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Recording Data from Metal-Detecting Activities in the Czech Republic: The Portal of Amateur Collaborators and Register of Individual Finds (AMCR-PAS)

Petr Pajdla, Olga Lečbychová, David Novák, Róbert Antal, Balázs Komoróczy, Tomáš Chlup and Jan Mařík

This article discusses the importance of the Portal of Amateur Collaborators and the Register of Individual Finds of the Archaeological Map of the Czech Republic (AMCR-PAS) in preserving data from metal-detecting activities in the Czech Republic. The context and legal framework of metal detecting in the country are explained along with the establishment of AMCR-PAS. The collaboration between amateur and professional archaeologists is also discussed. The recorded finds are analysed in terms of chronological, typological and spatial distribution. The AMCR-PAS system is recognised as a crucial tool for the preservation of data from metal detecting, and provides a valuable resource for national and transnational archaeological research, enabled especially by aggregation of AMCR-PAS data in the ARIADNE infrastructure. Overall, this article highlights the significance of the AMCR-PAS system and its potential to contribute to the understanding of the country's rich archaeological heritage. It also examines the shortcomings and challenges that accompany applying the system in practice.

1. Introduction

Metal detecting in the Czech Republic emerged as an amateur activity and gradually evolved in the 1990s in tandem with the transformation of social conditions following the fall of the communist regime in 1989. This new phenomenon encompassed a range of activities, from looting cultural heritage to attempts to participate in its preservation. From a legal standpoint, privately conducting metal-detector surveys to search for archaeological finds was considered an illegal activity and there were no

methodological interpretations of how such activities should be carried out in collaboration with professionals in the context of the law. There was an ongoing debate about the ethics of amateur detecting and the professional approach to it. Archaeologists were uncertain about the legality of collaboration, had no experience with this form of citizen science, and thought it was out of the question to include it in professional fieldwork (for discussions, see Čižmář 2006; Kuna 2006; Smrž 2006; Vencl 2006; Vích 2006). Nevertheless, cultural heritage was rapidly finding its way into private collections or onto the black market, and archaeologists could only helplessly watch this irreplaceable loss (e.g. Navrátil 2015). Despite the controversies surrounding amateur detecting, individual collaborative platforms, tied to specific archaeologists and often regionally limited, began to be formed to address this unsustainable situation. It took a considerable amount of time for the archaeological community to form a consensus on how to approach this issue, and many cultural heritage artefacts had not been officially recorded or had been completely lost in the meantime. For a general overview of metal detecting in the Czech Republic, see Komoróczy 2022 and Mařík 2013. For a review of the current state of metal detecting in Europe and beyond, see e.g. Thomas *et al*. 2022 and Dobat *et al*. 2020.

In 2017, a questionnaire conducted to monitor the attitudes and experience of the archaeological and detectorist communities in the Czech Republic revealed that most archaeologists considered collaboration to be necessary, beneficial and acceptable, and that metal-detecting finds were deemed scientifically significant (Komoróczy 2022). The resulting consensus intensified collaboration between archaeological institutions and the metal-detecting community, which led to more data being generated but still not consistently recorded. At the same time, such collaborations did not meet the legal obligations for conducting archaeological fieldwork, e.g. the submission of fieldwork reports to the archives of the Institutes of Archaeology of the Czech Academy of Sciences in Prague and Brno (IAP/IAB).

Both the IAP and IAB had been working for a long time to cultivate and formalise legal amateur archaeological activities. The archives at these institutes had systematically collected, recorded, and made available the results of archaeological fieldwork in the country for more than a century. In 2021, these two endeavours synergistically resulted in the establishment of a tool called the Portal of Amateur Collaborators and Register of Individual Finds (AMCR-PAS). The portal provides a formal framework for meeting the legal requirements for the announcement of archaeological fieldwork projects based on metal-detecting surveys within the amateur-professional collaboration, submitting results, and collecting, preserving, and presenting data from this collaboration. Such an approach meets the criteria of citizen science, as only data that are collected, preserved and published can be used to further the development of research and benefit the transfer of knowledge to society.

The social aspects of metal detecting are in themselves fascinating. Even though it is primarily a hobby activity, it plays a substantial role in the formation of cultural identity, particularly in relation to local communities. From this perspective, detectorists are an invaluable source of information that helps us to evaluate the social dimensions of cultural heritage. Interaction with the metal-detecting community

can be used to better understand this large stakeholder group and formulate strategies for collaboration, communication and the presentation of cultural heritage.

2. Context and Legal Framework

Relevant Czech legislation cannot be considered as a traditional 'Treasure Act' because, since 1941, the definition of an archaeological find is based not on '*the internal content of the monument, nor its external features* [authors' note: the material it is made of, its value, etc.], *but the method by which the monument is acquired*' (Böhm 1941). The legal definition thus corresponds well with the archaeological definition, when it states that '*An archaeological find is a thing or set of things that provide evidence or relics of human life and activities from the early stages of human evolution to the modern era and was usually preserved underground*' (Act No. 20/1987 Coll.). One weakness in this definition is the vague chronological scope as there are multiple ways to understand the term 'modern era'. To clarify this issue, the Ministry of Culture stated that finds originating from WWI and WWII, particularly militaria, should also be considered archaeological finds (Statement of the Ministry of Culture regarding the term 'archaeological find' within the provisions of S. 23, Act No. 20/1987 Coll.).

In the Czech Republic, the law generally stipulates full public ownership of archaeological finds. In practice, this is exercised by municipalities, regional governments and state institutions. Individuals, therefore, are basically prohibited from owning archaeological finds. Only organisations with a valid authorisation issued by the Ministry of Culture and an agreement with the Czech Academy of Sciences (referred to as licensed organisations in this text) are allowed to conduct archaeological fieldwork, including metal-detecting surveys. Metal detecting is, therefore, considered a form of archaeological fieldwork. Conditions for conducting fieldwork, i.e. territorial jurisdiction, essential parts of find reports, etc., are specified in the agreements with the Czech Academy of Sciences (S. 21 of Act No. 20/1987 Coll.).

For all types of archaeological fieldwork, an agreement with the landowner or developer is required (S. 22(1) of Act No. 20/1987 Coll.), and this also applies to all types of surveys (fieldwalking surveys, use of metal detectors, etc.). The use of metal detectors and other tools is not explicitly addressed by Czech legislation and, therefore, not prohibited. To comply with the above rules, individuals who are interested in metal detecting must be affiliated with an organisation licensed to conduct archaeological fieldwork and participate in its specific survey project. As part of establishing such a relationship, amateur collaborators undergo methodical training in the technical and professional standards for recording finds and the duration of the collaboration is set.

As of March 2023, there are 100 licensed archaeological organisations, which include 18 institutions specialising in development-led excavations, 72 national, regional and local museums, 7 universities, and the National Heritage Institute. The territorial jurisdictions of these organisations vary greatly, from those with a licence for the entire Czech Republic (typically universities, National Heritage Institute, IAP

and IAB, totalling 8 organisations) to those with a licence for several cadastral territories, as in the case of local museums.

