Environment and Rural Affairs Monitoring & Modelling Programme

ERAMMP Year 1 Report 17: Woodland Monitoring Review

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Abbreviations and some of the technical terms used in this report are expanded in the project glossary: https://erammp.wales/en/glossary (English) and https://erammp.cymru/geirfa (Welsh)

1 Introduction

The Welsh Government (WG) funded the Environment and Rural Affairs Monitoring and Modelling Programme (ERAMMP) and commissioned the Programme to complete a Woodland Monitoring Review to provide evidence of needs and monitoring activity associated with the woodland resource. The purpose was to identify where the ERAMMP could best contribute and add value to the wider woodland monitoring landscape.

1.1 Aim

To review the ongoing monitoring of woodlands and propose a set of recommendations to inform the commissioning of the ERAMMP field survey due in 2020-2021 to ensure the policy requirements and priorities of Welsh Government Forest Policy and NRW are met.

1.2 Approach

A review table for 6 major national current monitoring activities was co-developed by CEH and Forest Research (Table 1). Categories reported on for each scheme were:

- Sampling approach
- Extent
- Diversity
- Woodland structure
- Management / Impact
- Condition and pressures
- Landscape context, cultural features, connectivity and resilience

A series of options with rationale and costs were proposed for consideration by a NRW/WG working group. Finally, the opportunities for use of new technologies was addressed

Table 1. Summary of current national scale Woodland monitoring activities in Wales[1]

Issue relevant to SoNaRR and/or Woodlands for Wales Indicator	CS/GMEP	ERAMMP (as currently costed)	NFI	Woodland Trust Veteran Trees	Observatree	TreeAlert
Sampling approach						
Scale	1km squares	1km squares	All woodlands mapped in NFI map. Woodland – 1 ha squares for woodland. Small woods and hedgerows – 1 km squares.	Grid reference (mapped).	Variable between Grid References and 1 km squares.	Grid Reference.
Years (including future plans)	1978/90, 1998, 2007, 2012-16 depending on measurements.	As for CS/GMEP + re-survey in 2019/20.	Annually updated woodland map since 2006 – funding in place. Woodland – continuous rolling annual survey since 2009, funding for future years in place. Small woods and hedgerows last assessment 2017, next in 2022.	Ongoing on-line database.	2013-date (ongoing).	Evolved from the AshTag App (developed in response to the discovery of *Chalara* in 2012). Originally a smartphone app. Now a website allowing better (and 'real-time') input checking. (http://treealert.forestry.gov.uk)

[1] Abbreviations used are: Countryside Survey (CS); Glastir Monitoring and Evaluation Programme (GMEP); Environment and Rural Affairs Monitoring & Modelling Programme (ERAMMP); and National Forest Inventory (NFI).

Sampling approach (continued)						
Design	Structured stratified design by land classes.	Structured stratified design by land classes.	Full mapping of strata and stratified random sample.	Woodland Trust (WT) Ancient Tree Inventory (ATI) captures ad-hoc reports, primarily from interested publics.	Network of GB-wide trained and specialist 'citizen science' volunteers. Creation of high quality educational resources to support volunteers, but also for wider use by foresters, arborists, field biologists, *etc*.	For ad-hoc and centralised reporting of tree health issues by tree health professionals, forestry and arboricultural professionals and the general public.
Sample No.	Increasing over time from 26 to 100 (CS) to 300 (GMEP) 1km squares sampled every 8-10 years ca. 1% of Wales land in 2016	240 1 km squares sampled over 2 years (0.8% of Wales)	Woodland – 2000 × 1 ha squares every 5 years, 400 per annum (0.7% of woodland) plus 100% map. Small woods and hedgerows full map plus 31 × 1 km samples.	Number of reports highly dependent on population density and a relatively small number of spotters of (enthusiasts for recording) ancient and veteran trees. Records 'ancient', 'veteran' and 'notable' trees. WT ATI website advertises '160,000' trees recorded. (See also 'Other', below.)	Typically up to 20 volunteers working across Wales. Volunteers 'based' in England also submit survey reports from Wales. Reports of healthy trees or 'non priority' pests or diseases reported to project staff. Priority P&Ds reported via TreeAlert. Number of reports submitted is variable due to volunteer activity and outbreak situations. Reports generated via engagement activities are unrecorded.	Number of reports vary from year to year. Highly sensitive to the reporting of pests and diseases by the media.

