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Tree resources decline in Saudi Arabia: Climate change or pest attack causes?

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Abstract: In Saudi Arabia, tree mortality has abnormally increased over the past ten years, exceeding regulatory standards without clear interpretation. The present study aimed to investigate three attacked tree populations in different biogeographic regions of Saudi Arabia. For this purpose, climatic data from the last thirty years, forest densities, soil cover, pest search, and insect damage to trees have been reported. The results of this study show a distinct climate change manifested by an increase of 2 °C in temperature accompanied by a decrease in precipitation and the extension of drought periods during the last 30 years. Analysis of satellite images and the computation by quadrat methods revealed a decline in forest density and soil tree cover caused by dieback associated with an increase in the rate of tree pest attacks. Furthermore, tree investigations show attacks of the xylophagous beetles *Steraspis speciosa* and *Paropta paradoxus* on *Acacia* population in the north and centre of the country. In addition, many strains of termites are attacking the *Dobera glabra* population in the south of the Kingdom. This study shows that tree dieback, as a response to long periods of drought, when associated with pest attacks, provokes a dramatic decline in forest tree heritage. Climate change is the principal precursor to forest decline and pest invasion in Saudi Arabia.

Keywords: climate analysis; forest decline; tree death; xylophagous insects

On a global scale, forests constitute a fundamental key to ecosystem stability and environmental cleaning by playing a crucial role in the carbon cycle. Trees cover 30% of the land surface, which is nearly 41 million km^2 (Forzieri et al. 2022). They participate by absorbing nearly 33% of the global anthropogenic carbon emissions and play a central role in mitigating climate change on Earth (Pierre et al. 2022). Forests provide many exosystemic services by protecting the soil against water erosion, creating new ecosystem nurses, providing a source of nutrients for herbivorous organisms, and contributing to the well-being of humanity through food (fruits, honey bees, etc.) and timber products. However, forest richness is today in continuous decline, and some forests around the world are threatened with extinction. Principal disturbances include natural events (such as fires, wind storms, and insect attacks) and anthropogenic activities (McDowell et al. 2020; Forzieri et al. 2022).

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Disturbing forest ecosystems by insect pests has enormously increased, which threatens biodiversity at the environmental level (Boyd et al. 2013; Kautz et al. 2017), and causes a significant loss at the social and economic level (van Lierop et al. 2015; Marini et al. 2022). Tree attacks by a multitude of pest species are linked to multiple pressures such as climate change, land-use strategies, and invasion by alien and non-native species (Hellmann et al. 2008). The invasion by exogenous plant species increases the risk of attack by new pest species.

Forest richness in Saudi Arabia, a country with an extensive area, is influenced by the hot desert climate (BWh according to the Köppen climate classification). However, other anthropological factors, such as cutting trees for wood, pest attacks, and invasion by exogenous species (fauna and flora species), participate profoundly in forest degradation.

The vegetation of the central and eastern zones is generally sparse and dominated by annual plants (60%). Tree populations are represented especially by some *Acacia* species protected in the valleys and at the foothills of the mountains. *A. ehrenbergiana*, *A. gerrardii*, *A. seyal*, and *A. tortilis* are the most dominant trees.

In the southwestern mountains, such as the Jazan region, forest densities are more important, with a tree diversity enclosing many species like *Acacia asak*, *Acacia seyal*, *Olea europaea*, *Juniperus procrea*, *Ficus cordata*, *Salvadora persica,* and *Dobera glabra*.

During the last decades, many reports realised by government, academic or civil investigators have described serious problems affecting tree health and biodiversity. Tree population decreases and mortality from pest attacks are reported as crucial problems. This study aimed to investigate the status of three forests located in different regions (habitats) in Saudi Arabia. Explaining the causes of tree decline in each forest was the fundamental objective of this study.

MATERIAL AND METHODS

Study areas. The present study was carried out at three forests located in different regions of Saudi Arabia (Figure 1): Mishar Park (Hail, north Saudi Arabia), Om-Eid Park (Jazan, southwest of Saudi Arabia), and Al-Hyasiyah Park (Riyadh, central east of Saudi Arabia).

Mishar National Park is located in the northwest of Hail town with geographic coordinates 27°34'04"N, 41°37'09"E and an elevation of 1 077 m a.s.l. The park is situated on a plateau delimited by the Aja mountain chains where runoffs are collected by two dams. The plant cover is characterised by a sparse forest composed of some species of acacia trees concentrated on the bottom of the valley and at the foothills of the mountains,

