Emergent diseases threatening California ecosystems

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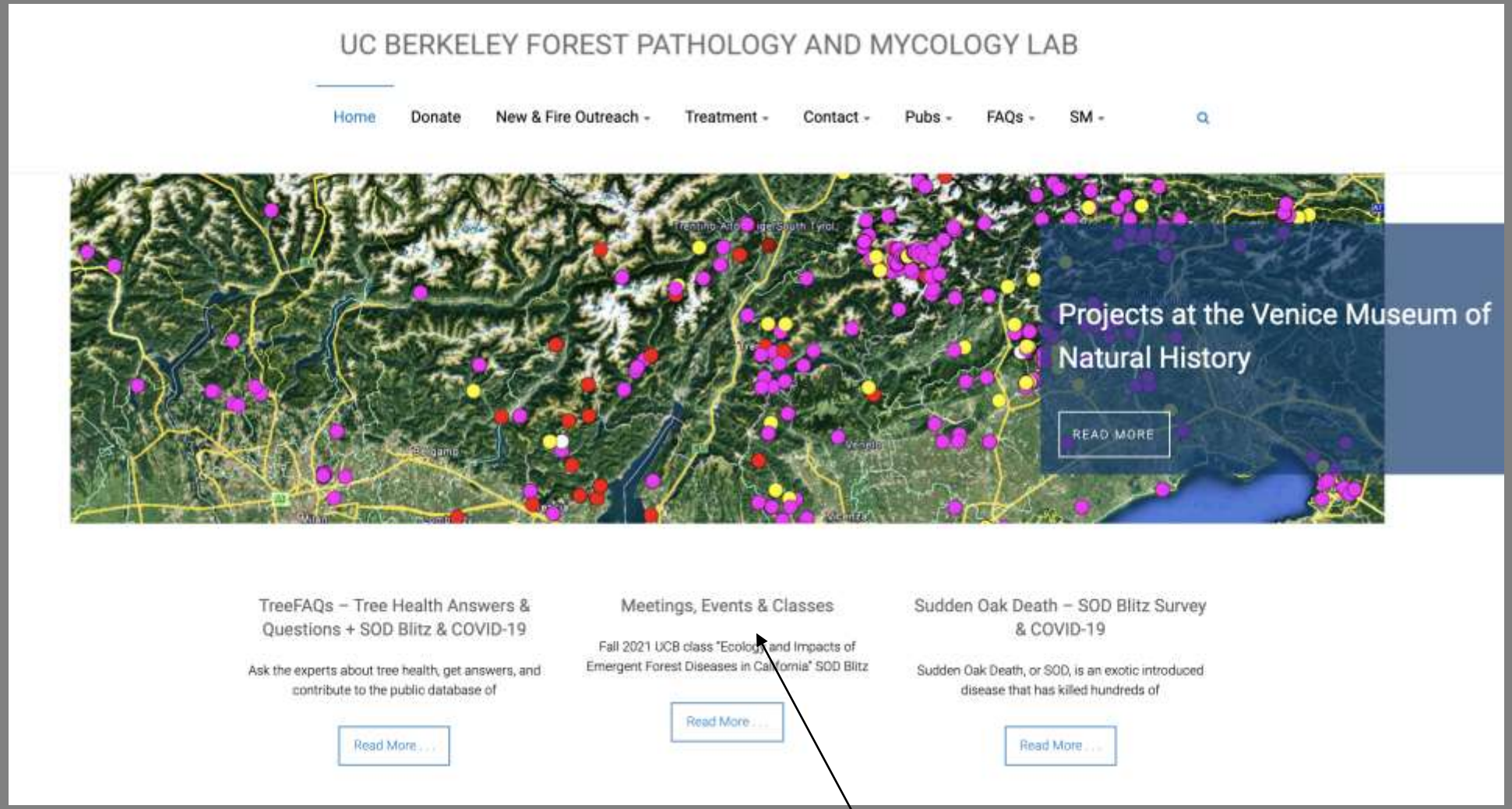
matteolab.org



UC BERKELEY FOREST PATHOLOGY AND MYCOLOGY LAB

Meetings, Events & Classes

- Fall 2021 UCB class "Ecology and Impacts of Emergent Forest Diseases in California"
- SOD Blitz Survey Spring 2021 – Special Guidelines
- Spring 2021 ESPM Colloquium
- SOD Blitz 2020 Results Online Meeting Thurs 11/12/20 6pm
- ESPM 150/290 Class Fall 2020 – Ecology and Impacts of Emergent Forest Diseases in California
- SOD Blitz Landing Page sodblitz.org

