

# Pathways, Detection, and Management of Invasive Forest Pathogens

Funda OSKAY

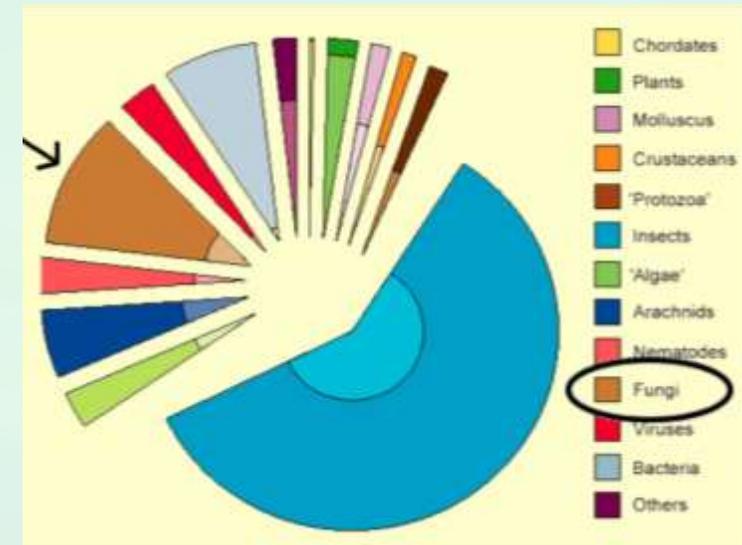
# Invasive Species and Global Impacts

Invasive species are organisms that establish, reproduce, and spread outside of their native habitats, often as a result of human activities and globalization.

These species pose significant threats to local ecosystems by outcompeting native species for resources, altering habitat structures, and sometimes introducing new diseases.

As a major driver of global biodiversity loss, invasive species contribute to the decline of native populations, disrupt ecosystem services, and cause economic damage in affected areas.

Invasive species are organisms including plants, animals, fungi, and microorganisms that spread beyond their natural geographical ranges. Their introduction may be accidental or intentional, but once established, they often become difficult to control.



# Invasive Species and Global Impacts

The impacts of invasive species are widespread, affecting ecosystems worldwide.

- They contribute to the **extinction of native species**,
- alter nutrient cycling and fire regimes,
- reduce ecosystem productivity.

Beyond ecological effects, invasive species impose considerable **economic costs** through damage to agriculture, forestry, fisheries, and infrastructure.

Their management requires extensive efforts and resources, making prevention and early detection crucial components of global biodiversity conservation strategies.

# Impacts on Biodiversity and Ecosystem Health

The spread of invasive species leads to significant ecological degradation and the irreversible loss of local biodiversity.

invasive organisms often outcompete native species for resources, resulting in disrupted food webs and altered ecosystem functioning.

Furthermore, the introduction and establishment of invasive species can cause major changes to ecosystem services such as pollination, water purification, and soil fertility, which are critical to both natural environments and human well-being.

## Ecosystem Degradation

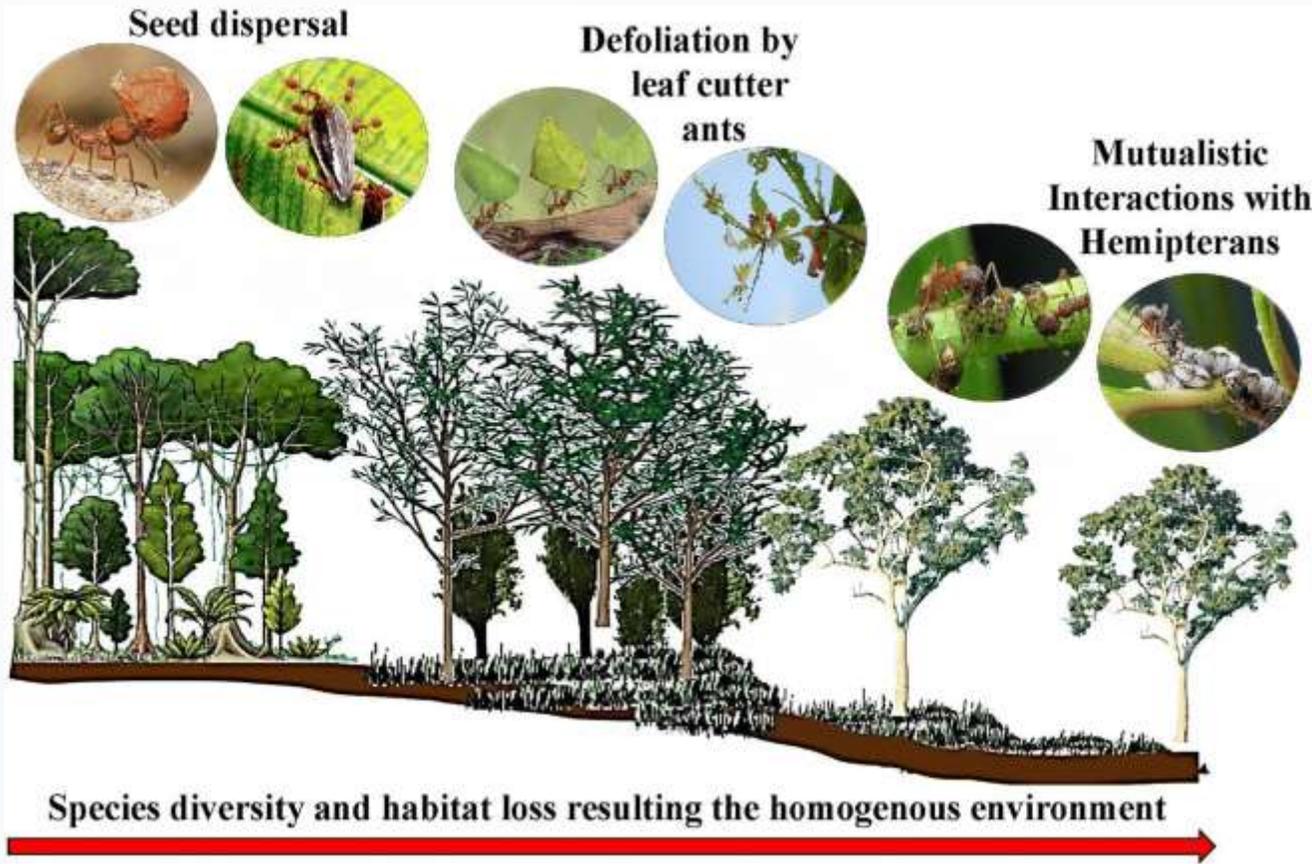
Invasive species disrupt natural cycles and ecological balances by altering nutrient cycling, increasing erosion, and modifying fire regimes. These changes compromise the resilience of ecosystems and reduce their ability to recover from disturbances.

## Local Species Loss

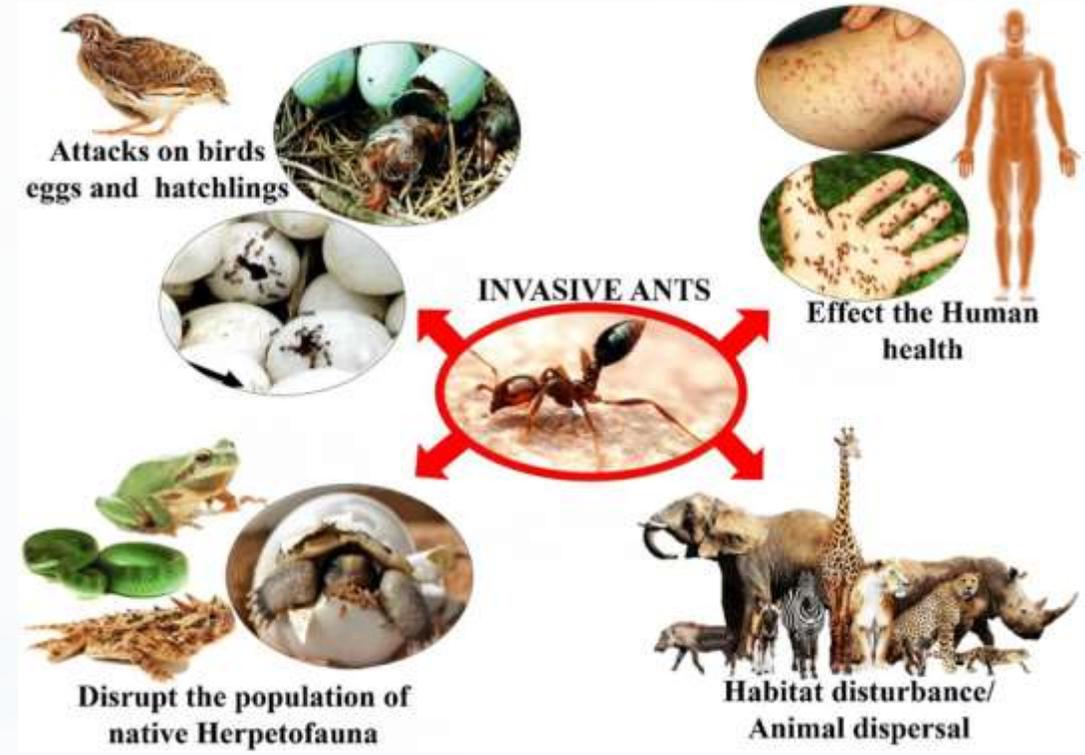
The aggressive competition and predation by invasive species often lead to the decline or extinction of native flora and fauna. This results in reduced genetic diversity and the loss of species that play unique roles in maintaining ecosystem stability.

## Habitat Change

Invasive species cause significant alterations in vegetation structure and faunal composition, leading to habitat fragmentation and degradation. These changes can transform entire landscapes, making them unsuitable for native wildlife and disrupting ecological interactions.

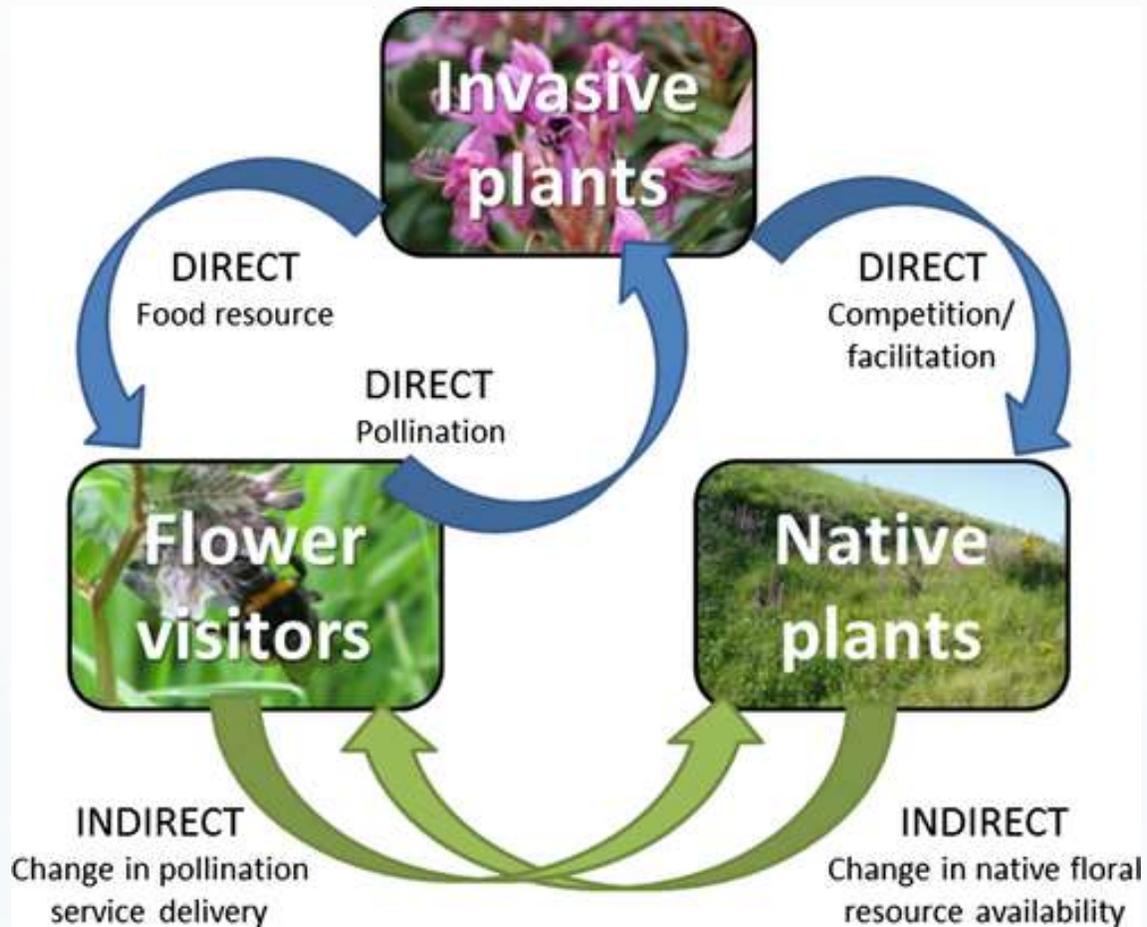


The schematic diagram represents the destruction of habitat, reduction of species diversity that leads to the homogenous environment by invasive species