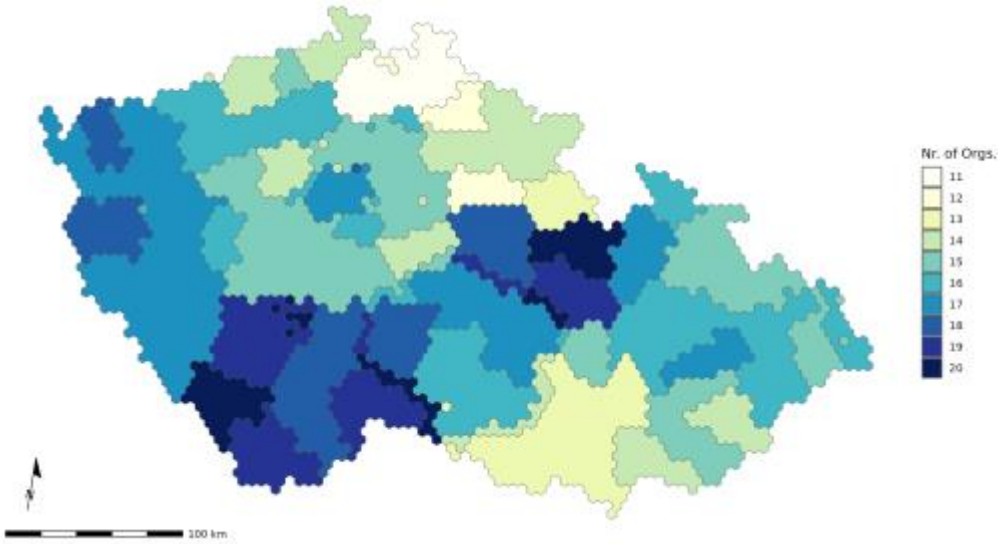

Figure 1: Map of the Czech Republic with the number of archaeological organisations licensed in a given area summarised on a hexagonal grid. Out of the 100 organisations, there are 8 with a licence for the whole territory of the Czech Republic

The distribution of licensed organisations varies greatly across different regions (Figure 1). For more detailed information on these organisations, including maps with polygons of their territorial jurisdictions and the actual distribution of fieldwork events recorded in the last five years, see the Map of Archaeological Organisations (Pajdla 2022). This tool also allows for a spatial search of licensed organisations based on a given point on a map, making it easier for metal detectorists, builders and other stakeholders to find and contact an organisation active in their area of interest. This is particularly important for metal detectorists, as for various reasons not all organisations are willing to collaborate, and without a concise and updated list it can be difficult, if not impossible, to find an appropriate collaborating institution.

Independent searching for archaeological finds outside of authorised archaeological fieldwork is a criminal offence and can result in fines of up to CZK 4,000,000 (approximately EUR 150,000). However, in practice the fines are much lower and rarely issued, although in the case of metal detecting the penalty usually includes confiscation of the metal detector or other tools used.

3. AMCR-PAS

The AMCR-PAS schema and module was established as an integral part of the Archaeological Information System of the Czech Republic (AIS CR) infrastructure to address the need to record and preserve data from citizen science collaboration, particularly metal detecting. AIS CR is a large research infrastructure that integrates

digital tools, services and resources for Czech archaeology and is jointly operated by IAP and IAB.

The Archaeological Map of the Czech Republic (AMCR, Kuna *et al*. 2015) is a key component of the AIS CR infrastructure, serving as a comprehensive information system for managing archaeological fieldwork, including reporting on construction activities, fieldwork management and submission of final reports. As of 2021, it also provides an interface for collaborators of licensed archaeological organisations to record individual finds in the context of survey projects. The overall objective of the AIS CR is to ensure the long-term preservation of recorded data and documents, as well as to increase their FAIRness. The AMCR data is published in several ways, first and foremost via the AMCR Digital Archive. Secondly, an OAI-PMH API allows users to access metadata about the finds in the AMCR database in a machine-readable format.

Access to the AMCR data is controlled by various user access groups, each with different levels of permissions. The first group includes anonymous users (anyone on the internet), who have limited access to the system. This group can browse the metadata records and view a selection of documents. The second group is registered users (*'researchers*'), who have access to view and download most of the documents. The third group is composed of archaeologists from licensed organisations who are eligible to create and edit fieldwork projects, collaborate with amateurs and accept individual finds. The final group is AMCR archivists who have full control over the system. Overall, the AMCR has a strict access control system in place to ensure that sensitive archaeological data is only accessible to authorised individuals.

3.1. AMCR-PAS workflows

To record finds under the AMCR-PAS scheme, a user account in the AMCR system is required, which requires identification of the user by their name, email address, and organisation (if available). For metal detectorists, the *'amateur collaborator'* option is usually selected as their organisation. All registered amateur collaborators are part of the *'researchers'* access rights group, enabling them to establish collaborations with archaeologists, record finds, and view most of the published documents, photographs, etc., in the AMCR Digital Archive.

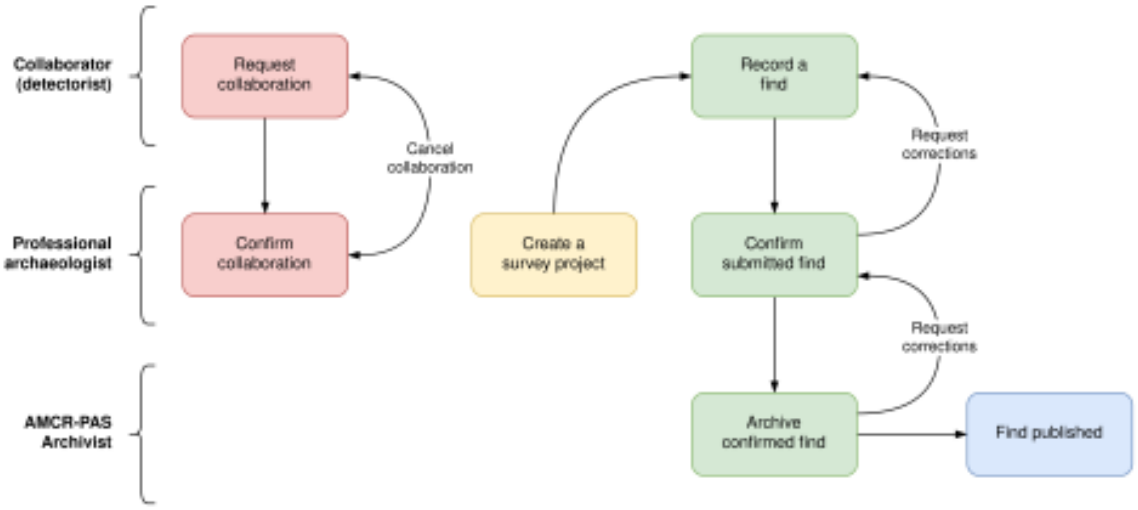

Figure 2: The workflow of recording a find under the AMCR-PAS scheme

Establishing a collaboration is the first step, which occurs both within and outside AMCR-PAS. It can take time to establish trust between the collaborator and archaeologist and may even result in the collaborator being employed part-time by the licensed organisation or forming another form of association. The collaboration is confirmed or rejected in AMCR-PAS by the archaeologist upon the request of the collaborator. An active collaboration can be terminated by either party at any time, and a collaborator may establish multiple collaborations with different archaeologists simultaneously. This allows detectorists who are active over large territories to submit finds to organisations operating in the relevant area.

