1

What is VETcert?

- Project from 2016 - 2019
- Developing a pan-European certification scheme for managing veteran trees
- Aimed at both practising and consultant tree professionals.
- VETcert builds on the EU VETree project and this course is a key product
- 10 partners, 7 countries

2

Introduction to course

- This course builds on the VETree foundation course and is more advanced.
- Helps prepare you for VETcert certification
  - does not cover everything!
  - more self-study required.
- Does not cover practical cutting work
- It is a stand-alone course even if you do not want to attempt VETcert

3

Introduction to course

- Plan for the two days
- Comfort information
- Health and Safety
- Overnight accommodation
- Time keeping
- Questions?
- Course outline


Photo: Vikki Bengtsson, Sweden

4

By the end of this course you will be able to:

- Understand how the management of veteran trees is influenced by their features and by factors that affect them:
  - (a) ageing and natural processes
  - (b) rooting environment
  - (c) hollowing and fungi
  - (d) location, species and situation

5

By the end of this course you will be able to (cont....)

- Undertake a survey of a veteran tree and take into consideration all relevant factors to produce a management plan
- Understand what affects the sustainability of a population of veteran trees and how you can influence it

6

Quiz time!

7

Development stages of trees

Why can trees live so long?

8

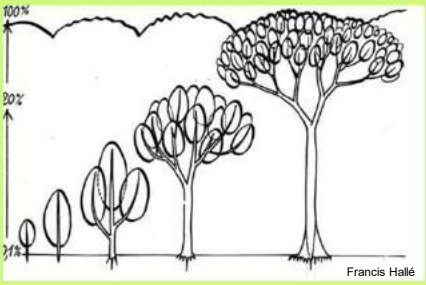
Life/development stages of trees

- For humans chronological age (in years) and development are strongly linked.
- For trees chronological age is far less strongly linked to development.
- Life stages in a tree are not always linear

9

Crown development by reiteration

Repetition/duplicate/copy of the 'young tree'



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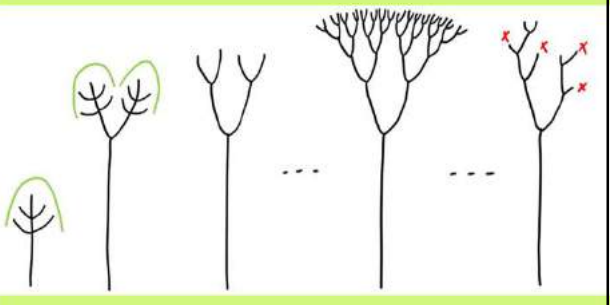
Development stages



Adapted after Drénou

11

Reiteration in reaction

12

Indefinite growth and reiteration

- Can produce new shoots, roots, wood and bark throughout their lives
- There is no theoretical limit to a tree's capacity to produce new tissues

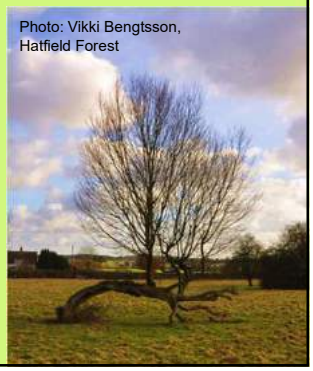


Photo: Vikki Bengtsson, Hatfield Forest

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Indefinite growth


Photo: Jim Mullholland, Tortworth Chestnut, England

- They can theoretically live forever unlike most animals

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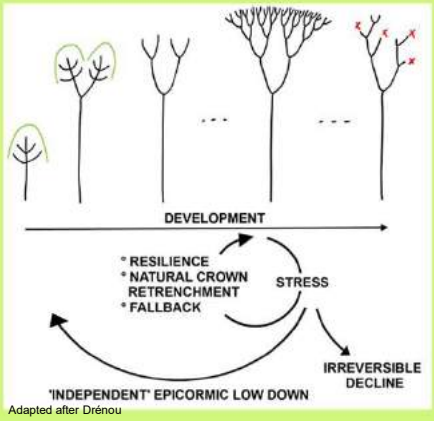

Adapted after Drénou

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Physiological function

- A tree's longevity relies on maintaining physiological function in the sapwood and phloem

16

Why does retrenchment occur?

