From "Improving Landscape" to Conserving Landscape

The need to stop Afforestation in Sensitive Natural Ecosystems in Israel

and Conserve Israel's Natural Landscapes

The Society for the Protection of Nature in Israel
Educate. Love. Protect.

From "Improving Landscape" to Conserving Landscape

The need to stop Afforestation in Sensitive Natural Ecosystems in Israel and Conserve Israel's Natural Landscapes

The Society for the Protection of Nature in Israel
Educate. Love. Protect.

The need to stop Afforestation in Sensitive Natural Sensitive Ecosystems in Israel and Conserve Israel's Natural Landscapes
May 2019

Author: Alon Rothschild, Biodiversity Policy Manager, the Society for the Protection of Nature in Israel.
alon@spni.org.il
Translated from Hebrew by Esther Lachman
Front cover photo: KKL tractor preparing land for planting near a group of Judean Iris. Photo: Avner Rinot.
Back cover photo: Natural grassland expanse in the Nahal Tavor area (En Dor), planned for planting by KKL. Photo: Alon Rothschild.
Photography: uncredited photos were photographed by Alon Rothschild.
Design: Yigal Amor, Roee Blank, Meital Menahem – we amor.

The Society for the Protection of Nature in Israel (SPNI): Israel's leading environmental NGO
Established in 1953, the Society for the Protection of Nature in Israel (SPNI) is the oldest and largest environmental non-profit organization in Israel. SPNI works to protect Israel's biodiversity through advocacy, land use planning, lobbying and environmental activism. https://www.teva2017english.com/. SPNI is IUCN member and *Birdlife international* affiliate.

This publication is largely based on the following papers:
- Blank, L. 2012. Open landscapes disappearing – biodiversity of shrublands and grasslands. SPNI, 33 pp. (in Hebrew)
- Rotem, G., Bouskila, A. and Rothschild, A. 2014. Ecological effects of afforestation in the Northern Negev. SPNI, 79 pp.
- Perlberg, A., Ron, M. 2014. The loess plains in the Northern Negev – an endangered ecosystem. SPNI, 58 pp. (in Hebrew)

This publication updates and expands the expert information in these publications to include a countrywide perspective of the ecological effects of afforestation in sensitive ecosystems.

Acknowledgements:
We would like to thank the photographers who contributed their beautiful photos to this publication and the scientists who shared essential knowledge that is expressed in this publication. Nevertheless, any errors in this publication are the sole responsibility of the editors.

We would like to thank the following people for their helpful comments on the Hebrew version:
Ofri Gabbai, Iris Han, Noa Yayon, Shmulik Yidov, Eli Haviv, Boaz Shacham – the SPNI; Yehoshua Shkedi, Dotan Rotem, Amit Dolev – the Israel Nature and Parks Authority; Neta Dorchin – Tel Aviv University; Assaf Shwartz – the Technion; Yoav Sagi; Asaf Meyrose; Didi Kaplan; Roi Talbi; Roi Egozi; Nir Herr; Dubi Benyamini, Guy Peer, Or Komei – the Israeli Lepidopterists' Society; Yael Mandelik.

Suggested reference:
Rothschild, A. 2019. **The need to stop Afforestation in Sensitive Natural Sensitive Ecosystems in Israel, and Conserve Israel's Natural Landscapes.** SPNI. 103 pp.

www.teva.org.il ; www.tevabiz.org.il

The Society for the Protection of Nature in Israel
Educate. Love. Protect.

Table of Contents

Preface

This report deals with one of the major nature conservation issues in Israel today, an issue with tremendous environmental consequences, whose scope is completely disproportional to the minor place it has occupied in public discourse to this day.

Forests have many benefits and they are an established fact in Israel. Keren Kayemeth LeIsrael (the Jewish National Fund), the organization entrusted with afforestation in Israel also has many merits. However, as in many other fields, it is time to reexamine the relevance of concepts that were once common and suited to those times.

When the State of Israel was established, afforestation had many purposes. For many years, it was considered a part of nature conservation and the preservation of open landscapes, and there was almost no discussion regarding its justification.

Over the years, Israel's population grew constantly and many of the unique habitats characteristic of the country decreased and deteriorated. We believe the time has come to ask loudly and clearly, what need is there today, in the reality of Israel in 2019, for additional afforestation that transforms natural areas into planted forests?

Ethical public discourse should be based on a foundation of expert information that will support rational deliberations, and that is exactly the purpose of this document. It lays the foundation and raises two major issues – the responsibility for managing natural, non-forested areas and the responsibility for managing existing forested areas. These issues have never yet been opened for significant, basic, profound discussion, despite, and possibly because, of their broad consequences. We believe that now is the time.

Nevertheless, the SPNI's function, as a civil society organization, is not just to get issues on the public agenda, but also to take clear stands and work to achieve them. Therefore, this document does not stop at laying the ecological-professional foundation and describing the environmental costs of afforesting natural areas, but also proposes a new and challenging roadmap for conserving the unique nature in these areas.

The major points of the roadmap, as they are elaborated in the document, are to halt afforestation of sensitive natural areas and hand them over to the management of the Israel Nature and Parks Authority that has the legal and organizational means to manage natural areas and enforce the laws to protect

them. At the same time we believe that existing forested areas should be managed by a government forestry authority that would be established by the enactment of a forest law.

I hope that the document will lead to a significant discussion that will create change for the benefit of nature and landscape conservation in Israel.

Nir Papai

Deputy Director for Nature Conservation
The Society for the Protection of Nature
in Israel

Summary

01

Planted forests are an established fact in Israel's landscapes, and they have diverse benefits, particularly for leisure and recreation.

02

This document focuses on the question: What is the need today for new afforestation that converts natural areas into planted forests? What are the scenic and environmental significances of these actions, and should they continue?

03

Israel is located in an arid to semi-arid region. In vast areas of the country, the characteristic natural landscape has sparse or no tree cover. **Open landscapes in ecosystems with a sparse natural tree cover are among the most threatened ecosystems in Israel.**

04

A significant portion of these natural areas are included in the Israel National Outline Plan for Forests and Afforestation (NOP 22), in detailed forest plans or in areas in which the Israel Land Authority (ILA) plans afforestation as a means of "asserting ownership".

05

Afforestation frequently involves heavy mechanical equipment, building earth embankments for channeling runoff (mainly in the Northern Negev), digging planting holes with excavators, spraying herbicides against "weeds" (the natural vegetation…), and of course – **planting trees that conflict with the natural character of the site – unleashing a chain of negative ecological effects.**

06

Afforestation carried out in sensitive ecosystems, which have few trees to start out with, **alters the native landscape**, and affects Israel's unique biodiversity and the ecological function of shrublands and grasslands and of loess, desert and calcareous sandstone areas.

07 **Afforestation causes changes** at all levels, from the ecological landscape level to the local level of soil function.

08 Negative ecological impacts of planted forests are not restricted just to the planted site: **forests have negative spatial effects on adjacent natural areas**, including pine dispersal, spread of invasive species, forest predators and generalist species into natural areas.

09 Afforestation in sensitive natural areas conflicts with Israel's commitment to conserve biodiversity. **Afforestation implemented indiscriminately in natural areas, affects the rehabilitation of the area**, does not contribute to soil conservation and climate change mitigation and can increase the risk of fires.

10 **Afforestation dramatically modifies** the natural ecosystem of shrublands, grasslands and loess plains (as well as desert, sandy and kurkar areas) as a complex of open natural landscape, displacing specialist animal species that cannot maintain sustainable populations in the converted habitats.

11 Despite the recognized role of planted areas as local picnic and recreation areas, the actual area used for this purpose out of the total forest area is very restricted, and **does not justify planting hundreds of new hectares at the expense of natural areas.**

12 **Our major recommendation is to cease afforestation of sensitive natural areas and restrict it to specific sites whose necessity is proven,** while allowing the area to develop according to natural processes (succession). This requires planning changes on the level of both national and detailed plans.

13 In light of the planned revision of the relations between KKL and the State of Israel, it is our recommendation that the **natural areas designated as "forests" should be managed by the Israel Nature and Parks Authority (INPA), which has the scientific and legal means to manage the sites and enforce restrictions. Existing forested areas should be managed by a government forest authority, to be established by a "forest law" that will determine the policy and the means of implementing the law, in a publicly transparent manner.**

Native shrubland area bordering on a planted forest. The forest was planted on area originally covered by native shrubland, which has since disappeared. The planting completely changed the ecological, scenic and functional character of the planted area, as well as creating ecological effects that spread from the forest into unplanted natural areas.

Executive Summary

Afforestation in Israel has been going on for some one hundred years, during which approximately 100,000 hectares of land were planted.
These planted forests are an established fact in Israel's landscapes and they provide diverse benefits, particularly from the perspective of leisure and recreation. Over the years, the methods used for managing existing forests have even improved.

In 2018, the time was ripe to ask – is there still a need for new afforestation that converts native non-forested areas into anthropogenic forested areas? What are the purposes of Afforestation of natural areas, what are its environmental impacts and what is the landscape that we wish to see in the remaining natural areas in Israel?

This paper focuses on the justifications, environmental costs and public benefits of continuing to plant forests and prepare new areas for planting **at the expense of natural areas.**

Natural areas are currently decreasing and the condition of sensitive plant and animal populations is deteriorating. We must consider the negative ecological consequences of continued conversion of natural areas into planted forests, particularly ecosystems in which trees are naturally rare.

This document does **not** relate to the management of natural areas that have already been forested. It focuses on conserving the natural landscapes of ecosystems sensitive to afforestation (ecosystems and natural landscapes whose natural state has few trees), which are included in outline plans and designated as "forests", or which are intended for afforestation in the future.

Israel is located in an arid to semi-arid region; consequently, the **characteristic natural landscape in many parts of the country lacks trees or has a very sparse tree coverage.**

These include natural grassland ecosystems (Golan Heights, Samarian Foothills, Eastern Galilee, Mt. Gilboa and Mt. Kna'an), the Mediterranean shrublands (batha) (Nahal Dishon, the Modi'in Hills and the Judean Lowlands), the semi-steppe shrublands (Southern Hebron Mountains, Lahav, Eastern Samaria), the loess plains (Northern Negev), desert areas in the Negev, the calcareous sandstone hills (the Shikma region, Gvar'am, Nes Tsiyona and the Sharon) and the coastal sands.

Ecosystems with sparse tree cover are also the most threatened ecosystems in Israel –

These are ecosystems that are under-represented in nature reserves and national

parks, and many of whose characteristic species are endangered.

A significant portion of these natural open spaces are included in the National Outline Plan for Forests and Afforestation (NOP 22), in detailed forest plans or in areas in which the Israel Land Authority (ILA) plans afforestation as a means of "asserting ownership".

Afforestation frequently involves the use of heavy mechanical equipment, building earth embankments for channeling runoff (mainly in the Northern Negev), digging planting holes with excavators, spraying herbicides against "weeds" (the natural vegetation…), and of course – planting trees that conflict with the natural character of the site – unleashing a chain of negative ecological effects.

This document presents clear evidence that afforestation activity conducted in sensitive ecosystems, in which trees are naturally rare, alters the natural landscape, and has a negative effect on Israel's unique biodiversity and on the ecological function of shrubland, loess, grasslands and calcareous sandstone areas.

This document describes the phenomenon of how the unique community characteristic of natural ecosystems is replaced by a different ecological community, while excluding some of the characteristic native species.

This phenomenon has been documented in arid areas in the Negev and transition areas, as well as in the Mediterranean region, in birds, reptiles, arthropods, mammals and herbaceous vegetation.

This document reviews the mechanisms that create this ecological impact, which include changes from the ecological landscape level to the local level of soil function. Among other things, afforestation leads to the addition of tall elements in the natural flat landscape and consequently modifies predation pressure in the area. This in turn leads to the displacement of specialist species; to shading, leaf litter and loss of habitat heterogeneity; to the reduction of natural patches and acceleration of spatial fragmentation; to damage to soil infrastructure and its function, and damages natural resources by the use of heavy equipment, earthworks and herbicide spraying.

The negative ecological impacts of planted forests are not restricted to the planted area: the forest has negative spatial effects on nearby natural areas, including spread of pines and invasive plants, forest predators and generalist species into the natural area.

Statutory "forests" are also a significant component of the national ecological corridor system and their management is critical for nature conservation in Israel.

Surveys and studies in Israel's Mediterranean region do show that veteran forest plantations, many years after planting, and subsequent to natural and artificial thinning, develop understory vegetation in which some of the species are native woodland species. In shrubland patches in the forest, some of the shrubland species are conserved as well.

Nevertheless, as a rule afforestation dramatically modifies the natural ecosystem of shrubland, grassland and loess plains ecosystems (as well as sandy and kurkar areas) as a complex of open natural landscape, displacing specialist animal species, from arthropods to reptiles, birds and even mammals that cannot maintain sustainable populations in the converted areas.

In light of this, afforestation activity in sensitive natural areas is not in line with Israel's commitment to biodiversity conservation, with the objective of NOP 22 to conserve biodiversity, with the obligation to safeguard protected natural species and with KKL's declaration, as purportedly obliged to afforestation that works with and not against natural ecosystems.

When we examine the suitability of the plantings to their stated goals, we can see that there is not sufficient evidence to support the claim that replacing natural areas with planted forests increases the supply of ecosystem services. Ecological restoration should be implemented after a clear and immediate need for it has been demonstrated. Moreover, it should restore the natural ecosystem, not replace it with a completely different ecosystem.

Current findings indicate that afforestation activity in the Northern Negev has damaged the soil and increased soil erosion and desertification processes in the decade following its implementation. Planted forests in the Northern Negev do not contribute to the positive balance of climate change mitigation because of the heating effect of the forest as a dark patch that emits heat compared to its light desert environment. Moreover, planted conifer and eucalyptus forests have been found to be more sensitive to drought and wildfires than native woodland in Mediterranean areas.
Finally, despite the proven contribution of planted areas as local venues for picnics, leisure and relaxation, the area used for this purpose is only a small fraction of the total forest area, while some of the forests (e.g. runoff harvest forests in the Northern Negev) are not suited at all for camping and recreation.

The planning institutions and the ILA discuss forestry plantings requests for hundreds and thousands of hectares yearly, at a time when natural areas in Israel are becoming smaller and smaller.

About half the lands included in afforestation plans (as part of NOP 22), are natural areas that have never been forested nor has their future been decided by detailed plans. Moreover, extensive areas (particularly in the Northern Negev, but also in the Galilee) are "marked" by the ILA as designated for planting as a means of protecting them from illegal occupancy.

At the same time, natural areas in Israel are constantly decreasing due to building pressures for housing, infrastructure and farming, and the conservation value of each hectare of natural area is rising (particularly in ecosystems sensitive to afforestation that are under-represented in nature reserves).

The decisions that will be made in the framework of NOP 1, which will determine which areas will be classified as "natural forest" (not designated for planting) and which as "planted forests" (designated for planting), will determine the fate of thousands of hectares of natural areas.

The same is true for decisions regarding detailed plans submitted by KKL to the planning authorities. these plans seek to convert natural areas to planted areas (e.g. in the Golan Heights, Eastern Galilee, Northern Negev, Ramot Menashe and the Modi'in Hills), and the decisions regarding afforestation plans submitted to the Committee for Coordinating Plantings to Protect the Land, headed by the ILA.

In the eyes of many people, the deliberations regarding afforestation of open natural areas, is considered an "internal argument" between environmental organizations, which ostensibly deals with nuances. However, the decision whether to plant natural areas or leave them in their natural state is critical from an environmental, scenic and ethical aspect.

Moreover, on the institutional level, KKL decided about three years ago, as a result of continued disagreements with the Israeli government, to unilaterally withdraw from the agreement it signed with the State in 1961, which gave KKL the afforestation rights and made it the national forester. Since the KKL unilaterally cancelled the 1961 agreement, it is negotiating with the Israeli government regarding the character and terms for a renewed agreement between them.

A number of serious issues are up for discussions, including the question of who will be responsible for managing forest areas and conducting afforestation in Israel and what the legal framework for such a body will be.

This paper specifies a series of planning and institutional recommendations whose goal is to conserve Israeli nature, focusing on the extensive natural areas designated for afforestation.

Our major recommendation is to cease afforestation in sensitive natural areas and restrict it to specific sites whose necessity has been proven, while allowing the area to develop according to natural processes (succession).

This requires planning changes on the level of both national and detailed plans. In light of the planned revision of the relationship between KKL and the government, we recommend that natural areas designated as "forests" be given over to the INPA to manage. The INPA has all the scientific and legal means to manage the area, including preventing the entrance of ATVs, lighting fires in sensitive areas and unsupervised night events, enforcing the laws that protect natural assets and protected species, and other means that KKL lacks. Existing forested areas should be managed by a government forestry authority, to be established by a "forest law" that will determine the policy and the means of implementing the law, in a publicly transparent manner.

KKL tractor excavating "planting holes" in a rocky area in the Judean Lowlands.
Photo: Avraham Shaked

Biodiversity and Natural Landscapes Sensitive to Afforestation

Grasslands in the Samarian Foothills.
Photo: Alon Rothschild

Black-eared Wheatear *Oenanthe hispanica*.
Photo: Yoav Perlman

Long-legged Buzzard *Buteo rufinus*.
Photo: Guilad Friedemann

Gunter's Cylindrical Skink *Chalcides guentheri*.
Photo: Roi Talbi

Grassland in the Golan Heights. Photo: Alon Rothschild

Batha (shrubland). Photo: Alon Rothschild

Grassland in Nahal Lakhish. Photo: Alon Rothschild

Calcareous sandstone. Photo: Alon Rothschild

Flowering loess plain. Photo: Alon Rothschild

Judean Iris *Iris atrofusca*. Photo: Uri Ramon

Be'er Sheva Fringe-fingered Lizard *Acanthodactylus beershebensis*.
Photo: Boaz Shacham

Batha (shrubland) in the Lahav area.
Photo: Alon Rothschild

From “Improving the Landscape” to Conserving the Natural Landscape

Why is it time to stop afforesting sensitive ecosystems – and instead conserve them in their natural state?

◄ Batha (shrubland) in Nahal Dishon

Afforestation in Natural Areas in Israel – An Environmental Problem

The afforestation of Israel is a fascinating story, interwoven with the history of Zionism. About one hundred years after it began, and some seventy years after the State of Israel was established, the time has come to ask, what is the need today for new afforestation projects, which convert natural areas into areas forested by man?

What goals does afforestation of natural areas serve, what is its environmental impact, and what is the landscape we want to see in the remaining natural areas in the country? About 100,000 hectares of open areas in Israel have undergone afforestation for various reasons in various times. These planted forests are an established fact in Israel's landscape, and they provide various benefits, particularly from the perspective of leisure and recreation (although it would be fitting to examine what percentage of their area is actually used for this purpose, as will be discussed below). The manner in which existing forest areas are managed has improved in recent years, at least on the policy level, which purports to base forest management on natural processes [2].

This document focuses on the issue of justification, environmental costs and public benefits of continuing afforestation activity to plant forests and prepare new areas for planting at the expense of natural non-forested areas.

As the extent of natural areas decreases and the conservation status of sensitive plants and animals deteriorates, it is essential to give serious consideration to the negative ecological consequences of continued conversion of natural areas to planted forests, in particular ecosystems with naturally sparse tree coverage. Decisions regarding the landscape character and the fate of natural areas should be made based on up to date information, while seriously evaluating the justification for intervening in natural areas, and bearing in mind Israel's commitment to protect biodiversity.
This document aims at promoting the protection of Israel's natural landscapes, with its characteristic unique and complex natural environment.

The document does not deal with management of natural areas that have already been forested, but focuses on protecting the natural landscape in ecosystems sensitive to afforestation (natural ecosystems and landscapes in which trees are naturally scarce), that are designated "forest" in outline plans, intended for afforestation in the future.

Israel is located in an arid to semi-arid region; consequently, the **natural landscape in many parts of the country is characterized by a lack of trees or a very sparse tree coverage**. These include natural **grassland** ecosystems (Golan Heights, Samarian Foothills, Eastern Galilee, Mt. Gilboa and Mt. Kna'an), the **Mediterranean shrublands (batha)** (Nahal Dishon, the Modi'in Hills and the Judean Lowlands), the **semi-steppe shrublands** (Southern Hebron Mountains, Lahav, Eastern Samaria), the **loess plains** (Northern Negev), the **calcareous sandstone (kurkar) hills** (the Shikma region, Gvar'am, Nes Tsiyona and the Sharon) and the **coastal sands**. (The Negev and Judean Desert also lack significant tree cover, but there, as a rule, afforestation efforts are less extensive, with the exception of the Northern Negev and localized micro-catchment plantings in the Central Negev, termed limans.)

The scenic and ecological diversity of natural areas characteristic of each region in Israel is part of its natural

heritage and identity. This natural diversity is not just important ecologically; it also broadens the horizon of visitors and provides the unique pleasure of open spaces with endless views.

The Mediterranean shrubland was once considered a "stage" in the succession path towards the development of native woodland. However, in many places it is a stable community in which trees are absent or rare (because of the type of rock and soil, which dictates a water regime that cannot support tree development)[3]. The open landscapes of treeless ecosystems are among the **most threatened landscapes in Israel**: areas with the highest development pressure that comes from the cultural and historical perception that treeless "wilderness" must be settled. Accordingly, conservation efforts in the early days of the State of Israel were concentrated on Mediterranean woodlands and distant desert areas, and less on ecosystems such as shrublands or loess plains. Consequently, these sensitive ecosystems are under-represented in existing nature reserves and national parks, and are far below the percent Israel is committed to in the framework of the Convention on Biological Diversity[4]. As a result of the decrease in the protected area of these ecosystems, many of the specialist species supported by these treeless ecosystems, became endangered. Thus, 57% of the breeding birds that are shrubland specialists are today endangered in Israel[5], as are reptile species such as the Be'er Sheva Fringe-fingered Lizard and Gunter's Cylindrical Skink.

Insufficient statutory protection of lands in sensitive ecosystems makes it very important to protect them as "open spaces" that are conserved in their natural state, outside nature reserves as well. A significant portion of these natural open spaces are included in the National Outline Plan for Forests and Afforestation (NOP 22), in detailed forest plans or in areas in which the Israel Land Authority (ILA) plans afforestation as a means of "asserting ownership". It is precisely these lands that are meant to stay open, and are not designated for residential use, infrastructure or farming – **that have the greatest potential for conserving natural open landscapes**.

Afforestation changes the character of these areas. The open landscape with its rich herbaceous vegetation and unique fauna is converted into forested landscape, which is dramatically different from the natural landscape with its sparse tree coverage, and lacks the unique species characteristic of the natural landscape. Afforestation frequently involves heavy mechanical equipment, building earth embankments for channeling runoff (mainly in the Northern Negev), digging planting holes with excavators, spraying herbicides against "weeds" (the natural vegetation…), and of course – planting trees that conflict with the natural character of the site – unleashing a chain of negative ecological effects. All these, when there are alternatives for managing open spaces in a manner that protects its natural resources, first and foremost – designation as a nature reserve, national park or "native forest for conservation". This document reviews the ecological effects of afforestation on sensitive ecosystems, which are not characterized by significant tree cover, and the mechanisms that create these effects. We will also review the environmental "benefits" that afforestation claims to create, as well as asking why is it necessary to continue afforestation in these areas and what is the (alleged) environmental problem that justifies such a significant intervention, along the lines of "If it isn't broken, why fix it?"

We will also examine the logic of afforestation in light of the future scenario of a climate becoming ever more arid due to climate change. It is precisely in this scenario that a vegetation infrastructure that is the result of long-term evolutionary adaptation to the arid conditions in Israel has value (unlike trees planted in shrubland and grassland, particularly alien species such as eucalyptus, mesquite and pines, which comprised a major portion of planting until recently).

To conclude, we will present our recommendations for

policy and decision makers, both on the national level of afforestation and open spaces management (institutional and legislative recommendations) and on the specific level of evaluating afforestation programs (recommendations to planners).

Afforestation in the Northern Negev.

Why is it important to deal with the issue, why now and for whom is this document intended?

Trivial differences between environmentalists or a fundamental discussion on the character of the country?

In the eyes of many people, the deliberations regarding afforestation of open natural areas, is considered an "internal argument" between environmental organizations, which ostensibly deals with nuances. For some of the policy makers and decision makers in the field of land allotment and planning, from the minute an area is designated "green" and will not be built-up, there is little, if any, significance to the ecological character it will have – whether a landscape of planted trees, or a natural open landscape with no tree plantations.