Sampling approach (continued)						
Purpose / data analysis	National metrics for stock and change on 8-10 year cycle of changes in the wider countryside using a landscape approach. Data analysis using a modelling approach to take account of increase in sample size over time. Baseline metrics for Glastir from 2012-16.	National metrics for stock and change on 5-6 year cycle of changes in the wider countryside using a landscape approach. Data analysis using a modelling approach to take account of increases in sample size over time. Impacts of Glastir part of purpose as well as ongoing national trends.	Provision of Official and National Statistics for woodlands in Wales on annual and 5 yearly cycles. As well as delivering traditional 'production forecasts', outputs also include estimates of actual timber removals, above-ground woody biomass and embodied carbon. Statistics concerning woodland condition and social usage of woods are also produced.	Locating iconic, ancient and veteran trees, primarily so that these can be protected.	Early detection, reporting and monitoring of key tree pests and diseases, using a network of trained 'citizen science' volunteers. Promotion of tree health issues and project educational resources to stakeholders and other targeted groups. Promotion of reporting via Tree Alert. All submitted data are analysed by tree health scientists at FR and findings shared with colleagues from NRW, WG and GB plant health (FC/Defra).	Primary reporting and subsequent monitoring of the [rate of] spread of tree pests and diseases across GB. Reports send directly to the disease diagnostic and advisory service for triage. Where needed, field-based follow-up by FR staff, country tree health officials *etc*. is prioritised.
Other				Worth noting that there are other similar resources including Treezilla (the monster map of trees, a part NERC-funded citizen science project coordinated by the OU, with FR and Treeconomics, 829,675 individual trees recorded) and the Bluesky National Tree Map (commercial product).		

Extent						
Extent of woodland	Field mapping of all patches of woodland including copses, small and large woodland within 1km squares. Creation of national estimates of extent and change by scaling from samples,	No field mapping currently approved (under discussion). LIDAR/EO estimates where available for extent.	Earth observation based map of all woodlands calibrated by fieldwork. Annual afforestation and deforestation including causes. Also measures fragmentation as required by SoNaRR.		Reports may be received from any publically accessible individual trees or woodland.	Has the potential to capture information for all scales of trees and woodlands – urban and rural, 'commercial' and 'non-commercial'.
Area of new planting per annum (SoNaRR)	New planting recorded in GMEP.	Recording new woodland could be included in ERAMPP.	Key WG target, assessed by FR through earth observation, NFI fieldwork samples and FC/NRW grant data.			
Estimate of clearfell / non-clearfell – WfW[2]	Clear-fell recorded in GMEP.	No	Annual estimates based upon earth observation.			
Hedges	Yes, extent and change of all hedgerows within 1 km sample square.	No (under discussion)	Earth observation based map of all woody features calibrated by fieldwork.	Individual ancient, veteran and notable trees within these features (see 'Design' and 'Sample no.', above).	Reports may be received for any publically accessible hedgerow tree.	Yes
Lines of trees	Yes, extent and change of all lines of trees within 1 km sample square.	No (under discussion).	Earth observation based map of all woody features calibrated by fieldwork.	Individual ancient, veteran and notable trees within these features (see 'Design' and 'Sample no.', above).	Reports may be received for any publically accessible avenue or landscape tree.	

