TREE-RING BULLETIN, *Vol. 33, 1973*

TREE-RING RESEARCH IN IRELAND

J. R. PILCHER

Palaeoecology Laboratory
Queen's University, Belfast

ABSTRACT

Tree-ring studies started in the Palaeoecology Laboratory in 1968. The impetus for the work was provided by the large amount of sub-fossil oak and pine that was brought to our notice by archaeological excavation and road construction. Sample preparation and ring measurement techniques were developed and crossdating was demonstrated in some of the sub-fossil material. A program of field collection was started and a research assistant employed on the laboratory treatment of samples. Good crossdating over a wide area was then established for both oaks and pines, demonstrating an overriding climatic influence on tree growth even under bog conditions. A number of floating sequences in excess of 500 years length have been constructed and timbers have been found from every half millenium back to 8000 radiocarbon years before present. Over 1400 timber samples have been collected and a large amount of material remains to be collected.

INTRODUCTION

During 1968-9 large-scale road building in Northern Ireland brought to light two sources of sub-fossil timber. The first was a buried lake dwelling or crannog in Teeshan Townland, Co. Antrim (Figure 1). The structure was unfortunately destroyed before any stratification could be revealed, but a large amount of worked oak timber and oak tree trunks were salvaged. Ring width measurements on several of these timbers established that crossdating was possible. At the same time, about 80 km (50 miles) south, road works were cutting through a major area of lake and bog deposits at the southern end of Lough Neagh. Vast numbers of oak trunks were removed from the foundation trench of the road. Again it was not possible to see or record the stratigraphy. It was soon clear that there was great potential for tree-ring research in Ireland. As well as the bog timbers already mentioned, a large number of bogs were known to us in which pine (*Pinus sylvestris*) trunks and stumps were preserved.

Extensive field sampling was carried out and continues as new material comes to light during road construction, river dredging, forestry, and ploughing. Because most of this sub-fossil timber cannot be assigned an age even to the nearest millenium on stratigraphic grounds, individual timbers and groups of timbers have been radiocarbon dated before dendrochronological work is started (Smith, Pearson, and Pilcher 1970, 1971a, 1971b, 1973a, 1973b, in press). While good crossdating was soon established within a number of sites, it was not known in the early stages whether the trees were responding to local conditions such as bog water levels or to more general climatic changes. It was only after a number of floating chronologies had been placed in a relative framework by radiocarbon dating that crossdating between the tree-ring chronologies of different sites was found. This crossdating proved to be very good, in many cases as good as that between trees from a single site. Figure 2 shows filtered mean ring widths from four widely spaced sites within the study area. The sites are underlined on the map

(Figure 1). The diagram illustrates only a portion of the total overlap of the four chronologies which date from the early centuries of the first millenium A.D.

While work on bog timbers was getting under way, M. G. L. Baillie was working at the modern end of our tree-ring sequence, building a chronology back from the present day using oak timbers as described elsewhere (Baillie 1973a, 1973b).

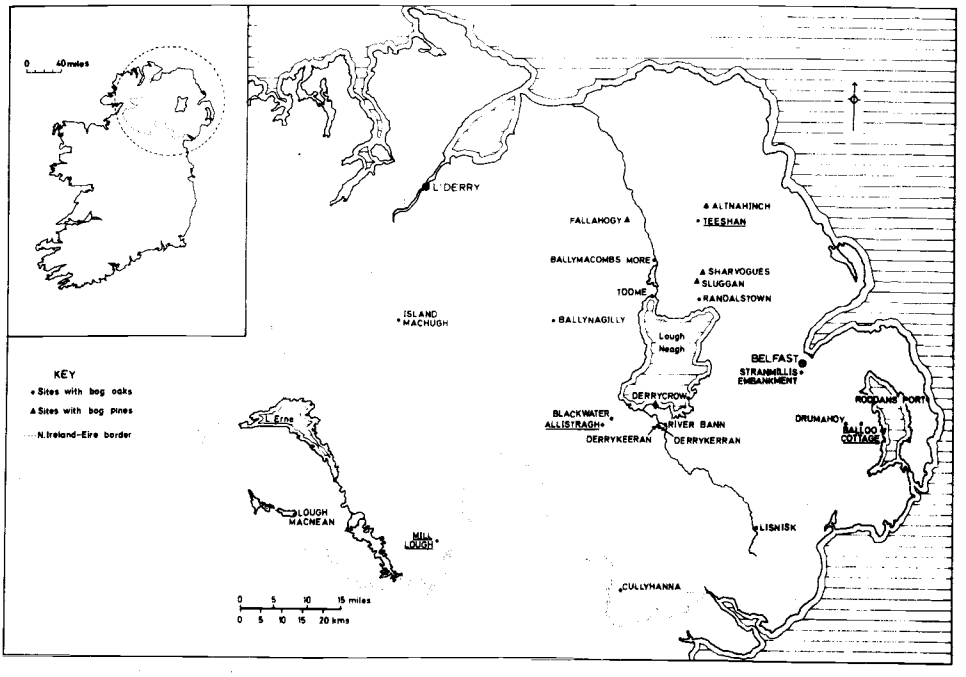

Figure 1. Map of Northern Ireland showing sites that have yielded bog oaks and bog pines. Crossdating of timbers from the underlined sites is illustrated in Figure 2.

