Forest Research

Managing Forests in Acid Sensitive Areas

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New Practice Guide & Research Note

Practice Guide: Managing Forests in Acid Sensitive Water Catchments

Summary

Acidification continues to affect acid sensitive regions of the UK, damaging fisheries and causing adverse ecological changes in freshwaters. Forestry is known to influence the degree of acidification, principally due to the ability of forest canopies to capture more acid sulphur and nitrogen pollutants from the atmosphere than shorter types of vegetation. As a result, there is a need to manage forestry within vulnerable areas to ensure that it does not lead to increased acidification or delay the recovery of waters to Good Ecological Status. This Guide describes the measures that can be taken to minimise adverse impacts and provides a methodology for determining whether new planting, felling or restocking proposals could pose a risk to freshwaters. It includes maps showing the areas at risk and decision trees to guide those involved with woodland creation or the felling and restocking of existing forests within vulnerable areas through the component steps of catchment-based critical load and site impact assessments.

Introduction

The quality of water draining large parts of the UK uplands has been profoundly affected by atmospheric pollution since the onset of the industrial revolution. Of primary concern has been the widespread acidification of lakes and streams by the deposition of acidifying sulphur and nitrogen compounds derived in part from the combustion of fossil fuels. Acidification has resulted in marked ecological changes in affected waters, including the elimination of many aquatic plant and invertebrate species, the decline or complete loss of fish, and a reduction in the density and distribution of higher animals such as certain amphibians and birds.

Growing recognition of the adverse environmental impact of atmospheric pollution led to international controls on acidic emissions being introduced in the 1980s. While these have resulted in dramatic reductions in the emissions of sulphur and to a lesser extent nitrogen gases to the atmosphere, the response of acidified waters has been slow and many water bodies remain impacted. The objective of the EU Water Framework Directive (WFD) is to achieve what it defines as Good Ecological Status (GES) in all water bodies by 2027, but the recovery time for waters to respond to emission reductions is hard to predict due to the complexity of factors involved. In some cases, full biological recovery is expected to take decades and GES may not be achieved until after 2027. Consequently, there is an urgent need to implement other measures to promote the recovery process, including measures within areas of forestry.

Forestry is known to affect the acidification of waters, principally due to the ability of forest canopies to capture more acid sulphur and nitrogen pollutants from the atmosphere than shorter types of vegetation. As a result, it is important to manage forestry within vulnerable areas to ensure that the problem is not exacerbated and opportunities for improvement are realised. The UK Forestry Standard (UKFS) Forests and Water Guidelines (Forestry Commission, 2011) has the requirement: "Where new planting or restocking is proposed within the catchments of water bodies at risk of acidification, an assessment of the contribution of forestry to acidification and the recovery process should be carried out; details of the assessment procedure should be agreed with the water regulatory authority". This guidance, agreed by the relevant forestry, water and nature conservation authorities in the UK, describes how to meet this requirement, including the need to undertake a critical load assessment where new planting or restocking is proposed within the catchments of

Forestry and surface water acidification

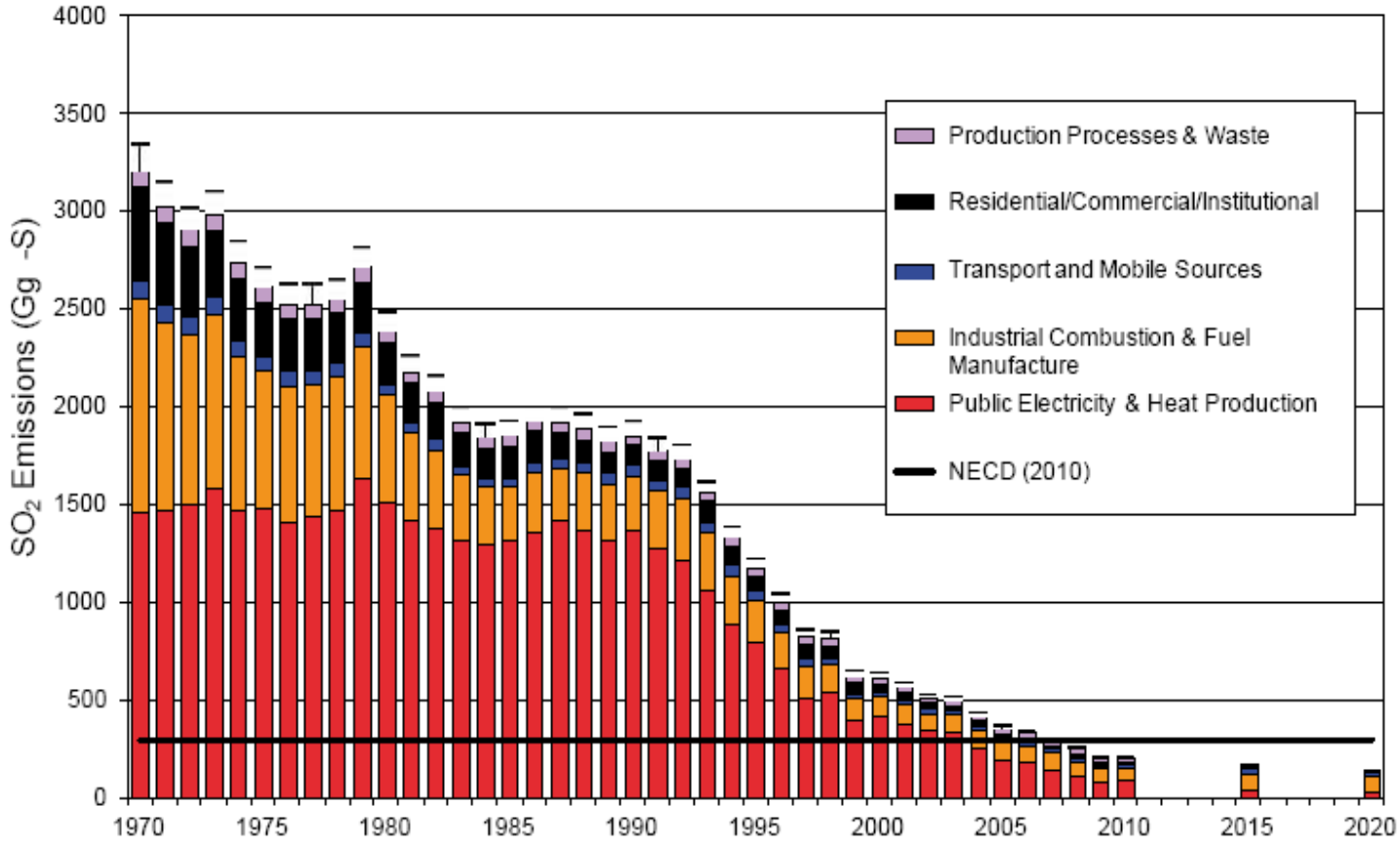
T. R. Nisbet of Forest Research and C. D. Evans of Centre for Ecology and Hydrology March 2014