Finds in AMCR-PAS are recorded under individual survey projects. A *'Project'* is an ontological concept and the resulting record represents a coherent unit, determined by the licensed organisation conducting the fieldwork, stating the purpose of the fieldwork and the approximate area under study. In rescue excavation projects, the incentive is usually a planned building activity reported directly by the investor, while survey projects are created by archaeologists to record finds under the AMCR-PAS scheme. Archaeologists have discretion in defining survey projects, with three main scenarios observed in practice:

1. Survey projects focused on individual sites or small-scale areas. This mode allows the recording of spatially and/or temporally related finds together. Finds from metal-detecting rallies organised by archaeologists to survey well-known sites or finds from long-term prospections are the best examples of this mode.
2. Survey projects with large territorial coverage used to record any finds in the organisation's catchment area or part thereof. This allows the recording of any number of mostly spatially unrelated finds by various metal detectorists cooperating with an archaeologist, hence being the most common use case.
3. Projects in which metal-detecting finds are retrospectively recorded by an archaeologist, bringing existing legacy databases or paper inventory lists into the digital records (see Figure 6, with finds recorded retrospectively in grey). It is expected that the number of finds recorded in this way will grow over time, particularly if regional governments provide funding incentives.

In general, projects within AMCR-PAS have an annual scope, and at the end of each project, a brief report is submitted detailing the project's progress, the interpretation and importance of the finds, and the modes of cooperation with metal detectorists, among other summarising information.

Once the archaeologist confirms the cooperation and communicates the project identifier to the metal detectorist, finds can be recorded in the system. The process of recording a find involves several stages, outlined in Figure 2. The interface of AMCR-PAS is a web-based application with responsive design (see Figure 3), which allows for directly recording finds on the find spot using a mobile device (mobile phone, tablet, etc.) or later using a computer or a combination of both approaches. A unique identifier is generated for each entry once a project is chosen under which it will be recorded. This identifier can be used to label the find bag or any associated field note entries. A metal detectorist usually fills in only the basic information about the find, while uploading one or more photographs and geolocating the find either by entering coordinates, clicking on the map, or using the built-in location service of the device, typically the GPS of a mobile phone.

The *'Finding Context'* section (see Figure 3) of the recording sheet includes the project identifier choice field, the name of the cadastral area, which is automatically detected based on the geolocation, and a field for details on the location. Any local names or plot numbers from the land registry are mentioned if necessary. Furthermore, there are fields for the date, context (surface find, in topsoil, etc.) and depth of the find.

The '*Find*' section of the recording sheet (see Figure 3) contains metadata about the discovered artefact, including a controlled vocabulary field for the period (Kuna and Novák 2019), a field for exact dating or additional notes on the period, and controlled vocabulary fields for the type and material of the find. Additionally, there are fields for recording the number of finds, allowing multiple potsherds or similar cases to be recorded as one entry, and a general note field for any other relevant information. While some fields are compulsory for the metal detectorist (period, type, and material), the information is verified and corrected by the archaeologist upon submission of the finds. The recording process of a find is also intended as an educational tool. Metal detectorists can conduct their research to fill in some of these fields correctly (e.g. chronological and functional determination of the finds), which can gradually increase their awareness of the material culture they may encounter during their practice.

Once the metal detectorist finishes recording details of the find, the record can be submitted to the archaeologist for review. We recommend that archaeologists meet with their collaborators at least once a year to review the submitted records and receive the finds. As mentioned earlier, archaeologists can edit or correct most of the fields in the *'Finding Context'* and *'Find'* sections of the find sheet. For instance, if a collaborator prefers to remain anonymous, the archaeologist can remove them from the name field.

The *'Deposition'* section (see Figure 3) is filled in exclusively by the archaeologist. Here, the archaeologist's organisation is recorded as the authority to which the finds were transferred, and where they are deposited. Additionally, an evidence number is

recorded to allow for identification of the physical find in the collection with the database record in AMCR-PAS. Finally, the accessibility of the geolocation information is selected, including the name of the cadastral area, notes on the location, geographical coordinates and the position on the map. The accessibility is based on the AMCR user access groups as described above. The majority of finds are released with access to spatial data limited only to archaeologists (approximately 70%), while around 30% are disclosed only to AMCR archivists.

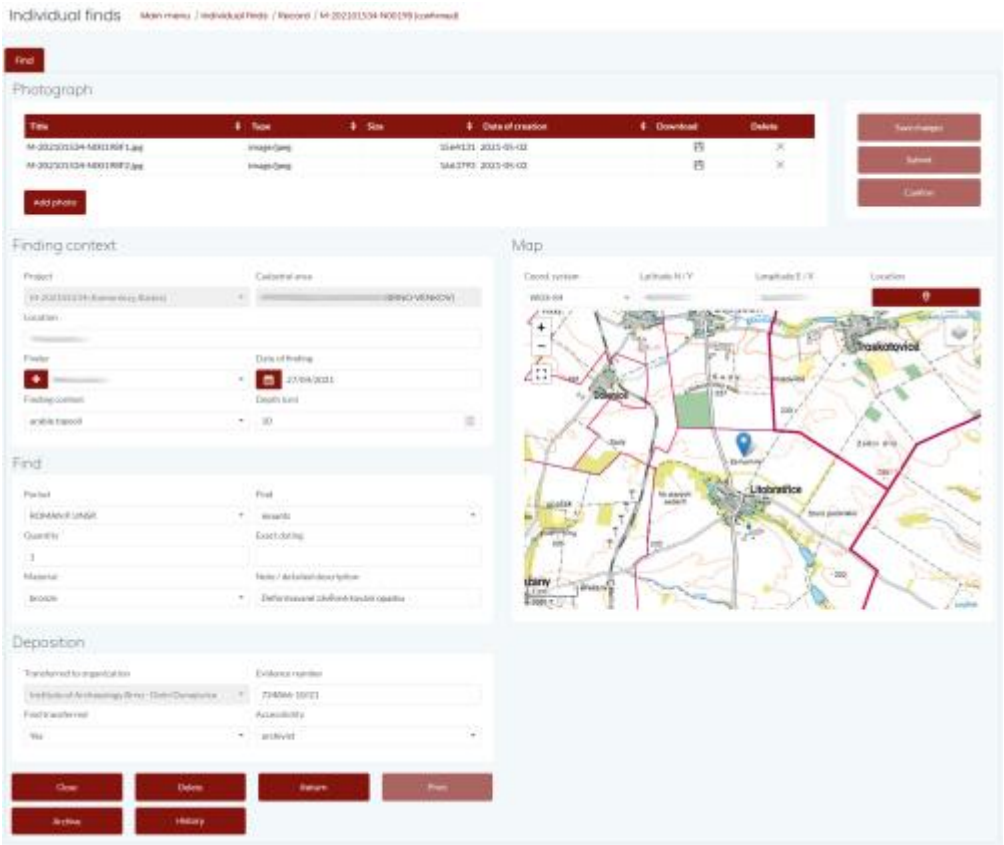

Figure 3: Screenshot of the AMCR-PAS finds recording interface. The exact location of the find on the map was changed to a random spot

After the archaeologist finishes editing the record, it is submitted for archiving to AMCR archivists at IAP and IAB (see Figure 2). The archivist performs a formal check, whether all the recorded information is according to good practice, the photographs are of sufficient quality (etc.), and archives the find. After the record is archived, it is published in the AMCR Digital Archive (see Figure 4). By publishing the finds, the contribution of metal detectorists to the preservation of cultural heritage is acknowledged. The accessibility of the data in the Digital Archive is controlled according to the AMCR user access groups and ensures that sensitive information, especially the geolocation of finds, is only available to authorised users.