Fire Recovery Guide

ESPM 150/290 Fall 2021

Ecology & Impacts of Emergent Forest Diseases in California

The course is organized in 8 parts

1- Part1: Introduction to tree diseases and their causal agents
2- Part2: Ecology of forest diseases, differences between native and non-native diseases
3- Part3: Principles of Biological Invasions and diseases caused by off-site hosts or by forestry practices
4- Part4: Emergent diseases in California caused by exotic fungi
5- Part5: Emergent diseases in California caused by exotic oomycetes
6- Part6: Newest threats
7- Part7: Molecular diagnostics in Forest Pathology
8- Part8: Pest Risk Assessment: modeling, predictions, laws and regulations

Class Schedule

▾ More

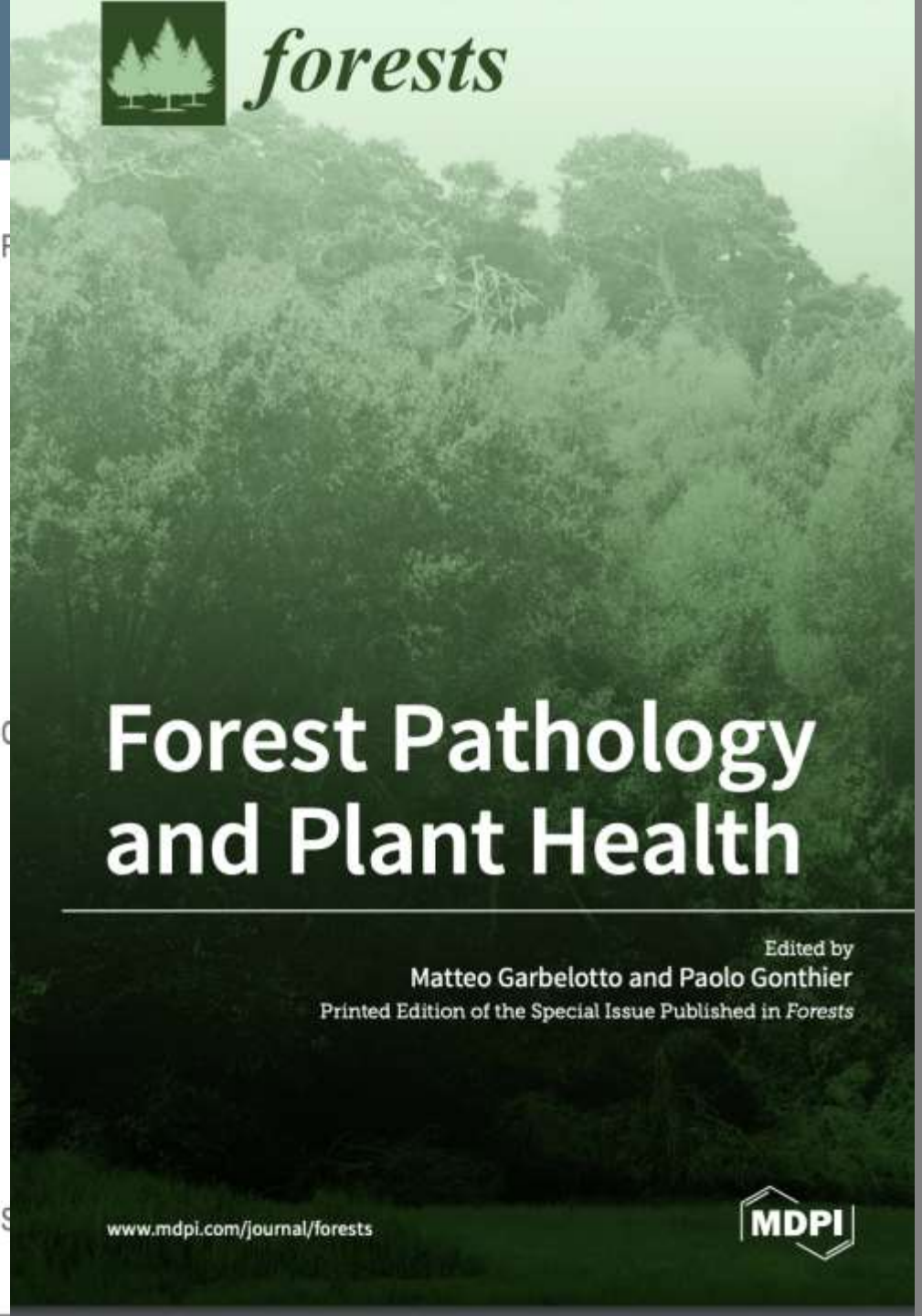
