



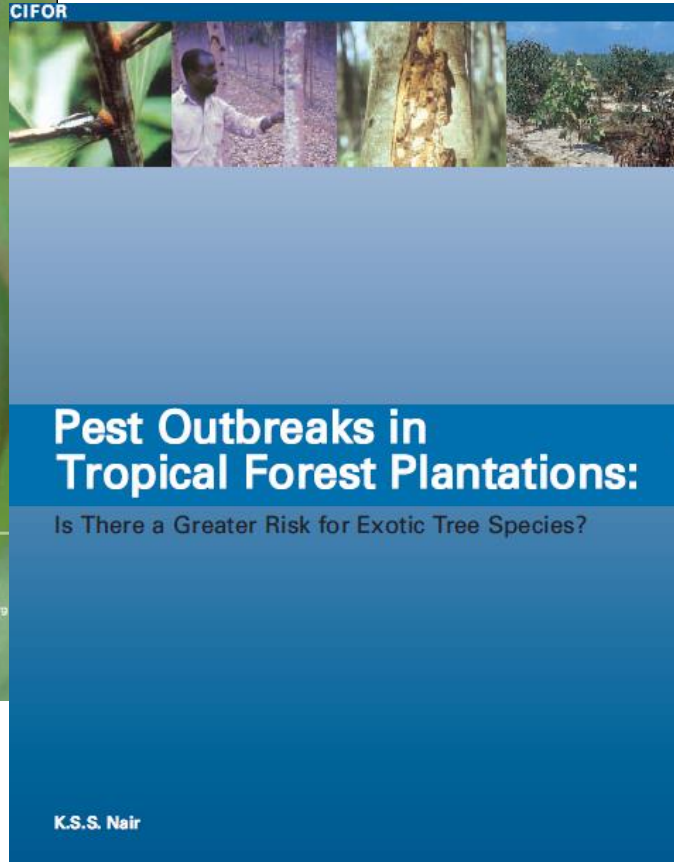
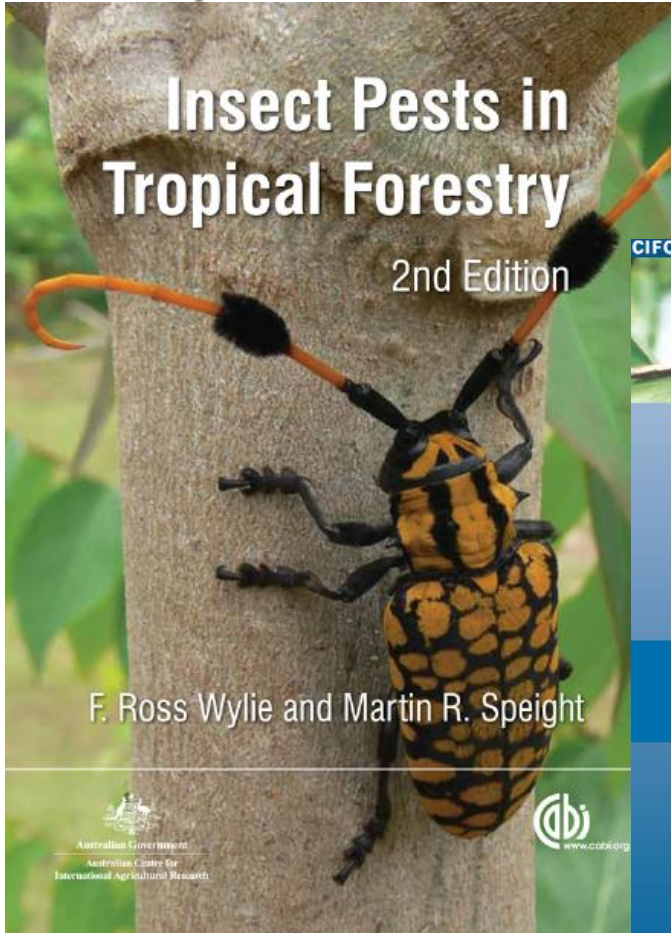
Forest Protection in Tropics and Subtropics

Introduction

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Other Resources



International agencies in FP

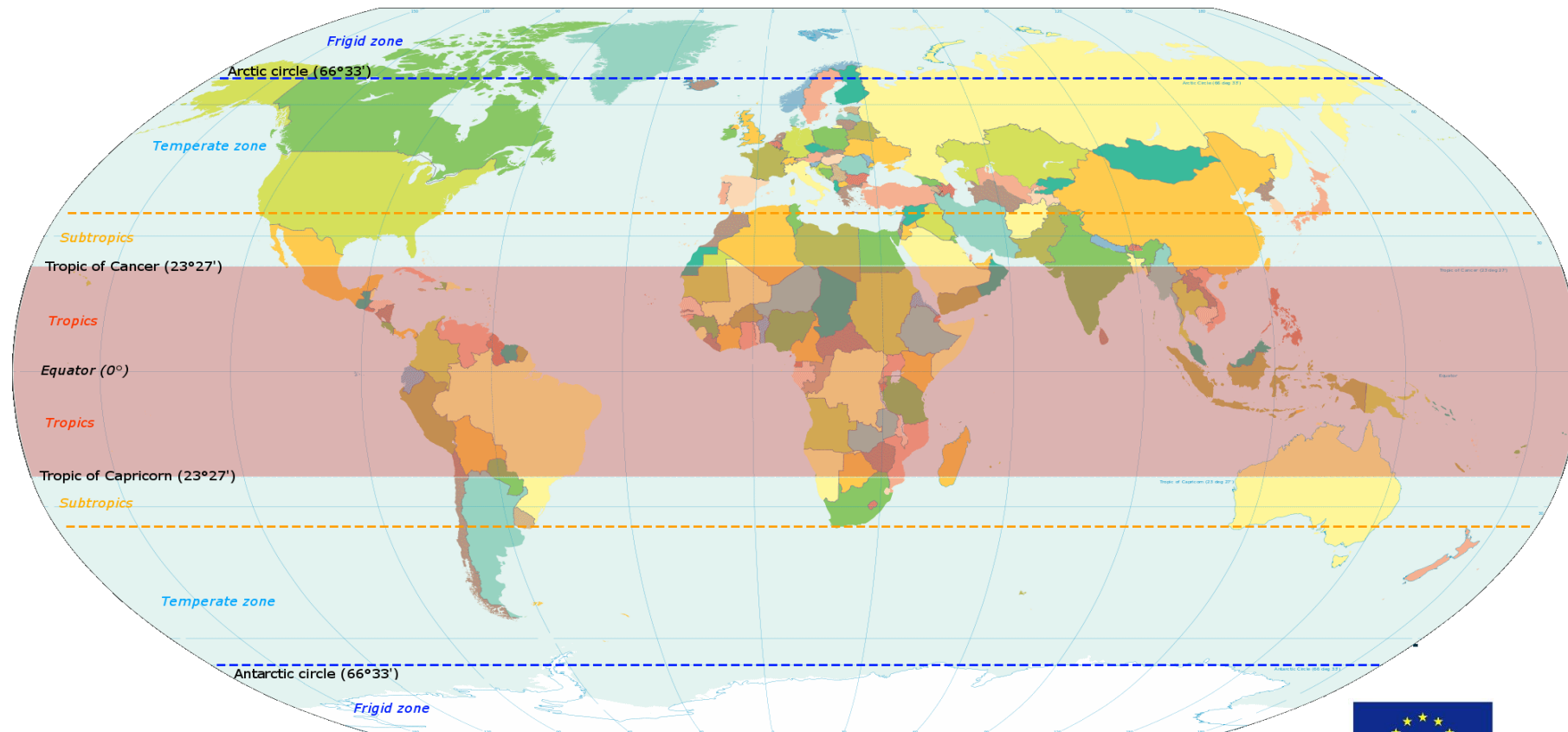
- International Union of Forest Reserach Organisations - IUFRO
- United States Department of Agriculture – Forest Service - USDA-FS
- European and Mediterranean Plant Protection Organisation - EPPO
- Food and Agriculture Organisation - FAO



