# Draft

# Forestry as a Pressure on the Ecological Status of Surface Waters in Ireland

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## Introduction

Forest plantations are generally seen as a benefit to the Irish environment – carbon sinks, water balance, biodiversity, landscape aesthetics and the planting of native woodland in riparian zones that act as pollution ‘hot spots’ or ‘critical source areas’ of pollutants near water can mitigate this form of diffuse pollution by soaking up excess nutrients and stopping further additions of phosphorus in particular.

This document, however, deals with coniferous forestry activities insofar as they pose a potential threat to water quality in certain environmentally sensitive types of landscape.

Forestry activities as a pressure on the ecological status of surface waters come under the following main headings:

1. Nutrient release especially on peat soils leading to eutrophication
2. Siltation during establishment and clear-felling
3. Acidification Impacts on acid-sensitive waters
4. Pesticide impacts (e.g. cypermethrin)
5. Shading of rivers
6. Loss of High Status aquatic ecology
7. Hydrological effects

## Eutrophication Pressures

Nutrient release from coniferous plantations on peat soils occurs in the early fertilisation phase when the plants’ ability to absorb the nutrients is limited due to the limited extent of root mass in young trees. This is not as big an issue on mineral soils with adequate iron and aluminium binding sites to bind phosphorus in particular.

Mid cycle aerial fertilisation with N or P on poorly performing plantations is also an issue. Broadcasting of nutrient granules directly into water or onto adjoining buffer strips will cause losses to water.

Nutrient release also occurs on peat soils following clear-felling. Even the lowest yield class, oligotrophic, plantations will have almost 20 kg/P/ha in the growing biomass – effectively in the brash which, typically, is left on the site. This leaches out slowly over a number of years as the brash biomass decays and flows through the underlying peat with no significant attenuation. If large coupes are cut the loading of nutrient can be very significant – 2 to 3 kg P/ha/year and will inevitably result in breaches of the WFD SI 272 of 2009 standards for phosphate in particular.

Extensive areas of coniferous forest have been planted especially in western counties and that are now nearing maturity. These will require particular care when clear-felling if ecological status is to be maintained or improved as required by the Water Framework Directive. Replanting on deep peat soils especially should not be permitted or grant aided. Similarly new plantations of conifers such as Sitka spruce on such soils should not be permitted or grant-aided for the same reason if problems such as that noted in the Lettercraffroe/ Owenriff catchment are to be avoided in the future.

Alder trees close to water potentially can pose a nitrogen risk especially to N-limited waters. This is due to the fact that Alder has root nodules with symbiotic nitrogen fixing capability. Thus while alder is tolerant of water the planting alder close to sensitive waters is counter-indicated in sensitive areas.

## Siltation Pressures

Siltation following drainage activities at establishment is particularly significant in salmonid spawning areas or where freshwater pearl mussel populations are found. The habitat directive includes a number of SACs for salmon and freshwater pearl mussels. Silt clogs gravels impeding the flow of oxygenated water through the gravel that is essential for the survival of juvenile stages of salmon, trout and *Margaritifera*, the freshwater pearl mussel. *Margaritifera*, in particular requires some five years of continuous well-oxygenated water through the subsurface gravels in which the young stages of this long-lived species live.

Siltation following clear-felling is an equally significant pressure with similar consequences to the release of silt at the establishment phase which may be typically 30 to 40 years earlier.

In active plantations new planting and clear-felling of mature trees may occur in close proximity, spatially and temporally, such that the aquatic ecology is impacted on an almost ongoing basis. Careful spatial and temporal planning of forestry activities is required to avoid such scenarios of continuous adverse impact on water quality.

