Chapter 13
Interdisciplinary Approaches to the Search and Location of Buried Bodies: A United Kingdom Context

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Over the past 20 years, the discipline of forensic archaeology has established itself in the United Kingdom as a primary method of detection for buried human remains. This has been achieved predominantly through the recognition of specific variations, patterning and disturbances in landscape, geological, botanical and ground signatures. These interpretations have subsequently been greatly enhanced by an increasingly sophisticated understanding, adoption and utilisation of geophysical search equipment and search techniques. In addition, the application of traditional archaeological excavation methodologies to criminal investigations that involve buried human remains can be seen to have become an important milestone in optimising an investigating team's ability to elucidate and extract evidence from the grave and burial environment (Hunter et al. 1995; Groen et al. 2015).

As a consequence, forensic archaeology has negotiated an important position within criminal investigation, existing as it does between the outdoor crime scene, normally controlled by the Crime Scene Manager and Police Search Advisor, the mortuary setting, typically dominated by the Forensic Pathologist and Anthropologist, and the laboratory environment of the Forensic Scientist.

It has been our experience that a multidisciplinary and strategy-led approach to the search for human remains offers by far the highest chance of success for the subsequent location and recovery of remains, whilst also maintaining effective control of the search area and preserving the integrity of the crime scene and any associated evidence contained therein (Harrison and Donnelly 2008). Within the United Kingdom forensic archaeology generally tends to be regarded as one of the disciplines of forensic ecology, which includes; sedimentology, soil science, botany, palynology (pollen), diatom analysis, entomology, stable isotope studies, radiocar-

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bon and other dating techniques, archaeology and anthropology (Roberts and Marquez-Grant 2012).

This paper presents a number of case studies that demonstrate what can be achieved when a comprehensive and integrated range of multidisciplinary search, ecological profiling and forensic solutions is applied in a complementary and synergistic way in order to best support criminal investigations.

In considering the search for and location of clandestine burials, it is crucial to understand the range of responses that may be considered by the investigative authorities. Depending on the nature and veracity of directed intelligence, it is often the case that the enquiry team will identify specific sites of interest. Where such sites can be defined within specific investigative parameters, they are often treated as crime scenes from the outset (ACPO 2006). Such a decision may be regarded as a high risk one; the deployment of staff onto a crime scene associated with a major enquiry entails the production of a forensic strategy and the consideration of extensive sequential evidence collection, to say nothing of the potential financial implications that such an approach will necessarily incur. It must also be noted that deployment to major crime scenes, including those that involve murder, fatal fires and sexual assaults takes precedence over the attendance volume crime scenes.

The confirmation of suspected scenes of major crime will initially be the responsibility of uniformed police response teams, who in relation to this role are referred to as First Officers Attending (FOA). Initial attendance at the major scene and ongoing examination would generally be undertaken by Crime Scene Investigators (CSIs). Any CSIs deployed to a major scene would be managed directly by a Crime Scene Manager (CSM) who has a responsibility to ensure that the forensic strategy is complied with, and that findings from the crime scene are communicated back to the Police Incident Room. Whilst the CSM is deployed to the scene with CSIs, the Crime Scene Coordinator[1] (CSC) has overall responsibility for deploying staff to scenes; coordinates the examination strategies of numerous CSMs, and ensures integration between the forensic strategy and the overall investigation directed by the Senior Investigating Officer (SIO). Because of the close relationship between the SIO and CSC, there is an expectation that crime scene coordination should be managed from the Incident Room. As such there is generally no requirement for CSCs to deploy to crime scenes, as this would compromise their pivotal management role in the major crime investigation.

All actions carried out by CSIs within the context of the major crime investigation should be guided by a written forensic strategy. This strategy is outlined in some detail at the highest level by the CSC, who ensures that the overall forensic strategy document is agreed by the SIO and integrates with other aspects of the investigation. This strategy can then be disseminated down to the lead examiners at each of the identified scenes; a large, complex scene with numerous opportunities for evidence gathering would be controlled by a CSM, because the CSC's strategy may require adapting to suit the challenges of the scene[2]. A relatively small and simple scene with a restricted range of forensic potential (such as a prisoner in custody) may well be entrusted to a lone CSI supported by a fairly proscriptive examination strategy.

