Chronology, Culture & Archaeology - Tree-ring analysis and fine resolution sequencing (CCA – 272490)

Introduction

Chronology, culture and archaeology is a project that explores the use of tree-rings as a mechanism for better understanding the construction and chronology of wooden structures and objects found within archaeological contexts. The broad project scope explores the utilisation of wood and timber in medieval maritime contexts and encompasses issues such as tree-ring analysis (growth patterns and phasing), dendrochronology (precise dating) and dendro provenancing (establishing the spatial origin of a piece of timber), see the project web site for a series of short reports that highlight examples of each of these techniques[1]. A core element of the research has been the collection and analysis of new field data from a complex of medieval fishing structures located within the inter-tidal zone of the Fergus Estuary, Co. Clare, Ireland (see figure 1) and this short report focuses on this aspect of the project.

Boarland Rock Medieval Fishing complexes – challenges in achieving a fine resolution chronology

On the Fergus Estuary, close to a prominent feature known as Boarland Rock, a series of approximately 25 fishing structures have become available for study over the last eight years broadly dated to between 1250 and 1450 AD (see figure 2). While analysis of tree-rings has become established as a highly reliable scientific dating method for archaeological timber this relies on the survival of large, long-lived timbers in our built heritage and on archaeological sites. The utilisation of large timbers for building is only a small part of the wood resource exploited by people and many structures utilised more easily available younger wood. This is the case for the fish weirs at Boarland Rock. The weirs are V-shaped fences, consisting of vertical posts with interwoven wattle, built along the river channel at low water, which would have trapped fish on a falling tide. Two of the largest weirs in the complex (BR1 and BR2) were extensively sampled for detailed examination (see figure 3). From these samples it was hoped that we could begin to address questions such as: how often were these structures repaired or re-built? What was the nature of the woodland from which the trees were derived? These questions in turn lead to broader considerations such as: what was the extent and intensity of the fishing at this site in the medieval period? What implications are there for our understanding of the exploitation both of the riverine fish resource and the terrestrial building materials? In attempting to answer these questions the challenge lay in the fact that these structures were built of very young trees. Could the annual variation in these short tree-ring series be used to identify different felling phases, and consequently constructional phases, for these inter-tidal structures? And what might the patterns reveal about the growth conditions of the original trees?

Boarland Rock Medieval Fishing complexes – results and future work

Sampling of the two structures could only take place at lowest spring tides, as it is only at this time that the lowest-lying structures are exposed for a sufficient length of time. A total of 550 samples were analysed and, in spite of the challenging nature of the material, distinct phases in the material were identified. To do this, each short tree-ring series was compared to each other through comparison of plots of the tree-ring curves (figure 4). As every post had bark edge preserved, the first objective was to establish which posts might belong to the same felling and building phase. Therefore grouping of posts was accepted if the tree-ring curve patterns agreed and if they also ended in the same year. Subsequently these patterns were examined spatially in terms of the position of the posts in the construction plan. This resulted in a series of discreet groups, which could then be compared to each other. Matches could be suggested between groups, but showing different end years, suggesting rebuilding of the structure often annually. In one section of the east arm of BR1 this is quite clear (figure 5). The tree-ring studies suggest full rebuilding of the east arm of Boarland Rock 1 at least three times, in arbitrary years 20, 22 and 23, while also showing additions in years 26 and 27. Clearly, as these structures were affected twice daily by the forces of the flowing tides they needed frequent maintenance. It

[1] http://www.ucd.ie/archaeology/research/researcha-z/cca/

can therefore be suggested that each fishweir needed to be rebuilt at least annually, and was in use for perhaps no more than ten years. This helps to explain why so many structures are found along this 800m stretch of the river channel. From the tree-ring studies we can suggest that the activity here does not represent an industrial scale fishing industry and perhaps only one or two structures were in operation at any one time, representing a very sustainable use of the river resource.

