Poster abstracts presented at the Annual Symposium of the Society of Irish Foresters, April 1997

The following is a series of abstracts from a poster exhibition presented at the Annual Symposium of the Society of Irish Foresters, 18th April 1997, included to offer the readership of *Irish Forestry* a snapshot of some of the ongoing forest research in Ireland.

Deciding when to lift and plant forest nursery stock

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The physiological development of Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) transplants was followed from September/October to April each year from 1991-1995, to develop physiological predictors of planting stock performance. The seasonal course of cold hardiness development, shoot and root mitotic index and root growth potential was monitored at 2-4 week intervals. Transplants were dispatched to a field trial at 4-5 week intervals to assess field performance. The influence of cold storage was assessed following placement of plants in a cold store for up to 7 months beginning between November and March. The transplants were less cold hardy in 1994/95 than in other years. The roots of seedlings were mitotically active throughout the winter of some years but not others. The period of high stress resistance is from November to early February, but the best time to plant freshly lifted stock is from November to December, when root growth potential is good and soils are relatively warm. Vitality of the stock in June following cold storage was good for those lifted to storage from December to February.

Research at the Radiological Protection Institute of Ireland into radioactivity in forest ecosystems

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The Chernobyl accident in 1986 resulted in the contamination of vast areas of Europe, mainly with caesium-137 (a biologically important, long-lived radionuclide). In parts of eastern Europe, the contamination was severe. Chernobyl fallout in Ireland was low and patchy in distribution. Research has shown that in contaminated forests, the caesium-137 has been transferred from the canopy to the forest floor and has become incorporated into forest nutrient cycles. Caesium-137 in the forest floor is relatively bio-available to plants and fungi so it is likely that it will persist in the ecosystem for many years to come. In eastern Europe, where contamination is severe, this persistence represents a serious problem for the forest industry and for other users of the forest environment. Research at the Radiological Protection Institute of Ireland (RPII) is aimed at developing strategies for managing severely contaminated forests. The dynamics of caesium-137 cycling in forests have been studied, enabling the development of models to predict the future behavior of

the contamination. Research into mechanisms which control the behavior of caesium-137 in forests indicate ways in which management may attempt to augment the natural decontamination processes.

The effects of sixteenth century deforestation on soil development

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Large scale clearance of oakwoods occurred in Ireland in the sixteenth and seventeenth centuries, chiefly for export as timber and for charcoal production. Uragh Wood, situated in the Clonee Valley 16 km southwest of Kenmare, is believed to be a surviving remnant of the original wooded landscape. There is good historical evidence supported by ^{14}C dating to suggest that the remainder of the wood was cleared approximately 400 years ago. A study of the soils within and immediately outside the wood was undertaken to examine the effects of deforestation.

The topography of the site comprises a series of steep ridges and corresponding troughs, many of which carry streams. Rock outcrops and large boulders are very common. The parent material is Devonian Sandstone. Mean annual rainfall is 1,900-2,000 mm.

Twelve soil profiles were studied, six from the cleared area and six from corresponding topographical positions within the relatively undisturbed portion of the wood. Differences in soil profile morphology were evident between the wooded and cleared areas. Surface accumulation of organic matter was greater on the cleared area. The ash content of the organic matter was higher inside the wood. Pan formation did not occur under the oakwood canopy but was observed in profiles from the cleared area. The eluvial (E) horizons of the latter had fragipan-like character, except where very wet.

Oakwood clearance appears to have resulted in increased water fluxes, changes in ground flora and soil morphology and an increased tendency towards peat development.

Modelling climate data to predict potential forest productivity in Ireland

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- Traditional predictions of forest productivity in Ireland have been based on empirically-derived models of forest growth developed in the UK.
- A physiologically-based, climatically-derived model, PnET, is being adapted to Irish conditions to provide complimentary predictions of potential forest growth.
- The PnET model's input parameters and validation are described.

- For regional predictions, PnET requires spatial data for five variables, *viz.* soil water holding capacity and monthly summaries of precipitation, maximum and minimum daily temperature, and solar radiation.
- A water holding capacity has been assigned to each of the 44 soil types digitised from the General Soil Map of Ireland.
- Polynomial regression equations are used to describe the spatial variation of the climate variables with latitude, longitude and elevation.
- Work is in progress to parameterise PnET for Sitka spruce (*Picea sitchensis* (Bong.) Carr.) to run the model for all of Ireland.

