18 The Role of Forensic Archaeology in Missing Persons Investigations

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18.1 Introduction

Forensic archaeology can be defined as a subfield of forensic anthropology or archaeology that uses archaeological methods and theory to answer legal questions (Connor, 2007; Dirkmaat, 2012a, 2012b; Dirkmaat & Adovasio, 1997; Haglund, 2001; Hunter, Simpson, & Sturdy Colls, 2013). Often these questions relate to deceased individuals recovered from outdoor scenes or fire scenes, but forensic archaeologists can also assist in the recovery of various types of buried or concealed evidence, such as clothing, tools, drugs, money, and weapons. In the USA, the discipline of anthropology is rooted in a four-field tradition that includes archaeology, as well as sociocultural, linguistic, and physical (biological) anthropology. Although forensic anthropology in the USA focuses primarily on physical anthropology (especially human skeletal biology), it typically also includes education and training in both archaeological method and theory. Thus, many forensic anthropologists in the USA have significant experience in forensic archaeological methods and techniques, especially as applied to outdoor scenes and fire scenes (Cabo & Dirkmaat, 2015; Dirkmaat, 2002). This contrasts with education and training in the UK, where forensic archaeology and forensic anthropology are two distinct fields; the former is a more specialized subfield of archaeology, focused on search and recovery of buried or concealed remains, while the latter involves the analysis of human skeletal remains. Thus, forensic archaeologists trained in the UK may have substantial experience in multiple areas of archaeology and related disciplines (e.g., geophysics), and they may also be cross-trained in both forensic archaeology and forensic anthropology (Cabo & Dirkmaat, 2015). Groen, Márquez-Grant, and Janaway's (2015) recent edited volume compares and contrasts the practice of forensic archaeology in a global context, and the interested reader should refer to this comprehensive volume for more information on the variations in education and training in forensic archaeology.

Regardless of education, training, and expertise, the value of forensic archaeology as a professional field of study has been clearly recognized over the past three decades. There is now a burgeoning literature, an increase in the

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number of programs offering advanced degrees focused in this area, and a rise in the global involvement of forensic archaeologists in assisting local jurisdictions with domestic casework, international and nongovernmental organizations in larger-scale humanitarian projects (such as the investigation of genocide and recovery of war dead from current and past conflicts), and both domestic and international agencies in mass fatality incidents (Cabo & Dirkmaat, 2015; Groen et al., 2015; Hunter et al., 2013).

Forensic archaeology emerged from a need for proper methods and techniques to search for, locate, document, excavate, and interpret human remains following a number of high-profile missing persons cases where victims were buried in clandestine graves (e.g., the Moors murders and Fred and Rosemary West murders in the UK and the John Wayne Gacy murders and the Branch Davidian Compound excavation in the USA; Dirkmaat, Cabo, Ousley, & Symes, 2008; Cabo & Dirkmaat, 2015). While crime scene methods were well established and rigorous for processing indoor scenes, there was little awareness that detailed protocols also existed that dealt specifically with outdoor scenes, particularly those involving an extended period of time between death and discovery of the remains (Dirkmaat, 2012a). Forensic archaeological methods and techniques involve a holistic approach to both outdoor and fire scenes and are ideally suited for the search, location, and recovery of human remains and evidence. Forensic archaeologists are well versed in understanding the role of the physical and biological environment on the preservation of surface-scattered, buried, and burned remains, and this taphonomic focus is crucial in the reconstruction of the sequence of events at a death scene. Specific details about the method of disposal of a corpse, differentiation of primary versus secondary graves or disturbed grave sites, and the relationship between human remains and associated forensic evidence can be revealed through careful and systemic forensic archaeological methods. Rather than treating a death scene as disturbed and lacking meaningful context, forensic archaeologists focus on reconstructing all processes that occurred from the time of deposition of a corpse to the time of its recovery (Sorg & Haglund, 2002). Therefore, forensic archaeological methods provide the best means for locating and carefully excavating human remains related to missing persons cases.

This chapter outlines the key stages involved in the search, location, and recovery of human remains from medico-legal contexts. Although we review well-known traditional methods, we also discuss more recent advances in forensic archaeology that will be of interest to investigators who work missing persons cases, especially with regard to domestic forensic cases. A more detailed discussion of method, theory, practice, and techniques in forensic archaeology can be found in a number of recent textbooks (e.g., Connor, 2007; Cox, Flavel, Hanson, Laver, & Wessling, 2008; Dupras, Schultz, Wheeler, & Williams, 2006; Fibiger & Ubelaker, 2016; Hunter et al., 2013).

18.2 Planning Stage

18.2.1 Law Enforcement Investigation

Domestic forensic cases typically begin with the investigative work of law enforcement personnel. Both the direction and the methods used in an investigation will shape how search and recovery efforts are approached. In addition, the success of a search and recovery effort often relies heavily on the quality of the pre-search investigation conducted by law enforcement in conjunction with a variety of forensic specialists. Gathering available witness statements, conducting record searches, and the acquisition of appropriate resources are all integral parts of the preliminary investigation (Connor, 2007).

18.2.1.1 Witness Statements

When available, some of the most important pieces of information collected prior to a search are witness statements. Information gathered from individuals who have knowledge of, or who played a role in, the crime being investigated can provide details on both the context of the crime in question and ultimately the disposal of the body. Witness statements may aid a missing persons investigation by providing the following information: the identity of the victim, potential trauma to the remains prior to or around the time of death, the location of the decedent, information related to the location and method of body disposal, and subsequent tampering of the crime scene. When this information is not readily available (because these questions have not been asked), forensic archaeologists should consider asking law enforcement to re-interview witnesses if possible.

Witness statements also can aid in defining the approach to be taken by both law enforcement and forensic professionals (Hunter et al., 2013). As discussed later, all recoveries include planning and preparation of both the equipment and personnel needed for the investigation. Information gleaned from individuals familiar with the context help establish the approach to a scene and the safety considerations for the team. For example, if information from a witness indicates that the body was deposited in a shallow grave, the recovery approach will probably call for the use of hand tools (such as trowels or shovels) in order to minimize the potential for causing postmortem damage to the remains. By contrast, if witness information suggests a deep burial, heavy machinery operated under careful supervision of a forensic archaeologist may be required.

18.2.1.2 Record Searches/Desk-Based Assessments

Record searches are often used to gain information about the location of a proposed search as part of desk-based assessments. Property histories, maps, aerial photographs, and satellite imagery of the general location can help narrow the search area. This information helps define the characteristics of the search area that would have been navigated by perpetrators. It can also help investigators note changes to the property that occurred between the time that the crime occurred and the search for human remains. Alterations to the landscape include new structures, disturbed areas of ground soil, plant growth, and standing or flowing water patterns.

As an example, a search in Seaside, California, in 2010 relied heavily on record searches of the surrounding area to establish a connection between areas of interest to search teams and areas known to the suspect. The search was part of an ongoing cold case investigation into a suspected 1980 disappearance of a teenage girl from the local area. The 2010 search area involved a hillside with significant vegetation overgrowth. Record searches in this case helped establish a timeline for changes to the landscape over time. The search area was located in the vicinity of the Fort Ord Military Base (Fig. 18.1). While the military base was officially closed in 1994, the suspect had a known association with the base in 1980 when it was still in operation and a connection to the hillside in question. Records showed that an elementary school, in operation from 1998 to 2001, had been constructed south of the hillside, while a new housing development was added to the north. Both changes affected the search area. For example, the original military barracks were demolished and were replaced by a residential neighborhood a year prior to the search. In addition, aerial photographs indicated changes to the hillside due to a previous search of the area conducted in 2008. This previous search involved extensive digging with heavy machinery. The information gleaned from the records search helped to define the search area based on the original 1980 landscape as well as disturbances that could be attributed to other subsequent activities in the area. Despite a thorough and systematic search, no human remains were located. Further investigation into the case suggested that the missing girl may have actually been a runaway and may be alive and well living in another state.