Achieving precise calendar dates from such short tree ring series is not possible but the material can be used for high precision radiocarbon dating. By taking a series of samples of single tree-rings at regular intervals through a wood sample we have some prior knowledge of the expected order of the resultant dates which can be used to refine the chronology. Although initial, conventional radiocarbon dates, indicated that BR2 was older than BR1, it only showed that BR2 was from some time in the 14th century while BR1 was from the first few decades of the 15th century. From this we could begin to form a model for the dynamics of the river system at the time the fishweirs were built, showing that the channel in medieval times had been migrating from east to west. Could a more precise dating for the two structures show us the rate of this migration? Samples from one of the oldest trees from each structure were chosen, to maximize the probability for success. Greater precision was forthcoming using this technique, as shown in the accompanying diagram (figure 6), but due to the marked pattern in the calibration curve at this period, two possible calibrated positions for BR2 emerges. We can say that the two fishweirs were built either about 25 years or about 90 years apart. Future research will extend and clarify this work. Repeated visits to the locality has revealed that that another fishweir structure is gradually emerging, to the west of BR1, as the Fergus river channel migrates westwards, eroding the mud of the estuary. A radiocarbon analysis of one of its upright posts, in the same high precision technique that has been utilised for BR1 and BR2, should enable a more refined understanding of the rate of the medieval channel migration.

While these fishweir structures are telling us a great deal about the exploitation of the river resource, we were also also able to gain insight into the use of the terrestrial resource, the woodland. Analysis of the samples suggests that the wood used was from unmanaged woodland, and the predominance of alder indicates woodland on low-lying wet lands where this species thrives. The numerous fishweir structures at this part of the estuary, with annual re-building, attest to an abundant supply of trees in probably marginal lands not suitable for cultivation. That young wood was used meant that this raw material was quick to regenerate, enabling a sustainable exploitation of this terrestrial resource.

Broader implications

This aspect of the work has focused on structures built in the 13th and 14th Centuries AD and it might appear at first glance that this has little relevance to the modern day. Examining the details of such structures does, however, have a series of important implications and impacts. Firstly, from the perspective of national and international heritage, these structures are some of the best preserved of their type and date in Europe, and they are being lost, day by day, year by year to channel migration and the data they hold needs to be assessed. Consequently, these investigations, and their results, have implications for heritage planning, survey strategies and preservation policies. Secondly, the heritage being exposed will only ever be seen by a very few people, it is hard to get to, only exposed for a limited time per month, for a limited time in the year, and has safety implications. It is clear from the response to newspaper articles, web site visits and open lectures, that the public, particularly locally, want to know more about the discoveries made and their implications. Thirdly, exposure of archaeological material within an estuarine zone provide some of the only fixed chronological indicators that can help us understand past channel movements and configuration, a notoriously difficult area of study in these environments. Such assessments may enable a more refined understanding of the impact of human alteration of the landscape such as land reclamation schemes over the last 200 years and beyond.

For further information:

Please see the project web site: http://www.ucd.ie/archaeology/research/researcha-z/cca/fei/

Please also feel free to contact: Dr Rob Sands (robert.sands@ucd.ie) or Dr Aoife Daly (aoife.daly@ucd.ie)

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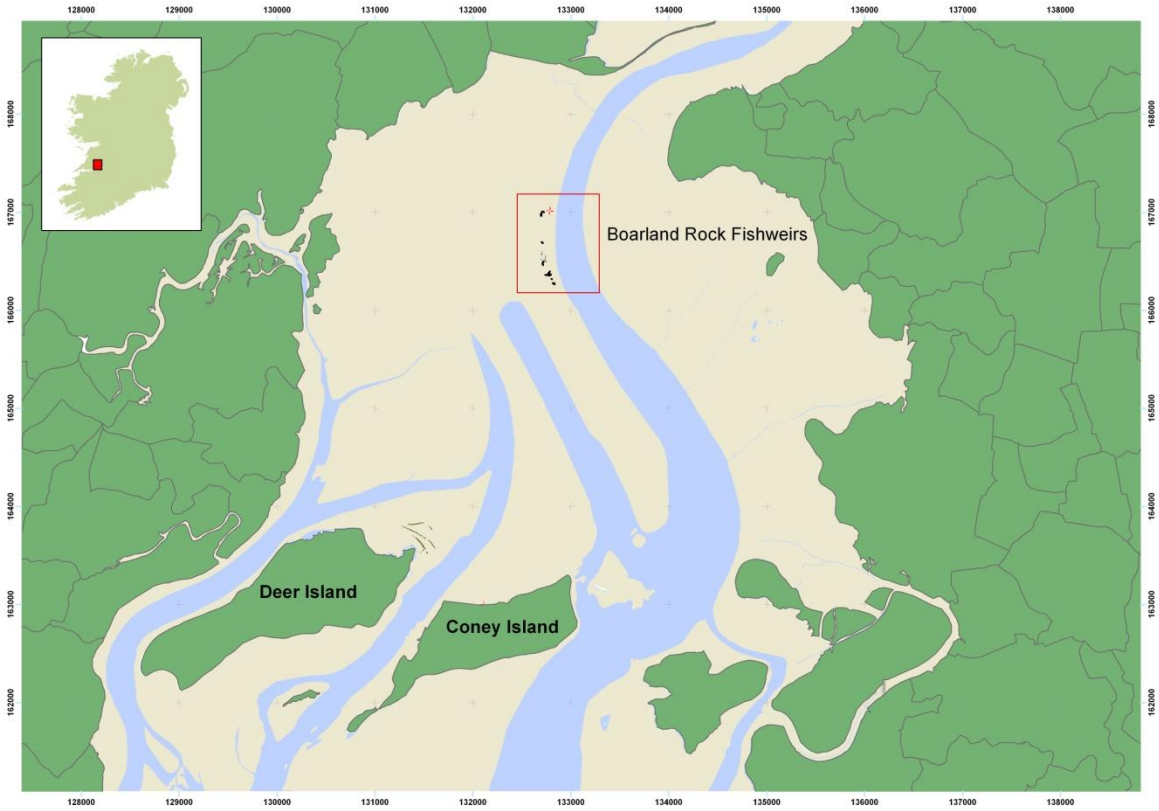

