



Abstract

The State of Nature Reports published by Hamaarag, Israel's National Ecosystem Assessment Program, which have been published since 2010, present the trends and processes occurring in Israel's ecosystems, and provide a glimpse of the state of nature in Israel. The reports aim to provide a scientific basis for developing sustainable, informed management regimes for open landscapes and biodiversity in Israel. To expand its applicability, the report is now published in two separate volumes - a Trends and Threats volume (this volume) and a Biodiversity volume, which will be published next year.

The State of Nature Report 2022 - Trends and Threats volume presents a spatial and temporal situation report of the main factors and processes related to human activity that influence the state of nature in Israel. The report is based on data processing, mapping and analysis, conducted by Hamaarag, from various scientific and cartographic sources. The report presents the results of seven different monitoring fields: land use change; analysis of spatial and temporal trends in vegetation cover; mapping and distribution of fires and fire frequency; indices of connectivity and fragmentation of open landscapes; mapping and analysis of protection levels of natural and afforested landscapes; spatial analysis of light pollution and its impact on ecosystems; a comprehensive review of the impact of climate change on biodiversity.

Chapter Topics and Main Findings

Chapter 1 – Land Use in Israel (land cover)

Mapping and analysis of land use change and conversion in recent years: built-up land, transportation infrastructure, agriculture (plantations and field crops), disturbed areas (quarries, solar farms, and more), natural and artificial water bodies and other uses.

- The rate of removal of open landscapes (natural, afforested and agricultural landscapes) in Israel remains high. During the period 2017-2020, 30 km² on average were removed per year for development.
- During this period, approximately 72 km² of natural and afforested landscapes were converted to other land uses (18 km² on average per year). Of these, 32 km² were converted to built-up areas, 22 km² were converted to agriculture, and the rest were converted to other uses, including transportation, quarries and solar farms.

- During this period, approximately 69 km² of farmland were converted to other land uses (approximately 17 km² on average per year, not including the increase in farmland area from conversion of natural landscapes): approximately 66% were converted to construction (not for agricultural use), and the rest were converted to other uses, mainly transportation (21%) and solar farms (9%).
- In ecological units that are underrepresented in Israel's protected landscapes, natural landscapes also continue to disappear: the coastal sand dunes, for example, lost 2% of their area during the period 2017-2020.

Chapter 2 – Vegetation Cover and Formations in Israel

Mapping and analysis of the state of Israel's woody vegetation based on remote sensing data: the current situation and the changes which have occurred since 1985, presented by phytogeographic region and climate variables.

- In the last 35 years, vegetation cover in the Mediterranean zone and the desert transition zone has increased in all natural landscapes. The increase in vegetation cover has been caused by a reduction in grazing, clearing and wood-cutting, which shaped the natural landscape of the Mediterranean zone for hundreds and thousands of years until the establishment of the State of Israel, and by increased growth of planted forests and natural woody vegetation.
- In contrast, the level of cover in the desert zone has not changed significantly in recent decades; a correlation was found between inter-annual fluctuations in woody vegetation cover and the amount of annual rainfall.
- In all vegetation units a positive correlation was found between the amount of rainfall and the rate of increase in vegetation cover (i.e., the increase in cover is greater when the amount of rainfall is higher).
- In some of the planted forests in the desert transition zones (Northern Negev and Mt. Gilboa) and other forests a trend of decreasing vegetation cover was observed after sequences of dry years.
- On the coastal sand dunes the rate of increase in vegetation cover is particularly high due to a rapid process of dune stabilization, caused in part by the spread of invasive species, specifically, *Acacia saligna* and *Heterotheca subaxillaris*.

Chapter 3 – Fire in Natural and Afforested Landscapes in Israel

Spatial and temporal mapping, as well as analysis of the frequency of fire events, in natural and afforested landscapes in Israel in the last seven years, presented by vegetation formation categories and the corresponding agencies responsible for each area.

- The frequency of fires in Israel is increasing.
- High-frequency recurrent fires have a significant impact on ecosystems and impede their recovery.
- Most of the areas with high fire frequency are located in and around military training grounds.
- Approximately 500 km² (ca. 15%) of the natural and afforested landscapes in the Mediterranean zone in Israel have been burned at least once during the period 2015-2021.
- Mediterranean maquis landscapes have been burned less than other vegetation formations - with respect to the relative area burned in each one of them, and also with respect to the area of each one of them that is located inside military firing ranges.
- Approximately one-quarter of the grasslands in Israel have been burned in the last seven years.