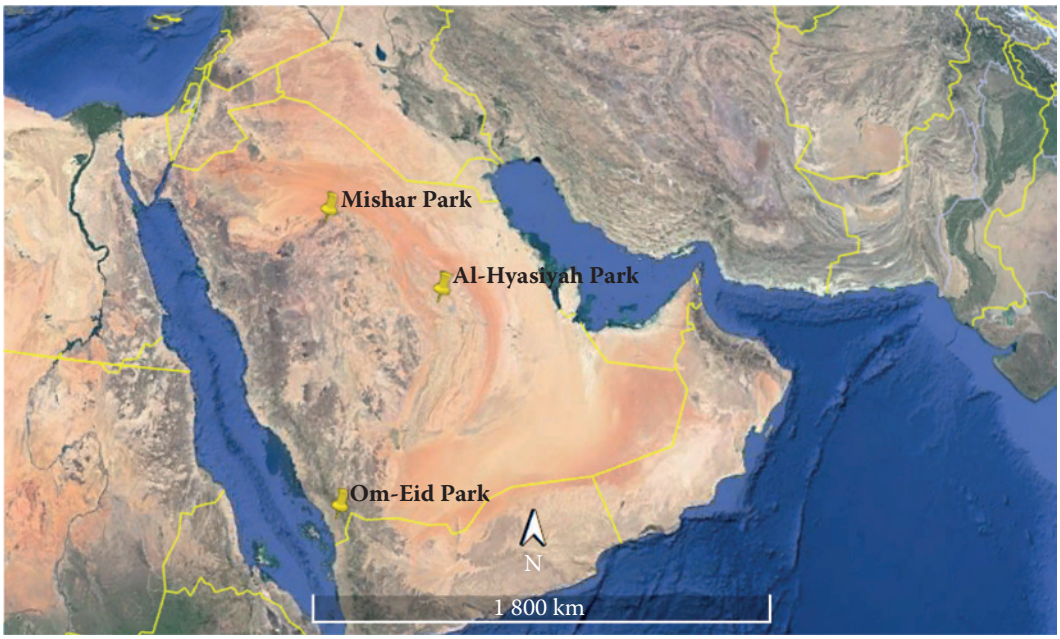

Figure 1. Locations of the studied areas in Saudi Arabia

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interceded by scarce shrubs. Thin herbaceous strata can be seen only after a rainy season. The climate is always influenced by desert winds coming from the Nufud desert delimiting the north and the west of Hail. It is a subtropical desert climate according to the Köppen-Giger classification, with an average annual temperature of 22.2 °C, which fluctuates between 4 °C (January) and 40 °C (August). The average annual precipitation is around 150 mm per year. The meteorological station is located in Hail province, ten kilometres from the study area.

The Al-Hiyasiah area is located 60 km from Riyadh city, with the geographic coordinates 24°55'01''N, 46°10'31''E and an elevation of 803 m a.s.l. It is a mountainous area crossed by a valley network with large beds holding a sparse forest of acacia trees. A dam was constructed to retain rainwater crossing the big valley of Al-Hiyasiah. With a central location in the Kingdom, Al-Hiyasiah is characterised by a desert climate type according to the Köppen-Giger climate classification, and it is hot-dry with a desert subzone according to Alrashed and Asif (2015). The average minimum temperature is 2.2 °C (January) and the maximum temperature is 43.7 °C with an average annual temperature of 25.1 °C. Annual precipitation is always below 100 mm per year. Climatic data is collected from the meteorological station located in Riyadh province.

Om-Eid Park is a large plateau located downstream of the Harub valley emerging from Jabal-e-Aswad at 25 km. The park has the coordinates 17°21'38''N, 42°49'10''E and the elevation of 218 m a.s.l. It is influenced by the Red Sea (60 km) and the Aswad mountain chains (25 km). The Jazan region in southwestern Saudi Arabia has a hot desert climate according to Köppen, with an average annual temperature of 30 °C and average annual rainfall below 200 mm. The meteorological station is located in Jazan province.

Climate data. For all areas, climate data are collected by the National Centre for Vegetation Cover (NCVC), belonging to the Ministry of Environment, Water and Agriculture of Saudi Arabia. Data on rainfall and temperatures during the period 1991–2020 are analysed.

An analysis of climate data was carried out in three study sites located in different geographical and bioclimatic areas, namely in Hail, Riyadh, and Jazan. Hail in the central northern part of Saudi Arabia is influenced by the Mediterranean climate; Riyadh, the capital, is located at the centre of Saudi Arabia within the larger Arabian Peninsula and characterised by a warm and dry climate; however, Jazan in the southwestern part of the Kingdom is a very hot area influenced by the Red Sea airstream. The climate analysis based on temperature and rainfall data during thirty years from 1991 to 2020 in all the studied areas shows a decrease in annual rainfall coupled with an increase in temperature (Figure 2). These climatic changes can be explained by the global climate change in the world. The Hail region was the warmest region, with the coefficient of determination (R^2) trend curve of R^2 = 0.5719 (Figure 2A). Also, it was suggested to be the driest area with a net decrease in precipitation (R^2 = 0.4647).

The Riyadh district also showed an increase in annual temperature of +2 °C (from 25 °C in 1991 to 27 °C in 2020), with R^2 = 0.4947. The humidity presented by annual cumulative rainfall also slowly decreased, with R^2 = 0.2295 (Figure 2B).