However, the decision whether to plant natural areas or leave them in their natural state is critical from an environmental, scenic and ethical aspect, as this document will extensively review. The discussion regarding planting density, type of trees and the like – is secondary, because **the fate of the site is, in fact determined, when the decision regarding whether or not to forest a given natural area is made.**

Therefore, **this document is intended for members of planning institutions, the Planning Administration, the ILA (Planning Division and Land Protection Division), the Supreme Lands Committee, and of course planners**

in KKL, the INPA, government offices and local government officials. It is also intended for government officials in the **ministries of Finance, Justice, Agriculture and Environment and in the ILA who are involved in formulating the current agreement between the State of Israel and KKL**, in light of the cancellation of the covenant between them and the need to formulate and alternative agreement.

Decisions of significance for extensive land areas

The scope of afforestation activities in Israel is very extensive. According to Israel Central Bureau of Statistics (CBS)[6], in 1960 there were 30,000 hectares of forested land in Israel. This number reached about 100,000 hectares in 2015, half of which are conifers and eucalyptus (in recent years planting of broad-leaved species has increased).

The annual rate of planting is significant: in 2000, 1,000 hectares of new forest were planted (and another 700 hectares were reforested), and in 2010, about 800 hectares of new forest were planted (and another 300 hectares reforested). In recent years the planted areas in forest plans have decreased, to about 200 hectares of new plantings annually, however, the scope of afforestation for "asserting ownership" initiated by the ILA (that are not included in these statistics) – has increased:
In recent years, the KKL's southern district is the most active in planting and preparing sites for planting. According to CBS data, 69% of plantings in 2010 and 73% in 2011 were conducted in the southern district.[7]

According to the 2010 ILA annual report, the budget for afforestation activity in land under ILA jurisdiction increased from 3.5 million NIS in 2008, to 20 million NIS in 2009, and 30 million NIS in 2010.[8]

KKL's southern district report for 2010[9] reports land preparation and afforestation activity on 1,600 hectares, of which 800 hectares are plantings [including reforestation (92.5 hectares), NOP 22 (164 hectares) and planting for asserting ownership of state land (520 hectares)]. An additional 800 hectares of land were prepared for planting in 2011 [that include reforestation (234 hectares), NOP 22 (143 hectares) and planting for asserting ownership (396 hectares)].

There was almost no public discussion regarding this tremendous scope of converting hundreds of hectares of natural landscapes. Until recently, planning deliberations on the matter were cursory, certainly compared to other, much smaller plans, which involved environmental conflicts, that had high planning and media profiles:
These included the public battle for the conservation of the Samar sands, an area of a few dozen hectares, the battle to conserve Palmahim coast rather than to designate it as a tourist resort, which focused on an area of less than 10 hectares, and the battle against building a hotel in the Sasgon Valley on an area of less than 20 hectares. In all these cases, there was extensive public, planning and judicial deliberation.

> **planning deliberations regarding this extensive scope of converting natural landscapes were cursory, until recently**

For the sake of comparison, planning committees occasionally discuss approval of extensive forest plans. For example, in 2007, the NOP 22 Monitoring and Oversight Committee, whose function is to assess the environmental

effects of forestry plans and approve them, approved 28(!) planting plans, in a single meeting[10]. The plans encompassed thousands of hectares, and were approved with almost no reservations, no environmental impact assessment, no extended public or planning discussion and no assessment of the macro-effects of the decisions on nature and the landscape. It should be noted that these were not detailed plans according to the Planning and Construction Law, but plans submitted in the framework of a transition settlement and were derived from the general level of the national master plan.

The gap in planning and public focus between afforestation and other development plans is conspicuous. This, despite the fact that the scenic and ecological difference between a forested area and a natural non-forested area is greater than the difference between industrial, residential or commercial areas, plans on which planning committees can spend dozens of hours deliberating, analyzing programs and the like (e.g. the IKEA complex in Rishon LeTsiyon that was converted from industrial to commercial use). Environmental impact assessments are not required for afforestation programs, despite the fact that their ecological consequences (as described in this document) are far reaching.

The relevance of understanding the ecological impacts of afforestation – in 2018

After decades of afforestation, it could be argued that there are no remaining sites whose designation for afforestation should be discussed. However, in a study conducted recently as part of the preparation of the unified national outline plan (NOP 1), it became apparent that about half the lands included in afforestation plans (as part of NOP 22), are natural areas that have never been forested nor has their future been determined in detailed plans. Moreover, extensive areas (particularly in the Northern Negev, but also in the Galilee) have been "marked" by the ILA as designated for planting as a means of protecting them from illegal occupation.

Statutory "forests" are also a significant component of the national ecological corridor system and their proper management is critical for nature conservation in Israel.

At the same time, natural areas in Israel are constantly decreasing due to building pressures for housing, infrastructure and farming, and the conservation value of each hectare of natural area is rising (particularly in ecosystems sensitive to afforestation that are under-represented in nature reserves).

Afforestation in a rocky area in the Modi'in shrublands.

Thus, despite the intuitive tendency to avoid harming trees when developing a site, in most cases the natural shrublands, adjacent to the forest, has far greater ecological and scenic value and deserve far greater conservation efforts in the framework of planning the area!

The decisions that will be made in the framework of NOP 1, which will determine which areas will be classified as "natural forest" (not designated for planting) and which as "planted forests" (designated

for planting), will determine the fate of thousands of hectares of natural areas and will affect their function as part of the ecological corridor network.

The same is true for detailed plans submitted to the planning authorities, that seek to convert natural areas to planted areas (e.g. in the Golan Heights, Eastern Galilee, Northern Negev, Ramot Menashe and the Modi'in Hills), and the decisions regarding afforestation plans submitted to the Committee for Coordinating Plantings to Protect the Land, headed by the ILA.

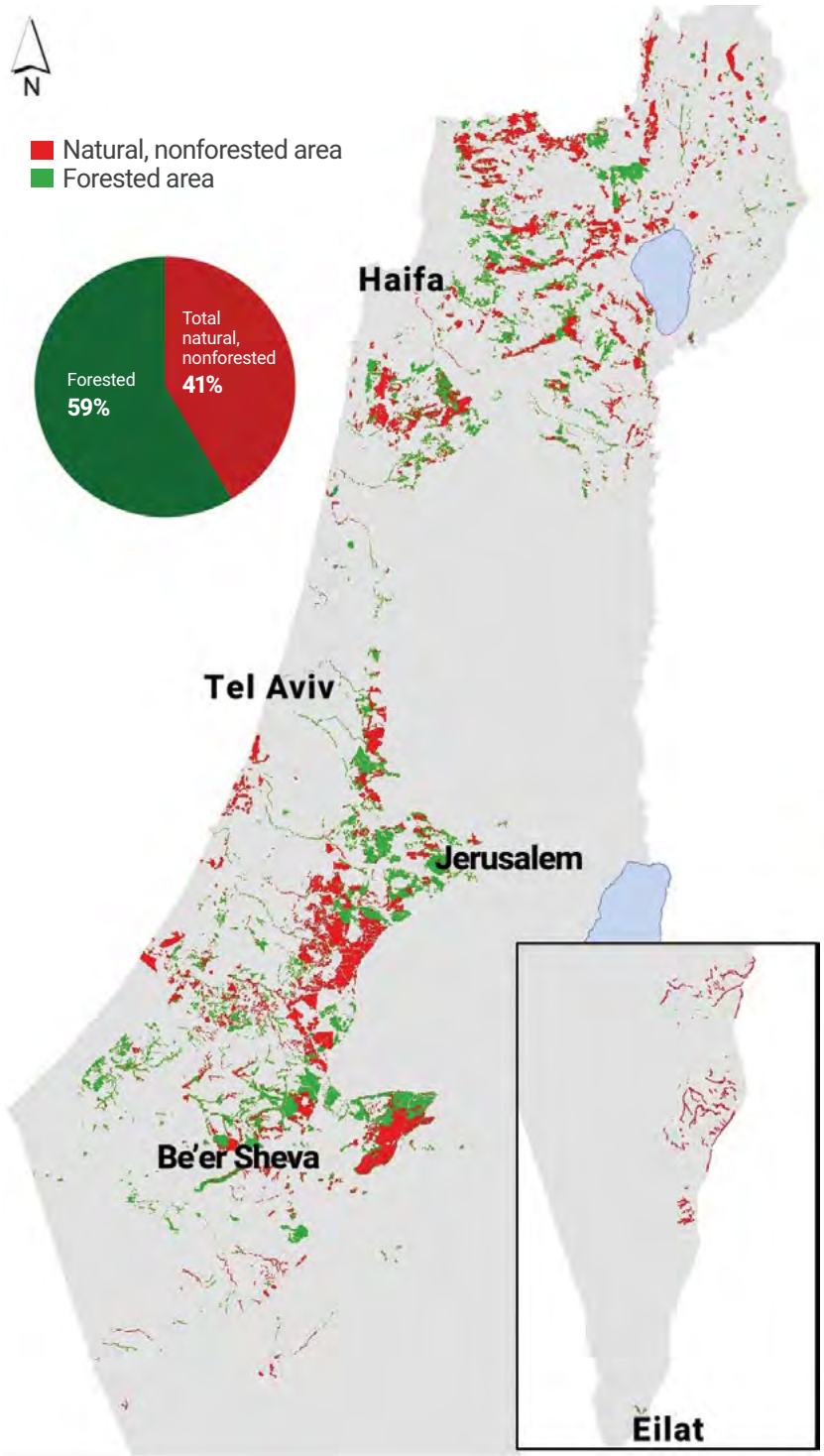
> **Evaluating the ecological impacts of afforestation and the need for public and scientific supervision of afforestation activity are part of the regulation needed as part of the planned revision of the relationship between KKL and the State of Israel.**

Moreover, on the institutional level, KKL has decided to separate from the State, and the agreement it signed with the State of Israel in the 1960s has expired. As part of this process, a number of serious issues are up for discussion, including the question of who will be responsible for managing forest areas and conducting afforestation in Israel and what the legal framework for such a body will be.

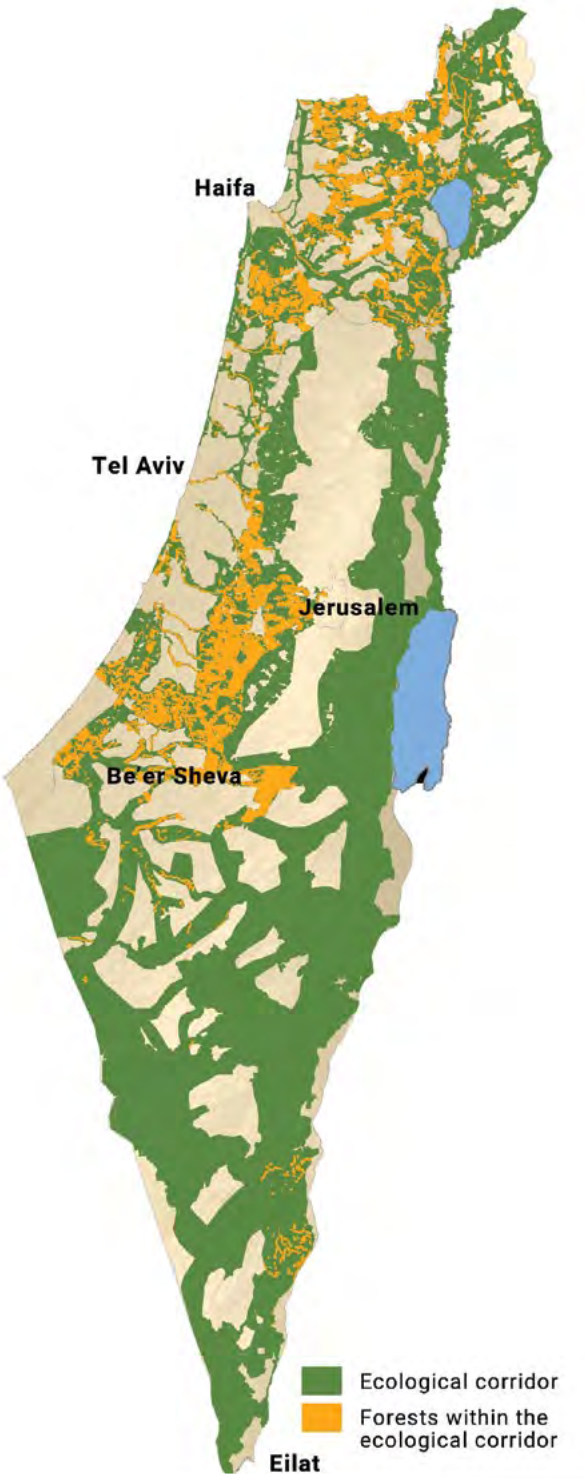
Should the KKL, a private company with no suitable government supervision, with conflicts of interest between its function as a development agency that reclaims land for agriculture and settlement, and with political affiliations, be Israel's forestry authority in the future as well? Can KKL be the public trustee for protecting sensitive natural areas?

Evaluating the ecological impacts of afforestation and the need for public and scientific supervision of afforestation activity are part of the regulation needed as part of the planned revision of the relationship between KKL and the State of Israel.

KKL bulldozer working as part of afforestation activity in the Northern Negev.



Map of planted and natural areas, within the framework of areas with a statutory designation of "forest" (the forest layer in NOP 1).
Mapping: Dikla Zeidman, SPNI



The national ecological corridors. Areas designated forests within the corridor are marked in orange.
Map produced by Dikla Zeidman, SPNI

How are afforestation decisions in Israel made, and what is the justification for planting?

History in a nutshell

Before the State of Israel was established, there were many reasons for afforestation, which ranged from "conquering the wilderness" and work-relief employment for new immigrants, to timber production initiatives for construction and other economic ventures – that failed[11]. The afforestation was carried out by the KKL (JNF), a Zionist institution involved in a series of ventures (of which afforestation was definitely of secondary importance), first and foremost of which was redeeming land as a basis for establishing a state.

However, beyond the rational justifications, which were once and are still given for afforestation in Israel, there is also an ideological/cultural aspect, as expressed in the words of the father of afforestation in Israel, Yosef Weitz [12]: "*The forest is a creation of its own. A cultural creation and a cultural need. The forest is a blend of hues, shades and sounds… Man finds serenity and an environment that brings him close to the Creator… In these, man finds food that is sometimes more important than physical food… This is the forest that the Jewish National Fund strove to establish in our land, a forest with three orientations: agricultural-soil, settlement-political – let the nations of the world see how we have revived the desert; and social-creative.*"

After the establishment of the state, an agreement was signed between the State of Israel and the KKL (1961). In it, KKL was designated as the organization responsible for afforestation, while the ILA would manage the lands owned by KKL (including the economic aspect, for which the ILA would transfer the revenues from the real estate development of the lands to KKL, which are to this day KKL's main source of revenue).

KKL established the Land Development Administration that is responsible for both afforestation and land development (developing water reservoirs, settlements, roads, agriculture and recently a variety of other initiatives such as tourism, bicycle trails, public municipal parks and more). The agreement determined a public and government oversight mechanism for the Land Development Administration, but the mechanism has not been established to this day, and KKL works with no government oversight on its policy [13].
After the state of Israel was established, and security considerations grew, afforestation became a means of occupying national lands and establishing sovereignty in border areas.

For many years, afforestation was not considered an activity that required planning and public engagement in Israel, and certainly not the integration of broad environmental or planning considerations. During these years, the "Forest and Grazing Committee" was responsible for approving plantings, with no clear standards and no process of public engagement and objections – unlike the common practice for plans according to the Planning and Construction Law.
In 1995, the National Master Plan for Forests and Afforestation (NOP 22) was approved and KKL planted forests by its authority.

In 2000 a petition was submitted to the Supreme Court (the "Forest Petition" – 288/00) after which the court decreed that KKL is obliged to prepare detailed plans for forest plantings (and to obtain building permits by virtue of said plans), including depositing the plans for public review.

Consequently, KKL began advancing detailed plans for forests in the planning system and the national planning committee established the "monitoring and oversight committee for NOP 22". Subsequently, amendment 4 to NOP 22 was approved, which determined an additional planning stage: after a detailed forest plan was approved, but before it was executed, the committee had to approve a "forest management document" that includes the details of the plan (tree types, density, planting sites, methods of land preparation and the like).

The processes for advancing forest plantations in Israel today

1. The Planning and Building Law:

- KKL submits a detailed forest plan that is approved in the relevant planning authority (local, district and occasionally national planning committee – including the deposit and objections stage).
- After the plan has been approved, and before implementation, KKL has to submit a forest management document in the NOP 22 monitoring and oversight commission for approval.

2. "Agroforestry plantings" as a means of asserting ownership over national lands:

The ILA conducts plantings not in accordance with the Planning and Building Law, as a means of preventing illegal occupancy of state lands, extending over thousands of hectares, with no public oversight. KKL is the planner and executor of these plantings.

The plantings are conducted under the heading of "agroforestry" and do not go through the planning process described in the section above. Following the SPNI's appeal to the High Court of Justice (HCJ 8391/15), the state decided to establish a "coordinating committee" headed by the ILA, which included representatives of the Ministry of Environmental Protection, the Ministry of Agriculture, the Planning Administration and the INPA, to approve plantings.

The SPNI argued that the plantings are not agriculture, but forestry plantings, and therefore should be subject to the standard planning process. The court did not decide regarding the specific arguments of the SPNI but emphasized the need for a supervisory mechanism for plantings in order to protect natural species.

The major argument in this document, which will be backed by the latest research from Israel and the world, is that forestry activity conducted in sensitive ecosystems, in which natural tree cover is sparse, modifies the natural landscape, negatively affect Israel's unique biodiversity and have a negative impact on the ecological functioning of shrubland, loess areas, grasslands and calcareous sandstone areas. This activity does not correspond with Israel's commitment to conserving biodiversity, with the biodiversity conservation goal of NOP 22, with the obligation to conserve protected natural values and with KKL's declaration that it is committed, purportedly, to afforestation that works with natural systems and not against them.

The need to mainstream nature conservation considerations in decisions relevant to afforestation of natural areas

The need to include ecological considerations in decisions relevant to afforestation in Israel is based on various sources:

The Convention on Biological Diversity

In 1995, Israel ratified the Convention on Biological Diversity and committed to conserving the biological diversity characteristic of its unique nature.

In 2010, Israel, together with the other signatory parties of the convention, adopted the strategic plan (the Aichi Biodiversity Targets) that determined 20 biodiversity targets for the decade of 2010-2020. Three of the targets are relevant to our issue:

Target 7: *"By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity."*

Target 11: *"By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes."*

Target 12: *"By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained."*

Conserving protected natural assets and species

The National Parks and Nature Reserves Law allows the Minister of Environmental Protection to declare protected natural assets, for which that: *"No person shall damage a protected natural asset without a general or special permit from the director"* (director = the Director General of the INPA). Damaging a natural asset is defined as *"including extermination, destruction, breakage, injury, extraction, picking and uprooting, taking, poisoning, alteration of appearance or of the natural position of a natural asset or interference in the process of its natural development, its reproduction or its conservation".*

NOP 22

NOP 22 allows forest areas to be designated ("forest" in the statutory sense) as "natural forests for conservation", and thus to conserve their natural landscape without planting or any other intervention in the field. In other words, the outline plan recognized that areas designated "forests" can also include areas with no trees, and they should not be planted.

Amendment 4 to the outline plan went even further and determined in the plan's objectives that forest plans would be planned "with maximal protection of biological and landscape diversity".

This definition is what in fact provides the statutory basis for evaluating forest plans from an ecological perspective, and requires that forest plans be executed with maximal protection for Israel's unique nature.

KKL's commitment to the public

KKL declares that *"Afforestation policy will be based on principles of sustainable development. According to these principles, KKL will implement forest management that: a. uses an ecological approach that will work with, and not against natural systems"* [14]

The major argument in this document, which will be backed by the latest research from Israel and the world, is that forestry activity conducted in sensitive ecosystems, in which natural tree cover is sparse, will

modify the natural landscape, negatively affect Israel's unique biodiversity and have a negative impact on the ecological functioning of shrubland, loess areas, grasslands, desert and calcareous sandstone areas. This activity does not correspond with Israel's commitment to conserving biodiversity, with the goal of biodiversity conservation as specified in NOP 22, with the obligation to conserve protected natural assets nor with KKL's declaration that it is committed, purportedly, to afforestation that works with natural systems and not against them.

Vehicle tracks and planting holes in the Judean Lowlands. Planting forests today is not done with a hoe and a funnel.
Photo: Boaz Shacham

Natural Ecosystems Sensitive to Afforestation Activity in Israel

◄ Judean Iris, an endangered species threatened by afforestation activity in the Northern Negev

Mediterranean shrubland (batha) and grassland

Shrubland is a vegetation formation characterized by low shrubs and/or dwarf shrubs whose height usually reaches about 50 cm, together with herbaceous vegetation that appears mainly in the clearings between the shrubs and the dwarf shrubs. This unique physical configuration attracts animals adapted to this formation.

In Israel, there are also areas dominated by annual plants, geophytes and perennial herbaceous vegetation, such as those found in the Golan Heights, in the Mt. Ami'ad Reserve in the Eastern Galilee and in some parts of the Samarian Foothills Reserve (east of Shoham). These grassy areas are sometimes termed herbaceous shrubland, and they too are characterized by open, treeless landscapes, and animals that favor this landscape.

Shrubland areas are an important habitat for diverse plants and animals. Shrublands enjoy abundant sunlight, are characteristically heterogeneous, and include rocky, shrubby and herbaceous areas. The great diversity found in shrublands exists on a small range of several meters and supplies varied niches, resources, cover, food and local climatic conditions. This diversity makes shrubland a favored habitat for many species, including rare and endangered species, some of them "shrubland specialists" that are found only there and not in forested areas.[15]

Vegetation

Shrublands have one of the highest diversity of herbaceous species[16]. The diversity of herbaceous annuals in woodland areas is low, and increases as the woodland opens up into more open and better-lit formations. The varied vegetation substrate supports the diverse animal life based on it.

Bees

Shrublands have been described as having the richest bee biodiversity in the Mediterranean region[17], probably because of the great diversity of herbaceous species in this habitat.

Birds

Shrublands are inhabited by "shrubland specialist" bird species that are adapted to breeding and foraging in areas with characteristic low vegetation, such as various ground breeding species. Today some of these species are endangered due to the decrease in shrubland areas. The Red List of Israel's Birds[18] found that of 21 shrubland specialist bird species breeding in Israel, 57% are endangered (Cretzschmar's Bunting *Emberiza caesia*, Black-headed Bunting *Emberiza melanocephala*, Rufous-tailed Scrub Robin *Cercotrichas galactotes*, Red-backed Shrike *Lanius collurio*, Spectacled Warbler *Sylvia conspicillata*, Black-eared Wheatear *Oenanthe hispanica*, Long-billed Pipit *Anthus similis*, Tawny Pipit *Anthus campestris*, Upcher's Warbler *Hippolais languida*, Blue-cheeked Bee-eater *Merops persicus* and European Bee-eater *Merops apiaster*).

Open, treeless shrublands are essential for foraging of many raptors (e.g. Lesser Kestrel *Falco naumanni*, Bonelli's Eagle *Aquila fasciata*, Long-legged Buzzard *Buteo rufinus* and Short-toed Eagle *Circaetus gallicus*), allowing them to identify their prey (rodents and reptiles) and stoop to catch them from great heights. These birds of prey find it difficult to hunt in forests and woodlands and depend on shrublands and grasslands for their food.

Reptiles

The structural diversity of shrublands that include rocky areas that provide shelter for reptiles, together with areas that combine grassy patches alongside shrubby patches, make it a paradise for reptiles. This habitat allows reptiles to control their body temperature more effectively by providing them with the opportunity to move between

open and shaded areas.

Shrublands are the major habitat for the Mediterranean Spur-thighed Tortoise *Testudo graeca* and Gunter's Cylindrical Skink *Chalcides guentheri* (classified in the Red Book of Vertebrates in Israel as a "vulnerable species"), Snake-eyed Lizard *Ophisops elegans*, Bridled Mabuya *Heremites vittatus* and Latast's Snake Skink *Ophiomorus latastii* (that is endemic to Israel and Jordan).

Shrublands – a Successional Stage or a Separate Landscape Unit?

The Mediterranean shrubland formation is occasionally one of the first stages in succession – the natural process in which plant communities develop from pioneering communities to the climax community. Succession in the Mediterranean region includes the following stages (in order of appearance): dwarf-shrubland, garrigue and woodland. Shrubland communities sometimes develop in native woodlands that suffered from anthropogenic activity that disturbed the woody vegetation (grazing, fire and cutting). Shrublands and grasslands, however, are not just important as a "transition stage", but also as sustainable communities in many parts of Israel, usually in bedrock or soils, which cannot support woodland or open woodland development.

Indeed, shrubland and grassland communities can be stable for tens of years and even more, and in many areas, they are not replaced by woodland communities, as would be expected in the successional process. Even in areas with relatively high precipitation (ca. 750 mm), such as Biriya and Bar'am, there are stable shrubland communities on hard chalk in the Mt. Scopus group formations[3].