Schematic diagram represents the impacts of invasive ants on animals sharing their habitat

Siddiqui, .A., Bamisile, B.S., Khan, M.M. et al. Impact of invasive ant species on native fauna across similar habitats under global environmental changes. Environ Sci Pollut Res 28, 54362–54382 (2021). <https://doi.org/10.1007/s11356-021-15961-5>

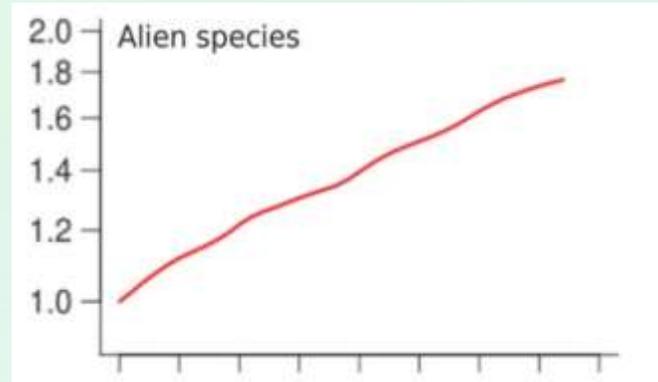


Invasive plants interact with native flower visitors directly (blue arrows) and indirectly via effects on interactions with native plants (green arrows)

PLANT–POLLINATOR INTERACTIONS FROM FLOWER TO LANDSCAPE  
**Direct interactions between invasive plants and native pollinators: evidence, impacts and approaches**

Jane C. Stout\* and Erin Jo Tiedeken†

## Introduction Pathways of alien invasive species



Anthropogenic factors play a critical and multifaceted role in the introduction and spread of invasive species across the globe.

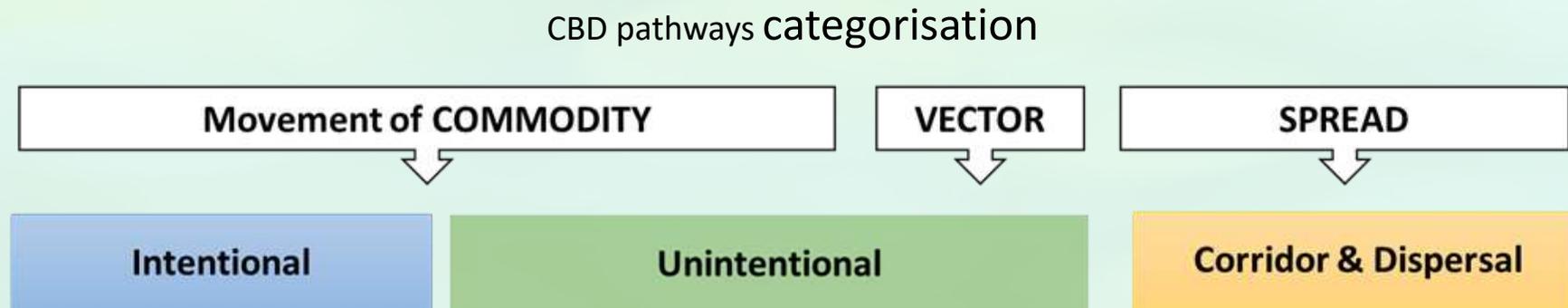
The identification and management of introduction pathways represent the frontline of invasive species prevention, forming the basis for targeted biosecurity measures such as pre- and post-border inspections, decontamination, and early-detection strategies

# Introduction Pathways of alien invasives

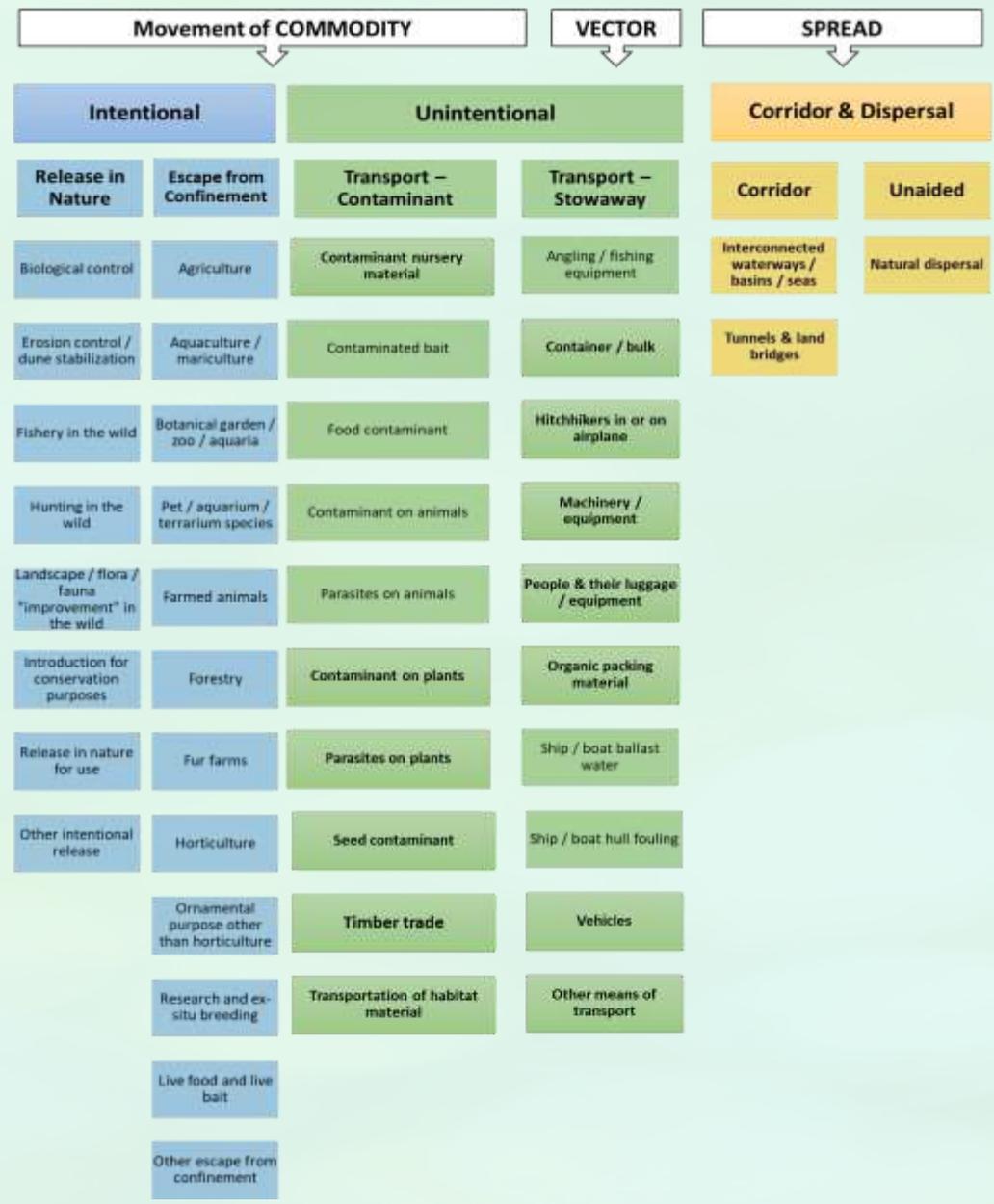
## Defining and classifying Introduction Pathways

The Convention on Biological Diversity (CBD) defines these pathways as the ‘means by which species are moved to new regions beyond their native range’ and differentiates between intentional and unintentional introductions, and the introduction mechanism is categorised as follows:

- the **importation of a commodity**,
- arrival via a transport **vector**,
- the establishment of an anthropogenic dispersal corridor, or the natural spread from a region where the species is itself alien



The CBD pathway categorisation builds upon the framework proposed by Hulme et al. (2008), utilising the six pathway types proposed (**Release, Escape, Contaminant, Stowaway, Corridor and Unaided**) and expanding upon them through the addition of 44 pathway subcategories nested within the main categories.



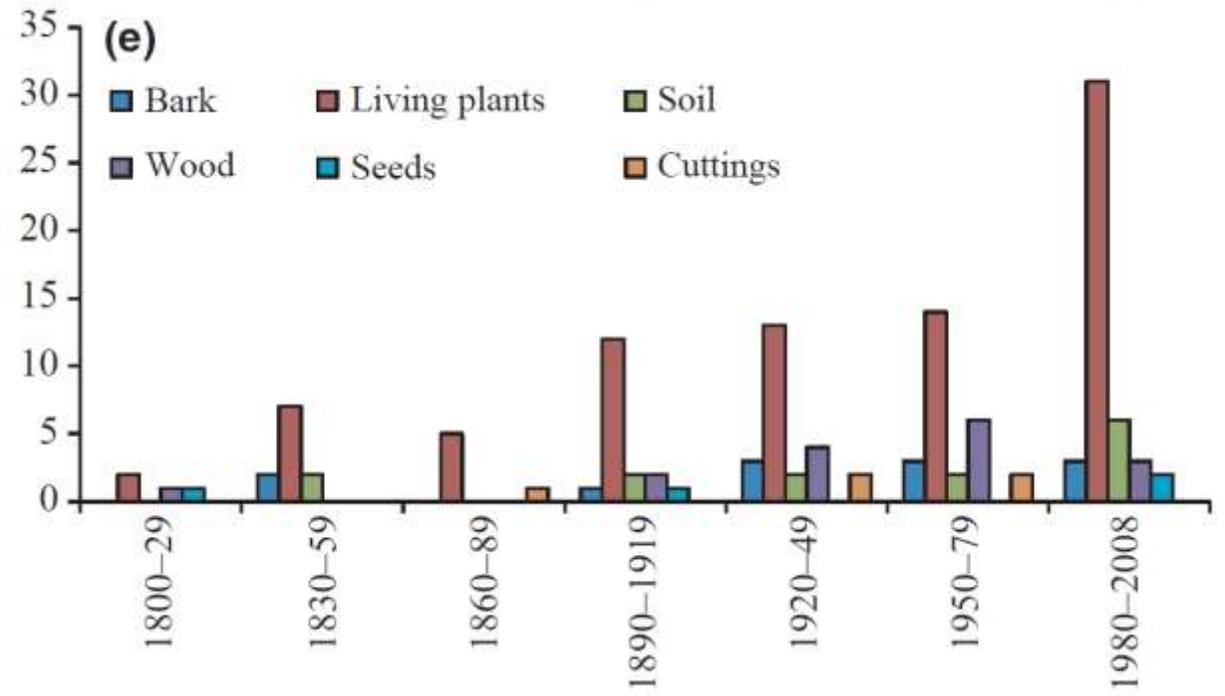
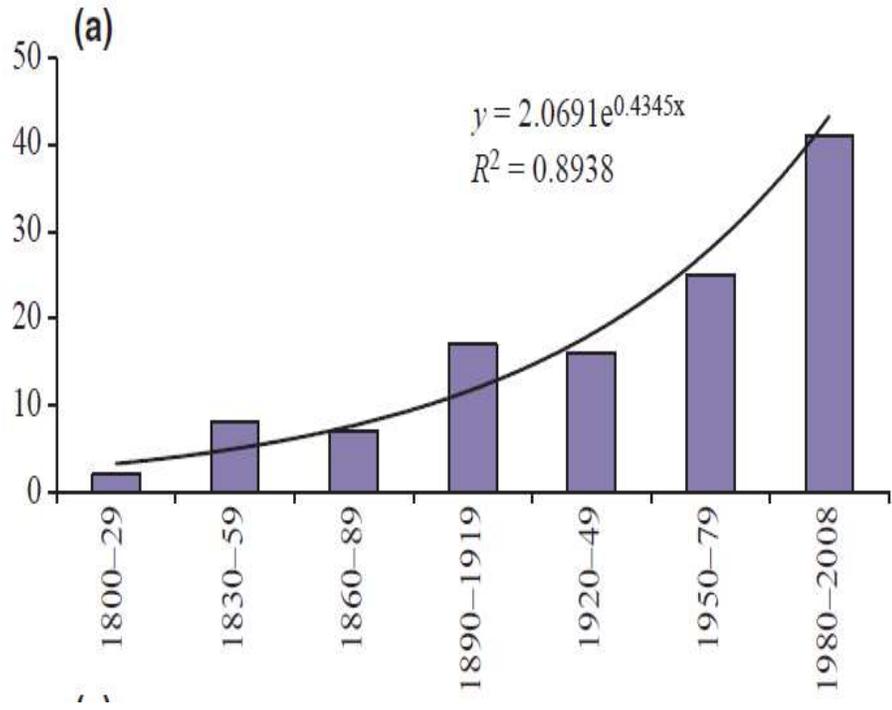
An overview of the CBD pathways categorisation scheme showing how the 44 pathway subcategories relate to the six main pathway categories (modified from (Harrower et al., 2018)).