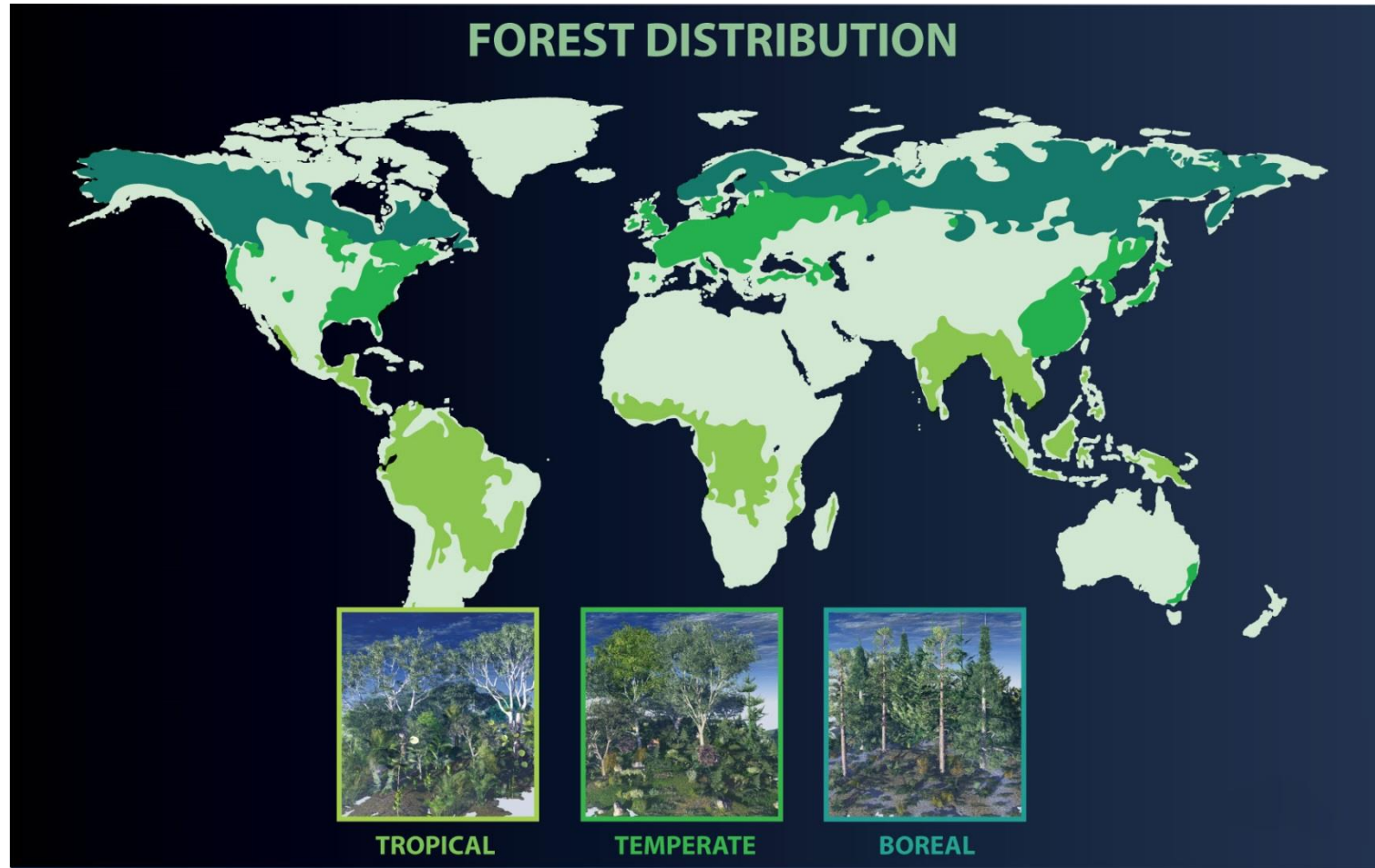
Definition of regions

Tropics – from equator to tropics of Capricorn/Cancer

Subtropics – from tropics of Capricorn/Cancer to approximate 40 latitude

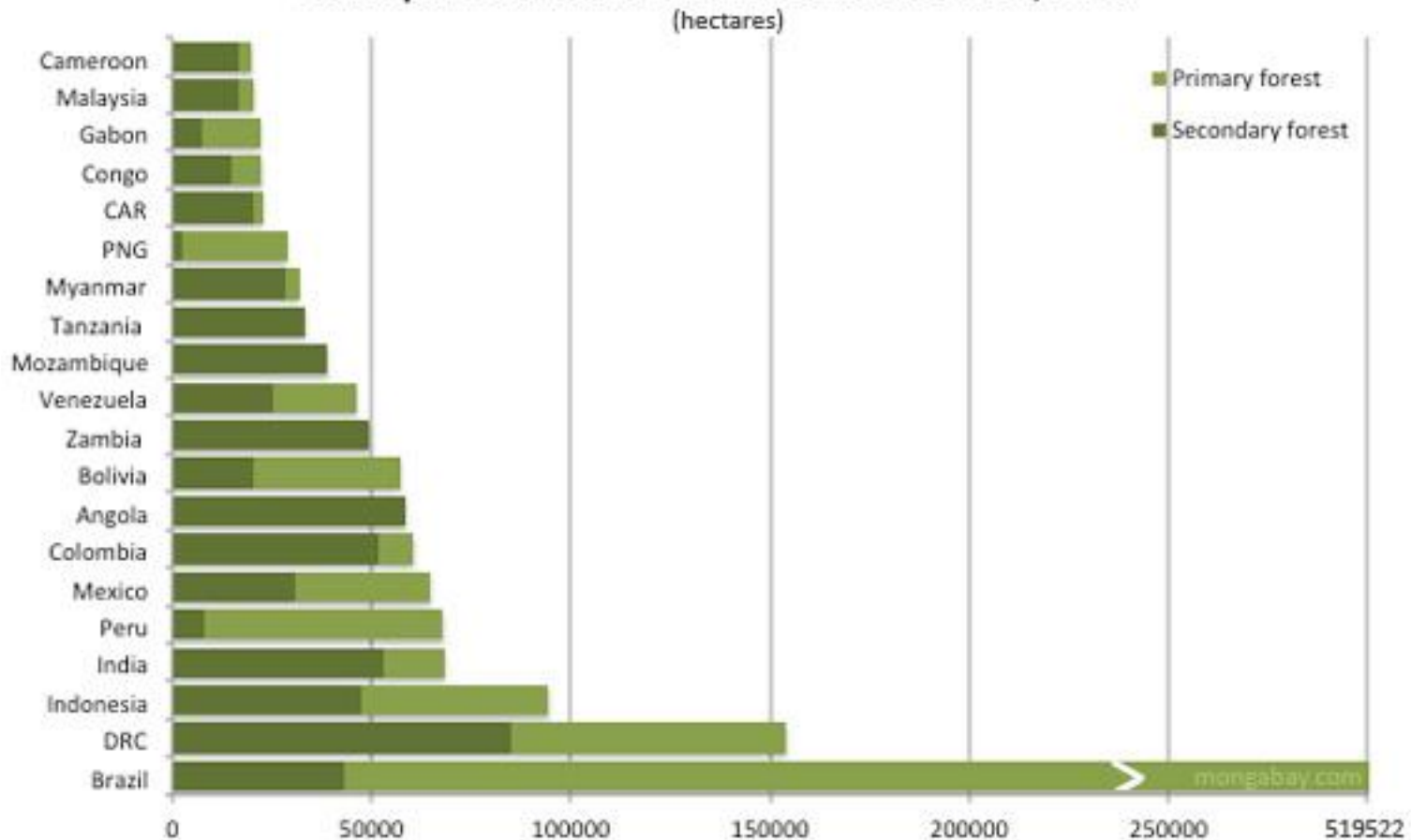


Forest Distribution



Forest cover

20 Tropical Countries with Most Forest Cover, 2010



Angola, Zambia, Mozambique, and Tanzania lack primary forest data. All data from ITTO 2011.



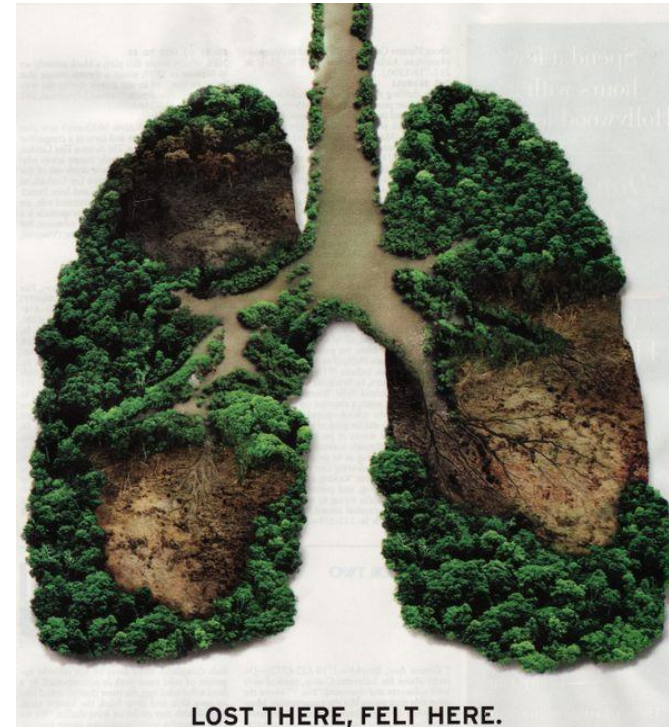
Definition of FP

- The study of the cause, evidence (symptoms), final consequence, and management (preventive and/or post hoc measures) of damage in forests.
- But...the damage of forest might be understood also as natural process which leads to natural ecosystem with tree species composition adapted to local conditions



Theoretical part

- study, define and characterize conditions in which damage is formed
- study individual injurious factors and process of damage in context of ecological conditions, symptoms of damage and definition from the point of injurious factor
- makes forecast (short-time mainly) of possible damage
- is searching for an ecologically acceptable and technologically suitable methods leading to prevention of damage and/or define necessary protection measures



Practical part

- is dealing with survey of pests and with possible traits of their damage
- define preventive and curative treatments which may decrease and or eliminate damage to forest to economically/ecologically acceptable level



Fundamental terms in FP

Stress factor (stressor)



Stress = state of plants in conditions of stressor effect



Stress response = the stress impact before the evident damage occurs

Injury ↓ the result of strong stress effect, beyond the possibility of compensation by repairing mechanisms of plants without structure change (causes the structure injury).

The injury can be:

i) latent ii) chronic iii) acute



INJURIOUS FACTORS

ABIOTIC

- the most important group of injurious factors and they represent negative impact of environment.

BIOTIC

- formed by wide spectrum of organisms from plants and animals
- xylophagous, phytophagous animals, feeding on tissues or sucking sap, heterotrophic organisms – phytopathogenic fungi, bacteria and viruses but also autotrophic plants

ANTHROPOGENIC

- group of various impacts outflow from human activity (even if human beings do not take part directly)
- air pollution, fire, animals grazing, direct damages: logging etc.



Injurious Factors

Abiotic

Radiation

Temperature (extreme heat,
wind, snow, frost etc.)