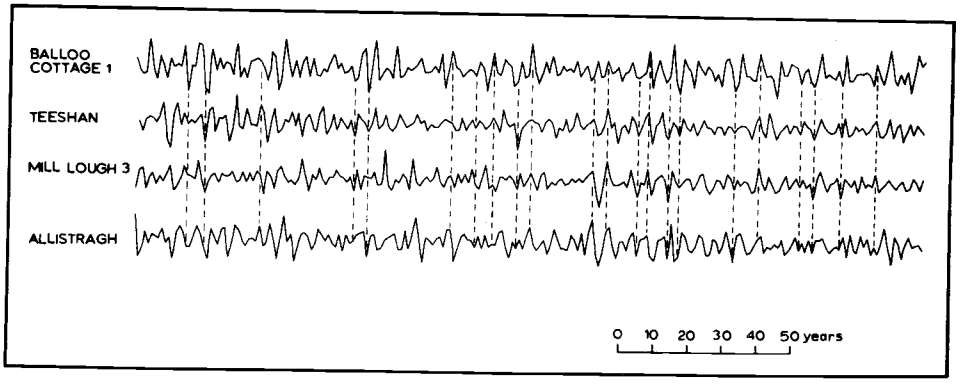

Figure 2. Portions of four, filtered, composite ring width patterns from sites in Northern Ireland. Floating sequences date from the early centuries of the first millenium A.D. Balloo Cottage was an 18th or 19th century building roofed with bog oak of unknown origin. Teeshan was a lake dwelling with a foundation of oak timbers. Mill Lough samples were from a natural lake deposit and Allistragh samples were from a river deposit.

FIELD AND LABORATORY TECHNIQUES

So far all our sampling has been bulk sampling rather than coring. Bog timbers are usually cut with a chain saw to give a complete cross-section. If possible two slices are taken in the field, one for tree-ring measurement and the other one for possible radiocarbon measurement. Samples of modern trees have similarly been taken from the bases or stumps of recently felled trees. So far over 1400 samples have been collected, mostly from sub-fossil timbers. Bog timber is waterlogged when first excavated and is left to dry slowly in an unheated store. No special preservative treatment is used. When dry the samples are sanded to a fine polish. It has sometimes been found helpful with the black bog oak samples to apply a little white chalk to the polished surface. This fills the lines of the spring wood pores and helps to make them clearly visible under the microscope.

Normally no attempt is made to establish crossdating visually on the timber. This can sometimes be done with bog pines when these are known to be contemporaneous; with oaks it is seldom possible. All crossdating is carried out using graphs of the ring width measurements. One radius in oaks and three in pines are measured. The measuring device consists of a moving stage with a take-off device and scaler arranged under a stereo-microscope. It is similar in operation to the Bannister Incremental Measuring Device (Bannister 1972). Graphs of the ring widths are normally plotted as measured or logarithmically; standardization is not normally necessary. In the case of pines, the three radii are plotted and checked for locally absent rings before a composite plot is made for the tree. This is normally a simple average of the three measurements for each year.

Most crossdating is established by examining graphs over a light box. However, with such a large time range of timber, many trees cannot be easily crossdated in this way. A computer program described elsewhere (Baillie and Pilcher 1973) is used to find crossdating and also to check crossdating found visually. The program calculates the correlation coefficient and hence the value of Student's t for each position of overlap of two chronologies. This technique can be used because the chronologies are generally free from errors caused by missing or double rings. In all the native Irish oak studied, only one or two cases of apparently locally absent rings have been found. These are cases where, on the radius measured, the rings run so close together that the spring wood lines merge into each other. In the case of the bog pines locally absent rings are sometimes found, but a ring is seldom absent in all three of the radii measured.

AIMS AND PROGRESS

There are various aims of the tree-ring research in the Palaeoecology Laboratory. The first is the construction of a chronology back from the present day for use in dating historic buildings and archaeological sites. This part of the work is described by Baillie (1973b). A standard chronology back to A.D. 1380 has been used to date over 20 historic buildings and archaeological sites. A floating chronology has also been constructed using timbers from the Medieval town of Dublin and it is hoped that this will soon be linked to the standard chronology (Baillie 1973a).