Forests and forest management practices can affect surface water acidification in a number of ways. The primary mechanism is the ability of tree canopies to capture more sulphur and nitrogen pollutants from the atmosphere than other types of vegetation. Pollutant scavenging is expected to have peaked in the 1970s when emissions were greatest and led to surface waters draining catchments dominated by forestry being more acidic. The introduction of emission control policies in the 1980s has achieved major improvements in air quality and studies show forest sites to be recovering in line with their moorland counterparts. However, forest streams remain more impacted, requiring continued restrictions on new tree planting and restocking. Tree planting can influence acidification by the scavenging of acid deposition, base cation uptake, the scavenging and concentration of sea salts, soil drying and the formation of an acid litter layer at the soil surface. Cultivation, drainage and road building, fertiliser use, felling and harvesting, and restocking also have effects. This Research Note considers each of these factors in turn and assesses the role of tree species, planting scale and design. It covers the identification and protection of vulnerable areas, use of critical load and site impact assessments, research and monitoring, and measures to promote recovery. Continued monitoring will be essential to demonstrate whether current measures remain fit for purpose and guide the development of good practice.

FCRN016 Forest Research

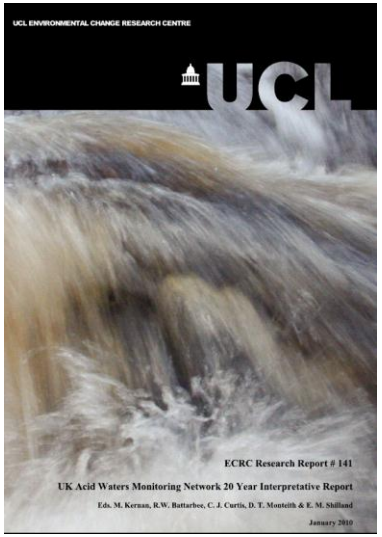
Pollutant S Emissions

Response of UK emissions of sulphur dioxide to pollution control (from RoTAP, 2012):