Height at peak maturity is determined by the tree's capacity to supply water to the top of its crown.

Depends on:

- Water supply and demand (soil, climate)
- Hydraulic efficiency of the sapwood (species, part of tree)


Photo: Ola Bengtsson, Landeryd, Sweden

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Retrenchment follows maturity

Combination of physiological & biomechanical processes

- Narrower sapwood increments
- Increased hydraulic resistance
- Smaller crown, less sugar, less root growth
- Less capacity to absorb water
- Branches break more easily

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Photo: Vikki Bengtsson, Bodfach Park, Wales

19

Decline vs senescence

Decline = regression before the tree has reached its maximal development (expansion) and is independent of age or life stage

Senescence = last phase in an organism's development and is related to its 'ontogenetic' age (~ development stage). This can be limited to one or more independent functional units in a tree.

20

Epicormic growth

Also a form of reiteration

Potential to react to external influences:

- Stress (or the disappearance of stress)
- Catastrophes
- Defoliation

Photo: Tom Joye

Allows for side roads and variations to the *normal* ontogenetic development

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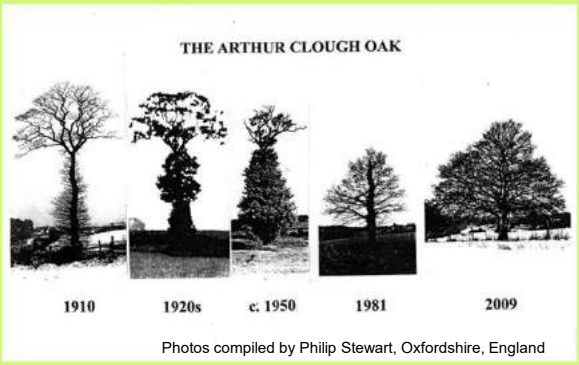
Tree Time!



Photos compiled by Philip Stewart, Oxfordshire, England

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Fungi - the unknown world

What are fungi?

Fungi and trees have co-existed for millions of years

Photo: Vikki Bengtsson, *Fistulina hepatica*

23

A video delivered by the VETcert project

VETCERT

CERTIFIED VETERAN TREE SPECIALIST

1. Introduction to fungi

24

Coffee break

Photo: Helen Read, Blenheim, England

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Film - Types of wood decay

A video delivered by the VETcert project

4. Different types of wood decay

26

The hollowing process

A video delivered by the VETcert project

5. Introducing heart-rot and hollowing

28

The hollowing process

What is the difference between the process of wood decay in a standing live tree and a fallen dead tree?

Photo: Helen Read, England

29

Sapwood function in relation to decay

- Low oxygen content protects functional sapwood from decay
- Columns of functional sapwood connect healthy branches with healthy roots

Photo: David Lonsdale

31

Maintenance of function

PASSIVE:

- High moisture-content in sapwood
- Durable heartwood in some species
- "Safety valves" between conducting cells
- Anatomical boundaries between cell types (e.g. latewood, earlywood, rays)

ACTIVE

- Reaction zones in functional wood
- Barrier zone protects wood formed after the decay-initiating injury

Photo: Helen Read

32

Decay after wounding of sapwood

- Columns of sapwood become aerated and dysfunctional after wounding
- Dysfunctional sapwood can become rapidly decayed

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Latency

- Fungi occur sparsely in intact, living sapwood, routes of entry uncertain
  - e.g. via seed, bud scars, via invertebrates, through thin periderm
- If conditions change fungi can switch from latency to active decay

Photo: Helen Read

34

Benefits of decay fungi to old trees

- Fungi break down wood releasing mineral nutrients
- Internal roots absorb nutrients
- Hollowing is a natural process for a tree

Photo: Tom Joye

35

Problems of decay fungi for trees

- Extensive decay can weaken the tree
- Wounding leads to dysfunction and/or aeration, and hence decay – the bigger the wound, the more decay.
- Internal roots in decaying wood may prise apart weak structures