Water (drought, flood,
tsunami)

Soil (physical and chemical
properties)

Biotic

Herbivores

Pathogens

Competitors

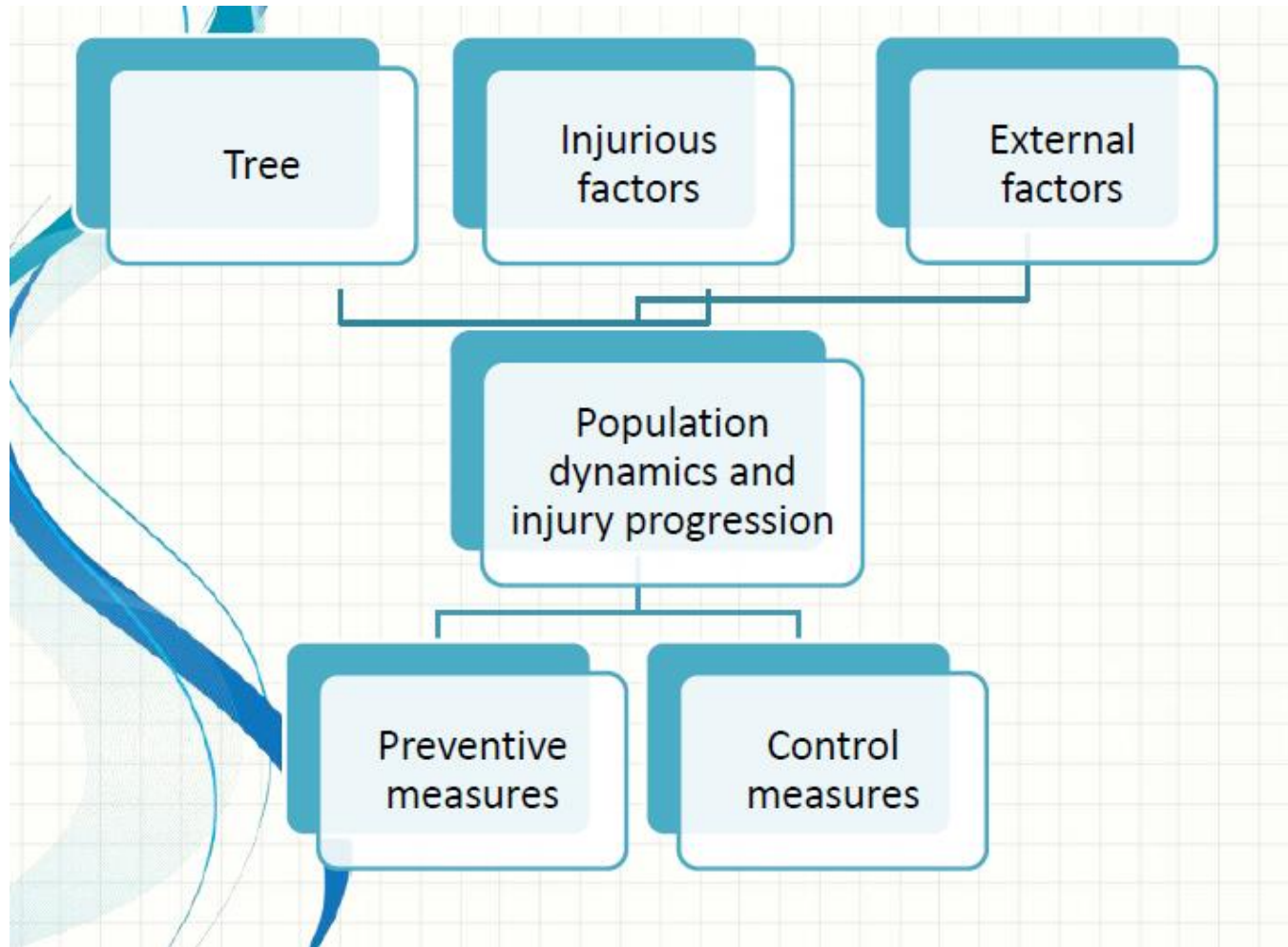
Antropogenic

Direct (physical
damage of trees)

Indirect (human
influence on
abiotic and biotic
factors)



Important concept



Population dynamics: Influences

Exogenic

Food availability

Environmental conditions

Biotic factors (natural enemies and competitors)

Endogenic

Fecundity

Lifespan

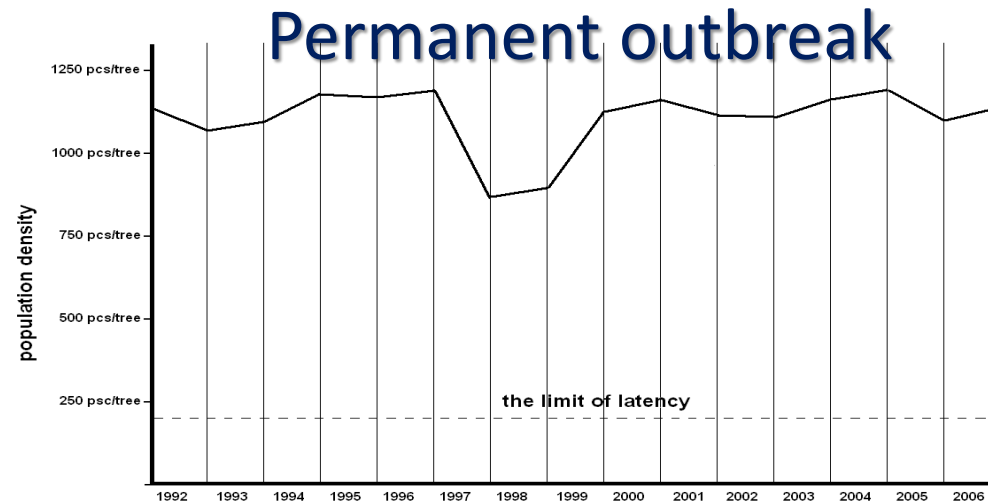
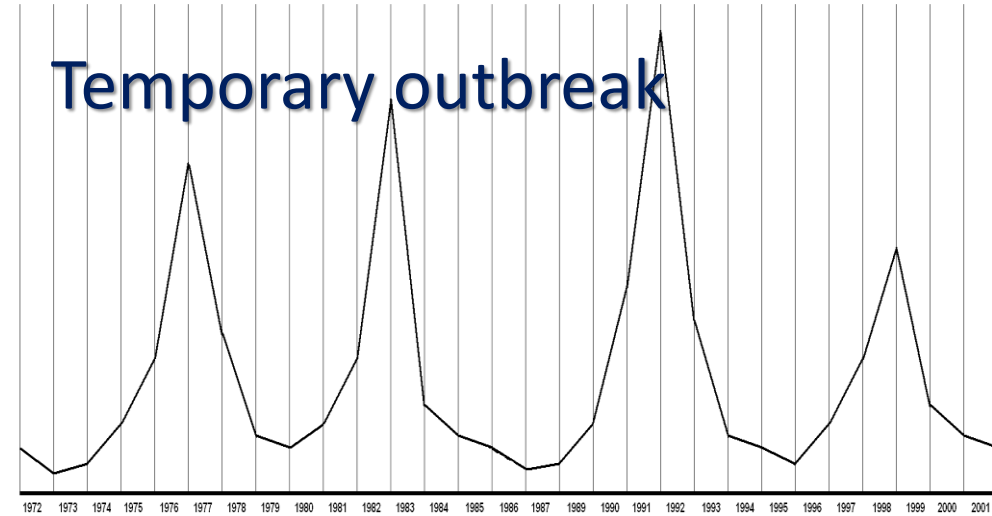
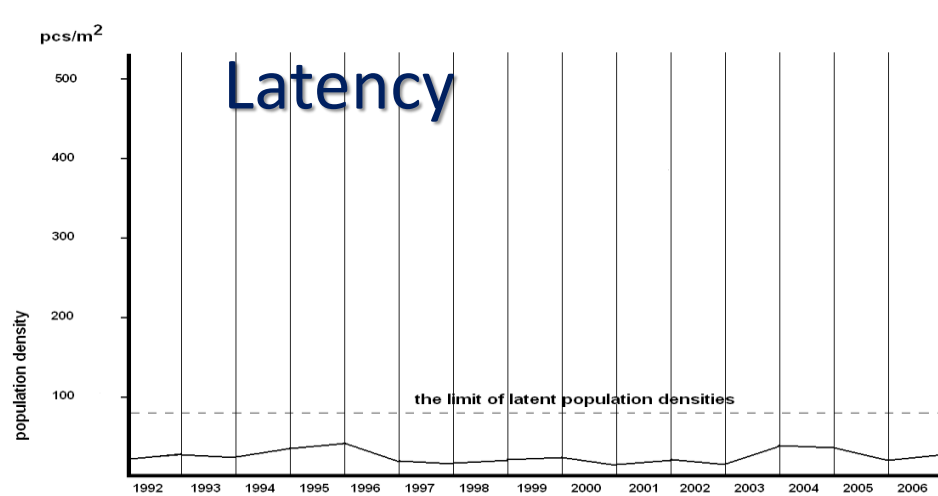
Number of generations per year