Geology maps, historic and current photographs, and other geotechnical records may also assist in determining how landscapes have changed over time, whether or not it was possible for a perpetrator to have dug a grave in a particular area, whether areas would have been in the line of sight of or concealed from surrounding properties and public spaces, and whether known archaeological sites of historic importance exist within a search area. By building up a detailed

Fig. 18.1 Aerial photograph showing the general search area (*red oval*) near Seaside, California. The structure below the red oval was a school in operation between 1998 and 2001 that was built on land previously belonging to the Fort Ord Base. The houses directly above the red oval represent a new housing development in the location of what was once base housing. (Copyright: Google Maps)

profile of a landscape (be it large, e.g., a moorland, or small, e.g., a backyard), it will be possible to prioritize search areas according to the likelihood that a burial could have occurred in given locations within it. In the UK, forensic archaeologists commonly use a traffic light system (RAG system) to categorize zones within a search area, with red being the highest priority and green being the lowest, based on a number of variables derived from record searches and police intelligence (Donnelly & Harrison, 2013).

18.2.1.3 Resources

One of the final stages of preparation prior to in-field investigation and/or recovery efforts is the identification of the resources that will be needed in the field, including both personnel and equipment. The search for and recovery of human remains are often complicated aspects of the investigative process. While establishing the context for the search is the responsibility of law enforcement, the actual recovery of surface or buried remains usually requires help from outside resources such as volunteer search and recovery teams, forensic archaeologists and anthropologists, forensic entomologists, remote sensing experts, and heavy equipment operators (Connor, 2007). When consulted, expert consultants will usually aid law enforcement in establishing a pre-excavation equipment checklist as well as addressing safety concerns (see Sect. 18.2.3 below).

18.2.2 Notes, Photography, and Mapping

An important component of any forensic archaeological investigation is consideration of the methods employed to document the scene.

The archaeological recovery of human remains, whether they are found on the surface or buried, is inherently a destructive process that cannot be undone; once a scene is processed, it is forever altered from its original state. Thus, it is key that all stages of the recovery effort are carefully documented. Likewise, it is important to thoroughly document search processes so that a complete and accurate record of any discoveries, as well as any areas that can be eliminated after being searched, is created.

Three commonly used methods for scene documentation include note-taking, photography, and mapping. Before any search begins, investigators need to establish a plan of action for who will be responsible for documentation and how it will be handled throughout the search and recovery effort. Note-taking is used to document scene characteristics, personnel present on scene, a time-log of the activities, the methods employed, and a catalog of evidence discovered during the process. Photography is used to document the overall scene, the search and excavation process, and any human remains or evidentiary items found during the search. Increasingly, 360° photography or videography is being used to capture more detailed scene images, and these are particularly valuable for the Electronic Presentation of Evidence (EPE) in court. Scene measurements and mapping allow investigators to associate physical landmarks near the scene to the recovered human remains and evidence. While measurements using meter tapes represent the most traditional method for scene mapping, the application of digital surveying equipment has allowed forensic archaeologists to increase the accuracy of scene measurements. These tools include total stations, handheld/differential kinematic GPS units, and other remote sensing equipment such as terrestrial and airborne LiDAR. Combined with applications such as GIS (geographic information systems) that allow the data to be associated with topographic and aerial maps, the result is an accurate visual representation of the scene. Figure 18.2 shows an example of a surface scatter of human remains from a riverine environment. The spatial location of each skeletal element was recorded using a handheld GPS unit (accuracy within 10 cm), and all data were plotted on a topographic map using GIS.

18.2.3 Personnel and Equipment

18.2.3.1 Site Safety

Every scene or search area presents varying types of safety concerns for search personnel. These concerns can include the physical environment; weather conditions; excavation equipment; chemical or biological hazards; hazardous plants, animals, and insects; and any physical or health limitations of individual team members. Addressing the potential hazards associated with a search for human remains is a necessary part of pre-search and pre-recovery planning (Anderson et al., 2008). While each agency or organization involved in a search may have different standard operating procedures regarding health and safety, all are responsible for ensuring that search personnel are briefed on likely hazards prior to the actual search and recovery operation. Release of liability forms as well as medical information forms is typically required of all participating in a scene investigation. Preparation for a field operation also includes making sure necessary personal protective equipment (PPE) is available and a plan of action is in place for emergency medical assistance.

18.2.3.2 Team Roles

While archaeological projects usually span months to years, forensic archaeology scenes are processed within a much more limited timeframe. To fit within the investigative parameters associated with the legal system, the methods employed by forensic archaeologists and anthropologists balance thorough documentation of a scene with expedient evidence collection. As such, assigning roles and responsibilities to each team member prior to the actual search and recovery effort is an important component of the planning stage. Ideally, each team member is equally capable of all typical search and recovery tasks. The ability to rotate certain tasks between group members

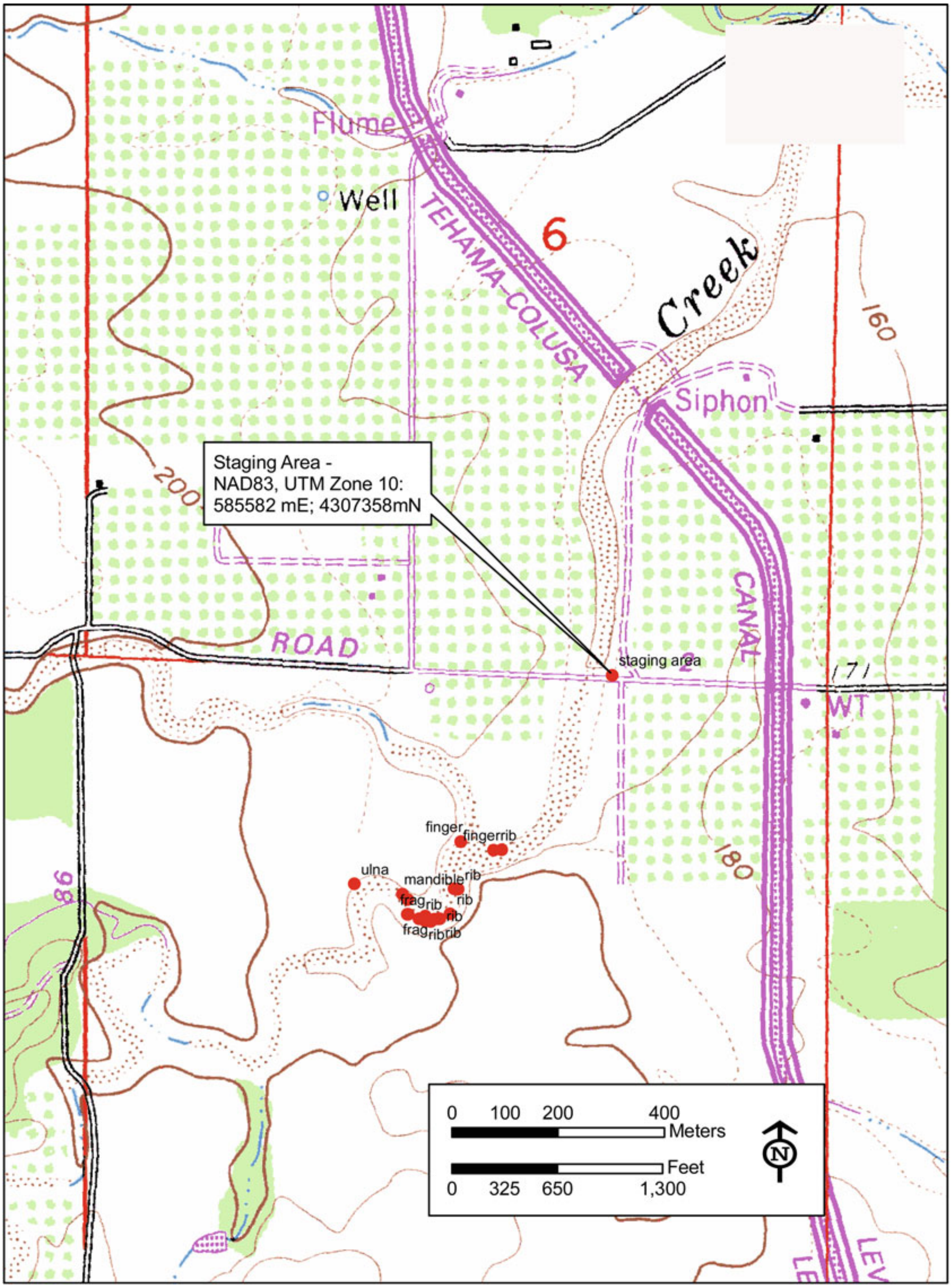

Fig. 18.2 Topographic map showing GIS data of the location of individual human bones recovered (*red dots*) from a seasonal creek in Yolo County, California (accurate to 10 cm). The bones in this case were transported through fluvial activity. (Map created by Kevin Dalton)

helps combat team fatigue, especially on operations that last several hours or days. Typical tasks associated with forensic archaeology efforts include note-taking, photography, excavation, sifting, collection of evidence, and mapping (Dupras et al., 2006).

