

Environment No. 8

© COFORD 2008

- ▶ In 2004, the European Environmental Agency's (EEA) Spatial Analysis Group published findings from an analysis of CORINE data suggesting that 84% of the afforested area in Ireland occurred on peat soils in the period 1990 to 2000
- ▶ Recent high resolution GIS and ground truthed<sup>5</sup> national forest inventory data show that the percentage of peatland afforestation between 1990 and 2004 ranged from 13 to 60% of the total afforested area, and that CORINE data do not provide a statistically sound estimation of forest land cover in the Irish context.

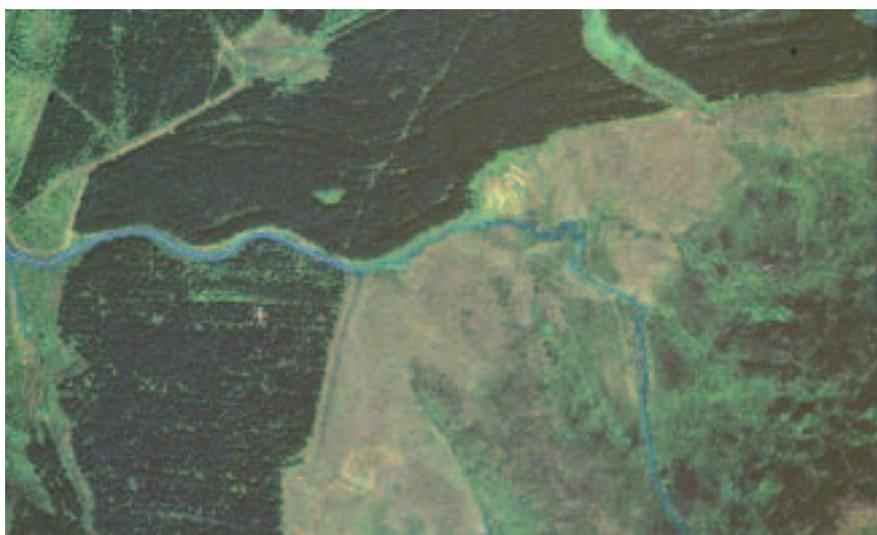
## Dispelling myths: the true extent of recent peatland afforestation in Ireland

*Kevin Black,<sup>1</sup> Gerhard Gallagher,<sup>2</sup> Phillip O'Brien,<sup>3</sup> John Redmond,<sup>4</sup> Frank Barrett<sup>4</sup> and Mark Twomey<sup>4</sup>*

Peatlands originally covered more than 17% (or 1,179,000 ha) of the land surface of the Republic of Ireland. However, anthropogenic exploitation and modification over many decades, including private turbary, the introduction of large-scale mechanised turf extraction, afforestation programmes and intensification of agriculture following Ireland's entry to the European Community, have seriously degraded peatland condition.

In 2004, the European Environmental Agency's (EEA) Spatial Analysis Group published findings from an analysis of CORINE data suggesting that the 84% of afforestation in Ireland between 1990 and 2000 was on peat soils (EEA 2004).

This note considers the validity of the EEA analysis in a national forestry context. The limitations of the CORINE methodology for detection of land use change, given the dispersed and fragmented nature of afforestation in Ireland is discussed. A comparison is made between the published EEA data and high resolution GIS data sources, coupled with results from the recently completed National Forest Inventory (NFI 2007).



Aerial photograph showing an afforested area (dark green) with adjacent upland blanket peat.

COFORD  
Arena House, Arena Road,  
Sandyford, Dublin 18, Ireland  
Telephone: +353 1 2130725  
Email: [info@coford.ie](mailto:info@coford.ie)  
<http://www.coford.ie>

<sup>1</sup> Corresponding author: FERS Ltd, 117 East Courtyard, Tullyvale, Cabinteely, Dublin 18; email: [kevin.black@ucd.ie](mailto:kevin.black@ucd.ie).

<sup>2</sup> COFORD, Arena House, Arena Road, Sandyford, Dublin 18.