Monitoring of forest ecosystems in Ireland

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Forest decline is not, as yet, a serious problem in Ireland. Thus, researchers are in the enviable position of being able to monitor the health status of Irish forest ecosystems in a relatively unpolluted environment, and to collect baseline data and conditions in relatively healthy forests. In 1988, the Forest Ecosystem Research Group (FERG) of the Department of Environmental Resource Management, University College Dublin established a monitoring plot at Ballyhooly, Co. Cork. In 1991, monitoring was extended to a further three forest plots at Brackloon, Cloosh and Roundwood in Co. Mayo, Co. Galway and Co. Wicklow respectively.

Precipitation throughout Ireland has a strong marine influence. Inputs of both sodium and chloride are high, particularly in the west of the country. Proton and nitrate inputs are highest at the Roundwood site, while there is a net consumption of protons and nitrogen at the two western sites, Brackloon and Cloosh. Concentrations of nitrate in the soil water are extremely low at Brackloon and Cloosh. Ammonium inputs at Ballyhooly are significant.

Sulphate inputs are similar at all four plots and the concentrations are significantly augmented in throughfall and stemflow. A much higher proportion of the sulphate at the Roundwood site is of non-seasalt origin.

Forest health results indicate a generally low level of discoloration and defoliation at the four forest plots.

Critical load mapping and the development of a sustainable forest resource

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In its simplest form, the principle of sustainable development imposes on us the responsibility to take care of the earth so that future generations may derive from it the same

benefits as we do today. The sustained yield concept, practised by foresters for generations, offers a perfectly valid view of sustainability, but it is relatively narrow. Modern ideas of sustainability suggest that 'sustained yield' should be replaced by the broader concept of 'sustainable forest management'.

The selection of sites for afforestation is increasingly being subjected to the planning process. Tools such as indicative forest strategies are being developed to assist in this process. The critical load concept has a potential application in planning forestry development.

Nitrogen dynamics in a forest ecosystem influenced by drought

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Increased rates of acidification and nitrification in some forest soils and waters, due possibly to changes in atmospheric inputs of ammonium and sulphates, are causing concern. Within the soil itself, however, acidification processes also occur. The nitrification process acidifies the soil and the rate and extent of this biological process is dependent upon substrate concentration, moisture, temperature and pH. In this study, the hypothesis is that periodic drought and rewetting of soil lead to a pulse of mineralisation of organic N followed by nitrification and acidification. The effects of drought and subsequent rewetting on nitrogen dynamics in forest soils and waters were studied as part of the European Union-funded EXMAN (EXperimental MANipulation of forest ecosystems) project. This involved six countries representing a climatic and pollution input gradient across Europe. The Irish site at Ballyhooly, Co. Cork has been monitored since 1989. It is situated 30 km from the sea and was planted in 1939 with Norway spruce (*Picea abies* (L.) Karst.) on an Orthic podzol over a sandstone colluvium till. The organic (O) horizon is between 6-10 cm deep and its average pH ranges from 3.6-3.8. The site is relatively remote from sources of industrial pollution, although ammonium deposition resulting from intensive animal production does occur. Annual precipitation of 1,000 mm deposits 12 kg of nitrogen/ha/yr, as ammonium and nitrate.

A summer drought was imposed at Ballyhooly for three successive years by installing a removable 10 m x 10 m transparent PVC roof below the forest canopy on the drought treatment plot. The roof was erected to coincide with bud-burst, and was removed when the soil water potential at 50 cm deep in the mineral soil reached -800 hPa. Once the roof was removed, the soil was allowed to rewet naturally when rain fell.

It was observed that levels of ammonium-nitrogen and pH values increased in the humus water of the drought treatment plot after rewetting at the end of drought treatment. A similar increase in ammonium-nitrogen and pH was not observed in the control plot. A nitrification pulse was not observed at these times. It can be concluded that, under prevailing Irish conditions, drought and subsequent rewetting can induce mineralisation but that significant nitrate production and consequent acidification do not occur.

Modelled and measured water fluxes in a forest ecosystem EXMAN project

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The Forest Ecosystem Research Group (FERG) controls a series of intensive forest monitoring plots with the aim of quantifying the effects of atmospheric deposition on forest ecosystems. A knowledge of water fluxes through the ecosystem can contribute greatly to the understanding of biogeochemical processes and acidification. While precipitation and throughfall can be measured directly, fluxes such as soil water and evapotranspiration cannot. Computer simulation models can be used to estimate these fluxes. The initial study describes four years of measured and simulated water fluxes for Ballyhooly, Co. Cork.