Analysis of climate data shows that the temperature of the Jazan region has increased by 2 °C with a higher coefficient of determination R^2 = 0.7529. However, precipitation slowly decreased, with R^2 = 0.0095 (Figure 2C).

As an output of the climatic studies, we can conclude that global warming and climatic change have a distinct effect on Saudi Arabia by an increase of about 2 °C combined with a decrease in annual precipitation.

Tree investigation. The actual status of trees in each area was evaluated by comparing satellite photos between the years 2005 and 2023, over a period of 17 years, by estimating the tree cover rate. During the last decade, severe forest disturbances by pest attacks and tree decline have been seen. The total number of infected and dead trees was estimated using quadrat methods. In each studied area, 10 quadrats of 100 m × 100 m were implanted randomly.

The tree cover rate is calculated according to the following Equation (1):

$$Tree\ cover\ (\%) = 100 \times \frac{surface\ occupied\ by\ trees\ in\ the\ quadrat}{total\ surface\ of\ the\ quadrat} \quad (1)$$

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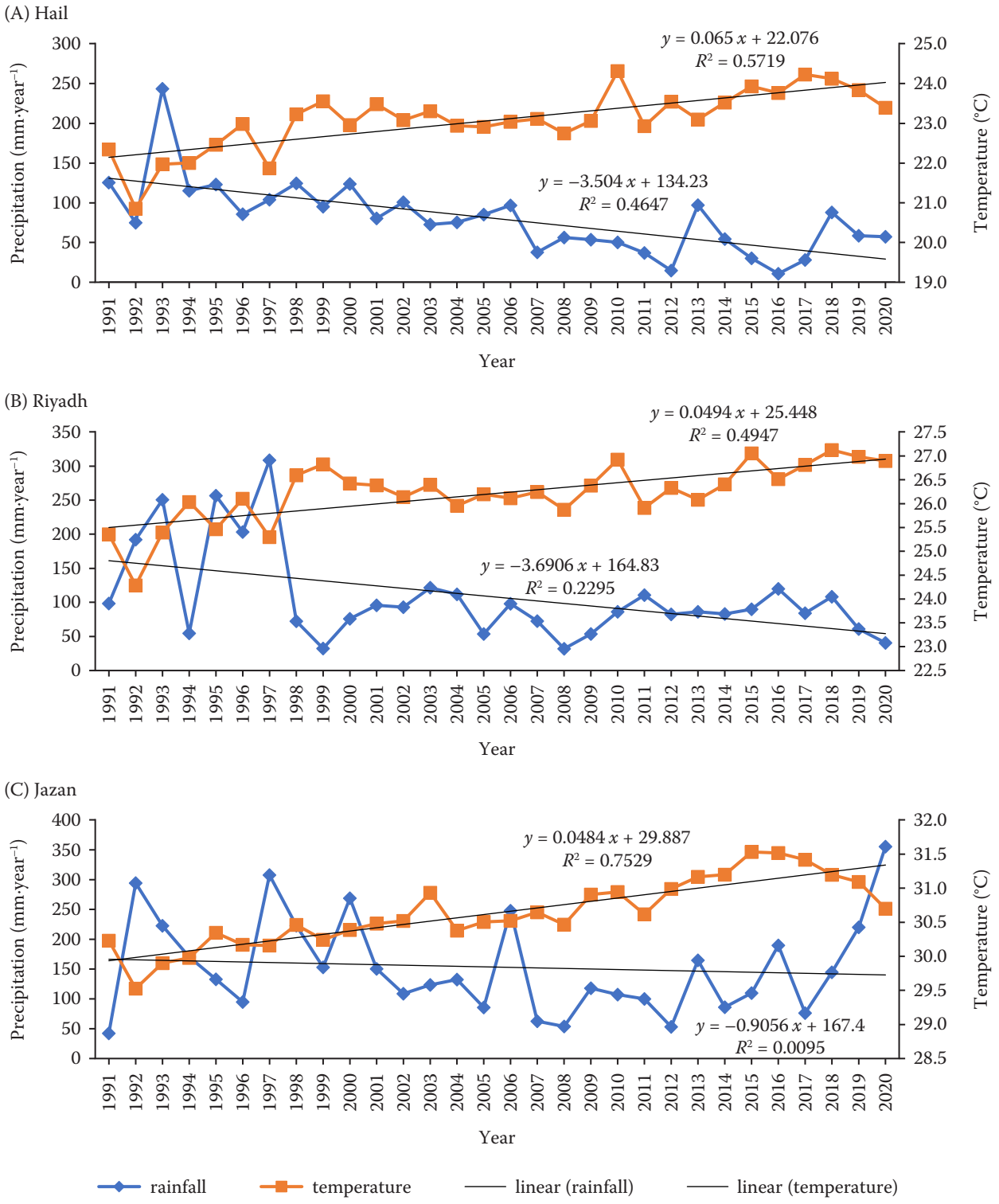

Figure 2. Analysis of climate data – temperature and rainfall during 1991–2020 in the three studied areas: (A) Hail, (B) Riyadh, and (C) Jazan

Pest identification. In each studied area, the collection of pests attacking trees was performed. The collected insects were identified and preserved in glass vials containing 80% isopropyl or ethanol alcohol in the laboratory of entomology at Hail University. To follow the tree infection parameters, the presence of pests (beetles, termites, moths), insect holes, tunnels, and larvae were measured.