[2] Woodland for Wales (WfW): https://gov.wales/woodlands-wales-strategy

Veteran and individual trees	Yes	No (under discussion).	Earth observation based map of all woody features calibrated by fieldwork.	Yes (also 'notable' trees). (See 'Design' and 'Sample no.', above).	Reports may be received from any publically accessible ancient or significant tree. There is ambition within the project to strengthen links with the Ancient Tree Initiative.	Yes

Extent (continued)						
Priority habitats	Yes – but poor coverage of some. Recorded as above with creation of national estimates (extent and change) from samples.	No (under discussion).	Earth observation based map of broad woodland habitats and provision of Welsh Habitats directive priority and Annex 1 habitats identified by fieldwork.	No.	If trees present, and if publically accessible.	Yes
SoNaRR and WfW-Ancient Woodland, ASNW and PAWS status			NFI confirms the categories in the field samples and assesses change in condition and the native / non-native mix in PAWS restoration targets.			
Other?			Woodland types (coppice, plantation, ASNW, *etc*.). Owner types (private, public, church, farm, estate, commercial *etc*.).		Potential to offer training for ERAMMP surveyors?	Urban (including street trees, urban woodlands, parks and private gardens).

Diversity						
Tree canopy	All tree species recorded for large and small woodlands.	No (under discussion).	All tree species recorded, including very minor components of woodland composition. No generalisation. Includes shrubs and lower stories.			
Ground flora	Permanent 2m x 2m and nested 200 m^2 plots recorded for full plant species composition in woodland. 5 randomly placed plots per square, if in woodland then 200 m^2 in size – Maximum of up to 40 other plots depending on complexity of habitat within the square, 2m x 2m and 1m x 10m.	Permanent 2m x 2m and nested 200 m^2 plots recorded for full plant species composition in woodland. 5 randomly placed plots per square, if in woodland then 200 m^2 in size– Maximum up to 40 other plots depending on complexity of habitat within the square, 2m x 2m and 1m x 10m.	Abbreviated ground flora assessment made at 2000 × 1 ha samples. Includes invasive non-native species.			
Hedge diversity	Yes, up to 10, 1m x 30m plots for woody species, and up to 7, 1m x 10m plots for hedge ground flora. Mapping of species composition	Yes, up to 10, 1m x 30m plots for woody species, and up to 7, 1m x 10m plots for hedge ground flora No mapping (under discussion)	Tree species diversity assessed.			
Lines of trees	Some 1m x 10m plots Mapping of species and DbH.	Some 1m x 10m plots. No mapping (under discussion).	All mapped.			

Diversity (continued)						
Veteran trees	Yes, up to 2 per species. Species, DbH, type of tree, epiphytic species, amount of trees dead/alive, missing limbs, lightning strikes, hollow trunk recorded.	No (under discussion).	Mapped in small woods map. All mapped in field samples. Species, rot holes, rot sites, deadwood, hollowing, water pockets, bark fluxes, tears, scars, lightning strikes, bird nests, bat roosts, woodpecker holes, foliose lichens, bryophytes, ferns, vascular plants, tree form, dbh, heritage tree or not.	Mapped, where noted (see 'Design' and 'Sample no.', above). For each specimen tree, species, girth and access (ibility) is recorded.		
Individual trees	Yes, all trees within square, species, DbH.	No (under discussion).	Mapped in small woods map. All mapped in samples. Species, diameter, height, tree health *etc*. recorded from a sample.	'Notable' trees mapped (see 'Design' and 'Sample no.', above). For each notable tree, species, girth and access(ibility) is recorded.		
Pollinators	2012-16 only.	As for GMEP but reduced sample size.				
Birds	2012-2016 only.	As for GMEP but reduced sample size.				
Genetic base – to be developed, if feasible Woodlands for Wales Indicators			No, other than species ranges and amounts.			
Other?						

