



## Research article

## Forensic archaeology and forensic anthropology within Swedish law enforcement: current state and suggestions for future developments

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## ABSTRACT

Archaeological theories and methods are developed to reconstruct past human behavior from fragmentary material remains. The interrelated discipline of physical anthropology addresses questions related to skeletal remains while acknowledging taphonomic parameters. The benefit of integrating these disciplines in forensic investigations has gained increasing acknowledgement over the last decades, but the use of forensic archaeology and anthropology (FAA) remains limited in Sweden. The aim of this study is to analyze the field of FAA in Sweden in relation to outdoor and fire crime scenes where human remains are encountered. Based on qualitative interviews, the state and potential developments of FAA within the Swedish police and the National Board of Forensic Medicine are discussed.

The results show that for ensic investigations and analysis of human fragmentary remains are not standardized in Sweden. A great responsibility is placed on the individual crime scene investigator who elects how to investigate these sites and who to contract for the analysis of osteological remains. This can endanger evidence collection and interpretation. This study shows that investigations of buried or fragmentary human remains in Sweden could be aided by a development of FAA. Key steps to further development of FAA within Swedish police involve 1) quantifying cases that could benefit from FAA, 2) establish FAA as an independent subject, 3) develop a national infrastructure, 4) offer professional education in the subject(s), and 4) develop best practice to advance evidence collection and legal security in investigations involving fragmentary human remains.

An ongoing ISO accreditation of outdoor crime scene investigations within the Swedish police will hopefully benefit FAA development and collaborations with external partners.

## 1. Introduction

Archaeological methods and theories are meticulously developed to reconstruct human behavior from fragmentary material remains and their contexts. Archaeological proficiency can therefore contribute to a range of forensic investigations where human behavior is to be interpreted from physical remains. The related discipline of physical anthropology has a long history of aiding forensic investigators with the identification of human osteological remains. 'Forensic archaeology' and 'forensic anthropology' (henceforth FAA) has emerged as specializations that has developed from traditional archaeology and physical anthropology. FAA can be used for investigations of clandestine burials, buried weapons and stolen items, dating strategies, landscape surveys, digital spatial analysis and visualization, mapping of surface finds, metal detection (e.g. when mapping shooting scenes), fire scene investigations, GIS landscape analyses, osteological analyses, and multiple types of investigations of subsurface elements, including

underwater investigations [1–5]. In human remains cases, FAA complements other forensic professions that similarly pursue the identification of the deceased and the *modus operandi*, helping prosecution and truth committees [6–14].

In an international context, FAA is practiced within forensic institutes, police forces, private companies, universities, non-governmental organizations, museums, intergovernmental institutions, and archaeological companies [15]. The value of FAA is widely recognized in investigations of mass graves connected to human-rights violations and cases of mass fatality incidents, not least in connection to disaster victim identification (DVI) [13,16–20]. However, even though incorporation of FAA in outdoor crime scene investigations (CSI) has proved beneficial in terms of evidence collection as well as time efficiency [13,21], FAA is still underused in national crime scene investigations in many countries [13,15,21–24]. Sweden is one of 10 European nations where FAA is not officially recognized [23]. Nevertheless, some FAA initiatives have been utilized, both within and

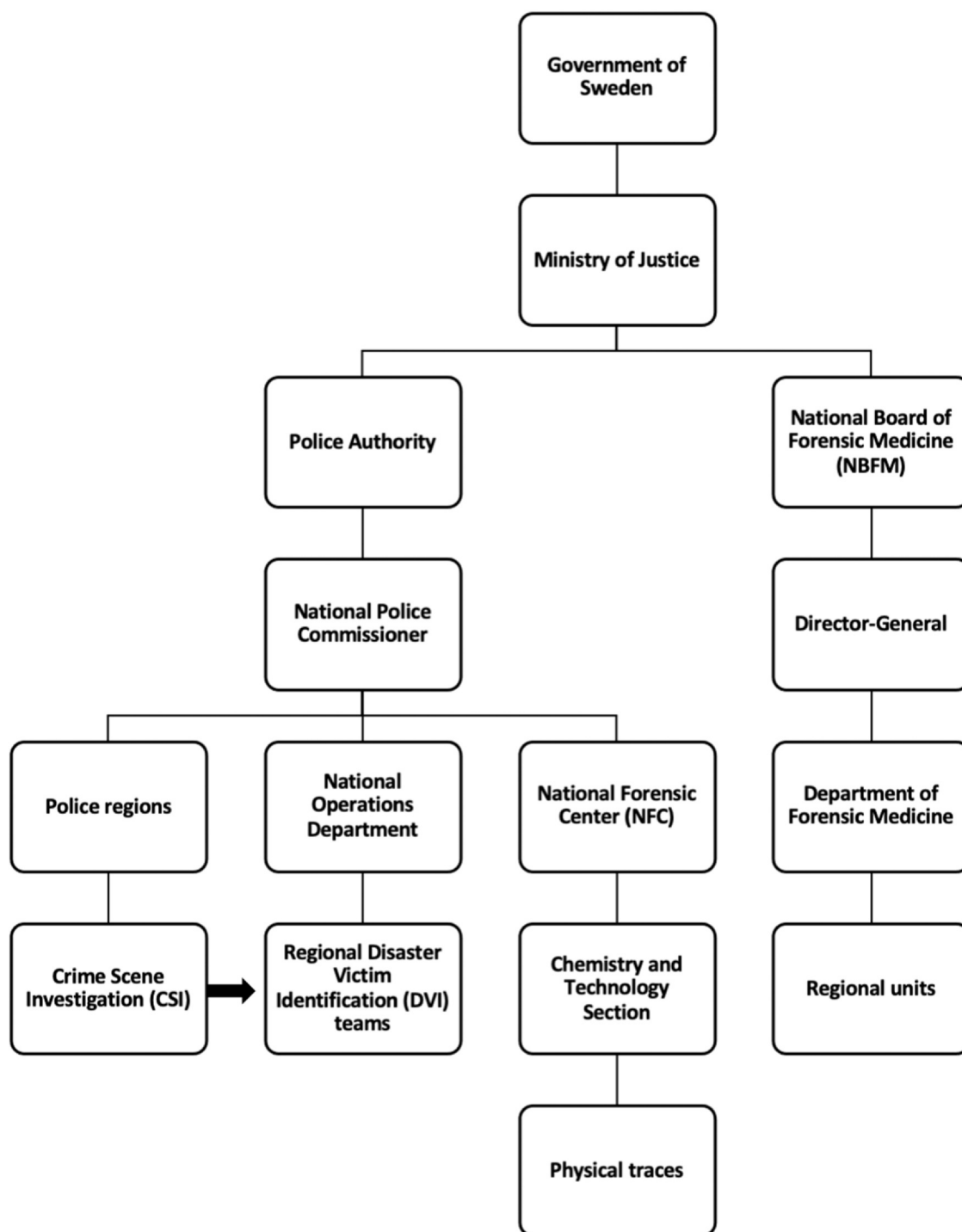
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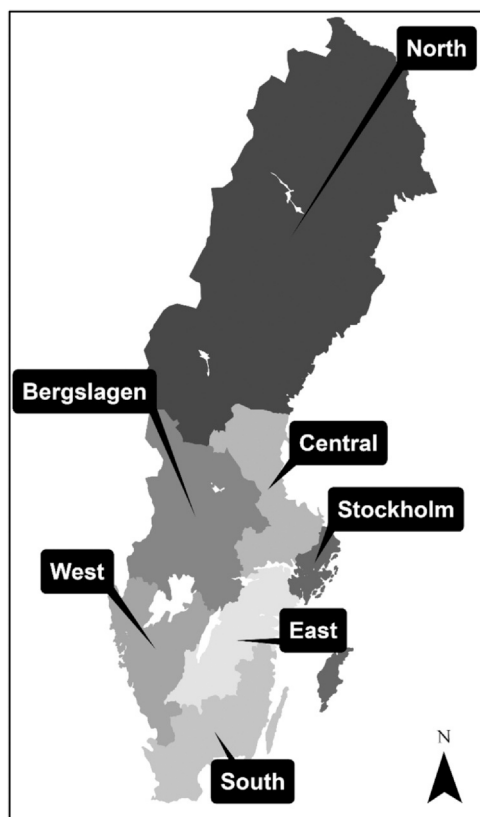


**Fig. 1.** Illustration of the relationship between the discussed organizations. For clarity, this figure only illustrates relationships within the authorities that are relevant for this particular study. ‘Physical traces’ (Sw. Spår) was proposed as the English translation by an NFC employee (Segerstedt 2020–09–15). All other English terminology was collected from The Swedish Police Authority [64,65], and the NBFM [59], where comprehensive information about the organizations can be consulted.

outside the police. A working group in forensic archaeology, ‘AFFA’ (Sw. Arbetsgruppen För Forensisk Arkeologi - The Working Group in Forensic Archaeology), was initiated by Stockholm CSI employees as early as the 1990’ s [25]. Thereupon, a full-time position in forensic archaeology was created within the Swedish police in 2018 (Jesper Olsson pers. comm. 2019–11–22). Furthermore, in 2017, Prof. Anna McWilliams started the Swedish network ‘ForArk’ (the Forensic Archaeology Association, Sw. Föreningen för Forensisk Arkeologi). ForArk brings practitioners and researchers together (from fields relating to

FAA such as archaeology, osteology, forensic pathology and odontology, CSI, entomology, geology, and law) with the aim to further FAA development and collaboration in Sweden. The author is currently a board member of ForArk.