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RESULTS AND DISCUSSION

Tree density evolution in the course of 17 years (2005–2022). Mishark Park is considered a perfect refuge for acacia trees. *Acacia gerrardii*, *Acacia ehrenbergiana*, and *Acacia tortilis* are the principal tree populations in this area, with a density of 28.8 trees per ha (Table 1). In the last decade, local populations and environmental associations have reported an alarming increase in the tree death rate. These observations were approved by the satellite images displayed by 'Google Earth Pro' in Mishar Park, showing a clear regression of tree cover and tree sizes during the period from 2005 to 2022. This period, despite being brief, seems to be enough to interpret the population dynamic of forests in the studied areas. The tree cover decreased from 14.9% to 12.5%. However, the tree density decreased from 33.5 to 28.8 trees per ha (Table 1). Some trees are shown to have disappeared, while others have lost a large part of their aerial volume (Figures 3, 4).

In Al-Hyasiyah, the dominant trees are *Acacia arabica*, *Acacia seyal*, *Acacia raddiana*, *Acacia tortilis*, and *Acacia etbaica,* with an average tree density of 58.3 trees per ha. However, an amelioration in tree densities was observed during the same period (from 2005 to 2022), with an increase in tree cover from 16.8% to 17.7% and also in tree density from 56.2 to 58.3 trees per ha (Table 1). This observation can be attributed to the location of the forest in the valley, which benefited from the rainwater flow accumulated by the valley network. In addition, the construction of a dam in the Al-Hyasiah Park improves the water supply to the region (Figures 3, 4).

Om-Eid Park in the southwest part of the Kingdom is dominated by *Acacia tortilis*, *Acacia ehrenbergiana*, *Acacia hamulosa*, and *Dobera glabra* trees, with a density of 64.5 trees per ha. Comparisons between the satellite images in Om-Eid Park show a clear decrease in the tree cover from 32.6% to 30.3% during the period 2005–2022 (Table 1). A decrease in the tree density from 70.1 to 64.5 trees per ha was also observed in the same period. This cover reduction is explained not only by the disappearance of certain trees but also by the reduction in the volume of trees. This phenomenon occurred as a fundamental strategy used by trees during the drought period by reducing their vegetative growth and so their aboveground biomass (Figures 3, 4).

Pest attacks. The infection of trees by various pests, especially xylophagous insects, is considered a natural process which aims to reintegrate matter into the environment. As a natural pathway, xylophagous insects attack old and diseased trees to release space for new germination and species renewal. However, in the last decade, the civilian population and many Saudi associations have reported an alarming increase in the tree death rate following a big wave of insect attacks in certain regions of Saudi Arabia (Table 2; Figure 5).

In the Mishar Park (Hail district), where *Acacia gerrardii* dominates tree populations, the rate of tree infection by the xylophagous beetle, *Steraspis speciosa* (Klug 1829), was estimated at 25.4% with a death rate of 11.7% (Table 2; Figure 5). The metallic wood borer *Steraspis speciosa* attacks specific trees in the forests of North Africa and the Middle East; acacia forests, in particular *Acacia raddiana*, were thought to be the beetle's preferred host (Mateu 1972). *Steraspis speciosa* is known to tunnel in living trees because many *Buprestidae* are limited to the bark of the tree and the outer sapwood of weakened and stressed trees

Table 1. Changes in tree cover in the studied areas between the years 2005 and 2020

Tree parameters	Mishar Park (Hail)	Al-Hyasiyah Park (Riyadh)	Om-Eid Park (Jazan)
Tree density (tree·ha^{-1}) in 2005	33.5 ± 2.8	56.2 ± 3.7	70.1 ± 5.5
Tree density (tree·ha^{-1}) in 2022	28.8 ± 1.1	58.3 ± 7.4	64.5 ± 6.6
Tree populations	*Acacia gerrardii* *Acacia ehrenbergiana* *Acacia tortilis*	*Acacia arabica* *Acacia seyal* *Acacia raddiana* *Acacia tortilis* *Acacia etbaica*	*Acacia tortilis* *Acacia ahrenbregiana* *Acacia hamulosa* *Dobera glabra*
Tree cover (%) in 2005	14.9 ± 2.3	16.8 ± 1.1	32.6 ± 3.7
Tree cover (%) in 2022	12.5 ± 1.4	17.7 ± 0.7	30.3 ± 2.2

