



## Forest protection and predominant risks to forests

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The growing human population, globalization and changing climate have been the main drivers of distinct changes in forests and other ecosystems over the past two centuries. Abiotic and biotic disturbances, such as forest degradation, extreme drought, forest fires, lack and surplus of precipitation, an increase in the intensity and frequency of extreme weather events, outbreaks of pests and diseases, as well as the introduction and establishment of certain alien species, have impaired forest health to such a degree that the economy, ecosystem services and human health and well-being in general are greatly affected.

Forest health has thus become one of the main concerns of contemporary forestry, and forest protection has increased in importance.

### Reporting, Prognostic and Diagnostic Service for Forests

Forest protection is ingrained in the Slovenian forestry and has been an integral part of forest management practices for decades regardless of forest ownership. Forest health issues in Slovenia are covered by the public forestry service, which brings together the Slovenian Forestry Institute and the Slovenia Forest Service. One of the highlights of the close collaboration of both institutions is the e-portal "Varstvo gozdov Slovenije", which was developed and is maintained by the Department of Forest Protection at the Slovenian Forestry Institute and is publicly available at [www.zdravgozd.si](http://www.zdravgozd.si).

One of the integral parts of the public forestry service is the Reporting, Prognostic and Diagnostic Service for Forests, which deals with biotic and abiotic threats to such ecosystems. The service monitors and provides forecasts for the occurrence and spread of biotic (forest pests and diseases) and abiotic disturbances (e.g. forest fires, windthrows, ice storms), carries out forest and tree health diagnostics, provides advisory services, creates guidelines and develops new knowledge through basic and applied scientific research.

The activities of the public forestry service are coordinated and funded by the Ministry of Agriculture, Forestry and Food (Directorate for Forestry). In addition, forest protection in Slovenia involves certain plant protection activities, which are coordinated and funded by the Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection (e.g. plant health surveys and diagnostics of quarantine plant pests).

The compliance of forest protection activities with the forestry and plant health regulations is supervised and ensured by inspectors of the Inspectorate for Agriculture, Forestry, Hunting and Fisheries and the Food Safety, Veterinary and Phytosanitary Inspection, respectively. The collaboration that occurs with forest owners and organizations related to forestry is of the utmost importance in the pursuit of healthy forests. Therefore, the Slovenia Forest Service is in close contact with forest owners and is also involved in the system of protection against natural and other disasters, which is governed by the Ministry of Defence. Public forestry service strives for healthy and resilient forests supporting sustainable, close-to-nature forest management with multipurpose forest development.

## Forest protection challenges

### Bark beetles

In recent decades Slovenian forests have been confronted with increasingly bigger challenges regarding abiotic and biotic disturbances. In 2014, an ice storm damaged more than half of Slovenian forests and induced an unprecedented outbreak of spruce bark beetles. This bark beetle disaster continued in the following years due to drought and windthrows, which provided suitable conditions to support the beetles' development and population growth. The ice storm damaged around 9 million m<sup>3</sup> of wood, mostly conifers. Additional 2 million m<sup>3</sup> of Norway spruce per year were consequently damaged by bark beetles in the following years. More frequent abiotic disturbances are expected in the future, and it is highly likely that they will bring about outbreaks of bark beetles and other pests and diseases.



Figure 23: Norway spruce forest damaged by a windthrow and subsequent bark beetle attack (Photo: A. Kavčič).

## Invasive alien species

Globalization and climate change bring another threat to forests, i.e. alien invasive species, which can have even more devastating consequences for forests than native ones. We have already seen the havoc of the ash dieback caused by the fungus *Hymenoscyphus fraxineus* Baral et al., the Dutch elm disease caused by *Ophiostoma ulmi* (Buisman) Melin & Nannf. and *O. novo-ulmi* Brasier, or chestnut blight caused by *Cryphonectria parasitica* (Murrill)

Barr. Sanitary felling of ash has risen severalfold in years after the first discovery of the disease in 2006. Currently, ash dieback accounts for 70% of the sanitary felling of ash. Recently, *Phytophthora* × *multiformis* (Brasier & S.A. Kirk) Husson, Iosif & P. Frey was recorded for the first time in Slovenia, and is already causing a distinct dieback of alders, the key species in the riparian forests of the NE part of Slovenia.