Photo: Tom Joye

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Exercise 1

- Fungi and trees
- Match the beginning and ends of the sentences

Photo: Helen Read

37

Fungi in trees

- Trees co-exist with fungi
- Many fungi are not detrimental to trees
- Fungi release nutrients
- Tree growth can keep up with fungal decay
- Stressed & weakened trees are less able to defend themselves
- Large wounds cause larger areas of dysfunction

Photo: Helen Read

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Trees, roots and soil

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Exercise 2

Soils - True or false?

https://www.youtube.com/watch?v=h8PILHkdqpA

40

Soil complexity & heterogeneity

- Soil communities are complex & diverse
- Heterogeneity at all scales
- Susceptible to disturbance
- Complex interactions between soils & plants
- Micro niches – very important
- Poorly studied and understood

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Video introducing mycorrhiza

A video delivered by the VETcert project

VETCERT
CERTIFIED VETERAN TREE SPECIALIST

2. Introduction to mycorrhiza

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Mycorrhiza

Questions for discussion:

1. What do plants get from fungi and what do the fungi get from plants?
2. What length of fungal mycelium might you have associated with 1m of tree root?
3. What is the wood-wide web?

Photo: Helen Read

43

Mycorrhiza

Ted Green

'A tree is not a tree, it is a tree plus fungus'

44

Complex interaction in soil between invertebrates, microbes and fungi

- Grazing of fungi & roots by invertebrates
- Fungi produce volatile compounds to deter grazing
- Roots produce exudates
- Lots we don't know about fungi / invertebrate / root relationships

Photo: Paul Richards

45

Roots (& the rhizosphere)

- Change physical structure of soil
- Die & decay
- Exude compounds which are high quality nutrients for fungi. This then increases numbers of microbes & their predators
- Tree roots in soil add to the soil strength (the more the better)

Photo: Brian Cleckner

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Interaction between soils, trees and man Exercise 3

- What are the consequences for veteran trees of the following?

- Nitrogen enrichment
- Compaction
- Erosion & physical disturbance of soils

Photo: Helen Read

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Conclusions

- Soils are precious & essential
- They damage easily and take a long time to recover
- Protect soils around veteran trees
- Avoid causing unnecessary stress to trees, including roots
- Trampling pressure & bare ground (without even leaf litter) is not 'normal' for woodland soils

Soils should be considered as a non-renewable resource

48

Lunch

Photo: Helen Read, Czech Republic

49

Manage the land around a veteran tree

Photo: Vikki Bengtsson, England

Manage the roots/soil

Photo: Vikki Bengtsson

Manage shade

50

Managing the land around the tree

51

High intensity grazing an issue

52

Forestry extraction also an issue

53

Land around film part 2

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Soil amelioration

- Aim to improve below-ground ecosystem and help local cycling of minerals to be restored.
- This is not the same as creating the 'ideal' soil conditions! (fertilisers, soil liming, …)
- Mulching must be seen as a 'kick start' for natural processes, not as the ultimate solution to soil problems
- Combine with measures to alleviate/avoid future degradation (compaction, …)

55

Soil amelioration - mulching

- Mulch material:
  - organic material (leaves, wood, wood chip, compost, …)
  - better to use organic material that is (partially) composted
- Application:
  - spread on surface vs. deeper application
  - spots/quadrants/wedges vs. complete surface
  - removal of vegetation prior to mulching?
  - planting of herb layer > think 'ecosystem'!
  - avoid volcano, think doughnut instead!

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Soil amelioration

- There is a myriad of soil amendments available:
  - Compost
  - Biochar
  - Minerals (e.g. ground lava)
  - Fertilisers
  - Bone meal and blood meal
  - Mycorrhiza and other microorganisms
  - Fermented organic matter (e.g. bokashi)
  - etc.
- Every one of the above should only be used after careful consideration > what is the problem and how is this product going to help?

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Managing the surroundings: Shade & competition

Photos: Vikki Bengtsson

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Light requirements tree species Exercise 4

Tree species	Light requirements – young trees (NB NOT seedlings)	Light requirements – mature trees
Fraxinus excelsior		
Carpinus betulus		
Fagus sylvatica		
Quercus robur		
Tilia cordata/platyphyllos		
Acer campestre/platanoides		
Salix sp.		