Woodland structure						
Age	No	No	Yes, expert field estimates made. Statistically calibrated by records and tree coring and ring counts.		(Yes) Approximate size of trees affected by pests or diseases recorded, also evidenced through uploaded images.	(Yes) Size of affected trees, evidenced through mandatory uploaded images.
Dbh	Yes	No (under discussion).	Yes, down to 7 cm over bark.		(Yes – for affected trees).	(Yes)
Height	No	No	Yes, *circa* 10,000 measurements per annum.		No	(Yes)
Hedge features	Base height, DbH, species.	No (under discussion).	Height, width, species.		No	(Yes)
Woodland structural diversity (SoNaRR)	Internal open habitats, rides, glades recorded. 200m^2 plot records different structural elements, ground flora, shrubs, trees	No	Yes. As part of the condition assessment NFI measures tree story structure, canopy composition, stand size, tree age, tree regeneration and internal open habitats such as glades, streams rides etc.			
Other….?					Three images uploaded. Affected tree from a distance (in context), affected part, and close-up of symptom(s). Allows some 'structural' information to be inferred. Information also recorded on context of affected tree.	Three images uploaded. Affected tree from a distance (in context), affected part, and close-up of symptom(s). Allows some 'structural' information to be inferred.

Management / Impact						
Felling	Yes	No	Yes, quarterly using Earth Observation techniques and annually from field work.		Potential management and felling impacts for significant pest or disease mitigation.	No
Re-planting	Yes	No	Yes, quarterly using Earth Observation techniques and annually from field work, including species, stocking rates and gross net area.			No
Timber removals and maintaining productive capacity of woodlands (Total harvest /availability ratio) SoNaRR and WfW			NFI measures actual timber removals each year within the NFI samples. It also measures growth and increment of timber against which to measure sustainable removals at present and to forecast this for future timber supply.			
Woodlands in management (SoNaRR)			NFI measures type and age of woodland management activity, enabling reporting against WG targets.			
Proportion of farmers who are harvesting firewood or timber – WfW			This can be calculated from NFI fieldwork and woodland owner questionnaire data.			

Habitat boxes	Yes	No	No			No
Grazing	Stock and non-stock, herbivore type, deer, squirrel etc.	No	Yes, herbivore type, damage and presence, (includes deer, squirrel, rabbit, domestic stock, *etc*.).			No
Pheasants and pheasant pens	Yes	No	Yes			No
Tree protectors/staked trees	Yes	No	Yes			No
Hedge management	Yes- none, recent management, newly planted, cutting e.g. flail or saw, laying or coppicing, tree protectors.	No (under discussion).	No (other than height).			No
Hedge margin	Yes	No	No			No
Hedge gappiness	% of vertical gaps.	No (under discussion).	Yes			No
Types of (recreational) activities undertaken in woodlands			Yes, NFI assesses a wide range of recreation activities; walking, dog walking, equestrian, cycling *etc.*			
Condition and Pressures						
Soil quality	Soil metrics (0-15cm) in 5 locations / square co-located with vegetation plots.	Soil metrics (0-15cm) in 5 locations / square co-located with vegetation plots.	FutMon (EU-level forest monitoring system) soil assessment network and intensive monitoring plots.			No

Tree disease	Some, surveyors asked to identify if there was *Chalara*, Dutch Elm disease, Sudden Oak death or *Phytopthora* but more training required.	No (under discussion).	Yes. Priority diseases looked for and recorded, regional concern species and general symptoms. National mechanism for monitoring tree health in wider population.		Yes. 22 Selected Priority pests and diseases. These are chosen in consultation with GB-wide tree health professionals. A further 8 are also promoted through the project website. Volunteers are also encouraged to report any other significant symptoms.	Yes. All diseases, novel and known.
Invasives and non-native species (INNS)	Yes- mapping and plots.	Yes- plots only.	Yes, all areas of plots.		Yes where applicable to tree pests or diseases.	No
Habitat condition – SoNaRR and Woodlands for Wales indicator	Disaggregated measures of habitat condition recorded.	No (under discussion).	NFI assesses in detail for each woodland habitat type providing a score of favourable / unfavourable *etc*. These scores are based upon 15 separate woodland condition factors including; deadwood, native canopy cover, number of natives, story structure, seedlings and saplings, herbivore damage, age distribution, proportion of open space, size of wood and adjacent habitat type.			