18.2.3.3 Equipment

The equipment needed for the recovery of human remains will vary from scene to scene. If, for example, the operation involves the excavation of a deep clandestine grave, heavy machinery (such as a backhoe) might be needed for the initial stages (Ceker & Stevens, 2015). Coordination between all agencies involved in a search and recovery effort helps ensure that all necessary equipment is available. It also ensures that the investigation is not limited or compromised because of missing equipment. Common equipment needed at the outdoor forensic scene includes tools used during the search for remains (e.g., probes, pin flags, flagging tape, compass), tools used for excavation and evidence collection (e.g., trowels, shovels, brushes, screens, a range of packaging materials, etc.), and tools used for scene documentation (e.g., compass, line level, measuring tapes, cameras, etc.) (Christensen, Passalacqua, & Bartelink, 2014; Connor, 2007; Cox et al., 2008; Dupras et al., 2006).

18.3 Search and Location

In some missing persons investigations, law enforcement will be in possession of concrete information which suggests that an individual is deceased and that their remains and/or associated evidence have been buried or hidden. In others, burial or deposition through other means will only be suspected. Information about the exact location of the deposition site may be equally varied: sometimes a precise location will be known, but, often, large areas will need to be searched. A known offender may be in custody or, in longer-term cases, may have been charged or convicted. Alternatively, law enforcement may have no suspects and/or may be relying on the successful location of a body in order to provide links between the victim and the offender. Some cases with which forensic archaeologists may become involved will relate to crimes that occurred relatively recently. Others will have a considerable time window between deposition and search. Therefore, forensic archaeologists may find themselves in a wide variety of case scenarios, all of which will require a unique search strategy.

As a general rule, search strategies should be designed so as to provide the best chance of locating human remains and any associated evidence. Forensic archaeologists should be involved in the search process as soon as possible when buried, scattered, or burned remains are suspected, and they should work closely with law enforcement personnel to decide upon the most appropriate methodology moving forward. In the authors' experience, all too often, forensic archaeologists are only consulted once remains have been found or after search areas have been cleared. This is often due to the misconception that forensic archaeologists are only specialists in excavation and recovery. As demonstrated throughout this chapter, this is not the case, and their involvement during the early stages of search will almost certainly allow investigations to be more focused.

18.3.1 Defining Scene Parameters

One of the most challenging aspects of processing outdoor scenes is determining the actual boundaries of the scene. For an intact body located on the surface or a buried body whose location is known, the scene may be circumscribed to a small area. However, in instances where remains have been scattered or disturbed from their original context due to animal scavenging or natural forces (such as moving water), the boundaries of the scene become less obvious. In cases where little in the way of specific intelligence has been provided by law enforcement agencies, it may be extremely difficult to define search boundaries, and multiple scenes may become the focus of search. In many outdoor scenes, clothing, trash, and other types of material remains may be present, yet their connection to the death scene may be unknown. Although complete collection of all *possible* evidence would seem to be ideal, this may result in a tremendous backlog for the lab analysts who are required to process items unlikely to have evidentiary value. Thus, the forensic archaeologist working in conjunction with investigators and other forensic specialists must decide what to include and exclude as potential evidence *at the scene*.

Forensic archaeologists are keen to pay attention to differential states of preservation of potential evidentiary items, as well as assessing the context of possible evidence in relation to human remains. This information will aid in determining what items are likely to be of forensic significance versus items that are unlikely to be associated with the scene. For many outdoor scenes (e.g., surface scatters, buried bodies, fire scenes), it is advisable to treat a larger area as the recovery scene instead of only the immediate area where remains are discovered as remains and associated physical evidence and personal effects may have shifted from their primary depositional context. It is important to be flexible during the recovery phase as remains and associated evidence may be found outside the bounds of the original scene parameters. Expanding the scene beyond its initial parameters is a relatively easy way to deal with the discovery of new evidence. If scenes are eliminated as body deposition sites during the search process (as is often the case in large-scale or ambiguous locations or in cases where witnesses have failed to provide detailed/concrete information), forensic archaeologists must provide a detailed rationale for expanding original search areas. In the UK, such decisions are made in conjunction with a POLSA (police search advisor), crime scene manager, and senior investigating officer (SIO). Once the scene parameters have been determined, it is important for law enforcement personnel to ensure the security and integrity of the scene.

18.3.1.1 Survey and Search Patterns

An initial walkthrough may be necessary to assist with defining search boundaries. This process is in effect a reconnaissance visit, during which the ground cover, natural and human-made boundaries and obstacles, the presence of surface evidence, and other factors that may impact the search are evaluated. It is vitally important that this process is documented using contemporaneous notes and photographs and that care is taken not to disturb any evidence that might be present. Once the search parameters have been defined, all searches should include a systematic walkover survey to identify and record the presence of surface evidence. A line search, where one or several people walk in equidistant transects across the search area, or a grid search, where two or more people walk in overlapping, equidistant transects to form a grid, is strongly advised (Dupras et al., 2006). Any evidence or potential indicators that are observed during this search process should be clearly marked, e.g., with a flag or other scene marker, and then recorded manually and/or digitally, e.g., using a Total Station or GPS (see Sect. 18.4.3) to create a detailed plan of the scene. A detailed search log should be maintained throughout to document observations and recommendations. Photographs (using appropriate scales) must be taken of each feature, and any evidence should be seized in collaboration with the relevant crime scene personnel. The procedures for doing so are described in Sect. 18.4.5 and in 18.5.3 in relation to scattered human remains.

18.3.1.2 Taphonomic Markers and Microbiological Change

In cases involving burial, the disturbance caused by the excavation of a grave will have a number of effects on the landscape that should be detectable during scene searches. These indicators, known as taphonomic markers, take many forms, and some or all of them may be visible depending on the time since deposition, the condition of the remains, the nature of the burial environment (e.g., its geology and vegetation cover), local weather conditions, land use, and attempts by the perpetrator to disguise the grave (Hochrein, 2002; Hunter et al., 2013).

18.3.1.3 Visibility of a Grave

Digging a grave will loosen and aerate the soil meaning that, when it is reinterred following the deposition of human remains, it will present a different visual and geophysical signature than the surrounding soil. Since the soil will rarely fit back into the grave in its entirety, in the early stages of an investigation, soil mounds may indicate the presence of a deposition site. As the soil settles in the grave (known as sedimentation) and the body decomposes, a visible depression may instead appear. The disturbance caused by digging a grave will also affect the vegetation directly above it. First, the vegetation and turf that must be removed in order for the offender to access the soil below will rarely be placed back over the grave without looking out of place, although this does depend on the nature of the vegetation and the precision employed by the person that replaces it. Bare earth or displaced vegetation could, therefore, be an indicator of ground disturbance, as could marks caused by the offender trampling down the grave fill. As the time since deposition increases, it may be more difficult to detect these changes because the vegetation may regrow. The species of vegetation growing over an area may also be altered by the loosening of the soil, the microbiological changes caused by decomposition of a corpse (see below), and the insertion of other materials into a grave. The growth of vegetation may be stunted in graves where a body is wrapped or where materials such as paving slabs, concrete, or corrosive chemicals were placed inside. Conversely, when an unwrapped body is buried close to the surface, the increase in nutrients may lead to increased vegetation growth. Different types of vegetation may colonize a grave at different stages of the decomposition process, and their detectability may depend on the season in which a search takes place.

18.3.1.4 The Effects of Decomposition

In the immediate period after death, putrefaction occurs, during which there is an increase in bacteria that breaks down the tissues of the body. Initially, this will cause the body to bloat and will result in the purging of bodily fluids from cavities such as the anus, groin, ears, nose, and mouth. This results in the leaching of body fluids and bacteria into the area immediately surrounding the body. If a body is within a grave, these fluids will leach through the grave sides and base, resulting in the discoloration and modification of the soil pH, moisture content, and levels of nitrogen, phosphorus, and volatile fatty acids present in the surrounding soil (Carter, Yellowlees, & Tibbett, 2007; Tibbet & Carter, 2008). This cadaver decomposition island (CDI) may be visible when the topsoil is removed during excavation, or, in some cases, it may be visible on the surface as leachate permeates the ground surface. Most often, leaching will result in visible changes to the vegetation above the grave, as the balance of microorganisms in the soil is altered. Alternatively, the decomposition process may attract insects and animals—the former may colonize the grave and its immediate environs, while the latter may bring remains to the surface—and this too may act as a useful indicator during searches. Where remains are on the surface to begin with, the leaching is even more likely to produce a visible CDI. Being above ground, the CDI will also likely attract animals and insects to the body. Soil analysis to determine the presence of volatile fatty acids has proven effective in cases where a burial is suspected but where a body has been removed, e.g., where there is a primary and secondary grave site or in cases involving scavenging. Techniques such as gas chromatography mass spectrometry (GCMS) can detect the presence of biomarkers in the soil, even when the body itself has long since been removed (Larizza & Forbes, 2013). As well as acting as a useful indicator during search, research has shown that CDIs may also be useful in estimating the postmortem interval (PMI) because of the presence of these biomarkers (Benninger, Carter, & Forbes, 2008).