Zoom Recordings

▾ More

Recommended Readings

▾ More

PowerPoint Lectures



Disease: injurious physiological activity caused by the **continuous (prolonged)** irritation by a primary causal factor and expressed in characteristic pathological conditions called **symptoms**

Disease: any disturbance of a plant that interferes with its normal, structure, function or economic value

Disease= reduction in:

- Biomass (Production)
- Life span
- Reproductive potential
- Biological associations (e.g. mycorrhizae)

Effects of diseases on host mortality, growth and reproduction

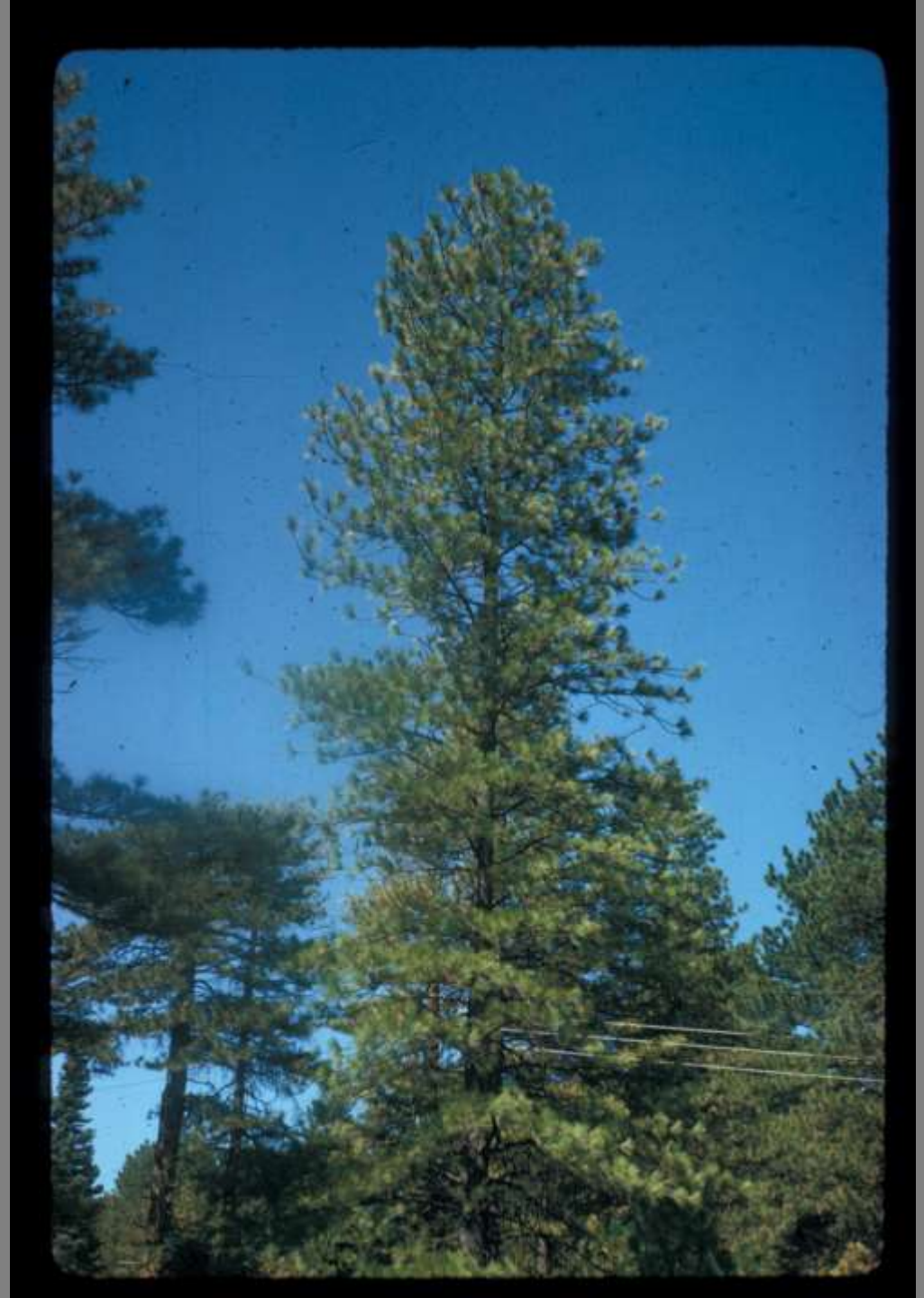
- Young plants killed before reaching reproductive age
- Affect reproductive output
- Directly affect flowers and fruits