One possible explanation is that dwarf shrubs and herbaceous species hinder penetration of species from woodland communities[19]. The major explanation for this is that local environmental conditions (lithology, soil and climate) affect different factors such as the water regime and minerals, so that the garrigue or woodland communities cannot develop[3].

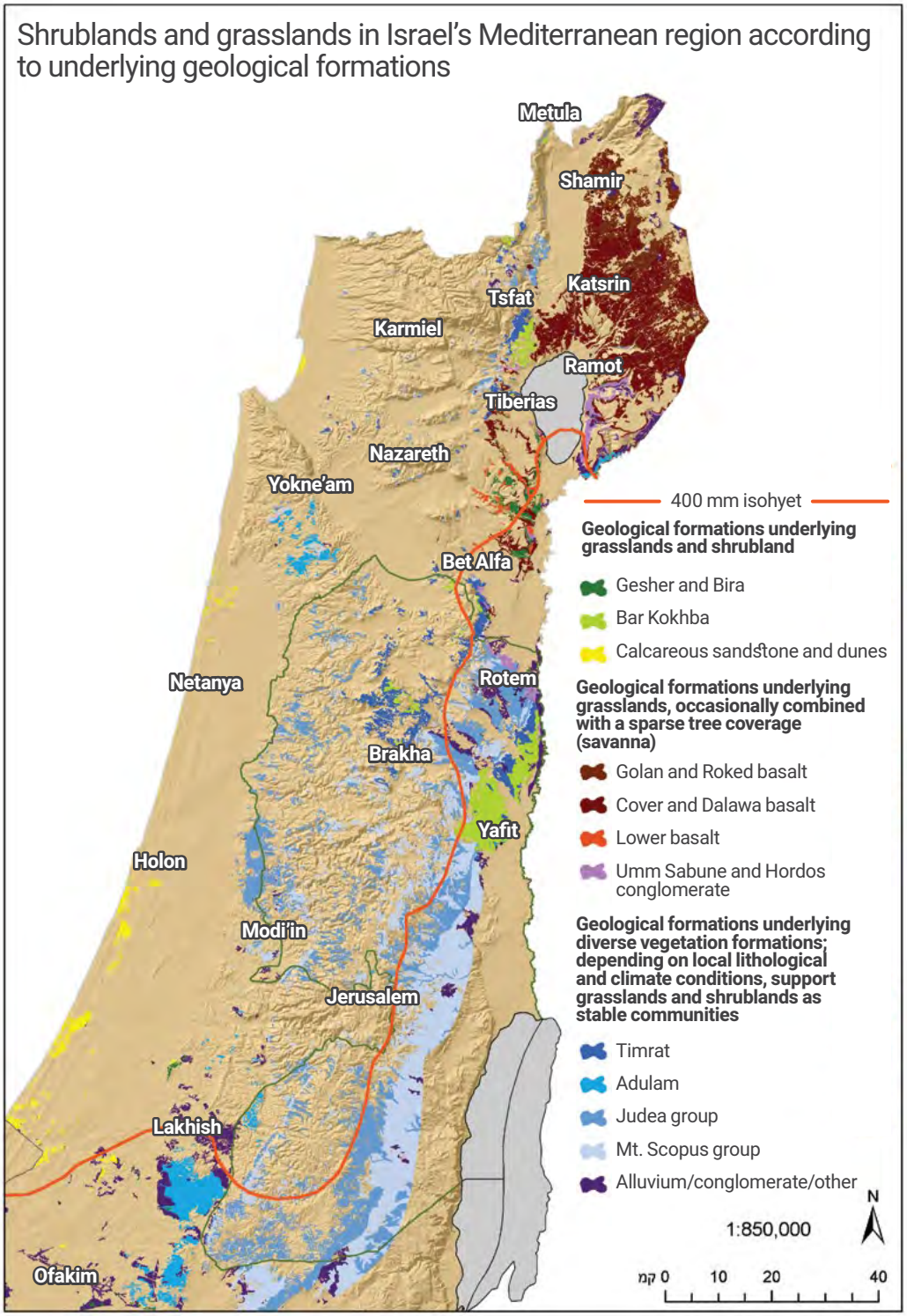
Thus, in various parts of the eastern Upper Galilee, the Golan Heights, Mt. Gilboa and the Jordan Valley (the Bar Kokhba and Timrat formations – Eocene hard limestone, the basalt plateaus in the Golan, and in the Eastern Galilee on basalt soil, the Gesher Formation and more), typical Mediterranean woodland did not develop because of the topography, lithology and soil. In these areas, there are grassland and shrubland formations and occasionally very sparse open woodlands[20].

It should be noted that there is almost no development of shrubby or woody vegetation on the basalt plateaus, except for basalt areas from specific geological periods.

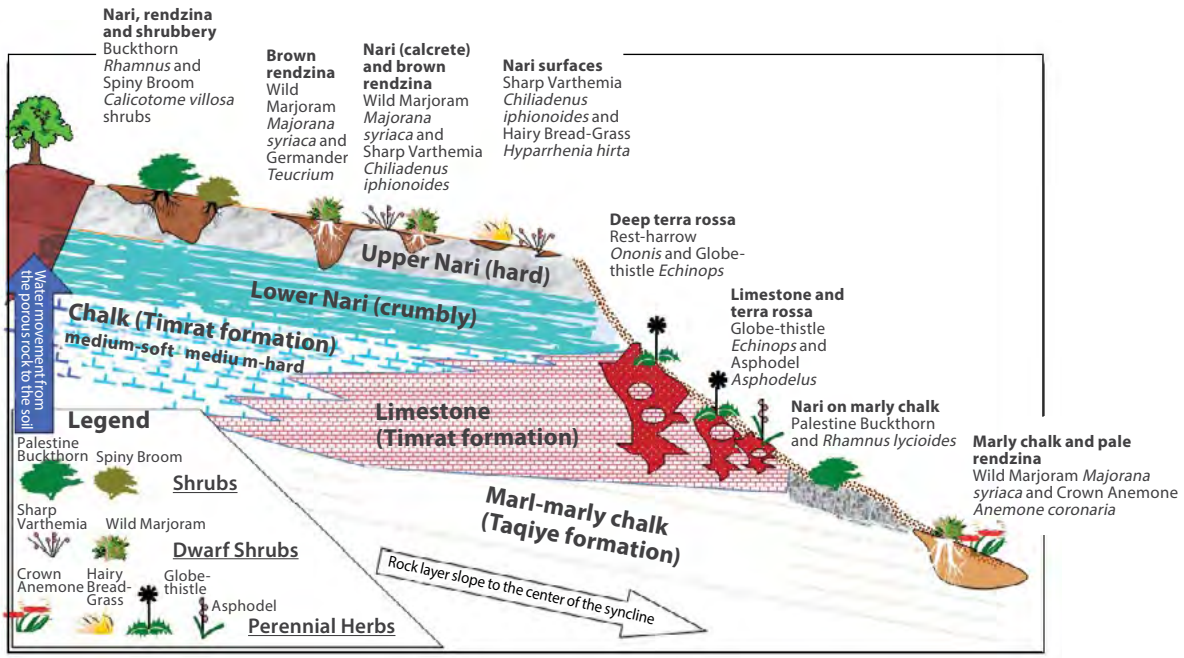
Even in areas that would have been expected to support woodland development, such as hard rock areas in the Ramot Menashe or Alon HaGalil area, shrubby or herbaceous communities developed instead of woodland or forest park, because of local lithological and soil conditions[21]. In Ramot Menashe there is historical evidence that shows that the central plateau had always lacked trees[22].

Between shrubland and grasslands and the potential "climax community" of woodland or open woodland there are various "intermediate stages"[23]. These stages, which include, for example, shrubbery (garrigue), grasslands with sparse tree coverage (less than 10% of the area), open woodland and more, are all ecosystems that possess some shrubland characteristics, and are suitable for a wide diversity of reptiles and plants as well as for raptor foraging – thanks to their open landscape (relative to dense woodland/forest).

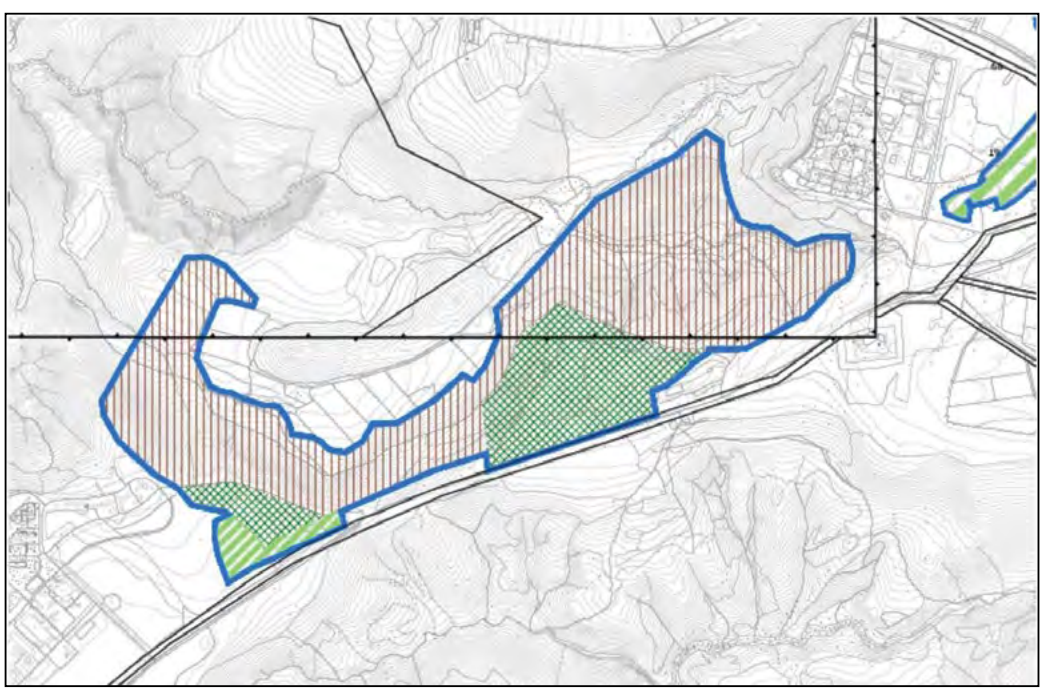
The best way, both ecologically and financially, is to manage these areas without interventions and to allow them to develop naturally, with no plantings, with a possibility of managed grazing in cases where intervention is needed (e.g. for fire prevention).



Distribution of shublands, grasslands, calcareous sandstone and sands in northern Israel, based on geological strata that support their development as "climax communities" or stable communities.
Map prepared by: Eli Haviv



Local conditions that create sustainable shrubland and grassland communities in the Mediterranean region: rock-soil-vegetation units on one slope, which developed according to changes in rock porosity and hardness and to the size of soil pockets. A transition from Tabor Oak forests that grow on soft-semi-hard chalk and large soil pockets, through shrubs and dwarf shrubs on hard or marly chalk and to only herbaceous vegetation on limestone. From Herr *et al.* 2015[21].



Section of the KKL afforestation plan for the Golan Heights – plan for forest plantings in the Metsar area – the narrow saddle between Nahal Metsar and Nahal Susita. An ecologically important grassy area, as well as being important for conservation as an open landscape as part of the biblical story of the site. October 2018.

Semi-steppe Shrublands

Semi-steppe shrublands are found in the transition areas between the Negev and Judean deserts and the Mediterranean region. In these areas there is a unique junction of Mediterranean and desert vegetation along with plants that are specific to this transition area, such as the Jerusalem Sage *Phlomis brachyodon*. The dominant shrubs and dwarf shrubs include Hairy Bread-Grass *Hyparrhenia hirta*, Jerusalem Spurge *Euphorbia hierosolymitana*, Israeli Thyme *Coridothymus capitatus* and Prickly Burnet *Sarcopoterium spinosum*, which originate in a number of biogeographic regions. Other characteristic plants include the Prickly Alkanet *Anchusa strigosa*, the Dominican Sage *Salvia dominica* and the Common Ballota *Ballota undulata*.

Due to the two-dimensional physical structure (lacking trees) semi-steppe shurublands support characteristic animals, such as the Spectacled Warbler *Sylvia conspicilata* and the Long-billed pipit *Anthus similis* (that are classified as vulnerable species)[18]. Ground nesting bird species flourish in semi-steppe shrublands, as do reptiles adapted to the habitat and large birds of prey that specialize in hunting their prey in open landscapes.

From a biogeographical aspect, semi-steppe shrublands are a "transition area" between the Mediterranean region to the north and the desert to the south. Transition areas between ecosystems and climatic regions are known as ecotones, ecological communities with a unique genetic diversity that makes them very important for conserving biodiversity[24],[25]. One such example is the existence of the southernmost population of wild emmer wheat (the progenitor of domesticated wheat) in the semi-steppe shrublands of the Yatir region. Conserving this population as a genetic reserve for commercial wheat strains to breed varieties more adaptable to heat and dryness is undoubtedly significant, particularly in times of global climate change. In a comparative survey conducted on Mt. Gilboa, the densest coverage of wild wheat was found on non-forested open areas and the sparsest coverage was found in dense forests[26]. Transition area shrublands are also the major habitat for the Mountain Gazelle *Gazella gazella* [27].

Only 2.5% of the semi-steppe shrublands are represented in nature reserves, far below Israel's commitment to conserving at least 17% of the area of all its ecosystems as part of the Convention on Biodiversity[4].

A semi-steppe area shrubland in the Lahav area. The typical vegetation is composed of low shrubs and herbaceous vegetation, with no trees. This landscape supports "specialist" animal species that do not survive after trees are planted. Photo: Alon Rothschild

A semi-steppe area shrubland in the Yatir region, with its characteristic open landscape, with low shrubs and no trees. Photo: OLI website

Characteristic Birds of Semi-steppe Area Shrublands

Long-billed Pipit *Anthus similis*.
Photo: Asaf Meyrose

Spectacled Warbler *Sylvia conspicillata*.
Photo: Avner Rinot

The Loess Plains of the Northern Negev

Loess soil is a mixture of sand and clay that is partially impermeable to water. The characteristic loess landscape in arid areas is a flat landscape, with sparse tree cover and therefore "two dimensional" in character. Its vegetation is a combination of herbaceous plants and dwarf shrubs, occasionally with some trees, mainly in streambeds.

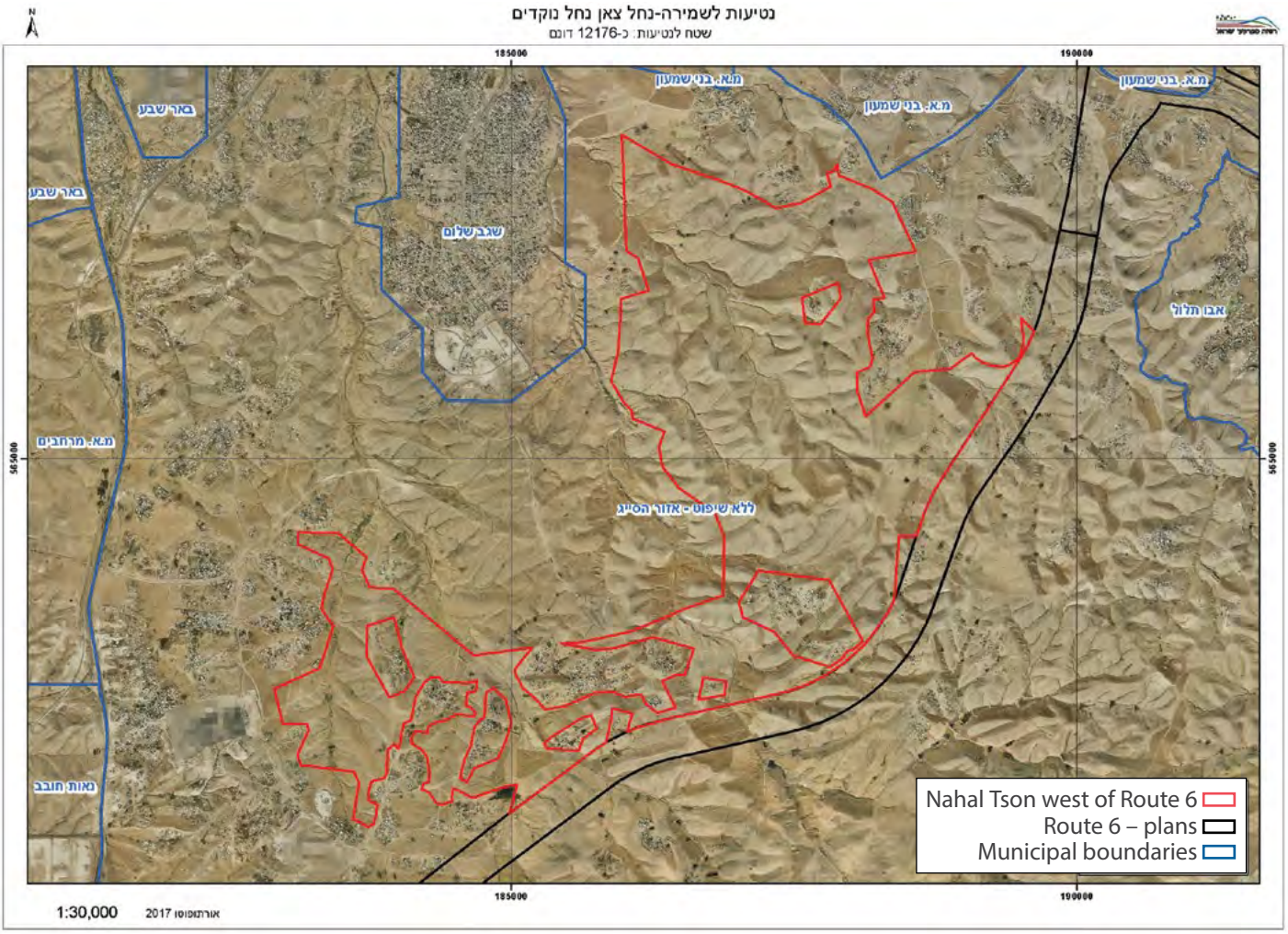
The foundation of the loess ecosystem is the biological soil crust composed of minute plants, algae, lichens and fungi, which provide food for various arthropods, which in turn provide food for reptiles and birds. The thin crust (less than 2 cm thick) is sensitive and easily damaged by heavy vehicles and earthworks[28].

A number of endemic species (unique to the area), adapted to the loess soil in open landscapes, inhabit the Northern Negev loess plains. These include the endemic Be'er Sheva Fringe-fingered Lizard *Acanthodactylus beershebensis* a critically endangered species[29] and the plant "red species" (endangered) *Allium kollmannianum* and the Judean Iris *Iris atrofusca*[30]. The open landscapes of the loess plains are also inhabited by characteristic birds such as the Asian Houbara *Chlamydotis macqueeni* and the Cream-colored Courser *Cursorius cursor*, also classified as endangered species, and by the rodent, Greater Egyptian Jerboa *Jaculus orientalis*, which was once common in the Arad Valley.

Only a small percentage of the loess plains are represented in nature reserves, far below Israel's commitment to conserving at least 17% of the area of all its ecosystems as part of the Convention on Biodiversity[4].

Allium kollmannianum.
Photo: Bar Shemesh

Loess plain in bloom.
Photo: Alon Rothschild



Plan for afforestation of some 1,200 hectares in the Northern Negev for the purpose of "conserving state lands" initiated by the ILA. Summer 2017

Desert Tulip *Tulipa systole* on loess soil. The loess soil crust, a biological crust composed of minute algae, extremely sensitive to crushing by heavy machinery, is visible.
Photo: Alon Rothschild

Asian Houbara *Chlamydotis macqueeni*, a ground nesting species characteristic of loess plains and absent from areas in which trees were planted.
Photo: Asaf Meyrose

Light Soils: Kurkar (Calcareous Sandstone) and Hamra (Red Sandy Soils)

Kurkar and hamra are typical coastal plain habitats that support a unique flora and fauna[31]. Today they are the beauty spots of the coastal plain – rich concentrations of plants and animals, at their peak during the spring months, when they attract the residents of the region's densely populated cities.

The kurkar and hamra substrate is quartz granules in various degrees of cementation: kurkar is lithified sand dunes and hamra is soil made up of quartz granules rich in iron oxides and clay. This unique and rare landscape was once characteristic of large parts of the coastal area in Israel.

Together with the changes that occurred in Israel since the early 20th century, the kurkar and hamra areas in Israel have decreased significantly.

Hamra soils were used extensively for agriculture, mainly for planting citrus groves. Accelerated urbanization, particularly along the coastal plain, which characterizes Israel since its establishment, accelerated the deterioration of these habitats even more.

A considerable number of settlements on the coastal plain, from Pardes Hanna-Karkur south to Gedera are built on kurkar ridges and hamra soils. The few natural remnants of these habitats are worth their weight in gold.

Kurkar soils have a **high sand content**; therefore, despite the **amount of precipitation** (400-650 mm mean annual precipitation) there is little water available to plants because of the high percolation rate of sandy soil. Consequently, conditions in kurkar habitats are **arid**, resembling desert conditions – in the heart of a **Mediterranean region**. This interesting combination has allowed **a unique combination of Mediterranean and desert species** growing side by side to develop. Thus, we can find desert species such as the White Broom Retama raetam and the Shaggy Sparrow-Wort *Thymelaea hirsute* alongside Mediterranean species such as Spiny Broom *Calicotome villosa* and species of Rockrose Cistus.

Rapid percolation is the reason that there are few trees in kurkar areas and the plant community in this habitat is characteristically composed of shrubs and herbaceous species, with sparsely scattered trees (usually Jujube *Ziziphus*) at specific sites.

In the Sharon area hamra soils once supported a sparse open woodland of Tabor Oak *Quercus ithaburensis*, most of which has disappeared[32].

Several hundred characteristic plant species grow on the kurkar and hamra soils – of which 38 are classified as endangered. These soils have a **relatively high concentration of endemic plants that cannot be found anywhere else in the world**, except for Israel's coastal plain. These include *Linaria joppensis*, Tel-Aviv Garlic *Allium tel-avivense* and *Trifolium palaestinum*. These plant species are particularly threatened because kurkar and hamra in Israel is their sole habitat, thus they are globally endangered and we are doubly responsible for their protection. The most famous of these is the Coastal Iris *Iris atropurpurea*.

Unique species of snails and wild bees have also been recorded from kurkar habitats, some endemic to Israel, including species that have just recently been described

and are new to science!

Less than 5% of the light soils in Israel are represented in nature reserves, far below Israel's commitment to conserving at least 17% of the area of all its ecosystems as part of the Convention on Biodiversity[4].

Hiking in kurkar (calcareous sandstone) habitats in the Sharon region

White Broom (white) and Spiny Broom (yellow) in bloom on the Gvar'am kurkar. The combination of desert and Mediterranean species is unique to the kurkar habitat.

Negative Ecological Effects of Afforestation in Sensitive Ecosystems

◄ Preparations for planting on the Goral Hills. The topsoil and vegetation have been removed with heavy mechanical equipment. The slopes above the site are covered by native vegetation that was not damaged

How Does Afforestation Negatively Affect Natural Ecosystems?

Afforestation has a dramatic impact on arid or semi-arid habitats, which lack significant tree cover, and in particular on ecosystems in which trees are naturally rare (grasslands, semi-steppe and Mediterranean shrublands, loess areas and kurkar ridges and sandy areas).

Afforestation and planting activity in natural habitats lacking trees modify the ecological landscape extensively, on a number of scales:

- On the landscape scale, the flat steppe-like landscape, "two-dimensional" and continuous, is replaced by a "three-dimensional" fragmented landscape with elevated elements (embankments, trees).
- On the spatial scale – there may be fragmentation of natural habitats and edge effects of forests on natural patches.
- On the local scale, the natural habitat is affected by shading, herbicide spraying and damage to soil crust elements and to the runoff regime (mainly in plantings in the Northern Negev). Occasionally alien species of planted trees penetrate into the natural area. Moreover, forest and generalist species immigrate into the area and establish themselves successfully thanks to these changes, displacing local native species.

For further information and details of findings and studies – see Appendix A.

Damming streambeds for afforestation involves earthworks that remove the natural soil and the vegetation, fragment the area hydrologically and in general negatively impact nature.

Changes in predation pressure and exclusion of "flatland" specialists

Decrease in shrubland foraging areas

Shading, leaf litter and loss of heterogeneity

Afforestation in Sensitive Natural Areas

Direct impact on natural resources

Damage to soil infrastructure and disruption of the runoff balance

Spatial fragmentation

Photo: Alon Rothschild, Yosef Segal, Asaf Ben David

What are the Consequences of Afforestation in Sensitive Natural Areas?

Creation of arboreal landscapes displaces animals specializing in open grassy landscapes, reduces the amount of light available to herbaceous species and reduces foraging areas available to birds of prey.

