The issue necessitates continuous and integrated long-term management to minimize the damage given to environmental, economic, and social values. Pest control is performed to protect native animals and plants, natural ecosystems, and cultural heritage, and also to minimize the spread of harmful insects to the national parks and surrounding areas (Jönsson et al. 2009).

✉ Sevim İnanç Özkan
inanc_sevim@hotmail.com

¹ Department of Forest Engineering, Faculty of Forestry,
Artvin Coruh University, Artvin, Turkey

There is Eastern Spruce (*Picea orientalis*), which is one of the 50 spruce species known in the world, in the National Park. It is an important forest tree that has spread in the Eastern Black Sea Region in Turkey and in Caucasus Region. One third of the forests in the area are spruce and fir trees, which are spread over an area of 300 thousand hectares mixed with beech, Scotch pine, and fir depending on the pure and altitude. Eastern Spruce is one of the 5 important coniferous forest tree species producing high-value wood raw materials for the economy of the country. Spruce forests, which undertake the highest level of functions that are expected from forests for providing water in nature, protecting soil. However, since 1960s and 1980s, these forests have been infested with the most destructive bark beetles of the Eurasian spruce forests. These pests continue to be destructive in France, Georgia, England, and Turkey. They came to our country from Georgia since the 1960s. The General Directorate of Forestry continues biological control against insects that damage forests. The management of the control against forest pests reduces the risks to humans and the environment while protecting the national park resources from pests (Aksu 2002).

The six-toothed bark beetle, *Ips sexdentatus* (Börner), Eight-toothed spruce bark beetle—*Ips typographus* L. and The great spruce bark beetle—*Dendroctonus micans* have been present in the area since the 1960s. The above-mentioned species devastate critical ecosystems that support countless other organisms. Careful pest detection and management is critical to protect the forests of the country, which are national treasures, from forest pests and their damages, which threaten human health (Müller et al. 2008).

In the present study, the damages that are caused by the forest pests that cause destructive effects in Kackar Mountains National Park, which continues to exist in the Eastern Black Sea forests, and which was chosen as the study area, and the work against them were examined and evaluated. Also, the opinions of the local people who lived in the area on this subject were obtained, and the importance of the subject was emphasized.

Material

Kackar Mountains National Park, which is 16 km away from the Camlihemsin District of Rize, and which is a part of it, extends to Erzurum and Artvin, consists of the three big mountain masses of Eastern Black Sea Mountains, Ucdoruk (Vercenik), Goller (Hunut), and Kackar Mountains. The National Park is spread over a very large area 35% (18.013 ha) of which is covered with forests (URL 1). There are 9 villages and 33 plateau settlements in the park (Anonymous 2013). The area was declared a National Park

in 1994, and now, Kackar Mountains National Park is a protected area (Fig. 1).

The presence of 2500 plant taxa was identified in the area. Among these plants, approximately 300 taxa are endemic to Turkey, and 160 are endemic to this area. It includes 149 taxa of invertebrate animals, 6 of which are endemic, and 178 taxa of vertebrate animals. This is the only region in Turkey where Rhododendrons reach 3000 m' elevation (Temizkan and Yıldırım 2014).

Three formation types were identified in the area, alluvial forests, boxwood forests, and natural old forests. Especially Firtına Valley and Palovit Valley occupy 4603 ha in the National Park area, which is considered among the few untouched forest ecosystems in the region and in our country Turkey with the natural old forest (Anonymous 2013).

Kackar Hill is among the important peaks of our country with 3992 m' peak. Being located in the wettest part of the country makes the National Park unique in terms of rivers as well as enriching the forest, alpine meadow, and under-forest flora.

The Caucasus Mountains Range, in which where the National Park is located is among the 25 hot spots in the world in terms of biodiversity and protection (Anonymous 2013).