Symptoms vs. Signs

- Symptoms= a change in the normal appearance of a plant, e.g. reduced (stunted) growth or yellowing of foliage (chlorosis) or wilting of foliage, or seeping on the bark

- Signs= any visible structure produced by the pathogen: fruiting bodies, spore masses, rhizomorphs, mycelial fans

Symptoms vs. Signs



Disease metrics

- Disease incidence: how many individuals (%) are infected and have the disease

- Disease severity: how severe are the symptoms, for instance for a foliar disease, what % of leaves are infected

Types of disease: biotic vs. abiotic or..

- **Infectious (biotic): a disease that is caused by a pathogen which can spread from a diseased to a healthy host.**

- **Non-infectious: a disease that is caused by an environmental (abiotic) or host factor (genetic). It is not spread between a diseased and healthy individual.**

1)-Primary agent= clearly a disease agent, responsible for disease symptoms and/or mortality

ABIOTIC= environmental factor
BIOTIC (incl. VIRUSES)=pathogen

2)-Multiple factors with no specific one being singly responsible for disease/mortality, often biotic + abiotic = **syndrome**

Note that determining causality is much more complex than simple association. In Plant Pathology we use “Koch’s postulate” to prove causality.

3)- Secondary or opportunistic pathogens:

They may appear to kill hosts, but these are pathogens that can only infect hosts whose health is severely compromised by a primary pathogen or by unfavorable environmental condition

4)- Latent pathogens, these have already infected their hosts but are normally beneficial or neutral until a “stressor” triggers their pathogenicity

In plants, we believe these to be mostly fungi, but our knowledge is limited.

These latent pathogens can be major players causing massive die offs when environmental conditions change and plants find themselves in difficult situations
Obviously climate change, will cause a massive insurgence of these latent pathogens.


JEKYLL and MR. H
THE TRANSFORMATION
"GREAT GOD! CAN IT BE !!"

Latent pathogens (continued)

- Dr. Jekyll- Mr. Hyde
- Reversal from Hyde to Jekyll may not be possible
- Because these pathogens are already present in the host, disease can be rapid and impossible to curtail
- Climate change by itself may not be enough to kill host, so these are key players
- Previously thought to be relatively rare and associated with off-site plantings, or rare climatic events. Now with climate change these are becoming:

“LATENT PATHOGENS WILL BE MAJOR DRIVERS OF PLANT MORTALITY, RESHASPING THE COMPOSITION AND STRUCTURE (e.g. plant density, size class distribution) OF OUR TERRESTRIAL ECOSYSTEMS”

Matteo Garbelotto

Other major drivers?