The natural ecosystem in shrublands, grasslands and loess areas (as well as desert, sandy areas and kurkar), as a complex of open landscape, changes dramatically as a result of afforestation, and specialist animal species, from arthropods to reptiles, birds and even mammals, are displaced and cannot maintain sustainable populations in the converted areas.

Evidence for changes in plant and animal communities and displacement of local species in planted areas in Israel have been recorded in a variety of taxonomic groups (birds, reptiles, mammals, arthropods and herbaceous vegetation), ecosystems and geographic regions.
The phenomenon is also well documented in studies from other parts of the world.

For further information and details of findings and studies – see Appendix A.

A Short-toed Eagle feeding a snake to its chick. Many birds of prey are unable to hunt in forested areas and depend on open shrubland to feed themselves and their young.
Photo: Guilad Friedemann, "Raptors Online", SPNI and INPA

Displacement of shrubland specialist birds and their replacement with woodland and forest species

Displacement of birds of prey from their hunting grounds

Decrease in reptile diversity, including endemic species

Afforestation in Sensitive Natural Areas Replaces the Animal and Plant Community and Excludes Native and Specialist Species

Exclusion of open-area mammal specialist species

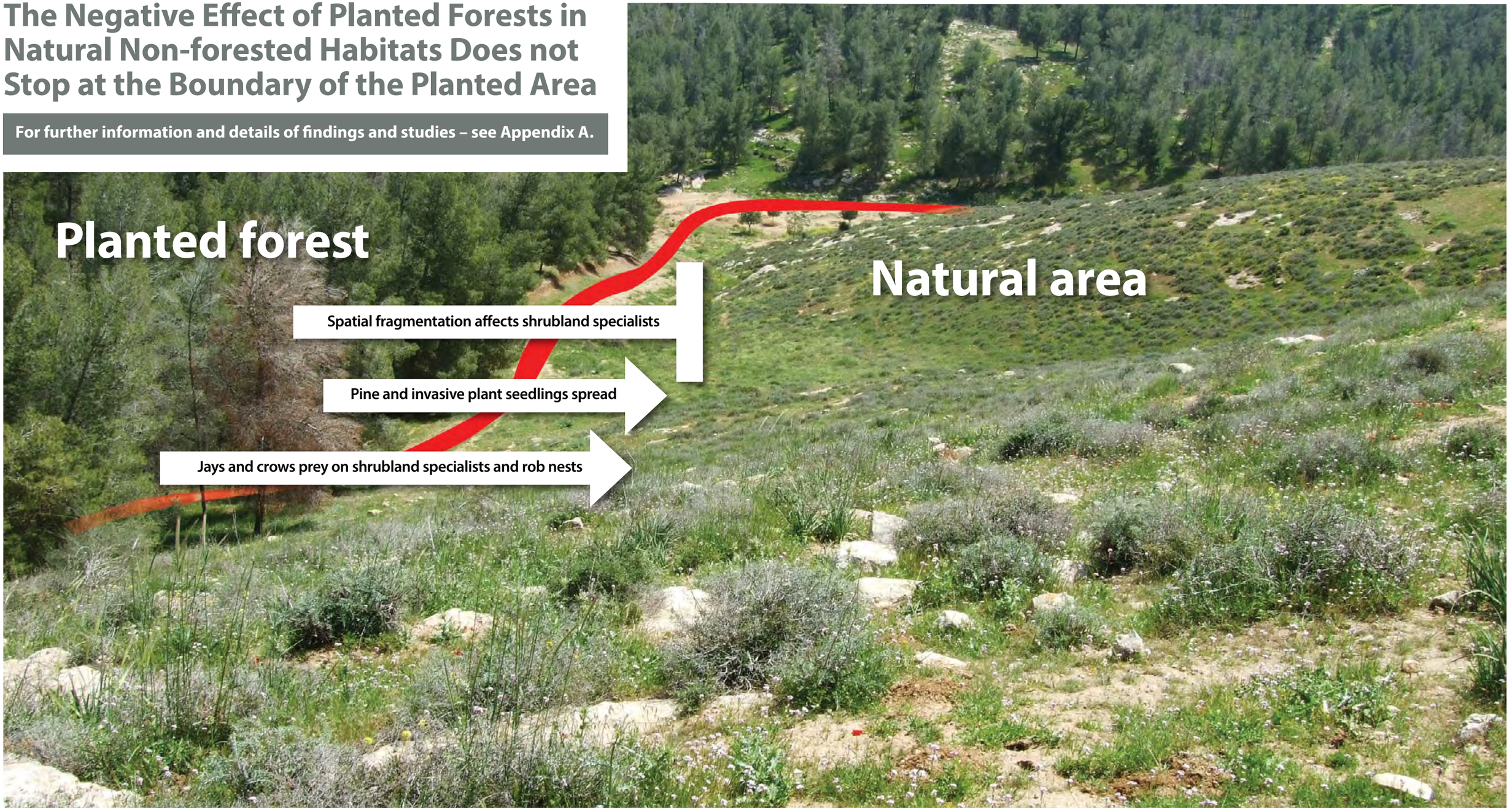
Changes in ant, spider and scorpion communities

Decrease in herbaceous species richness

Photos: Boaz Shacham, Guilad Friedemann, Asaf Meyrose, Roi Talbi

The Negative Effect of Planted Forests in Natural Non-forested Habitats Does not Stop at the Boundary of the Planted Area

For further information and details of findings and studies – see Appendix A.



Is it Justified to Plant Forests on Natural Areas in Israel?

Evaluating the Stated Reasons for Afforestation

◄ Mediterranean shrubland in Ramot Menashe

The Goals of Afforestation

Natural areas designated as "open spaces" were not intended for the production of food, housing or energy, but for the fulfillment of environmental goals. Thus, it is necessary to demonstrate clearly whether it is justified (publicly or ethically) to intervene and modify them so dramatically by afforestation.

Historically, afforestation had different goals, such as providing employment for new immigrants and asserting ownership over land for security reasons. In addition, KKL adopted the approach of "scenic improvement". The underlying assumption of this concept is that the natural landscape is not sufficiently good or diverse, and it has to be improved. It was also argued that the natural forest in Israel had been cut and burnt and it had to be renewed, by, among other things, a "pioneer forest" planted with pines, to pave the way (so it was claimed) for the return of natural forests. This approach originated with Yosef Weitz, the "father of afforestation" in Israel. Weitz's vision was to bring the European scenery from his homeland to Israel – a scenery consisting of dense conifer forests characteristic of rainy Europe.

It is also important to remember that KKL's main goal was redeeming the lands of the Land of Israel. After the State of Israel was established and the agreement between KKL and the government was signed, KKL looked for a new goal – developing the country for the Jewish People – and this included afforestation. However, in the KKL Law, which regulates its activity and in the KKL Articles of Association, there is no mention of the words Environment, Landscape and Nature, and the term Forest appears only in the context of purchasing land.

In recent years, KKL declared that afforestation is its major activity, and even defined its goals, although these are not anchored in any law or other binding document. The objectives of afforestation as listed on the KKL website are: "a. To improve the landscape and diversify it.

b. To provide recreational and leisure areas for the public.
c. To conserve and strengthen ecosystems and natural processes in order to allow forests to provide ecosystem services.
d. To increase tree planting by the public and to strengthen their bond with the forest.
e. To increase the economic use of forests and other areas planted with forest trees.
f. To provide work-relief employment at times of economic crises.
g. To protect trees.
h. To participate in protecting open areas in the State of Israel."

Various KKL publications claimed that afforestation (focusing on the Northern Negev and the desert) has a significant ecological and environmental benefit, and that it benefits both biodiversity and people . KKL even adopted an updated policy paper for forest management that declares its intentions to conserve biodiversity and base itself on natural processes[2].
Here we review the ecological effects of afforestation on sensitive ecosystems in Israel and provide an information base that allows us to evaluate the agreement between KKL afforestation activity and its stated environmental goals, namely: "*Improving the landscape and diversifying it, conserving and strengthening ecosystems and natural processes in order to allow forests to provide ecosystem services and participating in conserving Israel's open spaces*".

Planted pine forest in the Yatir region. In the background is the natural semi-steppe shrubland that is characteristic of the region. The pine trees in the Yatir Forest do not renew themselves naturally because of the low precipitation in the region

A. "Ecological Restoration" – Can Afforestation in Natural Areas be Considered "Ecological Restoration"?

One of the objectives of afforestation stated by KKL is: *"To conserve and strengthen ecosystems and natural processes in order to allow forests to provide ecosystem services".*
Traditional approaches considered afforestation an important method of ecological restoration. Thus, the Chinese government invested tremendous resources to plant trees to prevent soil erosion in arid and semi-arid areas. However, the results, after tens of years of extensive afforestation activity, showed that when the trees are not suited to the local environment, the result **is not an improvement in the environment – but degradation**[36]. The planted trees used more water than the native vegetation, which is adapted to arid conditions, reducing the moisture in the soil and increasing soil loss. The tree mortality and the damage to the native vegetation increased desertification.

> **The result is not an improvement in the environment – but degradation**

The scientists who conducted the study recommended the Chinese government focus on **restoring shrubland and steppes natural habitats, and not to attempt to establish forests in an area not suited for it**. Therefore, the conditions for afforestation for ecological restoration must be:

a. Measurable evidence that there is indeed an environmental problem at the site.
b. Identification of the factors that led to the environmental degradation and proposing a suitable solution for dealing with these factors (e.g. if the problem is "overgrazing" the solution should focus on grazing management).
c. Promoting an action plan to deal with the factors responsible for the environmental deterioration, while determining ecological indicators to evaluate the restoration, including the effect on biodiversity[37].

Another study, that indicated the major importance of natural grasslands, focused on the need to distinguish between **reforestation** (planting trees on deforested land) and **afforestation** (planting forests where they did not historically occur). Afforestation of grasslands that had not previously been forest had a negative impact on the biodiversity of grassland specialists, modified nutrient cycles, reduced the soil carbon content and modified the hydrology of the site (by reducing water infiltration and groundwater recharge)[38].

Afforestation in semi-steppe shrubland in the Lahav area. The natural area surrounding the site is covered with native vegetation, including unique species and there is no problem with erosion. Do the earthworks and planting really improve the situation?

B. The Effect of Afforestation on Ecosystem Services

The previous sections and Appendix A describe the negative ecological impact of afforestation on sensitive ecosystems from the perspective of nature conservation. We will now describe the consequences of these activities from the perspective of ecosystem services that benefit humans.

Ecosystems supply diverse services to people. These services, termed ecosystem services, have been defined as benefits we receive from ecosystems (Millennium Ecosystem Assessment, 2005).

Converting natural areas into forested areas, in semi-arid regions such as Israel, affects the ecosystem services we get from the area. We should examine the trade-offs associated with converting natural areas to forested areas. **The analysis of four major ecological functions, which KKL claims that afforestation activity provides positive returns for, shows that planting forests in natural areas, in some cases with the help of heavy machinery and brutal interventions in natural ecosystems, negatively impacts the provision of ecosystem services, thus adversely affecting human welfare:**

1. Soil conservation and preventing desertification: do planted forests prevent erosion better than natural habitats?

Vegetation (grasses, shrubland and microphytes – minute plants found in the soil crust) provides an essential service of protecting the topsoil from erosion and weathering. Occasionally, particularly in semi-arid areas, intensive activity (e.g. vehicle traffic, intensive grazing, etc.) that removes vegetation can expose the soil to aeolian erosion (wind erosion) and runoff erosion, and eventually to desertification[39]. One of the arguments used to support afforestation in general and afforestation in the Northern Negev in particular, is that these activities **supposedly** stabilize the erosion balance in the ecosystem, thus purportedly prevent desertification processes.

In reality, however, afforestation in semi-arid areas, which involves heavy machinery, soil trampling, and moving earth, adversely affects soil conservation. Damaging soil crusts, removing topsoil and compacting the soil layers beneath it with heavy machinery – have a negative effect on soil quality and its aggregation, reduce the productivity of herbaceous vegetation in the field and have an adverse impact on the soil quality for grazing and on ecosystem functioning[40]. The average function of the forested area (composed of the minority of the area that serves as a "sink" – the area in which water is retained by the artificial embankment, and the majority of the area that serves as the "source" – the area that contributes the runoff, which is most of the area trampled beneath the bulldozer wheels) **deteriorated from the aspect of soil quality and conservation**.

A study conducted in forested areas in the Ambassadors Forest north of Be'er Sheva, found that the afforestation work degraded the physical quality of the soil, compared to natural non-forested areas – even though the latter were subject to heavy grazing – **for all the parameters examined**. A pattern of **gradual, long-term** soil rehabilitation was identified in the areas that had been subjected to earthworks for afforestation; nevertheless, a decade later the soil quality values were equal to (in the best case) or inferior to (in most cases) the values found in the surrounding natural area[41]. The damage to the topsoil was found to have negative impacts, such as increasing runoff and reducing the soil capacity to absorb water – even 15 years after the treatment[42]!

Table 2
Land-use effect on the soil's mean value of clay content (%), silt content (%), sand content (%), particulate organic carbon content (g kg^{-1}), calcium carbonate content (%), mean weight diameter (MWD) of aggregates (mm), clod content (%), aggregate slaking index, clay dispersion index, stable aggregate content (%), and coarse root biomass (g 100 cm^{-3}).

Land-use	*p* value	2-Year-old afforestation system	9-Year-old afforestation system	Natural hillslopes
Clay content	**0.0002**	30.2 a (1.6)	28.9 a (1.0)	24.5 b (0.6)
Silt content	**0.0018**	31.3 a (1.7)	25.6 b (0.5)	28.3 ab (0.8)
Sand content	**0.0001**	38.5 b (0.9)	45.5 a (0.6)	47.1 a (0.9)
Particulate organic carbon content	**0.0001**	7.7 b (0.2)	8.4 b (0.3)	10.1 a (0.5)
Calcium carbonate content	**0.0088**	27.9 a (1.2)	23.4 b (1.4)	24.2 b (1.1)
Mean weight diameter	**0.0001**	3.32 b (0.06)	3.67 a (0.05)	3.72 a (0.10)
Clod content	**0.0001**	31.1 a (2.7)	18.5 b (2.6)	11.4 b (1.1)
Aggregate slaking index	**0.0001**	4.6 a (0.3)	4.9 a (0.2)	2.8 b (0.3)
Clay dispersion index	**0.0001**	3.8 a (0.1)	3.5 a (0.2)	2.6 b (0.2)
Stable aggregate content	**0.0001**	22.8 b (1.3)	22.2 b (1.4)	29.4 a (1.3)
Coarse root biomass	0.0765	0.06 a (0.02)	0.10 a (0.03)	0.14 a (0.02)

Notes: bold *p* value indicates a significant effect. Values in parentheses are standard error (SE) of the means. Means within the same row followed by a different letter differ at the 0.05 probability level according to Tukey's HSD.

The table shows that soil quality indicators and its resistance to erosion are maximal in the natural area, lowest in the two years following afforestation earthworks, and only improve to a certain extent 9 years after completion of the work, (Stavi et al. 2016)[41].

Another study showed that the method of planting in contour bench terrace systems (*shikhim* in Hebrew, a method of planting that builds earth embankments along the hillside contours to harvest runoff) in the Northern Negev led to **increased soil erosion and reduced soil infiltration capacity**[43].

This raises the question regarding how much soil was eroded and lost during the decade since the afforestation work, and what was the benefit of afforestation, if the soil health parameters returned (in the best case) to the original level of soil aggregation?

Another adverse effect, besides for earthworks, is the effect of pre-planting herbicide spraying, which is customary, particularly in the Northern Negev. Spraying increases runoff and erosion and its effect was still evident 15 years later. The effect of scraping the slope without spraying, on the other hand, was found to be shorter[42].

Observations in the field showed that fluting and erosion were intensified in the soil exposed in the early years following earthworks for afforestation, until its natural rehabilitation. Native shrubland, on the other hand, is a stable ecosystem, covered with vegetation and soil crust, which provides soil erosion control services.

To the best of our knowledge, there was no comprehensive long-term evaluation of the **soil erosion balance** in the forested areas of the Northern Negev compared to natural areas with herbaceous and shrub vegetation cover. This evaluation would also have to include the period in which the soil has not yet recovered as well as the period in which the system is functioning in its "mature" state.

Data from studies up to now indicate that intensive afforestation activity in the Northern Negev adversely affects soil quality and conservation and intensifies short-term soil erosion; original values are restored, (in the best case), only after many years. These findings cast a heavy shadow on the arguments that afforestation is intended to conserve soil and to prevent desertification.

The effect of afforestation on soil conservation. The land prepared for planting was characterized by minimal plant cover: most of the soil surface was exposed and prone to erosion. In the background is a natural shrubland slope characterized by herbaceous vegetation and shrub cover of close to 100%, which is resistant to soil erosion. Photographed at Lahav Forest, August 2013.

Fluting and soil erosion in lands prepared for planting in which natural vegetation was removed, therefore losing their natural protection from erosion.

Lahav region, spring 2012

Goral Junction

Pre-planting earthworks in a loess area in the Northern Negev. The natural vegetation and the soil crust have been completely removed. Photo: Yosef Segal

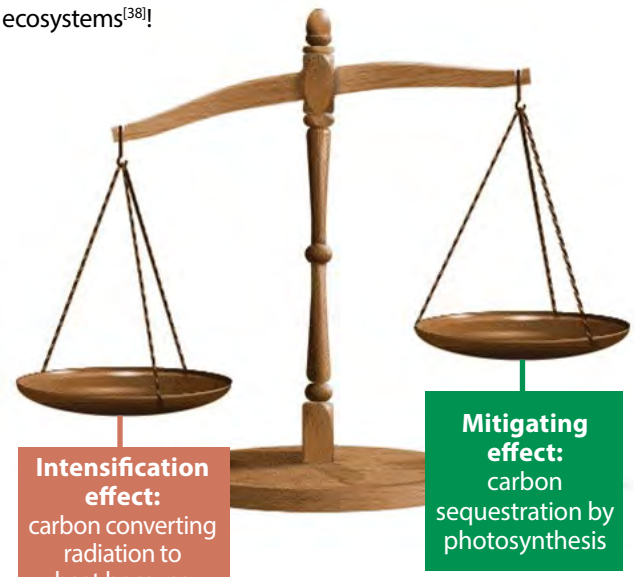
2. Climate change – Does afforestation in the desert help mitigate climate change?

Global terrestrial vegetation absorbs about 25% of the carbon dioxide (CO_2) emitted into the atmosphere. This service is termed global climate control because it mitigates the increase rate of CO_2 concentration in the atmosphere, thus mitigating the rate of global climate change. This was one reason that encouraged the promotion of global afforestation projects based on the belief that afforestation will offset emissions from fossil fuels to a certain extent, and help mitigate climate change. In a nine-year study conducted in the Yatir Forest[44], the forest was found to sequester CO_2 at a rate close to the global average for forests, despite its location in a semi-arid area.

The study performed a weighted calculation of the positive effect of the forest on carbon sequestration versus the negative effect of increased heat. The forest, which is darker than its natural environment (light-colored semi-steppe shrubland), reduces the reflected heat radiation* from the forested area relative to its natural surroundings. Thus, while CO_2 absorption has a cooling effect on the global level, the decrease in albedo has a warming effect. **Reaching the point where the cooling effect exceeds the warming effect in forests in semi-arid areas will take decades, and in the case of the Yatir Forest, it is estimated at about 80 years** (Professor Dan Yakir, Maarag Conference, 2012). Thus, afforestation in desert transition areas could adversely affect Israel's efforts to reduce its climate change footprint, because for now the forests in the Northern Negev and Southern Hebron Mountains have a warming effect on global climate.

The study also suggests that the phenomenon of global desertification, which increases areas with low woody vegetation cover (that are light and reflective), contribute to mitigating global warming because of the lower heat absorbance in semi-arid areas. These data make it essential to critically evaluate and study afforestation in desert transition zones and could suggest congruence between the benefits of natural areas for the ecosystem service of climate control and the benefit of natural areas to the conservation of the unique steppe species in the desert transition area.

Studies in the world have shown that the carbon content in herbaceous ecosystems is high below ground (unlike the high surface carbon content of forest systems) and on a global scale herbaceous ecosystems sequester as much carbon as forest ecosystems[38]!



The effect of forests in semi-arid areas on mitigation of global warming.

In this context, it should be mentioned, that planted forests, and particularly pine and eucalyptus, have been found to be less resistant to climate change, drought and wildfires, compared to the more resistant native woodlands[46]. It is also important to emphasize that pine forests in the Northern Negev do not renew themselves naturally, because of the arid conditions[47], and therefore are not sustainable as forests and are dependent on renewed planting. This emphasizes the irrationality of planting forests in arid areas, particularly in an era of climate change in Israel, as opposed to the alternative of encouraging the establishment of the natural vegetation of the region, including grasses and shrubs.

*Albedo is a measure of the reflectivity of a body or surface – it is the ratio between the electromagnetic radiation reflected from a body or surface and the incident radiation; the absorbed radiation raises the temperature of the body absorbing it.

3. Leisure and Recreation

Planted forests attract hikers and vacationers who use the forest as a picnic and recreation site in nature, mainly thanks to the shade created by dense plantations. **However, only a small part of the planted areas in forests is actually used for picnicking.**

Natural areas, such as shrubland and loess, provide a different experience, as an open area with little shade and with natural flowering of herbaceous annuals, geophytes, perennial grasses and dwarf shrubs. Shrublands offer nature lovers open spaces, the feeling of boundless areas and characteristic animals of open spaces such as gazelles *Gazella sp.*, Long-legged Buzzards *Buteo rufinus*, Lesser Kestrels *Falco naumanni* and bee-eaters *Merops sp.*

In a study that examined hiker preferences in northern Israel, open spaces were preferred over planted forests and dense woodland. Picnickers, on the other hand, preferred open spaces and planted forests equally, but favored dense woodland less[48]. Shrubland was particularly attractive for hikers in winter and spring, and presumably, the results in these seasons would be similar for hikers in the Northern Negev as well.

In summer, forests in semi-arid environments (such as the Yatir Forest) have almost no photosynthetic activity, and therefore the transpiration rate (evaporative water loss via plant leaf pores) is reduced. Thus, the role of the forest in creating a cooler microclimate is significantly reduced in summer (Professor Gabi Schiller, lecture at the KKL Land Development Administration Conference, Bet Dagan, May 9, 2012) and its attractiveness to vacationers (who seek the relative coolness of the forest) decreases.

The number of hectares actually in use for picnicking and relaxing in the shade, of the thousands of hectares of planted forests (e.g. Yatir Forest, HaZorea Forest, etc.) should be compared to the area used for hiking. Furthermore, the preferences of hikers and potential users of open spaces should be examined, to determine how much forested area is needed for recreational services vs. the amount of natural area.

The recreation and picnic services provided by planted forests can be obtained while reducing the damage to natural ecosystems. Shady groves can be concentrated in limited areas adjacent to developed areas, leaving most of the area open to provide hiking services. Small groves, adjacent to the edge of natural areas, which provide shade for picnics and recreation, have an advantage in that they provide the services the public needs but do not affect the function of natural areas as venues for hiking and recreation in nature.

The "runoff-harvesting" based forests in the Negev, which are designed as open forests (well-spaced trees) cannot provide comfortable shade for picnics, and their suitability for providing recreational services in nature as picnic areas is very low, and does not justify such significant damage to the natural landscape. The sight of earth embankments, that sometimes look like "fortifications" are neither convenient nor attractive for hiking.

Recreation in a Northern Negev forest. Local picnic areas are valuable, but in fact, only a small percentage of forested areas are used for picnics, while most of the area could remain in its natural state.

A young nature lover in a flowering loess field.

Planning and Managing Natural Areas with a Statutory Designation of Forests

Policy Recommendations

◄ Grassland on basalt soil in the En Dor area, which has been designated for planting

The Need for a New Vision for Natural Open Areas that have not yet been Planted

The scope of afforestation in Israel is impressive and is an integral part of Zionist History. Many of the existing forests that were once planted on natural areas (some 240 million trees, according to the KKL website) have diverse positive functions, such as providing shady picnic sites, a widespread network of single track and other bicycle trails, roosts for migrating raptors and the like.

However, **in view of the severe ecological consequences of afforestation for sensitive ecosystems, and a lack of clear-cut public benefits to justify new plantings, as already specified in this document, it is necessary to re-examine afforestation activity in Israel, and to move on from afforestation to landscape management.**

We suggest clearly distinguishing between forests that have already been planted, which extend over about 100,000 hectares, and between planning and managing natural areas, focusing on the conservation and management of sensitive ecosystems as natural landscapes, with minimal or no intervention. In other words **to stop afforestation of shrubland and grasslands, loess, kurkar, streambanks and deserts, with the exception of specific sites for recreation and rehabilitation of degraded areas**. Management of planted forests will continue, but there is no justification for the continued environmental damage caused by afforestation of sensitive natural areas.