The use of FAA within the Swedish police and the Swedish National Board of Forensic Medicine (NBFM, Sw. Rättsmedicinalverket) has not been subject to extensive analysis [see however European overviews in 24,26]. Since FAA has been identified as a key component in investigations of outdoor crime scenes [21,27–30], I am interested in how



**Fig. 2.** Interviewees by police regions Stockholm/East ( $n = 1$ ); Stockholm ( $n = 4$ ); North ( $n = 1$ ); South/North/Central ( $n = 1$ ); West ( $n = 2$ ); East/South ( $n = 1$ ); South ( $n = 2$ ). Interviewees with combined regions are either recently relocated from one to the other, or work in more than one region. Consequently, the interview responses were often discussed in relation to experiences in more than one region. The overrepresentation of Stockholm participants is due to the fact that AFFA working group is based in Stockholm. Most CSIs that have been involved in developing FAA are thus based in Stockholm.

The above figure was created by the author based on police regions as specified by The Swedish Police Authority [59], geodata was retrieved from © Lantmäteriet (CC BY, data accessed 2020-04-02).

forensic investigations of buried or fragmentary human remains are conducted in Sweden. Given that Swedish FAA is underdeveloped [23,24,31], the aim of this study is to analyze the field of FAA in Sweden in relation to outdoor crime scenes and fire scenes where human remains are encountered. Acknowledging that investigations of human remains is only part of the potential use for forensic archaeology and forensic anthropology [e.g. 32], this study has been limited to focus on investigations where a combination of osteological and archaeological expertise can be of value, as this lies within the author's research and practice field.

This paper presents the current state of FAA (including a brief background) and potential developments of FAA within Swedish law enforcement, as limited to the police and the NBFM. Qualitative interviews were conducted among police and NBFM employees to obtain information regarding FAA. Investigations involving skeletonized or semi-skeletonized remains (burned, buried, scattered), as well as buried remains in any stage of decomposition were within scope of this project. The study mainly targets CSI, but also briefly address DVI cases as they often include fragmentary and severely altered human remains.

### 1.1. Forensic archaeology and forensic anthropology

Forensic archaeology is often defined as the integration of archaeological theories, methods, and techniques in a legal context [2,15]. Forensic archaeologists are skilled in field and survey efforts, including

search, documentation, identification and recovery of physical remains from outdoor crime scenes, not least in relation to buried material. Owing to the interdisciplinary nature of archaeology, some archaeologists are specialized in subjects such as geophysics, DNA and isotopes. Forensic archaeology encompasses more than recovery of potential evidence, as theories and methods developed in archaeology are used to understand the temporal succession of events. To that end, stratigraphy and morphology of sediment and its relation to physical remains are analyzed upon and following the field investigation [1–7].

Osteology is the scientific study of hard tissue, i.e. bones and teeth [7,22,33], and the sub-discipline forensic anthropology (or 'forensic osteology') [32] involves cases of medico-legal, humanitarian or forensic interest [13]. Forensic anthropologists are mainly known to work with fragmentary and burned skeletal remains, as well as decomposed human remains. Tasks include (but are not limited to) species determination, biological profiling, victim identification, assessment of postmortem interval, skeletal trauma, skeletal pathology, and taphonomy. Previous publications that address the history and complexity of forensic archaeology and archaeology have been published elsewhere [forensic archaeology in 21,34–41; forensic anthropology in 20,42–48].

In cases where skeletal or decomposed remains are expected, a combination of forensic archaeological and anthropological skills are ideally combined to assist crime scene investigators. Both forensic archaeological and anthropological methods and theories are developed to interpret fragmentary physical remains and contexts in order to reconstruct past criminal activities, the identification of perpetrator, and (in cases with foul play) the deceased. The importance of combining these skills during the field phase is increasingly recognized, since an understanding of the interaction between site formation processes and human remains aids the reconstruction of events [6,21]. These ideas are further developed in the discussion.

The academic overlap of these subjects varies. The understanding of whether osteology is a subdiscipline to archaeology or vice versa, or if they are unrelated subjects depends on the country of study [32,42,49]. In Sweden, osteology is a sub-discipline to archaeology, provided that osteologists educated in Sweden are generally also archaeologists, or 'osteoarcheologists'. The osteology education includes both human and animal osteology [50]. Education in forensic archaeology and forensic anthropology is not offered in Sweden.

The scope of this paper is mainly forensic-anthropological in nature, if the reader understands forensic anthropology as covering both the field investigation and following analysis of human remains and associated context, and is limited to sites where human remains are encountered [as proposed by 21,51,52]. However, forensic anthropology is not always recognized as a field endeavor [21,41]. Regardless of definitions, forensic anthropology and forensic archaeology should be intimately intertwined. In so doing, the reconstruction of past human behavior from fragmentary material at sites where human remains are encountered can be enhanced [14,21,33,53,54]. 'FAA' is used as a merged term throughout the analysis to bring association to both field and laboratory analyses of human remains, which is the focus of this study. As the osteology subject is subsidiary to the archaeology subject in Sweden, these qualifications are often regarded as associated (albeit not all archaeologists are specialized in osteology).

## 2. Material and method: qualitative interviews

Qualitative interviews were used to obtain information about professional practices as well as experiences of FAA within the police and the NBFM. As the use of FAA in Sweden is scarce, the number of individuals with an understanding of the subject is limited. To decide how many interviews to conduct, A 'theoretical sampling' approach was used, after Gillham [55]. The method is a means to achieve an explanatory framework while maximizing the information gained per interview. In action, this means when similar explanations are repeated by several interviewees, a

'theoretical saturation' has been obtained and the interview process is concluded [55]. The reasoning behind this is that additional interviews are unlikely to bring radically different explanatory frameworks. In this study, theoretical saturation was reached after twelve interviews, as new information declined in the last interviews conducted.

Seven out of the twelve interviewees (henceforth I1-I12) were approached through the ForArk network. The remaining five interviewees were recommended through previous interviewees. Participants were either individuals with knowledge of FAA within the law enforcement, or individuals in professional roles that have an impact on investigation or analysis of burned or fragmentary human remains. Consequently, interviewees likely have a deeper interest and knowledge in FAA than the general CSI or forensic pathologist. The study is thus based on so called 'elite interviewing', targeting interviewees who have special knowledge in the research subject [55].

Individuals in varying professional roles and from various police regions were included (Table 1, Figs. 1 and 2). Six of the interviewees are females, and six males. This was not a conscious selection, the choices were based on professional role, recommendations by other participants, and region of work. All approached interviewees agreed to an interview.

In order to study FAA in relation to investigations of outdoor and fire scenes where human remains are encountered, interview themes were constructed around FAA competence, guidelines, working procedures, human remains analysis, and FAA development (Table 2). Interviews were semi-structured in the sense that the themes were pre-defined by the author, but the interviews were held with a low grade of standardization as they were based on a combination of open questions (with follow-up questions if needed) and spontaneous elaboration on the theme by the interviewees [following 55,56]. Furthermore, the interviews could focus on

varying aspects of the themes as different interviewees are responsible for different parts of the investigation process (see Tables 1 and 2). For example, forensic pathologists mainly provided information regarding medico-legal analyses of remains, whereas crime scene investigators primarily addressed questions about field praxis. Interviews were conducted in Swedish between October 2019 and May 2020. Nine interviews were conducted over the phone, and three in person. The interviews lasted between 20 and 50 min and were documented in writing throughout the conversation.

When all interviews had been conducted, the content of each interview record was restructured according to the original interview themes [55]. Topics that did not relate to these themes were excluded from the continuing analysis, a so-called 'step-one-analysis' [55]. Information that was repeated by several interviewees were then used as a basis for descriptive categories to structure the contents further.

Material from each interview was anonymized. A code key is kept on a separate USB stick that is stored by the author. Prior to the interviews, interviewees were informed about the aim of the study, the voluntary basis of participation, plan for publication, and the possibility of anonymity in documentation and publication. However, as some interviewees have unique job positions, the difficulty in obtaining complete anonymity was emphasized prior to the interviews. Preceding publication, the participants were provided the opportunity to review a draft of the manuscript for comment concerning parts of the analysis that pertained to their interview participation. Ten of the twelve interviewees gave feedback on the manuscript. Of the ten, six interviewees had no comments on the contents. Four interviewees suggested minor changes or additions of new information. In total three minor changes for clarity in the analysis were suggested and amended. Updates about developments that has taken place after the

**Table 1**

The table presents interviewee professions as well as the themes addressed for each interview. When only part of a theme was addressed, the area of interest (see Table 2) is within brackets. The order of interviewees presented in the table does not correlate to interviewee number (as that would make anonymity harder to maintain).

Interviewee profession	Themes addressed	Additional targeted information
Forensic pathology assistant (degree in forensic anthropology) at NBFM	1 (within NBFM), 2 (analysis & intake guidelines), 3, 4, 5	
Forensic pathologist (additional degree in forensic anthropology) at NBFM	1 (within NBFM), 2 (analysis & intake guidelines), 3, 4, 5	
Forensic pathologist (director of studies of Forensic Medicine) at NBFM	1 (within NBFM), 2 (analysis & intake guidelines), 3, 4, 5	Curriculum in forensic pathology and any courses in forensic anthropology
Crime Scene Investigator	1 (within the police), 2, 3, 4 (competence contracted for analyses), 5	The history of AFFA
Crime Scene Investigator	1 (within the police), 2, 3, 4 (competence contracted for analyses), 5	DVI infrastructure
Crime Scene Investigator	1 (within the police), 2, 3, 5	The history of AFFA
Crime Scene Investigator	2, 3, 4 (competence contracted for analyses), 5	
Crime Scene Investigator	2, 3 (competence contracted for analyses), 4, 5	
Forensic archaeologist at NFC	1 (within the police), 2, 3, 5	The development of forensic archaeology at NFC
National process developer at Physical Traces at NFC	1, (within Physical Traces) 2, 4, 5	Working process at NFC Physical Traces
Crime Scene Investigator (part of the harmonizing project)	1 (within the police), 2, 3, 4, 5	The harmonization process and what it means for FAA
Crime Scene Investigator	2, 3, 5	

**Table 2**

To obtain information and opinions about FAA within Swedish law enforcement, the following interview themes were constructed for the qualitative interviews.