The second aim is to build a chronology as far back as possible for the calibration of radiocarbon measurements. Calibration measurements have so far been carried out largely on bristlecone pine from high altitudes in California (Ferguson 1970). In order to provide an independent check on these measurements, it is desirable to measure the radioactive content of timber from low altitudes and from an area well removed from

California. This should provide a check on the world-wide distribution of carbon 14 and on the short term fluctuations in atmospheric carbon 14 postulated on the basis of the bristlecone pine measurements. The Palaeoecology Laboratory carries out its own radiocarbon measurements and is developing a high accuracy system from this calibration work. Figure 3 shows our progress towards obtaining a long, dated, tree-ring sequence for calibration of the radiocarbon timescale. It shows the radiocarbon ages of individual trees and floating sequences. The thick vertical lines represent floating chronologies of more than four trees. So far there is one floating chronology of over 1400 years and several over 500 years in length. At least some timber is present from every half millenium back to 8000 radiocarbon years before present. The radiocarbon measurements carried out so far have been used only to indicate the age range of the timber from various sites. Higher precision measurements will be carried out for the calibration when more of the floating tree-ring sequences have been crossdated.

The dating of a large number of bog timbers resulting from this tree-ring project will be used to elucidate the history of bog woodlands in Ireland. In many cases bog woodlands seem to have developed as a result of drying out of the bog surface. The climatic implications of this are being investigated in association with pollen analytic studies.

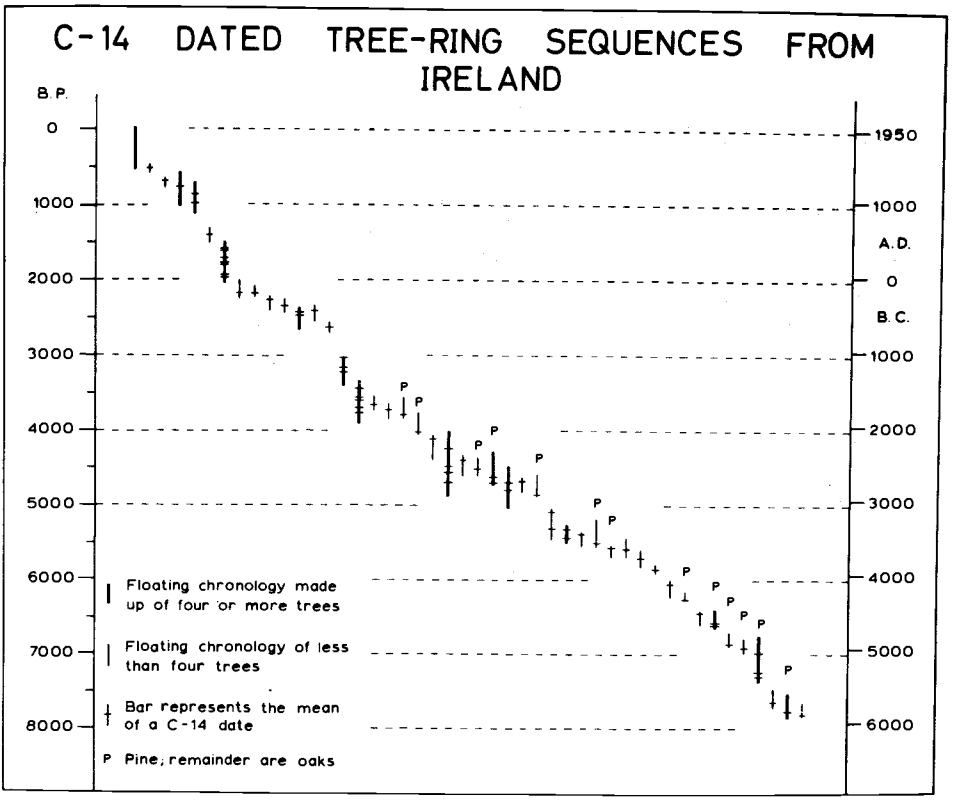

Figure 3. Summary of the radiocarbon ages of floating tree-ring chronologies and individual timbers from Ireland. (Since this diagram was prepared a chronology of over 1400 years has been established in the 4th/5th millenia B.P.).

The third aspect of dendrochronology that is just starting here is dendroclimatology (Fritts 1971). The Palaeoecology Laboratory is co-operating with the Laboratory of Tree-Ring Research in Tucson on a pilot study for a global climatic research program.

CONCLUSIONS

In spite of a climate with no great extremes, tree-ring patterns in Irish oak and pine timbers show good crossdating and have proved suitable for tree-ring research. The wet climate has caused the preservation of large amounts of timber in bogs and lakes from all periods from at least 8000 years ago. This timber provides the potential for building a long tree-ring chronology for dating archaeological sites, for calibration of the radiocarbon timescale, and for studies of the history of bog woodlands.

ACKNOWLEDGEMENTS

The tree-ring dating of bog oaks has been carried out by Miss J. Hillam and the radiocarbon measurements by Mr. G. W. Pearson assisted by Mrs. F. Qua and Miss A. Colville. The author wishes to thank them for their contribution to this research project and to thank all those who have helped us to collect timber samples or have brought sources of timber to our notice.

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