

1 Assessment of reliability and usefulness of radiocarbon dates while studying colonisation processes.

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One of the most important aspects of studying early humans is understanding how and when they entered and colonised new areas. For example, during the Mesolithic period, new areas of land became available for the very first time due to deglaciation. While it is known when these areas could not be inhabited, it is often hard to work out exactly from when they were the subject of human occupation. So can radiocarbon dates be used to date sites in a reliable enough fashion that an overall chronology of a region can be established?

The process of using radiocarbon dates as a tool for analysing population data has been around since the 1960's (Kuzim and Keats 2003). By the late 1980's, the first full numerical analysis of a radiocarbon dataset took place, with an emphasis on trying to establish a timeline of human population size (Rick 1987). Since then there have been attempts to model the process of peopling the Americas (Anderson and Gilliam 2000; Fidel 2002). More recently, Kuzim and Keats (2005) have used radiocarbon dated sites to try and track the original peopling of Siberia during the Palaeolithic in a very similar study to the one attempted here. From these efforts it is clear that many scholars in this field believe that radiocarbon dates have a place in such work. However, it should be noted that, as with any archaeological technique, there are limitations and weaknesses that need to be addressed before any data produced in this way can be produced or assessed.

Pettitt et al. (2003) have analysed the reliability of radiocarbon data through the lens of establishing population densities and colonisation patterns. They call into question the usefulness of radiocarbon dates, especially in regards to the more ambitious uses through larger and larger datasets and more widely ranging research questions. They argue that as more radiocarbon dates have been produced and published over the years it has become clear that some of the dates are more 'archaeologically valid' than others. If radiocarbon dating is to continue to be a useful tool then this issue needs to be addressed.

In their work looking at the reliability of using radiocarbon dates in the analysis of sites from the Palaeolithic, Pettitt and his colleagues (2001) cite H.T. Waterbolks' 1971 article: 'Working with Radiocarbon Dates'. In this paper he sets out a number of key factors that need to be addressed before any radiocarbon dates can be used in the analysis of a larger project. While not all of them are pertinent to this study, there are a few that need to be addressed here.

The most important point made is that any dated sample needs to be clearly associated with the site that it is being dated; this problem is negated in this study by the fact that all the dates used show direct evidence of human activity in their associated layer and thus any date retrieved through their study can be applied as evidence for human occupation at that time. The issue of contamination is brought up a number of times and there are a small number of sites that may show examples of this. The date given from the study conducted at Larig in Allt na Fearna in the highlands, for example, (McCullagh & Tipping 1998) has been noted as possibly being anomalous. However, the study from

which this date was taken was not clear on the subject either way and there are only two other dates associated with this study (Rideout 1992, MacKie 1976) that have any doubt in this way and both of these only have 'possible doubts'.

Another concern raised was the reliability of individual radiocarbon dates. While each date published in a reputable source must be taken on good faith to be as accurate as possible, the impact of single unreliable results on this study can be easily negated. If any of the radiocarbon laboratories which have produced the dates used in this study come into question in the future, either from outside sources or if they themselves realise information or reports that call into question any batches of data produced, the data in question can be easily removed from the study, since all of the sites have been entered into the database along with their radiocarbon codes.

In the aforementioned study of Palaeolithic Siberia, Kuzim and Keats (2005) lay down the basic problems that are associated with using radiocarbon dated sites as a method of tracking the colonisation of an area. They make a list of assumptions that need to be made before such a study can take place and many of their problems are relevant to this study. First and foremost it has to be assumed that there is a close and relative approximation between the sites that have been discovered and assigned radiocarbon dates, and the total number of sites that can be assigned to this time period.