The heat produced during decomposition may also be detectable using thermal imaging. If the period between burial and search is known to be a matter of days or weeks, thermal imaging (usually mounted from an aircraft) may present an optimal method to search large areas of terrain (Hunter et al., 2013). This can be coupled with aerial photography in order to observe visible changes to vegetation growth or visibly disturbed ground from the air. These methods are particularly useful when large areas need to be searched, and they have the added advantage that they can be undertaken covertly.

18.3.1.5 Recording Taphonomic Markers

If taphonomic markers are observed during scene searches, they should be photographed, and their positions (in relation to other markers, search boundaries and pertinent landscape features) should be recorded manually or digitally (Sect. 18.4.3). An accompanying search log should document the key characteristics of the markers, including their size, appearance, and orientation. The presence of taphonomic markers and other surface evidence may allow the search boundaries to be redefined and greater or lesser priority placed upon particular areas. Such recommendations should be discussed with law enforcement personnel and thoroughly documented in the search log.

18.3.1.6 Winthropping and Burial Scenario Profiling

When concealing human remains, offenders will be consciously or unconsciously guided by, or make use of, natural and man-made landscape features. For example, topography, ground cover, and geology may influence an offender's ability to conceal a body in particular locations or facilitate an easier means of doing so. Offenders do not plan on getting caught, and, therefore, they will often select burial sites that they believe will reduce the chance of detection. This means that burial sites are usually concealed from view and passing traffic (foot and vehicle). Therefore, generally speaking, it is far more likely that a grave will exist close to a hedge line of a field than in its center. Pathways or clearings might provide easier access to an area, and, at mixed-use sites, certain activities might preclude access. Walkover surveys should involve an assessment of these factors (known as 'winthropping'), and forensic archaeologists should consider other influences such as the offender's age, build, physical fitness, and access to a vehicle/machinery when identifying the likelihood that a burial could have taken place in a specific location.

The presence of large trees, rocky outcrops, or other distinctive elements may present an offender with an opportunity to use the landscape as a means of marking a scene so they can return to it later. The way in which this occurs will be influenced by factors such as whether a crime has been preplanned and whether an offender intends to return to the scene. In a well-known case in the UK, offenders Ian Brady and Myra Hindley buried the bodies of their victims in front of prominent rock formations and photographed themselves at these locations in order to provide both physical markers and "keepsakes" of their crimes. Forensic investigators subsequently used these photographs as part of searches in the 1960s, 1980s, and 2000s in an attempt to find their victims (Hunter et al., 2013, p. 28; Staff, 2013). Therefore, forensic archaeologists should evaluate whether markers may exist (drawing upon police intelligence) and undertake a search for these as part of walkover surveys. Any potential markers should be recorded in the same way as taphonomic markers, as outlined in Sect. 18.3.1.5 above.

18.3.2 Geophysical Methods

In order to narrow down a search area further, it may be appropriate to utilize geophysical techniques. Forensic archaeologists may be cross-trained in these methods, or they may suggest the deployment of a forensic geophysicist with whom they will work closely. Geophysical survey techniques offer the opportunity to detect the subsurface "anomalies" caused by the excavation and backfilling of a grave (Cheetham, 2005). The aeration of the soil, the creation of a grave cut, and the deposition of a body and other materials within the grave will all potentially exhibit a geophysical signature. While no geophysical technique will detect a body per se, trained operators are able to interpret these anomalies and prioritize them for further investigation based on comparison with intelligence and the results of desk-based research and walkover surveys.

Each method should be carried out in a grid pattern in order to ensure systematic coverage of a chosen search area (Conyers, 2013). A range of geophysical techniques exist, all of which detect different properties and further allow search areas to be examined without disturbing the ground.

Ground Penetrating Radar (GPR): This technique emits electromagnetic pulses and detects the speed and strength of their return. Using a range of different antennas, it is possible for GPR to penetrate both shallow depths and several meters deep. Two- and three-dimensional profiles provide a detailed record of buried remains and allow anomalies to be measured and characterized. Real-time data collection and its ability to penetrate through a wide range of surface and buried material, including concrete, make this technique suitable for an equally diverse set of terrain types and for rapid survey. Its main limitations lie with the need for a relatively flat survey area, devoid of obstructive vegetation, and the large amounts of post-processing required for interpretation and data presentation (Conyers, 2013).

Resistance Survey/Resistivity: By emitting an electric current into the ground and measuring the amount of resistance to it, this technique is capable of detecting shallow subsurface remains. As a general rule, solid features such as walls will exhibit high resistance, while loose, aerated features such as pits or ditches will exhibit low resistance. A grave may exhibit both high and low resistance, owing to the presence of a body mass and the aeration of the soil caused when excavating it, which can sometimes make interpretation difficult. Likewise, this method cannot penetrate through concrete or other solid surfaces, and it is only capable of penetrating shallow depths. A standard twin-probe array will, for example, rarely survey to a depth of more than 1 m. However, resistance survey represents a rapid way to detect shallow subsurface features, and the data it generates requires less processing than GPR. This makes it a valuable tool in forensic searches where a rapid assessment of a landscape is required (Watters & Hunter, 2005).

Magnetometry: When a grave is excavated or when remains are burned, a permanent change occurs in the earth's magnetic field. This contrast between the magnetic properties of buried remains and the surrounding subsoil may be detectable using a magnetometer or gradiometer. Likewise, metal objects or any other buried remains exhibiting magnetic properties are detectable using this technique. Unlike GPR, magnetometry can only detect shallow subsurface remains. It also requires an open survey area, devoid of any surrounding metal, and the operator must also refrain from introducing metal "interference" on their clothes or belongings (Cheetham, 2005). Therefore, magnetometry is rarely recommended in the search for clandestine burials, as there is almost always surrounding metal, except in the most remote of locations.

Because each of these techniques detects different properties, the use of multiple, complementary methods should be considered. This will of course be dependent upon time and budgetary restrictions. It is also important to bear in mind that the police will be bound to investigate each "anomaly" identified in the course of geophysical surveys in order to eliminate a search area. That said, this often still remains a more expedient and efficient option than excavating large areas, and so geophysical survey should at least be considered as a precursor to excavation in the context of the specific requirements and circumstances of each investigation.

18.3.3 Cadaver Dogs

In cases where specific grave locations are unknown, cadaver dogs may offer an effective search solution. Cadaver dogs are specifically trained to recognize and respond to the presence of human remains. Although it is not known exactly what cadaver dogs detect, they are trained to distinguish between human remains and those of animals (Rebmann et al., 2000). Once a search area has been identified, cadaver dog handlers will vent the ground and facilitate a systematic examination of the scene. Dogs will usually indicate the presence of remains by providing an indicator such as barking, sitting down, pawing at the ground, or placing their nose firmly into the handler's vent holes. Exactly which indicator is provided depends upon their training. A detailed overview of the use of cadaver dogs in missing persons investigations is provided in Chap. 19, and the reader is referred to this for a more detailed discussion of the operational capabilities of cadaver dogs. In the context of this discussion, it is important to highlight that cadaver dog handlers and forensic archaeologists should work together in order to target specific locations of interest. Once cadaver dogs have positively indicated the presence of remains, forensic archaeologists can subsequently examine and/or excavate each area in turn to confirm whether human remains are in fact present.

