

Enhancing the resilience of our trees, woodlands and forests
A framework for implementation

Step 1 worksheet

Define the system

What are you considering making more resilient?

It is essential to be clear about the focus of your thinking. For example, you might focus on the ecological integrity of woodland, in which case the system might be defined by the tree species or woodland type (e.g. an oak woodland).

Alternatively, you might want to focus on the resilience of your organisation, which includes objectives beyond forest management. Different spatial scales (e.g. the size of woodland or number of sites) and time frames (influenced by budgets or management plans) will impact the assessment of threats and appropriate actions. It is also necessary to define the main functions or services that you want the system to maintain over these scales. The table below contains guiding questions that will help to pin down the system identity and some examples from our case studies.

Guiding questions and examples for Step 1

Guiding questions applicable to all settings	Forest management company	County council
(a) What is the system? For example, woodland, ecosystem, organisation, business.	A large privately owned upland conifer plantation dominated by Sitka spruce	The entire county's treescape, including both publicly and privately owned trees, from street trees to ancient woodlands
(b) What is the time frame being considered? For example, years, decades, centuries.	35–40 years to match the average rotation length	Working to a 25-year vision with 5-year management plans while keeping longer timescales in mind
(c) What is the spatial scale being considered? For example, local, catchment, regional, national.	The entire 600-hectare forest site	County scale
(d) What are the main functions/services to be maintained?	To generate financial returns for investors	Multiple objectives (e.g. amenity, biodiversity, carbon sequestration) reflecting the diverse ownership

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Hints and tips for Step 1

- Clear system identification is important and will ease progression through later steps. Testing ideas among colleagues can be helpful and reaching a common understanding will be important if the group work is to continue (see box below).
- You may want to repeat the steps to focus on more than one system (e.g. a single woodland and a group of sites at a landscape level). This can be performed in parallel or one after the other.
- Defining timescales in the context of trees and ecosystems can be challenging. It may be dictated by management plans, budgets and rotation length that provide intervention points.
- Sometimes the system of interest becomes clearer after working through subsequent steps. You can return to Step 1 to refine the identification later in the process.
- It may be useful to start broadly then narrow in on the system later to avoid missing some threats.
- If the aim is to manage a transformation to a new system, use the same guiding questions to help identify both the current system and the future desired system.

Facilitating different opinions

Definitions and areas of priority can differ between and within teams. As a facilitator, it is important to allow each person the opportunity to contribute, and to challenge the group to question the current way of thinking. It might be useful to mind-map all the definitions of resilience and possible systems. This can help the group reflect on the similarities and differences. It might also be useful to refer to this later to see if there have been any changes of opinion after the workshop.

When defining the system, it might be worth considering all versions of the system (e.g. wildlife, economic, business or species) before deciding on a single definition that suits your context. It is possible to adjust your focus as you discuss each step. It is also possible to return to Step 1 and change how the system is defined later in the workshop.

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Step 2 worksheet

Identify threats to the system

What threats may challenge the system's ability to persist in its current or desired state?

These may be biotic (e.g. pests), abiotic (e.g. drought) or social/economic/political (e.g. built development pressure) threats, shocks and stresses, as shown in the table below. Some threats may be commonplace and manageable, while others may represent an unacceptable challenge to your system. Some may be negatively impacting your system already, whereas others may not yet be present. Threats can also interact (e.g. climate change and disease) leading to further disturbance.