Figure 24: Ash dieback (left) and an oak heavily infested by the oak lace bug (*Corythucha arcuata* Say) (right) (Both photo: A. Kavčič).

In recent years, reports on the first findings of invasive plant pathogens and pests have been growing in Slovenia (e.g. *Eutypella parasitica* R.W. Davidson & R.C. Lorenz (1938), *Petrakia liobae* Beenken, Andr. Gross & Queloz, *Xylosandrus crassiusculus* Motschulsky (1866), *Dryocosmus kuriphilus* Yasumatsu (1951), *Corythucha arcuata* Say (1832), *Lecanosticta acicola* (Thüm.) Syd., *Dothistroma* spp. Hulbary). However, there are even more species waiting on our doorstep, such as the emerald ash borer (*Agrilus planipennis* (Fairmaire, 1888)), Asian longhorn beetle (*Anoplophora glabripennis* (Motschulsky, 1853)), pine wood nematode (*Bursaphelenchus xylophilus* (Steiner & Buhner) Nickle), and thousand cankers disease (*Geosmithia morbida* M.Kolařík, E.Freeland, C.Utley, & Tisserat), to mention just a few. No tree species is safe from this threat.

## Protection against abiotic and biotic disturbances

Forest protection activities in Slovenia focus on preventive action, such as the improvement of forest resilience to negative environmental influences, and early warning and rapid response to possible future forest pests and diseases.

Computer-based models for short- and long-term forecasts of ice storms, forest fires, outbreaks of bark beetles and the spread of certain tree diseases have recently been developed for Slovenia. A phenology model for the European spruce bark beetle, (*Ips typographus* L.), called RITY, has been produced to model the development of this species on a local scale, which will improve the monitoring of bark beetle populations in Slovenia. In addition to this, we are currently testing different pheromone lures for *Ips typographus* and different types of traps to identify the most cost-effective approach for bark beetle monitoring. The possibility of using remote sensing technology for the detection of forest damage in Slovenia is also being investigated, while much effort is directed into training of forestry professionals in all aspects of forest protection.

Growing reference collections of insects and fungi associated with forests and woody plants, with specimens from Slovenian forest as well as potentially hazardous non-native species, represent an important source of information and add value to the diagnostic infrastructure.

Early warning and rapid response systems for biological invasions have become a top forest-protection priority. We perform annual plant health surveys for selected pests and diseases that pose the highest potential threat to forests, the so-called quarantine organisms for forests, as well as develop methods and introduce new diagnostic procedures for early detection of these organisms. Contingency plans and pest risk analyses for possible quarantine pest outbreaks in Slovenia are being prepared in order to strengthen the readiness to respond to these relatively unknown threats.