- **wood packing materials**
- logs,
- lumber,
- fuelwood and
- manufactured wood articles,
- and baggage carried by travellers.





- The most important pathways for the introduction of forest pests is the intentional movement of

➤ **live plants**







Tourism and recreational activities, in particular, serve as significant **vectors** by **unintentionally facilitating the transport of non-native species** through various means. These human-induced pathways accelerate the distribution of invasive organisms beyond their native habitats, often disrupting local ecosystems and biodiversity.



**Camping**



**Marine tourism**



**Hiking**



**How you can help**

- Never ever illegally bring home plants, seeds, flowers, fruit and vegetables.
- If you do wish to import plants into your country, contact your local Plant Health authorities to find out what you can do legally.
- If you are carrying any plants, seeds, flowers, fruit and vegetables, declare them to the Customs official.

When travelling, avoid bringing back to your home plants or other plant items ... because plant pests or diseases may be hiding on them.

The leaflet was prepared by:  
[your NPPO]

**DON'T RISK IT!**

Pests and diseases can hide on plants. Please do not bring home plants, seeds, fruit, vegetables or flowers.

QR code and logo at the bottom.

**Help us to protect our crops and beautiful countryside against plant pests and diseases**

In 2013, EPPO published a poster 'Don't Risk It'.

The objective of these documents is to raise public awareness about the risks of moving plants and their associated pests during international travel and to encourage responsible behaviour.

**Displayed in airports or any other sites where international travellers will see it (e.g. seaports, railway stations, travel agencies, embassies).**

# Firewood

Firewood logs accounted among important pathway by which invasive species, particularly the forest insects are transported to other areas.



Wood packaging material was likely the pathway by which EAB was introduced to North America, but firewood was been linked to new EAB infestations in the United States (Robertson and Andow 2009).



# Historical Emergence of IFPs

## Chestnut Blight

Early 1900s: Caused by *Cryphonectria parasitica*, devastating American chestnut populations.

1

## White Pine Blister Rust

Late 19th Century: *Cronartium ribicola* introduced, affecting five-needle pines.

3

## Dutch Elm Disease

Mid-20th Century: *Ophiostoma novo-ulmi* spread, decimating elm trees across Europe and North America.

Historical introductions, such as chestnut blight and Dutch elm disease, highlight vulnerabilities. Pathways included imported nursery stock, raw logs, and even military transport during military transport during WWII.



Canal du Midi  
*Ceratocytis platani*



2015



2016



2018



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ORIGINAL ARTICLE

WILEY Forest Pathology

## *Ceratocystis platani* is killing plane trees in Istanbul (Turkey)

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Editor: T. Sieber

### Summary

*Ceratocystis platani* was detected at several locations in the European side of Istanbul, causing severe dieback and mortality, mainly on *Platanus × acerifolia* imported from Italy approximately 160 years ago, but also on *Platanus orientalis*. In the work reported here, the causal agent of the dieback and mortality was identified based on morphological characteristics in culture and internal transcribed spacer (ITS) sequencing, confirming the presence of *C. platani* in Turkey. All analyzed *C. platani* isolates from Istanbul shared the same ITS sequence with European *C. platani* strains available in the NCBI, but differed from other species previously ascribed to the *Ceratocystis fimbriata* species complex. Pathogenicity of *C. platani* was proven by inoculation onto 25-cm-long and 4–9 mm diam. *P. orientalis* twigs and the causal agent reisolated from symptomatic tissues. In a survey of 976 *Platanus* in streets and parks of Istanbul, 26.5% of trees showed symptoms of *C. platani* infections, whilst 5.6% were dead. The proportion of symptomatic trees was higher where management interventions, such as topping or pruning and felling infected trees had been carried out.

Gülhane  
Parkı



Maçka  
Parkı



Çırağan  
cad.



Dolmabahçe  
Cad.



Dolmabahçe  
Sarayı



Gezi Parkı



Teşvikiye Camii







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1971



1984

- Elm-lined streets before and after Dutch Elm disease (<https://ferrebeekeeper.wordpress.com/tag/elm/>)



*Agrilus planipennis* (AGRLPL) - <https://gd.eppo.int>



*Agrilus planipennis* (AGRLPL) - <https://gd.eppo.int>



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07.11.2012, ŐimŐir Gen Koruma Ormanı, Rize



## Anoplophora chinensis

### İstanbul'da ağaç yiyen böcek alarmı

UĞUR YILDIRIM | Yaşam Haberleri  
Giriş Tarihi: 4.7.2015



Gemilerle yapılan bitki ve ağaç malzeme ithalatı esnasında Türkiye'ye "Anoplophora spp" isimli 'canavar böcek', İstanbul'un 3 ilçesi yüzlerce ağacı kuruttu. Asırlık çınarlar tehdit altında

### İSTANBUL'U ALARMA GEÇİREN 'CANAVAR BÖCEK' BARTIN'DA DA GÖRÜLDÜ

Paylaş Tweet G+



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### Antalya'da görülen böcek türü çiftçileri korkuttu

11-09-2017 21:12 Güncelleme: 11-09-2017 22:00

Facebook'ta paylaş

Tweet'te paylaş

Google+da paylaş

Whatsapp'ta paylaş



Ana vatanı Çin, Japonya ve Kore olan 'Anoplophora Chinensis' cinsi böceklerden olan Turuncgöl böceği (uzun antenli böcek) Antalya'da görüldü. Turuncgöl böceği tespit edilen 15 ağaç imha edildi. Bu böcek türü



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Manuscript submitted to Forest Pathology

In addition, needle blight symptoms, with defoliation in the lower crown of a Lebanon cedar (*Cedrus libani* A. Rich) were also noticed



*Dothistroma* sp.?





*P. nigra* subsp. *pallasiana* var. *pallasiana* f. *şeneriana*



*P. nigra* subsp. *pallasiana* var. *fastigiata*



*P. sylvestris*

Conidiomata on *C. libani*  
needles

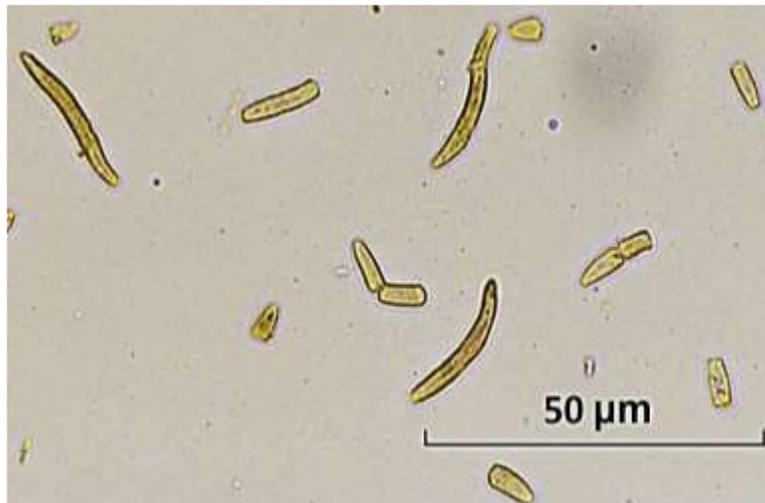


Dark olive green to black conidiomata

Conidia on *C. libani* needles



light green or olivaceous to pale brown  
truncate base and rounded apex  
verruculose surface  
Fusiform to cylindrical /straight or curved  
(1-)3(-7)-septate



27.79-(34.90)-46.56 x 3.00-(4.51)-5.87 µm.

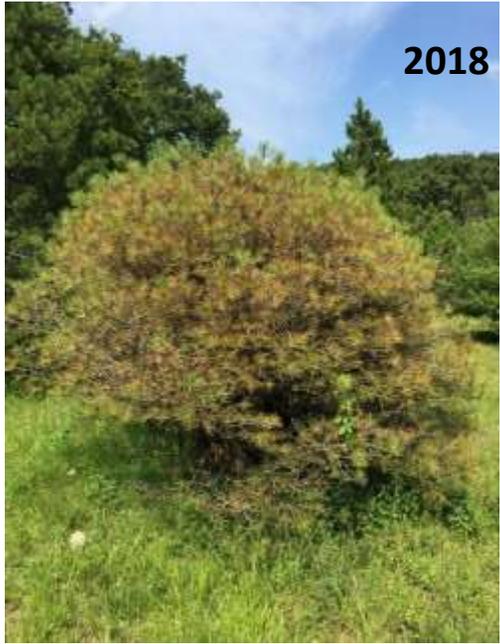
*P. sylvestris* → 22.15-(33.34)-38.38 x 3.59-(4.84)-7.32 µm,  
*P. nigra* subsp. *pallasiana* → 20.17-(30.03)-41.11 x 3.11-(4.36)-5.76 µm,

# Risk to native plants

- Native pine species, especially endemic varieties or forms are highly susceptible to BSNB
- But also to *Diplodia* sp. and *Dothistroma* sp.
- Co-occurrence of *Diplodia* sp. and *L. acicola* can be lethal to native species
- *Cedrus libani* is also susceptible to BSNB
  - **Probably more susceptible against BSNB than DNB**
- *Diplodia sapinea* was also detected on a different *C. libani* individual in the arboretum (Oskay et al 2018).