<sup>3</sup> Environmental Research Centre, EPA, Richview, Clonskeagh, Dublin 4.

<sup>4</sup> Forest Service, Department of Agriculture, Fisheries and Food, Johnstown Castle Estate, Co Wexford.

<sup>5</sup> Ground truthing refers to the establishment of the accuracy of remotely sensed data by field visit to the areas where the remotely sensed data refer to.

## What is CORINE?

Co-ordination of Information on the Environment, or CORINE, is an EU initiative established in 1985. It comprises a computer-aided visual interpretation of satellite imagery (Büttner et al. 2004), and in combination with GIS systems has been used to infer European land cover data for 1990, 2000 and 2006 and to consequently detect land cover change over the period 1990–2000.

The CORINE land cover (CLC) nomenclature comprises 44 land cover classes, covering agriculture as well natural habitats and urban areas. Land cover codes 311 (deciduous forest), 312 (coniferous forest) and 313 (mixed forest) were used to interpret the change to forest area. An additional class, CLC 324, including transitional woodland and scrub, was added to the analysis to include recently afforested areas which were ca. 10 years old.

The smallest unit identified in CLC is 25 ha, while the minimum width of a linear feature is 100 m. Changes detected in the CLC 1990-2000 were incorporated only if the final polygon met the minimum mapping unit criterion of 25 ha. The implications for the detection of land use change through afforestation are profound, as contiguous afforestation (i.e. one or more adjoining land parcels) of less than 5 ha is not catalogued in the CLC data. This means that a newly afforested area can only be detected by CORINE if it is larger than 25 ha, or where it adjoins an existing area of forest of 25 ha or more, it is larger than 5 ha. Clearly this is unlikely to accurately represent private afforestation since 1990, because the average size of newly established private forest parcels is 8 ha, and they are highly dispersed and fragmented.

## The use of national high resolution data

Various data sources are used in Ireland to derive land use change statistics to better reflect the Irish afforestation programme (for details see Black et al. in review):

- *The Forest Service premiums dataset* consists of privately owned forests in receipt of a premium payment following afforestation of lands (Forest Service 2003).
- *The Coillte afforestation dataset* represents 100% geo-data coverage for the reference period 1990 to 2000.
- *The Teagasc indicative forestry soils map (IFS) and land cover datasets* are derived from a number of map sources, remote sensed and ground truthed data. The soils and land cover map (Figure 1) (with a minimum resolution of 1 ha) was derived from aerial photography and satellite imagery (Fealy et al. 2006). The land cover mapping exercise exploits the known ecology of

grassland types in Ireland in relation to soils.

- *The OS county boundaries and colour air photos.* The OS boundaries were from the OS 50k series and the colour air photos were from the year 2000, at a scale of 1:40000. The latter were primarily used for visual checks of all the above datasets.
- *The Forest Service national forest inventory (NFI).* The Forest Service published results of the detailed field survey of Ireland's forests in 2007. The NFI was based on a randomised systematic sample design, at a grid density of 2 x 2 km (chosen to provide sufficient plots to achieve a national estimate of standing commercial wood volume with a precision of  $\pm 5\%$ , at the 95% confidence level). The grid was comprised of 17,423 intersections, each representing 4 km<sup>2</sup> or 400 ha. Of these 1,742 were classified as forest land. Permanent forest sample plots, 500 m<sup>2</sup> in area were set up at each of the forest points. At each plot a range of crop and site variables was assessed, including soil type. Assessment took place from November 2004 to November 2006.