Extreme climate change

Urbanization

Pollution

Land use change

Rising sea levels

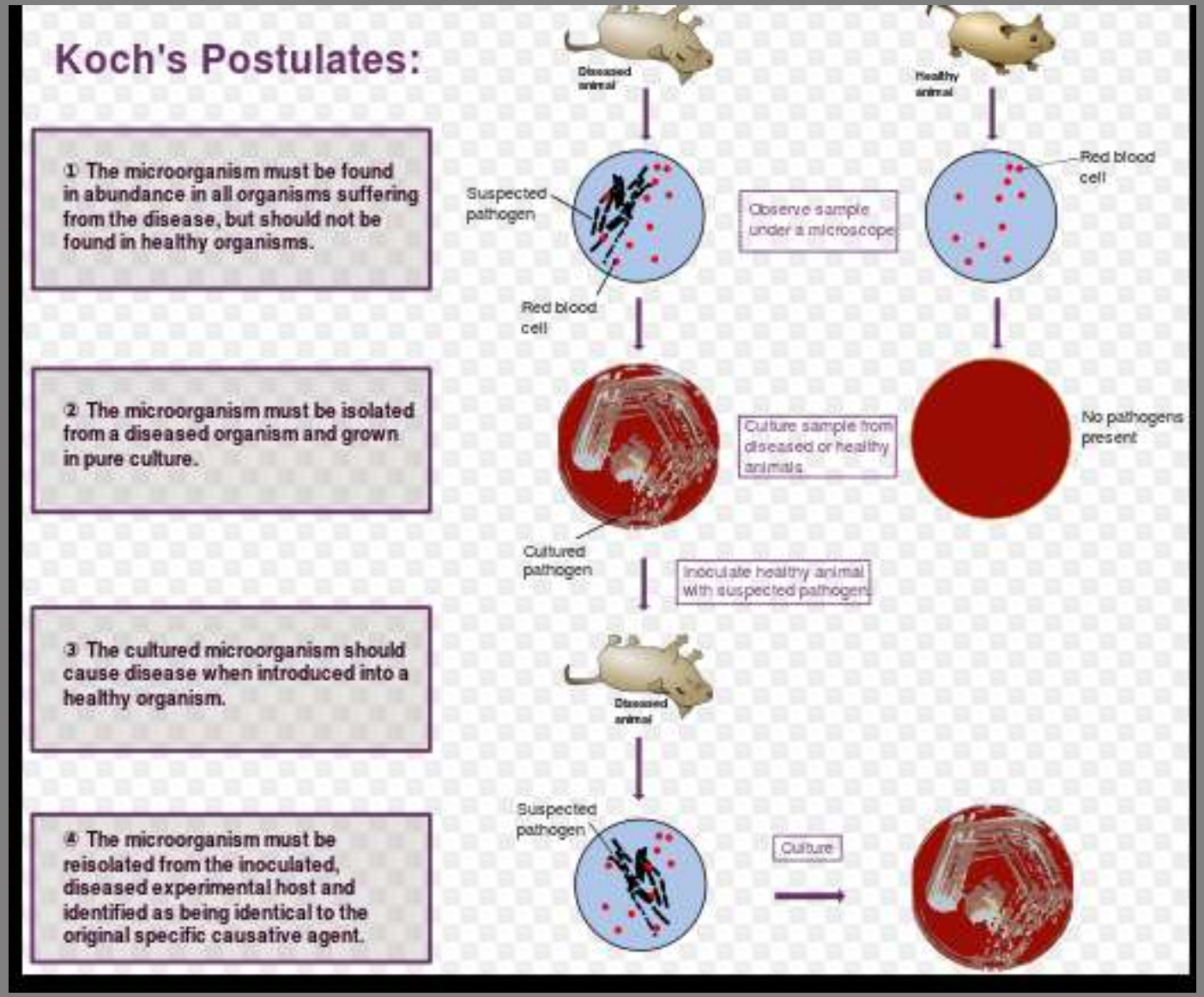
Exotic pathogens

Invasive species

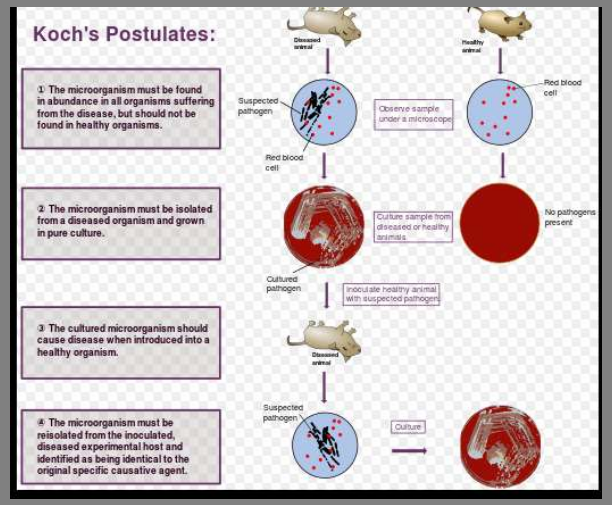
Which one is a disease causal agent, or is what I found simply a contaminant?

