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Metal-detecting data as citizen science archaeology

Anna Wessman & Eljas Oksanen

Abstract

Avocational metal-detecting in Finland has produced a mass of new and important archaeological data over the past ten years, and responsible metal-detectorists act as citizen science archaeologists. Important steps have been made in producing digital archaeological data services aimed at both professionals and the public, including the Ilppari online finds reporting service and the FindSampo citizen science data service and semantic online heritage portal. But with this development work we have also seen that more attention needs to be put on data quality, data structure, database design, and on development work of digital services in order for them to influence a higher user potential. In our paper we argue, through select case studies, that appropriately recorded metal-detected finds possess tremendous possibilities for advancing archaeological understanding of the past. This data can be used for creating new spatial analysis, for identifying previously unrecorded and therefore vulnerable archaeological sites, and for identifying new potential research areas.

Keywords: metal-detecting, citizen science data, data creation, Ilppari, FindSampo, GIS and spatial analysis.

34.1 Introduction: Archaeological metal-detecting in Finland

Avocational metal-detecting has changed Finnish archaeology in many ways during the past ten years. Metal finds from all over the country have either complemented previous conceptions of time periods where metals were used (particularly the Bronze Age, Iron Age and the Middle Ages) or changed our perceptions of their material cultures completely. Yet, only limited research has been done on the objects that have been found (e.g. Hakamäki 2018; Immonen 2013; Wessman 2016). In this paper we discuss the potential and the research value of metal-detected data, and demonstrate them through a few examples.

In Europe laws concerning avocational metal-detecting range from restricting or entirely prohibiting the activity to generally permitting it outside certain protected areas (Dobat et al. 2020). In Finland, metal-detecting is not prohibited, with the current Antiquities Act (295/1963, under review) being so outdated that it does not mention metal-detecting at all. The act prohibits interference on protected ancient sites and all recovered objects over 100 years of age must be reported to the Finnish Heritage Agency (FHA). It is therefore legal to detect on both fields and in forests (FHA 2015: 17), although forbidden at protected sites, such as in the immediate vicinity of archaeological monuments.

This is in contrast to some other European Countries, where metal-detecting is often restricted to arable land (e.g. Denmark and Norway) or it is advised that only recently disturbed land is searched (e.g. England and Wales). In Finland this has led to new and exciting finds from both agricultural land where plough-zone archaeological context has been destroyed by modern machinery, but also from pristine forest locations. While the latter may seem problematic to some, this might not always be the case as will be explored below.

Responsible metal-detectorists are citizen science archaeologists (e.g. Wessman et al. 2019). Citizen science approaches to the democratization of knowledge and sharing experiences has become increasingly popular in many fields of scientific inquiry, especially in natural sciences (Dickinson & Bonney 2015), but its applications are still under-explored within humanities and archaeology. One might compare citizen science archaeology with approaches to public archaeology, which has longer roots in Finland (Wessman et al. 2019: 6; see also Lorenzon, Preda-Bălănică and Thomas, this volume), although the two terms do have different connotations. For example, in Finnish public archaeology volunteers or amateur archaeologists take part in archaeological excavations, but their role usually remains passive. The projects are seldom initiated by members of the public, and during excavations volunteers follow the rules and guidelines given by professional archaeologists. Metal-detecting, on the other hand, is often initiated by amateurs themselves and their approach to their own fieldwork is active. The more experienced (or avocational) detectorists frequently possess significant knowledge regarding the objects they find, and may seek (albeit by chance) archaeology in places where professional archaeologists would not necessarily go. Therefore, avocational detectorists can be very knowledgeable of the past and act as an enormous asset to heritage management by, for example, identifying new sites and places at risk. It is a critical component of responsible metal-detecting as citizen science that the information gained is shared, aiding heritage management and advancing the common body of scientific knowledge. Advice on reporting has been set down by the FHA in its guide to responsible metal-detecting (FHA 2015).