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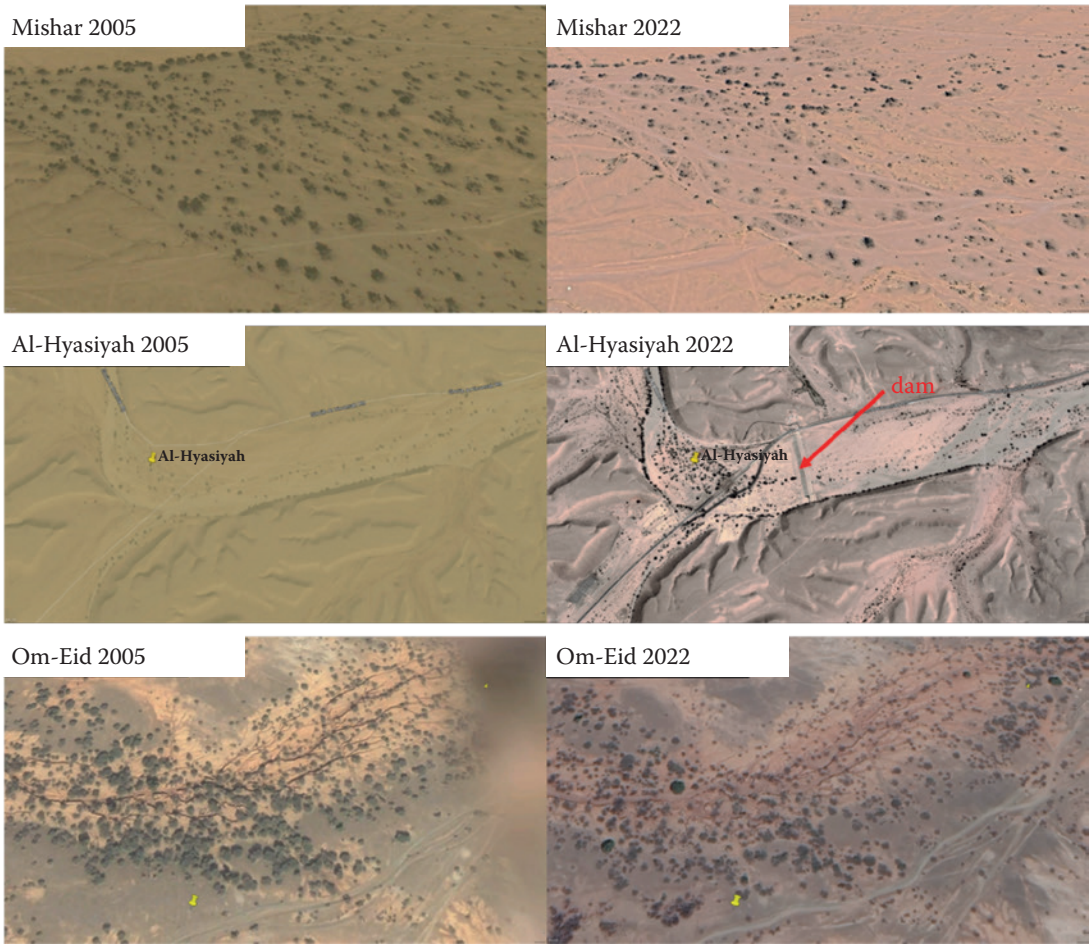

Figure 3. Satellite images of the studied areas in 2005 and 2022

(Gardner 1957). Previous observations have shown that adults of this borer occur between the beginning of January and the end of April. This borer was found gumming eggs onto the bark of acacia trees, and the larvae were boring closely into the wood, causing more gum exudation (De Meyer 2006). Ex-

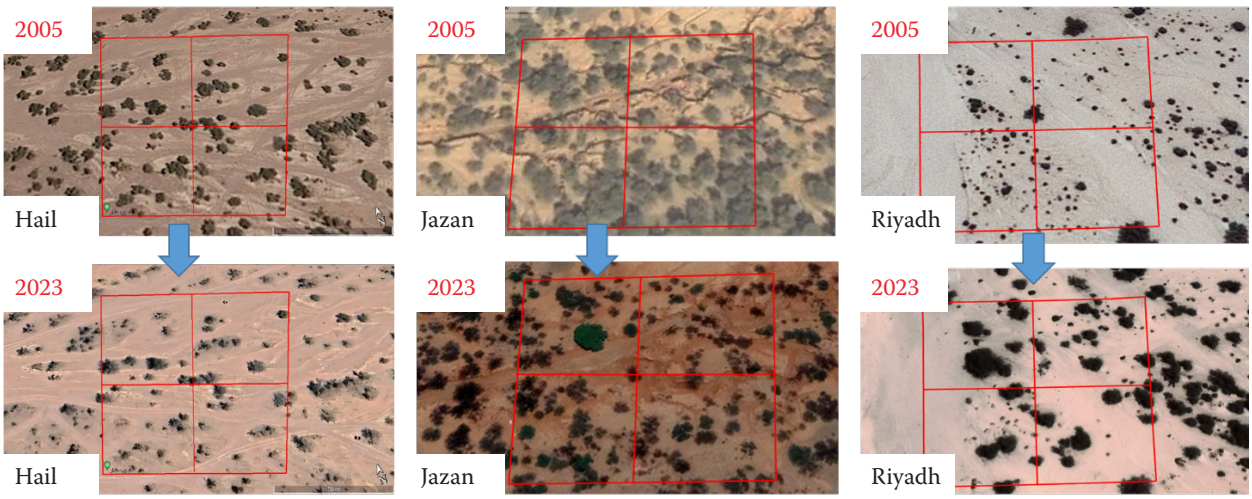

Figure 4. Acacia forest degradation in Mishar Park (Hail) and Om-Eid Park (Jazan), but with amelioration in the Al-Hyasiah Park (Riyadh) during the period from 2005 to 2023