Example systems and threats for Step 2

Main category of threats	Publicly managed multifunctional forest	Restoration site (plantation on ancient woodland site) managed by conservation organisation
Biotic (biological)	<ul style="list-style-type: none"> Mammals (e.g. squirrel and deer) Insect pests (e.g. pine weevils) Plant disease impacting species choice (e.g. <i>Dothistroma</i> needle blight affecting Corsican pine) 	<ul style="list-style-type: none"> Mammals (e.g. squirrel and deer) Current and new insect pests and diseases Loss of natural processes (e.g. woody debris)
Abiotic (physical/chemical)	<ul style="list-style-type: none"> Pollution (excessive atmospheric nitrogen deposition) Climate change (wetter/warmer winters and hotter/drier summers) impacting fire risk and water availability 	<ul style="list-style-type: none"> Climate change (in particular high rainfall events becoming more frequent, and coupled with the steep terrain causing erosion and flooding)
Social/economic/political	<ul style="list-style-type: none"> Reduction in value of timber markets Future food security may involve land-use change from forest to agriculture Recreational disturbance to ground nesting birds 	<ul style="list-style-type: none"> Opposition to thinning and felling (limits the options for building irregularity into the even-aged stands) Increased competition for funding internally and from other charities

Note: see more examples on the Research Implementation Framework – template

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Hints and tips for Step 2

- On the first attempt, treat this step as a brainstorming exercise. Evaluation of actions, prioritisation and synergies can take place later.
- You may want to add further columns to the table above to include:
 - (i) What is the likely frequency of the threat within the timescale of interest, and does the severity increase and decrease in 'pulses' or is it more prolonged and ongoing?
 - (ii) Are there synergistic effects in which one threat acts to increase the impact of another (e.g. the potentially increased susceptibility of stressed trees to secondary pests/diseases)?
- After threat identification, you may want to use a matrix to order by impact and likelihood. The focus should be on high/medium risk threats in the red and amber sections in the diagram below. The categories can be expanded to fit your circumstances.
- Look back at the system identified in Step 1. Do the threats match the defined system?

		Impact		
		Low	Medium	High
Likelihood	Likely	Amber	Amber	Red
	Possible	Green	Amber	Amber
	Highly unlikely	Green	Green	Amber

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Step 3 worksheet

Identify the level of acceptable change

How much can the system (or planned future system) change before it reaches an undesirable state?

At what point do the key structural or functional aspects identified in Step 1 become threatened and require action, either to avoid the threshold being reached or to bring the system back to a desirable state? These are often challenging questions and the answers are highly dependent on the system of interest and the local context (see the table below). There may be several acceptable alternative states (e.g. woodland of varying age or species structure), but maintenance of the system (i.e. always a form of woodland) may be the goal. Natural systems may not rapidly return to the pre-disturbance state, requiring judgements regarding whether recovery is taking place or if the path is one of degradation, in which case interventions may be required. An acceptable length of time for recovery to the pre-disturbance state should be selected.

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Guiding questions and examples for Step 3

Guiding questions applicable to all settings	Conservation organisation woodland
Is the level of acceptable change defined by structure? For example, mortality of certain species or habitat loss.	Positive: Increase in native broadleaved species Increase in ground flora Negative: Increase in invasive species Loss of target indicator species
Is the level of acceptable change defined by function? For example, reduced carbon sequestration or income.	Positive: Increase in natural regeneration Increase in structural diversity and mosaics Negative: Decline in visitor numbers or public support
Are the boundaries fuzzy or precise?	Species change and visitor numbers can be measured for a precise boundary Desired level of natural regeneration is a fuzzy boundary
Are thresholds involved?	Multiple thresholds, including the required complement of indicator species to achieve the desired habitat
Are there potential trade-offs or different stakeholder priorities?	Increase in visitors (desirable for public engagement) could result in site damage and wildlife disturbance

Hints and tips for Step 3

- This step will reinforce/test the clarity of the initial system definition (Step 1), which may need to be adjusted to make progress.
- It is often challenging or undesirable to define precise boundaries to acceptable change (see box below). In these cases the boundaries are deemed 'fuzzy'.
- It can be helpful to think about both positive and negative changes, and thereafter the thresholds or boundaries between them. This process may also be useful when planning a managed transformation to a new system.
- It may also be helpful to describe signs of degradation, that is, unwanted change towards an undesired system (e.g. reduced regeneration of desired tree species, greater unpredictability in yields, soil erosion at specific sites).