Professional archaeology will best benefit from the activities of metal-detectorists if there are clear and well-supported pathways and processes by which knowledge can be mutually communicated and exchanged. Baseline data on archaeological objects found (and on new sites they might identify) represents only a portion of the potential knowledge-base of the community. Equally important to findspots – crucial to placing these finds within a landscape context – may be an understanding of where no finds were made. So far this kind of data (the negative evidence) is not stored anywhere. Further, the vast amount of new metal objects found through avocational metal-detecting have become a burden to the heritage management, because there are not enough resources for identifying, recording and cataloguing or (even) conserving the thousands of finds now reported annually. As a result, the FHA has set out a strategy instructing that searching should stop after the first find at each findspot (FHA 2015: 8). Guidance has recently been given to the effect that finds made in undisturbed (i.e. unploughed) soil with an intact archaeological context should be left in the ground, rather than recovered and sent to the FHA (FHA 2021a).

In response to significant resource challenges, during recent years important steps have been made in producing digital archaeological data services aimed at both professionals and the public. The Ilppari online reporting service, developed by the FHA, was launched in February 2019, and in November 2021 over 14,000 finds or finds collections had been reported through it. Metal detectorists can report and give information on their finds through the service, and also get feedback on their discoveries (Wessman et al. 2019). Since March 2021 the service has been developed to include all archaeological public findings, such as new archaeological sites on land or underwater (FHA 2021b).

In May 2021 the FindSampo citizen science data service and semantic online heritage portal was launched by the Finnish Archaeological Finds Recording Open Linked Database (SuALT) project consortium of the University of Helsinki, Aalto University and the Finnish Heritage Agency. FindSampo displays and disseminates archaeology discovered by the public, the vast majority of it found through metal-detecting. The semantic portal can be used to search the data, or create custom data analyses with the aim of empowering and democratising knowledge discovery and creation (Hyvönen et al. 2021). From the beginning it was envisaged as important that user needs were studied and the service was developed together with its future core user communities: detectorists, researchers and heritage professionals.

34.2 Citizen science data in archaeological analysis

Both the growing quantity of data and the requirement to serve the needs of multiple user audiences highlight the need to pay particular attention to data quality, data structure, database design, and the development of cultural heritage data services. In this paper we select a few core characteristics of archaeological citizen science data and discuss how these influence its use potential.

The first question is how archaeological heritage data is being recorded in the first place. It should be borne in mind that all databases are themselves cultural artefacts, with individual institutional histories that shape them through design and maintenance priorities (Newman 2011). This is no less true for national cultural heritage databases, commonly built on top of longstanding – indeed generational – practices of archive and collections management. Especially in a dispersed multi-user and multi-recorder environment, characterised by a deep knowledge base and equally well-established recording workflows, the transition from paper to digital datasets is not without its challenges. How this is reflected in archaeological recording, which frequently deals with items difficult to interpret, was investigated by a recent project to digitise over 2.000 public archaeological finds records from 2000 to 2015 listed in the FHA's Artefact Register of Archaeological Collections (Fi. Muinaiskalupäiväkirja) (Oksanen and Kaivo, forthcoming). A free-text paper or pdf page record of, for example, a badly damaged metal brooch recovered from a probable Iron Age site might merely give a general description of the object and the findsite, accompanied by a professional hand-drawn illustration, but leave out specific interpretations regarding classification, dating, material composition or other features. An expert reader, assisted by the image and perhaps able to examine the object itself in the FHA collections, could form their own balanced interpretation on the character of the find.