Theme no.	Overarching theme	Areas of interest
1	FAA competence within the police or NBFM, past developments, and education	AFFA organization; AFFA report; current FAA competence within the police; FAA education and training of CSIs; FAA competence within NBFM; FAA education and training of forensic pathologists
2	Guidelines regarding burned, skeletonized, or buried human remains	Current field guidelines; analysis guidelines; intake guidelines; forthcoming guidelines
3	Working procedures at outdoor, fire, and DVI scenes containing burned, skeletonized, or buried human remains	Chain of command; documentation; recovery; challenges; assessments of remains; FAA competence
4	Analysis of skeletonized and/or burned human remains	Chain of command; competence consulted for analyses; questions addressed; FAA competence; praxis in comparison to fleshed human remains
5	FAA developmental work	Within the police; within NBFM

interviews (provided by two interviewees) were included as footnotes in the results section.

### 2.1. The organization of the Swedish police authority and National Board of Forensic Medicine

NBFM is an independent expert authority, while the National Forensic Center (NFC, Sw. Nationellt forensiskt centrum) is an independent expert organization within the Swedish Police Authority (Sw. Polismyndigheten) that is responsible for the national forensic process (Fig. 1) [57–61]. The forensic examinations undertaken at the different organization are in broad strokes separated by whether the material analyzed is intra- or extra-corporeal [57]. However, since the NFC is responsible for tool mark analysis, skeletal material can be subject to tool mark analysis by the Physical Traces unit within the NFC.

DVI assignments are coordinated by The National Operations Department, that among other responsibilities functions as the DVI point of contact. The regional DVI teams are responsible for DVI operations in collaboration with other expert organizations such as NBFM, see Fig. 1 (Johansson personal comm. 2020–07–20) for more details see the Police Authority [58–63].

## 3. Results

### 3.1. FAA competence within the police

#### 3.1.1. Past developments

I5 explained that AFFA was initiated by CSIs at the Stockholm police in the 1990's. A key person in the process had attended a tour of an archaeological excavation and found the archaeological techniques to be of interest to outdoor crime scene and fire scene investigations. The crime scene investigator contacted the archaeological department at Stockholm University which resulted in the establishment of a small working group, AFFA, that consisted of crime scene investigators (CSIs), archaeologists, a forensic pathologist, and an osteologist (I5, I6).

AFFA was not recognized as an official organization within the Stockholm CSI division, but was run as an interest group (I5, I6). AFFA CSIs did receive some funding from the police to develop FAA. They worked on cases with a FAA profile when possible, spread awareness of FAA applications in CSI, and attended and initiated FAA training (I5, I6). AFFA members attended two archaeological excavations, a ground penetrating radar (GPR) workshop, and organized a seminar [25]. Followingly, the 'AFFA report' was written at the conclusion of the project. AFFA members presented this work at criminological conferences and workshops, as well as gave lectures to other police employees (I5, I6, I10).

AFFA activities and the development of outdoor crime scene investigations had declined by 2010. This led AFFA members to offer an outdoor CSI course focused on buried human remains or objects (I5, I6). For this purpose, pigs had been buried to simulate clandestine burials. The course was run by an osteoarchaeologist at Stockholm University and given to a group of Stockholm CSIs in 2013. AFFA worked hard to explain the aim and the value of the course to colleagues. Once the course description was announced, the interest to attend was high among CSIs (I6). However, despite the efforts to build a forensic archaeological awareness within the Stockholm police, I6 reported that, "It has been a slow development since it is regarded that CSIs should be able to handle these cases. A lot of them do, but in what way [are they investigated]?"

#### 3.1.2. AFFA report awareness and usage

In the mid 1990's, 1000 AFFA reports were distributed throughout the police organization as an introduction to FAA practices (I5, see report [66]). Among the interviewees, four CSIs knew about the report, one of which had not seen it. Two CSIs were unaware of the report. I8 believed that knowledge of the report was higher among older CSIs, but it may also depend on regional differences. In one region, the AFFA report was not

used, but they have a one-page document describing methods for the location and investigation of clandestine burials (I3). The interviewee noted it was unclear who made the document, although it may be attributed to SKL (the predecessor to NFC) (I3).

When asked why the AFFA report was not used more broadly as a methodological guideline, I6 stated that the report was not accredited as an actual manual for CSI work. The 'field manual' (Sw. fälthandboken) manual describes CSI, and it has been regarded as sufficient to conduct CSI work. However, working descriptions for the outdoor crime scene are not included (I6).

#### 3.1.3. Current FAA competence

One person within the Swedish police (at NFC) is presently employed as a forensic archaeologist. Although initially hired as a Computer Forensics Analyst, the prior comprehensive archaeological professional experience was recognized as an asset although not part of their hired job description (I8). Eventually, the employee was to provide regional forensic archaeological experience, which has since 2018 turned into a full-time work with national responsibility for FAA. The employee assists in national assignments and drive development of FAA (I8). The development of this role was the result of case work where the value of forensic archaeology could be demonstrated, combined with a leadership that recognized the value of FAA within forensic investigation (I8).

Among Stockholm CSIs, two employees have previous education in osteology and archaeology. Although they are not employed in this capacity, the osteoarchaeological knowledge is regarded as beneficial (I5, I6).

#### 3.1.4. FAA education and training of CSIs

Swedish CSI education does not include clandestine burials, the recovery of scattered human remains, or any aspect of FAA as it is not part of the CSI educational curriculum (I6, I7, I11). FAA competence, as a result, is low. "Managers and colleagues have a positive outlook on the subject, the current shortfall mainly results from the lack of knowledge of forensic archaeology" (I7). However, sporadic regional FAA trainings have taken place. In one region in 2018, a plastic skeleton was buried in clothing with fired ammunition, and retrieved a year later (I7, I12). No one knew how to conduct the documentation and excavation, according to I7. This exercise led one employee's interests to FAA, and subsequently wrote a special assignment on the subject as part of the CSI education (I7). I4 reported that, "A long time ago, a [national?] excavation course addressing clandestine burials was given to CSIs." The exercise was followed by a successful similar regional training given to both CSIs and forensic pathologists (I4). One AFFA employee participated in two archaeological research excavations, as well as a three-week Forensic Archaeological course in Glasgow together with another CSI colleague (as mentioned under 'Past developments') (I5). In addition, the forensic archaeologist at NFC has given some ad hoc regional FAA training for colleagues in specific methodologies such as metal detecting. However, there is no plan for continuous FAA training, and NFC do not possess the expertise to give a comprehensive FAA training (I8).

### 3.2. Guidelines regarding burned, skeletonized, or buried human remains

There are no specific guidelines for localization, documentation and recovery of fragmentary human remains at fire scenes (I1), but I7 mentioned that there are guidelines for fire scenes that include complete deceased individuals. In terms of outdoor field praxis, "There are routines for how to investigate a dead body, but guidelines for buried, concealed or scattered human remains do not exist. There are no written protocols" (I10). I6 and I7 confirmed that there are no current guidelines on how to investigate scattered or buried human remains outdoors, or the location of clandestine burials (I5, I11). I3 explained, "At indoor crime scenes, there is more to investigate, such as how did the perpetrator get in, has mail been opened, is the food in the fridge still fresh? There are more routines connected to how an indoor crime scene is to be investigated" (I3).



(For intake and analysis guidelines at the NBFM, see 'Analysis of skeletonized or burned human remains').

### 3.2.1. Forthcoming accreditation of the outdoor crime scene

A 'harmonization process' was initiated when the police and NFC were merged into one authority in 2015, with the aim of establishing the same working procedures within forensic investigation nationally (I6, I10). This process is expected to be complete by 2022 (I6). Today, only laboratory work is subject to ISO (International Organization for Standardization) accreditation. The harmonization process will result in that field work is accredited as well (I10, I6). The incentive to standardize forensic work comes from the EU, but the process is conducted nationally (I10). General policy documents are developed, along with instructions for outdoor crime scene investigation. Today, the field praxis is based on what CSIs learn during their CSI education, although it is not specified in any formalized standards (I10). Essentially, the policy documents will describe how they work today (I10). The documents, developed by CSI and NFC staff, will contain broad methodological descriptions, as they need to allow for the variability of outdoor crime scenes (I4, I6, I8, I10).

Within the field organization, there are different specialized task forces that encompass fire, blood pattern analysis, ballistics, and deceased individuals, among other specializations. AFFA members noticed that FAA was not included in the field manual for deceased individuals, and felt it was imperative to incorporate (I6). After a long process, it was decided that a working description for FAA will become part of the ISO accreditation. Even though the descriptions will be very brief, it is still a leap forward. *"The main outcome is that the field [FAA] will actually exist!"* (I6). With a description in place, they aim to make it easier to develop FAA and involve external expertise with the police (I6, I8).

### 3.3. Working procedures at outdoor or fire scenes containing burned, skeletonized, or buried human remains

Locating clandestine burials can be challenging, but if you know what you are looking for, it's easier to plan the search and investigation (I4). Cadaver dogs can be used in searches for human remains (I11). In addition, three interviewees have used a dog that has been trained by an archaeologist to locate skeletal material (I3, I8, I11; for information on the dog training see [66]).