18.3.4 Low-Tech Methods

18.3.4.1 Probing

A traditional method often used in the search of clandestine graves in the USA is the use of a metal or fiberglass soil probe (Morse, Duncan, & Stoutamire, 1983). The tool used as an archaeological probe is usually a thin T-shaped metal bar, measuring approximately 1.2 m in length. Probes tend to be lightweight with a pointed tip and can be insulated to protect against electrical currents. Probes are used to detect differences in soil compaction and will move more easily through subsurface material that has been previously disturbed due to soil mixing (Connor, 2007). While probes provide an efficient method to quickly identify potential burial sites, they also may induce postmortem damage to buried remains in the process. Proper employment of the probe is dependent on training and experience. Most often, the probe is slowly forced through layers of soil to test for resistance and depth of disturbances (Fig. 18.3). Typically, within a given search area, the probe will systematically be inserted at regular intervals along a search pattern or grid to find areas of interest or to define the edges of a known burial site. However, the use of soil probes is discouraged in some other countries, such as the UK.

Fig. 18.3 The employment of a soil probe to define grave boundaries within a historic cemetery. (Copyright: Colleen Milligan)

18.3.4.2 Test Pits and Trenches

Test pits and trenches are often employed to gain information about areas of soil disturbance, the presence or absence of human remains, and the dimensions of a grave pit. Test pits and trenches are usually standardized in regard to size and the interval between pits or trenches and can be excavated with various types of equipment (Fig. 18.4). Both hand tools and heavy equipment may be

Fig. 18.4 Forensic recovery team employs both test pits (*red circles*) and trenching (*red arrow*) in the search for a burial site near Redding, California. (Copyright: Human Identification Laboratory, CSU, Chico)

employed depending on the area in question and the suspected depth of human remains or potential evidence. Test pits are generally excavated with hand tools at regular intervals to gain information about subsurface soil characteristics and the presence or concentration of potential items of interest. Likewise, trenching is often employed to gain information about characteristics of a site or to determine the extent of an area of soil disturbance, such as a grave outline. While trenches can be created using hand tools, it is also common to use heavy machinery, such as a backhoe with a straight-edged bucket, to quickly establish a deeper soil profile. A commonly used method in the UK is half-sectioning, which involves excavating half a potential feature in order to define its edges, likely orientation and contents. This has the advantage of minimizing the disturbance of a feature until its nature, and more importantly the nature of the material buried within it, has been ascertained. Excavation of the second half of the feature will usually proceed after the first half has been fully excavated, in order to eliminate the entire feature as a clandestine burial location or in order to recover the evidence that exists within it. If human remains are present, the excavation of both halves will cease until permission has been granted by a pathologist to continue (Powers & Sibun, 2014; Sect. 18.6).

18.4 Excavating the Scene

The processing of an outdoor forensic scene or fire scene is a multistage process that should proceed in a systematic, controlled manner. This involves following proper excavation methods; screening grave fill; mapping remains, features, and associated physical evidence; scene documentation (e.g., notes, photographs, and scene measurements); evidence collection; and maintaining chain of custody.

18.4.1 Excavation Techniques

Once located, it is important to photograph the scene extensively prior to disturbing the area. Note-taking should be used to document each stage of the excavation, including the different roles of each team member. Once the scene has been documented, the surface around the burial site should be carefully denuded of any vegetation using shovels and trowels. This vegetation and soil should be placed into buckets to screen for possible evidence, personal effects, or human remains. For buried bodies, trowels should be used to scrape the soil to reveal the demarcation between the undisturbed soil and the grave fill. Where multiple layers exist within the grave, each should be documented and given a unique identifier. Once the grave outline is defined, carefully troweling along with the use of small, handheld whisk brooms can be used to make the outline more visible. The outline should be photographed, measured, and recorded in notes before further excavation ensues. A baseline or grid system should then be established to map the human remains, evidence, and personal effects associated with the scene (Sect. 18.4.3). Excavation should proceed in a controlled manner, with the grave fill soil being removed with small hand tools, such as trowels, plastic scoopers, brushes, wooden tools, and dust pans. All soil should be placed in buckets labeled with information regarding the location within the grave. It is preferable to document evidence, personal effects, and human remains in situ; however, it is not uncommon for items to be discovered during the screening process (Dupras et al., 2006). Care should be taken to only remove the loose grave fill and to not destroy the grave wall features. Tool marks created from the digging implements may be present in grave walls and on the grave floor and should be preserved for photography and measurements where possible (Christensen et al., 2014; Hochrein, 1997). In addition, insect and botanical evidence should be recorded and preserved for future analysis.

Once the remains are located, wooden or plastic tools and soft brushes should be used to expose the corpse or skeleton. Care should be given to not dislodge or remove skeletal elements from their original position if possible. Once exposed, the remains should be documented with notes, a burial sketch (to scale), photography, and measurements (Sect. 18.4.3). In the USA, the discovery of human remains is immediately reported to the scene of crime officers, who will then notify the coroner's or medical examiner's office. Although procedures vary substantially, most often the excavation will be conducted without the direct involvement of a pathologist on scene. In the UK, the discovery of human remains means that excavation must immediately cease until a Home Office Pathologist has been consulted and gives permission for forensic archaeologists to proceed with the excavation and recovery (Powers & Sibun, 2014). In almost all cases, the Home Office Pathologist will attend the scene to document and assist with the recovery of the remains. If intact, the body can be lifted by team members onto a stiff board and then transferred into a body bag. However, if the remains are skeletal, each body region should be lifted separately and placed into paper bags. Left and right hands and feet and ribs should be bagged separately. The skull should also be bagged separately to keep any small skull fragments or teeth from being lost. After the remains have been removed, the remainder of the grave fill should be removed and screened. The final clean grave should be recorded with notes, photography, and mapping, including evidence of tool marks on the grave walls or floor. A final photograph is of critical evidentiary value since it shows that the grave is completely empty.

18.4.2 Screening

All soil removed from the scene should be screened for evidence, personal effects, and remains. For most scenes a 1/8 in. screen should be used to sift the grave fill soil. However, a

1/4 in. screen may be better suited some types of thick clay soils. If possible, a nested screen design can be used where soils and other materials can be separated based on their different particle sizes. This is especially useful for locating trace evidence (hair and fibers). The screening operation should take place away at least a few meters away from the grave site to avoid dust blowing back into the excavation. It is ideal to have more than one person helping to clear each screen. A tarp should be placed underneath the screen to contain the grave fill soil. This will facilitate replacing the soil back into the grave at the end of the excavation.

18.4.3 Mapping

For mapping the scene, a primary datum should be established. This usually is a fixed landmark such as a building or large tree located near the scene. Once the datum is established, a baseline or grid system can be set up to map in human remains, evidence, and personal effects (Christensen et al., 2014; Connor, 2007; Dupras et al., 2006). The location of the primary datum should also be recorded using a GPS unit and should be mapped in relative to the baseline or grid system. A baseline should minimally consist of a string of known length tied in between two stakes and set up along the long axis of the grave (with a recorded compass measurement). A line level is affixed to the baseline to ensure that it is level. The height above the ground surface also should be recorded and later subtracted from all depth measurements. One stake can be assigned as *x* and the other as *y*. Measurements made from *x* and *y* to the item to be mapped can be made using two tape measures using trilateration (Fig. 18.5). Another string and line level should be affixed to one corner of the baseline to ensure that *x* and *y* measurements are level with the baseline. Depth measurements, *z*, are taken from the point of intersection of *x* and *y*. This information should be recorded in a survey log to ensure that spatial information regarding the recovery scene

Fig. 18.5 Grave excavation simulation showing a skeleton being mapped using trilateration. (Copyright: Human Identification Laboratory, CSU, Chico)

is preserved. Grid mapping methods provide better control and less measurement error and involve setting up a grid and using quadrants over the grave site. Stakes are placed at regular intervals, and strings with line levels are used to ensure the grid is level. This mapping is especially useful for disarticulated remains and for fire scenes where there is a greater degree of fragmentation and dispersal of remains. Other mapping methods include triangulation, azimuth mapping, or use of a theodolite. Total stations or differential GPS systems are increasingly used to record burial sites and scattered remains, since they provide the opportunity to accurately record positional data with submillimeter accuracy (see examples in Christensen et al., 2014; Dupras et al., 2006). These methods provide a digital representation of a scene and the evidence within it. In the UK, this equipment is commonly used by road traffic investigators, and so forensic archaeologists will sometimes request these specialists attend a scene to assist with recording deposition sites. Their use is dependent upon factors such as line of sight between the instrument and evidence (Total Station) and satellite reception (GPS), and neither might be a suitable substitute for manual planning methods when very small or highly commingled remains are present. Terrestrial laser scanners, commonly used in mainstream archaeology to record landscapes and objects, can also be used to capture deposition sites in three dimensions (Vosselman & Maas, 2010). This technique has not been widely used to record clandestine burials because of the costs and expertise required to collect and process the data. However, as the quality of data captured using this method continues to improve, data collection in this way offers the possibility to create a three-dimensional visualization of crime scenes, grave edges, tool mark and footwear impressions, human remains (and the evidence of trauma they exhibit), and other evidence types, preserving the scene by way of record and offering the opportunity to re-interrogate the scene long after the recovery process is complete. In relation to all the methods described above, the specific mapping method used will depend on the scene context and characteristics, the terrain, and the timeframe in which to complete the scene recovery.