This lack of specificity is one practical solution to dealing with uncertain archaeology; it eschews potentially problematic interpretations in favour of keeping to the minimum verifiable information. From the perspective of digital citizen science, however, it presents two major challenges. Firstly, the record is not accessible to non-specialists, who do not possess expert knowledge to build upon the information given. Secondly, database structures usually expect straightforward classifications and are not well-equipped to deal with free-form mixed media descriptions; this is all the more so if mined for intensive 'big data' analysis. Typically, information is expected to be coded with scientific terminologies into dedicated fields: e.g. object type, typological classification, periodisation, material composition, and so forth. A digital database therefore does require a level of interpretation, of making a judgement, that can be avoided by less codified recording systems. This is, of course, hardly a new problem in digital cultural heritage (or any digital data). A number of different solutions have been proposed for recording "fuzzy" information, such as accompanying a record field (e.g. object dates) with a value representing certitude or probability (Bevan et al. 2013). They have not, however, seen popular adoption.

A further critical transition in Finland between "paper-based" and digital archives has been that the former used to necessitate only a limited codification of archaeological term lists. This has presently changed: a major recent achievement in creating digital infrastructure for Finnish archaeological cultural heritage has been the development of new ontologies and term lists that formally name and define relationships for key archaeological information, such as object types and historical periodisation. This work has been carried out by the FHA in conjunction with Finto (Finnish Thesaurus and Ontology Service) to be part of the Ontology of for Museum Domain and Applied Arts MAO/TAO, and it will provide, for the first time, a modern systemised ontological backbone for archaeological object recording (Rohiola & Kuitunen in press).

Ontological frameworks are crucial for both 'professional researchers' wishing to make sense of 'big data', but also (in our view just as importantly) empowering and democratising new deep analyses of mass data. Significant and still untapped potential lies in linking and translating archaeological ontologies transnationally, e.g. by enhanced data interoperability through Linked Open Data principles (Hyvönen 2012; Oksanen et al. forthcoming). Current developments in Finland are in line with current pan-European data infrastructure endeavours (e.g. ARIADNEplus, see Richards & Niccolucci 2019), which are breaking down barriers to understanding cultural heritage in its truly wider context, loosened from the constraints of modern political and social boundaries. This is particularly important for citizen science archaeology, if we consider that the principles of accessibility and democratisation of information cannot be fully realised if they are confined to only one country and language.

34.3 Spatial Contexts

Our second theme considers key information expected to be given by modern archaeological citizen science databases: spatial information, usually the findspot coordinates. In theory even if a find's morphological interpretation is difficult or contested, its findspot data should at least provide a solid starting point for a variety of archaeological analyses.

The precision of the coordinate data strongly influences how the find be used in GIS-led analysis. The level of spatial accuracy required depends on the research methodologies and questions. The Portable Antiquities Scheme (PAS), which was established in 1997 in England and Wales as the first European scheme to record public metal-detected finds, requires at least a 6-figure Ordnance Survey grid accuracy for all records. This means that the findspot can be located within a square 100 meters to one side. This is already somewhat better than a mere agricultural field-level precision, and usually allows the findspot to be meaningfully related to nearby key landscape features such as settlements and known archaeological monuments. One level higher in spatial precision (10 meter map square) empowers a significantly better level of spatial statistics analysis, relating the findspot location closely with natural (e.g. soils, slope, nearness to water bodies) or human-made (e.g. other finds concentrations, roads, field boundaries) landscape features. As the result of agricultural activity plough-zone finds do move within the confines of field boundaries, however, by some estimates by as much as an average of 5-10 meters per episode of ploughing (Daubney 2016: 85). Consequently, the assumption that more precise spatial data will always yield more precise information on deposition contexts should be approached with caution.