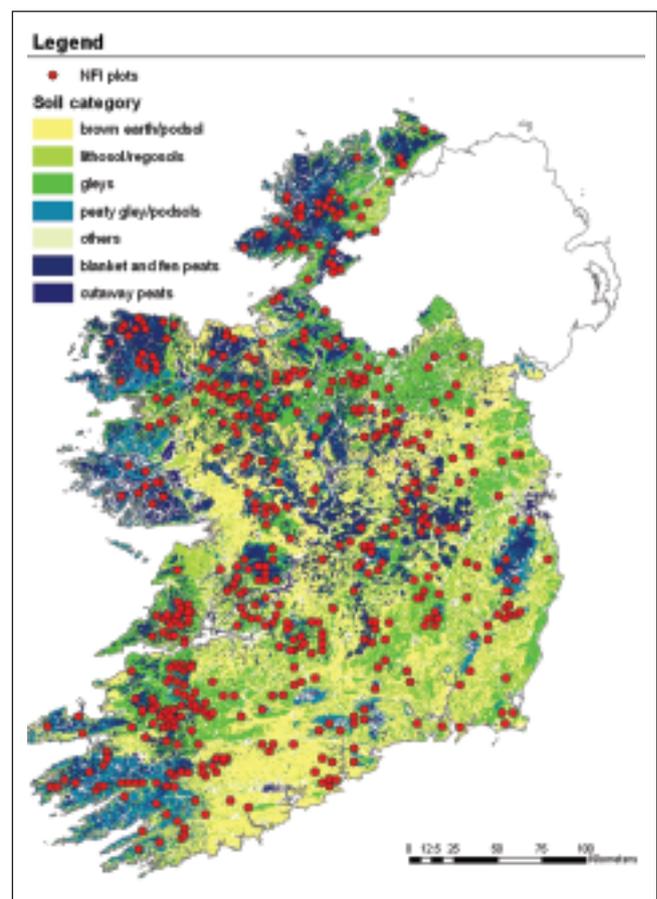


Figure 1: Indicative forest soils map (IFS) soils map, showing the national distribution of soil types and the NFI permanent sample plot layer overlay for post 1990 afforestation plots.

Results from the NFI indicate that 42% of the total forest estate is located on peats (NFI 2007). This includes planted forest as well as semi-natural woodlands, such as birch colonisation of peats. Gleys are the other dominant soil group, occupying 26% of the total forest estate.

## Comparison of different data sources

Overall, CORINE resulted in an underestimate of afforestation over the 1990-2000 period of more than 52,000 ha, compared with the forest premiums dataset. There was good agreement between the premiums area 1990-2000 and IFS soils/forest intersect method (Table 1). Although the premiums area is higher than the NFI estimated area, this is due to the land use classification used in the NFI methodology, where open areas within forest boundaries are not counted as forest.

Both the NFI and the intersect analysis showed a far lower afforestation level on peatlands compared to CLC 1990-2000 analysis; of the order of ca. 35 % in absolute terms (Table 1).

Table 1: A comparison of estimates of peatland afforestation (public and private) in Ireland between 1990 and 2000.

Data set	Estimated afforested area (ha)	Estimated peat area afforested (ha)	Estimated peat area afforested (%)
CORINE (EEA)	116,667	98,000	84.0
IFS soils/Forest	162,724	70,741	43.5
NFI	149,410	72,979	48.8
Total area 1990-2000 from premiums dataset	168,841		

Taken from Black et al. in review.

## Why are CORINE estimates so different from national estimates?

The over-estimation of afforested peat areas by CORINE seems to be related to two factors: dataset resolution and land use misclassification.

### ► Resolution:

*Total forest area:* The 25 ha minimum resolution of CORINE is too coarse to accurately represent forest areas due to the fragmented nature and small size (average 18 ha for all forests, while 8 ha is the average for private afforestation post 1990) of contiguous forest land parcels in Ireland. It is evident from the analysis (Figure 2A) that only 37% of forest land parcels are detected using CORINE (i.e. larger than 25 ha). CLC estimates of peatland forestry are over-estimated because of a disproportionate representation of peatland forest, particularly in western regions where many Coillte forest parcels are larger than 25 ha.

*Afforestation between 1990 and 2000:* Most of the afforestation for this period (79%) was carried out by the private sector. These forest parcels are typically small (mean 8 ha), isolated and fragmented. CLC 1990 to 2000 methodology would not represent a majority of the private afforestation, which is likely to occur on marginal agricultural land with mineral soils.