Territoriality

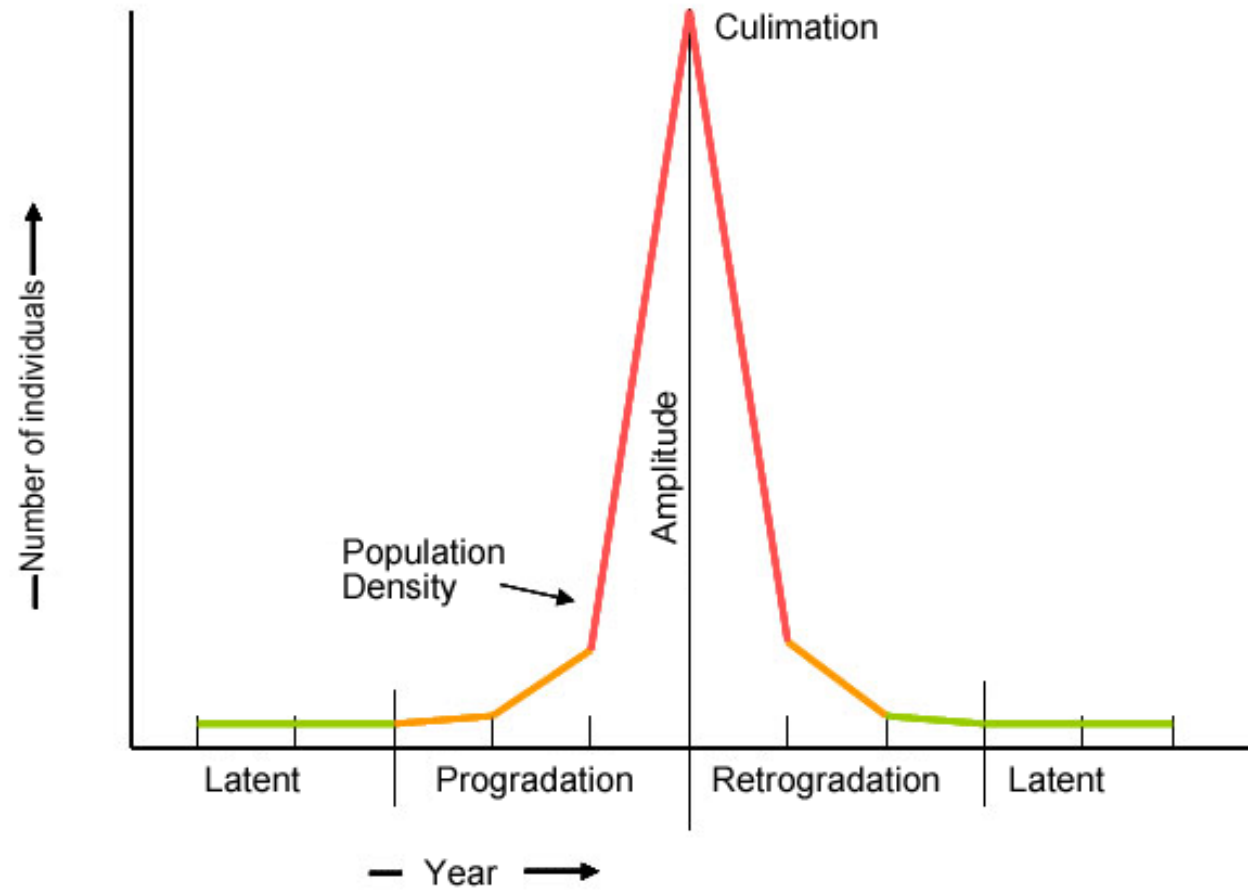
Ability to migrate



Population dynamics



Pest Outbreak





Concepts of modern forest protection



IPM = INTEGRATED PEST MANAGEMENT



Integrated pest management

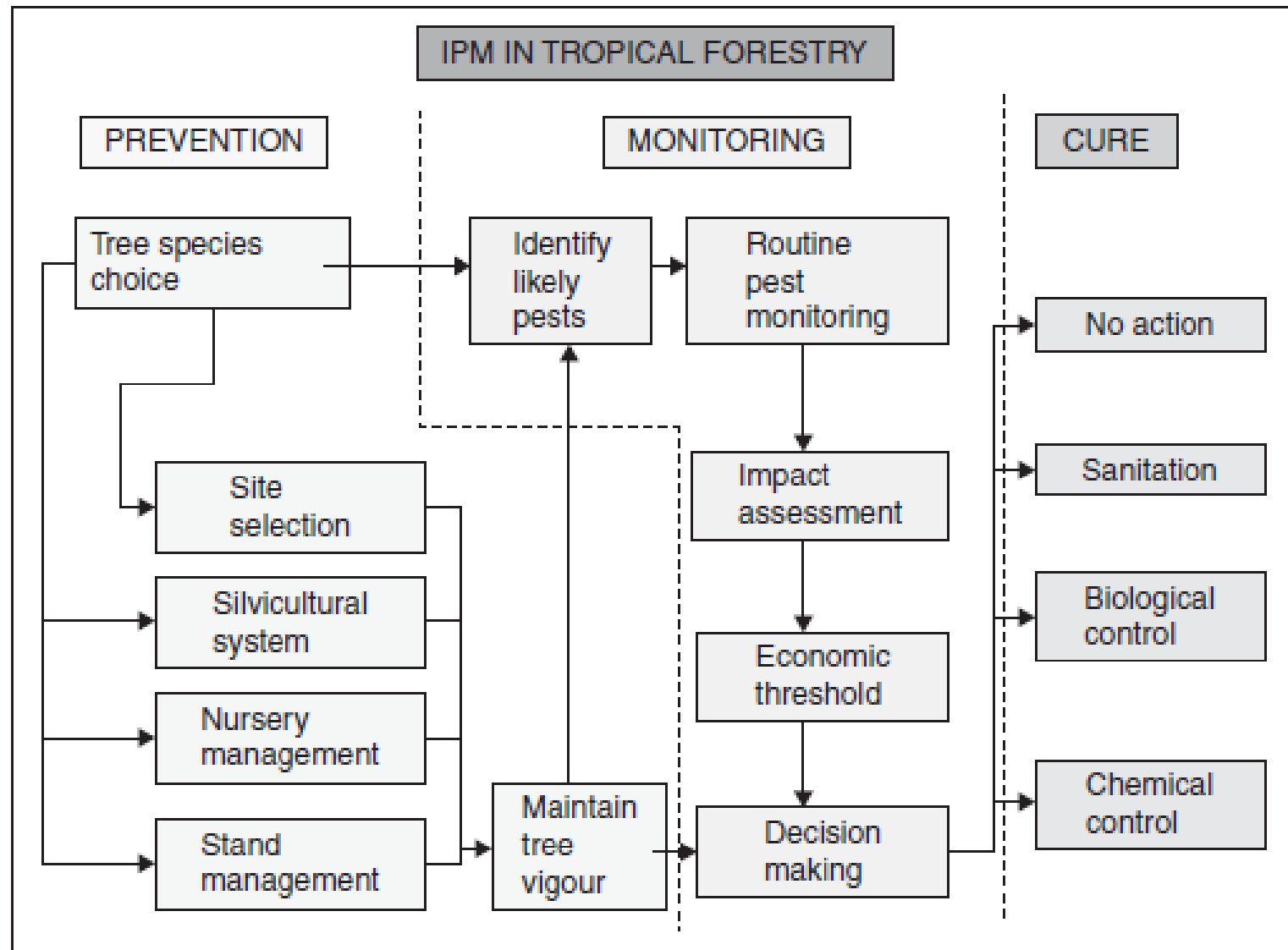
= the use of all appropriate tactics to maintain a pest population below an economically important level

- Economic injury level: the lowest pest density that will cause economic loss. When the cost of control is offset by crop lost.
- Economic threshold: pest population density at which active controls should be initiated to prevent pest from reaching the economic injury level (70-80% of Economic injury level)



Implementation

- 1) Identification of pests
- 2) Study of the key pests – conditions conducive to an outbreak, how much injury caused per pest unit, etc.
- 3) Economic knowledge of the production system (cost of control, market value, etc.)
- 4) Development of a pest management strategy based on pest numbers
- 5) Development of reliable monitoring techniques for pest population and damage