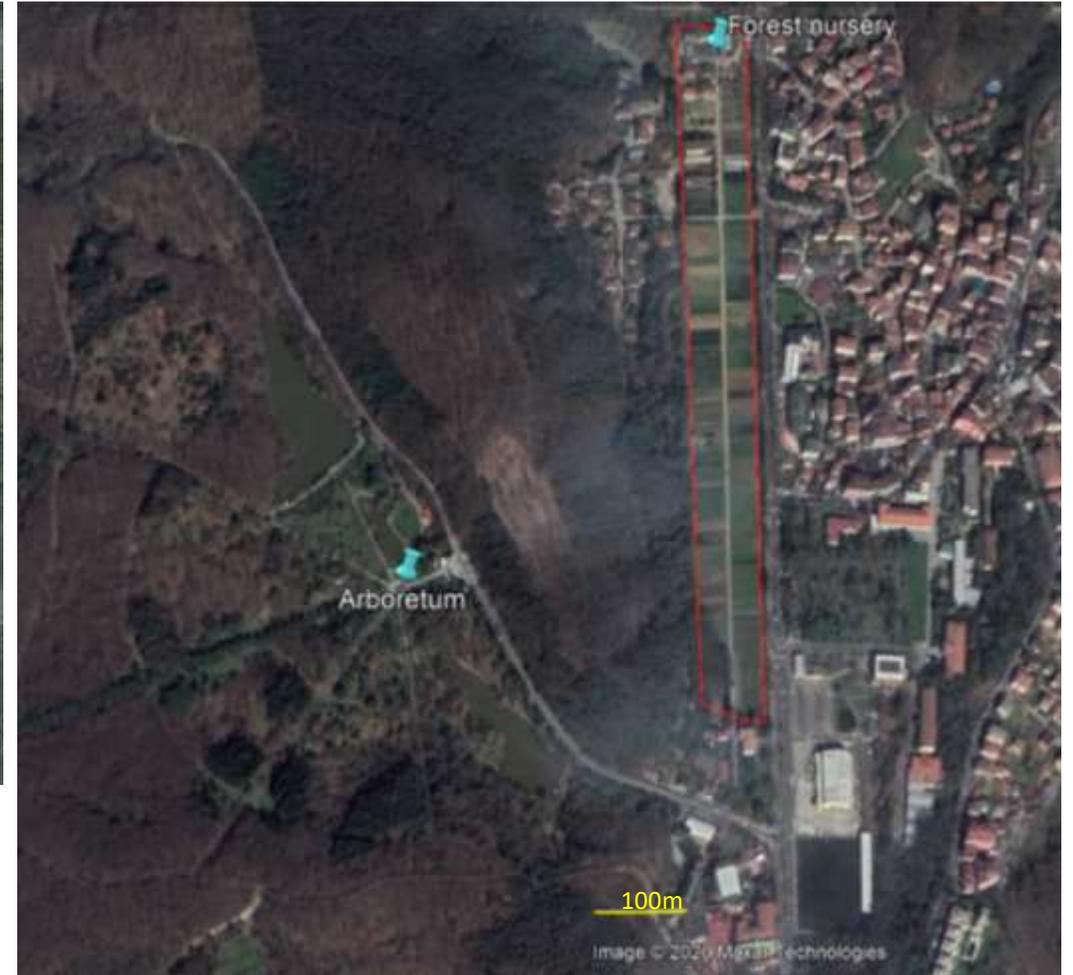
➤ Co-occurrence of *Diplodia* sp. and *L. acicola* can be lethal to native species



## Risk of spread



Arboretum locates in a natural deciduous forest, but also with Pine plantations (*Pinus pinaster*, *P. nigra*, *P. sylvestris*, and *P. pinea*)

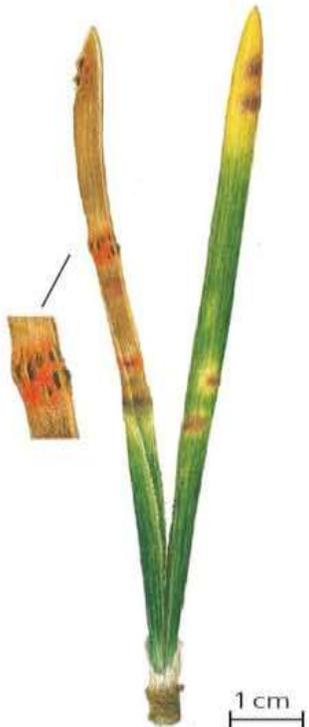


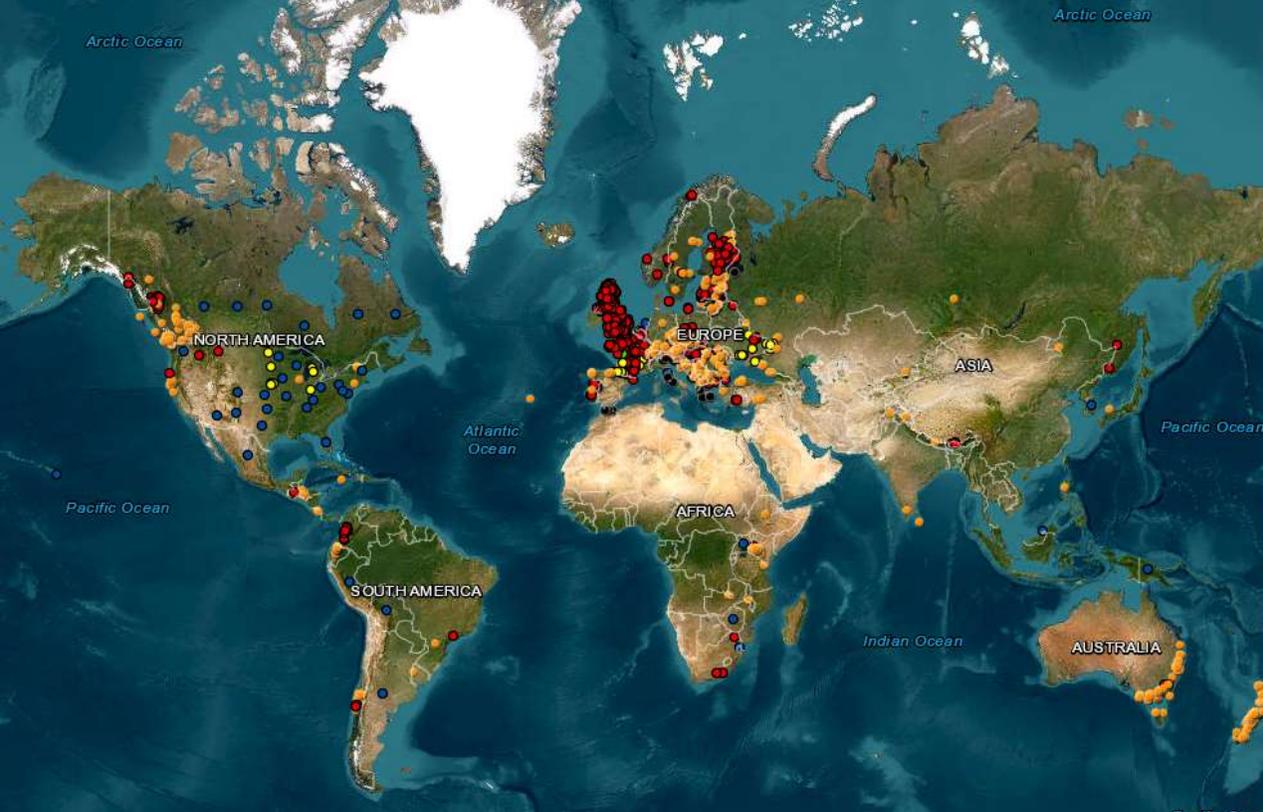
Forest nursery 500 m away from the arboretum (ornamentals including pines and christmas trees )

# Dothistroma needle Blight

Red band needle blight  
(*Dothistroma* spp.)

- The non-native red band needle blight (*Dothistroma* spp.) is one of the most significant diseases of pines.
- There are two species that cause the disease: *Dothistroma septosporum*, and *Dothistroma pini*. They can only be distinguished by means of molecular methods

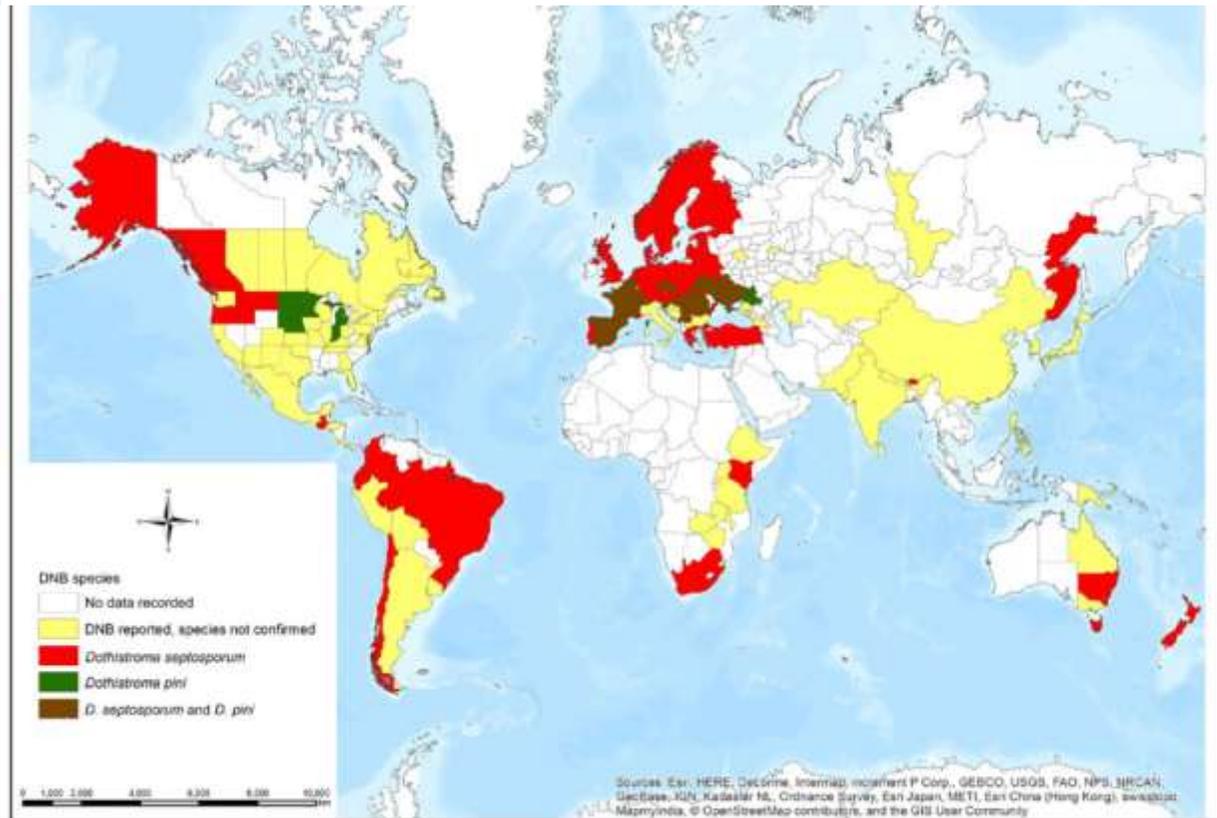




## Dothistroma spp.

- *Dothistroma pini* confirmed
- *Dothistroma septosporum* confirmed
- *D. septosporum* and *D. pini* confirmed
- DNB reported but species not confirmed
- DNB recorded without geographical coordinates
- DNB not found