Scale and position of acceptability

Change in a system may be more or less acceptable at different levels and scales in different organisations. The group might want to break into smaller groups to consider how a change could affect different stakeholders. For example, if a native tree species is affected by disease, what other species might this have an impact on? People and organisations will be invested with different interests, so take a moment to identify the groups you might not usually consider.

Here are some possible questions to think about:

- Is the change more acceptable at a county or neighbourhood scale?
- Is the change positive or negative?
- Where are the conflicts and agreements between the interested groups?

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Step 4 worksheet

Identify the desired pathway and related management actions

Which pathways and management actions produce the desired system outcome?

Resistance, recovery, adaptation and transformation represent pathways to increase resilience or change to a more resilient system. Focus can be given to one component (e.g. prioritising management techniques to increase **resistance** to an anticipated disturbance such as a pest). However, resilience may also be achieved by identifying appropriate actions for each component and then selecting from them.

It is important to identify, evaluate and prioritise a range of actions. Some actions already being taken may well apply, but there may also be a need to develop new methods, adapt old ones and consider the collective effect of all the actions being implemented. It is necessary to consider how management plans might be affected by future disturbance events or by changing objectives. A narrow set of actions, or locking the system into one rigid pathway, could be detrimental in the future, even if it appears suitable at present (see the table below).

The management objectives will influence responses to disturbance and the methods chosen for building resilience. For example, if it is vital to maintain the system in a particular state, then methods that emphasise resistance or very rapid recovery might be prioritised. The strengths and weaknesses of different management options and their potential for both desirable and undesirable consequences should also be considered.

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Management action examples for Step 4

Resilience component	Actions identified in response to the threat of insect pests and diseases by a private forest management company for an upland plantation	Actions identified in response to the threat of drought by the County Council managing trees in a diversity of settings
Potential resistance actions?	<ul style="list-style-type: none"> • Clean machines regularly (i.e. biosecurity of harvesting machinery, lorries and excavators) • Buy-British-first policy when sourcing plants (although some imports needed to meet demand) • Rhododendron removal (host for <i>Phytophthora ramorum</i>) 	<ul style="list-style-type: none"> • Plans and capabilities for watering to combat drought (especially of newly planted trees) • Vegetation management (e.g. weed control for young trees) • Site choice for new planting (e.g. use of sustainable drainage systems in urban areas)
Potential recovery actions?	<ul style="list-style-type: none"> • Licensing of mills (e.g. to accept infected timber) • Alternate restocking systems (e.g. use of natural regeneration) • New rides to improve inspection and harvesting access 	<ul style="list-style-type: none"> • Further use of the resistance measures outlined above (e.g. watering and vegetation management), if mortality has yet to occur • Pruning of street trees • Coppice management in woodlands
Potential adaptation actions?	<ul style="list-style-type: none"> • Alter restocking choices (e.g. no larch planting after <i>P. ramorum</i>) • Adjust forest design (e.g. thinning to increase airflow and reduce foliar pathogens) • Continuous cover forestry (site-specific, as a form of diversification) 	<ul style="list-style-type: none"> • Planting drought-resistant species • Installation of grey water systems • Amend local plans to directly reference best practice guidance • Encourage public engagement in watering schemes
Potential transformation actions?	<ul style="list-style-type: none"> • Species change (e.g. trialling the use of Lutz spruce in the east) 	<ul style="list-style-type: none"> • Infrastructure planning (e.g. changes to verge width) • Choose not to replace certain trees • Shift woodland creation to other less drought-prone areas