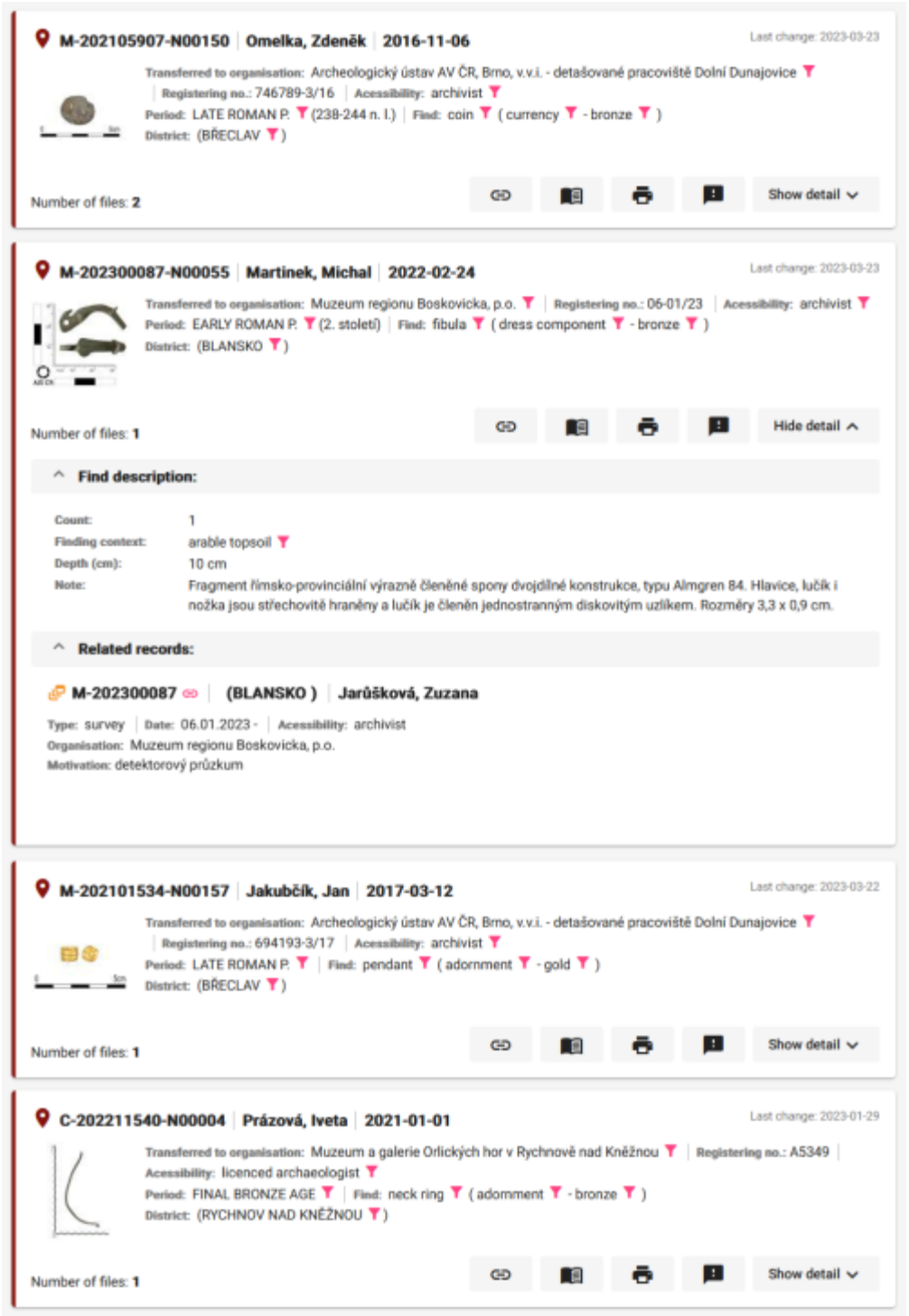

Figure 4: Screenshot of finds published in the AMCR Digital Archive

3.2. AMCR-PAS data in ARIADNE

Archived finds are also periodically aggregated in the ARIADNEplus infrastructure (Richards an Niccolucci 2019) and available through the ARIADNE Portal (see Figure 5). The process of data integration into ARIADNE is based on harvesting data from AMCR through the OAI-PMH API. Data in native XML format is mapped to the unified ARIADNE Catalog Ontology (Felicetti *et al*. 2023) derived from

the CIDOC-CRM standard using the 3M Mapping Memory Manager. All controlled vocabularies are also mapped to the authoritative Getty Art and Architechture Thesaurus based on the SKOS standard using the ARIADNE Vocabulary Matching Tool. This step ensures harmonisation of vocabularies across different datasets in ARIADNE. Similarly, all the chronology data is then mapped to the standard period definitions in the PeriodO portal, which again allows archaeological data of different origin to be presented on a single time scale. All these steps are set up to be repeatedly applied within an automated workflow and the data updated at selected cycles.

Given the ongoing re-implementation of some components of the AMCR, we anticipate that in 2024 there will be further optimisation and improved integration so that the ARIADNE Portal offers the AMCR-PAS data to users in the most understandable, complete and reusable form. It is experience with the ARIADNE aggregation process that has helped to significantly optimise and standardise some of the functions of the current API and some of the data models, which are going to further improve the interoperability of the entire AMCR system, including the AMCR-PAS module, and not only with respect to the ARIADNE services.