Streams, which actually have the size of a river, such as Firtına Stream and Hemsin Stream, surround the National Park. In line with the richness of the flora, there are mammals such as bear, wolf, jackal, fox, roedeer, wild boar, marten, weasel, hare, stoat, poppy, and songbirds and wild cocks in the National Park, and sea trout live in the Firtına Stream.

Trekking is done in the summer, and hiking activities are done in the 8 hiking trails available in Kackar Mountains. Kackar Mountains are also open for camping, mountaineering, hiking, picnic, and recreation activities in summer.

It is among the areas that have the richest ecotourism potential in terms of resource values in our country. Since Kackar Mountains National Park is an important bird migration route in our country Turkey, it has a high ecotourism potential in terms of photo safari and bird watching. Helicopter skiing activities are also done in the borders of Kackar Mountains National Park (Anonymous 2013).

Method

In the research, records of Trabzon Regional Directorate of Forestry and 12th Regional Directorate of Nature Conservation and National Parks, Kackar Mountains National Park Directorate were used. This institution is one of the first institutions in Turkey to control against forest pests. The institutional records that were kept from the beginning of the fight to the point reached today were examined, and the reports were reached. The methods used in the fight and the tools and equipment used were seen.

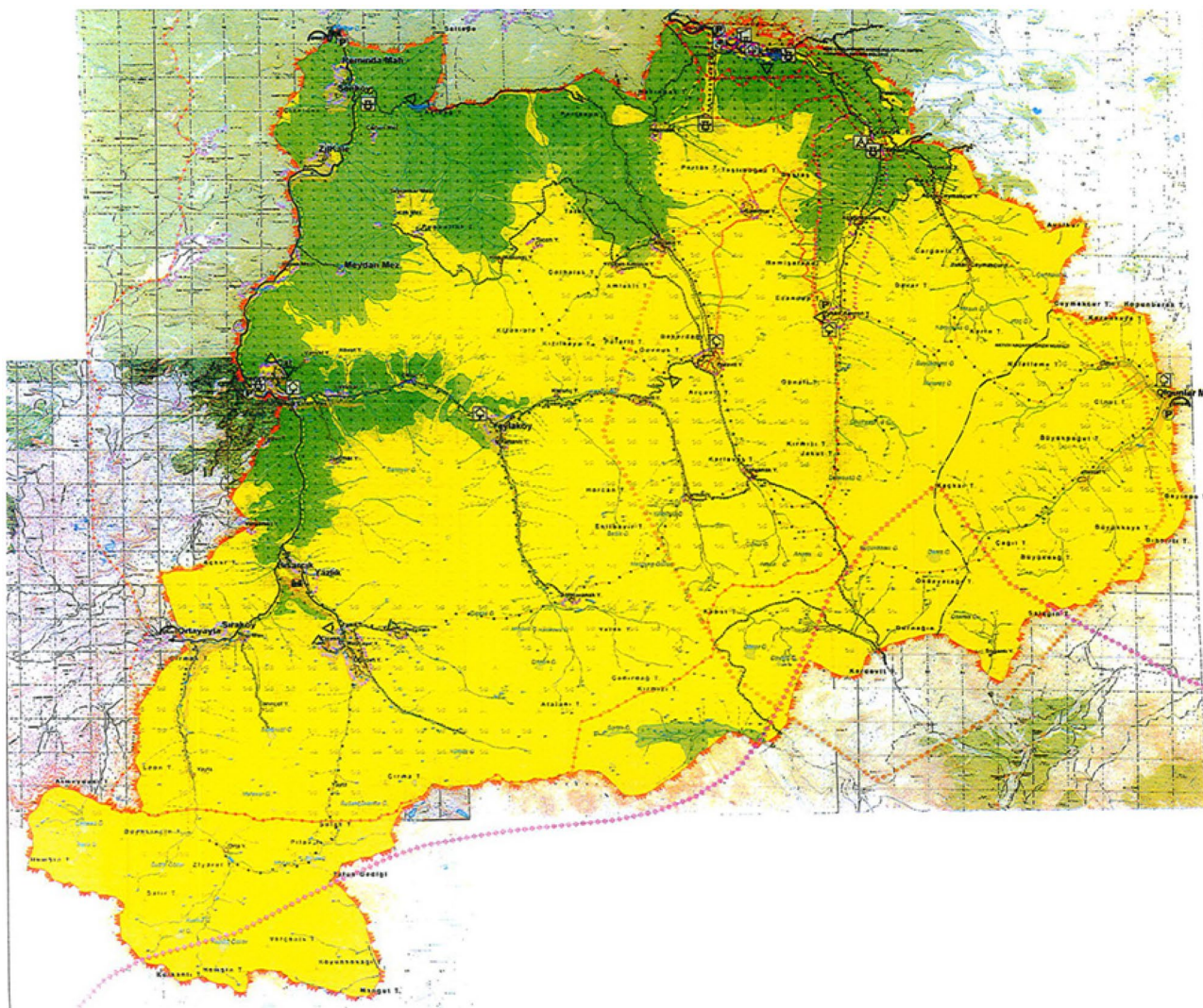


Fig. 1 Map of the research area

The data were obtained by interviewing the experienced institution employees on the subject and with face-to-face questionnaires conducted with forest villagers in the region were used.

There are 9 villages and 33 plateau settlements in the national park. Face-to-face interviews were performed and a questionnaire study was conducted to learn the opinions and perceptions of the local people who lived in the park about forest pests, especially insects. A total of 588 forest villagers live in 9 villages in the area (TUIK 2021). In this respect, the number of people to be included in the questionnaire in the region was determined to be 82 by using the formula below; however, 100 people were interviewed to make the study more reliable.