### ► Land use misclassification:

Significant discrepancies exist between CORINE and the IFS land cover data. Thirty two percent of the CORINE land areas classified as peat bog were not peat bog in the IFS land cover data. These discrepancies represented grasslands (17.3%) and rocky complexes (6.7%), respectively, according to the IFS land cover classifications.

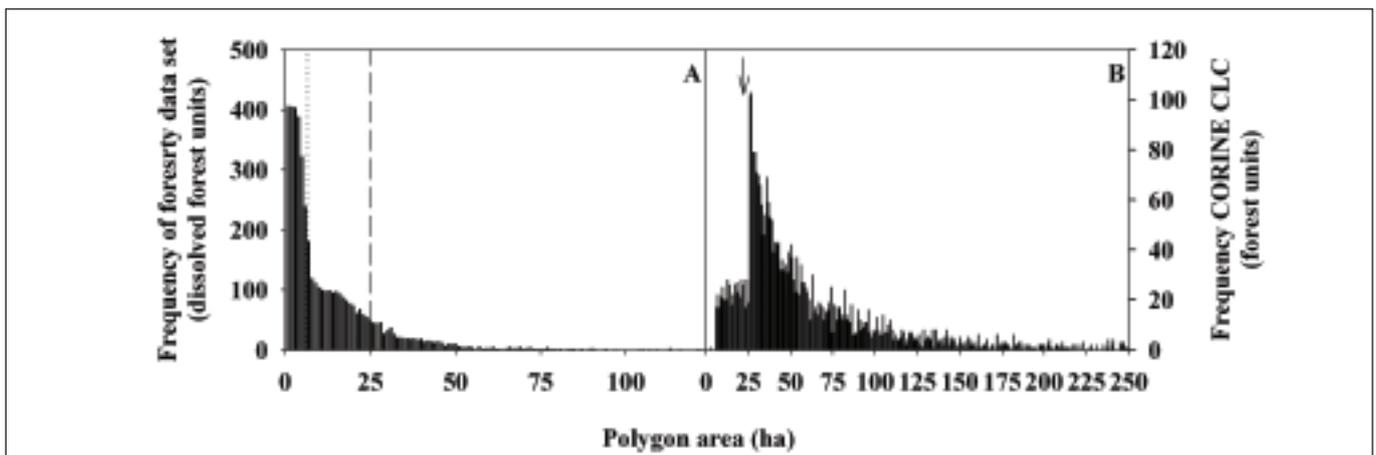


Figure 2: Frequency distributions of the forest land parcel size as derived from the national forest estate data (A) and CORINE 1990 and 2000 data (B). The dotted and broken lines in Figure 2A indicate the resolution of 1990-2000 land use change and CORINE 1990 areas, respectively. The arrow in Figure 2B indicates a distinct change in the detection frequency of the land use change (5 to 25 ha) and the total CORINE forest area (taken from Black et al. in review).

## Current trends in peatland afforestation

Both the NFI and IFS soil/forest intersect estimates show a general decline in the afforestation of peatland from 1990 to 2006 (Figure 3). The IFS soil/forest intersection estimates show a general downward trend of peatland planting, from 56.7% in 1990 to 29.9% in 2003. Similarly, the NFI data show a downward trend from 54% in 1990 to 39% in 2003. It should be noted that the *total peatland area* afforested since 1990 declined at a faster rate, when compared to proportional estimates, due to a decrease in the total area afforested in recent years. The total peatland afforestation in 1990 was ca. 9,000 ha, compared to ca. 4,000 ha in 2006.

## Conclusions

Based on this comparative analysis the EEA CORINE-based approximation of peatland afforestation over the period 1990-2000 is significantly over-estimated. Over-estimation may be associated with:

- Statistical misrepresentation of Irish forest land parcels in CORINE (i.e. low resolution of CORINE). CORINE 2006 is currently being updated to produce a higher resolution (1 ha) forest layer.
- Aggregation of classified categories, which may not reflect afforestation, particularly with reference to CLC 324 (transitional woodland and scrub), that may include areas such as the encroachment of hazel on the Burren or regenerating birch scrub on previously grazed upland peatland and cutaway peats, particularly in the midlands.