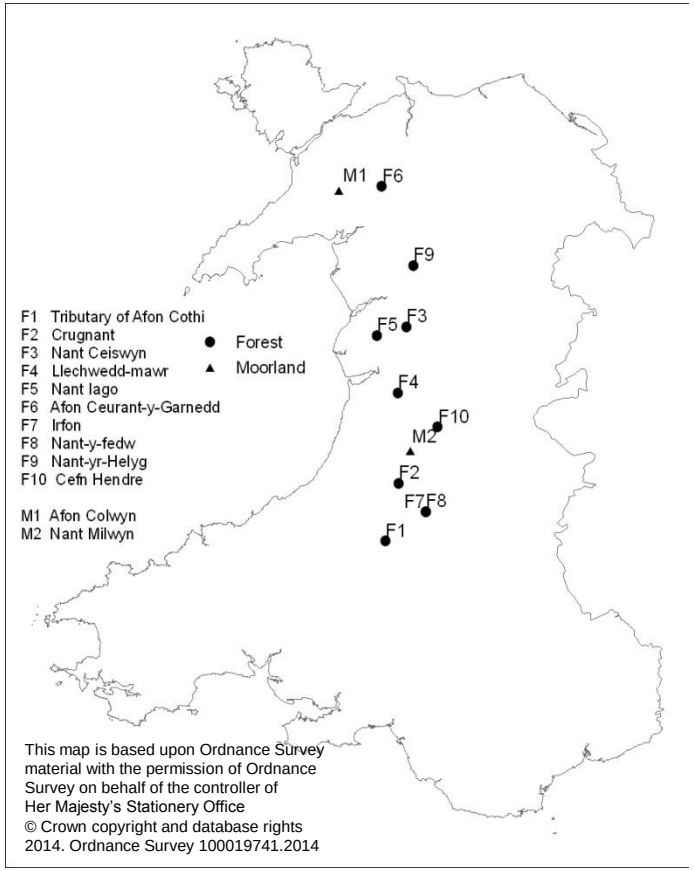


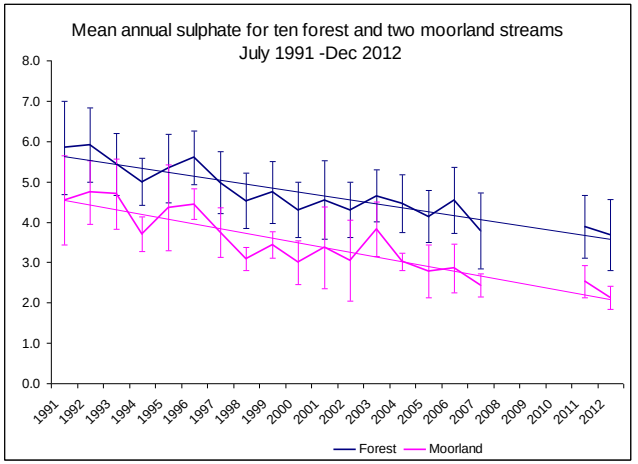
Findings of UKAWMN 20 year report:

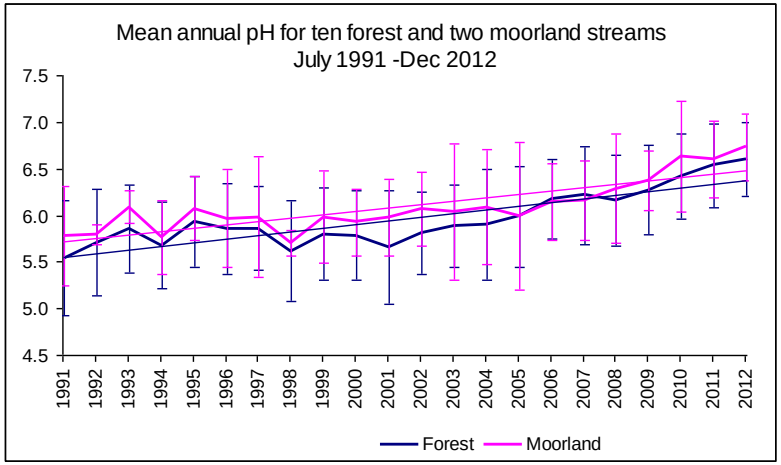
- "Chemical recovery is underway in both afforested and moorland catchments and if anything, ANC is rising more quickly in the afforested sites"
- "Looking to the future, MAGIC predicts a very rapid recovery at the acidified forested sites, with all except Loch Grannoch predicted to have an ANC >20 by 2020."
- "Planned reductions in forest cover will have a small effect on the risk of critical loads exceedance and are unlikely to significantly alter the path to recovery."
- However, afforested sites continue "to have higher acid anion concentrations and are more acidic."



FR/NRW acid waters network continues to show stream recovery, in line with UKAWMN