Nonetheless, yet more accurate findspot data (1 meter map square or less) is always desirable. Studies have proven that surface and plough-soil finds provide important information on deeper sub-soil features (e.g. Fredriksen 2019: 72; Maixner 2016: 140). Original deposition contexts may also be recovered and reconstructed by studying the post-ploughing scatter pattern of finds originat-

Figure 34.1. An even-headed arrowhead (KM43340:1) found by metal-detectorist and archaeology student Taneli Leinonen in spring 2021 in Vaala, northern Finland (Sirkkasuo 2). This is a good example of how metal-detecting provides new knowledge and research. When the find spot was later examined by an archaeologist, a fireplace was found close to the find spot. Together with the arrowhead and a piece of bronze sheet they may form the first Iron Age settlement site in this area. Photo T. Leinonen.

ing from a single source, such as a hoard or a grave (Daubney 2016: 86–7). Critical is also not only findspot precision, but information on what level of recorded precision the coordinates are given at, so that the spatial data may be appropriately used. The ubiquity of GPS-enabled smartphones does provide a baseline for recording a reasonably high precision of findspot coordinates, and this can be encouraged by guidance from the authorities. An example of this is the FHA guide to metal-detecting, which also highlights the relevance of recording other contextual information such as soil type, nearby surface features, vegetation, and so forth (FHA 2015).

Furthermore, and especially in Finland, metal-detecting takes place in forests. It is important to note that these are not necessarily old-growth forests, as most forests in southern Finland are industrial and may even have been planted on former agricultural fields. Historical tilling may have already impacted the findsite, and the expectation is that these forests will one day be worked over by heavy forestry machinery, potentially damaging or destroying unsurveyed sub-surface archaeology. Indeed, a recent survey of damage caused to ancient monuments highlights forest industry as one of its main causes (Maaranen 2020: 23). Yet metal-detected finds made in forests give completely new information on depositional practices – caches, offerings, and burials – that traditional academic or development-led archaeology has not produced in Finland. Responsible metal-detecting can also bring to light new sites (e.g. in Häme: Hänninen 2020), which if unsurveyed and unrecorded as protected monuments may later be damaged by industrial forest use. For both reasons, in these (present-day) forest contexts spatial record precision very obviously has heightened importance.

In Finland, as in other countries, metal-detected finds are sometimes devalued as archaeological evidence owing to their lack of stratigraphic context (Häkälä & Sorvali 2017: 38; Modarress & Hakamäki 2019). Spatial record precision is of key importance, yet, as long as *almost any level of spatial information* is provided the larger context of a set of finds can be examined using a variety of spatial analysis techniques. Wider socio-economic and material culture contexts at inter-regional and national scales are deductible even from data that lacks all but the roughest (e.g. settlement or parish level) spatial coordinate information.

As an example we examine the distribution of 83 metal arrowheads dating to Late Iron Age recovered by metal-detecting (Fig. 34.1). Our data consists of 5.269 finds, the vast majority of which are metal period finds recovered by detectorists, and which were listed between 2000 and 2015 in the Artefact Register of Archaeological Collections (Fi. Muinaiskalupäiväkirja, digitised in Oksanen & Kaivo, forthcoming), or reported between 2015 and 2017 for recording in the FHA's cataloguing application for archaeological finds (Fi. Luettelointisovellus). We use a spatial technique called Relative Risk Surfaces (RRS) in order to investigate whether their large-scale distribution gives us information about economic patterns in pre-modern Finland. RRS is a spatial analysis method closely related to kernel density surfaces. This latter is a common and highly useful data smoothing technique for visualising spatial event distributions, such as archaeological object findspots. Simple point-based distribution patterns, when composed of very large numbers of locations, can be difficult to interpret with the naked eye. This is especially so if many points lie adjacent or on top of each other. A kernel density map is a mathematically calculated surface that represents spatial variance in the event (findspot) intensity. The surface can be drawn as a colour-coded "heatmap", therefore enabling a much more finely grained analysis of the pattern (O'Sullivan & Unwin 2010). RRS does the same, but it represents the relative intensity of a subset of events (arrowhead findspots) when compared to the parent dataset (all public finds). In other words, RRS captures spatial information