The CORINE classification and resolution problems have been highlighted in other comparative studies in northern Europe (Hazeu and de Wit 2004, Cruickshank and Tomlinson 1996). A similar study conducted in Northern Ireland by Cruickshank and Tomlinson (1996) also highlights the resolution issue in relation to forest and woodland parcel size. It was suggested that there is a Mediterranean bias in the land use classification used in CORINE and a need for subdivisions to avoid generalisations of peatland. These findings, together with the results presented here, suggest consideration of additional land classes for north-western Europe may be warranted for inclusion in CORINE CLC. However, there is no indication that CORINE 2006 will include additional CLC nomenclature changes.

It is recommended that afforestation, soil type and land-use change trend statistics should be taken from nationally derived high resolution data. The resolution and land class classification used for CORINE is clearly not representative

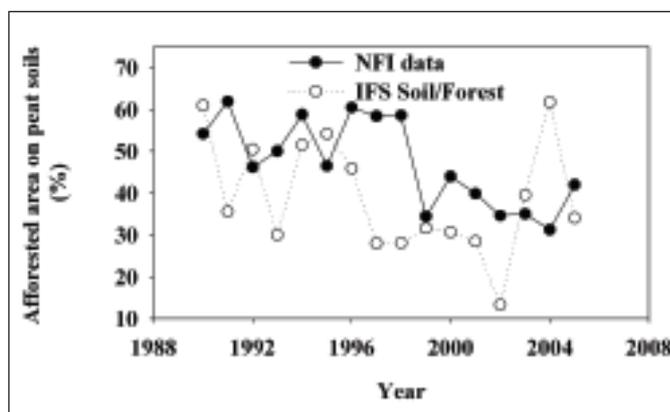


Figure 3: The afforestation of peatlands from 1990 as determined by the NFI and IFS soil/forest intersect estimates (taken from Black et al. in review).

of the Irish landscape. The publication of these data out of context, in the past, has significantly over-estimated the extent of peatland afforestation.

## References

- Black, K.G. et al. In review. The extent of peatland afforestation in Ireland. Submitted to *Irish Forestry*.
- Büttner, G., Feranec, J., Jaffrain, G., Mari, L., Maucha, G. and Soukup, T. 2004. *The CORINE land cover 2000 project*. In: Reuter, R. (Ed.), EARSel eProceedings, 3(3). Paris (EARSel), pp. 331–346.
- Cruickshank, M.M. and Tomlinson R.W. 1996. Application of CORINE land cover methodology to the UK - Some issues raised from northern Ireland. *Global Ecology and Biogeography Letters* Vol. 5, No. 4/5. Remote Sensing and GIS in the Service of Ecology and Biogeography: A Series of Case Studies (July - September 1996). p235-248.
- European Environmental Agency's Spatial Analysis Group. 2004. Revision of the assessment of forest creation and afforestation in Ireland. *Forest Network Newsletter Issue 150*, November 24 2004. <http://www.friendsoftheirishenvironment.net>.
- Fealy, R., Loftus, M. and Meehan, G. 2006. *EPA soil and subsoil mapping project: Summary, methodology, description for subsoils, land cover, habitat and soils mapping/modelling*. EPA project report, EPA. pp 31.
- Forest Service. 2003. *Forestry Schemes Manual*. Department of Communications, Marine and Natural Resources. Government Publication Sales Office, Dublin 2.
- Hazeu, G.W. and De Wit, A.J.W. 2004. *CORINE land cover database of the Netherlands: Monitoring land cover changes between 1986 and 2000*. EARSel proceedings 3, 3/2004 382 [las.physik.uni-oldenburg.de/e proceedings/vol03\\_3](http://las.physik.uni-oldenburg.de/e proceedings/vol03_3).
- NFI. 2007. *National Forest Inventory - Republic of Ireland - Results*. Forest Service, Department of Agriculture, Fisheries and Food, Johnstown Castle Estate, Co Wexford.