- Climate change
- Distribution and usage of infected seedlings within and between countries





a



b



d

c



*Damaged caused by D. septosporum on P. radiata seedlings, New Zealand*

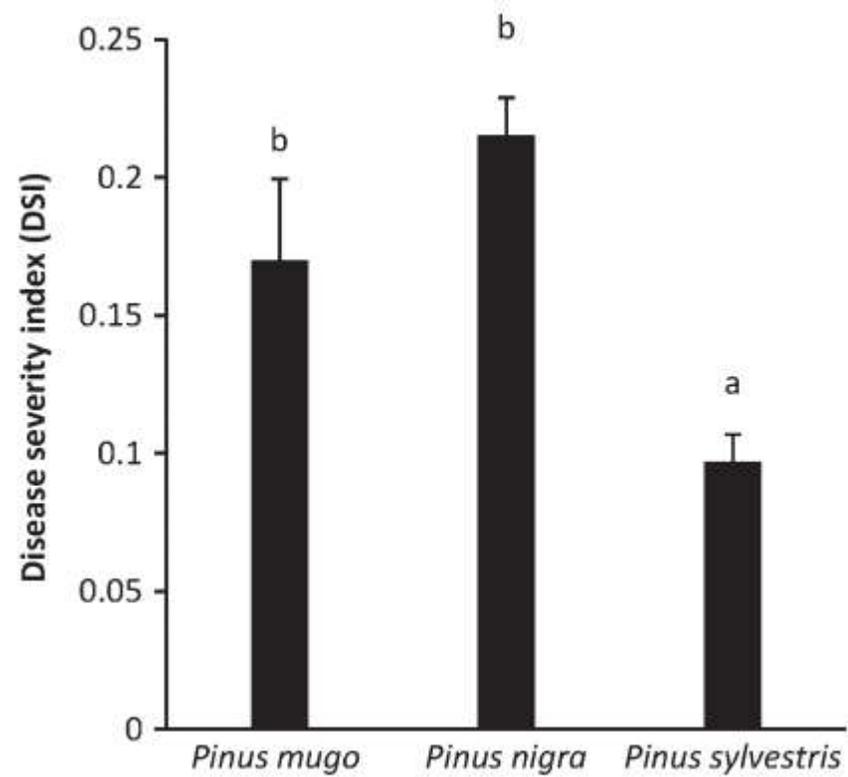
Lodgepole pine, British Columbia (Woods et al 2005)



Corsican pine  
and Lodgepole  
pine (UK, 2008)



*P. radiata* plantation, Spain, 2018



*Pinus mugo*, *P. nigra* and *P. sylvestris* are the most common hosts of the disease in Europe. *P. nigra* is the most susceptible (Drenkhan et al. 2016).



**FIGURE 3** *Pinus nigra* subsp. *laricio* showing severe Dothistroma needle blight (DNB) symptoms (centre and right of picture) growing adjacent to green *Pinus sylvestris* trees showing little or no apparent DNB symptoms (left of picture) in the south of England (Photo Credit: M.S. Mullett)



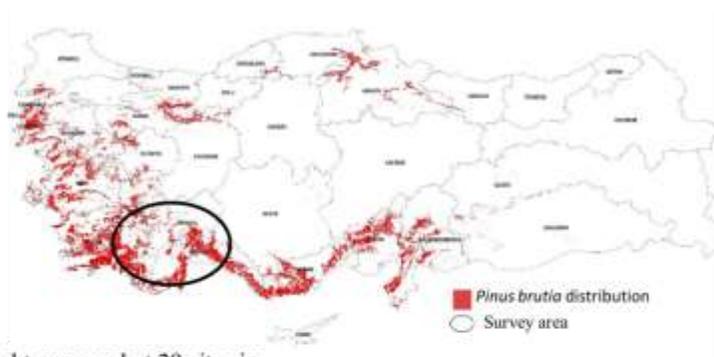
Dothistroma septosporum  
symptoms on  
*Pinus brutia*  
2013 (A. Lehtijarvi)





- *Pinus brutia* forests
- (Isparta - Burdur, 2013)



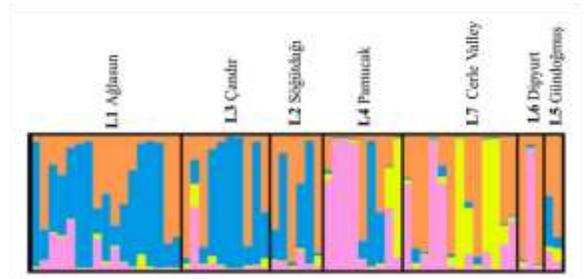
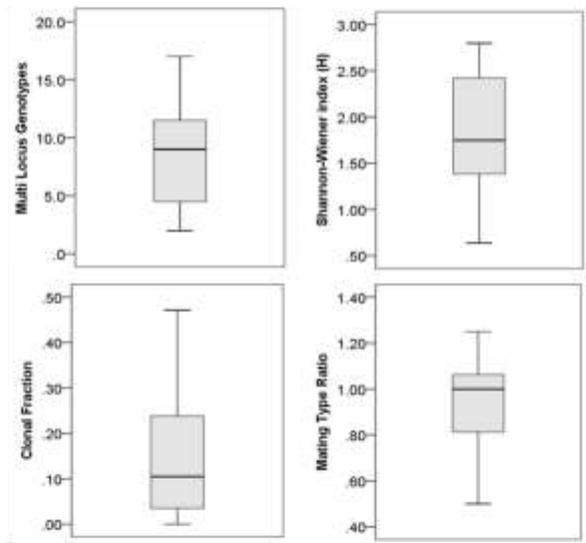


Dothistroma needle blight surveyed at 29 sites in south western Turkey. Infections confirmed at 18 sites. Caused solely by *Dothistroma septosporum*.



View of sites with severe *Dothistroma* needle blight infections  
12/07/2025

The first analysis of *Dothistroma septosporum* populations in Turkey, in a region with a Mediterranean climate.



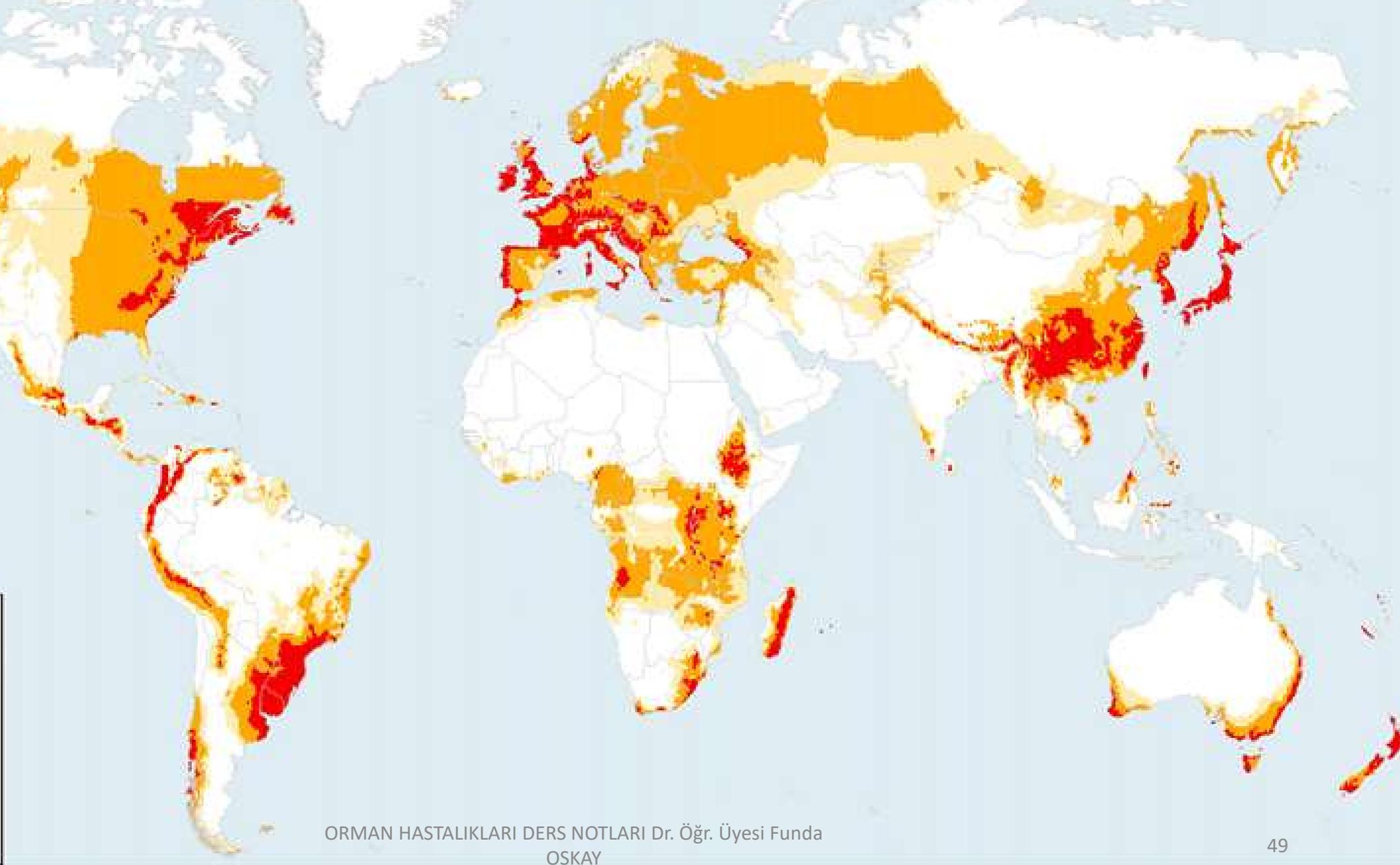
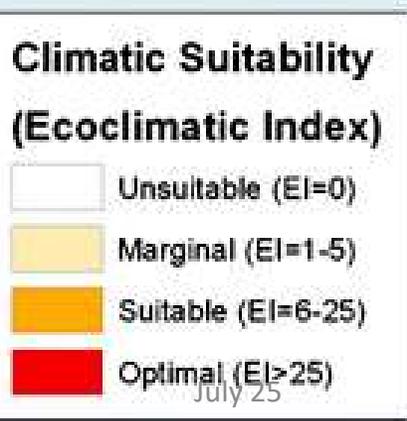
Genetic diversity and population structure across 7 locations

## Distribution and genetic diversity of *Dothistroma septosporum* in *Pinus brutia* forests of south-western Turkey

Funda Oskay<sup>1</sup> | Zeynep Tunalı<sup>2</sup> | Asko T. Lehtijärvi<sup>3</sup> | Hatice Tuğba Doğmuş-Lehtijärvi<sup>4</sup> | Steve Woodward<sup>5</sup> | Martin Mullett<sup>6,7</sup>

*Dothistroma septosporum*, the causal agent of Dothistroma needle blight, is wide spread especially in young *Pinus brutia* forests of south western Turkey with well established populations exhibiting **high genetic diversity** and clear population clusters.

Global ecoclimatic suitability for *Dothistroma* spp. under the 1961–1990 climate normals, as modelled using CLIMEX (Watt et al 2009).