$$n = \frac{F \times t^2 \times P \times Q}{(F \times m^2) + (t^2 \times P \times Q)}$$

n = Sampling size

t = Confidence interval (for 95% confidence, t = 1.96)

F = Main mass size (588 people)

p = The rate in which the size to be measured in the main mass (50%)

q = 1-p (0.5)

m = Acceptable sampling error (10%)

The data obtained in the interviews were made into a report, and the records were arranged in tables. The data

obtained in the questionnaires were discussed, evaluated, and recommendations were developed.

Results

Institution records

Ips sexdentatus (twelve-teeth pine bark beetle), *Ips typographus* (eight-teeth giant bark beetle), and *Dendroctonus micans* (giant bark beetle) species that are detected in Rize, Artvin, Trabzon, and Giresun in the Eastern Black Sea Region, invaded the spruce forests of the region as of 1960s. Kackar Mountains National Park is one of the areas where these insects are most common.

Kackar Mountains National Park, which hosts a unique natural presence in the eastern Black Sea Region, has a very large area of 51 thousand 550 hectares that stretches along the cities of Rize, Erzurum, and Artvin. This natural wonder, which is surrounded by gorgeous forests, fierce streams, and steep valleys that hide the most striking shades of green in the Eastern Black Sea region, has been on the list of protected areas in the status of a national park since 1994 (Anonymous 2013).

Firstly, drying started in the spruce forests in Yayla, Elevit, Kale, and Meydan villages of Camlihemsin County in the national park area, and in the foothills of Ayder, Kavron, and Amlakit plateaus, and then similar situations began in other spruce trees in the area. In this way, it was understood that there was insect damage in the region, and studies were initiated in this respect. The most important among these studies was the control action plan against forest pests of Rize 12th Regional Directorate of Nature Protection and National Parks, and Trabzon Regional Directorate of Forestry.

Bark beetle damage was observed in spruce forests that covered an area of approximately 700 hectares in Kackar Mountains National Park in late 2020. Three different methods are applied in the fight against these pests, mechanical, biological, and biotechnical. Chemical control is prohibited in the region by the decision of the ministry (Anonymous 2021b).