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Climate and access to water

Photo: Vikki Bengtsson

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Things to consider when haloing

- Exposure/wind
- Bark can heat up
- Transpiration reduces due to drought stress in leaves
- Drying out of soil
- Mildew - oak
- Nutrient stress
- Root stress

DO IT IN STAGES OVER TIME!

Photo: Vikki Bengtsson

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Exercise 5 Field session

Focussing on the land around the tree

Photo: Helen Read, Spain

63

Coffee & travel to the site

Field exercise -
TAKE WITH YOU:

- Clip board
- Pencil/pen
- Binoculars
- Forms to fill in
- .....

Photo: Helen Read, Sweden

64

Trees and natural survival strategies

Photo: Vikki Bengtsson, Windsor, England

65

Browsers and/or natural disasters?

Photos: Vikki Bengtsson; Sweden,Spain

66

Photo: Vikki Bengtsson; Sweden

67

Natural survival strategies

Photo:Vikki Bengtsson, Sweden and England

68

Survival strategies: functional units

- parts of the trunk differentiate into semi-autonomous functional units.
- each has its "own" crown, stem and roots
- one tree becomes two or three!
- layering another example

Photo: Vikki Bengtsson

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Assessing your tree: Things to consider

What happens if you do nothing?

- Health/vitality
- Likely response to pruning
- Functional units
- Stages of crown development
- Biomechanics
- Tree species

Photo: Helen Read

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Exercise 6 - Assessing your tree:

Indicators of health/vitality	Indicators of a positive response to pruning

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Assessing your tree: Development stage

Photos: Tom Joye

76

Assessing your tree: Reaction processes

Photo: Tom Joye

© Jeroen Rappé

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Exercise 7 Defect or habitat?

78

Assessing your tree: Biomechanics

- Different methods available, e.g. VTA (Mattheck), SIA (Wessolly), etc. (see bibliography)
- Methods focus on evaluation of biomechanical 'defects' in relation to (wind) load

Photo: Helen Read, England

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Biomechanics: why are veteran trees different?

- Methods mostly rely on statistics and assumptions based on relatively average and regular trees (e.g. a regular shape with hollowing)
- Veteran trees are often very complex biomechanical structures:
  - consisting of different functional and biomechanical units
  - often large stem, but small and low crown
  - hollowing, decay and complex adaptive growth
  - old large shell with new shoots and adventitious roots
  - lapsed pollards

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Using diagnostic tools to follow up on visual assessments

- Diagnostic tools can be used to complement visual assessments with measurable data
- Interpretation can be hard when used on biomechanically complex veteran trees
- Examples of diagnostic tools are:
  - resistance drilling equipment
  - sonic and electrical impedance tomography
  - pulling test
  - dynamic wind load analysis
  - etc.

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Resistance drilling

Photo: Helen Read

82

Tomography

Photo: Jim Mullholland

83

Questions?

Photo: Helen Read, France

84

What did you learn yesterday?

- What made the biggest impression on you?
- What information was new or contrary to your previous knowledge?
- Any aspect that needs more explanation?

Photo: Helen Read, Czech Republic

85

How do different tree species vary?

- In order to look at this we need to revisit some tree physiology....

Photo: Helen Read, England

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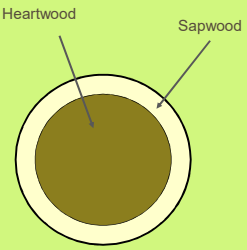
Sapwood & Heartwood

Sapwood
- Living tissue
- High moisture content
- (passively) defended against loss of function & activity of fungi
- If injured can form an active defence



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Heartwood & Ripewood

Heartwood
- Dead central wood of species where living sapwood has a finite and pre-determined lifespan

Durable heartwood
- Heartwood containing protective substances (e.g. Oak)

Ripewood
- Older central wood of tree species where sapwood gradually ages without being converted to heartwood (e.g. Beech)