- 6) Establishment of economic thresholds
- 7) Development of predictive models



Types of pest control

- ❖ **Biological control**
- ❖ **Chemical control**
- ❖ **Behavioral control**
- ❖ **Physical control**
- ❖ **Cultural control**
- ❖ **Host plant resistance**
- ❖ **Regulatory control**



Physical control

- direct removal of pest (mechanical control)
- in forestry mostly used for the control of weeds



Regulatory Control

European and Mediterranean Plant Protection Organization (EPPO)

Quarantine pests: Prohibition of movement of materials from infested areas or mandatory treatments for movement of those materials.

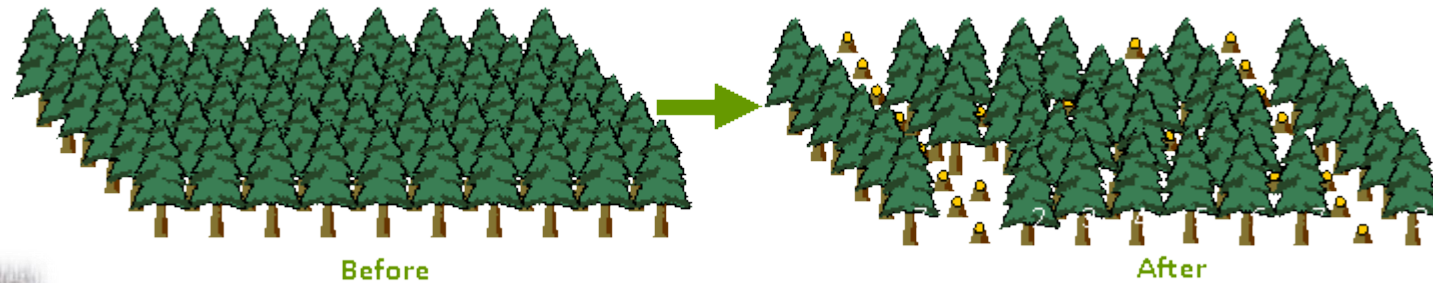


Erasmus+

Cultural control

Manipulate ecosystem to make it less favorable to pest species and more favorable to natural enemies:

- Selection of species and site
- Spacing
- Thinning
- Sanitation
- Trapping



Host plant resistance

Use of cultivars with the highest capacity to resist to injury by herbivores or pathogens