If the police receive information about the unanticipated discovery of skeletal or buried remains, the on-duty patrol is called to the scene. CSIs are to conduct an investigation if a crime is suspected (I3, I6, I8, I11), and any CSI team can be assigned cases that include skeletonized or buried human remains (I6). The CSIs decide on the field praxis in each individual case, as outdoor crime scenes are complex (I3, I4, I6, I7, I8, I10, I11, I12). General national policy documents state that the expertise needed in each case is to be acquired, but skeletal remains are somewhat of a gray area (I10). The crime scene investigator decides if and what experts are to be involved at the scene (I3, I12), and choices often depend on the personal contacts of the crime scene investigator in charge (I3, I6, I7, I10). CSIs with long experience have many contacts (both external and internal) that can assist in various investigations, while it is harder for newer employees (I3). *"It's difficult to reach out to people that you don't know, or know of, and communication over police regions is limited."* (I7). The leadership meet, but there is a limited exchange of ideas and experiences among operational employees in different regions (I7).

If human remains are encountered or expected, securing the crime scene and potential evidence is priority as investigating the context is a main focus (I3, I4, I6). For clandestine burials, archaeological methods are used according to several interviewees. The area is searched, thereafter the grave is delineated (I4). Investigations may include metal detecting, sampling of disintegrants, soil, botanics, and entomology. While photo documentation is also used throughout the recovery

process, GIS documentation is generally not used for crime scene documentation and analysis, but GIS competence exists on a national level at NFC (I7, I8). When cases require excavation, the AFFA report is used as a methodological guideline according to I4. Three interviewees said that they dig trenches around the grave before excavating it (I3, I4, I11). I4 reported that the filling of the grave is dug with planum method, *'like an archaeological excavation'*.

If scattered skeletal human remains are found outdoors, the CSIs collect what they find after using a metal detector, cadaver dogs, and photo documentation (I3, I4). A corpse or a complete skeleton is treated with more gravity than scattered human remains by the police, according to I1. This may be due to if a crime is suspected or not, rather than the preservation of the remains, said I12.

### 3.3.1. Challenges

CSIs cannot possess the qualifications needed at all crime scenes as their field of work is wide-ranging (I4, I7). *"The field of forensic investigation is extensive, which means that crime scene investigators are quite good at a lot of things, but not specialized in anything"* (I7). I5 stated, *"Outdoor crime scenes have not always been ideally excavated. It's hard to collect all evidence if the methodology is not thorough."* Staying updated on software and analysis is challenging as the technical advancement is rapid, and GIS and drone competences are among those in need of development (I4). I3 described that one challenge with the upkeep of competence among CSIs is that further training is seldom offered. *"In the past, training updates were given every 3–5 years. This is not the case today. Education is neglected, and you have to depend on transfer of knowledge from more experienced colleagues. However, one training update might be coming up soon."* (I3).

I4 expressed that, *"It would be ideal to have an archaeologist or osteologist in the field at outdoor crime scenes, but it's a question of costs. In specific cases, there is no issue in bringing in the required specialist needed, but in the long run it's unpopular. It's a shame, because the CSIs are open to this opportunity. They need to consult qualifications that they don't possess"* (I4). Several collaborative projects with archaeologists have been on the agenda but it is hard to follow through as archaeologists are generally bound to obtain external funding, while the police can act instantly on suspicion of crime (I4).

### 3.3.2. Assessment of human remains during field work

#### 3.3.2.1. Internal.

In the region where two colleagues possess osteoarchaeological competence, they can be called to assist in cases of FAA profile. This capacity is however limited nationally (I4, I6, I8, I10, I11).

#### 3.3.2.2. Forensic pathologists at the NBFM.

The praxis of how often and in which cases forensic pathologists are called to scenes varies between regions (I2, I12). This is in part due to some NBFM units responsible for vast geographical areas, making it challenging to attend crime scenes in other various parts of the region (I2, I4), (see Fig. 2). I4 also noted that *"It can be challenging to get a pathologist to assist in outdoor crime scene work as they don't work 24/7 like the CSIs. However, we usually solve this through using video calls so that the forensic pathologist can give feedback during the field phase."*<sup>1</sup> I3 reported that if a relatively complete dead individual is found, a forensic pathologist is often called to the scene, although they are generally not called to scenes where skeletal or burned human remains are found according to several interviewees (I1, I2, I3). One interviewee noted that forensic pathologists are more often called to suspected crime scenes in the interviewees region of work than other regions, even in cases of skeletal remains (I12). In contrast, I3 wondered why a forensic pathologist was to be utilized at a scene where only scattered human skeletal remains were encountered (I3).

<sup>1</sup> One interviewee commented that there is always a forensic pathologist on call in every region.

I1, I2 and I12 stressed that some data can only be collected at the scene by people with a knowledge of human anatomy or osteology, as understanding the context helps to interpret findings at the scene. Spatial information such as slopes can give clues about where to look for missing skeletal elements. This can infer where the original location of the deceased was, or if animal scavenging or weather events such as flooding have affected the scene and the remains. Similarly, if scavenging animals have been at the scene, this may explain injuries that may otherwise be misinterpreted as intentional modifications by humans (I2). Furthermore, if one is unaware of what to look for, information and material can be lost during the field phase (I2, I12). Therefore, the identification of fragmentary biological material is needed to maximize the collection of material for analysis (I12). To further limit the damage of material during recovery, knowledge of the proper recovery techniques for human remains is crucial (I12). This is why calling specialists to the scene is beneficial so that more information can be obtained and given to the police during the early stages of investigation (I2).

Forensic pathologists receive some education in the recovery of human remains at crime scenes. This includes collection methods that do not damage the remains, and obtaining data such as temperature and body position of the deceased. Excavation knowledge, however, is limited (I12).

**3.3.2.3. Osteoarchaeologists.** When cases of FAA profile arise, CSIs in some regions involve archaeologists and/or osteoarchaeologists to help conduct excavations and osteological assessments (I3, I4, I11). I6 explained that an osteologist needs to be consulted if the investigator cannot tell if bones are human or animal. There are no legal issues with hiring external contractors if the police can advocate for it (I4, I6). However, since it is an expense paid for by the police, it is not as economically feasible in the long run (I4). In the Swedish legal system, it is up to the court of law for each specific case to judge the expert's competence, and therefore external competence can be contracted as seen fit (I4). However, it is important that the external part is well informed about the secrecy demanded when working on police cases (I5, I8).

### 3.3.3. Fire scene praxis

A current practice for the fire department is to allow buildings on fire to burn down completely, even if human remains are anticipated to be inside (I1, I3). This practice complicates police investigation (I1, I3). CSIs attempt to obtain as much information as possible about the scene prior to investigation (I3, I7). Complete corpses are recovered from the scene and sent to the NBFM (I3). For incomplete remains, a dog can be used to assist in locating human remains. Upon location, CSIs then either manually collect pieces of human remains, or place a board underneath the remains to collect all the debris for sieving. Large pieces of human remains are collected first, then the debris is sieved for smaller fragments (I3, I7). However, CSIs are generally not trained to recognize fragmentary human remains (I1, I7).

Archaeologists have successfully been involved to help document and investigate fire scenes, said I3. If foul play is expected, forensic pathologists are sometimes called to fire scenes (I7). However, I12 reported that this seldom happens, but that the extensive documentation from CSIs informs the following postmortem analysis. Forensic pathologists do not have much to bring to fire scene investigations, except for advice on how to treat the human remains to reduce further damage, said I12. However, the current practice can sometimes reduce the information collected from human remains according to other interviewees (I1, I2). I1 provided an instance where human remains were collected in a box and taken for analysis to NBFM following a car fire. In photos from the scene the cranium was seen intact, but when the remains arrived the cranium was in fragments. More data could have been collected prior to fragmentation if osteologists had been called to the scene, (I1). Events like this are probably the result of insufficient knowledge (I1). *"It's hard to ask the right questions if you lack the sufficient*

*knowledge. What you do in the field is irreversible. It's possible to re-listen to an interrogation, but it's not as easy here [at a fire crime scene]"*, argued I5.

### 3.3.4. Disaster victim identification - DVI

There are four national DVI teams that run parallel to the everyday police organization (I4, Fig. 1). When DVI cases arise, police lead DVI investigations and the NBFM assists with postmortem analyses in accordance with Interpol standards (I4). Osteological competence plays an important part in DVI cases with fragmented human remains (I4). This expertise can be provided by NBFM, who either provides pathologists with forensic anthropological skills or contracts an osteological specialist, according to I4. In cases of international collaborations, osteologists are often provided by another nation (I4).

### 3.4. Analysis of skeletonized or burned human remains

#### 3.4.1. Chain of command

The CSIs in charge of the case decide where human skeletal remains are sent for analysis. The remains can either be sent to external experts, to NBFM, to CSI employees with osteological competence, or if tool marks are identified on the remains – to NFC Physical Traces (I3, I4, I6, I7, I10). The choice of where to send skeletal remains for analysis often depends on the professional contacts of the ranking crime scene investigator (I3, I6, I7, I10).

#### 3.4.2. Competence consulted for analyses

##### 3.4.2.1. The National Board of Forensic Medicine (NBFM)

**3.4.2.1.1. Intake and guidelines.** Human remains can be transported to the NBFM by different means (I1, I2). Deceased individuals in various forms of decomposition or skeletonization (especially when there is suspicion of crime) are transported by professional companies in body bags (I1, I2). Scattered or fragmentary skeletal remains are often transported by the police in paper boxes or bags, or occasionally sent by mail (I1, I2). Fragmentary remains from fire scenes have sometimes been delivered in sieves, resulting in further fragmentation of the fragile material during transport (I1, I2). If remains are received in a body bag at the mortuary intake, they are handled with standard operating procedures unlike remains that are delivered by other means (I2). Standard guidelines for the recovery, transport and intake are somewhat of a gray area when it comes to fragmentary burned human remains (I1, I2). I1 stressed that, *"It's still a matter of a dead human being, but they are not being treated in the same manner as fleshed remains by the police. But we're still investigating an arson! No one would doubt setting up a standard death investigation [at intake] if only the feet were burned"* (I1). All human remains deserve proper administration and investigation, but the treatment sometimes depend upon the state of preservation of the remains at the time of collection (I1, I2).