18.4.4 Scene Documentation

As mentioned above, scene documentation should include extensive notes, photography of the area, scene, and recovery process and also mapping (Connor, 2007). Careful and accurate recording of the datum, baseline or grid system, and the location of human remains, personal effects, and evidence is crucial for reconstructing the crime scene and eventually for their evidentiary value in court. If these data are collected accurately, then the report should hold up to scrutiny in the courtroom. Using standardized recording forms for mapping, sketching and note-taking are critical and should be developed well in advance of the recovery. The forms should minimally include an inventory sheet for the remains and personal effects, a photography and evidence log, a survey log, and gridline paper for sketching the scene.

18.4.5 Evidence Collection

In many jurisdictions, evidence collection is conducted by law enforcement personnel. However, forensic archaeologists should be prepared to collect evidence at the scene. All evidence should be assigned a unique identification number, which should track the evidence through all stages of recovery and analysis. Evidence information may include a jurisdiction name, case number, date, and other case pertinent information. All evidence should be photographed in situ where possible, with an evidence label card, a visible scale, and a north arrow. The evidence should be mapped in relation to the baseline or grid system or using a theodolite, total station, or other digital recording techniques. The evidence log, photography log, survey log, and notes will provide the principle record of the evidence. Once everything has been recorded, the evidence item can be removed and placed into an evidence bag and sealed.

18.4.6 Chain of Custody

It is critical to maintain chain of custody of evidence throughout the entire recovery process and during transportation and storage. Evidence is typically placed in paper or plastic bags or plastic containers with an evidence label that includes the pertinent case information. Evidence should be sealed with evidence tape and should include the date and initials of the person who last handled the item. This should be done each time evidence is accessed. However, for human remains, this may be impractical and may also cause further degradation to remains. In these instances, it is best to leave the skeleton on an analysis table within a locked, secure laboratory facility where access is monitored. Once the case analysis is complete, the remains can be resealed within evidence boxes and stored in a secure evidence room until such a time that they are returned. Other evidence types, such as metal and leather, will also require alternative handling, packaging, and storage. Forensic archaeologists should be able to advise law enforcement regarding the most appropriate recovery and packaging techniques.

18.5 Recovery Scenes: Three Case Studies

18.5.1 Buried Remains

In August of 2012, the California State University, Chico Human Identification Lab (HIL) was called to assist a local county sheriff's office with the recovery of a buried body on private property in northern California. The multi-acre rural property was situated in the foothills of the Sierra Nevada Mountains and contained an illegal marijuana grow, a methamphetamine lab, and a butane hash oil lab. Prior to the search, an informant stated that an earlier homicide occurred on the property and that the body was buried on-site. A ground survey with a search and rescue team and cadaver dogs subsequently located an area of interest. The HIL team consisted of two faculty members, one staff member, and four graduate students.

A backhoe with a straight-edged bucket was used to scrape away topsoil to delineate the area of disturbance (Fig. 18.6). Once an area of interest had been defined, the backhoe was used to slowly remove approximately seven to 15 cm of soil at a time (Fig. 18.7). The grave fill consisted of clay-based soil, mixed rocks and pebbles, and scattered fragments of charcoal. At a depth of 123 cm, the backhoe uncovered the top of a quilted blanket resting on top of the decedent. The backhoe was subsequently used to expand the area surrounding the remains to facilitate a hand excavation. Once the remains were located, the rest of the excavation proceeded with small hand tools to avoid damaging the remains. The excavation exposed an intact, clothed corpse, which was buried face down in a fetal position. The body depth ranged from 123 to 148 cm. Plumbing tape was wrapped around the decedent's mouth, zip ties and handcuffs were used to restrain the arms, and the decedent's pants were pulled down around the ankles, possibly to restrict movement of the legs. A pair of shoes was found alongside the body.

All material from the pit was screened using a 1/4 in. mesh (Fig. 18.8). Once the body was photographed and mapped in situ, it was removed from the grave and placed in a body bag for transport to the local coroner's office. Following removal of the body, hand tools were used to excavate the bottom of the grave pit, which was composed of shale bedrock. The profile showed that a small backhoe had been used to create the grave in a north-south direction. The decedent's feet were located on the north-end of the grave shaft, while the head was located on the deeper south end. The bottom of the pit was 52 cm in diameter. For this 14 h excavation, personnel rotated responsibilities throughout the process. Recovery tasks included photography, note-taking, excavation, screening grave fill, use of a metal detector, and mapping. The team worked closely with the sheriff's office to document the scene, collect evidence, and maintain the chain of custody for the body and associated evidence.

The recovery process included several notable safety concerns. The first was the use of a backhoe. The use of heavy machinery was handled by a set of qualified and skilled operators, where one driver operated the controls and another worked

Fig. 18.6 Grave site with topsoil removed. The area of disturbed soil (*red circle*) is visually distinct by the difference in soil coloration with surrounding matrix (Copyright: Human Identification Laboratory, CSU, Chico)

in tandem with a recovery team member as a spotter during excavation activities. The use of spotters ensured that the backhoe did not come into contact with the remains. The second concern came with the uncovering of the blanket, which was covered by an unknown white, crystalline substance that had been poured into the grave and around the body. An informant suggested that the unknown substance could be lye. The level of personal protective equipment used for the excavation was increased to respond to the presence of this potentially hazardous material. The third concern was the depth of the excavation. The area surrounding the body was expanded and graded to allow for multiple team members to safely climb in and out of the grave shaft while excavating. The final concern was the length of time required for a successful removal of the body. Hunger, dehydration, and fatigue were monitored throughout the operation.

18.5.2 Surface-Scattered Remains

In August of 2009, the HIL team was called out to assist in the recovery of a surface scatter of human remains. The remains were located in a heavily wooded area within a dry seasonal pond. The scene was located adjacent to a homeless camp known for extensive drug activity. The recovery team consisted of a faculty member, a lab supervisor, five graduate students, and three undergraduate interns. Although the majority of the remains were located on the surface of the ground, several elements were partially buried within tiny drainage channels (5–10 cm wide) associated with the seasonal pond. Most of the extensive and thick vegetation at the scene was removed by the team with gardening shears and trowels to allow for greater visibility of the disarticulated remains (Fig. 18.9). A hand-and-knee surface survey was then conducted, and pin

Fig. 18.7 Forensic archaeology team members using hand tools to expose the grave outline. The trapezoid outline is delineated by the lighter border of undisturbed soil. (Copyright: Human Identification Laboratory, CSU, Chico)

flags were used to mark the location of each skeletal element. A small-scale hand excavation was conducted to ensure a thorough recovery of the remains. All bones were mapped in situ and photographed prior to their removal. The skeletal elements showed extensive evidence of sun bleaching, surface weathering, and carnivore scavenging damage. The recovery effort successfully located about 90 % of the skeleton, including a complete skull. Although no clothing, personal effects, or evidence was recovered from the scene, the biological profile assessment led to a missing persons case and eventually to a positive identification of the decedent.

18.5.3 Fire Scene Recovery

In June of 2013, the HIL received a request for assistance from a local county sheriff's office with the recovery of three bodies from a suspicious vehicle fire. The vehicle, fully engulfed in flames, was discovered in the foothills of the Sierra Nevada Mountains. Once the fire was extinguished by the California Department of Forestry and Fire Protection (Cal Fire), three burned bodies were discovered within the vehicle. The vehicle was subsequently moved to a sheriff's department facility to process the scene and to excavate the remains.