Contaminant: a microbe that may be ubiquitous due to its large population size, large propagule pressure and “spilling over” from another host or substrate, or even from a previous and different disease cycle

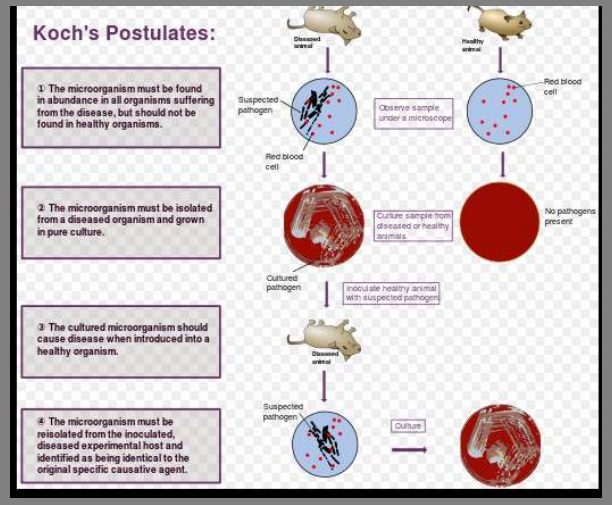
KOCH's POSTULATE



Stressor absent



Stressor present



DISEASE

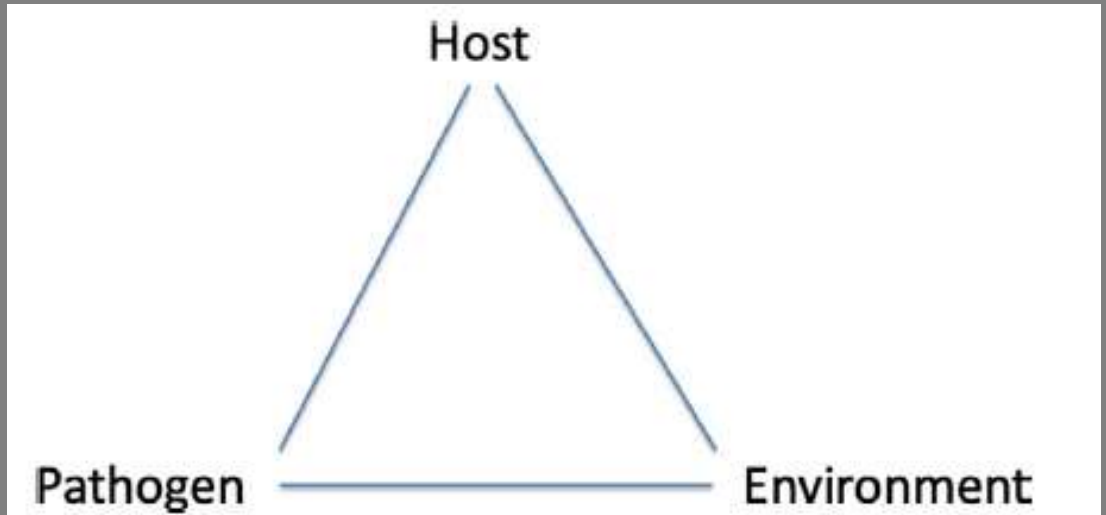
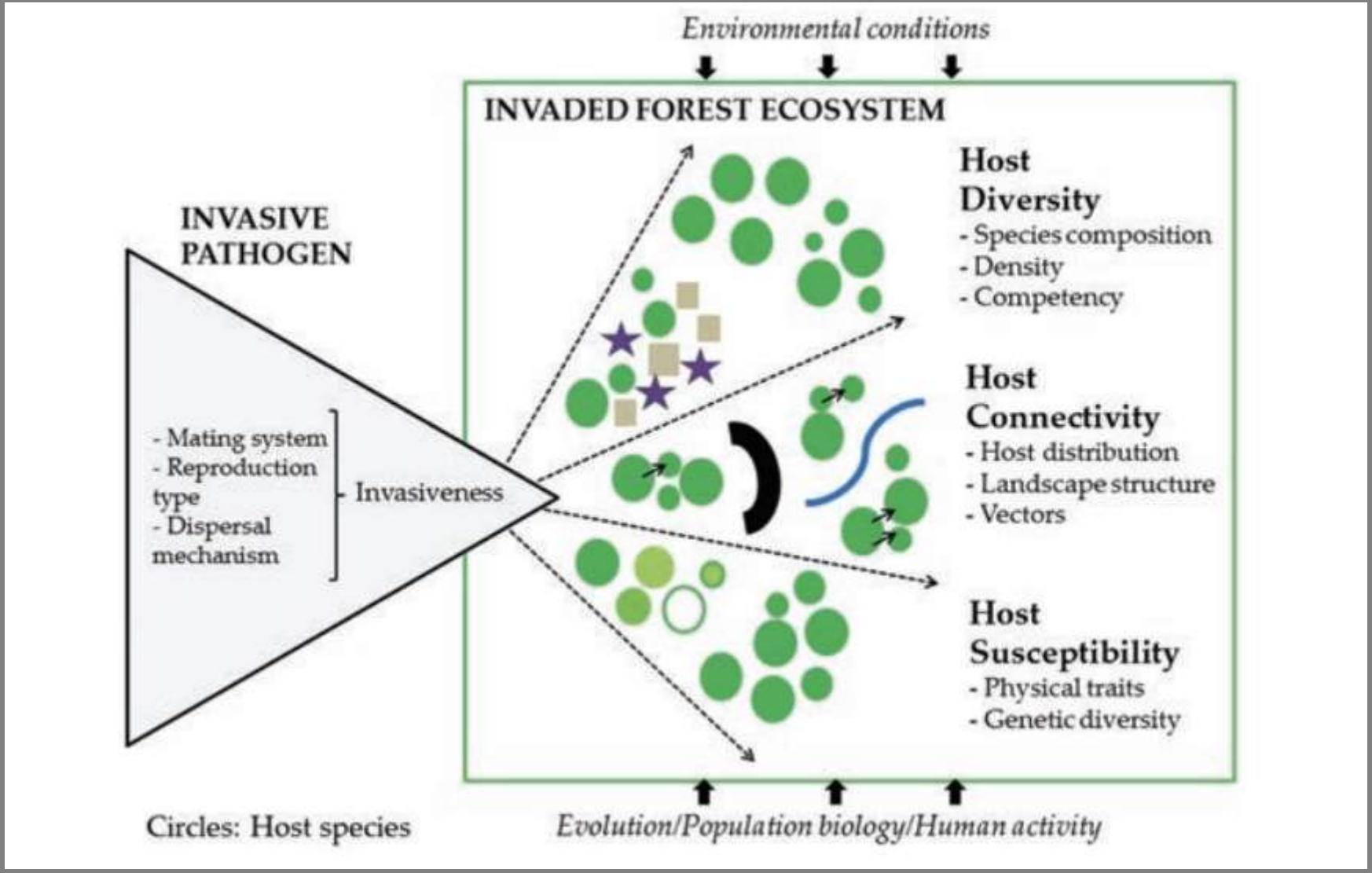