Photo: Helen Read

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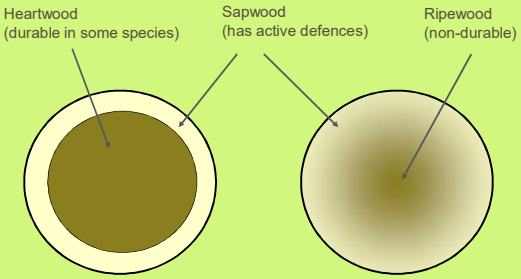
Heartwood, sapwood & ripewood



Comparison between tree species with a true heartwood (left) and with a ripewood core (right)

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Shoot formation

Dormant buds
- An axillary bud which doesn't develop into a shoot until after the second season following its formation. Buds may persist throughout the life of a tree, only developing if stimulated to do so

Adventitious shoots
- Shoots that develop neither from terminal nor axillary buds

Epicormic shoots
Shoots initiated on mature woody stems
Can be from **dormant buds** or **adventitious**

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Exercise 8

- How do different species of tree respond to management work?

Photo: Helen Read, Spain

91

Extreme dysfunction

- Pruning is a form of wounding
- If dysfunction becomes very severe, the whole tree may die

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Summary: Assessing your tree

94

Pruning techniques film

95

Unconventional pruning techniques

Natural fracture / coronet cut	Cut and/or rip branch followed by some sculpting to give the appearance of a more natural torsional break
Rip cut	Cut and let branch fall, tearing the bark
Ring-bark reductions	Ring-bark branches instead of cutting off
Leaving stubs	Cutting well beyond a branch union: not target pruning

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Natural fractures and rip cuts

Advantages	Disadvantages
More natural appearance	May be considered untidy
May encourage more new growth	Unknown if this works; variable results
More woody tissue for invertebrates to colonise	Unproven, either for rare or potentially harmful invertebrates
May enhance or speed up production of decay-related habitats	May lead to weakening by excessive decay
	Slower/ more expensive
	More dangerous to do

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Ring-bark reductions and stubs

Ring bark reductions

- New growth stimulated from below the ring bark (in the few trees tested so far)
- Branch part beyond the ring bark dies slowly
- Branch breaks off giving a natural appearance
- Not evaluated

Stubs

- May encourage new shoots where there is a lack of an adequate pre-existing twig structure (in beech trees, less clear results with oak).

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UNCONVENTIONAL PRUNING

A video delivered by the VETcert project

Unconventional cutting techniques

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Exercise 9
Field session
Management planning in practice

- Critically evaluating the management needs of an old tree
- Drawing up a work programme
- TAKE COFFEE WITH YOU!


Photo: Helen Read

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Lunch & travel to the site

Field exercise -
TAKE WITH YOU:

- Clip board
- Pencil/pen
- Binoculars
- Handout
- .....

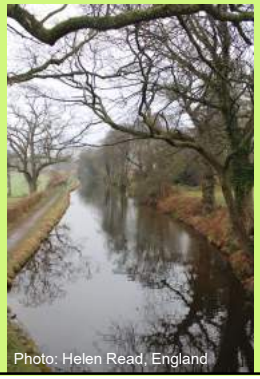
Photo: Helen Read, England

101

The decision-making process

Handout is for guidance only


Photo: Helen Read, England

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Managing heritage or urban veteran trees

- Veteran trees with high heritage values and/or in urban environments may have different management constraints
- Lots of factors may influence what work you can do on the tree.
- Greater intervention may be appropriate or desirable (e.g. propping, cabling etc.)

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ADD URBAN VIDEO

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Urban Trees need space!

Photo: Vikki Bengtsson, Suffolk, England

Photo: Helen Read, England

105

Propping, bracing and tethering

- All forms of artificial support for trees
- All systems have pros and cons (see fact sheet)
- Carefully consider the need and the system and material used. There is often no way back!