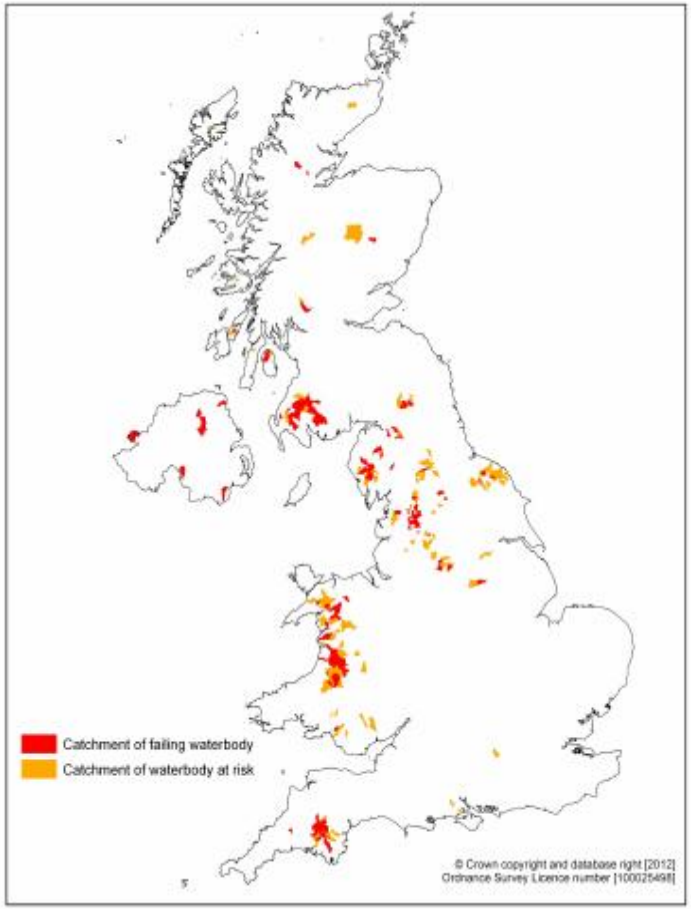


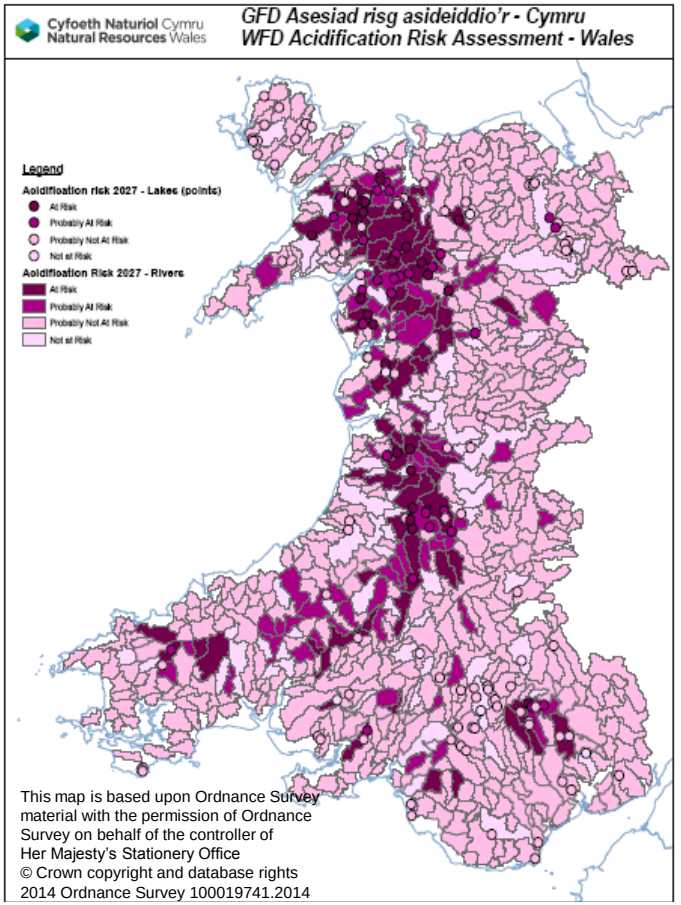




Identifying Vulnerable Areas

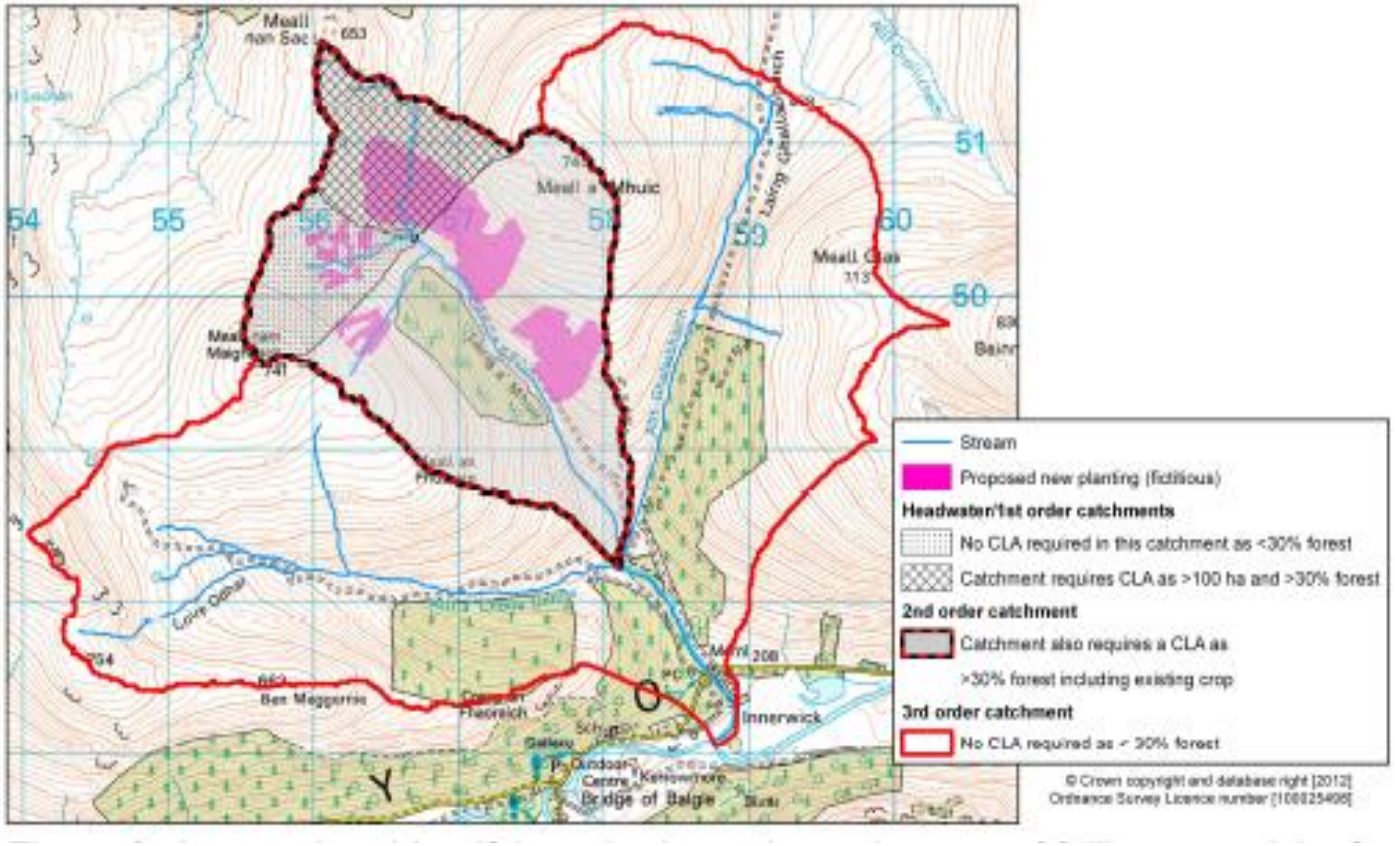
Catchments of river and lake water bodies failing or at risk of failing GES due to acidification caused by acid deposition:





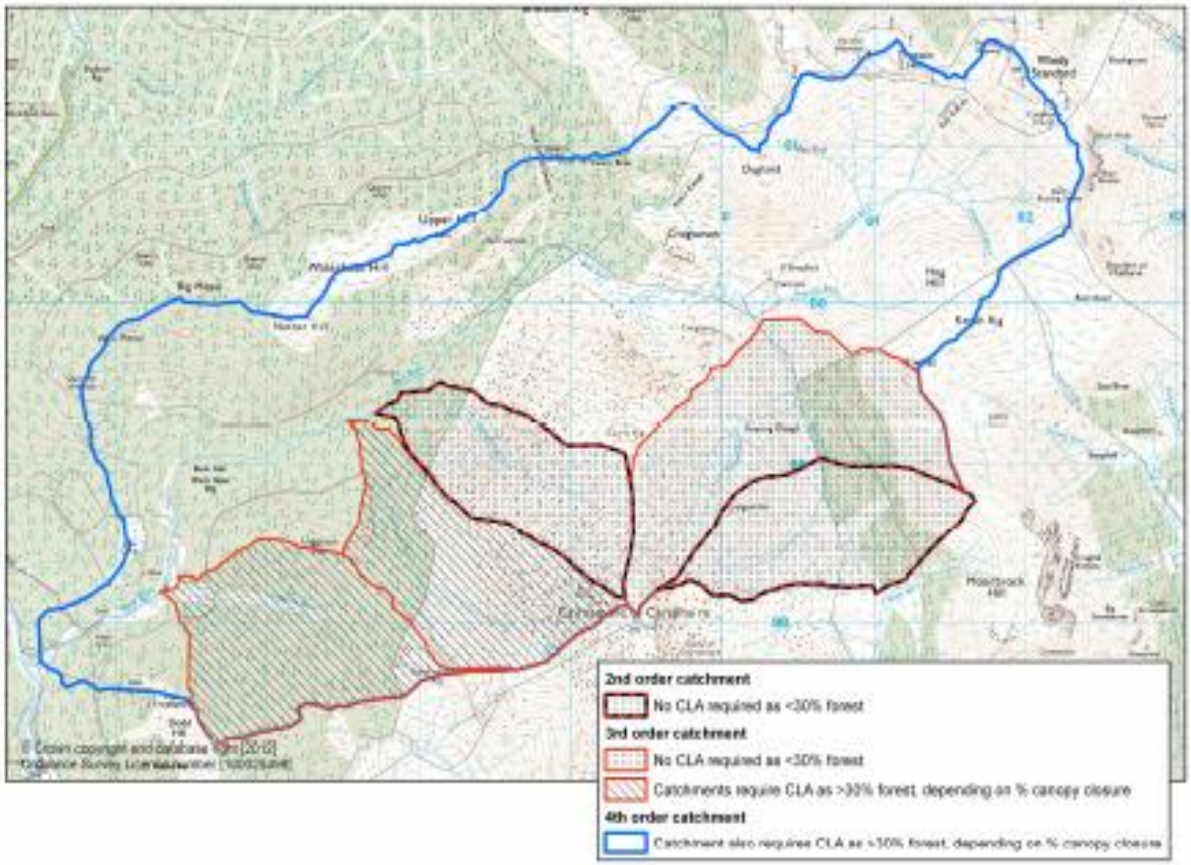
Identifying Vulnerable Catchments

Approach to identifying whether catchments within failing or at risk water bodies require a Critical Load Assessment for New Planting:



Identifying Vulnerable Catchments

Approach to identifying whether catchments within failing water bodies require a Critical Load Assessment for Restocking:



Henriksen Steady-State Water Chemistry Model:

CL = ([BC]o* – [ANC limit]) . Q

CL = Critical Load (keq H/ha/yr)

[BC]o* = Non-marine base cation concentration in streamwater prior to acidification (Na + K + Ca + Mg)

[ANC Limit] = Critical concentration appropriate to target organism. Value of 20 μeq/l selected for brown trout

Q = Run-off (rainfall/1.15)

Calculation of critical load exceedance:

Clex = S*dep + [NO_3^-] . Q – CL

Clex = Critical Load Exceedance (keq/ha/yr)

S*dep = Non-marine sulphur deposition (keq H/ha/yr)

[NO_3^-]= Nitrate concentration in run-off (μeq/l)

Q = Run-off (rainfall/1.15)

CL = Critical Load (keq H/ha/yr)

Measures to reduce impact of new planting:

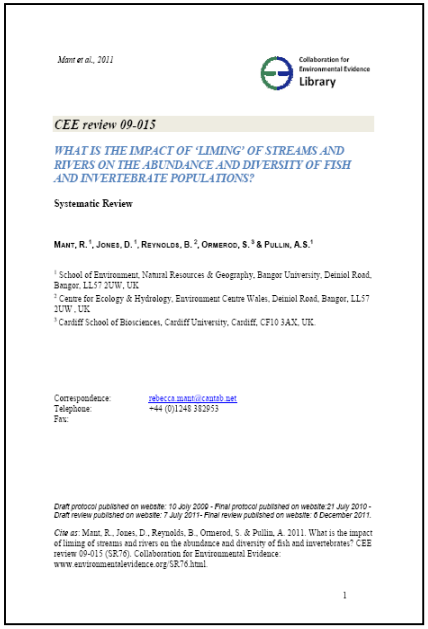
- Reduce scale of planting to below 30% cover in affected catchments;
- Change conifers to broadleaves - while this will have a small effect on pollutant scavenging, it could help to reduce nitrate leaching;
- Restrict planting of N-fixing species to <10% of forest cover;
- Where existing forest cover contributes to new planting exceeding 30% threshold, reduce its contribution through re-design (e.g. change age distribution or increase open space).

Measures to reduce impact of restocking:

- Adjust crop age or increase open space so that the proportion of future closed canopy forest cover falls below the 30% threshold in affected catchments;
- Convert to Continuous Cover Forestry or Low Impact Silvicultural Systems;
- Convert conifers to broadleaves where N is an issue;
- Deforestation.

Case for Liming?

- While on average, liming increased abundance and richness of acid-sensitive invertebrates and increased overall fish abundance, the benefits were variable and not guaranteed;
- Notably, there was an 18% probability of liming reducing fish abundance, no overall effect on trout abundance (mean effect was negative but not significant), and an overall negative effect on total invertebrate abundance;
- The significant risk of ecologically negative impacts makes it difficult to justify liming when natural recovery is underway, albeit slowly;
- Before sampling for critical loads, need to check whether area has recently been limed and adjust sampling programme accordingly.



Mant et al., 2011

Collaboration for Environmental Evidence Library

CEE review 09-015

WHAT IS THE IMPACT OF 'LIMING' OF STREAMS AND RIVERS ON THE ABUNDANCE AND DIVERSITY OF FISH AND INVERTEBRATE POPULATIONS?

Systematic Review

MANT, R.[1], JONES, D.[1], REYNOLDS, B.[2], ORMEROD, S.[3] & PULLIN, A.S.[1]

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Draft protocol published on website: 10 July 2009 - Final protocol published on website:21 July 2010 - Draft review published on website: 7 July 2011- Final review published on website: 6 December 2011.

Cite as: Mant, R., Jones, D., Reynolds, B., Ormerod, S. & Pullin, A. 2011. What is the impact of liming of streams and rivers on the abundance and diversity of fish and invertebrates? CEE review 09-015 (SR76). Collaboration for Environmental Evidence. www.environmentalevidence.org/SR76.html.

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Promoting biological recovery:

- Accelerate the clearance of dense shading riparian conifer stands;
- Co-ordinate timing of conifer removal in riparian zones to promote ecological recovery (to link with previous clearance work and connect reaches supporting fish);
- Encourage active management of cleared riparian zones to facilitate quicker establishment of native riparian woodland and to control conifer regen;
- Where possible, extend width of the riparian buffer zone along small streams (channel <1 m wide) to a minimum of 10 m where potential to support fish;
- Work with fishery groups to identify barriers to fish movement that may be constraining recovery and where appropriate plan for their replacement;
- Encourage expansion of riparian woodland into treeless areas to improve habitat conditions for fish.

Conclusions

- Primary mechanism responsible for a forestry acidification effect is the ability of forest canopies to capture more acid pollutants from the atmosphere;
- Emission control has led to major improvements in air quality, marked chemical recovery and increasing evidence of biological recovery in acidified waters;
- Monitoring shows forest sites recovering in line with moorland counterparts but remain more acidic;
- Modelling indicates that improved air quality will reduce the forest effect to a small margin, although the most acid-sensitive waters are likely to remain impacted;
- Appropriate controls and measures are in place to protect sensitive sites from any potential forestry effect;
- Continued monitoring is essential to demonstrate that measures remain fit for purpose and to guide the need for future revisions.