Figure 1: Location of Boarland Rock fishwiers. Note that the background mapping does not accurately reflect the position of the modern channel relative to the fishing structures. The current research has considerably refined our understanding of channel change from the time at which the sites were constructed to the modern day.

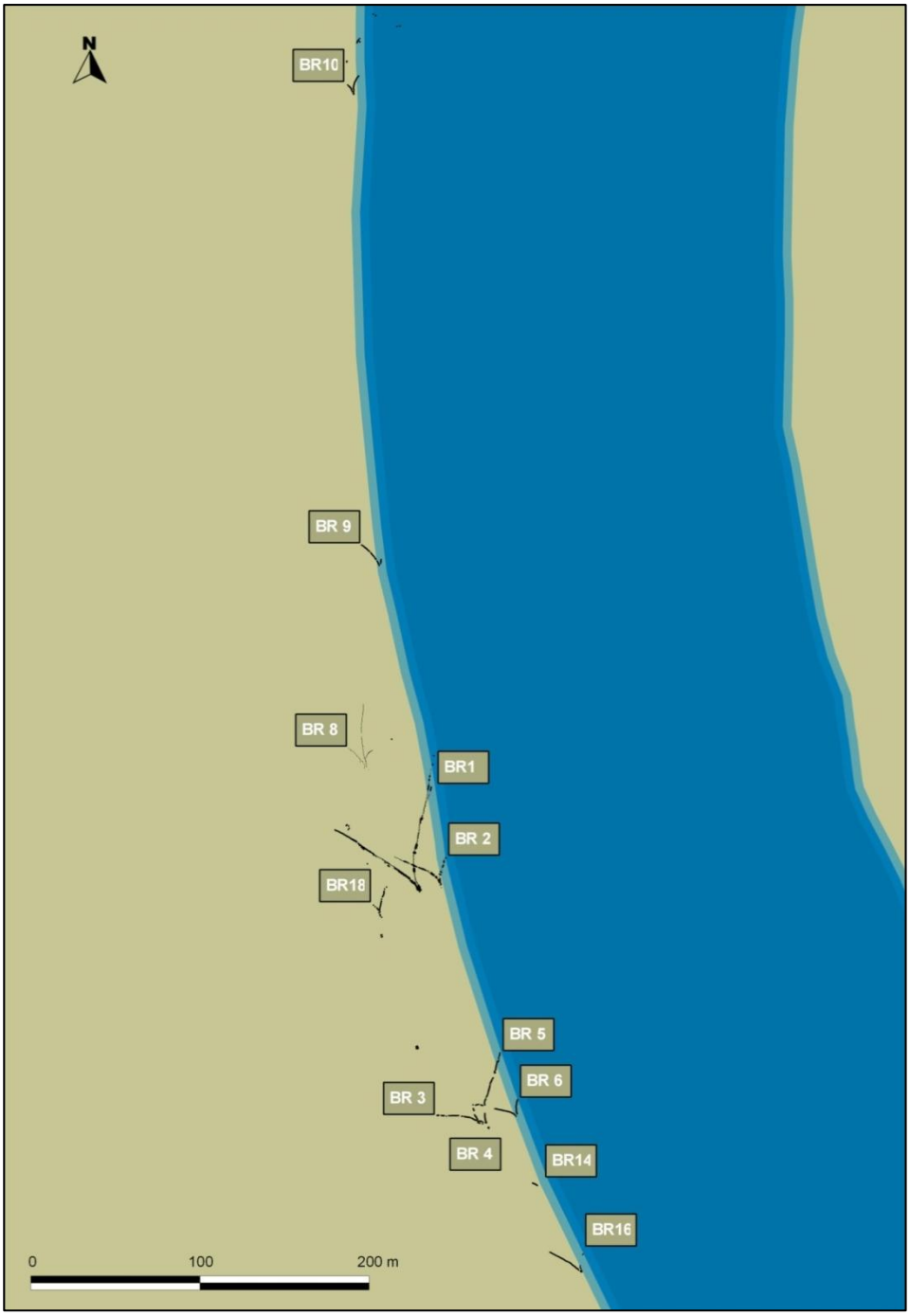

Figure 2: Location of the main Boarland Rock fishing structures. BR 1 and BR 2 provided the core focus of analysis. These are the largest, most complex, fishing structures in the group. Note that they seem to respect the modern channel we now know that they originally sat in a channel to the west, which migrated west and the structures were covered over. The modern channel is now re-exposing the structures from what would have been their landward arms.

Figure 3: Looking along the eastern arm of BR1 - the larger fish weirs are complex multiphase structures. Results from this project suggest yearly repair of the structures with perhaps a total life span of no more than 10 years.

