

## HISTORIC PINE AND DENDROCHRONOLOGY IN SCOTLAND

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### INTRODUCTION

This paper focuses on the development of native pine dendrochronology in Scotland, based on investigations of historic pine timbers and ancient pine woodlands as part of the Native Oak and Pine Dendrochronology Project (Crone & Mills 2008a). The results will be published in full in appropriate journals within the next few years. In this NWDG celebration of Steven and Carlisle's work, which championed the case for the conservation of the ancient pine woods, it seems appropriate to emphasise the importance of these woods as a resource for scientific research into aspects such as their past exploitation, their future management and climate change studies. These issues are not divorced from each other, as was recognised in Steven and Carlisle's (1959) remarkably holistic appreciation of historical, ecological and management issues.



*Plate 1 Glen Derry ancient pine woodland at Mar Lodge has been sampled to enable native pine chronology expansion. L: Some of the oldest trees at Glen Derry North (photo Rob Wilson). R: Core sampling at Mar Lodge Estate (photo Anne Crone).*

Dendrochronology, as undertaken within the heritage sphere, is capable of providing not just dates but also precise information on provenance of timber. Information on age of trees, growth rates, wood-working techniques, timber dimensions and quality is also obtainable in the course of the work. Together, these strands contribute to understanding wider issues such as: historic woodland stand dynamics; historic management regimes; the nature of timber exploitation in the past; the development of the timber trade; and the impacts of trade and exploitation on Scottish woodlands.

So why is native pine a focus of dendrochronological development for cultural heritage purposes in Scotland? In the UK, the application of dendrochronology in heritage dating has traditionally concentrated on oak. In England, for example, a great network of oak chronologies has been developed and it is a routine matter to date oak timbers. Dating is not so straightforward in Scotland, due to the more complex history of timber supply and the fewer native chronologies so far available. Pine is common as a timber in Scottish buildings, especially after AD 1600, and the historic exploitation of native pine woodlands lends the development of pine dendrochronology a special prominence here. Another impetus is that conservation interest in post-medieval and early modern buildings has grown enormously in the UK over the last 15 years or so. Pine is common in these later buildings, but very little historical pine tree-ring work had been done in the UK until recently.

The Native Oak and Pine Dendrochronology Project is being undertaken to further the application of dendrochronology in the Scottish heritage arena (Crone & Mills 2002; 2008a). Prior to this project, there were no long native pine chronologies for Scotland. There were some pine chronologies based on living trees from the Highlands (Hughes 1987) but only giving good coverage back to the 18th Century and not thought old enough to date most historic pine timber given the long overlap needed. This paper concentrates upon the recent development of native pine woodland reference chronologies and parallel investigations of historic buildings with pine timbers in Scotland.

### **Background: Scottish dendrochronology**

Before AD 1000, there are only a few dated tree-ring chronologies from oak on early historic archaeological sites in Scotland (Crone 1998), and none so far from Roman or Prehistoric sites, at the time of writing. Tree-ring coverage for oak improves dramatically in the medieval period, based on timbers from urban excavations and standing buildings (Crone 2000; Crone & Mills 2002). Good quality native oak timber is still available in medieval times, at least in areas such as NE and SW Scotland. So far, there are no dated pine timbers from the medieval period, apart from some early 16th century Scandinavian pine boards imported for the use in the Renaissance Palace at Stirling (Crone 2008a). By the late medieval period there is compelling tree-ring evidence that Scottish woodlands could no longer meet the home demand for oak timber. Few buildings after 1450 contain native oak, and the frequency of imported and re-used oak increases (Crone & Mills 2002; 2003; Crone 2008a). In the 17th and 18th centuries much more pine is found in buildings and, until recently, the few dated examples have had imported pine. However, the picture of increasing importation may be exaggerated. Imported timbers are easier to identify because there are far more reference chronologies available abroad, and there is a large body of undated historic timber samples in Scotland which do not match foreign chronologies. Some of these must be native. Proof depends on developing a network of native chronologies with which to match this material.

### **ANCIENT PINE WOODLANDS: NATIVE REFERENCE CHRONOLOGY EXPANSION**

Expansion of the native pine chronology coverage in Scotland is being pursued in two ways. The primary mechanism so far has been building chronologies from long lived trees in the surviving ancient pine woodlands, and this will continue. Collaborating dendroclimatologists Rob Wilson and Neil Loader are starting to explore sub-fossil pine in lochs, to push tree-ring coverage back further in time. If successful, the longer chronologies will be applied in both heritage and climate reconstruction spheres.