# How to Identify?

## Morphological

- Red-orange bands
- Black fruting bodies
- spores



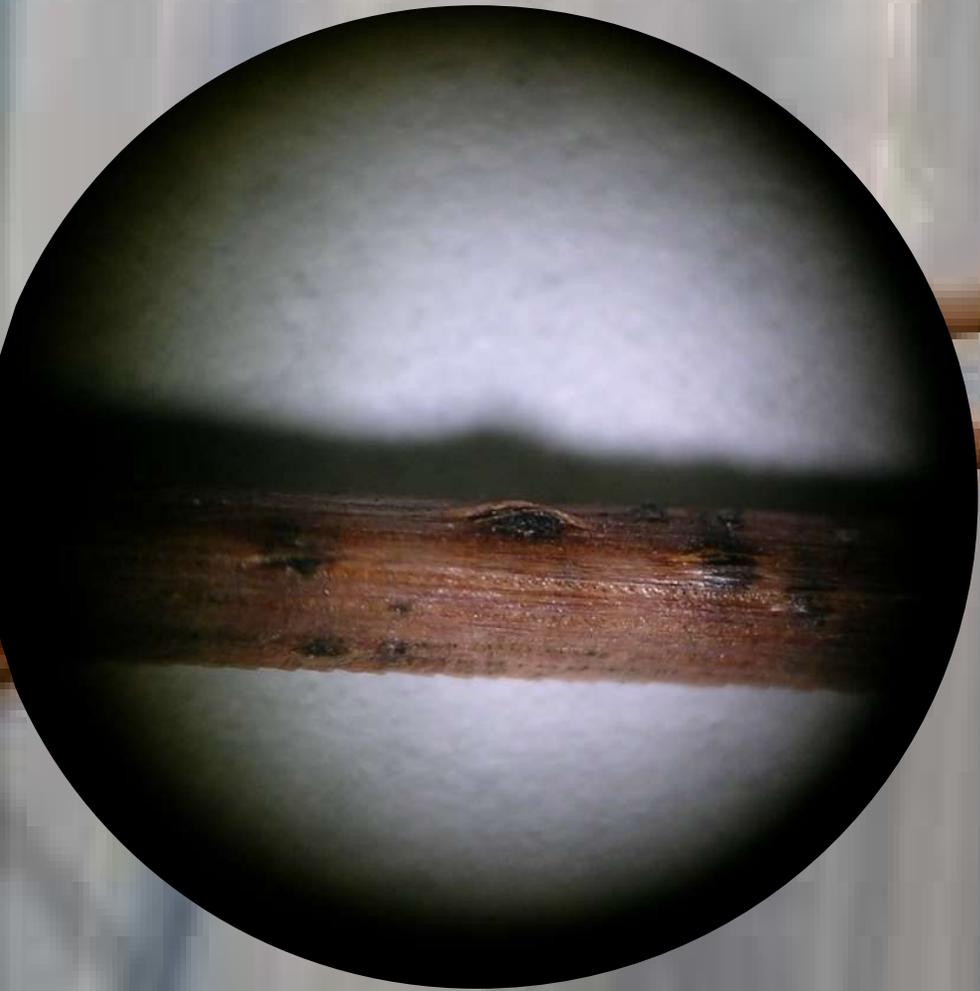
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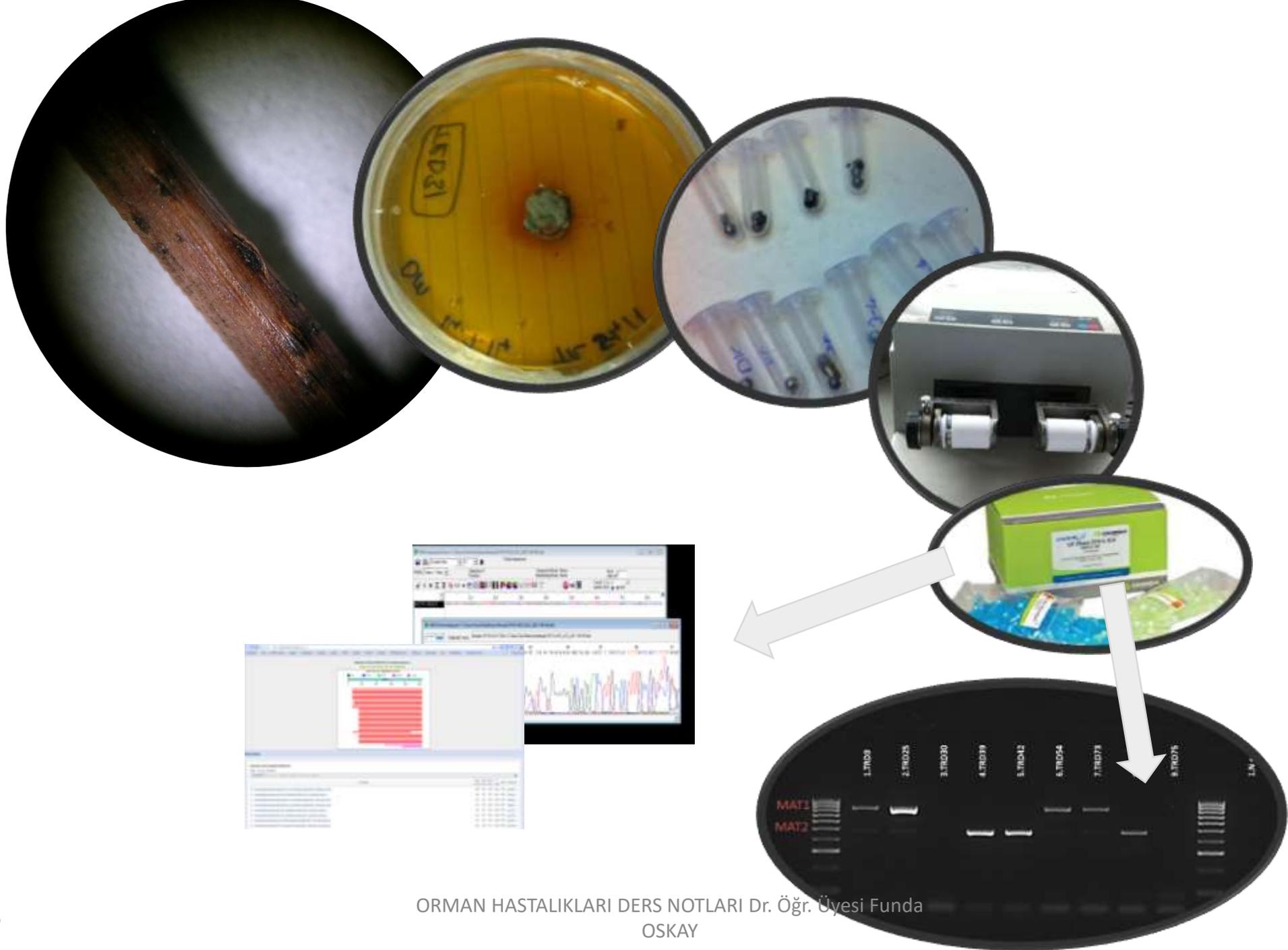


## MOLECULAR

- ✓ Fast
- ✓ Reliable

- D. pini vs. D. septosporum can not be separated via morphology
- DNA sequencing
- cPCR with species-specific primers
- qPCR







DNA extraction from needles



cPCR



Visualization of PCR products  
And scoring based on the presence of  
bands of species specific sizes

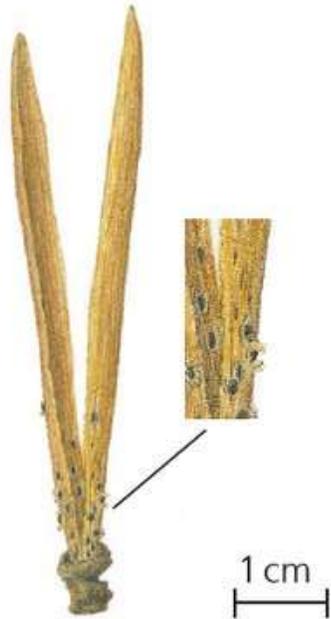




## Shoot or tip blight and dieback diseases of conifers

- *Diplodia* pine tip/shoot blight (*Diplodia sapinea*)
- *Cenangium* dieback (*Cenangium ferruginosum*)
- *Scleroderris* dieback / *Brunchorstia* dieback (*Gremeniella abietina*)
- Snow blight (*Gremmenia infestans*)
- Black snow mould (*Herpotrichia pinetorum*)
- *Sydowia* dieback of pine (*Sydowia polyspora*)

# Tip/shoot blight (*Diplodia sapinea*)



- *Diplodia sapinea* (syn. *Sphaeropsis sapinea*) is one of the most common diseases afflicting pine trees worldwide.
- Conifers from other genera (e.g. *Picea*, *Abies*, *Cedrus*, *Larix*, *Pseudotsuga*) can also be affected.
- outbreaks of the disease in accross Europe is related to
  - Drought--hot and dry summers
  - severe hail storms



Dynamics of the symptoms development of *D. sapinea* in South-East Estonia in 2014.

July 25

Dr. Funda OSKAY



July 25

Dr. Funda OSKAY

# *D. sapinea* in Arboretum

## Hosts

*P. brutia*, *P. sylvestris*, *P. nigra*, *P. pinea*

*Cedrus libani*

*P. radiata*, *P. teada*, *P. pinaster*, *P. elderica*.....



Atatürk Arboretum, 2017, F. Oskay





*P. brutia* natural regeneration sites (A. Lehtijarvi ,2005).



Young natural *P. brutia* stands infected with *D. sapinea* and *Dothistroma septosporum* (A. Lehtijarvi, 2013).



*Pinus sylvestris* tohum bahçesi



*Pinus nigra* tohum bahçesi  
Izmit, Kerpe, FO, 2012



*Pinus nigra*



## Occurrence and Genetic Similarity of *Diplodia pinea* on Shoots and Cones in Seed Orchards of *Pinus* spp. in North-Western Turkey

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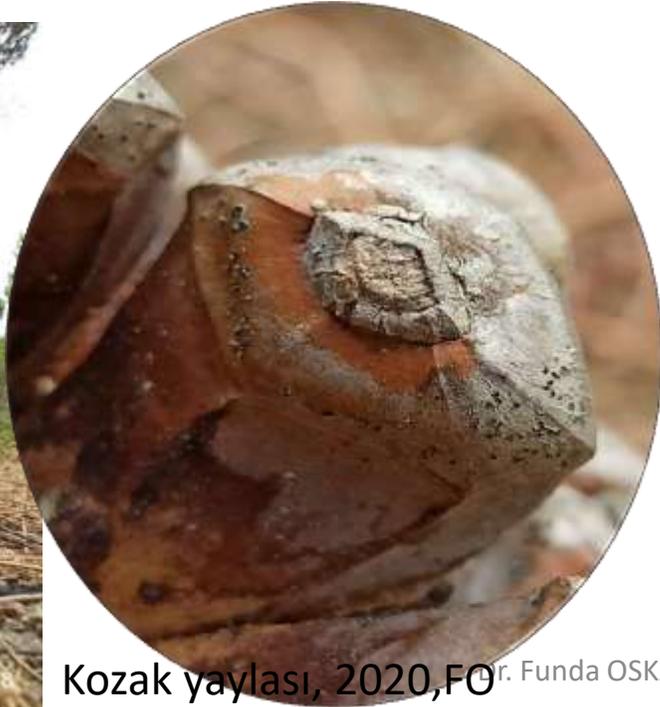
Citation: Aday Kaya A.G., Yeltekin S., Doğmuş Lehtijärvi T., Lehtijärvi A., Woodward S. (2019) Severity of *Diplodia* shoot blight (caused by *Diplodia sapinea*) was greatest on *Pinus sylvestris* and *Pinus nigra* in a plantation containing five pine species. *Phytopathologia Mediterranea* 58(2): 249-259. doi: 10.14801/Phytopathol\_Mediterr-10813

Research Papers

Severity of *Diplodia* shoot blight (caused by *Diplodia sapinea*) was greatest on *Pinus sylvestris* and *Pinus nigra* in a plantation containing five pine species

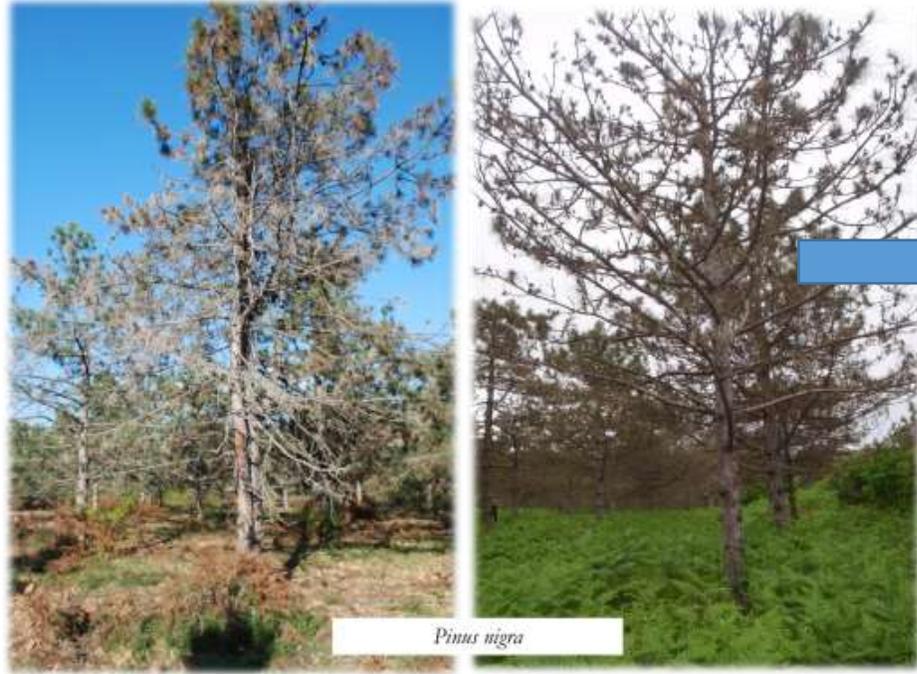
AYŞE GÜLDEN ADAY KAYA<sup>1,4</sup>, ŞULE YELTEKİN<sup>1</sup>, TUĞBA DOĞMUŞ LEHTIJÄRVI<sup>1</sup>, ASKO LEHTIJÄRVI<sup>1</sup>, STEVE WOODWARD<sup>1</sup>