Cyfoeth Naturiol Cymru
Natural Resources Wales

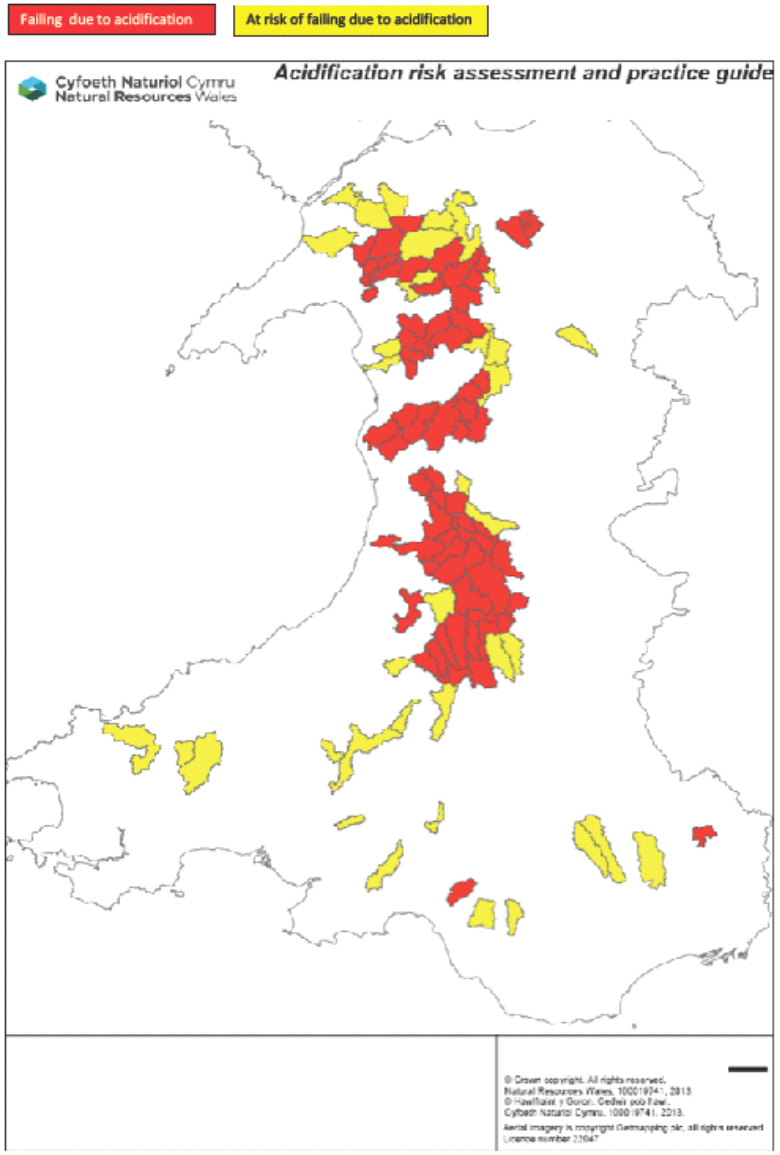
Implementing the Practice Guide to Managing Forests in Acid Sensitive Water Catchments in Wales