Advantages

- specific, cumulative, persistent
- no toxic residues
- low cost

Disadvantages

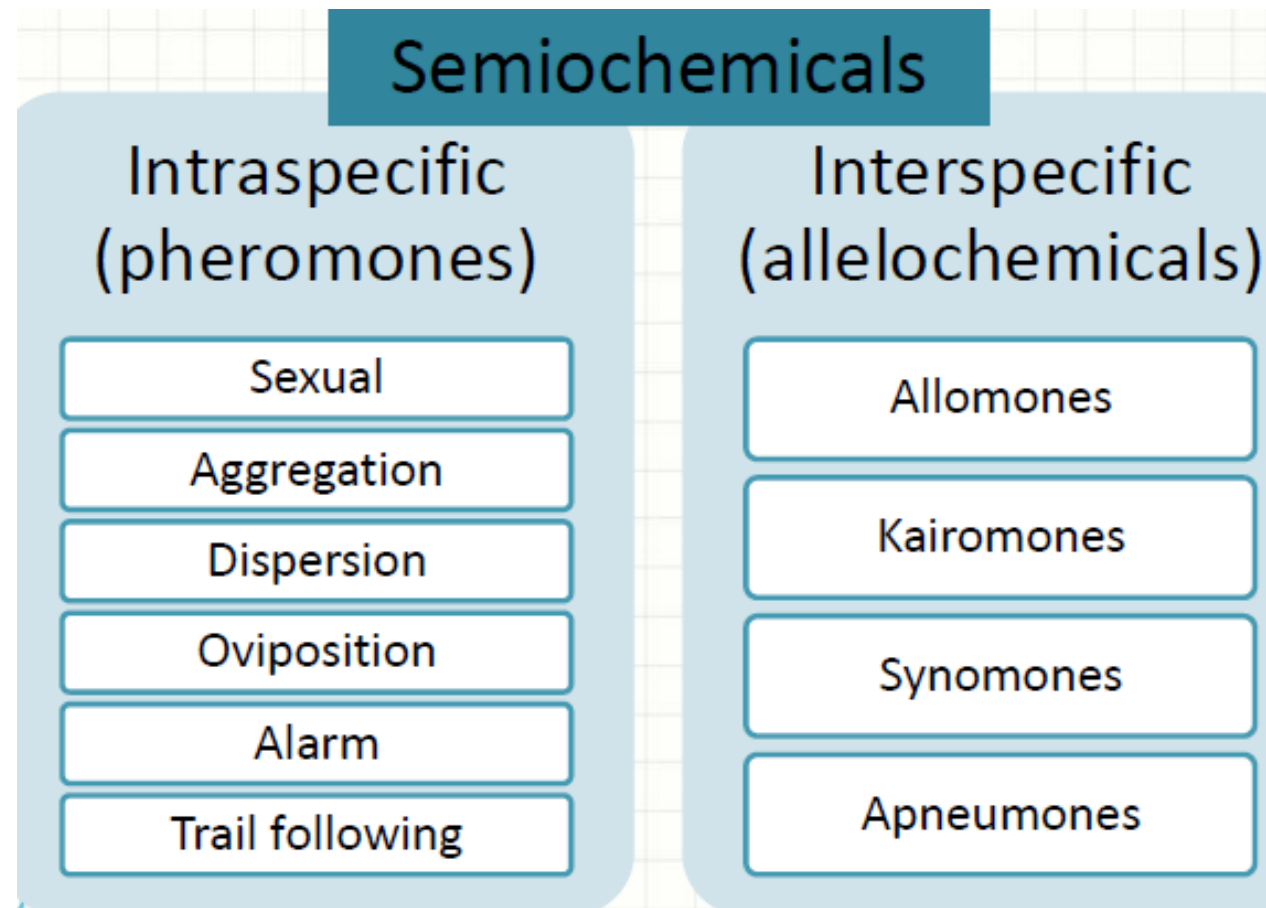
- time for development: 15-20 years (preventive)
- undesirable characteristics of resistant variety
- new pests

Host Plant Resistance



Behavioral control

- Use of physical (vibrations, electromagnetic radiations) and/or chemical stimuli (gustatory, olfactory) to modify pest behavior.



chemical control

In the Forest Protection there are used many different chemicals for various purposes with various effects:

- Pesticides
- Repellents
- Antifeedants
- Pheromones
- Biopreparations



Pesticides

- **active ingredient** + additional substances – **adjuvants** (solvents, emulsifiers, tensids, adhesives, pigments, filling agents etc.) = **FORMULATION** :

The type of formulation is usually a part of the name of the preparation, and there is as an abbreviation, for example:

- ✗ EC – emulsifiable concentrate
 - ✗ L – liquid
 - ✗ D – dust
 - ✗ G – granules
 - ✗ WP – wettable powder
 - ✗ DP – dipping powder
 - ✗ WG – wettable granules
 - ✗ DG – dipping granules (=wetable granules)
 - ✗ ODC – oil dispegable concentrate
 - ✗ ULV – Ultra Low Volume, aplication with ULV techniques
- (the abbrevitations of formulations are many)



Pesticides according target organism

I. ZOOCIDES:

- acaricides
- nematocides
- insecticides
- moluscocides
- rodenticides...

• III. FUNGICIDES

II. PHYTOCIDES:

- ✗ algicides
- ✗ herbicides
- ✗ arboricides

IV. BACTERICIDES

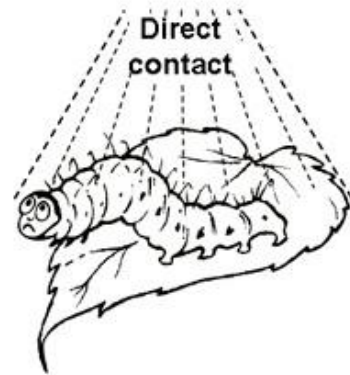


Common chemical groups

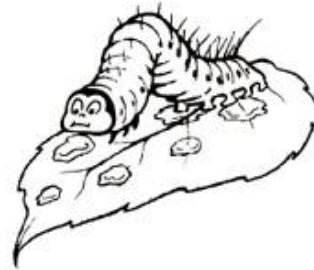
- Botanical insecticides (nicotine, pyrethrin, etc.)
- Inorganics (Sulfur, arsenic, fluoride, etc.)
- Organophosphates (ACHE inhibitor)
- Carbamates (ACHE inhibitor)
- Organochlorines (Axonic poison)
- Dinitrophenols
- Pyrethroids (Axonic poison)
- Neonicotinoids (inhibition @ ACH site)
- Growth regulators (Ecdysone agonists, Juvenile hormone mimic, Chitin synthesis inhibitors)
- Others