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Table 2. Identification of pest species attacking trees in different study areas

Tree infection parameters	Mishar Park (Hail)	Al-Hyasiyah Park (Riyadh)	Om-Eid Park (Jazan)
Most attacked tree species	*Acacia gerrardii*	*Acacia arabica*	*Dobera glabra*
Identified pests	beetle: *Steraspis speciosa*	moth: *Paropta paradoxus* beetle: *Steraspis speciosa*	termites: *Heterotermes aethopicus*, *Heterotermes wittmeri*, *Psammotermes hybostoma*, *Microtermes najdensis*, *Microtermes buttikeri*
Rate (%) of infected trees	25.4 ± 2.3	55.3 ± 3.7	69.2 ± 7.1
Rate (%) of dead trees	11.7 ± 1.3	3.6 ± 1.2	18.0 ± 4.5

tensive tunnels through the stem caused enough damage to kill trees, especially when coupled with an extended period of drought.

At the centre of Saudi Arabia (Riyadh province), *Acacia arabica* var. *nilotica* was a dominant tree in the Al-Hyasiyah Park. *Acacia arabica* was infected at 55.3% by the xylophagous moth Paropta paradoxus (Herrich-Schaffer 1851). The calculated average tree death rate was 3.6% (Table 2; Figure 5). Paropta paradoxus is a species of moth in the family *Cossidae*. From Asia Minor, *Paropta paradoxus* spread to Egypt, Saudi Arabia, Lebanon, Iran, and Jordan via Syria (Schoorl 1990; Yakovlev, Witt 2017). Also, they reported that the host plants of this insect are *Ficus carica*, *F. pseudosycomorus*, *Albizia lebbeck*, *Vitis vinifera*, *Acacia arabica*, *Cercis siliquastrum*, and *Crataegus* species. It was recognised as a grapevine pest, more recently, in Türkiye (Atay et al. 2019).

In the Om-Eid Park, Jazan area, *Dobera glabra*, an important *Salvadoracea* tree, was gravely attacked by many termite species with an infection rate of 69.2% and death rate of 18% (Table 2; Figure 5). Recorded termite species are *Heterotermes aethiopicus*, *Heterotermes wittmeri*, *Psammotermes hybostoma*, *Microtermes najdensis*, and *Microtermes buttikeri*.

In Saudi Arabia, a large discussion was held a few years ago to explain the principal causes of tree death, sometimes called dieback disease. In this context, many reports established by civil society, foresters, governmental and non-governmental organisations have revealed that many wild regions and forests are attacked by this phe-