Barbara Spence

Forest Management and Environmental Quality Officer

Cyfoeth Naturiol Cymru
Natural Resources Wales

Acid sensitive water bodies in Wales



Implementing the practice guide in Wales

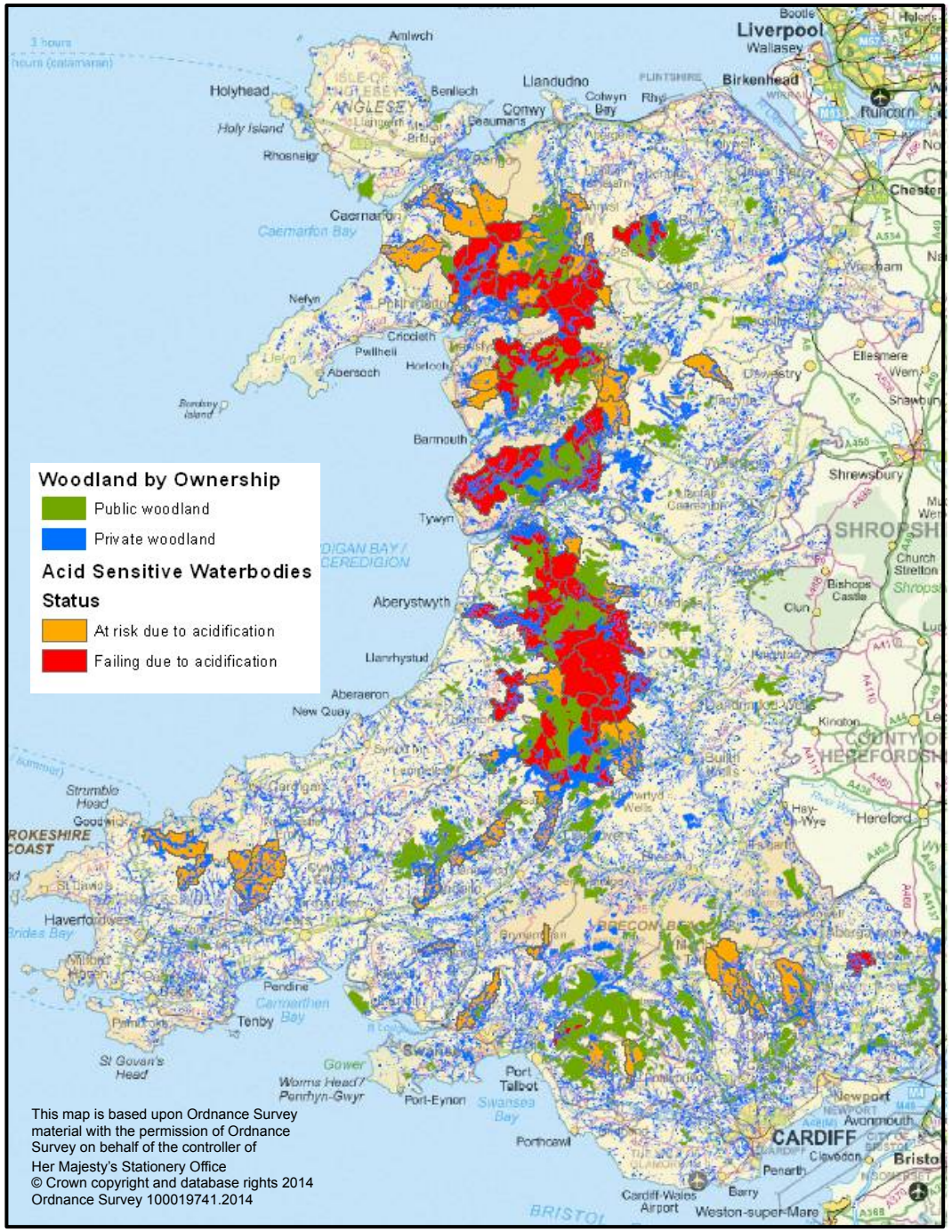
Total area of Wales in acid sensitive water bodies
301k ha - 14.5% of total land

Woodlands in acid sensitive water bodies

Total area of woodlands affected
48.3k ha - 15.6% of all woodlands

Private woodlands
21.9k ha – 7.1% of all woodlands

WG woodlands
26.4k ha - 8.5% of all woodlands



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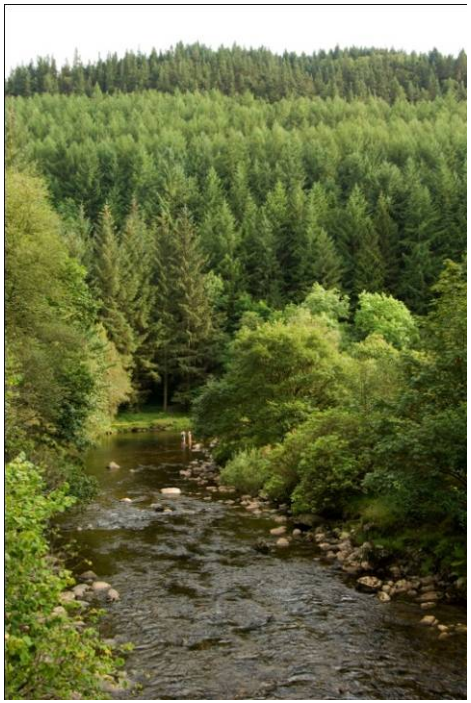
Applying the rules in the practice guide



- The guide allows flexibility in implementation
- It allows the countries to determine how it will be implemented – Wales are undertaking an 18mth pilot
- 30% closed canopy rule for restocking and new planting
- In Wales - a 5ha threshold for new planting proposals subject to other constraints - no assessments needed
- Presumption that restocking will be allowed subject to constraints and management measures being addressed
- No more than 20% of the catchment felled in any 3 year period

Implementing the practice guide in Wales

Issues (include)

- Determining if proposed project is affected by acid sensitivity
- Indentifying ownership and relevant forest ops in adjacent areas
- Operations planned by others may affect plans
- The EIA process may require Environmental Statement
- Water sampling if required – costs, timing, method, health and safety
- Reliability of available data

Implementing the practice guide in Wales
NRW's roles

- **As regulator NRW will determine the requirement to implement the guide**
- **18 month pilot period during which NRW will undertake water sampling if required – charges may apply.**
- **NRW will implement the guide on the WG woodland estate using best available data.**
- **NRW will assist Glastir contract managers and advise in felling licence applications**

Implementing the practice guide
What NRW are going to do

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- Implement the practice in WG woodlands with target dates
- Develop our forest resource plans - looking beyond our fence
- Support others to implement the guidance
- 18 month pilot period - undertake water sampling if required – charges may apply
- Make information and data available to others
- Encourage the use of forest management practices to minimise impact
- Communicate to staff and the sector
- Provide timely decisions and advice
- Improve our monitoring

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Thank you for listening