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Propping

Photo: Helen Read

107

Dynamic fabric cable bracing

Photo: Tom Joye

108

Static (steel) bracing

Photo: Tom Joye

109

Steel rod bracing

Photo: Tom Joye

110

Steel rod bracing

Photos: Tom Joye

111

Tethers/guy ropes

Photo: Brian Cleckner

112

Compression belts

Photos: Tom Joye

113

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Well-loved trees

Photos: Helen Read

115

Taking care of well-loved trees

Photo: Jim Mullholland, England

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Common sense guide to risk

A video delivered by the VETree project

VETREE
VETERAN TREE NETWORK

Common sense risk management of veteran trees

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Legislation

- Many different laws deal with trees
- What you can/cannot do depends on the trees' situation and the relevant legislation in that country
- Don't forget that some landscapes have protection

Photo: Helen Read, England

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Legislation and trees

Wildlife legislation
Landscape protection
Heritage protection
Tree protection
Site protection
Planning

Photo: Vikki Bengtsson, Sweden

119

Economic evaluation of trees

- Political agenda
- Legislative measures
- Replacement costs
- Many countries have produced methods
- Mainly for urban trees
- Larger trees = higher value

BUT

Photo: Vikki Bengtsson, Sweden

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Evaluation methods

- All systems give lower value for decay, hollows or wounds.
- Assumptions are:
  - That these shorten the life of the tree
  - Lower vitality equals lower value

Photo: Vikki Bengtsson

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Veteran trees and diseases

- Size helps?
- Functional units
- Long life-cycle
- Perhaps "protective" organisms e.g. endophytes
- Develop resistance/tolerance
- Genetic variation
- May have an impact on your management decisions
- Stress?

Photo: Vikki Bengtsson, Sweden

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Populations of veteran trees and the associated species

What affects the sustainability of a population of veteran trees?

What are the problems for the associated species?

How can this be influenced and managed?

123

Conservation - problems

- Species cannot survive indefinitely in a single tree
- Large populations of old trees required
- Variety of niches required
- Tree population may have an age gap
- Extinction debt

Photo: Helen Read, Spain

124

Photo: Vikki Bengtsson, *Fistulina hepatica*

Photo: Vikki Bengtsson *Lucanus cervus*

Photo: Vikki Bengtsson

Photo: Vikki Bengtsson *Lobaria pulmonaria*,

125

Rare & threatened species

- 18% of European saproxylic beetles are threatened (IUCN, 2018)
- Most threatened species community in Europe

Photo: Roger Key

Limoniscus violaceus adult and larva

Photo: Roger Key

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Invertebrates

- HUGE number and variety!
- Annual life cycle
- Many specialists

Photo: Henk-Jan de Jong, *Ctesias serra* (cobweb beetle) larva

Photo: Roger Key, *Helophilus pendulus*

- Larva and adult - different requirements
- Many rare!

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Species' requirements

Fact sheets – species' guilds

- Wood-decay fungi
- Cavity-dwelling mammals
- Cavity-dwelling birds
- Epiphytes
- Saproxylic insects

Photo: Vikki Bengtsson, Sweden

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Extinction Debt

A biotope that has once covered a much larger area or had a much higher quality, now contains more species than it can support in the long term.

More biotope = more species!

129

Populations of veteran trees

- 1-2% of our veteran trees remaining?
- 0.5 – 2.0% mortality per year
- Mortality may be greater in overgrown sites
- Generation gaps
- Delivery time!

Photo: Vikki Bengtsson

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Exercise 10
Sustainable populations?

- How do you define a 'site'?
- How many trees do you need for a sustainable population?

131

What makes a site sustainable?

- Geography
- Biology
- Chronology
- Ownership

- Species
- Regeneration
- Mortality
- Growth rates
- Succession

Map: Vikki Bengtsson

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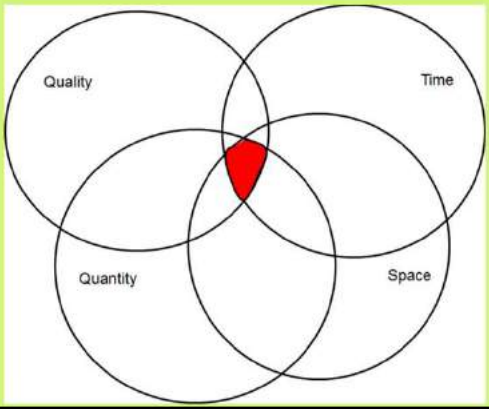