This vision is not only based on the Convention on Biological Diversity, of which Israel is a signatory, but on NOP 22 and the goals of the "Forestry Policy" that KKL promoted (but unfortunately, did not implement sufficiently in its planting and land development programs).

The major objective of planning and managing natural landscapes should be the conservation of natural ecosystems and landscapes, and the indicator of success should be the improvement of the status of the unique species characteristic of them, focusing on natural ecosystems (that are under-represented in protected areas in Israel).

This approach proposes to "let nature take its course", i.e. to rely on natural processes in planning and managing open spaces, and not to coerce the field into alien landscape and forestry approaches. This approach will allow time and space for natural processes, such as natural succession.

Managing open spaces is a worthy challenge (both from the aspect of management and Zionism) for any organization and is not inferior to afforestation. Managing natural open spaces includes many tasks, including dealing with visitors and making scientific content accessible, ecological management to protect species and natural processes from anthropogenic influences, enforcement, dealing with invasive species, managing the interface with infrastructures, the military, and more.

> "it is necessary to re-examine afforestation activity in Israel, and to move on from afforestation to landscape management"

Managing sensitive natural areas requires not only stopping afforestation (as could have been done by means of the designation of "native forest for conservation"), but also applying management methods, such as preventing off-road vehicle entry, campfires and parties in sensitive areas, and other measures. KKL lacks these tools because it has no law authorizing it, and its staff are not government workers who can enforce these measures (even if the proper law existed).

Obstructions for Realizing the Vision

Managing open spaces in general, and forests specifically, is the task of the government, in its capacity as the provider of public goods to all the inhabitants of the country. This management, which also includes tasks such as enforcement, closing of areas for rehabilitation, and representation in government institutions, requires that determining policy on one hand, and enforcing it on the other, should be the responsibility of a governmental body, acting according to a designated law, and overseen by the public.

At present, KKL is the actual national forestry service, acting as policy maker, planner, executor and manager. KKL, as a private non-governmental organization, has conflicts of interest, does not act according to a law that determines the goals of managing and conserving open spaces, and is not subject to government policy and public oversight in aspects of planning and managing open spaces[49].

Moreover, KKL lacks the essential tools to manage large expanses of natural areas (there is no law authorizing KKL workers to prevent harm to natural assets and to define binding rules of behavior in the field, no tools for enforcement, no significant scientific division, etc.).

Appropriate management and conservation of natural open spaces designated as "forest" in outline plans, demands institutional and legislative changes as well as renewed planning guidance.

Policy Recommendations for Conserving Natural Areas Included in Forest Plans

Institutional Recommendations

Separating between management of forested areas and management and planning of natural areas included in outline plans under the designation of "forests".

A. Natural areas that have not undergone afforestation

Transferring **management of sensitive natural areas designated as "Forest" to the Israel Nature and Parks Authority (INPA),** the government body authorized by law to conserve nature in Israel, which has the legal tools and the expertise suitable for this task according to the Natural Parks and Nature Reserves Law. For this purpose it will be necessary to change planning designations, in, among others, NOP 1 (the section on open spaces), and in the framework of the strategic plan for open spaces led by the Planning Administration. It will also be necessary to promote detailed plans for the conservation of these areas according to the land uses that the INPA is entrusted with.

B. Planted areas that have undergone afforestation

The forested areas that are already planted will be managed according to a **new forest law**. This law will determine the government office entrusted with managing planted forests in Israel, will define management goals, government regulation and how this will be executed.

As some of the tasks required for effective forest management include enforcement and determining policy – a clear-cut government task – these tasks will be executed by the "forest division" staff in the government ministry (Environmental Protection or Agriculture).

Ongoing forestry tasks can continue to be carried out by KKL staff, who are not government employees.

Planning Recommendations

A. Planning sensitive natural areas whose current designation is "forest"

Promoting detailed outline plans for sensitive natural areas that are currently classified as "forest", which will designate them as "nature reserves" or "national parks". These land designations are the only ones that allow effective protection of an area in its natural state with no interventions of planting trees foreign to the native landscape, or other threats to native biodiversity.

Until the forest law is legislated and countrywide institutional change is implemented, sensitive natural areas in forest plans should at the least be designated as "natural forests for conservation" to prevent them from being converted into anthropogenic forested ecosystems.

B. Integrating ecological considerations in discussions regarding forest plans in planning institutions

Until the institutional change suggested above is promoted, we recommend that the planning institutions discussing afforestation programs take a conservative stand involving minimal intervention in sensitive natural areas:

- To require an independent environmental assessment as a pre-condition for discussing afforestation programs.
- To adopt the criteria and standards for judging planting programs (appendix B) formulated by the monitoring and oversight committee for NOP22, **as a planning standard for**

judging in planning commissions at the stage when the plan is deposited for public review.

- To allow planting and intervention in natural areas only for the following needs:
  1. Planting for creating entrances, specific picnic or recreation areas.
  2. Localized rehabilitation of disturbed areas (e.g. landfill).
  3. Planting a narrow buffer strip (a few meters wide) to "mark the boundary" at the plan's blue line (marks the plan boundary in Israeli planning documents), to create a visual buffer between managed and unmanaged areas (e.g. between the plan area and agricultural land, settlements or roads) – if so required.
  4. To avoid planting pines and eucalyptus.
     - **Pines** have been proven to spread from the planted areas into adjacent natural areas, with adverse ecological impacts. Thus, in order to conserve Mediterranean and semi-steppe shrubland, and to conserve the native Tabor Oak *Quercus ithaburensis* open forests, pine plantations should be avoided, both for protecting natural habitats in the area intended for planting (native shrubland, grassland and open forests) and to conserve adjacent natural areas.
     - **Eucalyptus trees** modify soil composition, repress fauna and flora assemblages below them and are home to invasive species (Rose-ringed Parakeet *Psittacula krameri*, Bronze Bug *Thaumastocoris peregrinus*) and eruptive species (Hooded Crow *Corvus corone*, Cattle Egret *Bubulcus ibis*).

C. Planting to assert ownership - forest plantings that require planning like any other planting

Plantings initiated by the ILA as "agricultural plantings" to assert ownership on land, are forest plantings for all intents and purposes. Therefore, and in view of their significant impact on the landscape (particularly in the Northern Negev), they should be required to submit plans according to the Planning and Building Law, just like any other forest plan. Otherwise, they should propose other alternatives for protecting the land (contingent on its ecological value), including promoting a nature reserve on the site.

Another possibility, until a properly functioning planning mechanism is implemented, is to improve the effectiveness of the Committee for Coordinating Agricultural Plantings, which was established following the petition submitted to the High Court of Justice by the SPNI, and to integrate a balanced decision-making mechanism and not "agree to" mechanism in which the ILA is the sole adjudicator.

D. Careful planning and management of kurkar and hamra lands planted with veteran groves

Occasional relictual native vegetation remains in kurkar and hamra lands, planted with historic plantings (usually eucalyptus trees) in the Sharon and Pleshet regions[50], thanks also to the plantings that protected the sites from construction. In this case, the plantings made an important contribution to conserving the relicts in a period in which the awareness of the kurkar vegetation's importance was low, in an area in central Israel subject to extreme development pressure.

It is now time to manage sites such as these while providing maximal protection to the natural assets of the kurkar and the hamra, and we propose preparing an **ecological management program** for each site, based on a detailed survey of natural assets. We suggest thinning the trees gradually (to the point where only a few trees remain) in order to open the area and let in light, taking care to conduct the work only in summer, to prevent trampling of sensitive vegetation.

Natural treeless landscape - an ecosystem that should be conserved and managed as a nature reserve.

Appendix A

Adverse Ecological Effects of Afforestation on Natural Ecosystems

◄ **Afforestation in the Northern Negev.** Photo: Yosef Segal

A. Afforestation adversely affects nature when it is implemented through modification of the original ecological landscape

Afforestation dramatically affects arid or semi-arid natural landscapes, characterized by sparse tree coverage. This is particularly true for ecosystems in which trees are naturally rare (grasslands, Mediterranean and semi-steppe shrublands, loess areas, kurkar ridges and sandy areas).

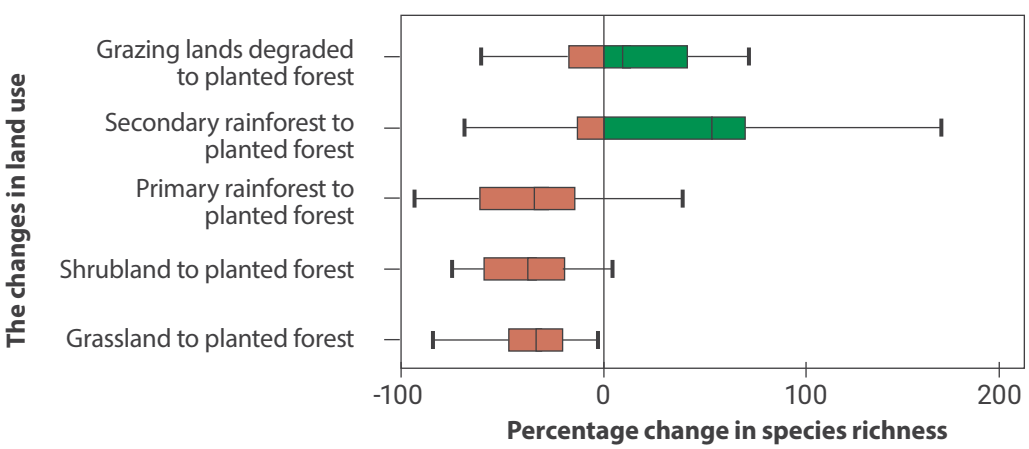
Various studies throughout the world have only recently begun to record the effects of afforestation on biodiversity of treeless habitats:

Thus, in China plant biodiversity in forested areas decreased by 52% compared to natural non-forested areas[36]. In Jordan, planted pines in semi-arid regions were found to significantly reduce the herbaceous cover and to significantly reduce plant species richness[51]. In Ireland afforestation of grasslands was found to have biodiversity loss consequences as early as five years from planting: afforestation encouraged growth of generalist species and reduced native plant biodiversity (with the exception of mosses, which were more common in the forested area), particularly of shade-sensitive species[52].

A comprehensive paper that reviewed tens of studies that examined ecological effects of afforestation under different conditions found that afforestation contributes to biodiversity when implemented in disturbed or degraded areas (which have been classified according to distinct criteria) and uses native plant species. On the other hand, afforestation was found to adversely affect biodiversity conservation when implemented in natural habitats, such as grasslands or shrublands, and when exotic species were used (e.g. eucalyptus)[37].

Similar results were recorded in an additional study that determined that afforestation in areas that were not originally forests is undesirable for conserving biodiversity[53].

Surveys and studies in Israel's Mediterranean region show that in old planted forests, many years after the original planting and following natural and artificial thinning treatment, understory vegetation develops, in which some the species are native woodland species. In shrubland patches in forests some of the shrubland species are conserved[46][54]. However, as a rule, the natural shrubland, grassland and loess flats ecosystems (as well as sandy and kurkar areas), as a complex of natural open landscape, changes dramatically as a result of afforestation, and specialist animal species, from arthropods to reptiles, birds and even mammals, are displaced and cannot maintain sustainable populations in converted areas.



The percentage of change in plant species richness because of afforestation, as measured in a number of s tudies. We can see that afforestation of grasslands, shrublands and primary forest (ancient rainforests) hurts plant species richness, when compared to afforestation in disturbed grazing land or secondary forests (rainforests that were damaged and re-grew), which increases the species richness. Adapted from Bremer and Farley, 2010[36].

Judean Iris not affected by earthworks to prepare land for afforestation. In the background, in the stripped and planted area the ecological impact and the removal of natural vegetation from the work area is visible.

B. Evidence for changes in animal and plant communities and displacement of native species in planted areas in Israel

Reptiles

Loess Plains

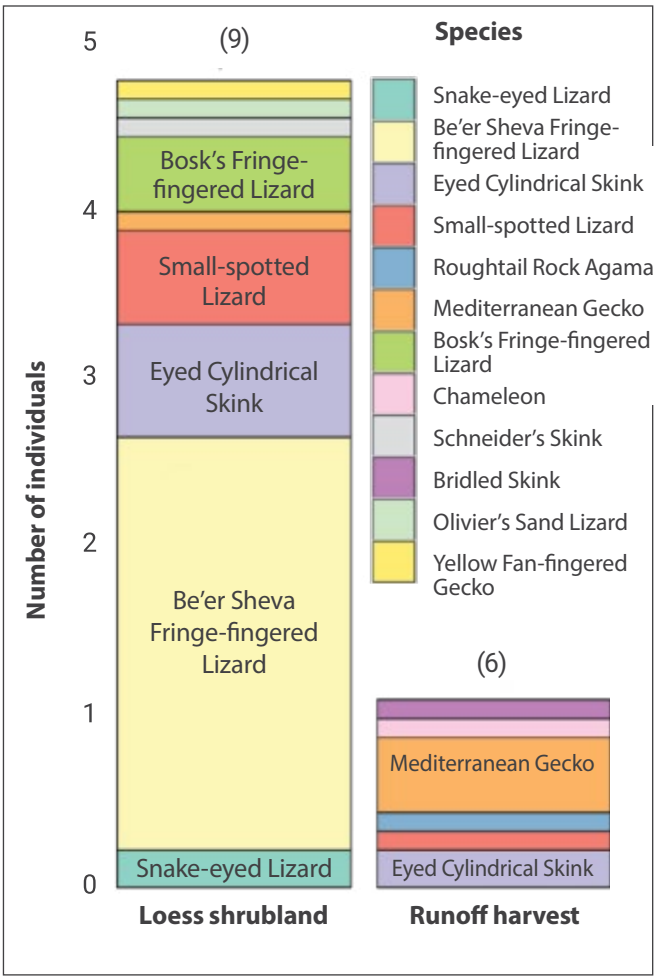
Reptile species richness in natural loess plains and planted (runoff harvest forests) ones was found to be higher in natural areas compared to planted areas and the number of individuals was higher in the natural area compared to the planted area[53].

Forest plantations in loess areas caused significant changes in the reptile community:

Thus, half of all the reptile observations in natural loess areas were of the Be'er Sheva Fringe-fingered Lizard *Acanthodactylus beershebensis*, a species endemic to Israel's loess plains, which was completely absent from the planted areas. The Small-spotted Lizard *Mesalina guttulata*, a typical desert species, was found mainly in the natural loess plains.

The Roughtail Rock Agama *Laudakia stellio*, on the other hand, a species with a broad range, is found in the planted areas, but is not found at all in the natural loess plots, and the same is true for the Chameleon *Chamaeleo chamaeleon*. In other words, afforestation in loess areas led to the disappearance of the natural reptile assemblage and its replacement with a generalist and Mediterranean reptile community.

Latast's Snake Skink *Ophiomorus latastii*, a typical shrubland reptile, which is not found in forested areas. Photo: Roi Talbi



Observations of reptiles in natural loess areas compared to an area forested by "runoff harvesting" in the Northern Negev loess plains. Reptile species richness (number of species) in the natural loess areas is considerably higher than in the forested (runoff harvesting) area, and that the endemic species Be'er Sheva Fringe-fingered Lizard *Acanthodactylus beershebensis* is completely absent from the forested area. Adapted from the Report on the State of Nature, 2016, Hamaarag[39]

Semi-steppe Shrublands

There is a decrease in the frequency and abundance of all reptile species in the Lahav Forest compared to adjacent semi-steppe shrublands. Certain species such as the Eyed Cylindrical Skink and Schneider's Skink *Eumeces schneideri*, whose frequency and abundance were low in natural areas, were completely absent from forested areas. In pine forests there was a decrease in abundance of all the reptile species except for the Juniper Skink *Ablepharus rueppellii* (classified as Least Concern, LC), a common Mediterranean species, which was found in the survey only in planted areas[55].

Mediterranean Shrublands

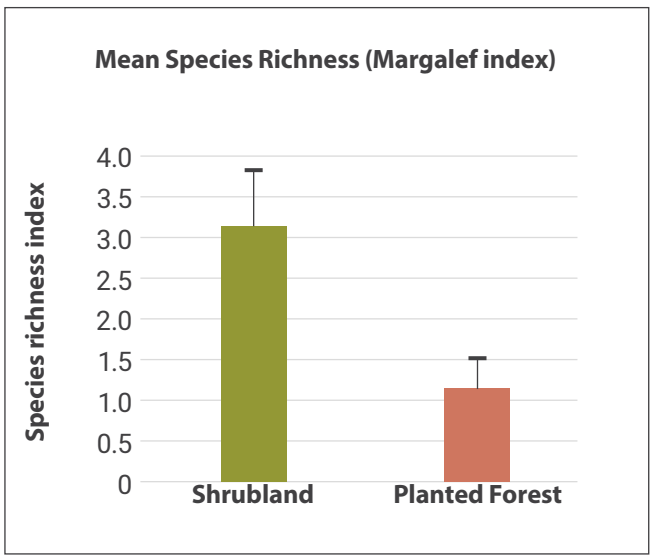
When Mediterranean shrublands, planted forests and native woodlands were compared, the shrublands were found to have the highest reptile species richness and diversity.

The number of lizards and snakes was also found to be highest in shrublands. The reptile assemblage in shrublands was found to be different from that of forests and woodlands[56]. This can be explained by the structural diversity of shrublands that include rocky areas that provide shelter for reptiles together with areas that combine grassy and shrub patches. This environment allows reptiles to regulate their body temperature more effectively by moving between exposed and shady areas.

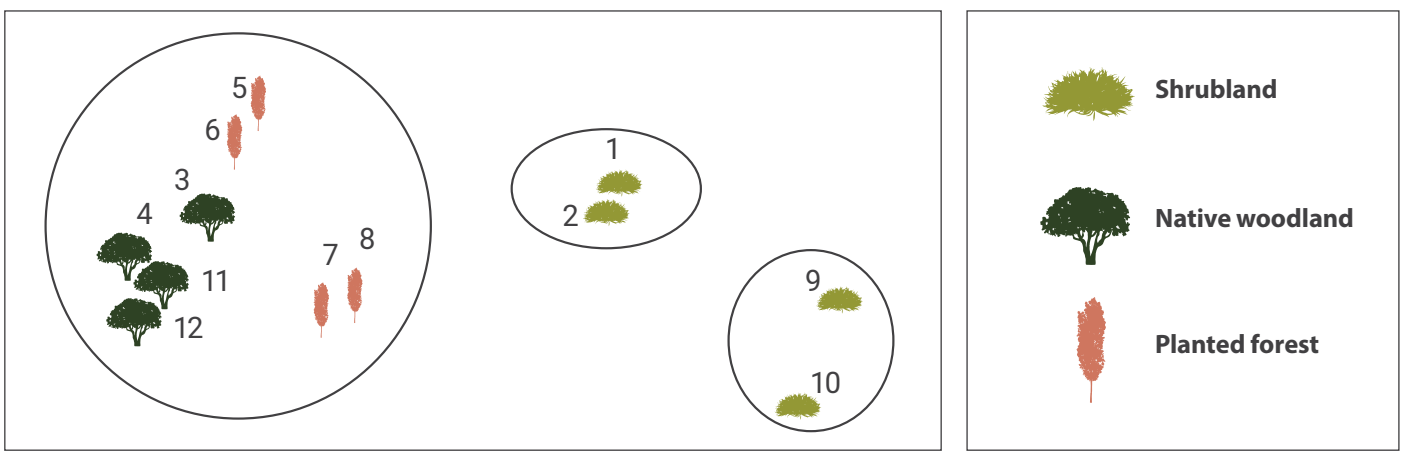
Shrublands have been found to be important for the rare Levant Green Lizard, *Lacerta media israelica* that is endangered in Israel[57].

The reptile surveys conducted by the Maarag, however, do not compare planted forests to adjacent natural areas. This is a significant gap in the monitoring work conducted by the Maarag.

The reptile assemblage of shrublands is different from that of forests and woodlands.



Mean reptile species richness in shrubland and in planted forest. Adapted from Mazeh 2008[41].



The reptile assemblage in various habitats in the Mt. Meron region. The analysis groups samples according to the similarity of their species composition. The species composition of the reptile assemblage of shrublands is distinct from that of the forest and woodland. Adapted from Mazeh 2008[41].

Birds

The effect of afforestation on grassland and open landscape birds has been extensively reviewed the world over. Thus, in South Africa, afforestation of grasslands was found to affect specialist bird species, including globally endangered birds, even when the percentage of planted area out of the total area was small. Afforestation also led to the spread of forest birds not characteristic of the area before afforestation[58].

Loess Plains

A comparison of natural and planted (runoff harvest forests) loess plains found that the avian species composition was different[53]. Specialist desert species (birds requiring natural desert areas for foraging, breeding and survival), such as the Asian Houbara *Chlamydotis macqueeni* (EN – Endangered), the Cream-colored Courser *Cursorius cursor* (VU – Vulnerable), the Pin-tailed Sandgrouse *Pterocles alchata* (EN – Endangered) and the Black-bellied Sandgrouse *Pterocles orientalis* (LC – Least Concern) were found only on natural areas, and not on planted plots. In other words, they were displaced from these areas, where they were once common, because of planting.

Generalist (species that can make use of a wide variety of habitats, including disturbed habitats) Mediterranean species, on the other hand, such as the Eurasian Collared-dove *Streptopelia decaocto*, the White-spectacled Bulbul *Pycnonotus xanthopygos*, the Hooded Crow *Corvus corone cornix*, the Orange-tufted Sunbird *Cinnyris bouvieri* and the Graceful Prinia *Prinia gracilis* – were more common in planted areas than in natural areas. These species spread to open areas in the Northern Negev, among others, in the wake of afforestation in the region.

Semi-steppe Shrublands

In a comparison between semi-steppe shrublands in the southern Hebron Mountains (Lahav and Yatir regions) and planted forest areas, out of 36 common breeding species in the region, 10 species nested only in the natural area, 17 species nested only in the forest and only 9 species nested in both habitats. In this comparison, similar to the findings above regarding bird communities in loess areas compared to runoff harvest forests, the semi-steppe shrubland bird community was found to differ from the planted forest bird community. Shrubland specialists, such as the Long-billed Pipit *Anthus similis* (VU – Vulnerable) and the Spectacled Warbler *Sylvia conspicillata* (VU – Vulnerable) were absent as breeders in forested areas and in fact, were displaced from it after planting – and their habitat area decreased. Instead of the natural bird community characteristic of transition areas, Mediterranean species such as the Eurasian Blackbird *Turdus merula*, the Great Tit *Parus major* and the Eurasian Jay *Garrulus glandarius*, spread and became established in the area thanks to afforestation.

Very sensitive species, such as the Long-billed Pipit were displaced from shrubland patches smaller than 50 hectares and did not nest in them. Thus, planting forests in semi-steppe shrublands also reduce sensitive species populations, when these forests reduce shrubland patches and fragment them.

Pin-tailed Sandgrouse, a ground-nesting species characteristic of treeless loess plains. Photo: Asaf Meyrose

Mediterranean Shrublands

Shrublands are essential foraging areas for many birds of prey such as Lesser Kestrels, Bonelli's Eagle, Long-legged Buzzard and Short-toed Eagle. The open treeless shrubland allows them to identify their prey (rodents and reptiles) and to swoop on them from great heights. These raptors have difficulty hunting in forests or dense woodlands and are dependent on shrublands and grasslands for their food.

Friedemann et. al.[61] found that nesting Long-legged Buzzards on Judean Mountain cliffs decreased dramatically, until they disappeared (except for a single nest), at the same time as extensive afforestation activity began in the area in recent decades. This, because their foraging areas – shrublands – decreased dramatically (60% of the land cover change in the area is due to afforestation; the remaining change is a result of urban expansion and native woodland renewal). The buzzards adapted their behavior and shifted their nests to trees in the Judean Lowlands, foraging in the shrublands and agricultural fields in the region.

The study found that the availability of open, non-forested areas, in the breeding area raised breeding success (number of fledglings) significantly. A subsequent study[62] (using GPS transmitters) found that the Long-legged Buzzard forages close to its nest (unlike the Short-toed Eagle that forages further away from its nest) and depends on natural shrublands as its exclusive foraging area, as can also be seen from examining its prey, which is composed mainly of typical shrubland animals.

Prey consumption of top predators in shrublands during the nesting season is immense: A pair of Long-legged Buzzards fed its chicks with 260 different prey items during 45 days! A pair of Short-toed Eagles fed a single chick with 215 prey items (mainly snakes) over two and a half months[63]! These data do not include additional food consumed by the parents during this period. Thus, **the extent of natural shrublands required to support successful breeding of these raptors is significant, and any reduction in it could adversely affect breeding success, both individually and on a broader scale, affecting long-term survival of these birds in the area.**

Native non-woody vegetation (herbaceous species, geophytes)

Semi-steppe Shrublands

In northern Jordan, in semi-arid areas (with precipitation similar to the northern Negev and the transition area in Israel), pine plantations have been found to reduce plant species richness from 30 species in a treeless area to 17 species in an areas with sparse plantations, and to only 8 species in dense plantations[50]. The impact on herbaceous species richness can be explained by the effect of shading created by trees, combined with the pine needle cover and its allelopathic qualities, which prevented germination.