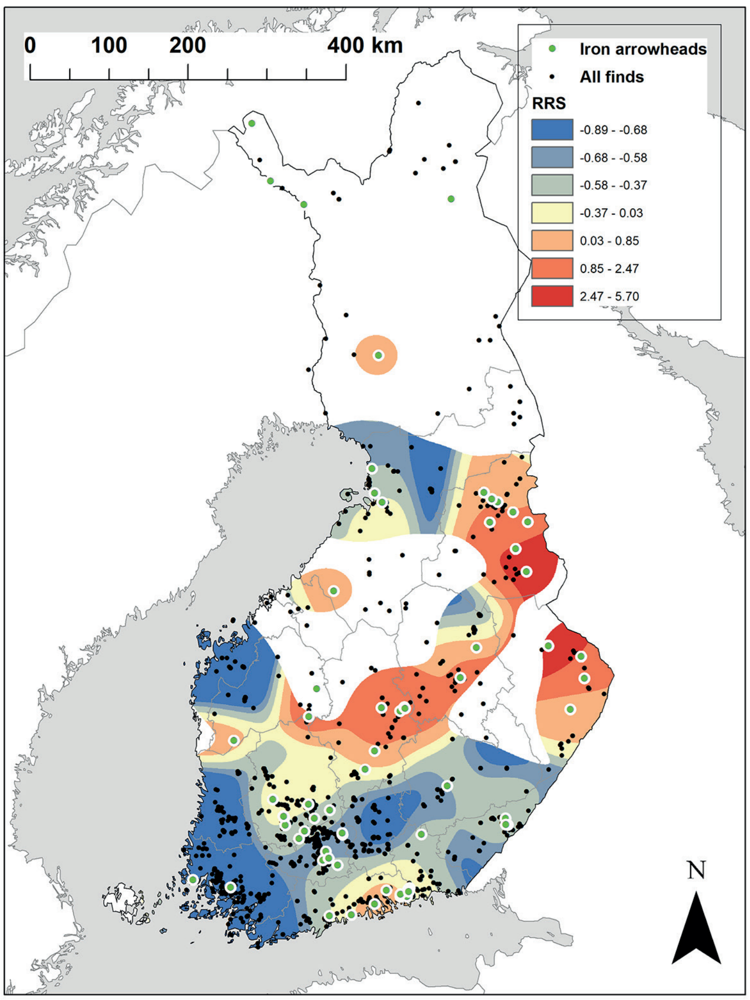

Figure 34.2. Distribution of finds from FHA's cataloguing application for archaeological finds (Luettelointisovellus) and the Artefact Register of Archaeological Collections (Muinaiskalupäiväkirja) (2000–2017, n=5269), with iron arrowheads (n=83) picked out. The underlying relative risk surface (sigma=30 km) is mathematically calculated map surface highlighting in warmer colours (values above 0) areas of higher concentrations of arrowheads finds relative to the overall findspot distribution. Regions of few or no finds have been excluded to avoid statistical anomalies. Map E. Oksanen.

on where there is a higher than statistically expected, or a lower than statistically expected, concentrations of a subset of finds (Bevan 2012).

When dealing with public finds data, this is a good technique for dealing with geographical recovery biases inherent in the material. A simple point distribution map of arrowhead finds shows that in absolute numbers most are recovered in southern Finland, specifically in Häme (Fig. 34.2). This is to be expected, as during the time our finds were recovered Häme was the most active region for metal-detecting. However, the RRS calculation shows that in terms of relative numbers arrowhead finds Häme (and the other highly active region of southwestern Finland) is not particularly well represented. Instead, arrowheads are relatively more common further up north, especially in the regions of Central Finland, Northern Savonia and Carelia, and Kainuu. These are regions with far fewer metal-detected finds. During the Iron Age and medieval period they were heavily forested and with a low density of populations that would produce and deposit metal artefacts.