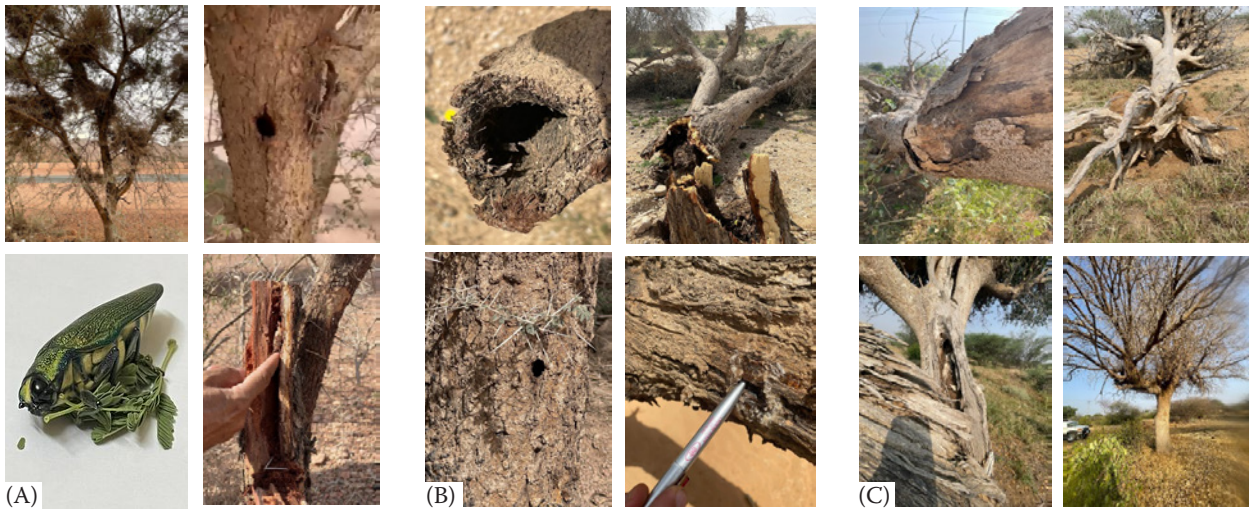

Figure 5. Damages provoked by insect attacks: (A) *Steraspis speciosa* on the *Acacia* population in Mishar Park (Hail), (B) *Paropta paradoxus* on the *Acacia* population in Al-Hyasiyah Park (Riyadh), (C) termites on the *Dobera glabra* population in Om-Eid Park (Jazan)

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nomenon, and as a consequence, tree richness and biodiversity are seriously threatened. Hail, Riyadh, and Jazan regions, i.e. Northern, Central and Southern districts in Saudi Arabia, respectively, are concerned about tree population declines in many of their regions.

In the Hail region, dieback disease has existed for a long time, but without big loss or tree death, up to approximately 2015. However, since then until now, the rate of mortality has increased suddenly and has become alarming for forester communities. Alanazi et al. (2022) reported that the infection by *Steraspis speciosa* was a principal cause of the acacia tree population decline. They also reported that the infection concerned especially old trees; however, the infection rate decreased near the dams in Mishar Park. Al-Hyasiyah area, in the margin of the capital of Riyadh, has been reported as a focus of pest infection. In this study, it was shown that 55.3% of *Acacia arabica* was infected by at least one of two xylophagous species: *Steraspis speciosa* and *Paropta paradoxus*. This finding correlates with the warmer climate in Hail and Riyadh regions with the prolonged drought-warm period through about 30 years. Many studies confirmed that a drought-warm climate was the principal cause of tree decline, as reported by Lloret and Kitzberger (2018) and by Romagnoli et al. (2018). Indeed, it was reported that a warm climate encourages pest growth and multiplication (Csank et al. 2016; Lloret, Kitzberger 2018; McNichol et al. 2022).

Temperature increases, disturbance rainfall frequency and severity of drought are linked to climate change, and these factors can have an impact on the resilience of forests at different scales. Herbivorous insects experience changes in their phenology, range, and population dynamics due to prolonged growing seasons brought on by higher temperatures (Hlásny et al. 2011). Among the most significant herbivorous insect species in terms of ecology and economy are bark and xylophagous beetles, which can experience population explosions and result in widespread deaths of a large number of tree species, especially coniferous and *Acacia* populations. In particular, stressed, dead, or dying acacias are the targets of preference for jewel beetles; it is anticipated that the prevalence of these tree states will increase with climate change.

More often than not, forest decline and mortality have been attributed to a variety of causal factors arising from the interaction of contributing (such as bark beetles and poor forest management practices) with predisposing (such as low site productivity and advanced tree ages) and inciting (such as climatic changes, insect defoliation, and droughts) factors (Oak et al. 1996).

The Om-Eid Park belongs to the Jazan district, a southern region of the Kingdom where the climate is rainier and hotter, imitating a tropical climate. Forest populations change, and so does biodiversity. One characteristic species in the famous *Salvadoraceae* family, *Dobera glabra*, was one of the important endogenous heritages of this region. Unfortunately, this species is the most threatened tree in the Kingdom because its natural renewal (by seed) is totally absent. The rate of infection and the death rate are both elevated and the extinction of this species is unavoidable in case of non-intervention. Alanazi and Mseddi (submitted 2024) has shown that an excessive infection by a multitude of termite species provokes root and stem destruction, followed by bending and falling trees. The invasion by termites was explained by climate and anthropological reasons.

Insects are the most dominant taxon in terms of the number of species and organisms, with about one million species (Brusca, Brusca 2003). In addition, it was estimated that about 7 million species were undescribed until then (Groombridge, Jenkins 2002). At the ecosystem level, insects play some crucial roles in food chains (herbivores, xylophagous, parasites, etc.), biochemical recycling of matter, and population evolution (Price et al. 2011). However, insect invasions, especially in forest ecosystems, have become a crucial problem. In the USA, about 455 insect exogenous species were recorded during 2008–2010, with 2.5 new species recorded every year (Aukema et al. 2010). In Europe, approximately 400 species feeding on woody trees are recorded (Roques et al. 2009). Herbivores, predators, and detritivores are the most invasive species, with xylophagous, woodborers, foliage feeders, seed eaters, and sap feeders being the most damaging to trees (Brockerhoff, Liebhold 2017).