**3.4.2.1.2. Skeletal remains: analysis and FAA education and competence.** The focus and extent of the postmortem analysis is determined by a series of questions put forth by the police. Common questions include the cause of death and identity of the deceased (I12). The forensic pathologist on call is expected to conduct analyses of all kinds of human remains, which include skeletal or fragmentary remains (I1, I2, I12). Forensic anthropology is not recognized as an independent field in Sweden, but as a subdiscipline to forensic pathology (I1). As such, it is part of the forensic pathologist's responsibility to know some osteology (I2, I12), but few have in-depth osteological knowledge as the competence to analyze fragmentary skeletonized remains is beyond their training (I1, I2, I4, I6, I12). Forensic pathology comprises a large field, and therefore multiple special competences is hard to sustain (I12). They are however required to know *what* information that special analyses can add, and thus when another competence is useful (I12).

I12 believed that many colleagues consult external forensic anthropologists or osteoarchaeologists for cases with fragmentary or skeletonized remains. However, some forensic anthropological

competence exists at regional units of NBFM. To the knowledge of I1, three NBFM employees have special competence in forensic anthropology; two forensic pathologists with a degree in forensic anthropology, and one forensic anthropologist who is employed as an assistant. Alas, none of them are employed primarily as a forensic anthropologist (I1). However, these employees are often utilized in osteological cases received at their respective NBFM unit (I1, I2, I12). In addition, they sometimes get 'digital' errands from NBFM units that lack forensic anthropological competence, while still other units frequently consult osteoarchaeologists, especially if in doubt of whether the skeletal material is human or animal (I1, I2, I12).

Standard operating procedures and quality systems are in place for administration and postmortem analyses of fleshed remains (I2, I12), while there are no protocols that describe how skeletal material is to be analyzed (I2). Some working routines exist, but skeletal material are generally not analyzed as thoroughly as fleshed remains according to I1. However, I12 argued that the extent of the analysis mainly depends on whether there is a suspicion of foul play, rather than on the preservation of the remains. For all cases regarding the analysis of human remains, the report is quality controlled by another forensic pathologist (I2). According to I12, the pathologists can generally answer the questions posed by the police. However, in terms of buried or skeletonized and fragmentary remains, the analyses can likely be improved through a more extensive collaboration with osteoarchaeologists (I12).

I1 expressed a perceived paradigm shift in the perception of osteological remains at the interviewee's workplace. Traditionally, human skeletal material has been given little time for analysis (I1). Both forensic pathologists and the police often fail to recognize information that can possibly be gained from skeletal (burnt or unburnt) material, such as the minimum number of individuals, age at time of death, or manner of death (I1). Now that it is recognized that a forensic anthropologist can assist in osteological analysis at the unit, the interviewee perceived a change in mentality. Colleagues have realized that forensic anthropology is not just a subcategory to pathology, and that the breadth of information gained from osteological material is greater than previously expected. Extensive development is needed at NBFM when it comes to osteological analyses (I1).

**3.4.2.1.3. Development work at NBFM.** NBFM is working on creating a national standardization to ensure that cases are treated with the same 'minimum standards' in all regions. In 2017, NBFM originally consisted of independent regional departments and was restructured into one national department with regional units to fulfill this aim of national standardization. The goal of a national standard needs to continue as practices still vary between regions (I12).

I12 was not aware of any ongoing development work regarding forensic anthropology but saw potential for future development in this area. I1 noted that the head of NBFM has discussed creating an active position for forensic anthropology. Due to extensive accreditation and legal requirement demands, this proposal would need thorough work. However, I1 was positive about the suggestion. For the time being, a protocol for the analysis of skeletonized human remains is still under development at NBFM (I2).

Among forensic pathologists with forensic anthropological background, the formation of the ForArk network is seen as a positive development as it facilitates networking over professions and administrative regions (I1).

**3.4.2.2. Analysis by NFC Physical Traces.** Among other responsibilities, the NFC Physical Traces unit analyzes material displaying damage or tool marks in relation to the possible tools that created them. The forensic scientists mainly come from a natural science background, with a two-year specialization in forensics that is taught by NFC. The material in question can, among many other materials, be skeletal, and thus questions can relate to trauma analyses and cause and manner of death. The skeletal assignments can come from NBFM or from the police, and stem from recent or cold cases (I9). Species identification can be conducted by either

Stockholm CSI employees with an osteology background, or by NBFM (I9). In the latter case, the skeletal element often derives from a deceased individual that has first been subject to postmortem investigation (I9). The forensic scientists do not possess osteological competence, and (I9) expressed that, *"There is a lot left to accomplish within the area. Trauma to bone is especially neglected. [...] Pathologists are better at assessing trauma, but bone in general is a hard material [to analyze]."*

Osteological tool mark analysis can be vital to the CSI investigation, but due to the lack of competence in this area, osteological material analysis is often turned down by NFC (I9). *"The cases that we turn down probably don't get analyzed,"* said I9. However, some osteological cases that are taken on by NFC can be sent to the Netherlands Forensic Institute (NFI) for a second opinion as NFI provide forensic scientists with an osteological background.

**3.4.2.2.1. Development work at Physical Traces.** There is a great need to increase the competence to conduct skeletal analyses, and there are plans to conduct staff exchange with the Dutch NFI. Swedish NFC are also working to develop a collaboration with CSIs, as interdisciplinary skills are needed in tool mark errands (I9). Additionally, there are also plans to write a method description for how to conduct skeletal trauma analysis (I9).

The NFC Physical Traces unit might employ an individual with osteological competence, where the osteological competence is seen as a complement to fingerprinting skills. When asked why NFC Marks do not have osteologists employed for skeletal trauma analysis, I9 explained that it is a combination of few incoming skeletal cases, and few individuals with osteological background that apply to the NFC. *"However, now that the prescriptive period for murder has been removed, cold cases are being revisited to a larger extent. This means that skeletal cases will likely increase"* (I9).

**3.4.2.3. External osteological competence.** When bones are encountered, several CSIs contact an osteoarchaeologist that they are familiar with (I3, I6). I6 often consults osteoarchaeologists at Stockholm University since the interviewee feels confident in their competence. In another region, osteological analysis of bones assumed to be from animals are sent to a natural history museum since they have a vast skeletal collection (I7, I12). Bones are sent there even though there are no longer any osteologists employed at the museum in question (I7). *"This is probably due to old habit, it's quicker than reaching out to someone new"* (I7). However, if skeletal material is expected to be human, the choice in the same region is often to send it to NBFM (I7). In the North, an osteologist that is employed by the neighboring Finnish police is sometimes contracted (I4).

### 3.5. Police development work in regard to FAA

#### 3.5.1. The need for FAA

FAA has yet to prove its value within the Swedish law enforcement in order to grow. *"Should there be a couple of cases where you see the need [of FAA], such opportunities will open up at once."* (I4). This was echoed by I8, who also stressed that internal advertisement of FAA is needed. Another interviewee suggested that, *"There would have to be some sort of 'package' presented with statistics of the needs, and the benefits of forensic archaeology such as GIS, metal detection and the like in order to justify forensic archaeology"* (I7). Similar opinions were stressed by I4, *"If someone has the competence of both GIS, archaeology and osteology, that is a multicompetence that the police need to have."*

There has been no systematic investigation of how many cases could benefit from FAA in Sweden<sup>2</sup> (I8), although two interviewees expressed that they are probably not as frequent (I5, I8). The question remains regarding the need for FAA competence at NFC (I8). The one employee in this capacity reported that, *"I have to motivate the value [of FAA] time*

<sup>2</sup> An overview of cases that have used FAA over the last four years is currently underway, conducted by AFFA and the forensic archaeologist at NFC. Since 2016, these employees have assisted in over 300 cases of varying scale.



and time again. The issue is that the contributions are not visible in the statistics, they just end up as notes in the CSIs protocol.”<sup>3</sup> (I8). Essentially, FAA needs to be presented as the wide-ranging field it has the potential to be, and the array of cases that could benefit from FAA needs to be quantified in some manner (I4, I8). FAA assignments are not only handled by the forensic archaeologist or by AFFA, but several police departments work directly with external archaeologists or osteoarchaeologists, which further complicates reliable statistics as well as standardization and legal security in FAA errands (I8).

### 3.5.2. FAA infrastructure

A sustainable FAA infrastructure was proposed as a means to improve in the investigation and recovery of outdoor finds of human remains (I8). It is important to build a long-term FAA structure to avoid reinventing procedures and know-how every time a FAA case arise (I5, I6). The development and upholding of infrastructures such as AFFA is undermined if all FAA assignments are directed to one single employee (I5, I6). It is crucial that colleagues with FAA competence work as a collective group that can support other colleagues (I5, I6). Solid directives for how assignments are dealt with needs to be established including a transparent workflow (I6).

The ForArk network is seen as a mechanism to implement a national FAA forum that can facilitate professional development, networking, and create awareness on the subject (I5, I6, I7, I8). The involvement in ForArk has helped put FAA back on the agenda within the Stockholm department (I5, I6, I10). “The sector is moving!” (I6). A new FAA course is to be given by Stockholm University in 2021 for a group of Stockholm CSIs, at the request of the Stockholm CSI department (I5, I6).

Special competences such as FAA is hard to provide in all regions today. Although forthcoming ISO accreditation entails that the competence should be available in all regions, or at least the knowledge of how to access this competence (I4, I6). I4 was impressed by the FAA competence in the Netherlands where archaeologists are employed by the National Forensic Institute, but noted it may be hard to transfer the setup to Sweden. “In order to have enough assignments, it might be feasible to employ [FAA] specialists on a national level [as in the Netherlands]. However, it’s a [geographically] small country compared to Sweden, so the specialists can be anywhere in a matter of hours which makes the national model reasonable” (I4).