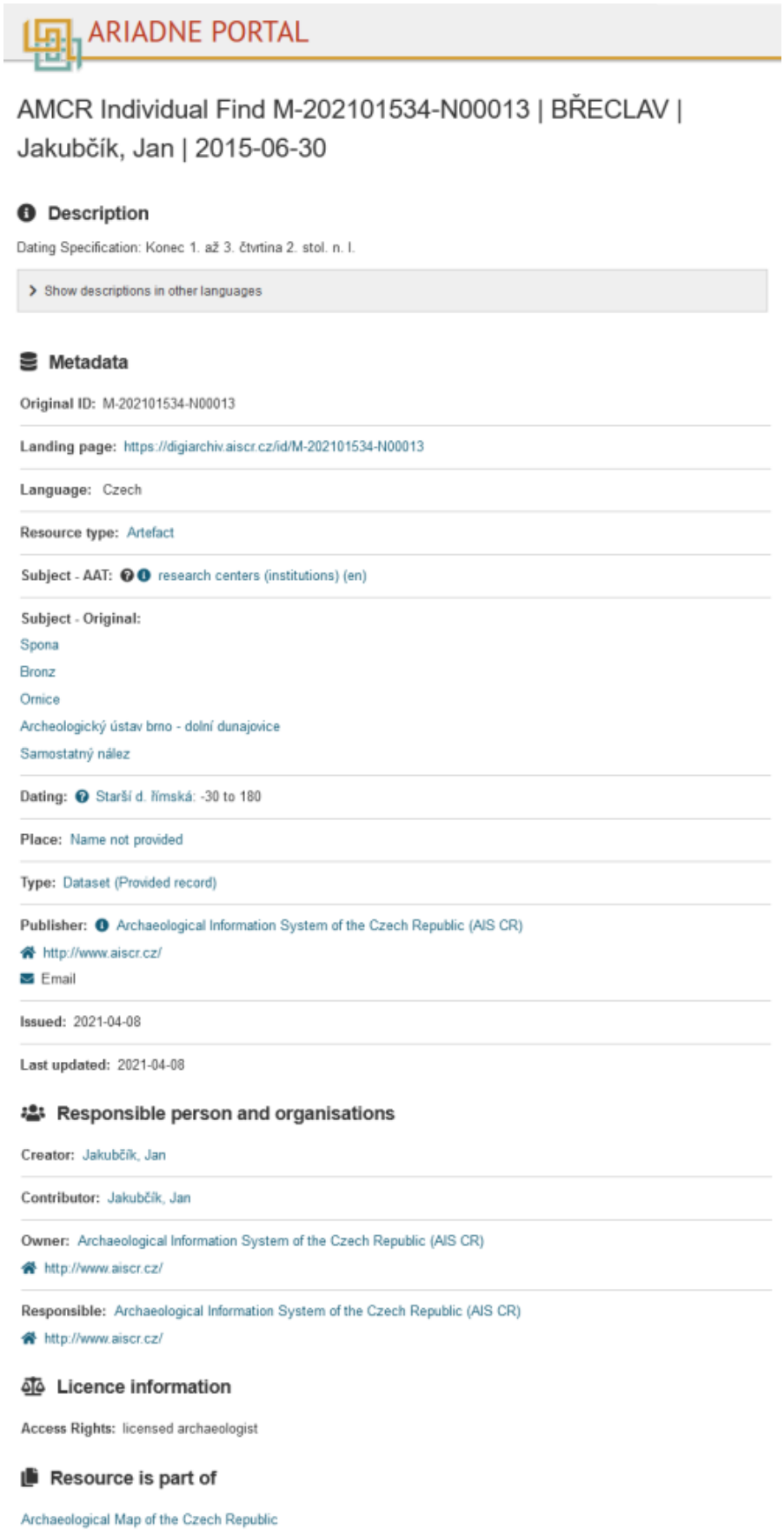

Figure 5: Screenshot of a record published in the ARIADNE Portal

4. First Look at the Data

In this section, we provide a preliminary analysis of data on finds resulting from metal-detecting activities and collaborations between archaeologists and amateurs, as recorded in AMCR-PAS. As the system has been in operation for only a short period, from its introduction in 2021 until mid-March 2023, the insights into spatial, temporal and other aspects are limited but are included to showcase the AMCR-PAS dataset as an emerging source of archaeological data on the Czech Republic.

4.1. Collaborators and archaeologists

At the time of writing (mid-March 2023), there are more than 3000 recorded finds in the AMCR-PAS system, with over 50% of these finds already archived, i.e. in the final stage of the AMCR-PAS cycle, and approximately 40% submitted to archaeologists that are waiting for further processing or transfer to licensed organisations. Since the AMCR-PAS launch in 2021, around 800 finds have been recorded annually (see Figure 6) and close to 1200 finds were recorded retrospectively (columns in grey in Figure 6). This highlights the demand for a central solution for preserving and presenting data resulting from collaborations with citizen science contributors from the community.

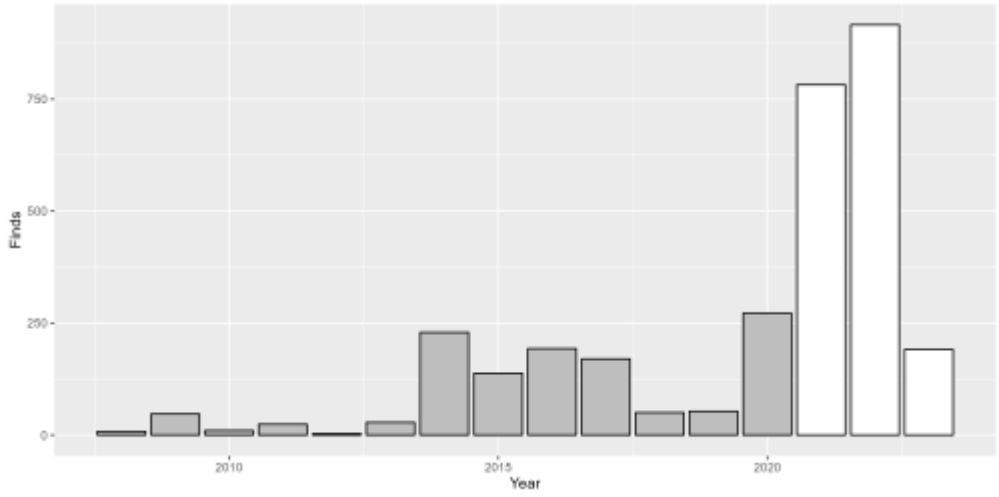

Figure 6: An overview of finds recovered per year. The years corresponding to finds recorded retrospectively, i.e. found before the AMCR-PAS launch, are in grey

Currently, there are 343 active collaborators in the system and 142 of these have recorded at least one find, i.e. at least 40% from active users. The number of registered collaborators is expected to rise as more organisations adopt the AMCR-PAS system. The majority of active collaborators (90%) work with one archaeologist at most, with 42 archaeologists from 35 organisations having active collaborators and 25 archaeologists having at least one collaborator with one or more recorded finds.

The relationships between collaborators and archaeologists are visualised on a network in Figure 7. The network is divided into different clusters, which mostly have

a regional meaning (see Figure 10 with corresponding labels). Clusters A, B (Figure 7) and several unlabelled ones show how the long-term joint support of the IAB and the South Moravian Region regional government influences how archaeologists cooperate with metal detectorists in terms of the number of collaborations and recorded finds. Both the clusters are star-shaped networks with a highly centralised structure around an archaeologist from a museum (Figure 7B) and from the IAB (Figure 7A). Cluster C is an example of two archaeologists from the same organisation (IAP) sharing most of the active collaborators in the Kutná Hora District. Cluster D shows an interconnected network in the mid-Central Bohemian Region with metal detectorists cooperating with multiple archaeologists from different institutions at the same time. The structure of other unlabelled clusters is mostly similar to one of the cases described above, with a prevalence of star-shaped networks centred around a single archaeologist. We presume that the network will grow in size, i.e. the number of nodes, as new organisations and archaeologists join AMCR-PAS, and in the number of connections between different clusters created by metal detectorists collaborating with multiple archaeologists across organisations.