Chapter 4 – Management and Protection of Natural and Afforested Landscapes in Israel

Mapping and analysis of the protection levels applied to natural and afforested landscapes in Israel, in regards to the main land management agencies, and changes in the degrees of protection applied in recent years.

- More than one-third of Israel and approximately half of its natural and afforested landscapes are managed by the Israel Nature and Parks Authority and Keren Kayemeth LelIsrael (KKL-JNF).
- The area protected by declared and approved nature reserves and national parks stands at 26.1% of Israel's terrestrial land.
- Approximately half of the area of nature reserves in Israel and approximately 15% of the afforested areas managed by KKL-JNF are located within active military firing ranges.
- Since 2017 the area of declared and approved terrestrial nature reserves has grown by 9.6%.

- In 2021, significant areas of land in the Golan Heights and Mt. Hermon were declared and approved as nature reserves.

- Since 2017, 426 km² have been added to the afforested areas managed by KKL-JNF.

- In the last three years, two nature reserves were declared for the first time over extensive parts of Israel's territorial waters. Israel's protected marine area grew 13-fold compared to the situation prior to 2018, and currently stands at 3.9%.

- The different ecological units in Israel are not protected uniformly. The Mediterranean Sea, Gulf of Eilat, Sea of Galilee, Dead Sea, northern Jordan Valley, coastal kurkar and sand dunes, coastal salt flats, transition shrublands and loess plateaus are underrepresented in terms of their protected areas in comparison to the target of 30% protection set by the Ministry of Environmental Protection.

Chapter 5 – Connectivity and Fragmentation of Open Landscapes in Israel

Mapping and analysis of the connectivity and fragmentation of Israel's open landscapes.

- Accelerated development has a marked impact on the fragmentation pattern of Israel's open landscapes - in the north and center of the country the open landscapes are divided into small, fragmented units, while from Be'er Sheva southwards most of the open landscapes are relatively extensive and continuous.

- The land area located within 1 km of the closest road in Israel stands at 12,113 km² (55% of the country's land area): north of Be'er Sheva 83% of the land is located within 1 km of the closest road, compared to 29% of the land from Be'er Sheva southwards.

- The Golan Heights boasts the highest continuum of natural open landscapes in Israel's Mediterranean zone.

- Edge effects on natural and afforested landscapes are highest in the planted forest units, coastal sand dunes, loess plateaus and Mediterranean maquis.

Chapter 6 – Light Pollution in Israel – Ecological and Spatial Aspects

Definition of a threshold level of light pollution, mapping of the current situation and changes during the last decade, analysis of pollution levels in nature reserves and KKL-JNF forests, as well as select regional examples.

- Artificial night lighting has negative impacts on ecosystems and on the functioning of the organisms living in them. The intensities of artificial night lighting in Israel's open landscapes and the extent of the lit up area are steadily increasing.

- 67% of Israel's land area north of Be'er Sheva is lit up at night at intensities that have been found to cause damage to ecosystems and the functioning of the organisms living in them.

- Even protected areas, such as nature reserves, are affected by light pollution reaching them from nearby sources: 30% of KKL-JNF afforested areas and 16% of nature reserve areas north of Be'er Sheva are constantly exposed to artificial night lighting at a higher intensity than that of a full moon. Small, narrow reserves are particularly affected by light pollution, since there is not enough land buffering them from external sources of light pollution.

- Within Israel's territorial waters in the Mediterranean Sea, which were largely in darkness until a decade ago, permanent sources of light have been introduced within the framework of gas infrastructure development in the sea.

- Nearly all of Israel's beaches are exposed to artificial night lighting; approximately 78% of them are exposed to a higher intensity of artificial night lighting than that of a full moon. In Eilat, light pollution on the beaches is endangering the coral reef.

Chapter 7 – Climate Change and its Impact on Biodiversity

A review of climate change phenomena, global and local climate forecasts, along with widespread and expected impacts on flora and fauna.

- There is a scientific consensus that global warming and climate change are a global phenomenon caused mainly by greenhouse gas emissions resulting from human activity, primarily combustion of fossil fuels.

- The mean global temperature during the last decade was approximately 1.1°C hotter than the mean temperature during the first half of the 19th century. The temperature of Planet Earth has not been so high for at least 125 thousand years.

- The temperature of the oceans and seas is increasing, together with the sea level.