I7 and I8 suggested that FAA should become a ‘specialization’ (Sw. förhöjd förmåga) within CSI work. A specialization entails that some employees have an in-depth knowledge in the subject and can assist colleagues in errands nationally, similar to existing specializations in blood pattern analysis, coordination, and fire (I7). Two levels of FAA competence were proposed by I8. The basic level would consist of CSIs who have participated in forensic archaeological training such as search and excavation, and the second level would be comprised of the specialized employees with a background in archaeology/osteology, ideally CSI and NFC staff (I8). FAA competence among CSIs in every police region would be preferred, with the possibility to partake in national assignments (I8). Alternatively, FAA competence could be provided externally, for example through a collaboration with an external network like ForArk (I8). One recent development that may enhance overall FAA competence is that the Swedish police now allow hiring and education of civilians as crime scene investigators (I4, I7).

It is crucial that FAA becomes an independent subject at NFC, and that it is implemented in the CSI education curriculum to secure FAA development<sup>4</sup> (I8). Small steps are taken in this direction as there are plans to give some forensic archaeological lectures on the CSI education in the future<sup>5</sup> (I8). There is however a long way to go. “Forensic

archaeology is a very broad discipline that is not yet recognized [within the Swedish police]. Today, it is viewed as methods that can be applied.” (I8). The difficulty lies in getting decision makers to understand the full range of FAA and the benefits if it is integrated holistically, and not solely as a methodological praxis (I8).

## 4. Discussion

The results from the qualitative interviews show that Swedish outdoor and fire CSI containing skeletonized, buried, or burned human remains are non-standardized, both in terms of investigation and analysis. No protocols address how scattered, burned or buried human remains are to be investigated and what competences are to be involved. Thus, individual CSIs carry a great responsibility in choosing how the scene is to be investigated. The CSI education does not directly address these circumstances, which leaves investigators to their own devices when it comes to navigating these cases. Several interviewees questioned the general quality of previously conducted excavations and analyses of fragmentary human remains. Little exchange takes place over regions, and FAA is more developed in some regions than others. When specialists are involved in casework, they are often consulted on a case-to-case basis which is seldom visible in the statistics. Essentially, the FAA development that has taken place thus far is owed to initiatives by single individuals employed within Swedish law enforcement. As stressed previously by Danehed [31], FAA in Sweden is in want of development to not fall behind in outdoor CSI quality.

Despite these shortcomings, numerous interviewees expressed that FAA is positively perceived among colleagues; that the police are open to collaborations, and that fire scenes, outdoor crime scenes, and DVI scenes can benefit from FAA competence. However, several concerns need to be resolved if FAA and outdoor CSI is to be advanced. Essentially, the issues raised in the analysis are closely connected to a lack of knowledge, acknowledgement, infrastructure, and quality of FAA on a national level. There is also a question of how large the demand for FAA competence is. This in turn relates to the potential uses of FAA and the perception of how the field(s) could contribute. These issues are discussed in the following sections.

### 4.1. Cases aided by inclusion of FAA competence

If the value of FAA is demonstrated successfully in the police work, opportunities for expanding this competence will likely arise, according to interviewees. However, in order to demonstrate this value, the crime scene investigator must know to ask for this specific competence in cases where it can prove beneficial [67]. While a few law enforcement employees in some regions have FAA competence, the investigator in charge may not be familiar with the array of questions FAA can assist in answering, among those being who to contact. As a result, FAA competence is not requested in all relevant cases. Consequently, investigation, documentation, evidence collection, analysis, and even transportation of human remains from outdoor or fire scenes can vary greatly in terms of quality and evidence collection in Sweden.

One could argue that a low frequency of murder and concealed or scattered human remains limits the need for FAA [67]. However, the author argues that despite sporadic cases, this begs for special competences in FAA in order to establish and uphold knowledge of proper investigations for outdoor crime scenes involving fragmentary or buried human remains once such cases arises. In addition, a holistic FAA can demonstrate a wider use of the discipline(s), and that it can reintegrate back into CSI work [29,46]. While many non-archaeologists assume that FAA is limited to cases of clandestine burials (indeed the focus of this paper might add to that narrow assumption), FAA can be useful in many different scenarios. The array of scenarios span from search, documentation, analysis and interpretation through drone surveys, GIS data, GPR and metal detection, 3D modelling, dating strategies, investigation of subsurface elements, skeletal and fragmentary remains,

<sup>3</sup> An inclusion of FAA as a separate inquiry in the CSI protocol has been requested. This will facilitate future estimations of the use of FAA in case work.

<sup>4</sup> The forensic archaeologist at NFC is working on making this a reality.

<sup>5</sup> There are now plans to include basic orientation in FAA as part of the CSI education from the end of 2020.

and fire scenes [2,12,23,68]. These competences can be used in both DVI and CSI. A holistic integration of FAA is demonstrated and supported by the results, including several interviewees calling for a FAA multi-competence package.

To assess whether FAA is to be further developed in Sweden, the frequency of cases that could benefit from FAA must be documented and quantified in order to assess the need. However, the difficulty in such a quantification was noted. Given that several FAA consultations may consist of a phone call and pictures sent to a personal contact (with competence in osteoarchaeology) for cases requiring bone assessments. As a result, the use of this osteoarchaeology competence is not recorded in the official documentation. Even when FAA assistance is consulted from within the police organization, this is registered as a note by the CSIs. Consequently, this informal documentation cannot easily be quantified for future recordation and need based assessments. Despite the challenges of obtaining representative statistics, a survey of cases and working areas that may benefit from FAA competence could be conducted to get an idea of the potential use of FAA, as exemplified above. In addition, a quantification of cases at NBFM that consist of decomposed, skeletal or burned human remains could be conducted in order to calculate how many cases could benefit from forensic anthropological assessments. However, such a quantification would not capture the 'hidden' assignments that are delegated to osteoarchaeologists, or those turned down by departments such as the Physical Traces unit. Nevertheless, a statistical representation to assess the minimum number of cases where FAA would be of value.

#### 4.2. The perception of forensic archaeology and anthropology

As argued above, it is crucial that CSIs know when and how FAA can be useful. To achieve this, FAA practitioners must convey the broad scope of the subject(s) to non-archaeologists, and knowledge of FAA within the law enforcement needs to be advanced.

The results indicate that forensic archaeology is often perceived as a method. This is not exclusive to the Swedish context. Previous research has shown that archaeological techniques are often used by the police, but generally without the understanding of theoretical concepts that form the basis for reconstruction of the activities performed at the site of investigation. Rather, the material evidence retrieved using archaeological methods are often regarded as objects that speak for themselves [68,69]. The assumption that archaeological excavations can be conducted by anyone is a common misconception [68,69]. Rather, it is the understanding based on the site investigation that informs the interpretation of what occurred at the scene, as is discussed in the following paragraphs. Basic methodological understanding - while important is not sufficient to conduct high-quality outdoor investigations including subsurface remains or fragmentary human remains in general [9,32,68]. The inclusion of archaeological methods in forensic investigations does not equate to including qualified archaeologists on a forensic team [23,69].

The theoretical framework underlying archaeological interpretations is crucial when reconstructing past human behavior from fragmentary remains [23,29,70,71]. In order to interpret site formation processes, the knowledge of taphonomy, or the 'laws of burial' are paramount. [51,52,72–76]. Within forensic anthropology, forensic taphonomy.

*"[...] focuses on reconstructing events during and following death by collecting and analyzing data from the depositional context, discriminating peri- and postmortem modification of the remains, and estimating the postmortem interval. It includes the application of archaeological search and recovery techniques, the laboratory analysis of the remains, and an understanding of unique and overlapping agencies of soft tissue and bone modification and distribution."* [27, Haglund & Sorg 1997:13]

Thus, understanding osteological taphonomy, decomposition, and site formation processes such as animal scavenging, water

transportation, root etching, and weathering and sedimentation processes are necessary in order to make interpretations of outdoor human remains contexts [27,52,77–79]. Similarly, stratigraphic and anatomical observations may aid in assessing whether decomposing or skeletal remains have been moved, identify potential tool marks in the ground, and recognize backfilled soil [21,33,80,81]. By separating human agency from 'natural processes', one or several possible chains of events can be reconstructed. This is for example essential in order to understand if an injury was sustained in connection to the death of the deceased or by taphonomic factors during the early postmortem process [8,72,75,78,82]. Therefore, laboratory analysis and contextual investigation are interdependent and begs for a substantial background knowledge of the professionals involved, see 'quality assurance of FAA'. Non-archaeologists who conduct excavations may misinterpret or not recognize taphonomic transformations [9]. Groen [29] expressed the interdependency of the field investigation and interpretation on findings as:

*"It is a truism that the forensic value of material evidence studied at a forensic laboratory is only as good as its recognition, documentation and recovery at the crime scene. Since collection, analysis, interpretation and evaluation of physical evidence goes hand in hand; evidence collection and evidence evaluation are interdependent rather than independent. Collection and sampling of physical evidence are therefore subject to a selection process, based on the theoretical and methodological aspects and the background knowledge of the available to the investigator. [...] If not recorded properly, the destructive nature of an archaeological excavation will lead to loss of evidence at best, but it could also lead to ambiguous or erroneous interpretation of the obtained forensic record."* [29, Groen 2018:10]

The material record does thus not speak for itself but is collected and explained through an interpretative framework that is reliant on the background knowledge of the investigators. An interpretive framework is needed to reconstruct natural and man-made material manifestations at the scene, and consequently information about what happened before, during and after the crime took place. In forensic archaeology and anthropology, a *criminological* interpretive framework should be incorporated in order to assess criminal behavior [23,29,70,71], see Fig. 3. Furthermore, FAA assignments should feed back into criminological knowledge in order to advance theoretical models for future investigations [23,29]. For example, all cases of clandestine burials could be input into GIS for spatial analysis of where a perpetrator chooses to conceal the dead, and how far from a road a person carries the deceased. This would inform future search efforts [23]. While human behavior is variable, case studies can still inform criminal behavioral patterns [29].