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Mortality scenario

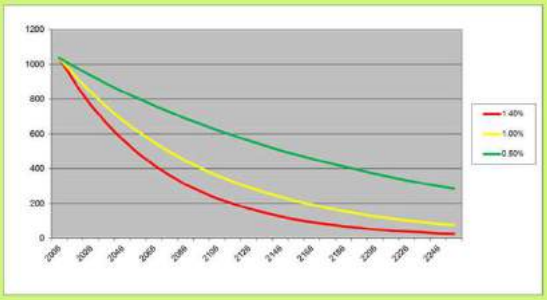

Figure: Vikki Bengtsson

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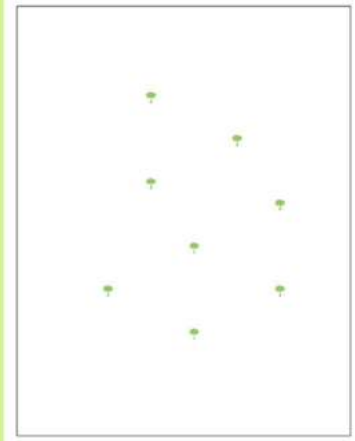
Figures:
Vikki Bengtsson



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Threshold values?

- Oak & hermit beetle
- At least 50 individuals & 20 sites (20 trees?)
- 57 – 280 ha & 160 hollow oaks
- 2.8 hollow oaks/ha
- Sustainable mortality rate?
- Sustainable regeneration rate?

Photo: Vikki Bengtsson

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Managing habitat

- Plenty of veteran trees, relatively close together
- Good age structure in tree population
- Flowering bushes and plants
- Sunny, sheltered open spaces
- Decaying wood in all shapes, sizes and locations!

Photo: Vikki Bengtsson, Sweden

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Creating habitat!

Illustration: Per Axell
Photos: Vikki Bengtsson, Roger Key, Ola Bengtsson

Where there are no 'future' veteran trees to close the generation gap it may be desirable to create some!

138

What is veteranisation?

- Mild treatments
- Complementary management tool
- Alternative use
- NEVER on VETERAN trees!

Photo: Vikki Bengtsson

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Photos: Vikki Bengtsson

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Does veteranisation work?


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Does veteranisation work?

- Postive results so far from trial with 980 oaks!
  - –Only 3 trees have died!
  - – birds nesting in 65% of the "boxes"
  - –45% woodpecker holes used
  - –5% used by bats
  - –Sap runs, woodpecker activity, hornets moved in!

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Monitoring is vital!

- Mark up the trees
- Take photos
- Dead/alive surveys
- Keep it simple
- What does success look like?
- Document what you have done and document what happens!
- Must be able to learn from the past

145

Remember future generations of trees are crucial for long term viability

146

Veteran trees – conclusions

- Biodiversity
- Ageing process and natural processes very important
- Veteran trees need space
- Plan any management very carefully
- Plan for the future
- Protect for the future

147

Veteran trees are challenging to work on

- Understanding of veteran trees is relatively poor
- Difficult to compare management techniques scientifically
- Difficult to give clear recommendations
- Requires more complex thought processes and open minds

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VETcert

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VETcert assessment: Pre requisites

Practising level

Arboricultural qualification (or equlivalent)

ETW or equivalent chainsaw & climbing/MEWP certificates

5 years experience

Consulting level

Relevant qualification

5 years experience (3 in consulting)

Or equivalent experience and 10 years experience (5 in consulting/advising)

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VETcert standards

www.vetcert.eu

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VETcert assessment methods

Practising level

Multiple choice questions

Written paper

Outdoor exercises and oral examination

Consulting level

Written paper

Outdoor exercises and oral examination

Preparation of tree management plans

Both assessments take 1 day

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- www.vetcert.eu
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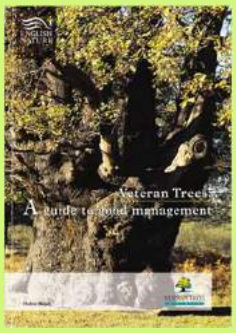
Further information



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Please fill in your evaluation forms!

Photo: Helen Read, England

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