In a study conducted in the Yatir Forest region, the biomass of herbaceous and shrub vegetation was found to be significantly higher in natural non-forested areas (semi-steppe shrubland) compared to forest areas. Moreover, the density of shrubs in non-forested areas was significantly higher than in forested areas. There was no significant effect of forested areas on herbaceous vegetation density, but the average density on non-forested areas was 278 plants per square meter compared to 224 plant per square meter in forested areas.

Plant species richness in non-forested areas was found to be significantly higher than in forested areas[64]: 95 species in natural areas compared to 79 species in forested areas. In addition, 43 species were characteristic of natural areas and were absent from forested areas, compared to 27 species that were found in forest areas and were absent from natural areas (52 species were found both in natural and forested areas)[65]. These data reinforce the picture according to which species richness is greater in natural areas than in planted forest areas, and that there are native plant species characteristic of the region that do not survive in forests. Moreover, there is reason to believe that due to the decrease in plant richness in the forest and the decrease in the biomass of herbaceous and shrub vegetation there is a parallel decrease in arthropod diversity in forest areas compared to natural areas, with an emphasis on shrubland and loess soil specialists characteristic of the natural landscape in the region.

Mediterranean Shrublands

As a rule herbaceous vegetation species diversity increases the more open the woodland – i.e. the larger the area of shrubland/grassland[16].

In a study that compared herbaceous vegetation species richness in plots with trees and plots in which trees were removed, species richness was found to be significantly higher in the treeless plots compared to the forest plots. The major factor affecting species richness in the plots with trees was found to be the shade created by the trees[66]. This indicates the effect afforestation has on herbaceous vegetation in forested areas.

A survey conducted on Mt. Gilboa found differences in the composition of plant communities between areas with differing tree densities (but no significant differences in species richness were found).

Most of the rare species (e.g. the Gilboa Iris) and wild relatives of cultivated species (such as Wild Emmer) were found in open non-forested spaces, or sparsely planted areas, unlike areas that were densely forested[26]. A later survey found fluctuations in the distribution of the Gilboa Iris, which has a stable population in open forests on porous chalk[67].

In the Jerusalem Mountains, plant species diversity in a dense mature forest was found to be less than about 50% compared to an adjacent unplanted area. Nevertheless, thinning the forest resulted in a rapid rise in species richness, and plots in which trees were cut down attained the same species richness as non-forested areas, within two years of the treatment[46].

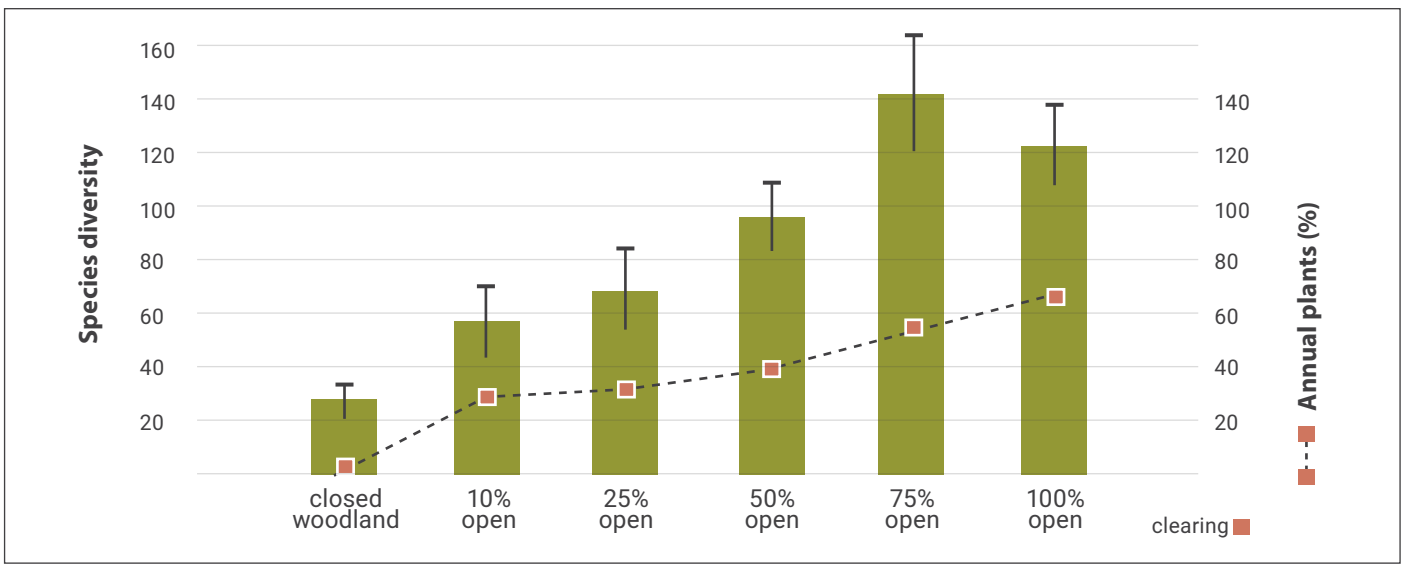
Light Soils

In the "Netanya" Forest (Sargents Grove), an important area for light soil vegetation in the Sharon region, plant species richness was found to decrease with increasing tree density, apparently due to shading[68].

Desert Wadis

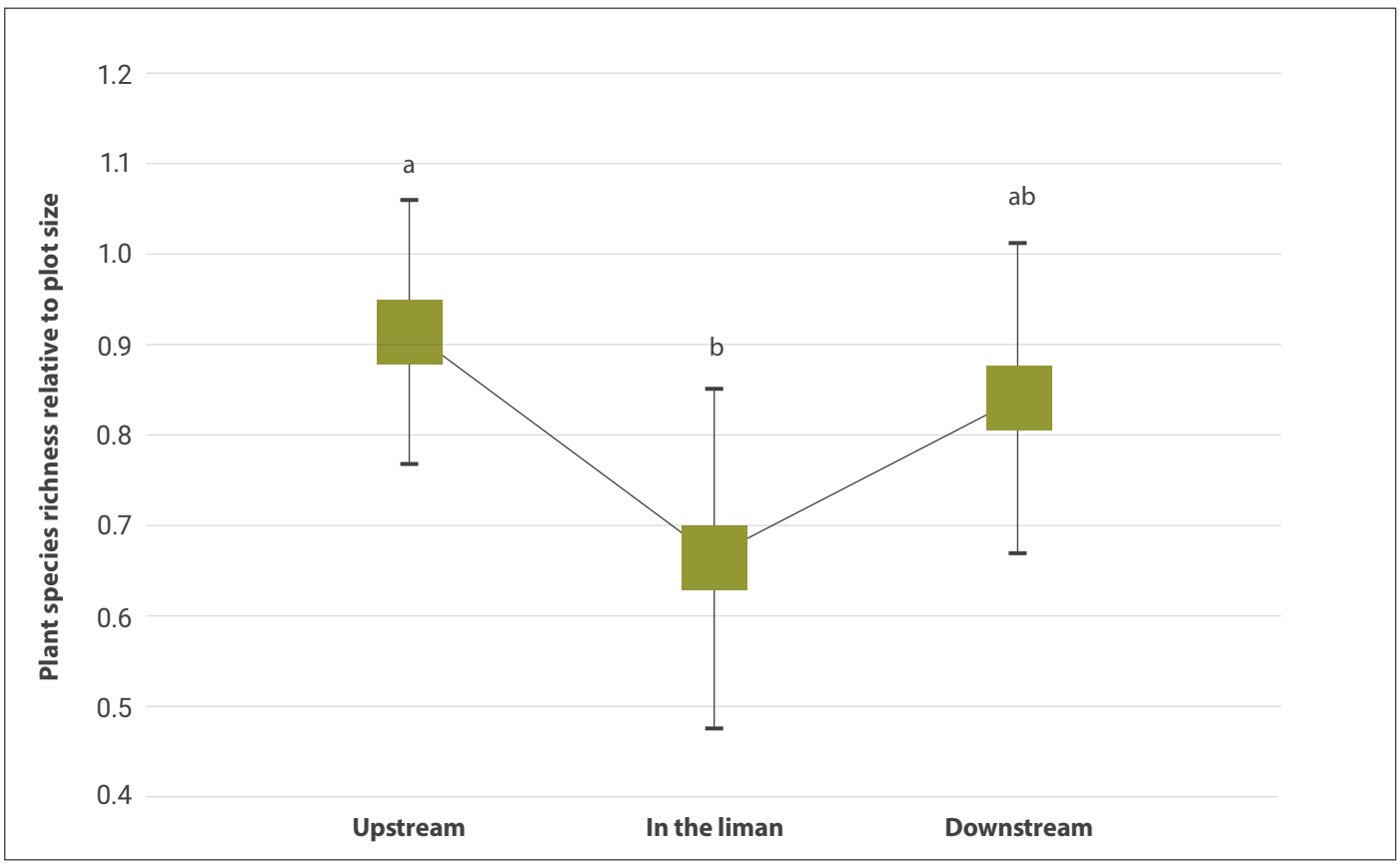
Limans are desert micro-catchments in which trees are planted. A survey conducted in limans in the Negev[69] found that the ratio of plant species richness to area was smaller in the liman, than in the natural area upstream (before the dam) or downstream (after the dam). The survey also found that the liman plant community differed from the natural plant community upstream or downstream: there was a lower percentage of plants found only in natural habitats, while a high percentage of the plants was characteristic of disturbed habitats.

In the past KKL developed limans as isolated sites. In recent years, they have been developing them as a series of dams across the entire flow channels. This sort of liman formation is a more severe interruption of the flow channel continuity and its effect is consequently more significant.



Plant species diversity in native woodlands as a function of woody tree cover. Adapted from Shmida 1985[16]

Be'er Sheva Milk-vetch, an endemic species characteristic of loess plains.
Photo: Alon Rothschild.



Plant species richness in a liman, relative to plot size, upstream (before the dam) and downstream (after the dam). Adapted from Shochat et al, 2016[68].

Arthropods

Loess Plains

A study comparing spider diversity in natural loess plains and planted (with eucalyptus) loess plains[70] found that species richness in eucalyptus plantations was higher than in natural areas. However, 63% of the species sampled in natural areas were completely absent from planted areas (e.g. all the species in the Zoridae family and many species from the Linyphiidae), whereas a number of Mediterranean species (e.g. *Drassodes* and *Zodarion*) were found in the planted plots but were absent from the natural areas. **In other words, afforestation modified the natural desert spider community and replaced it with a different spider community (mostly Mediterranean).** It also increased the potential for fragmentation of spider communities in the natural habitats.

Another study[71] found that spiders from the Linyphiidae and the Theridiidae families, which serve as biological pest controllers of aphids in wheat fields in the Northern Negev, avoided the planted forests in the area. The planted eucalyptus forests did not provide an exclusive alternative habitat for spiders important as pest controllers, whereas the natural areas are a source for reproduction and dispersal for spiders belonging to these families, and thus **the natural areas (that are not planted) are a significant source of biological pest controllers for wheat fields.**

Interestingly, **spider abundance and their level of activity were higher in natural areas** than in planted areas[69]. One hypothesis suggests that as local organisms that developed outside the natural range of eucalyptus trees, they have difficulty using it as a source of food, as they have not undergone long-term adaptation to it[72]. Consequently, the amount of prey available to spiders in eucalyptus plantations is lower than in natural areas, and supports a smaller number of spiders.

Mediterranean Shrublands

A study that assessed the diversity of arthropods in the Judean Lowlands, found that beetle, spider and plant species richness is 30%, 27% and 20% lower respectively, compared to native woodland at various degrees of succession[73].

A study that focused on ants found that ant species composition in forests differs from that in adjacent shrubland and that the species composition of ants in forest firebreaks is more similar to that found in shrubland than that found in planted forests[74].

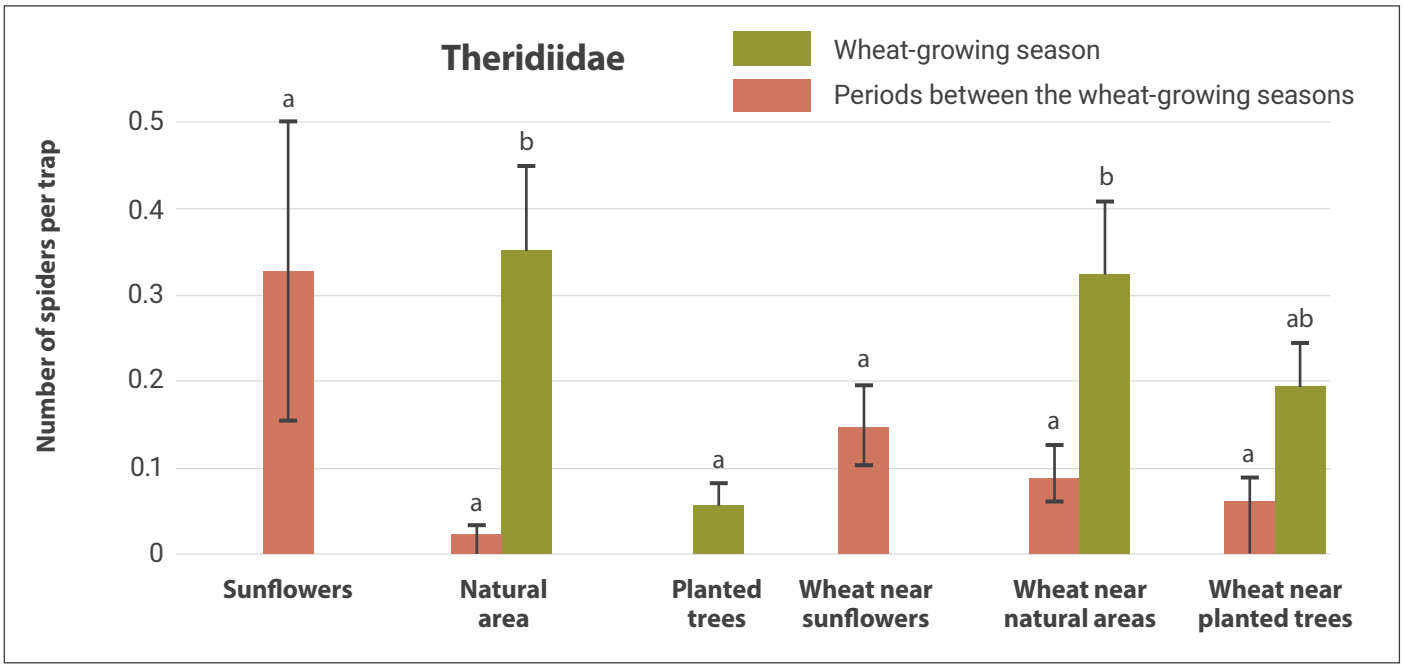
In the Judean Lowlands, native vegetation patches (shrubland and woodland) have a different species composition of wild bees, compared to planted patches. In shrublands and woodlands there were more foraging resources (flower abundance and richness) and nesting (nesting substrate diversity and distribution) for wild bees, compared to the planted forest. Natural patches in agricultural landscapes were found to be more important for wild bees than forest plantations[75].

A comparison between a forest plantation with a developed understory and an adjacent natural habitat showed that the abundance and species richness of bees in the natural area were higher compared to the forest area with its renewing understory[76].

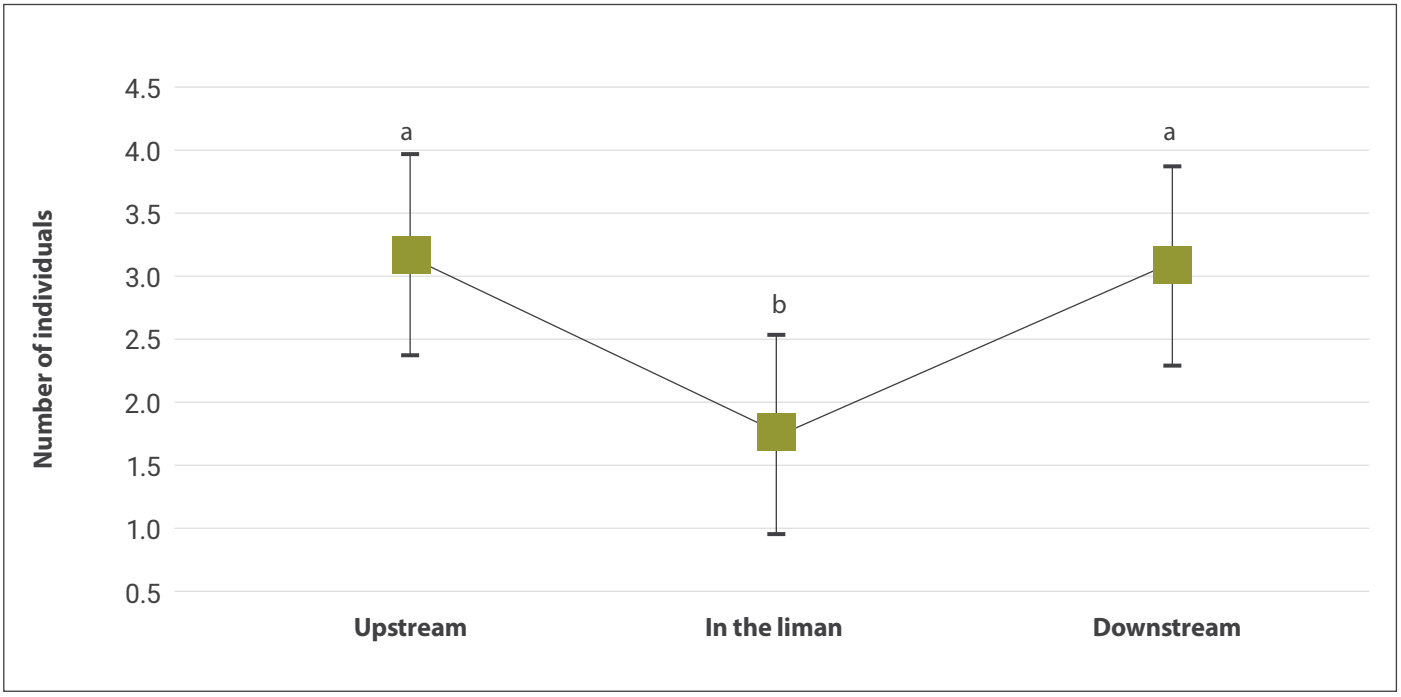
Desert Wadis

A survey conducted in Negev limans and in a natural flow channel up and downstream from them found that the number of scorpions in the liman was lower compared to the surrounding natural area[68].

A wild bee pollinating a flower. Photo: Ariela Gottlieb



The number of spiders beneficial to agriculture from the Theridiidae family, in different habitats in the Northern Negev. This group is more common in natural areas and adjacent sites than in planted areas and adjacent sites. Adapted from Opatovsky et. al., 2013[56].



The number of scorpions in a desert *wadi*: upstream, in a dammed liman in the *wadi* and downstream. The difference between the number of scorpions in the natural area and the liman is statistically significant. Adapted from Shochat *et al*, 2016[53].

Butterflies

There are 146 species and subspecies of butterflies in Israel, of which 90% prefer natural open spaces, particularly shrublands and grasslands. Only about 15 species (10% of Israel's butterflies) utilize forests as their major habitat[77], most of which feed on herbaceous species growing in the forest/woodland or at its edges (e.g. the Eastern meadow brown *Maniola telmessia*), and disappear when there is no adjacent shrubland[78]. In an assessment of the status of rare butterfly species in Israel[79], three species were classified as directly threatened by afforestation (Southern Swallowtail *Papilio alexanor*, Steppe Large Grizzled Skipper *Muschampia proteides* and Zephyr Blue *Plebejus pylaon*). All three were declared protected species in 2009.

Mediterranean Shrubland and Grasslands

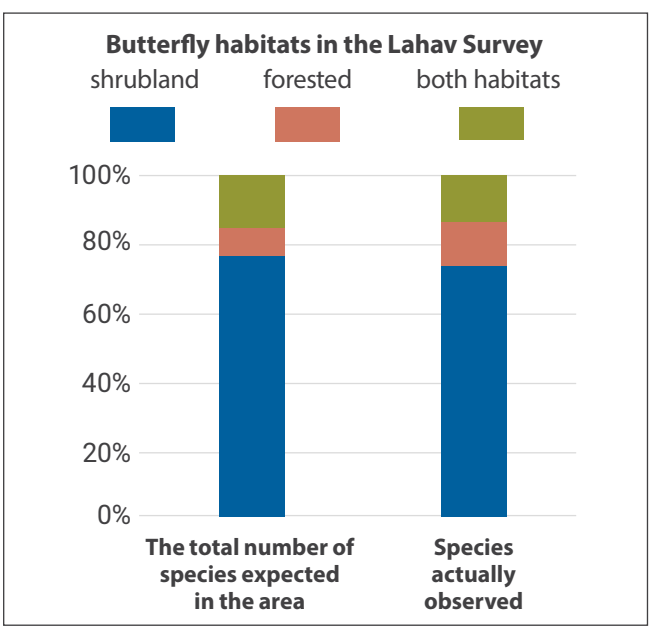
A study conducted at the Ramat Hanadiv Park[80] found that all the diversity indicators were lower in pine plantations compared to adjacent natural areas. This decrease was explained by the reduction in sunlight but also by the displacement of the necessary nectar plants needed for adult nutrition. On the other hand, a number of butterfly species (e.g. Eastern meadow brown *Maniola telmessia*) enjoy the shade in the groves for estivation or avoiding overheating.

In a comparison of species assemblages in three types of habitat junctions: Mediterranean shrubland/wheat fields, shrubland/olive groves and forest plantations/wheat fields, dense pine forests were found to be the poorest in species. The species richness and total abundance was lower in planted forests compared to corresponding sites in the same climatic zone. In one pine forest, a relatively high species density was found: in this site, the distance between the trees was large and there were a number of non-forested patches with diverse herbaceous vegetation. In all the other forest sites examined, most of the butterflies were found in edge areas near the forest, and the main butterfly source in the forest was the adjacent shrubland (in cases of forest/shrubland contact) or the margins themselves (in cases of forest/wheat contact)[77].

Semi-steppe Shrublands

In a comparison between natural areas and forest plantations in the Lahav region, 27 butterfly species were found exclusively in natural areas, four species were found only in forests and five species were found in both habitat types[81]. The abundance of observed individuals in shrublands was greater than in forests by several orders of magnitude. In dense conifer stands, only a few individuals were seen (mainly Painted Lady *Vanessa cardui* and Satyrini). In less dense areas, the number of butterflies, as well as the number of species, was higher (particularly on dirt paths in the forest and between forest plots). In shrublands on the other hand, thousands of butterflies per dunam (1/10 hectare) were seen. As a rule, species diversity and abundance are significantly lower within forests and afforestation reduces the extent of habitats available for the characteristic species of the area.

Two butterfly species seen in shrublands in northern Israel (but not in natural habitats in transition areas) were seen in the forest in this area: Orange Tip *Anthocharis cardamines* and Large White *Pieris brassicae*. This leads to the conclusion that forests enable Mediterranean species to penetrate transition areas from which they were probably absent.



Butterfly habitats in the Lahav Survey. The numbers refer to the number of species, not the number of individuals.[98]

Light Soils

Thinning conducted in the Sargents Grove in Netanya tripled the abundance of butterflies in the thinned plots, in which tree density was lower than in plots with a high tree density[67].