Table 1 The number of predatory insects produced in the laboratories of Trabzon Regional Directorate of Forestry between 2017–2021 and released on the field

Year	Produced (Number)	Released (Number)	Area (Ha)
2017	70.000	70.000	4.165
2018	70.000	70.000	4.115
2019	65.000	65.000	3.001
2020	40.000	40.000	1.123
2021	40.825	40.000	1.648
Total	285.825	285.000	14.052

Table 2 Insect control activities in the National Park

Year	Released into the field (Number)	Hanging pheromone trap (Number)
2017	2.000	50
2018	10.000	50
2019	5.000	50
2020	-	80
2021	-	80
Total	17.000	310

“Pheromone” traps are used in the fight against forest pests in the National Park area. The capsules embedded in pheromone spread the odor secreted by the opposite sex and attract the insects to the traps ensuring that the insects coming to the capsule are caught. In the controlled traps, harmful insects are destroyed between 7–10 days.

Another method used against harmful insects is biological control in Kackar Mountains National Park, which contains endemic species. The insect species “*Rhizophagus grandis*”, also known as “Terminator”, which is the only natural enemy of the harmful insect, is reproduced in the laboratories of Trabzon Regional Directorate of Forestry, and is left in the bark of the spruce trees where the larvae and adults of the harmful insect are detected in the National Park area by the Forestry Organization teams (Anonymous 2021a, b). The damaged insect trees are then removed from the area (Table 1).

A total of 285.000 predatory insects were released on the field, and important steps were taken in biological control in Trabzon, Rize, Macka and Torul Regions, where there is an intense control against forest pests (Anonymous 2021a, b).

The methods and amounts of control against forest pests are shown in Table 2 (Anonymous 2021b).

Table 3 Socio-demographic characteristics of the respondents

Gender	%	Job status	%
Female	25	Employee	24
Male	75	Officer	39
Age	%	Retired	17
17–20	1	Housewife	15
21–30	9	Student	5
31–40	10		
41–50	35		
51 +	45	Income level (TL)	%
		1000–2500	35
Level of education	%	2501–4000	40
Primary	35	4001 ve +	25
High School	35		
University	30		

Table 4 Is there any insect damage in the national park forests?

	Person	%
Yes	75	75
No	20	25
I dont idea	5	5
Total	100	100

A total of 310 traps called “pheromones” were placed in the Kackar Mountains National Park Area as part of the control against the eight-teeth giant bark beetle. The traps were placed at intervals of 10–15 m on the trees in the forests. The capsules that were embedded in pheromone lure insects into traps by emitting the scent of the opposite sex ensuring that insects that come to the capsule are caught. In the controlled traps, harmful insects are destroyed between 7–10 days, and beneficial insects are released back to nature. A total of 2500 harmful insects and 150 predatory insects were detected in the traps in 2021. However, this method is not adequate alone for the complete extinction of the insect species.

For this reason, biological methods are applied to control forest pests damaging trees in Kackar Mountains National Park; and 17.000 *Rhizophagus grandis* reproduced in the laboratories of Trabzon Regional Directorate of Forestry were supplied by the teams of the 12th Regional Directorate of Nature Protection and Kackar Mountains National Park Directorate, and left installed under the bark of the spruce trees where the larvae and adults of the harmful insects were detected (Anonymous 2013).

Also, the removal of the infected trees that are exposed to insect damages from the area also plays important roles in the scope of the fight. In this respect, 2.769.521 m³ *Picea orientalis* was removed from the area (Anonymous 2021b).

The villager's level of knowledge about insect damage

In the scope of the present study, face-to-face interviews were made with a total of 100 people in 9 forest villages. As can be seen in the table given below, 75% of the

Table 5 What is the cause of insect damage?

	Person	%
Climate change	35	35
Sabotage	50	50
Deforestation	10	10
I dont idea	5	5
Total	100	100

Table 6 Is there a control against insect damage in the national park?