- Extreme weather events, such as storms, droughts and heat waves on the land and sea are expected to occur more

frequently and at higher intensity, and are anticipated to be devastating for both ecosystems and humans.

- Due to climate change, significant changes are also taking place in species distributions, physical traits of animals and activity patterns of plants and animals.

- According to the last report of the Intergovernmental Panel on Climate Change (IPCC), Israel and the Eastern Mediterranean are warming at a faster rate than the global mean.

- During the period 1961-2015, temperatures in the countries of the Eastern Mediterranean Basin increased at a rate of 0.24°C per decade - 13% faster than the global mean (0.21°C per decade). The mean terrestrial temperature is expected to continue rising by approximately 1.5-3.7°C until 2070-2100 with respect to the mean during the last three decades. The main warming is expected to occur in the summer.

- The Eastern Mediterranean Basin is expected to become more arid. In Israel, the amount of rainfall is expected to decrease by 15-25% by the end of the century (with respect to the period 1961-1990).

- Israel has warmed by 1.7°C since the late 1980s. Israel serves as the edge of the global distribution of many species. Populations on the edge of their distribution tend to be particularly vulnerable to changes in their environment, including climate change.

- The decrease in the amount of rain combined with the increase in mean temperature in Israel are expected to have a significant impact on freshwater aquatic habitats such as streams, springs and winter ponds. Other sensitive areas are transition zones, between the desert zone and the Mediterranean zone, and areas characterized by cool temperatures, such as the Negev Highlands and Mt. Hermon. Moreover, maquis, forests and grasslands are expected to be impacted by prolonged drought events and increased frequency of fires. In the desert zones of Israel, changes in the rainfall period, sequences of dry years and increasing temperatures are expected to affect vegetation and wildlife.

- The Mediterranean Sea has warmed by approximately 1.5°C in the last forty years. This rate is significantly higher than the mean global rate of ocean warming. Due to warming of the Mediterranean Sea, about one-fifth of the fish species endemic to this sea are expected to go extinct by the end of the 21st century.

- Warming of the sea will ease the establishment of invasive species from other water bodies (Red Sea, Indian Ocean

and southern Pacific Ocean), further impacting the local species composition.

- Currently, there are significant knowledge gaps with respect to the effects of climate change on biodiversity and ecosystems.
- There is an essential need for long-term monitoring and empirical research to close the knowledge gaps and set up a basis for sustainable management of biodiversity and ecosystems in Israel.

Looking Ahead

This volume reviews two significant threats that have not yet received widespread attention in the fields of research and planning in Israel - light pollution and climate change - with respect to their impact on biodiversity. The chapter on light pollution defines, for the first time, threshold levels of artificial night lighting intensity with respect to their level of impact on ecosystems, and enables spatial analysis of this threat based on satellite data. The chapter on climate change provides predictions of the expected impact of climate change on Israel's ecosystems, including several examples of the changes expected to occur in the near future.

The next volume of the State of Nature Report - Biodiversity - will present data processing and analysis from the National Monitoring Program which is currently in its tenth year (fifth sampling cycle). Additional chapters of the report will present the state of Israel's ecosystems and biodiversity based on the products of Hamaarag and various other scientific sources.

Systematic, uniform gathering of information is essential for building a substantial knowledge base and improving management and interventions for nature conservation. In the coming years, Hamaarag will continue monitoring the impacts of humans on ecosystems and the state of biodiversity in Israel.

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Hamaarag is a partnership between the Ministry of Environmental Protection, Keren Kayemeth Lelsrael (KKL-JNF-JNF), Israel Nature and Parks Authority and the Steinhardt Museum of Natural History - the National Center for Biodiversity Studies at Tel Aviv University. Hamaarag's central mission is the assessment of the state of nature in Israel in order to enable knowledge- and science-based management of Israel's open landscapes and biodiversity. Hamaarag contributes to promoting knowledge-based management of open landscapes and natural resources by continuously creating and sharing scientific knowledge on the state of Israel's ecosystems and biodiversity. This knowledge is accessible to decision makers working in open landscape management, researchers and the general public.

The work of Hamaarag includes: coordinating the National Terrestrial Biodiversity Monitoring Program; managing national monitoring programs following ecological disasters; writing and publishing the State of Nature Report; coordinating and publishing the National Assessment Program for Ecosystems and Human Wellbeing; developing and coordinating the National Index of Biodiversity; coordinating and executing the agricultural remnants mapping project; writing the Red Book of Invertebrates in Israel.