It appears that metal arrowheads indicate hunting of game and wildfowling, possibly also exploitation for pelts and furs by local communities living in this forested area (Hakamäki 2018; see also Hennius 2021). This contradicts previous interpretations of arrowheads deriving from hunting expeditions by populations living outside this area (the so-called *erämark* economy). These arrowheads strongly stand out in the composition of the recovered metalwork culture in central and eastern Finland, giving new information on its regional variance. With this new data we can finally come closer to the mobile communities of people that settled this area, which so far have been almost invisible in the archaeological material. This is an example of how public metal-detected finds produce new information on the material culture of the past, even at very large scales of analysis. Furthermore, arrowheads recovered away from previously known historical settlements also illustrate the potential of forest finds to uniquely enlarge the body of archaeological knowledge.

34.4 Conclusion

Citizen science archaeology, and the data it produces, is part of the larger digital transformations that are increasingly impacting many fields of scientific research. Archaeology, in common with many traditionally field-based disciplines, has been very good at gathering and creating data, but less so at disseminating it on a public scale. Recent calls have been made to place resources into enabling the exploitation of under-used data and archival resources as a way of democratising scientific research (e.g. Scerri et al 2020). Data services such as Ilppari and FindSampo, and the recent ontological work, are important steps in this direction. Here it is critical that data creation is buttressed by clear guidance to detectorists who provide the contextual information on finds, and as well as by good quality metadata that follows the recognised best practice principles for international data standardisation (e.g. CIDOC-CRM and Getty Arts and Architecture Thesaurus).

Two further major causes of damage to recorded Finnish archaeological sites over the last decade have been non-forestry land use (e.g. for construction, infrastructure improvements) and metal-detecting (Maaranen 2020). Where instances of damage per annum caused by other land use remained fairly static, it is noteworthy that instances of damage related to metal-detecting have declined over the last half-a-decade after the hobby first took off in a major way in 2013–2015. This is attributed to increased guidance produced and promulgated by the FHA, and by actors and stake-holders in the metal-detecting community (e.g. Moilanen 2015; Siltainsuu & Wessman 2014). These experiences underline the need to produce and maintain good information and communication lines by heritage professionals, but also acting in a manner that strategically enables the growing and over time changing community of detectorists to continue informing and offering guidance to each other.

The significant resource challenge for heritage management is their slow recording process of metal-detected finds, which is at the moment for most artefact finds two to three years from reporting. One possible or partial solution is to increase the direct and active engagement of metal-detectorists as citizen science archaeologists in the recording process. As noted, many active detectorists are highly knowledgeable in object typologies. This knowledge-base could be meaningfully tapped into by, for example, offering further training to detectorists or anyone interested in archaeology to act as volunteer recorders for the FHA, or by enhancing digital pathways for detectorists to provide more precise information on their finds upon reporting. A possibility could be the further integration of the archaeological ontologies into the Ilppari recording system, or developing other means to enable detectorists to offer structured data on finds and their contexts for the FHA for checking and validation. In the User Experience research conducted during the development work of FindSampo a majority of the users wanted to contribute to this work by e.g. helping out in validating finds (Wessman et al. 2019: 10). There have been encouraging results in adopting such participatory approaches internationally, such as by the PASt Explorers project in England and Wales (funded by the National Lottery Heritage Fund in 2014–2021), which conducted outreach, trained volunteer recorders and produced finds recording guides to help the public in identifying and describing new finds (Lewis 2020).

Metal-detecting has been a popular hobby in Finland since the early 2010s, with detectorists recovering thousands of finds from all over the country. These public finds should not be overlooked in archaeological work because they are not found within a precise (stratigraphic) archaeological context. On the contrary, when appropriately recorded metal-detected finds possess tremendous potential for creating new analysis, for identifying unrecorded and therefore vulnerable archaeological sites, and for identifying lacunae in the body of archaeological knowledge that will help to target future research areas with greater precision. It is time for us who are working with the metal periods to start utilising finds material in our research. Everyone who works with metal periods, academic or the general public, can and should use this data.

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