	Person	%
Yes	50	50
No	35	35
I dont idea	15	15
Total	100	100

participants were male, and the rest were female. When the age ranges of the participants were considered, it was seen that 50% of them were 51 years old and above. The active population is migrating abroad because of the lack of job opportunities in forest villages, and the average age of the people living here is high. When the educational status was evaluated, it was seen that 70% of the participants were primary and secondary education graduates (Table 3).

The local people who participated in the questionnaire answered 75% yes, there is destruction, 20% said no, and 5% had no idea in the question of whether there was any insect destruction in the National Park forests (Table 4).

When the participants who considered the situation was bad in the forests in the area were asked about the reason, they mentioned sabotage in order of importance, namely, they thought that tourists from other countries were damaging the country's forests deliberately by bringing harmful insects to the country. The number of those suggesting climate change was determined to be 35% (Table 5).

The villagers were also asked about their opinions on whether the Forestry Organization made any efforts to control insect damages in the forest. A total of 50% of the participants said that they were aware of the fight, but the rest said that they did not know about it (Table 6).

When the causes of the damage were questioned, 40% of the villagers said the wrong practices of the Forestry Organization in the first place, insect damage in the second place at a rate of 30%, and climate change in the third place at a rate of 20% (Table 7).

Table 7 The most important cause of damage to forests?

	Person	%
Climate change	20	20
Fires	6	6
Illegal tree cutting	4	4
Faulty practices of the forestry organization	40	40
Insects	30	30
I dont idea	-	-
Total	100	100

Conclusion and discussion

The Forestry Organization Management Unit takes many precautions for the protection of the forests and their sustainable management for the benefit of society. The fight is performed in cooperation with the society to reduce the damages caused by human and non-human resources to forests. In the present study, the knowledge and awareness levels of people of the area on this fight were investigated in Trabzon Regional Directorate of Forestry, which has been fighting insects that are harmful to the forest for about 60 years in Turkey.

Ips sexdentatus, *Ips typographus* and *Dendroctonus micans*, which entered Turkey from Georgian borders as of 1960, and damaged the spruce forests until Rize, Trabzon, Giresun, and Ordu. Efforts are made to control these species in Kackar Mountains National Park. Chemical fight is prohibited in the area, and mechanical, biological, and biotechnical control continues because of the fact that the area is a National Park.

In the national park, the population and activity of *Ips sexdentatus*, *Ips typographus* and *Dendroctonus micans* species increased a great deal, and caused intense drying in spruce forests. For this reason, other predatory insect species were reproduced to eat insects that damage trees to control insects by biological means. Today, tree drying has approached 700 hectares in the National Park area.

Mining, road works, unplanned tourism practices, energy investments and activities, which do not comply with scientific requirements, cause great damages to natural old forests. The deterioration in the ecosystem accelerates when the reasons such as climate change and drought are added in addition to the intense forestry activities. The increased harmful insect population also accelerates the negative effects on forests.

The control against insects that are harmful to the forests in the area was first initiated in 1960 against the *Ips sexdentatus* pest. In this respect, Pest Control Group Directorate was established in Trabzon. The Group Directorates were abolished after 1984, and their duties were transferred to the Protection Branch Directorates under the Regional Directorates. Then, the Forest Pest Control Branch Directorates were established separately from the protection branch, and a more effective control was aimed in this regard.

Although the mechanical and biotechnical control is performed in the National Park, biological fight was also initiated with the laboratories established in the area as of 1985. *Rhizophagus grandis* was reproduced to destroy the insects that damaged the forests. In this context, 285.000 *Rhizophagus grandis* were produced and placed in forest trees from 2017 to 2021. Also, a total of 310 pheromone

traps were placed in forest areas by placing pheromone contents in the traps prepared to detect the insect population and the management of the control. A total of 2.769.521 m³ *Picea orientalis* were dried and removed from the area because of insect damage.