The effect of harvesting on the pore size distribution of blanket peat

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Large areas of forested blanket peatland are currently being clearfelled. The majority of these felling operations are fully mechanised. Extensive compaction damage has been reported following such operations on mineral soils and situations have resulted where the aeration level of the soil has been reduced below that necessary for crop root development.

Defining the water retention capacity of compacted soils provides a picture of the distribution of different pore size categories and how they are affected following machine passage.

Blanket peat is highly porous, with most of the pores being of small diameter. A small percentage are macropores, which provide the basis for soil aeration and gas exchange. Compaction reduces the proportion of macropores and this has serious implications for the level of aeration present following operations.

Preliminary results show that some compaction occurs following traffic. It appears, however, that certain properties of the peat, i.e. its fibrous nature, enable it to resist compaction to some degree.

Gaseous SO_2 measurements with passive samplers at forest sites

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Although the mean concentration level of sulphur dioxide (SO_2) has decreased in recent years, it is still the most significant pollutant in relation to acid deposition in many parts of Ireland. Using advanced techniques, SO_2 has been intensively measured in areas where concentrations are generally high, such as those close to emission sources (e.g. power

plants). Continuous monitoring systems are costly and require electrical power. The id monitoring device for forest sites should be portable, self-contained, accurate, reliable a low in cost. For use on sites in Ireland, the device should also be capable of measuring l ambient concentration levels of SO_2 (1 mg/m^3). In this research, the 'Willems-badge' p sive sampler, developed at the Department of Air Quality, Agricultural Univers Wageningen, Netherlands, is evaluated for measuring monthly average SO_2 concentrat levels at forest sites in Ireland. The effect of different exposure times is investigatec field comparison studies. The final goal is to incorporate the passive sampler into ongoing forest ecosystem monitoring programme.

Estimation of evapotranspiration in small forested peatland catchments usi the water balance method and its comparison with potential evapotranspi tion values by Penman-Monteith equation

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Evapotranspiration is important as a term in the hydrological cycle, e.g. in soil water a ground water balances and in salinisation studies and predictions. There are a numbe mathematical methods which give an approximate value of evapotranspiration by using matic data such as radiation, humidity, wind speed, etc. The most commonly-used equat is the Penman-Monteith equation. In this study, the Penman-Monteith equation method be compared with the water balance equation method (ETa=P+∂SW±RO-D, wh ETa=actual evapotranspiration, P=precipitation, ∂SW=change in storage water, RO=run water and D=drainage). This equation is modified taking into consideration the reductio precipitation (P) due to interception (Ic). Interception is the amount of water intercepted the plant canopy, which prevents the water from reaching the ground. The amount of w that can adhere to the surface of the leaves depends on factors such as rainfall intens amount and distribution of precipitation, evaporation flux, and leaf shape, size and nat The amount of water intercepted can be measured indirectly by measuring the precipitati throughfall and stem flow. Interception values for a fully developed canopy of a Sitka spr (*Picea sitchensis* (Bong.) Carr.) forest in western Ireland vary from 25-45% of P. Field ues for the water balance equation will be collected at small forested peatland catchment Cloosh Valley, Connemara. The parameters in the water balance method will be measu (P, R) or estimated (Ic, ∂SW) and evapotranspiration (ET) will be calculated as ET (Ic+RO+D). Due to a continually high water table, ∂SW is regarded as negligible. potential evapotranspiration (ETp) value obtained will then be compared with the val obtained from the Penman-Monteith equation using measured data from the nearest Met rological Service synoptic station. The difference in the ETp values may provide a modi term for the application of the Penman-Monteith equation to such sites.

Interception of seasalt by coniferous and broadleaved woodland in a maritime environment in western Ireland

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Atmospheric deposition in maritime regions is dominated by seasalt. High inputs of seasalt can induce short-term acidification in surface waters by the displacement of hydrogen and aluminium from the soil exchange complex. Measurement of sodium fluxes in two forest stands (one coniferous and one broadleaved) in a maritime region of western Ireland resulted in almost equal deposition at the two stands. This is remarkable given that the broadleaved forest has a low interception of water. Weekly throughfall data emphasise the enormous fluctuation in seasalt deposition. In both stands, deposition is highest in winter.