Mode of dose transfer

- I) **Total = non-selective** (active to all organisms-f.e. insecticides = all insects)
- II) **Selective** (active to a group of organisms-f.e. aphicides = active to aphids)



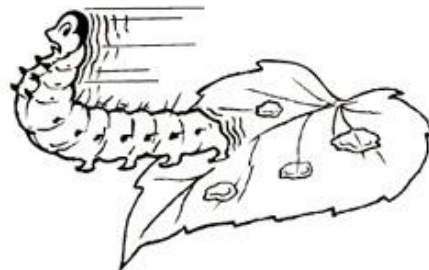
Secondary contact



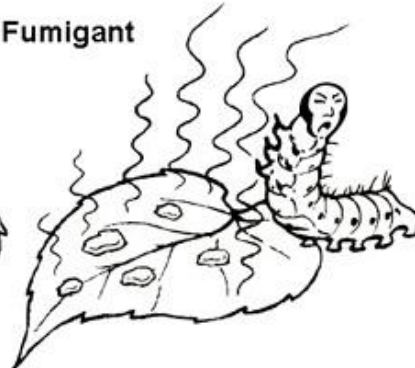
Ingested



Repellent



Fumigant



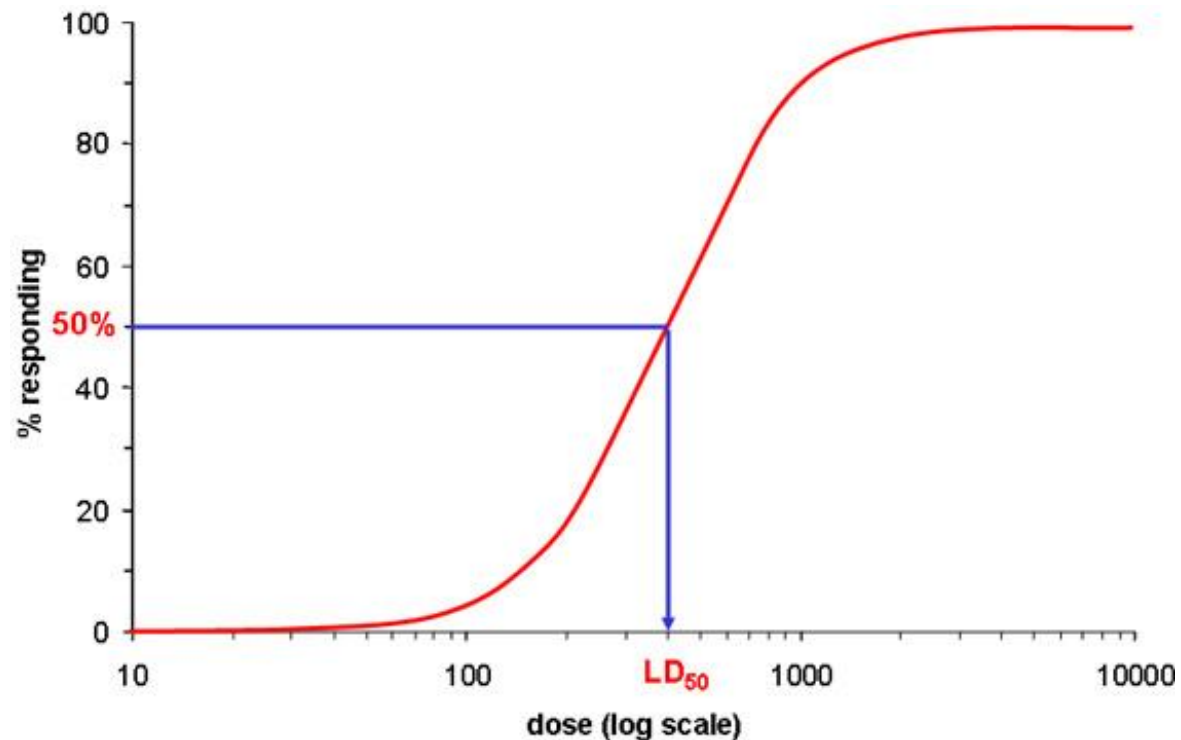
Lure and kill



Modified from original by J Cooper & H Dobson

Measurements of toxicity:

- LD_{50} - dosage producing 50% mortality (expressed in mg/kg)
- LC_{50} - concentration producing 50% mortality
- LT_{50} - time of exposure producing 50% mortality



Knapsack sprayers



The membrane pump is powered by lever, for pesticide application (herbicides, insecticides and fungicides)

Application

Engine sprayers



The „core“ of this sprayers is a ventilator, powered by engine.



Application

Rotary atomizers - used in aerial application, mounted on airplanes.



The rotary atomizer
Micronaire AU 3000

Application

Hot aerosol generator

Igeba TF 35

- used in greenhouses, stored products, in the forestry sometimes against greenflies of the family Adelgidae (in young stands)

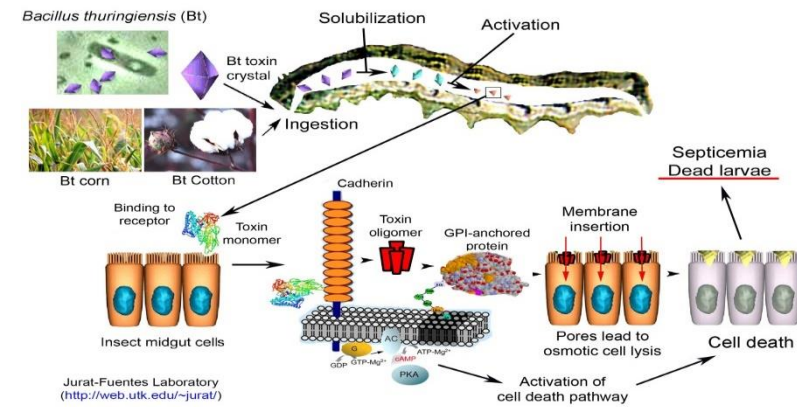


Classical biological control

- Augmentation of natural enemies: the periodic release of natural enemies
 - Inundative release = involves releasing large numbers of natural enemies for immediate reduction of a damaging or near-damaging pest population
 - Inoculative release = involves releasing small numbers of natural enemies at prescribed intervals throughout the pest period, starting when the pest population is very low

Conservation of natural enemies

- Environmental manipulation
- Proper spray practices



Biological control - examples

- *Rhizophagus grandis* x *Dendroctonus micans*
- *Entomophaga maimaimaga*, LdMNPV x *Lymantria dispar*
- *Cordyceps sp.* x *Leucopholis coneophora* (coconut pest in India)



<http://www.youtube.com/watch?v=XuKjBIBBAL8>