Bursa OBM, Ö. Arıcı, 2020

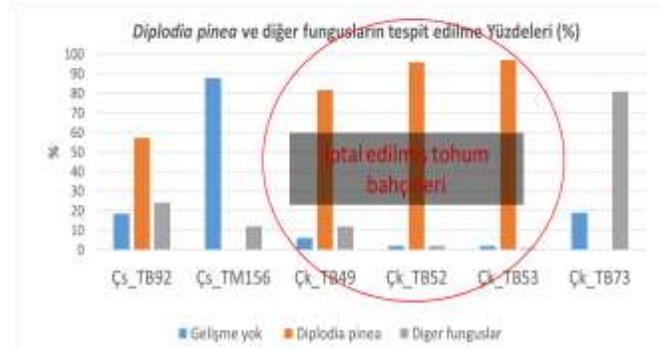
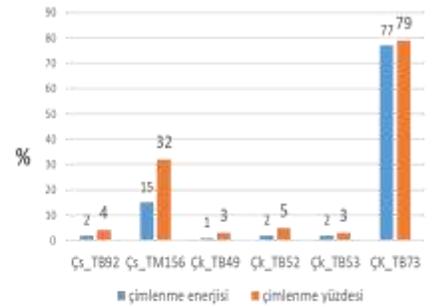
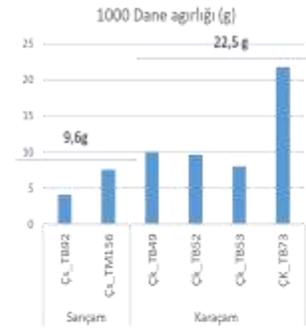
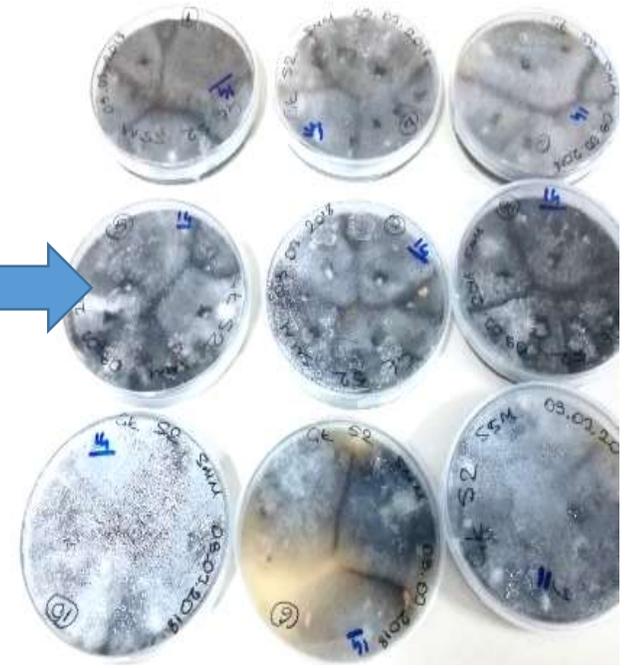


Kozak yaylası, 2020, FO r. Funda OSKAY

# Infected seed orchards



*Pinus nigra*



İstanbul URL1; 2017)



July 25

Dr. Funda OSKAY

Şanlı Urfa URL2; 2018)

63



First report of *Diplodia sapinea* on *Cedrus libani* in Turkey

F. Oskay<sup>1</sup>, A. Lehtijärvi<sup>2</sup>, H.T. Dogmuş-Lehtijärvi<sup>3</sup> and S. Woodward<sup>4</sup>



# Cypress canker

## *Seiridium cardinale*

- Invasive alien species
- Can kill seedlings in nurseries and mature trees
- The disease is transmitted at long distances via the use of infected seedlings



## Lesion and resinosis

Mitospores (conidia)



Cypress dieback and mortality



Asexual fruiting produced  
**ONLY ON LIVE TISSUE**



Topkapi palace, Istanbul



8.05.2019, Italy, FOskay

Orman Hastalıkları Dr. Öğr. Üyesi



8.05.2019, Italy, FOskay

# Globalization and climate change

- climate extremes,
- global trade,
- failure to implement proper quarantine measures have been commonly considered as essential factors exacerbating the spread of invasive plant pathogens
- most of the introductions happen via the trade of live plants –plants for planting- especially the ornamental plants thus occurs in urban areas
  
- Frequent and continuous occurrence of Draught and heat waves as stress factors (predisposing trees)
- Climate extremes such as warmer winters
- Triggering outbreaks of native or established pests

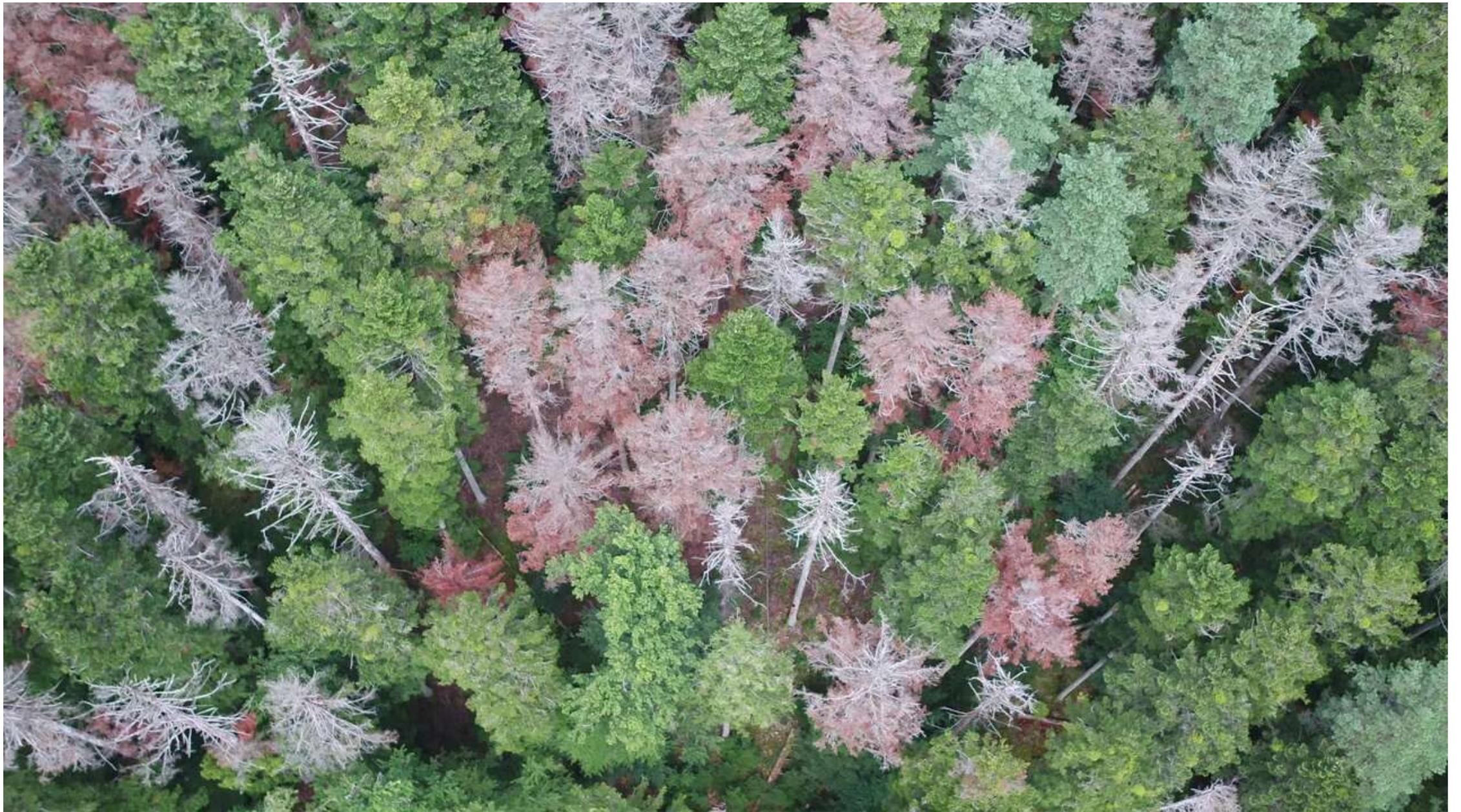


Dead  
conifers in  
a forest  
near  
Königshain,  
Germany.  
Policies and  
tradition  
often  
discourage  
leaving  
dead trees  
in place

FLORIAN GAERTNER/PHOTOTHEK VIA GETTY IMAGES

[Germany's trees are dying. A fierce debate has broken out over how to respond | Science | AAAS](https://doi.org/10.1126/science.acx9733)

<https://doi.org/10.1126/science.acx9733>



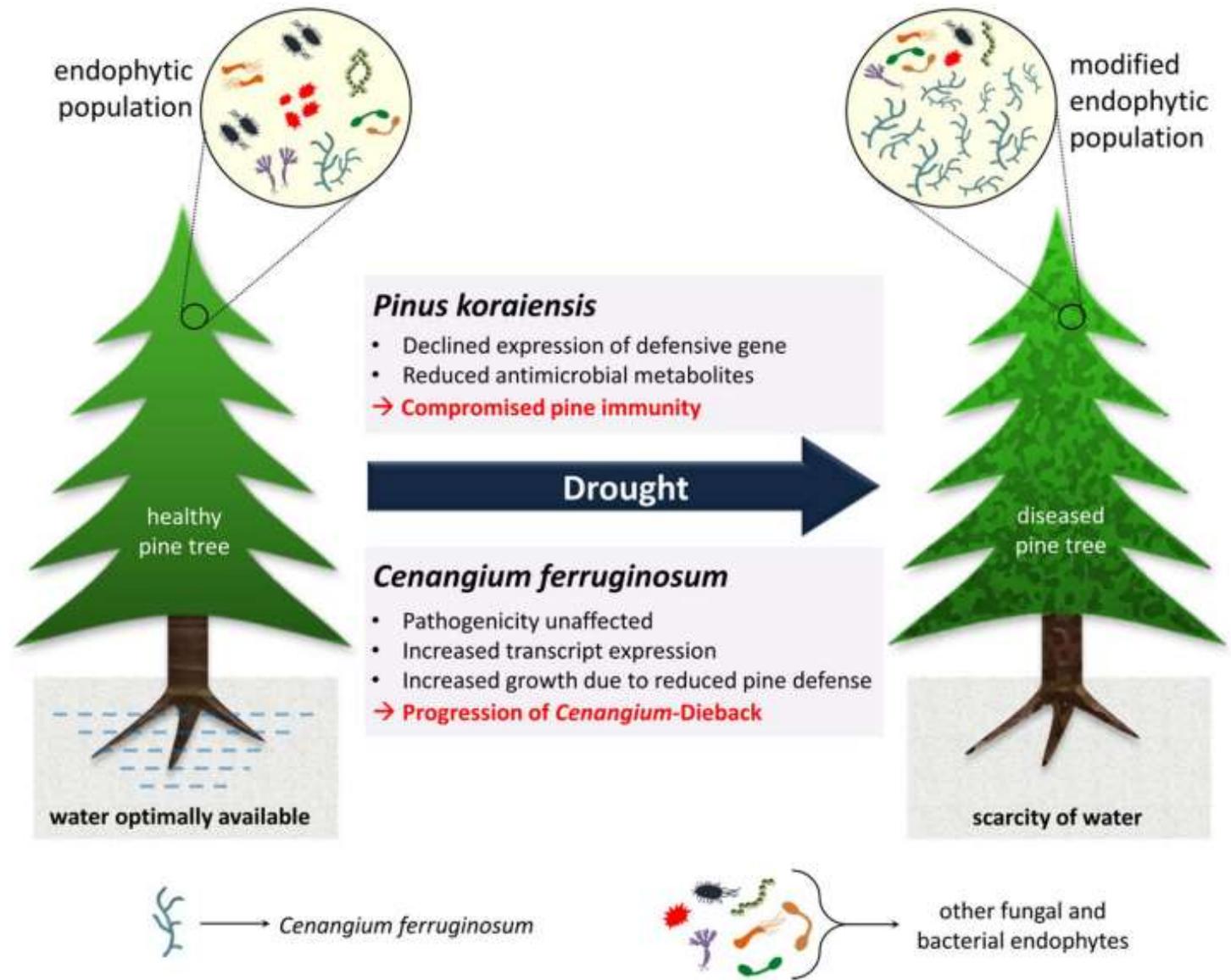
Damaged and dead silver firs in the drone aerial photo (Photo: FVA BW/Riemer)