Number of potential generations in 2019  
31. 10. 2019

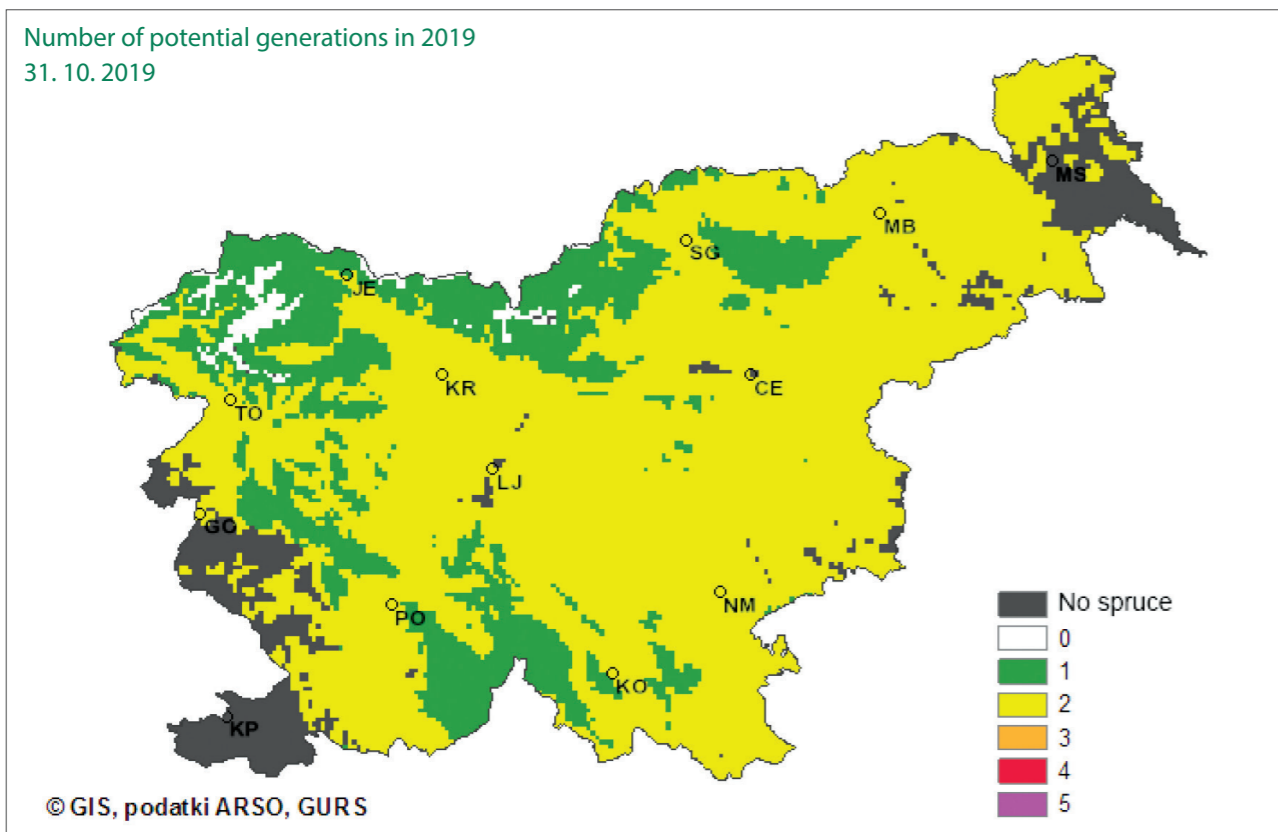


Figure 25: Predicted no. of potential generations of the European spruce bark beetle, according to RITY-2 (source: [www.zdravgozd.si](http://www.zdravgozd.si)).

The consistent support from policymakers, forest owners and the general public is a prerequisite for any action to be effective. Therefore, forest protection activities include number of awareness-raising and educational events for the relevant ministries and other forestry-related institutions, forest owners and the general public. An information system "Invazivke" ([www.invazivke.si](http://www.invazivke.si)) that has been developed within the project LIFE ARTEMIS shows how the general public as citizen scientists can contribute to forest protection by early detection of invasive alien species. Due to the great success of this information system, it was later introduced to the whole Danube region and translated into six languages (<https://danubeforesthealth.eu>) in the project REFOCuS.

Forest protection challenges are common to countries in a wider European area and require combined efforts in our striving for healthy forests. Slovenia collaborates closely with research laboratories worldwide, and is actively involved in international associations from the field of forest protection, e.g. EPPO – European and Mediterranean Plant Protection Organization, REUFIS – Forest Invasive Species Network for Europe and Central Asia, EMN – European Mycological Network, EMA – European Mycological Association, and EFSA - European Food Safety Authority, thus actively contributing to global forest protection and plant health issues.

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Figure 26: Sixtoothed spruce bark beetle (*Pityogenes chalcographus* L.) (Photo: A. Kavčič)