Informing people who will be affected by these practices, in other words, informing local people, and their participation in the decision-making processes are important factors for being successful in the control against insects that damage the forests. A total of 75% of the participants were aware of the insect damage; however, only 50% of them were aware of the work of the Forestry Organization. The knowledge of people will be much more useful in protecting the tools used in the control. It would be useful to hold meetings by the institution to inform people, and to prepare informative brochures and deliver them to this community.

When the results obtained in the present study were evaluated in general, it was found that people do not have enough information on forests and forestry. The Forestry Organization is considered as the most important responsible institution for the lack of information, and even it is considered that the organization harms the forests. The people of the area must be informed to eliminate this perception and to ensure the safety of forests. Also, ensuring the participation of local people in the decision-making process in the fight against forest pests will be an important element for being successful in this respect.

Data availability Not applicable.

Code availability Not applicable.

Declarations

Conflict of interest There are was no conflict of interest.

References

- Aksu Y (2002) Research On Pheromone Trap and Pheromone Preparation Trials Against Bark Beetles Named *Ips typographus*, *Blastophagus minor* and *Pityokteines curvidens*, Which Damage Artvin Scotch Pine (*Pinus sylvestris* L.) and Spruce (*Picea orientalis* L) Forests, Ministry of Agriculture and Rural Affairs, General Directorate of Protection and Control 2003, issue: 267, Ankara
- Anonymous (2013) Rize Nature Tourism Master Plan 2013–2023, Forest General Directorate, 2013, Ankara
- Anonymous (2021a) Trabzon Forest Regional Directorate, Combating Forest Pests Branch Office Records, 2021, Trabzon
- Anonymous (2021b) Rize 12th Regional Directorate of Nature Protection and National Parks records, 2021, Rize
- Brilha J (2002) Geoconservation and protected areas. Environ Conserv 29(3):273–276. <https://doi.org/10.1017/S0376892902000188>
- Bruno JF, Bates AE, Cacciapaglia C, Pike EP, Amstrup SC, van Hooijdonk R, Henson SA, Aronson RB (2018) Climate change threatens the world's marine protected areas. Nat Clim Change 8:499–503

- Inanc S, Ayaz H (2019) The role of local people in the fight against forest pests: the case of artvin regional directorate of forestry. FEB Fresenius Environ Bull 28:4569–4578
- Inanc Ozkan S (2021) Management of the control against forest pests in artvin spruce forests. Int J Trop Insect Sci 42:527–534
- Jönsson AM, Appelberg G, Harding S, Barring L (2009) Spatio-temporal impact of climate change on the activity and voltinism of the spruce bark beetle, *Ips typographus*. Glob Change Biol 15:486–499
- Müller J, Bubler H, Gobner M, Rettelbach T, Duelli P (2008) The european spruce bark beetle *ips typographus* in a national park: from pest to keystone species. Biodivers Conserv 17:2979
- Saout S, Hoffmannychuan M, Hughescyril S, Bernardthomas M, Bertzkystuart BHM, Stuart BN, Rodrigues ASL (2013) Protected areas and effective biodiversity conservation. Science 342:803–805. <https://doi.org/10.1126/science.1239268>
- Temizkan SP, Yıldırım G (2014) The application of local guidance within the context of sustainable tourism: The case of National Park at the Kackar Mountains. Electron J Soc Sci ISSN:1304–0278 13(49):124–149
- Tilki F, Güner S, Tüfekçioğlu A (2005) Insect Damage (*Ips typographus* L.) In Artvin-Hatila valley national park and silvicultural studies in national parks, Protected Natural Areas Symposium, 8–10 September 2005, SDÜ, Isparta
- TUIK (2021) Turkey statistics institute, population and demographics. <http://www.tuik.gov.tr/> Access: 28 Oct 2021
- Watson JME, Dudley N, Segan DB, Hockings M (2014) The performance and potential of protected areas. Nature 515:69–77
- Wermelinger B (2004) Ecology and management of the spruce bark beetle *Ips typographus*—a review of recent research. For Ecol Manag 202(1–3):67–82

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.