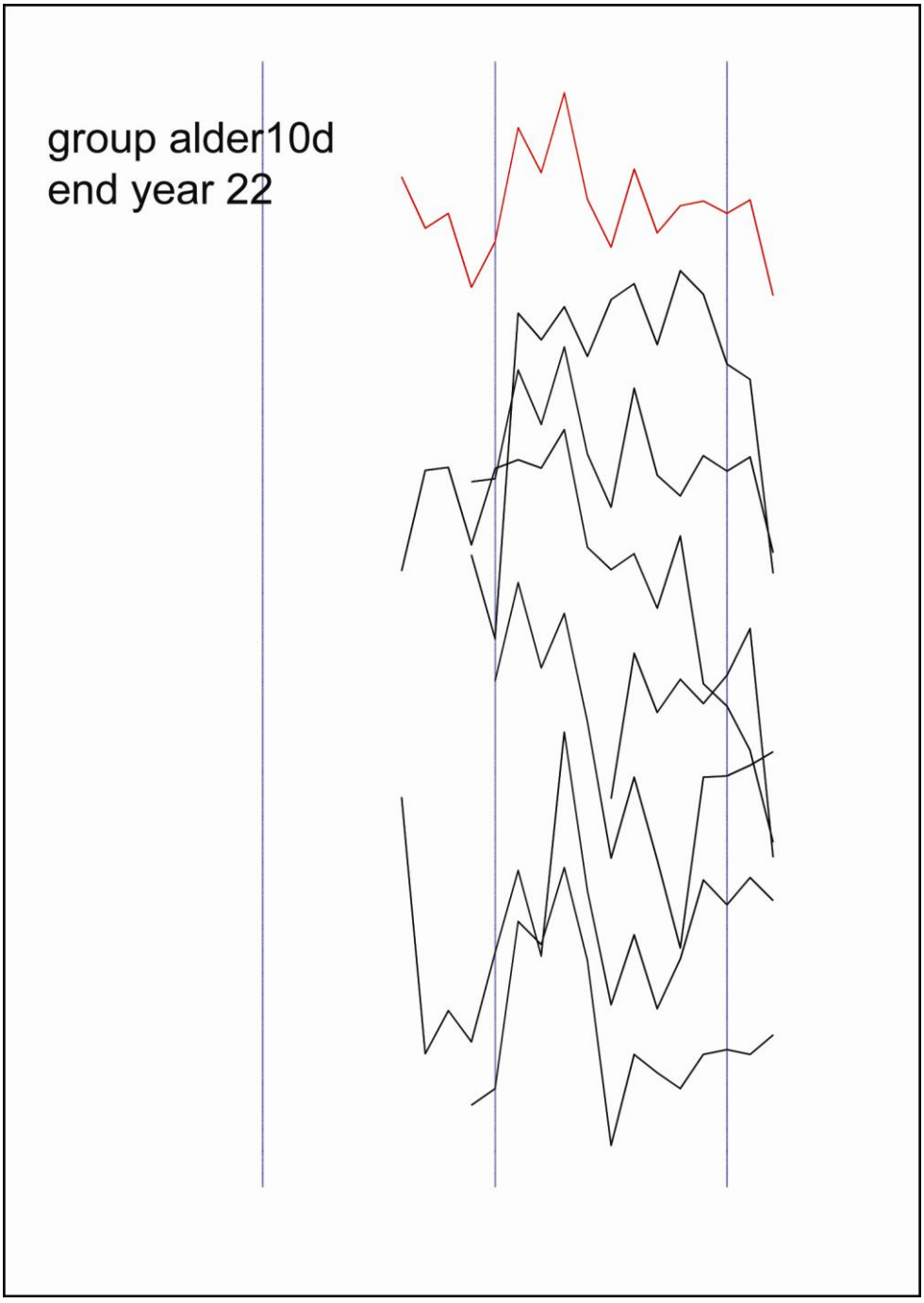

Figure 4: Plot for the comparison of tree-ring curves assigned to group 'alder10d'. The plots of the tree-ring widths for individual posts are shown in black. The average of these is in red. All trees in this group were felled in the same year: arbitrary year 22.