Note: see more examples on the Research Implementation Framework - template

Hints and tips for Step 4

- Similar to Step 2, treat this step as a brainstorming exercise on the first attempt. Evaluation of actions, prioritisation, consideration of trade-offs and synergies can take place later.
- Depending on your focus you might find it useful to look at toolkits and guidance available elsewhere, such as the [UK Forestry Standard \(UKFS\)](#) or the [Woodland Star Rating](#) self-assessment scheme. Further resources are also available at the end of this framework.
- Categorising actions as part of resistance, recovery, or adaptation pathways is useful for understanding timescales and for identifying complementary actions that ensure resilience is fully considered. However, actions do not always clearly belong to one pathway or another. If one is causing difficulty, consider making a holding decision and a note to come back to it later. You may eventually decide that the same action belongs in more than one pathway.
- The pathway under which certain actions are listed may change depending on how you identify the system in Step 1.
- Once completed, you may want to prioritise actions (see box below), search for recurring actions and synergies and develop an implementation plan. This could also take into consideration potential trade-offs and conflicts/unintended consequences of potential actions.

How to prioritise actions

Step 4 may result in a long list of possible actions. The best way to deal with this is to evaluate, prioritise and assign each task to the relevant person or team. There are several ways of approaching this and different teams may find that one method works better than another. Once you have created a list of possible actions, here are two possible methods to prioritise them:

The Breakdown

Identify the short- and long-term goals.

Breakdown the tasks required to achieve the goals into actions.

Categorise each action into a time frame (e.g. this year, next month, this week).

Assign the actions to the relevant person or team.

The Matrix

Create a 2 x 2 table, with Importance on the y-axis and Urgency on the x-axis.

Assign each action to an area on the table based on how urgent and important each is.

Thus, highly important and urgent actions would appear in the top-right corner.

Assign a deadline based on the priority.

The time frame will differ between actions and goals as your system may work on a 5- or 25-year cycle.

Importance	medium priority	high priority
	low priority	medium priority
	Urgency	

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Step 5 worksheet

Monitor and learn

How might the system change and when will the desired outcome be achieved?

The outcomes of the management and the implementation of the actions identified in Step 4 should be monitored and assessed to learn more about the resilience of your system.

In this way, management can adapt to the sequence of events that occur, to early signs of degradation and the changing environmental/economic/socio-political conditions. Monitoring also helps to understand how effective different actions are, and how they might be changed in the future (see the table below). Such learning may be a continual process, but a formal review may need to be scheduled to ensure that lessons are captured. It is important to ensure that information is collected and stored in ways which allow review and learning.

A useful exercise can be to examine a selection of priority threats and associated potential management actions from the previous step and compile a list of monitoring activities (some of which you may already conduct; others may be desirable).

Monitoring examples for Step 5

Threat	Current monitoring	Desirable monitoring
Insect pests and diseases	<ul style="list-style-type: none"> • Allow access to Observatree volunteers • Regular surveys (e.g. for ash dieback) • Forestry Commission aerial survey 	<ul style="list-style-type: none"> • Further collaboration and knowledge exchange with neighbouring land managers • Further training in pest/disease identification
Habitat degradation	<ul style="list-style-type: none"> • Site-level species and habitat surveys • Monitoring locations of invasive species 	<ul style="list-style-type: none"> • Woodland Wildlife Toolkit could help identify management actions to increase habitat quality and availability • Coordination with national monitoring (e.g. bird surveys)

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Hints and tips for Step 5

- Consider the routine information collected by your organisation and collaborators, and whether this can be used to focus on resilience.
- Build in staged reviews and link this to resource planning that supports further action. Start with a manageable set of actions and monitoring sources, and subject these to scrutiny. This will build knowledge regarding what works for your context. Take the opportunity to reflect and build such opportunities into your future actions (see box below).
- Some organisations create 'resilience champions' to support teams and managers in applying and monitoring resilience more broadly across the organisation.

End of the workshop

The end of the workshop is a good opportunity to reflect upon what has been discussed. Sometimes the discussions themselves are the most valuable activity. You could ask different members of the team to give a reflection to the group. After the meeting it may be useful to provide a summary of the key discussion points for future reference. Other users of this framework have found it productive to arrange a follow-up meeting to review the assigned actions in Step 4. This meeting could also be an opportunity to discuss how to monitor and record, as prompted in Step 5.

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