Steppe Large Grizzled Skipper *Muschampia proteides*. A species threatened by afforestation.
Photo: Dubi Binyamini

Zephyr Blue *Plebejus pylaon* (female). A species threatened by afforestation.
Photo: Dubi Binyamini

Southern Swallowtail *Papilio alexanor*. A species threatened by afforestation.
Photo: Ofir Tomer

Mammals

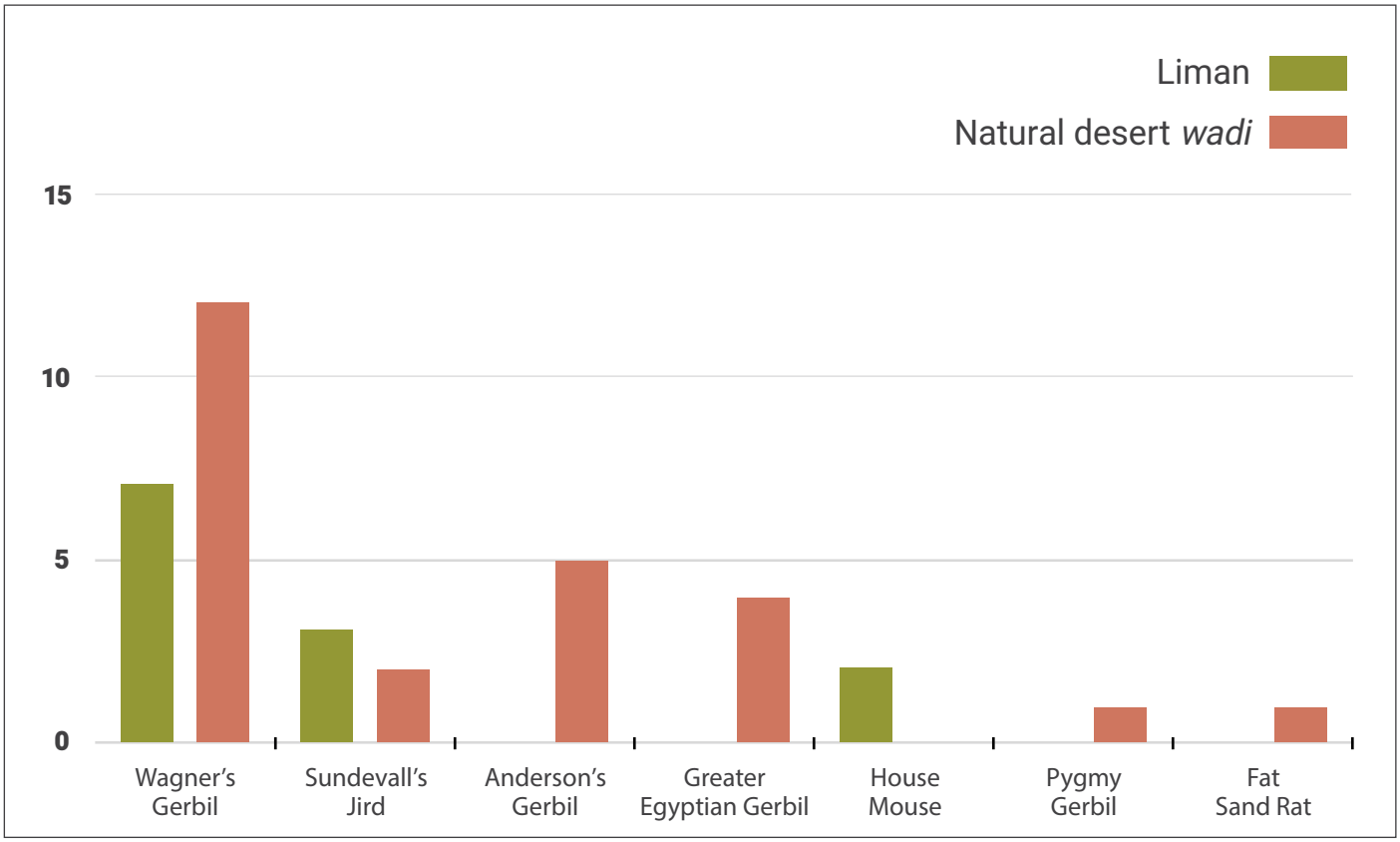
Semi-steppe Shrublands

A survey conducted in the Lahav area found that the number of mammals observed in open areas (semi-steppe shrublands) was double that found in forest areas. The survey showed that mammal diversity and abundance was greater in natural and agricultural opens areas than in veteran pine stands. The results of this survey suggest that monoculture forests are a poor habitat (relative to natural areas) and therefore the number of individuals and the species diversity in them decreases[82].

Desert Wadis

A survey that compared the inventory of rodents in limans in the Negev and in the natural dry streambed, found that most of the rodents were observed in natural areas, and species diversity was higher in natural areas than in limans.

Species associated with humans, such as the House Mouse *Mus musculus*, were found only in the limans, while specialist desert species such as the Greater Egyptian Gerbil *Gerbillus pyramidum*, the Anderson's Gerbil *Gerbillus andersoni* and the Fat Sand Rat *Psammomys obesus* were found only in natural areas (the number of observations was small and therefore not statistically significant)[68].



Number of rodents of different species in a liman (blue) and in a natural desert *wadi* (orange). Adapted from Shochat et al, 2016[68].

Lesser Egyptian Jerboa *Jaculus hirtipes*, a species of treeless loess and stabilized sandy soils.
Photo: Photo: Roi Talbi.

C. The mechanisms that lead to the reduction and displacement of local fauna and flora subsequent to plantings in sensitive habitats

Afforestation and planting in habitats that are naturally treeless cause extensive landscape and ecological changes on a number of levels:

- On the landscape level – the landscape changes from a flat, "two-dimensional" continuous landscape to a "three-dimensional" fragmented landscape, with high elements (embankments, trees).

- On the spatial level – there is possible fragmentation between natural habitats and edge effects of the forest on natural patches.

- On the local level – the natural habitat is affected, including shading, spraying and damage to components of the soil crust and to the runoff regime (particularly in plantings in the Northern Negev). Occasionally exotic planted tree species invade the natural area. In addition, generalist forest and woodland species immigrate to the natural areas and flourish in it, due to these changes, at the expense of native species that are displaced.

Preparing land for planting in the Judean Lowlands.
Photo: Avraham Shaked

Changes in predation pressure and exclusion of "flatland" specialists

Decrease in shrubland foraging areas

Shading, leaf litter and loss of heterogeneity

Afforestation in Sensitive Natural Areas

Direct impact on natural assets

Damage to soil infrastructure and disruption of the runoff balance

Spatial fragmentation

Changes in predation pressure and displacement of "flat landscape" specialist species

Adding trees and tall soil embankments, as a foreign element in loess plain natural systems increased the density of predator perches, particularly for two bird species – the Common Kestrel *Falco tinnunculus* and the Great Grey Shrike *Lanius excubitor*. Consequently, there was a dramatic decrease in reptile, bird and rodent species characteristic of the original habitat, both in the planted areas and in adjacent natural areas. The endemic lizard, Be'er Sheva Fringe-fingered Lizard *Acanthodactylus beershebensis*, was particularly affected. The planted areas became an ecological trap for this lizard, and led not only to its accelerated predation[83] but also to modifications in its foraging activity to smaller prey (which apparently requires shorter handling time and thus shortens the lizard's exposure time to its predators)[84].

Another example is the increased predation of artificial ground nesting birds near tall elements, as found in the loess plains in the Hatserim area (Dr. Asaf Tsoar, INPA, 2012, pers. comm.).

Observations on birds that specialize on walking on the ground (e.g. bustards and coursers) show that these birds prefer areas with open landscape, because, among other factors, they allow them to see potential predators. The *shikhim* used for runoff harvesting (savannization – afforestation in the Northern Negev that is based on soil embankments to create catchments for collecting surface runoff) which can be over a meter high – create a "closed" environment from the perspective of the bird on the ground, and this is probably what leads to its exclusion from the area – even without the presence of trees (Mayrose & Perlman, 2012, pers. comm.).

A study that examined the effect of pine invasion from a forest area to adjacent shrublands in Ramat Hanadiv[85], found that in all the land units examined, that of shrubland invaded by pines had the highest percentage of simulated-nest robbing of Sardinian Warblers *Sylvia melanocephala* by Eurasian Jays. In shrubland with scattered pines 75% of the nests were robbed (!) compared to 42% of the nests robbed in shrubland without pines. Incidents of warblers mobbing jays were more frequent in sparse forests and shrubland with pines and rarer in shrublands.

These findings illustrate the **intensified predation pressure in shrublands because of pine penetration (whether due to planting or due to spread from the adjacent forest), that can serve as perches for jays allowing them to rob songbird nests in shrubland areas**.

In a similar process, ground-nesting birds disappeared completely from shrublands planted with trees[59].

Eurasian Jay robbing a simulated Sardinian Warbler nest as part of a study conducted at Ramat Hanadiv on the effect of pine invasion in natural areas.
Photo: Asaf Ben David

Reduction in foraging areas of shrubland specialists

Adding trees prevents shrubland-specialist raptor species (Long-legged Buzzard, Lesser Kestrel and others) to forage effectively because they are not adapted to find and hunt prey in forested areas[60].

Shading, leaf litter and loss of heterogeneity

Afforestation converts sunny, open landscapes, into landscapes in which the ground is shaded because of the addition of trees and their foliage. Moreover, leaf litter (pine needles, eucalyptus leaves, etc.) that does not decompose easily (particularly in arid and semi-arid environments) covers the ground. This makes germination of herbaceous vegetation and shrubs difficult and reduces their ability to grow[50]. In wetlands as well, stream sections planted with eucalyptus trees were found to have less streambank vegetation and low fish abundance[86]. In many cases, afforestation (land preparation, planting and forest maintenance) involves earthworks, spraying herbicides and presence of heavy equipment on the site. These actions reduce habitat heterogeneity (remove shrubs and rocks, straighten soil folds, etc.) and thus reduce the diversity of available niches for local species, while opening niches for species associated with humans.

Reduction of natural patch area and spatial fragmentation

Small isolated populations have low survival rates due to their low genetic diversity and low resilience. In order to conserve species diversity in natural areas, large continuous natural patches are needed. Reducing shrubland patch size will affect shrubland specialists, due to their sensitivity to edge effects, and even possibly lead to their disappearance from the area. A survey conducted in the Lahav region[87] found that there is a positive correlation between the shrubland patch size and the population density of shrubland specialist species (e.g. Long-billed pipit and Spectacled Warbler). Small natural shrubland patches (surrounded by planted forests) were found to have lower population densities than large natural patches. Some of the species stopped breeding when the size of the natural patch decreased below 50 hectares[59].

Planted eucalyptus trees in the Northern Negev. Effect of shading, soil trampling and allelopathy leaves the soil with no vegetation cover even at winter time, when the surrounding area is green with annual plants' cover.

Damage to Soil Infrastructure and Disruption of the Runoff Balance

Topsoil compaction, soil crust destruction and damage to its function

Afforestation activity, particularly in the Northern Negev and Transition areas, involve movement of heavy equipment, building soil embankments along slopes (*shikhim*) and flow channels, and occasionally herbicide spraying of native vegetation. The heavy equipment compacts the topsoil, thus hindering herbaceous plant germination – at least during the first years following the work.

Moreover, the soil crust in arid areas is bound together by microphytes – cyanobacteria, algae and lichens. Heavy equipment compacts the soil and damages soil quality and function[40]. The outcome is damage to the organisms based on the crust for foraging and for the stability of their burrows[88].

The effect of heavy afforestation equipment on the soil has been recorded not only in the Northern Negev but in light soils as well. Monitoring of plots in the Netanya Forest (Sargents Grove), an important hamra site in the Sharon, a year after thinning treatment with heavy equipment (including vehicle traversing and dragging trees during the sensitive winter season, when plants germinate), showed that the work damaged the topsoil, reduced plant species richness sharply and reduced germination to close to zero[89].

Germination recovered about three years after the work, as did plant species richness, but the species richness in the damaged plots was still lower (focusing on sensitive species) than in the control plots – three years after the work.

As soil is the infrastructure of the ecosystem (contains the seed bank, growth substrate for plants, refuge for arthropods and reptiles, and the like), damage to it, is damage to the foundation of the system and it affects the entire functioning of biodiversity in the area.

Earthworks for planting preparation in a loess area in the Northern Negev.
Photo: Yosef Segal

Disruption of the Surface Runoff Balance

The artery of life in the Northern Negev and the transition zone are the *wadis* (ephemeral streams) that flow in winter rains and concentrate the water that supports the entire ecosystem throughout the year. Afforestation in the Northern Negev and southern Hebron Mountains involves damming flow channels, whether as part of broad afforestation (savannization) or local plantings (limans). Damming *wadis* blocks the flow of seeds and resources, such as water and organic matter, downstream, with a resulting decrease in plant productivity[90].

Physical damage to soil infrastructure in kurkar and hamra

Kurkar is a soft rock that crumbles easily and is easily grooved by traversing vehicles and heavy equipment. The soft soil that is formed on the kurkar is easily trampled as well and is sensitive to physical disturbance.

The unique ecological community on kurkar and hamra is based on low vegetation – herbaceous vegetation and geophytes that are sensitive to spraying and shade, and of course to heavy mechanical equipment (particularly in winter and spring)[89]. The many wild bees found in the kurkar and hamra areas, mostly nest in burrows in the ground, and are consequently, also sensitive to soil disturbance.

Direct damage to natural assets during planting

Preparing land for planting trees involves aggressive engineering of the soil, particularly in the Northern Negev and arid habitats: Earthworks and heavy equipment used in natural habitats, digging holes with excavators, herbicide spraying and the like, affect natural assets directly. When damage is done to protected natural values, it is lawbreaking, unless a permit was obtained in advance from the INPA. Below are a number of examples:

The Judean Iris in the Northern Negev

The Judean Iris is a species endemic to Israel. Afforestation (including land preparation, shading by forests and invasive exotic species) has been identified as one of the major threats to the species in Israel[91]. A number of incidents in which Judean Irises were damaged were recorded during KKL afforestation activities, including a report by Dr. Yuval Sapir from 2004. Despite comprehensive documentation regarding Judean Iris stands in the district, there is at least one case of afforestation conducted at a flowering site (Goral Hills), after the INPA mapping had been conducted, thus fragmenting the population in the area.

Coastal Iris in the Sharon

The Coastal Iris is a species endemic to Israel's Coastal Plain. In a number of incidents, there were documented cases of damage to this beautiful flower in areas of light soils that underwent forest maintenance with heavy equipment in the winter, which is the season in which geophytes are sensitive and grow leaves and flowers. Damage was recorded in the Sargents Grove in Netanya (2011), Ilanot Forest (2012) and Kadima Forest (2012)[92].

Large Sternbergia in the Yatir Forest

As part of KKL work in the Yatir Forest, on November 11, 2004 a tractor damaged a concentration of Large Sternbergia, at the site known as the "Sternbergia Trail" (Ynet, November 11, 2004).

Plant and Animal Species in the Ramot Forest

In spring 2016, during work done to prepare land for afforestation in the Be'er Sheva area, extensive damage to a number of natural assets was documented (Turban Buttercup *Ranunculus asiaticus*, Crown Anemone *Anemone coronaria*, Desert Tulip *Tulipa systole*, Dominican Sage *Salvia dominica*, *Limonium lobatum*, Blue Desert Lily *Ixiolirion tataricum*, Tumble Thistle *Gundelia tournefortii*) due to trampling by heavy equipment[93].

Common Asphodel damaged during work to prepare land for planting north of Be'er Sheva.
Photo: Udi Columbus, INPA

Judean Iris near a tractor preparing land for afforestation, Goral Hills, Spring 2013.
Photo: Avner Rinot

Work to forge a new trail in Ilanot Forest, during which concentrations of Coastal Irises growing in hamra soil were trampled. Photo: Moshe Perlmutter

Judean Iris on soil pile created by earthworks to create soil embankments in afforestation work in the Northern Negev. Photo: Yuval Sapir

Work to forge a new trail in Ilanot Forest, during which concentrations of Coastal Irises growing in hamra soil were trampled. Photo: Moshe Perlmutter

D. The effect does not end at the edge of the forest: spread of pines, invasive species and other edge effects on natural areas adjacent to forests

The effect of the forest does not stop at the last line of trees. Forests have "edge effects" – adverse ecological effects spill over into natural areas adjacent to the forest, including invasion of pines[94], which can cause significant changes in native shrublands to the point of conversion to forests[95], while modifying their ecological function. Invasive plant species or species characteristic of disturbed habitats, nest-robbing birds and the like, spillover from the forest to native areas.

Planning committees profess to determine where the boundary between forests and natural areas, will pass. In fact, ecological dynamics determine this, and additional natural areas, which were not planned as pine forest, are converted from natural areas to forested areas. The significance of this process is that when forest plantings are planned, the fate of adjacent natural areas is sealed: shrublands adjacent to planned forest will be converted into pine forests (more or less dense) and native open woodlands will become denser forests, more susceptible to wildfires.

The Negative Effect of Planted Forests in Natural Non-forested Habitats Does not Stop at the Boundary of the Planted Area

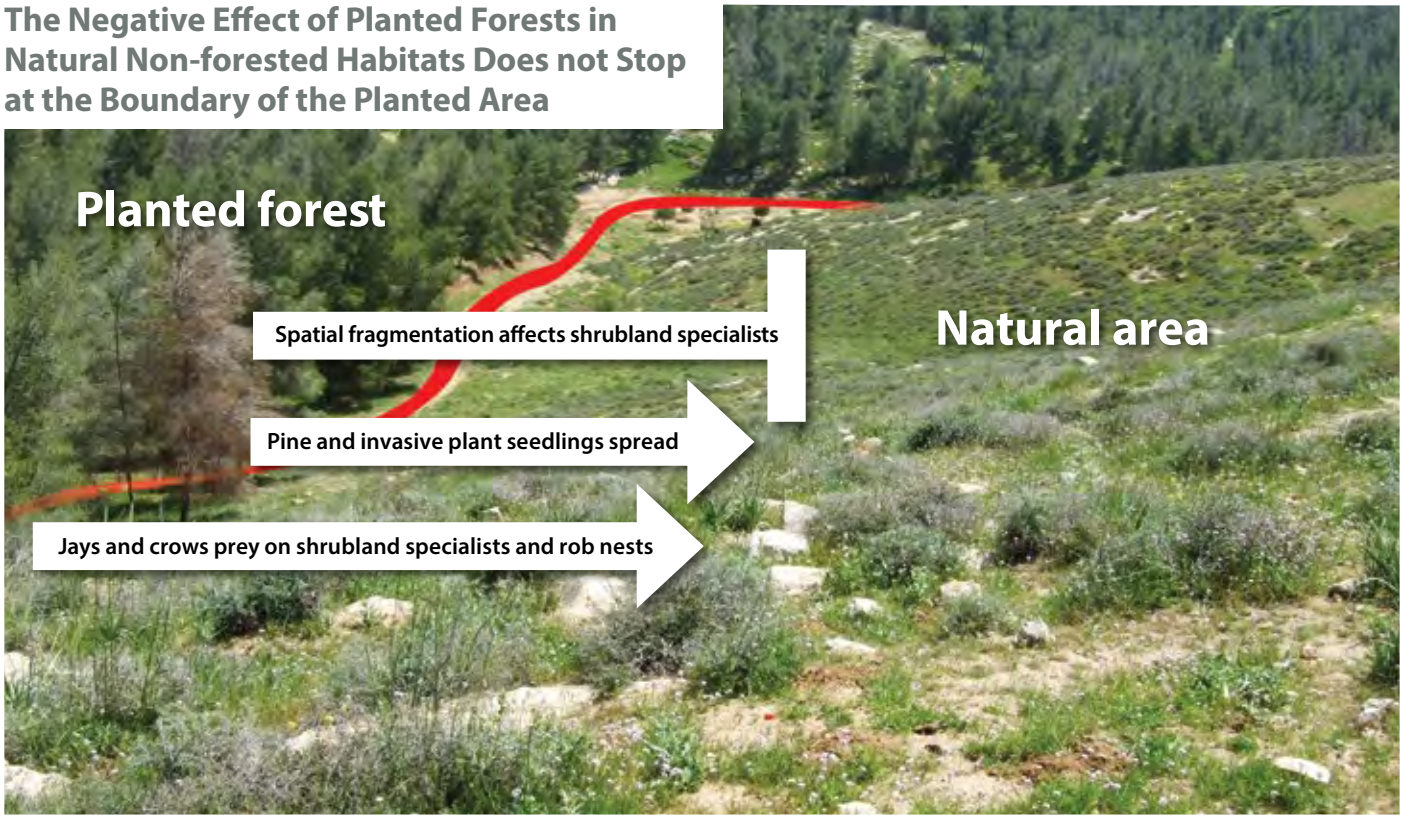


Illustration of the Effects of Forest Plantations on Adjacent Natural Areas.

Edge effects of predators from forest areas

Forest areas affect widespread areas because of the extensive movements of woodland birds. Thus, jays can locate and destroy bird nests in shrublands two kilometers away from the forest[59].

In a survey conducted in limans in the Negev, they were found to be occupied by species associated with humans that are not characteristic of native desert environments, such as the Hooded Crow, feral pigeons and the Eurasian Collared-dove[68]. The limans may possibly serve as stepping-stones for these species to spread into natural areas.

Spread of Aleppo Pines

The Aleppo Pine is a native Israeli tree, but its original distribution was probably small. Forest plantations of Aleppo Pines cover extensive areas from the Northern Negev to the Upper Galilee and the Golan Heights. The seeds used to prepare saplings for planting were not collected in Israel, but from different sites in the Mediterranean Basin. A genetic study indicates that the genetic composition of pines in forest plantations is essentially different from the wild populations of Aleppo Pines in Israel, and the genetic diversity of the planted pines is relatively smaller than that found in the native wild population[97]. The Aleppo Pines from foreign sources brought into Israel for plantations was found to genetically "pollute" the native Israeli populations[1].

Aleppo pines have been found to spread from plantations to natural areas in many parts of the world, including Israel[98]. A sort of "advancing front" of young pines has been identified within a distance of tens of meters from the forest boundary. Moreover, establishment of lone pine trees has been observed at much longer distances, where the trees serve as dispersal centers for new seeds[46]. A study conducted in the Shahariya Forest [99] and its adjacent shrubland found that the forest is a source of pine seedling dispersal into the shrubland. The proximity to the planted forest is the most significant spatial factor in determining the density of pines in natural areas. The high density in the proximity of the forest decreases with distance from the forest line into the natural area.

Models found that the percentage of pines in native shrubland could increase from 1% to 11% within 60 years, in arid habitats such as the Lakhish region, and up to 70% or more (!) in habitats favorable to pines, such as Nahal HaHamisha or HaSolelim Forest[98].

Pine colonization in natural areas could significantly change the structure and function of the ecosystem: reducing the light available to herbaceous vegetation, modifying the rate of decomposition of organic matter in the soil[97], causing plant biomass to accumulate, increasing the risk of wildfires and modifying soil qualities (mineral composition, acidity and the composition of the microorganism assemblages) and the water regime. These changes could eventually lead to extreme changes in the habitat characteristics and to changes in species composition and biodiversity[53].

Invasion of pines into natural habitats has been found to increase predation pressure on songbird nests[84].

Spread of the Turkish Pine *Pinus brutia*

The Turkish Pine is not a native species to Israel. It has been observed massively invading open woodlands of Tabor Oaks *Quercus ithaburensis* in the Mt. Hurshan Nature Reserve[100]. The Turkish Pine increases the woody cover in the open woodlands, which increases the shaded area and consequently reduces the herbaceous layer and affects the natural biodiversity. Moreover, the Turkish Pine invades native woodland in the mountain areas (e.g. the Nahal Sorek Reserve). There is well-founded concern that the scope of its invasion and colonization in native vegetation units is expected to grow in coming years[99].

Planting of exotic invasive trees

Afforestation is a significant factor in the spread of invasive tree species in Israel. This is a common and well-known phenomenon the world over, particularly in countries with Mediterranean or arid climates. The tree species used in afforestation or for soil stabilization in Israel, which became invasive include the Willow Wattle and the Gundabluie *Acacia victoriae*, which were planted in the early 1990s in

the northwestern Negev, when they were not known as invasive species. After this was discovered, it was decided to halt planting of species such as the Cape Gum, the Gundabluie, the Sydney Golden Wattle *Acacia saligna*, the Prickly Thorn *Parkinsonia aculeata* and others. However, those species that already established seed banks continue to spread[99].

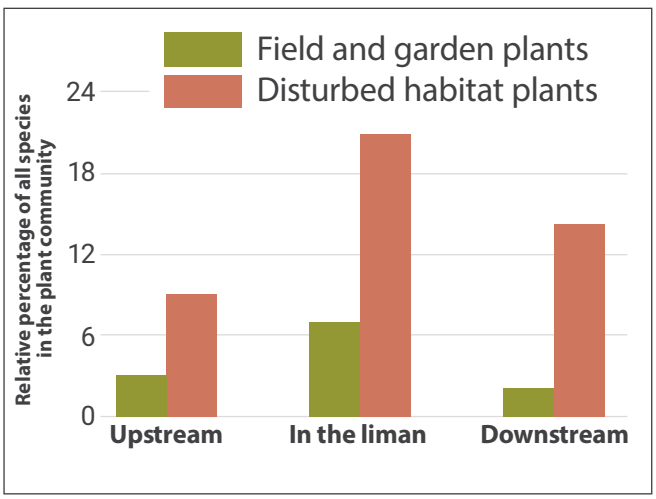
Invasive acacia spreading in Nahal Karkur (near the Goral Junction).