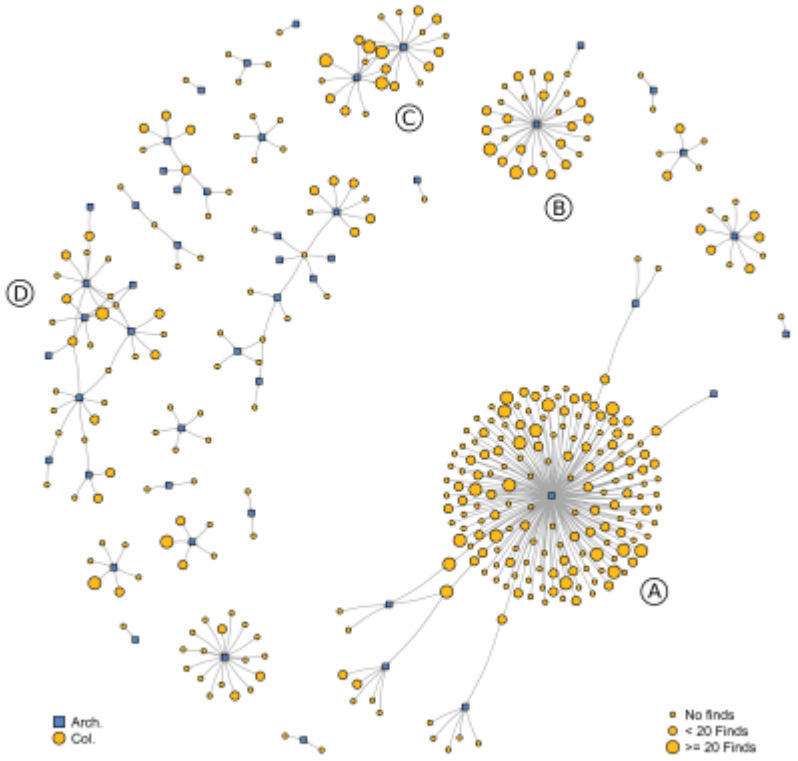

Figure 7: A network of active collaborations. The blue squares represent archaeologists from licensed organisations and the yellow circles amateur collaborators. The size of the circle indicates the number of finds recorded by the given collaborator. Chosen regional clusters are labelled the same as on the map in Figure 10: A – South Moravian Region, B – Boskovice area, C – Kutná Hora District, D – mid-Central Bohemian Region

The majority of collaborators have recorded between 1 and 20 finds, with an average of around 12 finds per collaborator (see Figure 8). Some highly active metal detectorists have recorded over 100 or even 300 finds, often specialising in long-term surveys of endangered archaeological sites or having a particular interest in chosen regions. The collaborators who recorded a low number of finds were mostly occasional contributors who recognised the importance of submitting both the data and the finds to responsible institutions. The majority of finds were discovered during spring and autumn periods when the fields were bare and allowed for walking surveys with metal detectors (see Figure 9).

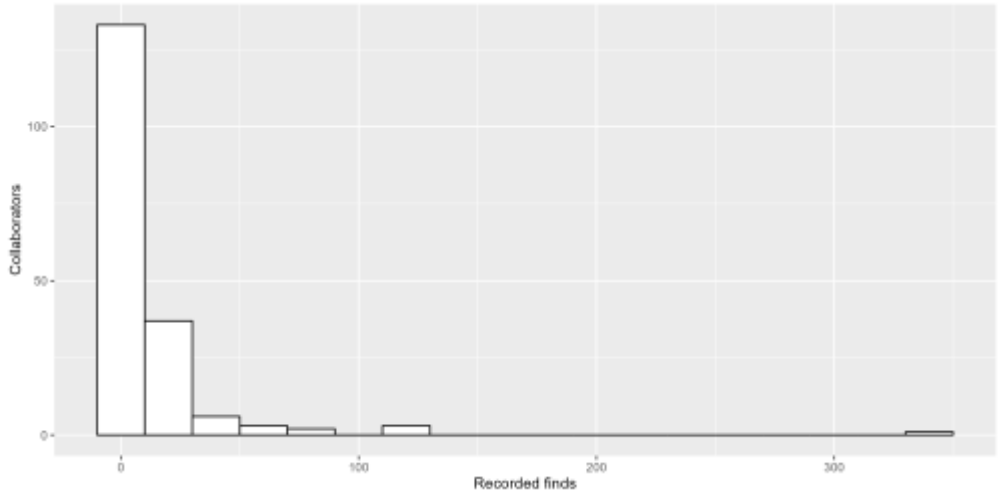

Figure 8: A histogram of the number of finds reported by individual collaborators. The strongly right-skewed distribution shows that most of the collaborators recorded between 1 and 20 finds although in some cases, collaborators recorded more than 100. The figure includes finds from all processing states

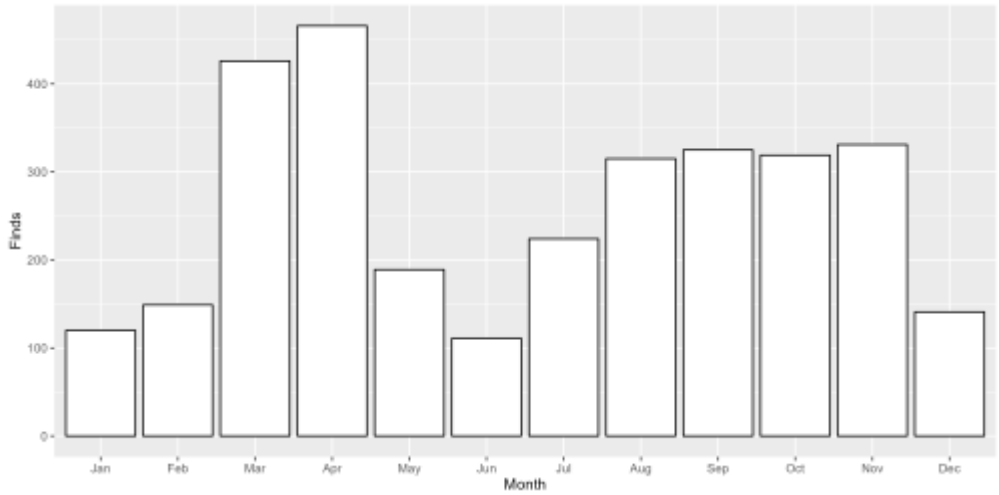

Figure 9: Number of finds recovered in different months showing seasonality in the metal detecting practice

4.2. Nature of finds

While the previous section focused on the nature of collaborations, in this section we explore the nature of the discovered finds. The spatial distribution of recorded finds

follows the activity of archaeologists in different regions (see Figure 10 for a distribution map and Figure 7 for the network of collaboration). The largest concentration of recorded finds is observed in the South Moravian Region, including the Boskovice area where long-term support for collaboration between metal detectorists and licensed organisations is provided by the region's governing body (see Figure 10A and B). Another notable concentration of finds is found in the Kutná Hora District (Figure 10C), as well as in the mid-Central Bohemian Region and Prague (Figure 10D). Despite some emergent concentrations of finds in other regions across the Czech Republic, there are still many areas where no metal-detecting finds have been recorded in the system.