The responding HIL team, consisting of one faculty member and one staff member, worked in conjunction with CAL FIRE personnel, the county sheriff's office personnel, and the county forensic pathologist to document the bodies in situ prior to their removal from the vehicle. Upon removal, it was determined that two teenage males were located in the trunk of the vehicle, and one adult female was found lying across the backseat. The bodies and associated evidence were designated as Jane Doe #1, John Doe #1, and John Doe #2. No tools were used for the removal of each body. Given extensive thermal damage, identifiable bone fragments associated with the head and extremities of each decedent were collected by hand. Each body and associated fragment were placed in separate body bags and removed to the county coroner's office.

Fig. 18.8 Forensic archaeology team members sifting grave fill. Team members systematically rotated between sifting and grave excavation tasks throughout the recovery operation (Copyright: Human Identification Laboratory, CSU, Chico)

Fig. 18.9 Forensic archaeology team members removing vegetation from the scene to expose human skeletal remains located on the surface of a dry seasonal pond (Copyright: Human Identification Laboratory, CSU, Chico)

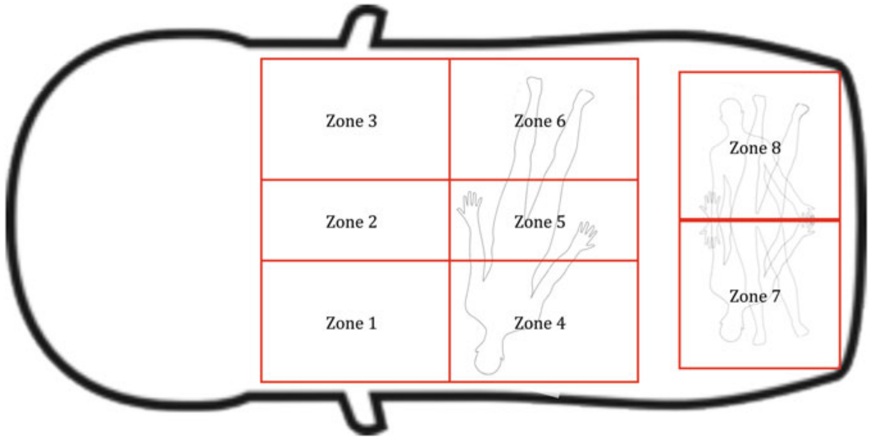

Fig. 18.10 Outline of burned car with evidence zones (*red boxes*) and the position of recovered bodies (*gray body outlines*) (Copyright: Colleen Milligan)

Following the removal of the bodies, the vehicle was moved to the county sheriff's office for evidence collection. A HIL team, consisting of one faculty member, one staff member, and one undergraduate lab intern, returned to assist in the final processing of the vehicle. The vehicle was divided into eight evidence zones for processing (Fig. 18.10). These zone distinctions were used to systematically search for bone fragments and evidence. Each zone was excavated individually using hand tools, and all collected debris was screened. The sifting process was divided into two stages with debris screened first using 1/4 in. mesh to remove large items and subsequently screened using 1/8 in. mesh to remove small items.

The safety concerns associated with a vehicle fire differ slightly from burial or surface-scattered scenes. In this case, full personal protective equipment was used given the potential of encountering hazardous materials in the burned car debris and the need to avoid cross-contamination of evidentiary zones. In any fire, the materials consumed often include wood, metals, plastics, cloth, and foam material. Masks were utilized to minimize the inhalation of both particulates and any remaining fumes. The last major safety concern was the high number of sharp edges found in the vehicle's metal frame. Only one team member at a time moved around within the vehicle to maximize the space available and avoid movements that could result in injury.

18.6 Legal Procedures

The importance of careful scene documentation is often more fully realized at the latter stages of an investigation, especially for homicide cases that end up in the courtroom. Although the actual scene recovery may not be challenged in court, forensic archaeologists should be prepared to testify as expert witnesses in regard to the methods and techniques employed during the recovery, as well as their interpretations of the scene context. Attorneys on the opposing council will try to identify errors or shortcuts in methods or documentation employed at the scene. The forensic archaeologist should be prepared to defend their use of a set of standard operating procedures and any instances where practices in a given case deviated from standard procedures. The courtroom is by its nature adversarial, and it is not uncommon for an expert witness to experience harsh questioning from the opposing council. Regardless of the circumstances, forensic archaeologists are ethically and morally bound to provide scientifically supported testimony regarding the methods and techniques utilized at a recovery scene as well as their scientific interpretations regarding the scene context. All notes, photographs, measurements, sketches, and reports may be admitted as evidence into the courtroom. In cases where the recovery and analysis of the human remains were conducted by the same person, it is important to be forthcoming with any biasing information provided to the analyst prior to assessment of the remains. The legal process can vary widely between jurisdictions within a single country and especially between different countries (Groen et al., 2015). Here we briefly review the relevant aspects of the legal process in the UK versus the USA.

18.6.1 United Kingdom

Violent or suspicious deaths in the UK are investigated jointly by the police, an appointed Home Office Pathologist, and a local HM Coroner. Forensic archaeologists may be brought in to assist as expert witnesses in cases involving buried or concealed human remains, although there is currently no legal statue which stipulates that this is an essential requirement. This is an unfortunate reality owing to the loss of evidence that will undoubtedly occur when trained specialists are not used. Forensic archaeologists in the UK are not commonly employed by police forces, although there are some police officers who do have forensic archaeological training. More often, forensic archaeologists are employed by private forensic service providers or by universities, and they are then sub-contracted as expert witnesses on a case-by-case basis. Trained forensic archaeologists can apply to become a member of the UK Forensic Archaeology Expert Panel, overseen by the Chartered Institute for Archaeologists and endorsed by the UK Home Office. Members are required to comply with the *Standards and Guidance for Forensic Archaeologists (*2014*)*, as well as national legislation and guidance signposted therein such as: the *Human Tissue Act* (2004) regarding the treatment and retention of human remains and the *Criminal Procedure and Investigations Act* 1996 and *The Disclosure Manual* (2005) regarding record-keeping, retention, and disclosure of documentation compiled during search and recovery. Forensic archaeologists are also affected by the *Police and Criminal Evidence Act* (PACE) (1984), which stipulates that police have an initial 24 h and (upon application) a maximum of 96 h to question a suspect. When bringing charges against a suspect depends upon locating human remains or other evidence associated with concealment, forensic archaeologists will find themselves under the pressure of the "PACE clock" during the search and/or recovery process.

When human remains are discovered in the course of missing persons investigations, the police and forensic archaeologists are legally bound to immediately inform a Home Office Pathologist and HM Coroner and to cease recovery efforts until advice has been sought from them. The pathologist will usually attend the scene, examine the body and associated evidence in situ, and supervise the recovery process before accompanying the body to the mortuary and undertaking the postmortem examination (Home Office, 2016). The HM Coroner will then assume responsibility for conducting an inquest, drawing upon evidence provided by law enforcement, forensic specialists (including archaeologists and anthropologists as appropriate), and the autopsy results. They are also legally responsible for releasing the body of the deceased to the family for reburial (Ministry of Justice, 2014).

18.6.2 United States

In the USA, death investigations are conducted either by a coroner's office or by a forensic pathologist (medical examiner). The coroner system in the USA traces its origin to medieval England and initially involved individuals who worked under the authority of the crown to conduct judicial matters. The modern coroner system is followed in more than half of US states, with the remainder following a regional medical examiner system. One variation of the coroner's system is the sheriff-coroner system used in California. Under the sheriff-coroner system, the sheriff (an elected official who often lacks medical training) is responsible for conducting a death investigation and can determine whether a particular case will be investigated as a potential homicide. Deaths that occur within the county or local area are then autopsied by a forensic pathologist at a local morgue. Under the medical examiner system, a forensic pathologist has the authority to determine whether an investigation (including autopsy) will occur for a given case. Deaths that occur within a certain geographic area fall within the purview of a regional medical examiner's office. Many states also use a hybrid coroner-medical examiner system for death investigation.