These harmful tree attacks were explained by many previous studies. A recent study (Skendžić et al. 2021) reported that climate change is a substantial cause of this excessive invasion, followed by losses worldwide in agriculture and forest systems. In the last few decades, the spiraea aphid

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(*Aphis spiraecola* Patch) has become a widely distributed pest of apple and citrus orchards across Europe (Borbély et al. 2021). Linking climate change to species invasions was also reported earlier by Ward and Masters (2007). Various drivers responsible for climatic change exert heavy pressure on forest and agricultural systems at two levels. The first one is represented by plants, where climate change can impact their growth and crop yield, while the second level is the vulnerability of plants to pests and harmful organism attacks (Kurukulasuriya, Rosenthal 2013; Florentine et al. 2020). This situation can be more complicated because a significant number of plant pests are alien or invasive species (Ward, Masters 2007; Skendžić et al. 2021). Increases in temperatures and variations in precipitation patterns promote extreme climatic events and can affect plant and animal distribution (Parmesan, Yohe 2003). The increase in temperature is followed by insect pest spread and survival (Bale, Hayward 2010). Variations in temperature and humidity strongly disturb the herbivorous insect life cycle, their physiology, and geographical distribution, as well as changing the host plant (Shukla et al. 2019). For example, it was reported that many insect pest species have expanded their geographic ranges from tropical habitats at lower altitudes to temperate regions at higher altitudes (Parry 1992; Rosenzweig et al. 2001; Parmesan, Yohe 2003; Bale, Hayward 2010).

Climate change and commerce worldwide enhance the emergence of insect populations beyond their native areas (Aukema et al. 2011). According to previous studies (Cocquempot, Lindelöw 2010), the larvae of alien invasive species are inadvertently carried through ports, handling facilities, or truck roads in wood packaging of internationally traded goods to locations that are not biologically suited to control their growth (i.e. low plant resistance and lack of natural enemies). Rigakis et al. (2021) reported that wood-boring species of the coleopteran family *Cerambycidae*, also known as longhorn beetles, which are native to various regions of Asia, are now regarded as established or expanding in Europe. These countries include Italy, Spain, Germany, Finland, Montenegro, Switzerland, Türkiye, and Austria (Rigakis et al. 2021).

More than 140 distinct tree species are being attacked by longhorn beetles, particularly citruses and fruits (nectarines, cherries, peach, apricots), as well as forest woods [infected trees become unfit for pulp and timber exploitation (Rigakis et al. 2021)]. The production of roundwood for industrial purposes and stone fruits is believed to be worth several billions of dollars. Thus, the expense of removal and control measures as well as damages to these goods, are substantial (Aukema et al. 2011).

Female wood borers deposit their eggs in physical cavities, wounds, and fissures in their host trees, as well as beneath the bark. Borers that have just hatched gnaw right through the heartwood. Chewing in live wood causes severe damage to the tissues that carry sap and water. After breaking through the bark, the adults emerge from afflicted trees in the spring or summer. This presents an extra issue because the tunnels they depart serve as entry places for a number of plant diseases (Rigakis et al. 2021).

Repeated digging of many borers over many generations eventually deteriorates the health of the tree, resulting in fruit loss, weakened structure (wind breakage), and the final decline and death of sensitive trees (Lanfranco, Dungey 2001).

It is commonly acknowledged that the international commerce in live woody plants, such as cypress or nursery stock, is a primary conduit for the introduction of microbial diseases and alien arthropod pests (Eschen et al. 2015). Any sort of human activity that exports organisms beyond their natural range and capacity for dispersal qualifies them as alien species, subspecies, or lower taxa. Due to the fact that their host is frequently planted outside, pests that are brought in via the plant trade can establish themselves quite quickly (Levine, D'Antonio 2003; Aukema et al. 2010). Over the course of the last two centuries, the number of established alien tree pests in Europe and in the USA has steadily increased; the most likely pathway for the majority of these pests was the international trade in live plants (Aukema et al. 2010; Roques 2010; Liebhold et al. 2012; Santini et al. 2013). Early in the 20th century, national phytosanitary regulations were implemented in North America, which slowed the annual establishment of new exotic insects of woody plants (Roques 2010). However, from the 1950s onward, annual establishment rates increased once more, most likely as a result of an increase in trade volume.

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Comparative satellite images show a decrease in the forest vegetation cover from 2005 to 2022. However, the diminution in tree size was more pronounced. Either by drought stress or by insect attacks, stressed trees begin to shorten the main stem before the final decline and death in case of extended stress.

CONCLUSION

Tree elimination by xylophagous insects and pests is considered a natural phenomenon in biodegradation, organic matter recycling, and the contribution of many elements in biogeochemical cycles, such as carbon. In Saudi Arabia, the investigation of tree attacks by insects revealed dramatic decreases in tree populations caused by xylophagous and polyphagous insects. The beetles *Steraspis speciosa*, belonging to the *Coleoptera Buprestidae*, and *Paropta paradoxus* are responsible for attacking *Acacia ehrenbergiana* and *Acacia tortilis*, respectively. However, many termite species are attacking *Dobera glabra.* Multi-analysis data combining climatic data with anthropological activities has shown a complicated relationship between all these parameters, allowing for high reproduction and population growth of these pests, provoking uninspected tree declines.

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