Landscape context, cultural features, connectivity and resilience						
Contextual information	Co-located data within 1km squares with respect to other habitats and assets including headwaters, ponds, birds, pollinators, historical environmental features, public paths.	Co-located data within 1km squares with respect to other habitats including headwaters, ponds, birds, pollinators, historical environmental features, public paths.	Adjacent and internal non woodland broad and priority habitats mapped. Ponds, rivers, drains *etc.* mapped and assessed.		Contextual information about the surrounding environment of an affected tree.	(No – some information can be inferred from contextual photographs.)
Landscape visual quality	360 degree landscape photos from each square used to quantify state and change of landscape using Visual Quality Index (VQI).	360 degree landscape photos from each square used to quantify state and change of landscape using Visual Quality Index (VQI).	No			(No)
Resilience	Mix of extent, condition, diversity and connectivity captured used to report on resilience characteristics of land in GMEP.	Mix of extent, condition, diversity and connectivity captured could be used as in GMEP.	Covered in detail. Ratio of seedlings and saplings to established trees, plus tree ages to assess succession. Tree growth rates assessed on 5 year cycle to assess vigour, plus general indicators of poor health.		Monitoring of Sentinel tree network within the project records the changing health and condition of individual trees.	(No)
Integrated catchment management (SoNaRR)			Woodland extent and type per water catchment, plus impacts of new planting and restocking per annum.			

2 Options for additional woodland measurements in ERAMMP field survey

Options for including additional woodland measurements into the ERAMMP field survey.

Whilst costs for each option has been costed separately the costs are not very helpful as they do not reflect the efficiencies of adding on an additional measurement once surveyors are within a survey square. To cost up all possible combinations of all possible measurements is beyond the resource of the project office and would be very complicated to review – therefore ERAMMP has proposed two 'bundle' options of similar cost to review and prioritise. These are as follows:

Table 2 Costed options for additional woodland measurements

SoNaRR category	Potential support to 'Woodland for Wales' Indicator No.	Feature	Specific option for inclusion in ERAMMP field survey	Why	Why not	Cost (incl. all T&S, planning etc.)	ERAMMP team proposed priority order
State (extent & connectivity)	1, 2, 7	Woody Linear Features.	Length of every hedgerow and line of trees in the square.	To maintain time series with CS and GMEP which has reported since 1990. No other data source.	LIDAR may do it in time but needs ground truthing data. Uncertain if LIDAR will be repeated.	£238,000	1
State (diversity)	2	Woody Linear Features.	Condition measures - DbH, species, evidence management, gappiness, disease.	Only large scale data on WLF condition. EO and LIDAR will not provide the information. Disease would be new.			1
State (extent & diversity)	1,2, 7	Small woodlands.	Extent and structure (e.g. belt, clump) - Habitat type includes PH- all small woodlands in square, species composition.	Unique record of change data since 1990.	NFI some reporting of small woods but new baseline so no change in data to		1

SoNaRR category	Potential support to 'Woodland for Wales' Indicator No.	Feature	Specific option for inclusion in ERAMMP field survey	Why	Why not	Cost (incl. all T&S, planning etc.)	ERAMMP team proposed priority order
					date so we lose the 30 year record. Cost for all 3 above = £223,000.		
Pressure	8	Small woodlands.	Tree disease.	No-one else checking tree disease on small woodland patches.	Cost £117,000		2
State (extent & connectivity)	1, 2, 7	Woody Linear Features.	Length of every hedgerow and line of trees in the square.	To maintain time series with CS and GMEP which has reported since 1990. No other data source.	LIDAR may do it in time but needs ground truthing data Uncertain if LIDAR will be repeated	£291,000	1
State (diversity)	2	Woody Linear Features.	Condition measures- DbH, species, evidence management, gappiness, disease.	Only large scale data on WLF condition. EO and LIDAR will not provide the information. Disease would be new.			1
State (extent & diversity)	1,2, 7	Small woodlands.	Extent and structure (e.g. belt, clump) - Habitat type includes PH- all small woodlands in square, species composition.	Unique record of change data since 1990.	NFI some reporting of small woods but new baseline so no change data to date so we lose the 30 year record. Cost for all 3 above = £223,000.		1
State (extent & diversity)	1,2	Individual trees.	Number/presence of trees, species, DbH, signs of disease.	Data on individual trees outside woodland is scarce.	£173,000		2