In a Scottish case study (Dickson 2011) it seems that this is indeed the case. There are a number of areas or regions that, while they have sites associated with them, do not all have a radiocarbon date, such as in the administrative district of Moray. There are two sites associated with the region (Carter 1993, Burl 1984), one dated to 6740 cal BP and the other to 6006 cal BP. However, there is at least one more site associated with the area known since the 1940's: the coastal site of Culbin Sands (Lacaille 1944). It simply has not appeared in the study due to it being a lithic assemblage and thus has no radiometric date associated with it. However, this seems to be the exception rather than the norm and it should be assumed that as much of the area is represented through the study as is possible.

Another problem raised by the study conducted by Kuzim and Keats (2005) concerns differentiating between sites that have been occupied continually for a long period of time and sites that were occupied intermittently. Their solution was to group together dates in 'occupation episodes' regardless of whether the dates came from different occupation layers. If the dates all came from the same 1,000 14C period they are counted as one occupation episode. If the overall time period is more than 1,000 14C then they were counted as two or possibly more occupation episodes. This was originally an issue relating to this study of the Scottish Mesolithic, but it was one that resolved itself once it was decided that the focus would be limited to the first date for each site as opposed to a larger analysis of continued occupation.

In conclusion while there are certainly doubts relating to the reliability of radiocarbon dates (Pettitt 2001; Pettitt et al. 2003), studies such as the one produced by Kuzim and Keats (2005) show that, as long as the limitations are laid out beforehand, radiocarbon dates can be used to gain a wider understanding of the population changes and colonisation chronology of a given area.

Bibliography

- Anderson, D G., and Gilliam, C. (2000). 'Paleo-Indian Colonization of the Americas: Implications from Examination of Physiographic, Demography, and Artefact Distribution.' *American Antiquity* 65:43-66.
- Burl, H.A.W. (1984). Report on the excavation of a Neolithic mound at Boghead, Speymouth Forest, Fochabers, Moray, 1972 and 1974. *Proceedings of the Society of Antiquaries of Scotland* 114.
- Carter, S. (1993). Tulloch Wood, Forres, Moray: the survey and dating of a fragment of prehistoric landscape. *Proceedings of the Society of Antiquaries of Scotland* 123, 215-33.
- Dickson, R. (2011). 'Radiocarbon dates and colonisation: A case study from Scotland'. Unpublished dissertation.
- Fidel, S J. (2002). 'Initial Human Colonization of the Americas: An Overview of the Issues and the Evidence.' *Radiocarbon* 44:407-36.
- Kuzim, Y. V. and Keats, S. G. (2005) Dates are not just Data: Palaeolithic Settlement Patterns in Siberia Derived from Radiocarbon Records in *American Antiquity* 70, No. 4.
- McCullagh, R.P.J and Tipping, R. (Eds). (1998). *The Lairig Project 1988-1996: the Evolution of an Archaeological Landscape in Northern Scotland*. Edinburgh: Scottish Trust for Archaeological Research.
- Mackie, E.W. (1976). Radiocarbon dates for two Mesolithic shell heaps and a Neolithic axe factory in Scotland. *Proceedings of the Prehistoric Society*, 38, 412-6.
- Pettitt, P. B. and Pike, A. W. G. (2001). Blind in a cloud of data: problems with the chronology of Neanderthal extinction and anatomically modern human expansion in *Antiquity* 75.
- Pettitt, P. B., Davies, W., Gamble, C.S. and Richards, M.B. (2003). Palaeolithic radiocarbon chronology: quantifying our confidence beyond two half-lives in *Journal of Archaeological Science* 30.
- Rick, J.W., (1987). Dates as data: an examination of the Peruvian pre-ceramic radiocarbon record. *American Antiquity* 52, 5573.
- Rideout, J.S. (1992). The Dunion, Roxburgh, Borders. In J.S. Rideout, O.A. Owen and E. Halpin, *Hillforts of Southern Scotland*, 73-119. Edinburgh. AOC Scotland Ltd.
- Waterbolk, H. T. (1971). Working with radiocarbon dates *Proceedings of the Prehistoric Society* 37 15-33.