The work at some of the oldest living pine sites in Scotland to create longer native chronologies is summarised below. Much of this work has been undertaken in collaboration with Colin Edwards and Rob Wilson, and will be published more fully elsewhere.

#### **Glen Loyne pine chronology: AD 1459-2001**

The sparse ancient pine woodland at Glen Loyne is extremely stressed and slow-grown, and was chosen as the first study site because Colin Edwards had previously identified the extreme ages of the trees here. A chronology has been constructed covering the period 1459 to 2001, 543 years in length, and the oldest tree sampled started growth in the 1450s (Mills 2005). This chronology considerably extends the period of native pine tree-ring coverage for Scotland. There were many technical problems to overcome in making this chronology, including missing rings and extremely compressed growth. While Loyne has the potential to assist dating due its extreme age, its slow growth and stressed forms might be atypical of preferred building material.

#### **Ballochbuie pine chronology: AD 1589-2003**

Ballochbuie, on the Balmoral Estate, Deeside, was more straightforward, with better conditions for pine growth. Cores had been taken by Glenn Iason of MLURI for an ecological study. A chronology built from these cores spans AD 1589 to 2003, some 415 years, and there is potential to get back further (Mills 2006). This chronology was the first to extend pine tree-ring coverage for north-east Scotland, with the previous longest chronology from the area being Inverey going back to 1706 (Hughes 1987). Ballochbuie matches extremely closely with other woodlands on Deeside. It shows weaker matches with sites from north-west Scotland, including Loyne, indicating that a network of regional pine chronologies will be required for historic dating purposes in Scotland. A network is also fundamental in allowing historic timbers to be provenanced closely.

#### **Glen Affric pine chronology: AD 1709-1996**

Glen Affric was selected because of the dead standing stems thought to have potential to extend back before Hughes' (1987) chronology from living trees which went back 1735. The work has strengthened the replication considerably and allowed a modest extension back in time to 1709 (Fish *et al* 2007a). Rot in the standing stems limited their usefulness. Affric shows good correlation with Ballochbuie and more modest correlations with Loyne.

#### **Mar Lodge Stage 1 pine chronology: AD 1629-2004**

Mar Lodge, Upper Deeside, was selected because it is known to have been exploited for timber during the postmedieval period. Mar timber was likely to be found in historic buildings on the estate and more widely. Mar had also benefited from extensive core sampling by Colin Edwards of Forest Research. For Stage 1 a total of 200 living trees were analysed from four different woodlands at Mar (Glen Derry, Glen Luibeg, Dubh Ghleann and Glen Quoich). Twenty disks from dead trees scattered over the estate were also analysed. Previously, Inverey was the oldest woodland chronology from the area, back to 1706 (Hughes 1987). The first stage of work improved the replication, and hence the signal for the area and extended coverage back to 1629, with Glen Derry having the oldest trees (Fish *et al* 2007b). This

led to a second stage of chronology development at Glen Derry, reported below. These new Mar chronologies show very good correlations especially with Ballochbuie.

### **Mar Lodge Stage 2 (Glen Derry North) pine chronology: AD 1477-2008**

A second stage of work at Mar Lodge involved sampling trees at Glen Derry and Luibeg, resulting in a considerable extension back in time at Glen Derry North. The Luibeg samples proved rather even aged at about 200-250 years, and have not yet been measured. However, Glen Derry revealed some unexpectedly old trees which extended the Mar pine chronology coverage back considerably, to AD 1477. Only one sampled tree goes back into the 15th Century, while a few originate in the late 16th or early 17th century. The core from the oldest tree did not quite reach centre. It was estimated to have started growth in the 1450s, and is very similar in age to the oldest tree at Glen Loyne.

### **SEEKING NATIVE PINE TIMBER IN BUILDINGS**

Originally it was thought that historic buildings might provide a means of extending pine chronologies. Extensive reconnaissance has been undertaken in the north east as part of the Native Oak and Pine Project to find buildings with suitable pine timbers. We looked at buildings of all types, at first concentrating efforts away from the coast (Crone & Mills 2008a). Many buildings have lost their original roof structures but where historic timbers survive, pine is commonly present. However it is usually fast grown and too young for tree-ring dating to work. Given the lack of long-lived pine in the historic building stock, the approach has shifted away from using historic timbers for chronology building, and towards testing whether it is possible to date young pine timbers against the growing network of native woodland reference chronologies.