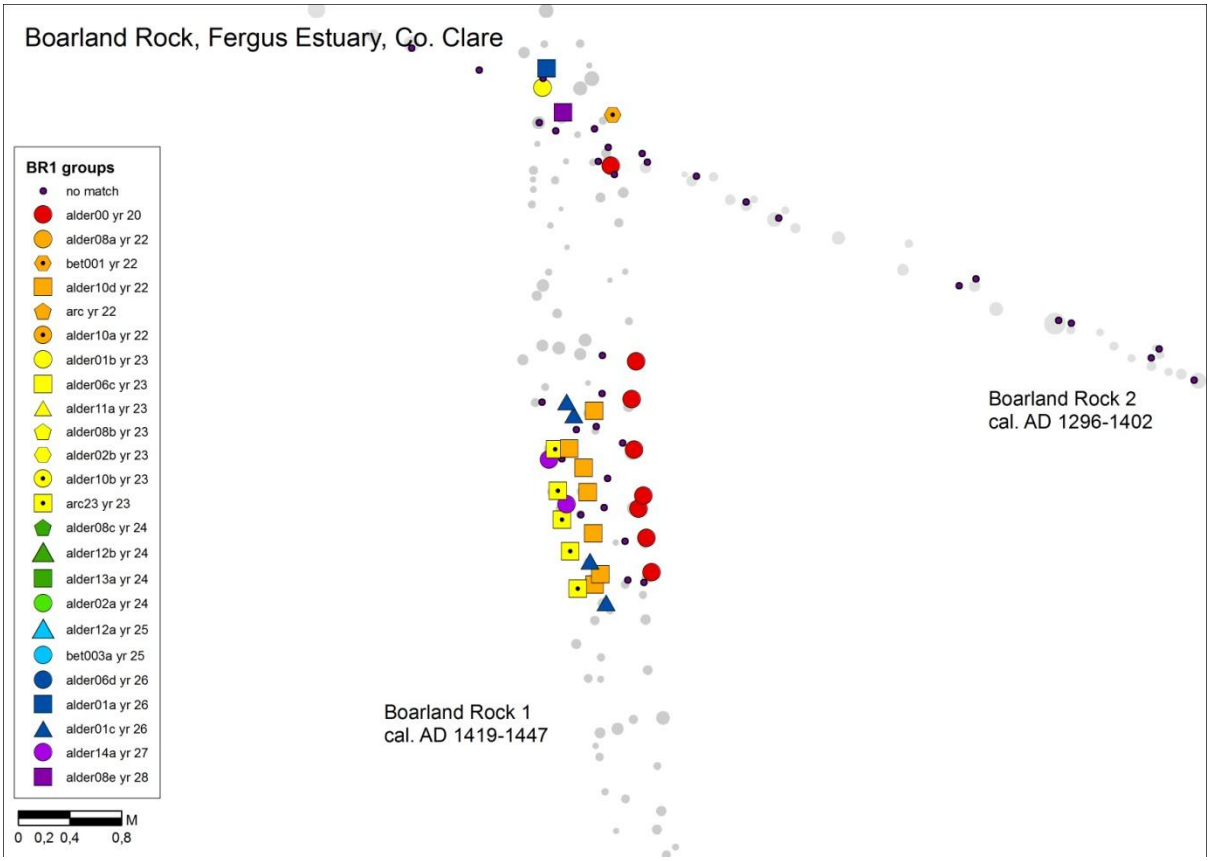

Figure 5: Plan of a section of the east arm of the BR1 fishweir, running North-South intersecting the west arm of the earlier BR2 weir that runs WNW-ESE. The symbols illustrate the results of the chronological groupings as suggested through the tree-ring studies. The red circles represent a group of posts felled in arbitrary year 20, the orange squares (group alder10d shown in figure 4) from arbitrary year 22, while the yellow squares are from year 23. The tree-ring studies suggest an east to west rebuilding of the east arm either annually or bi-annually. The tree-ring study also suggests additional phases at years 26 and 27. (The grey dots represent