FIGURE 1 The plant disease triangle



Review

Effects of Host Variability on the Spread of Invasive Forest Diseases

Figure 1. Local, regional, and continental-scale factors governing the spread and impact of invasive forest pathogens *post-introduction and establishment* are affected by three main factors: host diversity, host connectivity, and host susceptibility. Following arrival and establishment, invasiveness is inherently affected by organismal traits (mating system, reproduction type, and dispersal mechanisms). ***Host diversity*** is mainly affected by plant species richness (density/composition) creating a dilution effect of pathogen impacts on the ecosystem. Non-hosts, competent hosts, and less competent hosts will have variable effects on their ability to intercept inoculum and subsequently reduce pathogen spread. ***Host connectivity*** is largely influenced by the distribution of available host species; more or less aggregated. Spatial heterogeneity of hosts becomes important for vector-induced pathogens. Variations in landscape structure (topography, natural geographic/environmental barriers, forest fragmentation) will largely influence spread dynamics on the landscape level. ***Host susceptibility*** to invasive pathogens is influenced by physical traits (size, age, morphology), the random presence of other (potentially antagonistic) organisms, environmental and site factors, and host genetic background. Intraspecific genetic diversity (mixtures of host genotypes) offers the best insurance against invasive pathogens through a dilution effect on inoculum production/deposition and the likelihood that some hosts will possess effective mechanisms to resist or minimize damage caused by invasives. Evolutionary and environmental factors, as well as continuous pressures caused by human activity will influence spread dynamics over time. Understanding how host variability is affected by ***host diversity, connectivity***, and ***susceptibility*** will improve our ability to predict disease spread on the landscape and potential consequences to ecosystem services.

Review

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