#### **Castle Grant**

One of the better candidates for identifying native pine timber was Castle Grant with much pine in the roofs which, given the location, was likely to be native (Crone 2006). Further investigation showed that most timbers were too young for useful analysis, apart from eight pine timbers with between 80 and 146 rings from the earliest roof, believed to be 16th Century. However, only two sequences matched each other so a site chronology could not be constructed and no individuals matched with dated chronologies, at home or abroad (Crone 2006). As the network of native chronologies grows, it may become possible to date and provenance these timbers.

#### **Duff House & Fort George**

There were reasons to suspect that Fort George and Duff House might contain some native pine, principally the documentary evidence. Assessments revealed some longer sequences which, if native, could assist chronology building (Crone & Mills 2008a). Duff House was an ideal candidate. It was designed by William Adam for Lord Braco, and built between 1735 and 1740, after Braco acquired the Mar Estate. Adam and Braco fell into legal dispute and consequently documentary evidence survives regarding its construction. A Court of Sessions record states:

*'And as for the Timber, the Petitioner provided himself partly from his own Woods in Braemar, where there are very fine Trees, which he caused to be flotted down the River Dee to Aberdeen, and from thence brought about to Banff, and partly by Cargos, which he caused to be imported for his own Use from Norway, and some part of the Timber.....were furnished to him by Mr William Adams of Edinburgh, Architect'*

The records showed that timber from Norway and Mar had been used but no native material was identified by the analysis. The Duff House chronology (1565-1737) matched chronologies from Norway and Sweden (Crone 2008). There were many fast grown timbers in the roof which were not sampled, some with as few as 15 rings, which could be the Mar timber mentioned in the documents.

At Fort George, two sources of pine timber were identified (Crone & Mills 2008b), but both proved to be imported. The Ordnance Store South chronology (AD 1492-1744) matches chronologies from Latvia, Lithuania, Sweden and England, reflecting widespread use of this particular source of imported pine, representing timber from the Belarus region exported through Riga. The results for the Chapel and Staff Block pine timbers (AD 1350-1764) indicate a common source area in Karelia, a region which straddles the Finnish Russian border today (Crone & Mills 2008b).

There was some much younger pine timbers (30-50 years) in the roof of the barracks which were too young for analysis. These could be the native Scottish material thought to be present (Crone & Mills 2008b).

#### **Buildings in the Mar Lodge area, Upper Deeside**

Analysis completed since the conference has tested the feasibility of dating young pine timbers in vernacular buildings near source woodlands when local reference chronologies are available, using Mar Lodge as a test case (Mills 2009). This test proved successful. For the first time anywhere in the UK, dendro dates have been obtained for native pine timbers in historic buildings, and have shown that local timber was used.



*Plate 2 The Red House, Mar Lodge Estate (L, photo Coralie Mills), contains a remnant pine cruck frame from an earlier phase of building. Dendro sampling of the cruck elements (R, photo Anne Crone) has allowed them to be dated against the local Mar Lodge area woodland chronologies.*

Cruck elements within The Red House, at Mar Lodge Estate, were felled in AD1799 and AD1808, for sequences with 86 and 102 rings respectively (Mills 2009). The main construction of a cruck-frame byre at Inverey has felling dates of AD1799/1800 and a remodelling phase of AD1815 (Mills 2009). Surprisingly, over half of the timbers at the byre had more than 100 rings. The results from these two buildings indicate that previous in-situ visual assessments of pine timbers have sometimes underestimated sequence lengths and dating potential. However, success is not guaranteed even with local chronologies available: timbers from Derry Lodge could not be dated because they were mostly too young, came from multiple sources and were in poor condition leading to core fragmentation.

The outcomes of this research can be deployed as useful guidance on the best way to secure dendro-dates for such buildings in the future. The good condition of the timbers, their sequence lengths and the number of samples per construction phase are important factors in influencing dating success for pine in buildings (Mills 2009). Having multiple samples with over 80 rings from the same phase represents the ideal situation. It is necessary to have local reference chronologies available to date and provenance such material. The strategy of developing a Scottish network of local pine reference chronologies from ancient woodlands is working and should be continued. There is now much greater potential for dating the rural vernacular historic building stock in Scotland (Mills 2009).