the parts of the structure that were not sampled, while the black dots are posts that were sampled and analysed, but could not be assigned any tree-ring group.)

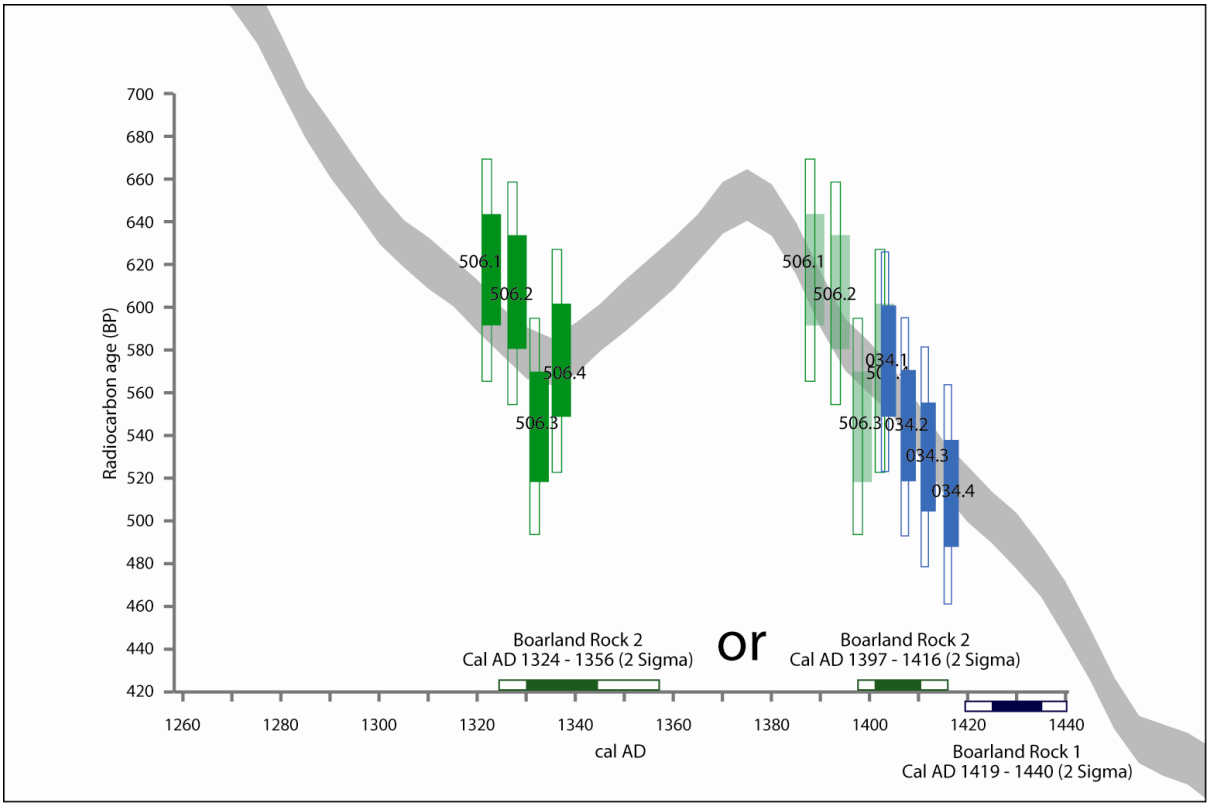

Figure 6: Calibration of the radiocarbon dates of a series of sub-samples from posts from the two fishweirs. One post from each weir was sub-sampled at five-year intervals. Boarland Rock 1 is in blue while the two possible positions for Boarland Rock 2 are shown in shades of green. Due to the marked pattern in the calibration curve at this period, two possible calibrated positions for BR2 emerges. We can say that the two fishweirs were built either about 25 years or about 90 years apart.