#### 4.3. A national infrastructure

In order to integrate FAA in forensic work, and not just use it as an 'applied method', a national infrastructure is key to guarantee a minimum best practice at outdoor crime scenes, fire scenes, and analyses of skeletal remains. A structure that is based on single individual initiatives is vulnerable, as argued in the analysis. Currently, employees that advocate for FAA in Sweden needs to 'reinvent' FAA every time a case arises. The lack of FAA infrastructure makes development difficult, as there is little or no possibilities to use past experiences to inform future CSI. Cases are sporadic, and with the exception of one employee, employees are to a great extent not hired to purposefully dedicate their work to FAA development. Several suggestions on how to form a stable infrastructure were, however, proposed by interviewees. Proposals included: a need for an official recognition of the subject, to demonstrate the value of FAA, to secure continuity and professional development, and to spread awareness of the field within the Swedish law enforcement.

Nations that recognize FAA have different infrastructures. For example, in England the police are comprised of 40 regional forces and

forensic laboratories are generally privatized. Law enforcement organizations decide when and if FAA experts are to be contracted, and FAA practitioners are generally employed outside of the forensic organizations and do not work full time with FAA [83–85]. However, FAA has a relatively long tradition in the UK, as the discipline has gained increased attention since the late 1980's. FAA education is given in several universities, and FAA competence is consulted for CSI and laboratory work on a regular basis [4,68,85,86]. In order to guarantee a high-quality and standardized FAA, professional organizations in forensic archaeology and forensic anthropology provide accreditation systems for practitioners. This guides law enforcement employees with who to contact for expert advice in cases where FAA is requested [4,83].

Recently, the Danish police have gone from contracting archaeologists on a case-to-case basis to establishing an 'excavation group' that include CSIs, dog handlers, a forensic pathologist, a forensic anthropologist, and archaeologists in order to advance outdoor CSI. Despite the infrequency of cases, the police recognized the value of such a task force (Schjellerup Jørgov pers. comm. 2020–04–30).

In the Netherlands, forensic archaeology is housed at the NFI (an agency under the Dutch Ministry of Security and Justice). A vital part of the forensic archaeological work undertaken at NFI is the education and training of police officers. De Leeuwe & Groen [3] pointed out that even if a short course in forensic archaeology will not make a police officer a full-fledged archaeologist, one of the main results is that the officer can assess *when* FAA expertise is needed, *who* to contact, and the extent of data that can be collected at the outdoor crime scene. The Dutch forensic archaeologists have identified several advantages to being employed by the national forensic center. The FAA practitioners have been accepted as forensic experts and forensic archaeological skills are requested in a wide range of investigations [3]. The stable work situation allows the archaeologists to combine theories, methods, and case reviews from both archaeology and criminology in order to improve theoretical frameworks and future assessments of potential crime scenes, as well as other development work [3].

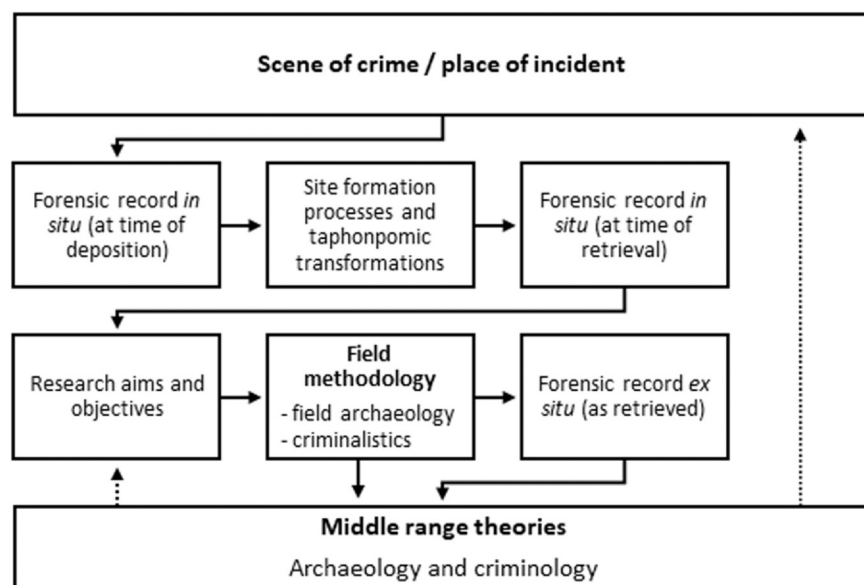
While one interviewee brought up the Dutch national system as a promising one, the interviewee also recognized that it might not be as suitable in Sweden as the geographical area of Sweden is 11 times that of the Netherlands. However, several possible ways to improve the national infrastructure of FAA were acquired from the analysis. First of all, NFC, who are responsible for the national CSI training and education, should drive the holistic development of FAA. Both linking

external FAA expertise to the police, as well as employing expertise, where proposed. Interviewees suggested that FAA could be implemented as a specialty within the police to facilitate a national FAA infrastructure and regional assistance of colleagues. In addition, basic FAA and outdoor crime scene training should be given to CSIs [31]. This would hopefully result in a situation where CSIs are familiar with such scenes, aware of the potential uses of FAA, and knowledge of who to contact when cases arise.

One important step in establishing FAA in Sweden is the harmonization process that will lead to (brief) working descriptions and ISO accreditation for outdoor crime scenes. This will mean that forensic archeology is actually a recognized field within the Swedish police. Importantly, the ISO accreditation entails that all regions should in some way have access to the competence described, whether external or internal. The ISO accreditation of field methods and descriptions of consulting professionals for assistance, will hopefully lift responsibility from the single crime scene investigator in terms of personal networks and previous experiences, and help standardize investigations in terms of quality.

#### 4.4. The information value of skeletonized, fragmentary, and/or burned human remains

The results indicate that there is a discrepancy between how skeletonized and fragmentary human remains are investigated and handled in contrast to fleshed remains within the Swedish law enforcement. Data collection in the field is not standardized for skeletonized remains, the transportation of skeletal material is inconsistent and sometimes destructive, and guidelines for the analysis of skeletal are lacking. While the variation in treatment between hard and soft tissue remains could in part potentially be explained by fewer instances of foul play in crime scenes with skeletal remains present, this does not account for the discrepancy in the handling of burned human remains. The varying treatment of human remains based on preservation is reflected in the manual for fire scene investigations, which states that in cases of deceased individuals, "[...] *the crime scene investigator should, if the body is intact, investigate the body prior to the general fire scene investigation.*" [87, Ohlsson 2013:4, as translated and emphasized by the author]. It is noteworthy that the state of the deceased has explicit implications for the investigation of the remains. No section of the manual describes how and when fragmentary human remains are to be investigated. Similar trends have been described from other countries



**Fig. 3.** An illustration of how archaeology, criminology, and criminalistics can be combined for a thorough investigation and construction of forensic hypotheses. Figure after Groen, Márquez-Grant and Janaway 'Proposed structure of a forensic archaeological interpretation' [23:530] Reproduction permission from Wiley books (2020–08–30) and Márquez-Grant & Groen 2020–04–20.



where skeletonized remains are seldom documented as thoroughly as fleshed remains [72]. This is possibly due to a rudimentary knowledge of what information that can be gained from fragmentary or skeletonized human remains. The fact that skeletal trauma analyses are sometimes conducted without osteological competence involved at Physical Traces reflects this discrepancy in quality assurance in cases of fleshed human remains versus skeletal remains. Skeletal fracture analysis is heavily reliant on knowledge of fracture appearance in relation to bone healing and plasticity, and consequently the understanding of whether the fracture was sustained before, around the time of, or after death [14,88]. Skeletal trauma analysis is one of several well-established research fields within osteoarchaeology and forensic anthropology, which the management of NFC and NBFM should embrace to improve evidence collection and legal security in osteological cases. Forensic anthropology should ideally be recognized within the law enforcement as a valid subject within itself to heighten knowledge and standardize practices. Over a decade ago, Dirkmaat and colleagues argued that:

*“Today less than at any point in the past, forensic anthropologists cannot be considered forensic “sidekicks,” who may be useful advisors when forensic pathologists or law enforcement step into an unusual case or situation, but the most appropriate, and most logical first choice professionals in cases involving all manner of outdoor crime scenes and commingled or severely altered human remains. It remains one of the main challenges for the field to convey this fact to the law enforcement community and, alas, to many forensic anthropologists. It is our belief that promoting a better understanding of the importance, objectives, and rationale of forensic taphonomy is a key element to attain this goal.”* [21, Dirkmaat et al., 2008:37].

Forensic anthropology needs to be recognized a professional role in its own right. While forensic anthropology and forensic pathology overlap in some respects, these competences are not interchangeable, and need to exist side by side as argued by Cunha & Cattaneo [28]. Importantly, it also highlights that forensic anthropology should start in the field, which is in line with reasoning from two interviewees from this present study. This will in turn inform the interpretation of the scene, the following laboratory analysis, and the ongoing police investigation at an early stage. Recognition of the value of forensic taphonomy and site formation processes has advanced greatly over the last two decades, especially in the USA [36,41,89]. This development has transformed the previously exclusively laboratory-based subject forensic anthropology into an investigative competence that combines archaeological and osteological competence in cases where human remains are encountered [21,27,28,52,89,90]. Internationally, forensic anthropology has, in many nations, gone from a case-by-case consultation basis to being recognized and employed by institutes of forensic medicine and NGO's [34].