The fragmented nature of death investigation in the USA has resulted in a high level of variation in the qualifications of expert witnesses and in the quality of crime scene documentation. For example, three different standards are used in US courts to determine eligibility of an expert witness to testify. The earliest was the 1923 ruling, *Frye v. United States*, which argued that there must be general scientific acceptance of a method or technique for it to be admitted into court. The *Frye* ruling was followed up in 1975 by the *Federal Rules of Evidence: Rule 702*, which was enacted by US Congress. *Rule 702* expanded on the language in the *Frye* ruling, and indicated that expertise could be defined based on knowledge, skill, experience, training, or education (Christensen et al., 2014). Although this helped to clarify the qualifications of an expert witness, it left the door open for nonscientific expertise to be admitted into the courtroom. In 1993, the US Supreme Court ruled on *Daubert v. Merrell-Dow Pharmaceuticals, Inc*. Known as the *Daubert* standard, the ruling provided more specific guidelines for expert witness testimony. *Daubert* requires that the technique follows the scientific method, has been subjected to peer review, has known or potentially known error rates, has applicable professional standards, and is generally accepted by the scientific community (Christensen et al., 2014; Connor, 2007). About two-thirds of the US states have now adopted *Daubert* guidelines, and these states give judges the authority to determine whether a particular witness and their findings will be admitted into the courtroom. Regardless of which standard is followed, forensic archaeologists working within the USA should be intimately familiar with the legal system as it pertains to qualifying expert witnesses and their testimony.

18.7 Summary and Conclusions

As outlined in this chapter, forensic archaeology has emerged as a distinct field of study with a well-established suite of methods and techniques aimed at locating, excavating, mapping, and documenting human remains and associated evidence within their depositional context. Forensic archaeologists rely on both low-tech and high-tech methods in search and recovery operations and have increasingly incorporated advanced applications within geophysics and GIS as part of their standard field kits. Forensic archaeology utilizes a holistic approach to locate and recover missing persons and will continue to embrace new technologies and approaches that facilitate rapid location and recovery of victims of homicide. Investigators should utilize forensic archaeologists as well as other relevant experts in all stages of a search and recovery effort, including the planning stages. Greater reliance on the expertise of forensic archaeologists will increase the likelihood of a successful outcome in resolving missing persons cases.

References

Anderson, A., Hanson, I., Schorfield, D., Schlotz, H., Vellema, J., & Viner, M. (2008). Health and safety. In C. Margaret, A. Flavel, I. Hanson, J. Laver, & R. Wessling (Eds.), *The scientific investigation of mass graves: Towards protocols and standard operating procedures* (pp. 109–147). Cambridge: Cambridge University Press.

Benninger, L. A., Carter, D. O., & Forbes, S. L. (2008). The biochemical alteration of soil beneath a carcass. *Forensic Science International, 180*(2), 70–75.

Cabo, L. L., & Dirkmaat, D. C. (2015). Forensic archaeology in the United States. In W. J. Mike Groen, N. Marquez-Grant, & R. C. Janaway (Eds.), *Forensic archaeology: A global perspective* (pp. 255–270). Oxford: Wiley.

Carter, D. O., Yellowlees, D., & Tibbett, M. (2007). Cadaver decomposition in terrestrial ecosystems. *Naturwissenschaften, 94*(1), 12–24.

Ceker, D., & Stevens, W. D. (2015). Recovery of missing persons in Cyprus: Heavy equipment methods and techniques for complex well excavations. *Journal of Forensic Sciences, 60*, 1529–1533.

Cheetham, P. (2005). Forensic Geophysics. In J. Hunter & M. Cox (Eds.), *Forensic archaeology: Advances in theory and practice* (pp. 62–95). London: Routledge.

Christensen, A. M., Passalacqua, N. V., & Bartelink, E. J. (2014). *Forensic anthropology: Current methods and practice*. San Diego: Elsevier.

Connor, M. A. (2007). *Forensic methods: Excavation for the archaeologist and investigator*. Walnut Creek: Rowman AltaMira.

Conyers, L. B. (2013). *Ground-penetrating radar for archaeology*. Walnut Creek: Altamira Press.

Cox, M., Flavel, A., Hanson, I., Laver, J., & Wessling, R. (2008). *The scientific investigation of mass graves: Towards protocols and standard operating procedures*. Cambridge: Cambridge University Press.

Dirkmaat, D. (2002). Recovery and interpretation of the fatal fire victim: The role of forensic anthropology. In W. D. Haglund & M. H. Sorg (Eds.), *Advances in forensic taphonomy: Method, theory, and archaeological perspectives* (pp. 451–472). New York: CRC.

Dirkmaat, D. C. (Ed.). (2012a). *A companion to forensic anthropology*. Chichester: Wiley.

Dirkmaat, D. C. (2012b). Outdoor crime scene: Why bother? In D. C. Dirkmaat (Ed.), *A companion to forensic anthropology* (pp. 48–65). Chichester: Wiley.

Dirkmaat, D., & Adovasio, J. M. (1997). The role of archaeology in the recovery and interpretation of human remains from an outdoor forensic setting. In W. D. Haglund & M. H. Sorg (Eds.), *Forensic taphonomy: The postmortem fate of human remains* (pp. 39–64). New York: CRC.

Dirkmaat, D. C., Cabo, L. L., Ousley, S. D., & Symes, S. A. (2008). New perspectives in forensic anthropology. *Yearbook of Physical Anthropology, 51*, 33–52.

Donnelly, L., & Harrison, M. (2013). Geomorphological and geoforensic interpretation of maps, aerial imagery, conditions of diggability and the colour-coded RAG prioritization system in searches for criminal burials. *Geological Society, London, Special Publications, 384*(1), 173–194.

Dupras, T., Schultz, J., Wheeler, S., & Williams, L. (Eds.). (2006). *Forensic recovery of human remains: Archaeological approaches*. New York: CRC.

Fibiger, L., & Ubelaker, D. H. (Eds.). (2016). *Forensic archaeology*. London: Routledge.

Groen, M., Márquez-Grant, N., & Janaway, R. (2015). *Forensic archaeology: A global perspective*. Oxford: Wiley.

Haglund, W. D. (2001). Archaeology and forensic death investigations. *Historical Archaeology, 35*, 26–34.

Hochrein, M. J. (1997). Buried crime scene evidence: The application of forensic geotaphonomy in forensic archaeology. In P. G. Stimson & C. A. Mertz (Eds.), *Forensic dentistry* (pp. 83–99). Boca Raton: CRC.

Hochrein, M. (2002). An autopsy of the grave: Recognizing, collecting, and preserving forensic geotaphonomic evidence. In W. D. Haglund & M. H. Sorg (Eds.), *Advances in forensic taphonomy: Method, theory, and archaeological perspectives* (pp. 45–70). New York: CRC.

Home Office. (2016). Forensic pathology: Role within the Home Office. Retrieved from https://www.gov.uk/guidance/forensic-pathology-role-within-the-home-office. Accessed 20 Jan 2016.

Hunter, J., Simpson, B., & Sturdy Colls, C. (2013). *Forensic approaches to buried remains*. Chichester: Wiley.

Larizza, M., & Forbes, S. L. (2013). Detection of fatty acids in the lateral extent of the cadaver decomposition island (CDI). In D. Pirrie, A. Ruffell, & L. Anne Dawson (Eds.), *Environmental and criminal geoforensics: Geological society, London, Special Publications 384.1* (pp. 209–219). London: Geological Society.

Ministry of Justice. (2014). *Guide to coroner services and coroner investigations—A short guide*. Retrieved from https://www.gov.uk/government/publications/guide-to-coroner-services-and-coroner-investigations-a-short-guide. Accessed 20 Jan 2016.

Morse, D., Duncan, J., & Stoutamire, J. (1983). *Handbook of forensic archaeology and anthropology*. Tallahassee: Bills Bookstore.

Powers, N., & Sibun, L. (2014). *Standards and Guidance for Forensic Archaeologists*. Retrieved from http://www.archaeologists.net/groups/forensic. Accessed 22 Jan 2016.

Rebmann, A., David, E. & Sorg, M.H. (2000). *Cadaver dog handbook: forensic training and tactics for the recovery of human remains*. CRC Press.

Sorg, M. H., & Haglund, W. D. (2002). Advancing forensic taphonomy: Purpose, theory, and process. In W. D. Haglund & M. H. Sorg (Eds.), *Advances in forensic taphonomy: Method, theory, and archaeological perspectives* (pp. 3–30). New York: CRC.

Staff, D. (2013). *The lost boy*. New York: Random House.

Tibbet, M., & Carter, D. O. (2008). *Soil analysis in forensic taphonomy: Chemical and biological effects of buried human remains*. Boca Raton: CRC.

Vosselman, G., & Maas, H.-G. (Eds.). (2010). *Airborne and terrestrial laser scanning*. Caithness: Whittles Publishing.

Watters, M., & Hunter, J. (2005). Geophysics and burials: Field experience and software development. In K. Pye & D. J. Croft (Eds.), *Forensic geoscience: Principles, techniques and applications* (pp. 21–32). London: Geological Society of London.