#### **The need for protection of historic timbers**

The owners of buildings mentioned in this paper have taken great care of their historic timbers and have been keen to allow this research to take place. However, all too often over the last 20 years, in the heritage dating work more generally, samples have been salvaged from the skip or the bonfire pile after they have been stripped out during development work. There is little protection for historic timbers when alteration or demolition takes place, even if the building itself is listed. There is a need to protect historic timbers specifically for the rich information they contain, not just about their own history but about the larger history of Scotland's environment, economy and trade. Conservation efforts have tended to concentrate on high status buildings but the modest buildings are very important too, and more likely to contain native Scottish timber.

#### **NEXT STEPS IN PINE DENDROCHRONOLOGY DEVELOPMENT IN SCOTLAND**

As the funding for the Native and Oak and Pine Dendrochronology Project approaches its conclusion, new sources of support will be required to continue research in Scottish pine. Further opportunities to expand the network of native woodland pine chronologies will be sought, looking for other areas with long-lived trees. A wider, denser network of woodland-specific native pine chronologies will be required to allow dating and dendro-provenancing to work properly. The other main objective will be to extend the chronologies back further in time, before the period covered by the old living pines. This would aid both historic and climate research, and is being undertaken collaboratively with dendroclimatologists Rob Wilson and Neil Loader. They have undertaken exploratory sampling of living trees and sub-fossil material in Glenfeshie, Rothiemurchus and around Loch Morlich (Wilson 2008). Analysis is in progress, and the sub-fossil material shows promising signs of covering a long period, but currently there are few Speyside living tree samples which extend back beyond the mid-19th century. A wider sampling programme is planned.

The expanding network of native pine chronologies still has rather sparse geographical coverage, and it would be desirable to augment this. Some particular priorities are evident. Speyside clearly has a rich tradition of native pine exploitation and will be a particular focus of future chronology expansion. This could assist the dating of some recently investigated Speyside vernacular buildings, where dating has not yet proved possible (Crone 2009). Much of the native pine tree-ring research undertaken so far has concentrated in the north east, and the western pinewoods are not well-represented. Creating a stronger network for westerly pine woodlands would be a great advantage, given their history of exploitation for timber export to Glasgow and beyond.

It is clear that the Scottish post-medieval buildings so far investigated do not contain the old slow-grown pine expected of ancient pine woodland. Where the timbers are native or thought to be native, they are commonly from young trees which started life in the late 17th or early 18th centuries. This provokes the conclusion that much of the timber is from plantations or regenerating woodlands, and of course landowners were creating plantations in this period, both for ornament and economy (House & Dingwall 2003). The results beg the question as to why it has not yet been possible to find any timber from older trees felled in the native pine woodlands during the post-medieval period. Even if their economic use was beset with problems of timber quality and transportation, exploitation of the ancient pine woods during the 17th to 19th centuries is well documented, as related by Steven & Carlisle (1959, 58-60), and explored in greater detail by several authors since (for example, Smout 1997; Smout & Lambert 1999; Stewart 2003; Smout *et al* 2005). It may be that we must examine far more Scottish buildings and search further afield for such material, much of which was destined for specialist uses like ship-building, mast-making and for export by external timber merchants. Scottish boatbuilding using native timber was important into the 19th Century, not just on the coasts but also on inland waters (Skelton 1994; Stewart 2003, 92). An assessment of the dendrochronological potential of timber in any surviving historic Scottish-built vessels would be worth attempting. A comparison of undated pine timbers in English post-medieval buildings is underway with Cathy Tyers, dendrochronologist at English Heritage, to discover whether Scottish native pine is represented there, as might be expected from the history of exploitation by external timber merchants (Smout *et al* 2005, Chapter 8). A similar exercise might be usefully undertaken in Ireland, from whence some of these merchants came (Smout *et al* 2005, 200).

## CONCLUSION

A larger body of historic native pine sequences, dated and provenanced against a growing network of native woodland chronologies, would clearly have benefits for the understanding and conservation of our built heritage. It would also allow meaningful investigation of the wider themes of historic woodland stand dynamics; historic management regimes; the nature of timber exploitation in the past; the development of the timber trade; and the impacts of trade and exploitation on Scottish native pine woodlands. Such themes will be pursued as the body of Scottish native pine tree-ring data grows.

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