A thorough collection, analysis and interpretation of buried, burned and scattered skeletal remains can lead to more accurate understandings of what occurred at the scene of investigation and increase the chances of identifying the deceased [12,28]. Involvement of experienced FAA professionals is crucial to secure proper data collection, as the data does not exist without thorough collection [12]. This is important and references arguments raised by professionals in this analysis stating fragmentary skeletal remains should not be collected, transported, and analyzed with any less gravity than fleshed corpses. Although severely fire altered human remains are sometimes limited in terms of the type of information that can be extracted; the burn pattern itself can aid in deducing how the body was treated [12]. This can shed light on whether fire affected fresh or dry bone, whether fractures were induced before or after fire exposure, and the position of the body at time of thermal alteration [12,79]. Judging from previous research and the present analysis, the recognition that important data *can* be obtained from fire damaged and fragmentary skeletal remains needs to be recognized within Swedish law enforcement more broadly, and should

preferably be reflected in both guidelines and education. Haglund and Sorg [51] identified the ‘collection bias’ as a main threat to thorough investigation of fragmentary remains. *“Collection bias may be the most identifiable weakness in processing in human forensic skeletal cases. This can be attributed to the relative complexity of the scene and/or lack of qualified personnel to process them [...] Familiarity with nonhuman vs. human bones, recognition of partially represented bones or those of immature individuals, and decisions about search area perimeters come into play as potentially biasing factors.”* [51, Haglund & Sorg 1997:20].

Furthermore, successful field recovery not only begs for correct human remains identification, but also the contextual understanding of the findings and their association (or non-association) between the elements at the scene [21,27,52]. Increasingly, thorough recovery by experienced FAA practitioners is recognized as a vital aspect of forensic investigations of human remains to avoid loss of data and to guarantee a retrieval that limits damage to fragmentary human remains [37], leading us to quality assurance of FAA competence.

#### 4.5. Quality assurance of FAA

According to the results, Swedish outdoor crime scene investigations are generally conducted by CSIs, while skeletal analyses can be carried out by the NBFM, by external or internal osteoarchaeologists, or by forensic experts without osteological competence (at Physical Traces). While some individuals among CSI and NBFM employees possess extra-curricular archaeological, osteoarchaeological, or forensic anthropological competence, they are ultimately not employed in these capacities (except for the one forensic archaeologist). This makes a continuous professional development and upkeep of FAA skills close to impossible. As accreditation is lacking, the professional background of individuals asked to assist (whether external or internal) can vary greatly. While the involvement of FAA competence can be a means to improve the documentation and retrieval of both human remains and associated evidence, not all archaeologists and/or osteoarchaeologists possess the combination of competences needed for FAA work [69]. For example, as osteoarchaeologists in Sweden study both human and other animal species, a specialization during the career often takes place and thus the areas of competence varies between practitioners. While Swedish osteologists can make species determination for most species in the Scandinavian fauna, work with human remains in a forensic context requires extensive work experience with human skeletal remains including: varying perimortem and postmortem treatment and deposition, varying degrees of preservation, taphonomy, pathologies and trauma, as well as additionally acquired skills in forensic taphonomy [14,28,32,41,69]. In the US for example, FAA professionals need certifications and re-certifications in forensic anthropology to guarantee a high standard in legal cases and a continuous update in new methods and paradigms within FAA [24,28]. This is a stark contrast to the Swedish ad-hoc outdoor CSI and analysis of fragmentary or skeletal human remains.

Ideally, FAA should not be a side activity or practiced sporadically by traditional archaeologists or osteoarchaeologists [21,91]. However, it is paramount for archaeologists and/or osteoarchaeologists who want to conduct forensic work to obtain substantial experience within the field of archaeology and/or osteoarchaeology, including several years of fieldwork and experience directing archaeological projects [21,30,32,69]. Furthermore, archaeologists and/or osteoarchaeologists who go into FAA need to educate themselves in forensic aspects such as chain of evidence, secrecy, court system knowledge, law procedures, forensic scientist responsibilities, forensic ethics, and basic principles of criminalistics and criminology [23,29,30,32,72,92]. Alas, archaeologists and osteoarchaeologists who practice forensics needs to be able to modify archaeological methods and theories to forensic or humanitarian work, as well as understand their role when collaborating with other forensic specialists [32,92–94]. In terms of legal procedures, it is up to the court of law to assess the competence of the expert witnesses in each case in



Sweden (as noted in the results). This contrasts with countries such as the US where the competence of the expert and the validity of theories and methods (e.g. 'Daubert ruling') must be demonstrated [38]. The Swedish system thus allows flexibility in contracting competences in forensic work, but the shortage of standards places a greater responsibility on the individual as well as on the court of law in terms of assessing expert competence.

Currently, the quality of investigations of subsurface elements and analysis of skeletal remains depend on ad-hoc data collection in the field and the individual competence of the professional faced with sporadic forensic analyses of fragmentary human remains. To increase standardization and quality assurance, FAA should ideally be recognized as a subject in its own right in Sweden, and not as a 'bonus' skill that compliments another competence. The openness to employ osteological competence at the NFC Physical Traces, together with the fact that NBFM has discussed making forensic anthropology into a subject, shows potential for development of FAA within Swedish law enforcement.

Sweden is not unique in their need for standards regarding FAA cases and practitioners. Accreditation, certification, and quality assurance in terms of codes of ethics and standard operating procedures are put forward as essential in the advancement of FAA in general [24,28,36,90,93–95]. In order to further FAA in Europe, the Forensic Anthropology Society of Europe (FASE) was initiated in 2002 under the International Academy of Legal Medicine [24,28,95], and in 2012–2013, a working group in forensic archaeology was created under ENFSI (European Network of Forensic Science Institutes) [15,23]. The ENFSI working group is developing a best practices manual for forensic archaeology, and FASE offers certification of forensic anthropologists in Europe as of 2014 [15,23,36]. Internationally, accreditation of forensic anthropologists started as early as 1977 in the US, and 'Scene detection and processing guidelines' are provided by the Scientific Working Group for Forensic Anthropology, while a certification program for forensic archaeologists is in place in Latin America [36]. The work and education provided by these organizations can be used to guide future development of best practices in Sweden, as well as provide accreditation systems for practitioners. Additionally, the Swedish network ForArk can hopefully work as a link between both national and international interests and advance the exchange and continuous development of knowledge and network between law enforcement and universities. While academic education in FAA has not been the focus of this paper, it is a paramount aspect for the future advancement of the discipline(s) in Sweden.

Based on the results of this study combined with previous research from other countries, a few individuals with a specialized professional background in FAA would ideally work continuously with the national development of the subject(s) in order to become a natural part of forensic teams, drive FAA development work, implement new knowledge, and aid in professional training. The work would preferably include both research and case work. The findings of the study indicate that FAA competences can be beneficial in several areas of forensic work such as CSI, analysis of skeletal material at Physical Traces (at NFC), forensic anthropology at the NBFM, and complement existing national DVI specializations. Several interviewees acknowledged a current increased interest in FAA in their workplaces and were positive about future developments in their respective professions.

## 5. Conclusion

Swedish outdoor and fire crime scene investigations of fragmentary, skeletal, or concealed human remains are not standardized in terms of investigation as well as analysis of remains. Regional differences are evident, and the national CSI education does not address FAA<sup>6</sup>. A great responsibility is placed on the individual crime scene investigator in

choosing the best method for the investigation of these sites, and subsequently deciding the consulting party for the analysis of human skeletal remains. This creates a situation where the quality of investigations of outdoor crime scenes with human remains are not standardized and can vary greatly. This study demonstrates that investigations of buried or fragmentary or buried human remains in Sweden could be aided by a development of FAA.

Based on the results of interviews and previous research, the author argues that key steps to further development of forensic archaeology and forensic anthropology within the police and NBFM in Sweden are to 1) identify the quantity and type of cases that could benefit from FAA; 2) establish FAA as an independent subject within the police and at the NBFM; 3) develop a national infrastructure that can provide similar competences nationally, with minimum requirements, experience and accreditation for FAA practitioners; 4) offer professional education in the subject(s); and 5) develop national standards and best practices for outdoor CSI and FAA in order to advance evidence collection and legal security in cases of fragmentary human remains investigations.

In order to argue for FAA competence to be sanctioned by the police in greater extents, FAA practitioners must demonstrate that FAA is a holistic framework that can benefit and advance various investigations. A sustainable FAA infrastructure is expected to feed new knowledge back into CSI and DVI work, and hopefully create a large enough workload to sustain FAA competence within the police authority and the NBFM on a permanent basis. This would enable archaeological and osteoarchaeological professionals to develop into forensic professionals in a way that an 'ad-hoc' FAA system would not.

In terms of postmortem analyses, a working title in forensic anthropology would ideally be created at the NBFM to complement forensic pathologists and odontologists. Given that contextual information is important, forensic anthropologists with archaeological knowledge and experience should ideally be called to the scene of investigations in order to collect as much evidence and information as possible. This is expected to enhance knowledge of site formation processes, interpretations of what has occurred at the scene, as well as expedite feedback on police investigations and inform subsequent laboratory analyses.

The ongoing accreditation of crime scene investigations will likely benefit the development of FAA within the Swedish law enforcement and the Swedish police, and according to these results, indicates their openness for collaborations and development of FAA. This suggests a promising outlook for the future advancement of FAA in Sweden.

## Declaration of Competing Interest

No conflict of interest has been identified.

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<sup>6</sup> One-day basic orientation in FAA is now planned to be included in future CSI education.

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