Willow Wattle planted south of Metar

Cape Gum in a KKL plantation south of Metar. Spring 2012

Dispersal of disturbed habitat plants

A survey conducted in limans that were planted in Negev *wadis* and their surroundings, found 91 species upstream, 88 species downstream and 56 species in the liman itself. The liman contained a higher percentage of plant species characteristic of cultivated and disturbed habitats, compared to the upper section of the natural flow channel. The liman was also found to affect the section downstream of it, which contained a relatively high percentage of plants characteristic of disturbed habitats – apparently due to seed dispersal from the liman. In this manner, the liman is a source for dispersing unwanted species into the natural area downstream of the liman[92].



Percentage of plant species characteristic of disturbed habitats (brown) and field and garden plants (green) in the upper section of a natural *wadi*, in the liman and downstream. Adapted from Shochat et al, 2016[53].

Pine seedlings that spread from a pine plantation into adjacent native shrubland (red) and a simulation of the predicted spread of pines for 2070 (pink). From Weitz[78]

Appendix B

Criteria for Assessing Planting Programs

The Monitoring and Oversight Committee for NOP 22, 2016

◄ Planting in grasslands in the Golan Heights conducted without a detailed plan as required by law

Criteria for Assessing Planting Programs The Monitoring and Oversight Committee for NOP 22, 2016

Ecological and Planning Guidelines for Assessing Forestry Management Documents:

The guidelines for assessing forestry management documents are intended to integrate all the planning and environmental aspects of plans submitted to the committee in the proposed area, as a document that will guide the committee and bring up the various existing considerations at the time the planting programs are assessed.

The ecological aspect examines the impact the planting will have on the natural ecosystem including conserving its biodiversity as defined in the goals of NOP 22 and in the goals of the Israel afforestation doctrine ("supporting Israel's unique biodiversity, ecological restoration of damaged habitats", etc.)

The guidelines are as follows:

1. **The designation of the land in the national outlook plan and in the detailed plan** – Examining the designation of the land and adapting the planting program to said designation and the type of forest according to the national outlook plan and the detailed forest plan.
2. **The goal of the plantation** – Evaluating how the planting program conforms to the goals of the planting (e.g. leisure and recreation in nature, scenic road, grazing, restoration and conservation, service to the community – including assessing the degree of contiguity with existing and/or approved construction, creating a green zone, buffers from noise/pollution, soil rehabilitation and conservation, conserving ecological assets).
3. **The representativeness and rarity of the ecosystem** – Assessing the degree of representativeness of the ecosystem in protected areas in Israel (at least 17% representativeness of each ecosystem according to the Aichi targets) or its rarity in Israel according to the mapping of Israel's ecological units (Rotem & Weil 2014; Rotem et al 2016).
4. **Physical-ecological status of the land** – Assessing the degree of land degradation, if it exists, including physical damage and ecological problems and examining means of rehabilitating the site in the framework of the planting plan (e.g. fencing for grazing, closing the site to off-road vehicles, etc.).
5. **The degree of disturbance for planting** – Assessing the intervention needed for preparing the site for planting and actions associated with planting (including earthworks, herbicide spraying, introducing heavy machinery, irrigation, creation of *shikhim*, drainage operations, etc.) and examining alternatives to reduce the impact as much as possible.
6. **Connectivity and continuity** – Assessing the effect of the planting on the connectivity and continuity between natural land units, taking the type of site into consideration (natural area or planted forest).
7. **The impact on plant and animal species** – Assessing the effect on the ability of the species characteristic of the ecosystem to subsist, with a focus on endangered species, protected wildlife and natural assets, including in the spatial context.
8. **Natural tree cover** – Assessing how the planting program conforms to the tree density in the natural

ecosystem in the region (examples of ecosystems that are not dominated by tree cover: semi-steppe and Mediterranean shrublands, grasslands, loess plains, kurkar and hamra, coastal sands).

8.1 **Considering the existing vegetation planted in the region**.

9. **Planting native species** – The planting program will be based, to the extent possible, on native species characteristic of the region.
10. **Invasive species** – Assessing the species designated for planting, and suggesting ways to deal with invasive species found in the plan's area. "Unwanted Exotic Ornamental Plants in Israel", the species list in "Alien Invasive Plants in Israel" (2012 edition) and any updates to these publications, will serve as guidelines for the committee.
11. **Eruptive Species** – Assessing the species intended for planting and their potential for establishment in adjacent natural areas and treatment of existing eruptive species (species whose populations grow due to anthropogenic interventions).
12. **Landscape effects** – The effect of the plan on the landscape on two main levels: the landscape unit integrity and the local level (do the plantings conceal scenery from a scenic lookout, road, etc.)
13. **Wildfire considerations** – The degree of proximity of the planting sites to settlements and/or roads and consideration of firebreaks (according to the regulations of the Israel Fire and Rescue Services).
14. **The historic and heritage connection** – How the planting program conforms to the historic and cultural context of the area (e.g. battles in the area, archaeological sites, etc.), if relevant.

References

1. Osem Y. 2013. Major topics in the study of conifer forests in Israel – a summary of forty years of study (1972-2012). Part 1: The history of afforestation and its relevance to the landscape in Israel. Ecology and Environment 4(3): 248-254. (in Hebrew)
2. Osem Y., Brand D., Tauber, Y., Perevolotski A. and Tsoref H. 2012. Forest management in Israel – Policy and guidelines for planning and managing forests. KKL. (in Hebrew)
3. Herr, N. 2013. Shrubland and open forests – stages in succession or stable habitats, and the role of rock and soil in the development of vegetation formations. Biodiversity website: Israel Nature and Parks Authority. (in Hebrew)
4. Rotem, D., Weil, G., Walczak, M. and Amir, S. 2016. The degree of representation of natural ecological units in homogeneous areas in Israel. Ecology and Environment 7(1): 16-23. (in Hebrew)
5. Meyrose, A., Vine, G., Labinger, Z., Hatsofe, O., Haviv, A., Perlman, Y., Alon, D. and Lider, N. 2017. The Red Book of Breeding Birds in Israel. The SPNI and the INPA. (in Hebrew)
6. CBS. 2016. Extent of planted forests. (in Hebrew)
7. Summary of southern district activity. 2011. KKL, Land Development Administration, Southern District. (in Hebrew)
8. Report on ILA activity for the budget year of 2010. 2011. Jerusalem: ILA http://www.mmi.gov.il/Osh/Aspx/DownloadTofes.aspx?Maarechet=71&TofesId=%20167&UserId=-1&RO=true. (in Hebrew)
9. Summary of southern district activity. 2010. KKL, Land Development Administration, Southern District. (in Hebrew)
10. Minutes of the NOP 22 Monitoring and Control Committee meeting on 8.8.2007. The Ministry of Environmental Protection. (in Hebrew)
11. Liphschitz, N. and Biger, G. The afforestation policy of the Zionist movement in the Land of Israel 1895-1948. (in Hebrew)
12. Weitz, Y. 25 years of forest creation. Lecture, 11.1.1945. (in Hebrew)
13. State Comptroller. 2004. Annual Report 54b, pp. 619-631. (in Hebrew)
14. http://www.kkl.org.il/afforestation-and-environment/forestry-environment-policy/afforestation-policy/ (in Hebrew)
15. Blank, L. 2012. Open spaces that are disappearing – the biodiversity of shrublands and grassy areas. SPNI. 33p. (in Hebrew)
16. Shmida, A. 1985. Species richness and the evolution of annual plants in Mediterranean woodland. Rotem 18: 57-68. (in Hebrew)
17. Dafni, A. and O'Toole, C. H. 1994. Pollination syndromes in the Mediterranean: generalizations and peculiarities. In: Plant-animal interactions in Mediterranean-type ecosystems. M. Arianoutsou and R. H. Groves, editors. Kluwer Academic Publishers, Dordrecht. Pp. 125-135.
18. Mayrose, A., Vine, G., Labinger, Z., Hatsofe, O., Haviv, A., Perlman, Y., Alon, D. and Lider, N. 2017. The Red Book of Breeding Birds in Israel. The SPNI and the INPA. (in Hebrew)
19. Naveh, Z. 1985. The Mediterranean woodland climax – imagined or real? Rotem 18:33-38 (in Hebrew)
20. Rabinovich-Vin, A. 1986. Rock-soil-vegetation in the Galilee. Kibbutz HaMeuhad and the INPA. (in Hebrew)
21. Herr, N., Riov, J. and U. Shani. 2015. The vegetation formation in the Alonim-Menashe region according to the spatial structure of the rock-soil system and habitat characteristics. Ecology and Environment 6(1): 40-52. (in Hebrew)
22. Paz, U. 2018. The Tabor Oak forests in Ramat Menashe and the Sharon. Kalanit 5. (in Hebrew)
23. Sever, N. Leshner, H. and Ramon, U. 2014. Guide for mapping vegetation in Israel (Mediterranean vegetation). OLI, INPA, KKL, HaMa'arag, Ramat HaNadiv and the Ministry of Environmental Protection. 58 pp. (in Hebrew)
24. McGill, B, Collins, C. 2003. A Unified Theory for Macroecology Based on Spatial Patterns of Abundance. Evolutionary Ecology Research. 5:469-492.
25. Kark, S, Philip, U, Safriel, U, and Randi, E. 1999. Conservation Priorities for Chukar Partridge in Israel Based on Genetic Diversity across an Ecological Gradient. Conservation Biology. 13: 542-52.
26. Hadar, L. 2004. The effect of shading on the diversity and composition of the understory in a pine forest on Mt. Gilboa. INPA, KKL, Ramat HaNadiv Gardens. (in Hebrew)
27. Yom Tov, Y. 2016. Gazelles in Israel. Dan Perry Publications, with the support of Ramat HaNadiv, the INPA and the SPNI. 176 pp. (in Hebrew)
28. Perlberg, A. and Ron, M. 2014. The Loess Plains in the Northern Negev – an Endangered Ecosystem. SPNI. 58 pp. (in Hebrew)
29. Bouskila, A. 2002. Reptiles in Israel, in: The Red Book of Vertebrates in Israel. Eds. Perevolotsky, A. and Dolev, A. (eds), pp. 69-122. The INPA and the SPNI. (in Hebrew)
30. Shmida, A. and Pollack, G. 2010. The Red Book of Israeli Plants: Plants in Danger of Extinction in Israel. INPA. (in Hebrew)
31. Levanoni, T. 2011. Kurkar and Hamra Habitats – Beauty Spots on the Coastal Plain. SPNI. 28 pp. (in Hebrew)
32. Paz, U. 2018. Tabor Oak forests on Ramat Menashe and the Sharon. Kalanit 5. (in Hebrew)
33. http://www.kkl.org.il/afforestation-and-environment/forestry-environment-policy/afforestation-policy/ 26.9.2018. (in Hebrew)
34. Brand, D. and Shachak, M. 2015. Functional rehabilitation of desertified ecosystems in the Northern Negev. Position paper for KKL restoration activity in the Northern Negev. KKL. (in Hebrew)
35. Bernstein, I. 2010. Limans in the Negev – policy paper. Planning Department, Southern Region, KKL. (in Hebrew)
36. Cao S., Tian T., Chen L., Dong X., Yu X. and Wang G. 2010. Damage caused to the environment by reforestation policies in arid and semi-arid areas of China. AMBIO 39:279–283.

37. Bremer L.L, Farley K.A. 2010. Does plantation forestry restore biodiversity or create green deserts? A synthesis of the effects of land-use transitions on plant species richness. Biodivers Conserv. 19: 3893-3915.
38. Veldman, J.W. Overbeck G.E., Negreiros, D., Mahy, G., Le Stradic, S., Fernandes, G.W., Durigan, G., Buisson, E., Putz, F.E.and William J. Bond. 2015. Where tree planting and forest expansion are bad for biodiversity and ecosystem services. BioScience doi:10.1093/biosci/biv118
39. Zhao, H.L., Zhao, X.Y., Zhou, R.L., Zhang, T.H. and Drake, S. 2005. Desertification processes due to heavy grazing in sandy rangeland, Inner Mongolia. Journal of Arid Environments 62:309-19.
40. Stavi I., Fizik E. and Argaman E. 2015. Contour bench terrace (shich/shikim) forestry systems in the semi-arid Israeli Negev: Effects on soil quality, geodiversity, and herbaceous vegetation. Geomorphology 231: 376–382.
41. Stavi, I. and Argaman, E. 2016. Soil quality and aggregation in runoff water harvesting forestry systems in the semi-arid Israeli Negev. Catena 146: 88-93.
42. Zaady E. Arbel S. Barkai, D. and Sarig S. 2013. Long-term impact of agricultural practices on biological soil crusts and their hydrological processes in a semiarid landscape. Journal of Arid Environments. 90: 5-11.
43. Mussery A. Leu S. Lensky I. and Budovsky. A. 2013. The Effect of Planting Techniques on Arid Ecosystems in the Northern Negev. Arid Land Research and Management. 27: 90-100
44. Rotenberg, E. and Yakir, D. 2010. Contribution of semi-arid forests to the climate system. Science 327:451-4.
45. Albedo is a measure of the reflectivity of a body or surface – it is the ratio between the electromagnetic radiation reflected from a body or surface and the incident radiation; the absorbed radiation raises the temperature of the body absorbing it.
46. Klein T, Cahanovitc R, Sprintsin M, Herr N, Schiller G. 2018. A nation-wide analysis of tree mortality under climate change: Forest loss and its causes in Israel 1948–2017. Forest Ecology and Management 432: 840–849.
47. Osem Y. 2014. Major topics in the study of conifer forests in Israel – a summary of forty years of study (1972-2012). Part 2: Understanding the natural processes occurring in forests and moving on to managing forests as multi-functional ecosystems. Ecology and Environment 4(4): 321-330. (in Hebrew)
48. Koniak G., Sheffer, E. and Noy- Meir I. 2011. Recreation as an environmental service in open landscapes in the Mediterranean region in Israel: public preferences. Israel Journal of Ecology & Evolution 26:151-171.
49. The SPNI. 16.8.17. "This is not how we plant forests (anymore): lack of governance and conflicts of interest in forests and afforestation in Israel: a collection of anomalies in the relations between KKL and the State of Israel and the necessary correction". Memo from the Executive Director of the SPNI to the Attorney General of Israel. (in Hebrew)
50. Pollack, G. and Kagan, S. 2016. Preserving native vegetation in planted eucalyptus forest areas and in a landscape rehabilitation site east of Sitriya. Kalanint www.kalanit.org.il/sitriya/ (in Hebrew)
51. Alrababah M.A, Alhamad M.A, Suwaileh A and Al-Gharaibeh M. 2007. Biodiversity of semi-arid Mediterranean grasslands: Impact of grazing and afforestation. Applied Vegetation Science 10: 257-264.
52. Buscardo E., Smith, G.F., Kelly D.L., Freitas H., Iremonger S., Mitchell F.J.G., O'Donoghue S. and McKee A.M. 2008. The early effects of afforestation on biodiversity of grasslands in Ireland. Biodivers Conserv. 17: 1057-1072.
53. Brockerho E. G., Jactel H., Parrotta J. A., Quine C.P. and Sayer J. 2008. Plantation forests and biodiversity: oxymoron or opportunity? Biodivers Conserv. 17: 925-951.
54. Sorek, M., and Perevolotsky, A. (eds.). 2016. Report on the state of nature. The Ma'arag. (in Hebrew)
55. Hawlena, D. 2002. Reptile survey in the Lahav region. In: Tsoar, A. and Ramon, U. (eds.) Lahav Survey. Survey, analysis and assessment of nature resources, landscape and heritage. Pp. 86-92. The OLI Institute Survey Unit. (in Hebrew)
56. Mazeh, A. 2008. The diversity of reptile species in planted forests compared to Mediterranean native woodland and shrubland in the Meron Mountains. M.Sc. Thesis, Tel-Aviv University. (in Hebrew)
57. Loos, J., Dayan T., Drescher N., Levanony T., Maza E., Shacham B., Talbi R. and Assmann, T.2011. Habitat preferences of the Levant Green Lizard, Lacerta media israelica. Zoology in the Middle East. 52. 17-28.
58. Allan D.G., Harrison H.A., Navarro R.A., Van Wilgen B.W. and Thompson M.W. 1997. The impact of commercial afforestation on bird populations in Mpumalanga Province, South Africa - insights from bird-atlas data. Biological Conservation 79: 173-185.
59. Shochat, E., Abramsky, Z. and Pinshow, B. 2001. Breeding bird species diversity in the Negev: effects of scrub fragmentation by planted forests. Journal of Applied Ecology 38:1135–1147.
60. Shochat E. and Tsurim I. 2004. Winter bird communities in the northern Negev: Species dispersal patterns, habitat use and implications for habitat conservation. Biodiversity and Conservation 13: 1571–1590
61. Friedemann, G., Yom-Tov, Y., Motro, U. and Leshem, Y. 2011. Shift in nesting ground of the Long-legged Buzzard (Buteo rufinus) in Judea, Israel - An effect of habitat change. Biological Conservation 144: 402-406.
62. Friedemann, G. et al. 2016. Multidimensional differentiation in foraging resource use during breeding of two sympatric top predators. Sci. Rep. 6: 35031.
63. Friedemann, G. 2018. Personal communication, from the project "Birds of Prey on the Air".

64. Ariza C. 2004. Vegetation monitoring in a semi-desert afforestation project. MSC thesis at the Jacob Blaustein Institute for Desert Research Albert Katz International School for Desert Studies, Ben-Gurion University of the Negev. (in Hebrew)
65. Safriel U., Novoplansky A., Laronne J.B., Karnieli A., Moshe I., Kharabsheh A., Mohammad A.G., Kusek G. 2010. Soil erosion - desertification and the Middle Eastern anthroscapes. In: Kapur S., Eswaran H., Blum W.E.H. (Eds.) Sustainable Land Management Learning from the Past for the Future.Pp 57-124. Springer Publication.
66. Igra, H. 2007. Woody plants as landscape modulators in native Mediterranean woodland. M.Sc. Thesis, Haifa University. (in Hebrew)
67. https://www.nirforestecosoil.com/gilboa-iris-population-dynamics
68. Avishar, A. 2018. Forestry Report – Sargent's Grove, 2013-2018. Netanya Municipality. 65pp. (in Hebrew)
69. Shochat, E., Dumar, A. and Tsvik, Y. 2016. Ecological effects of limans in the Northern Negev on the flora and fauna. Duchifat Center, Survey for the INPA. (in Hebrew)
70. Herrmann, J.D., Opatovsky I., Lubin Y., Pluess T., Gavish-Regev E. and Entling M.H. 2015. Effects of non-native Eucalyptus plantations on epigeal spider communities in the northern Negev desert, Israel. The Journal of Arachnology 43: 101-106
71. Opatovsky, I., Musli, I., Weintraub, P.G. and Lubin, Y. 2013. Where do all the natural enemies of agricultural pests go after the wheat has been harvested? Alternative-seasonal habitats for spiders in agricultural environments in the Northern Negev. Ecology and Environment 4: 64-69. (in Hebrew)
72. Paine, T.D., Steinbauer, M.J. and Lawson, S.A. 2011. Native and exotic pests of Eucalyptus: a worldwide perspective. Annual Review of Entomology 56:181-201.
73. Levanoni, T. 2005. Species diversity in planted forests compared to native woodland in the Judean Lowlands. M.Sc. Thesis, Tel-Aviv University. (in Hebrew)
74. Martinez J.J.I. 2008. Firebreaks in planted pine forests in Israel: Patches for Mediterranean bata ants. Vie et Milinu – Life and Environment 58: 233-236
75. Roth, T. and Mandelik, Y. 2018. The effect of land use on the diversity and composition of bee communities in a mosaic of agricultural and natural lands. The 55th Conference of the Israel Zoological Society (abstract). (in Hebrew)
76. Chaprazaro, T. 2017. Bee communities and pollination networks in planted conifer forests compared to adjacent native woodland. M.Sc. Thesis, Faculty of Agriculture, Food and Environment, the Hebrew University of Jerusalem. (in Hebrew)
77. Binyamini, D. 1990. A guide to Israel's butterflies, including butterflies of the Hermon, Sinai and Jordan. Expanded edition. Keter Publishing House. (in Hebrew)
78. Pe'er, G. Kark, S. and Binyamini, D. 2006. Agricultural areas in the service of butterflies: preserving biological diversity in open areas along a climatic gradient in Israel. Final Report for the Nekudat Hen Foundation. (in Hebrew)
79. Pe'er, G. and Binyamini, D. 2008. A template for publishing the" conservation chain" from problem identification to practical action, exemplified through the campaign for butterfly protection in Israel. Israel Journal of Ecology and Evolution 54:19-39.
80. Schwartz-Tzachor, R. 2007. Multivariate analysis of a butterfly community that serves as a bio-indicator for anthropogenic impact and habitat quality in the Ramat Hanadiv Park. Ph.D. Thesis, Department of Evolutionary and Environmental Biology, Faculty of Science and Science Education, University of Haifa. (in Hebrew)
81. Pe'er, G. 2002. Butterfly survey in the Lahav region. In: Tsoar, A. and Ramon, U. (eds). Lahav Survey. Survey, analysis and assessment of natural resources, landscape and heritage. OLI, Survey Unit, pp. 93-102. (in Hebrew)
82. Dolev, A. 2002. Mammal survey in the Lahav region. In: Tsoar, A. and Ramon, U. (eds). Lahav Survey. Survey, analysis and assessment of natural resources, landscape and heritage. OLI, Survey Unit, pp. 76-85. (in Hebrew)
83. Hawlena, D. and Bouskila, A. 2006. Land management practices for combating desertification cause species replacement of desert lizards. Journal of Applied Ecology 43:701-709.
84. Hawlena, D. and Pérez-Mellado, V.2009. Change your diet or die: predator-induced shifts in insectivorous lizard feeding ecology. Oecologia 161:411-419.
85. Ben David, A. 2016. The effect of Aleppo pine (Pinus halepensis) invasion on nests predation. M.Sc. thesis, Tel Aviv University. (in Hebrew)
86. Elron, A. and Mayrose, A. 2016. Comprehensive ecological survey in the Kishon River – final report. DHV, ordered by the Nahal Kishon Drainage Authority and the Ministry of the Environment. (in Hebrew)
87. Ron, M. and Tsoar, A. 2002. The value of natural vegetation. Lahav Survey – Analysis and assessment of natural resources, landscape and heritage. Survey Unit, OLI, SPNI.
88. Zaady, E. and Bouskila, A. 2002. Lizard burrows association with successional stages of biological soil crusts in an arid sandy region. Journal of Arid Environments. 50: 235-46.
89. Frumkin, R. and Avishar A. 2014. The effect of forestry treatment on wild plants in the Sergeants' Wood in Netanya, three years after a fire and tree thinning. Report no. 2: Summary of spring monitoring, 2014. Netanya Municipality, 27 pp. (in Hebrew)
90. Tsoar, A., Alon, E., Shalmon, B. and Rotem, D. 2012. INPA position on the ecological perspective in "Limans in the Negev Policy Paper", KKL. INPA, Southern District. (in Hebrew)

91. Belcher, M. 2007. The Judean Iris in the Northern Negev: Interim survey results. INPA
92. 6.1.2013. Enforcement of INPA authority regarding protected natural assets. Application to the INPA by the SPNI CEO.
93. Columbus, A. 2016. Ecological expert opinion regarding damage to natural values in the Ramot Forest. INPA, Southern District. (in Hebrew)
94. Sheffer E, Canham CD, Kigel J, Perevolotsky A. 2014. An Integrative Analysis of the Dynamics of Landscape- and Local-Scale Colonization of Mediterranean Woodlands by Pinus halepensis. PLoS ONE 9(2): e90178.
95. Sheffer, E., Canham, C.D., Kigel, J. and Perevolotsky, A. 2014. Predicting the formation of a new upper canopy strata following colonization of native shrublands by pines. Forest science 60: 841-850
96. Sheffer, E., Canham, C.D., Kigel, J. and Perevolotsky, A. 2015. Countervailing effects on pine and oak leaf litter decomposition in human-altered Mediterranean ecosystems. Oecologia, DOI 10.1007/s00442-015-3228-3
97. Walczak, M. 2016. INPA policy regarding Aleppo pines. INPA. (in Hebrew)
98. Lavi A., Perevolotsky A., Kigel J. and Noy-Meir I. 2005. Invasion of Pinus halepensis from plantations into adjacent natural habitats. Applied Vegetation Science 8: 85-92.
99. Weitz, Y., Perevolotsky, A., Cohen, Y. 2014. Spread of Aleppo Pines from forest plantations into open areas – ecological processes and landscape consequences. Ecology and Environment 4: 312-320 (in Hebrew)
100. Dufour-Dror, J-M. 2018 (unpublished). Alien Invasive Plants in Israel – Second Edition. INPA and the Ministry of the Environment. (in Hebrew)

Spectacled Warbler nest in a Prickly Burnet shrub. Tree planting in shrublands affects predation pressure and displaces ground-nesting or shrub-nesting bird species. Photo: Asaf Mayrose.

The Society for the
Protection of Nature in Israel
Educate. Love. Protect.