SoNaRR category	Potential support to 'Woodland for Wales' Indicator No.	Feature	Specific option for inclusion in ERAMMP field survey	Why	Why not	Cost (incl. all T&S, planning etc.)	ERAMMP team proposed priority order
State (extent & diversity)	1,2	Veteran trees.	Number/presence of trees, species, DbH, limited condition measures- only 2 per species recorded in square.	Data on veteran trees outside woodland is scarce.	£104,000		2

3 Recommendations Going Forward

3.1 WG Forest Resources Policy Decisions

3.1.1 Extent, connectivity & diversity (small woodlands/linear features)

WG concluded that inclusion in the ERAMMP field survey is justified due to their fundamental importance for WfW and also for capturing the state and condition of woodlands set within the wider landscape of non-woodland resources including properties related to resilience. This maintains an historical timeline back to 1978 which is missing from the more recent recording of small woodlands e.g. in the NFI.

3.1.2 Veteran/ancient trees/individual trees

This topic prompted more discussion:

WG Forest Resources Policy comments received were as follows:

“There are a number of databases where information on ancient/veteran and individual trees is collected, including the Woodland Trust ancient tree inventory and Treezilla. Both rely on citizens to record trees and is a scattergun/very selective approach.

Capturing this data through the ERAMMP field survey will provide a systematic sample approach which is repeatable. It will provide consistency with previous GMEP survey and provide additional data not held by the Woodland Trust data base.

It will also extend any data on ancient/veteran trees captured by NFI – and it would be worth contacting NFI re: what they collect and potentially align, but we are particularly interested in recording condition so no wish to lose this element.

There may be a need to retain the ERAMMP field survey data as stand-alone so that it can be repeated in future and recorded trees monitored especially in relation to condition.

If it is possible to align with the Woodland Trust approach to capturing *species*, that would be helpful as this can affect whether some trees are classified as ancient/veteran.”

WG concluded that inclusion in the field survey is justified.

“This records the state of an important element of our natural resources, and also helps meet a commitment in the Woodlands for Wales strategy (p.43): We have more information about wood pasture, parkland and ancient and veteran trees in Wales, so that we can improve mapping and monitoring of their extent and condition.”

3.1.3 Tree Disease

Again considerable discussion:

"Observatree is a major tool in gauging pests and diseases but there is an urgent need to increase the data collected in Wales which is the opportunity provided by ERAMMP field survey. Data is then passed on to Treealert for ongoing confirmation/verification and recording which is resourced by Forest Research.

It was acknowledged that ERAMMP field survey should **not** be expected to do a full survey of all tree pests/diseases as this is complex and time consuming.

However they would require some training in order to be able to differentiate between biotic and abiotic symptoms.

The number of tree and pests included in the standard Observatree training does include some that are widespread so would no longer warrant recording in Wales as we know they are prevalent.

The proposal is that Forest Research provide a cut-down version of the Observatree training, focusing on key pests and diseases. The focus is to identify trees that look sick during the field survey, identify whether it is a key disease/pest and if so, record on Treealert."

WG concluded there was insufficient rationale for including disease within the ERAMMP field survey due to other ongoing activities and cost of ensuring full and effective data capture of a complex topic. Non-specialists could end up reporting instances of drought/frost or wider spread common ailments which is not helpful.

4 Opportunities for exploitation of new technologies in the future

Both LIDAR and EO offer major potential in the future but this is currently expensive, still evolving and not available for full operational use. There may be scope to share ERAMMP captured data with this in future and continued engagement with e.g. Living Wales and Defra activities will be continually reviewed.

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