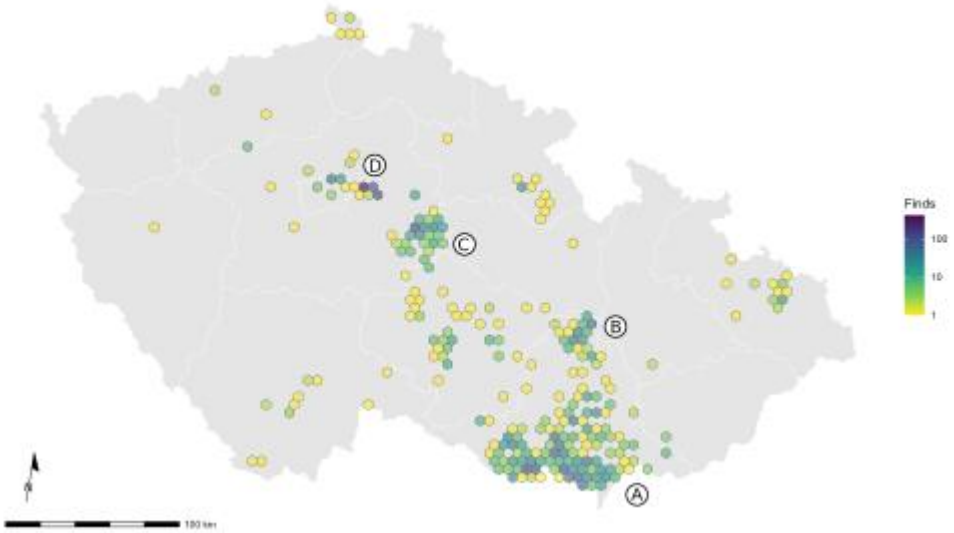

Figure 10: Map of the Czech Republic with a spatial distribution of recorded finds (with log-scaled colour range). The exact locations of the finds are generalised on a hexagonal grid with a cell size of 25km². The figure includes finds from all processing states. Chosen concentrations of finds are labelled the same as in the network in Figure 7: A – South Moravian Region, B – Boskovice area, C – Kutná Hora District, D – mid-Central Bohemian Region

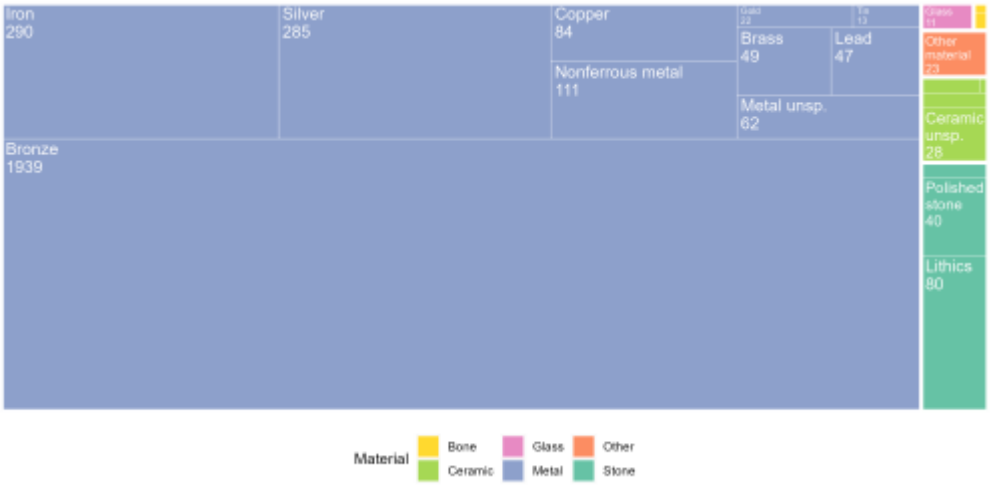

Figure 11: A treemap chart of material specifications of the recorded artefacts with the highest proportion of metallic finds

Although the focus has been on the collaboration of metal detectorists, it is important to note that not all the recorded finds are made of metal. Non-metallic artefacts, including pottery, lithics, polished stone tools, glass (etc.), make up to 10% of the recorded finds (see Figure 11). Among the metallic artefacts, the majority are made of bronze (65%). This is in accordance with the typological distribution (see Figure 12), where the most commonly found category of dress components is dominated by bronze artefacts. Specifically, fibulae make up 70% of this category. The rest of the distribution of artefact types recorded is relatively balanced between coins, personal adornments, building elements, weapons, tools, etc.

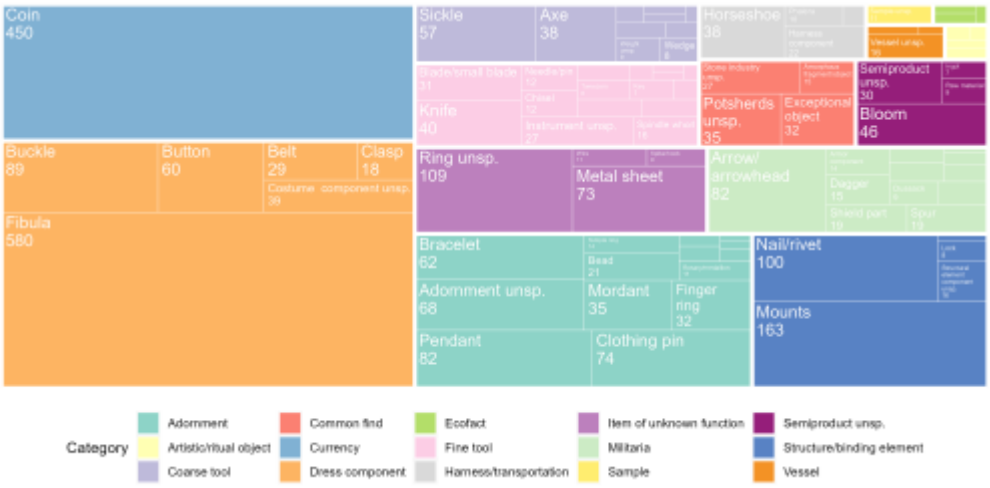

Figure 12: A treemap chart of artefact types recorded in AMCR-PAS

The temporal distribution of finds shows a notable predominance of Roman-period artefacts, with another peak in the Late Medieval era and a significant amount of Bronze Age finds (see Figure 13). The disproportionate focus on Roman-period finds is partly the result of the involvement of the Research Centre for the Roman and Migration Periods of the IAB in collaboration with metal detectorists (represented by cluster A in Figure 7). The decline in finds between the Bronze Age and the La Tène period, as well as after the Roman period during the Early Medieval period, is currently challenging to explain. Inevitably, the adoption of the AMCR-PAS system by more organisations in more regions will result in increased discoveries from these time periods. The aoristic sum in Figure 13 represents the modelled number of finds in a given 100-year timeframe, obtained by distributing the probability of a discovery uniformly across each temporal fraction of the considered period. Currently, both the spatial and temporal distribution of finds are not sufficiently representative to be able to draw any large-scale conclusions.