## Acidification

Mature conifer canopies lead to acidification of water due to ion-stripping of rainfall. Aluminium release causing toxicity to fish in acid-sensitive areas is a well-documented phenomenon. Recent reductions in sulphur deposition has reduced the extent of anthropogenic acidification but ongoing caution is required. While the Long-Range Transboundary air pollution protocol was undoubtedly a success in reducing sulphur deposition across Europe, it should be noted that emissions of the other main acidifying ions, nitrogen oxides and ammonia have remained steady. The fourth assessment report from the IPCC predicted that global sulphur emissions would increase over the coming decades, driven by the increasing use of coal and oil in emerging industrialised nations. Recent Irish studies have demonstrated that despite the significant decline in non-marine sulphate emissions in Ireland over the last decade, there were no significant changes in pH or aluminium concentrations in 60 acid sensitive lakes (Burton and Aherne, 2012). It is likely that sea-salt inputs and increases in dissolved organic carbon concentrations may have contributed to the delay in the recovery of pH. A similar effect was noted in afforested catchments in Scotland (Dunford *et al*., 2012) where despite the significant reductions in airborne pollution, the relationship between forest cover and pH did not show conclusive signs of having declined. Additional evidence of forest scavenging of sea salts implied that the forest acidification effect may continue in the absence of anthropogenic pollutant inputs, particularly in coastal areas. Typically the acid sensitive areas are also dominated by peat soils and eutrophication is also a significant pressure as described above under the first heading above.

An additional issue in many such acid sensitive regions is that they may coincide with areas of high ecological status for surface waters – the best quality rivers and lakes. High status ecology has declined dramatically over recent decades. At establishment the associated drainage activities and the fertilisation of peats, even with best practice guidelines implemented, is likely to result in the further losses of high status waters.

The current acid-sensitive maps and protocols associated applications for planting on such areas should be maintained and strengthened. Some research is currently underway to assess the existing and potential impact of native Irish broadleaf species on acid sensitive areas.

## Pesticide Impact

Cypermethrin is used to control pine weevil particularly in newly planted trees. There is growing evidence that recent, unexpected decline in ecological status of some remote rivers, particularly in Donegal, is due to pesticides such as cypermethrin which is very toxic to aquatic invertebrates. This decline in ecological status is suspected to be primarily associated with sheep farming but some evidence of loss of invertebrate taxa inside fenced forestry plantations is also available and pesticide use is the primary suspected cause. Cypermethrin is on a short list for addition to the priority hazardous substances by the European Commission. Alternative approaches to control of pine weevil are required – fallowing or alternative non-toxic substances.

## Shading of Rivers

Shading of rivers reduces productivity of salmon and trout indirectly by reducing light levels and primary production. Forest and water guidelines now require buffer zones to prevent shading. It is important that setback distances are observed in new plantations.

## Loss of High Status Aquatic Ecology

The impact of peat-soils afforestation on ecological status has been noted above under the eutrophication and acidification headings. Planting on mineral soils may, however, also have an impact on rivers and lakes that are currently achieving high ecological status under the Water Framework Directive (WFD). Protecting high ecological status where it exists is a key objective of the WFD and river basin management plans. While high status waters are still to be found in Ireland the rate of decline has been alarming in recent decades. It is important to note that even relatively minor disturbance within a catchment can cause the loss of high ecological status. Drainage, fertilisation, land clearance, road building, house construction, septic tanks are examples of the kind of pressure which lead to the loss of high status. Thus, it is critically important to reduce such impacts in areas of high ecological status. All extant high status waters are mapped under the WFD River Basin Management Plans and it is critical that they are integrated into the forestry planning system. It is important to note that not all rivers and lakes achieving high status are located within existing SACs but under WFD must be maintained at high ecological status.

## Hydrological Effects

Mature forest canopy can divert large quantities of water via evapotranspiration away from bogs, rivers and lakes and groundwater recharge. Thus, potentially this may reduce the flow of water in rivers. If climate change were to lead to reduced rainfall in summer the impact on juvenile salmonid populations in particular may be affected. The dry summer of 1995, for example resulted in extensive loss of salmonid habitat in catchments such as that of the River Moy.

At the establishment phase drainage channels designed to channel water off the site can lead to enhanced siltation and nutrient loss. At the clear-felling stage, similarly, the change in land cover may result in increased flashiness leading to flood damage or erosion and here silt transport is potentially an issue. Buffer strips, control of drainage networks and control of coupe size may be required to ensure that siltation or hydromorphological damage does not occur. Climate change must also be factored in here taking the potential for increased rainfall intensity into account. Erosion and silt loss is enhanced by rainfall intensity and recent events suggest that this is a climate change reality that has to be factored into planning of all land use and land use change.

The overall water cycle and balance within catchments requires modelling and careful planning to cope with both reduced flows and enhanced discharge through the lifecycle of forest plantations and ensure that water bodies in the catchment are protected. Surface water and groundwater aspects must be considered.

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