<https://www.fva-bw.de/top-meta-navigation/fachabteilungen/waldschutz>

**OPEN** Drought-induced susceptibility for *Cenangium ferruginosum* leads to progression of *Cenangium*-dieback disease in *Pinus koraiensis*

Received: 3 April 2018  
Accepted: 15 October 2018  
Published online: 06 November 2018

Minji Park<sup>1</sup>, Ratnech Chandra Mishra<sup>2</sup>, Junhyun Jeon<sup>1</sup>, Sun Keun Lee<sup>2</sup> & Hanhono Bae<sup>1</sup>



**Figure 8.** Summary of the mechanism of drought-induced susceptibility for *Cenangium ferruginosum* in *Pinus koraiensis*.



## Drought in the forest breaks plant–fungi interactions

Andrzej Boczoń<sup>1</sup> · Dorota Hilszczańska<sup>1</sup> · Marta Wrzosek<sup>2</sup> · Andrzej Szczepkowski<sup>3</sup> · Zbigniew Sierota<sup>4</sup>

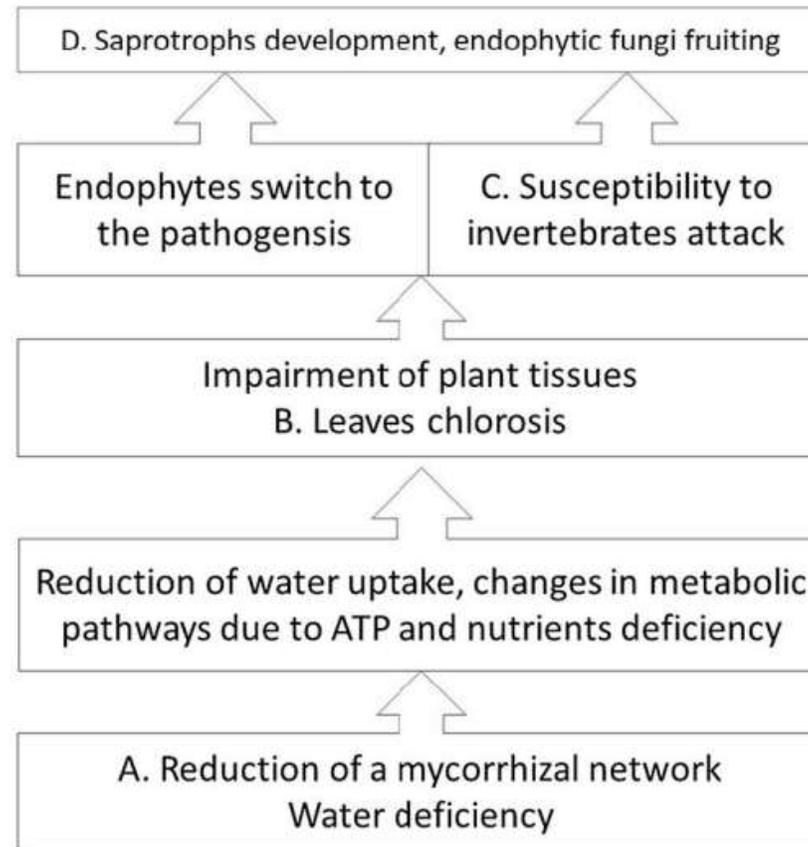
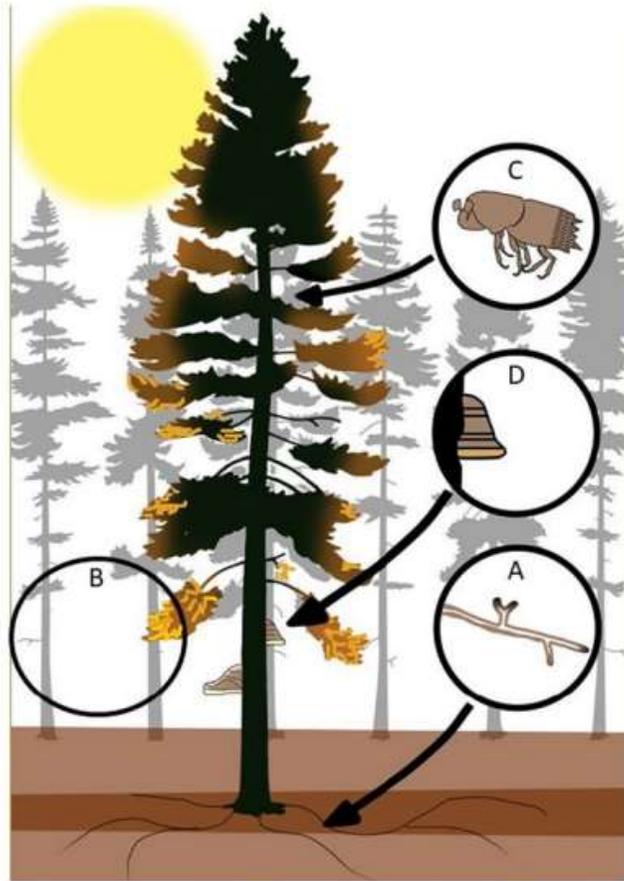


Diagram showing the order of changes in the health condition of trees in drought conditions (drawing: M. Wrzosek)



- Numerous apothecia of *Cenangium ferruginosum* on a branch of a dead *Pinus sylvestris* previously weakened by drought (Photo: A. Szczepkowski); b-*Pleurotus abieticola* basidiomata occurring on standing spruce after drought and infestation by spruce bark beetles, Tatrzański National Park, 2019 (Photo: M. Wrzosek); c-crown of *Pinus mugo* growing in water deficiency and infected by *Sphaeropsis sapinea* (Photo: A. Szczepkowski), d-droughted Scots pines with numerous **mistletoe** in the crown (Photo: courtesy by K. Nowik).



<https://gd.eppo.int>



*Agrilus planipennis* (AGRLPL) - <https://gd.eppo.int>



Monoculture is the main reason why Dutch elm disease has been so devastating in our towns and cities. The pathogens can move between closely spaced trees via insect vectors or root grafts, leaving devastation in their wake. The Dutch elm disease epidemics illustrate the value of diversity in plant populations including in urban environments

- Elm-lined streets before and after Dutch Elm disease (<https://ferrebeekeeper.wordpress.com/tag/elm/>)

EPPO A1 pests are absent from the EPPO region	A2 pests are locally present in the EPPO region	EPPO Alert List (last updated in 2017-08)
<b>Fungi</b>		
1 <i>Alternaria mali</i>	1 <i>Botryosphaeria laricina</i>	1 <i>Neonectria neomacrospora</i>
2 <i>Anisogramma anomala</i>	2 <i>Ceratocystis platani</i>	2 <i>Raffaelea lauricola</i> (laurel wilt)
3 <i>Apiosporina morbosa</i>	3 <i>Ciborinia camelliae</i>	3 <i>Sirococcus tsugae</i>
4 <i>Atropellis pinicola</i>	4 <i>Cronartium kamschaticum</i>	4 <i>Thekopsora minima</i> (blueberry leaf rust)
5 <i>Atropellis piniphila</i>	5 <i>Cryphonectria parasitica</i>	
6 <i>Ceratocystis fagacearum</i>	6 <i>Diaporthe vaccinii</i>	
7 <i>Chrysomyxa arctostaphyli</i>	7 <i>Fusarium circinatum</i>	
8 <i>Coniferiporia weirii</i>	8 <i>Fusarium foetens</i>	
9 <i>Cronartium coleosporioides</i>	9 <i>Fusarium oxysporum</i> f.sp. <i>albedinis</i>	
10 <i>Cronartium comandrae</i>	10 <i>Geosmithia morbida</i> and its vector ( <i>Pityophthorus juglandis</i> )	
11 <i>Cronartium comptoniae</i>	11 <i>Glomerella gossypii</i>	
12 <i>Cronartium fusiforme</i>	12 <i>Gymnosporangium asiaticum</i>	
13 <i>Cronartium himalayense</i>	13 <i>Heterobasidion irregulare</i>	
14 <i>Cronartium quercuum</i>	14 <i>Lecanosticta acicola</i>	
15 <i>Endocronartium harknessii</i>	15 <i>Melampsora medusae</i>	
16 <i>Gymnosporangium clavipes</i>	16 <i>Monilinia fructicola</i>	
17 <i>Gymnosporangium globosum</i>	17 <i>Phialophora cinerescens</i>	
18 <i>Gymnosporangium juniperi-virginianae</i>	18 <i>Phytophthora fragariae</i>	
19 <i>Gymnosporangium yamadae</i>	19 <i>Phytophthora kernoviae</i>	
20 <i>Melampsora farlowii</i>	20 <i>Phytophthora lateralis</i>	
21 <i>Mycosphaerella gibsonii</i>	21 <i>Phytophthora ramorum</i>	
22 <i>Mycosphaerella laricis-leptolepidis</i>	22 <i>Phytophthora rubi</i>	
23 <i>Ophiognomonia (Sirococcus) clavignenti-juglandacearum</i>	23 <i>Plenodomus tracheiphilus</i>	
24 <i>Ophiostoma wagneri</i>	24 <i>Puccinia hemerocallidis</i>	
25 <i>Phyllosticta citricarpa</i>	25 <i>Puccinia horiana</i>	
26 <i>Phyllosticta solitaria</i>	26 <i>Stagonosporopsis chrysanthemi</i>	
27 <i>Phymatotrichopsis omnivora</i>	27 <i>Stenocarpella macrospora</i>	
28 <i>Pseudocercospora angolensis</i>	28 <i>Stenocarpella maydis</i>	
29 <i>Puccinia pittieriana</i>	29 <i>Synchytrium endobioticum</i>	
30 <i>Septoria malagutii</i>	30 <i>Verticillium albo-atrum</i> (hop-infecting strains)	
31 <i>Sphaerulina musiva</i>	31 <i>Verticillium dahliae</i> (hop-infecting strains)	
32 <i>Stagonosporopsis andigena</i>		
33 <i>Stegophora ulmea</i>		
34 <i>Thecaphora solani</i>		
35 <i>Tilletia indica</i>		

83 %

100 %

61%

Forest pathogens %

- EPPO A1 and A2 Lists of pests recommended for regulation as quarantine pests





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Thank you for  
your attention!

Any  
questions?

2020/7/9 18:56