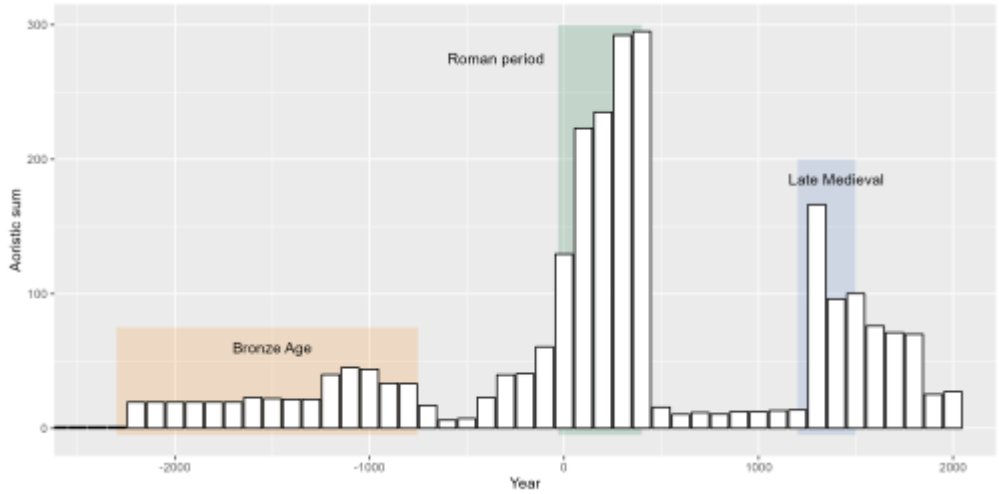

Figure 13: Aoristic sum of finds in time with visible peaks. The Bronze Age (yellow), Roman (green) and Late Medieval (blue) periods are highlighted

5. Discussion and Conclusions

Finds obtained through metal detecting over the years since the first individual collaborative platforms were formed have helped to fundamentally change the perception of archaeologists on numerous aspects of past societies. For example, they have significantly enriched our understanding of the extent to which coins were used by the communities of the La Tène period (450–30 BC; Goláňová *et al*. 2020), or they have brought knowledge of the previously unsuspected variety and quantity of Roman products (e.g. brooches and other fashion accessories or metal vessels) that occur in the Czech Republic, i.e. beyond the borders of the Roman Empire, in the first four centuries of our era (Komoróczy *et al*. 2017). Although the archaeological community has recognised the benefits of incorporating amateur field activities into a formal framework, the practical implementation of this approach is not without challenges. While amateur collaborators, estimated to be between 15,000 to 30,000 individuals in the Czech Republic, can be of significant help in fieldwork surveys, the limited time capacities of archaeologists often make it difficult to establish a comprehensive collaboration that includes communication, administration, training, regular contact and education. In Czechia, there are approximately 500 professional archaeologists who conduct fieldwork, curate museum collections, educate and present archaeology to the public, and conduct research. Their scarce time is frequently the main reason limiting cooperation with metal detectorists (Komoróczy 2022) and will become a problem on the data curation level as well with the rising numbers of AMCR-PAS users. Most archaeologists engage in collaboration with metal detectorists outside their regular work activities and, therefore, the impact of formalising the processes and providing tools to record finds within AMCR-PAS is significant. Although the tool cannot solve the staffing capacity issue on its own, it provides a framework for collaboration to be carried out.

Additionally, the system provides valuable data on which it is possible to demonstrate how cultural heritage is being saved (and endangered). This in turn is important for dealing with official bodies that can address staffing capacity issues. The AMCR Digital Archive where finds are published as the last step in the AMCR-

PAS workflow is essential for the personal presentation and satisfaction of the finders by giving them appropriate credit, sharing a cultural heritage with the public and reinforcing a responsible approach to amateur detecting.

Active collaboration between archaeological organisations and amateur collaborators also faces the challenge of inadequate capacity for finds conservation, as the number of finds often exceeds laboratory capacities. With the data available, it is possible to negotiate with competent authorities to find practical solutions. Although the limited capacities of licensed organisations are the largest issue, AMCR-PAS implementation is not without problems either. One of the challenges frequently mentioned by metal detectorists is the requirement to manually enter information about their finds into a web-based database form. They also note that there is currently no dedicated mobile application available to simplify and streamline the recording process. Currently, it is challenging for us to change this owing to the technical background of a project, but there is a possibility for future modifications if/as the number of AMCR-PAS users continues to increase. Furthermore, the refusal of amateurs to cooperate is not an exception, especially with reference to personal freedom and an unwillingness to submit to formal rules. Some of the archaeological organisations still opt not to use AMCR-PAS, since they can submit standard fieldwork reports instead.

While AMCR-PAS cannot solve the structural problems associated with metal detecting, it formalises the collaboration between amateurs and professionals and creates an official platform for recording its results with clear principles that correspond to all national legislative requirements. This comprehensive approach helps to make collaboration transparent and professional, making metal detecting at least a partly beneficial public activity, with results available both to the research community and the general public, rather than a completely illicit and unethical hobby.

In conclusion, this article has highlighted the significance of the Portal of Amateur Collaborators and the Register of Individual Finds of the Archaeological Map of the Czech Republic as an important tool for the preservation of data from metal-detecting activities in the Czech Republic. We have discussed the legal and contextual framework of metal detecting in the country and the role that AMCR-PAS plays in the collaboration between amateurs and professionals after its establishment in 2021 as a part of the national archaeological infrastructure AIS CR. Although it has been in operation for two years and only some institutions and detectorists have been involved in its use so far, we can clearly assess the benefits and weaknesses that need to be addressed in the future. Through the analysis of recorded finds and collaborations, we have demonstrated how AMCR-PAS is being adopted by the community and presented the quality and coverage of data in this emerging collection. The Czech case of the AMCR-PAS recording scheme paves the way for initiatives in countries with similarly restrictive legal frameworks and could help to address issues associated with metal-detecting activities and promote collaboration between amateurs and professionals in archaeology. Aggregation of AMCR-PAS data in the ARIADNE infrastructure enhances data visibility and promotes transnational cooperation both in preservation and analysis of such data and further promotes transparent metal-detecting workflows and practice. Despite the challenges involved in this collaborative approach, the transparency and

coverage of data provided by AMCR-PAS will prove invaluable to both the scientific community and the public for years to come.

6. Note on Data and Software

Data analysed in the article is deposited in the AMCR repository. A portion of the data that is archived is accessible through the AMCR Digital Archive and the OAI-PMH API interfaces. As most of the exact geographical coordinates of the find spots are protected and accessible only to selected user groups, a full dataset is not published here. Most of the visualisations in the article were created in the R ecosystem for statistical analysis and graphics (R Core Team 2023) using the *tidyverse* family of packages (Wickham *et al*. 2019), especially the *ggplot2* package (Wickham 2016) for plotting and *dplyr* (Wickham *et al*. 2023) for data manipulation. The network was created using the *igraph* package (Csardi and Nepusz 2006), spatial data were analysed with the *sf* package (Pebesma and Bivand 2023), treemap charts were created with the *treemapify* package (Wilkins 2021), and the aoristic analysis was computed using the *kairos* package (Frerebeau 2022). Spatial layers for the Czech Republic were obtained via the *RCzechia* package (Lacko 2023).

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AMCR-PAS or any other initiative would not be possible without archaeologists active at a regional level in various types of licensed organisations devoting their time and energy to collaboration with amateurs and facing the challenges that it brings. We acknowledge their contribution to the bottom-up process of building up this type of citizen science in the Czech Republic.

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