In contrast with the fixed framework associated with the definition and examination of a major crime scene, it is more common that the no-body murder investigation is characterised by a period of search. Where directed intelligence associated with specific identified sites is absent or uncorroborated, a Senior Investigating Officer (SIO) would be unlikely to consider speculative forensic examination. More probably, a Police Search Adviser (PolSA), normally a middle-ranking police officer with specialist training in search coordination, would be given responsibility for identifying anomalous locations that might be associated with body deposition within a wider landscape of potential search possibilities. Such coordination would usually comprise both the deployment of search-trained police officers, as well as the integration of specialist services, such as findings derived from forensic telephonic examination, aerial reconnaissance, or attendance by forensic ecologists, in particular forensic archaeologists.

Whether the investigation is focused primarily on sequential forensic examination in the first instance, or on wider intelligence and search operations, it is fundamental that the contracted expert recognises the investigative priorities established by the SIO and the Incident Room. Whilst it is crucial that scientific procedure is deployed in the most robust way possible, it must also form part of an integrated inquiry which is ultimately initiated and directed by police action. Investigating detectives rarely attend crime scenes associated with major offences. Developments in DNA recovery, concerns about scene contamination, and tighter strategic control of detective actions via the Home Office Large Major Enquiry Suite (HOLMES; www.holmes2.com) has largely removed the requirement for a detective to be present at the scene. For similar reasons, it is preferred that a single ecological expert is present at the scene and can be trained to take samples for other experts such as botanists, soil scientists and entomologists to subsequently work on.

13.1 Case Study 1

A UK police force was investigating a suspected no-body murder in which a settled member of a traveling community had gone missing. Proof of life enquiries were centered on mobile phone and bank activity which added further confidence to suggest that the missing male was deceased. Witness intelligence from the male's family implicated a second male in the disappearance. The potential scene most strongly associated with the suspect as a site of body deposition was a pig farm owned by the suspect's family.

The investigative team had initially considered the successful recovery of human remains from a site such as a pig farm as being practically impossible, due to the belief that hard tissue fed to pigs would be entirely digested leaving to evident trace; the capacity of pigs to smell buried items and disturb them; and the extensive sewage system lying under the pig stalls which carried large quantities of water, effluent, feed and bedding. Despite these significant challenges, on seeking the opinion of the forensic archaeologist it was suggested that pig digestion would be unlikely to

completely destroy human bone without further processing, and that stalled pigs would be unlikely to have an opportunity to detect and disturb deeper burials, or indeed to interfere with burials located elsewhere on the farm site, such as the extensive raised earth embankments that functioned as a windbreak around much of the farm area.

The search phase of the operation was initiated on the arrest of the suspect. A search of the farm revealed large areas that the investigative team were happy to be of low significance, such as the farmhouse itself and the concreted animal stalls. Of more immediate concern were a large pile of dead and decomposing pig carcasses which had been set on fire prior to police arrival and was still smoldering at the initiation of the search operation. This suspicious area could only be searched by hand-raking out the animal remains in order to confirm the absence of any intermixed or commingled human remains.

Ultimately, the search was partial and inconclusive. Whilst much of the farm area was searched by eye, there was no systematic sequence of 'least to most' invasive searching, which would be consistent with strategies of search and forensic examination. The pile of decomposing pigs was subjected to a partial search, but as the archaeological excavation grew deeper, safety concerns about collapse of the newly dug trenches grew greater, and ultimately the search was discontinued. Prosecutors advanced a 'no body murder' case against the two defendants that was based on a hypothesis that the body of the missing male had been fed to the pigs and as such could not be found. The jury consequently delivered a not guilty verdict on both of the charged males.

13.2 Case Study 2

An extensive search for a missing female by a UK police force ultimately ended in a successful conclusion through a mix of investigative skill, technical expertise and the use of specialist search techniques. The female in question had been missing for just over a year, during which time police enquiries had established the likelihood of her being deceased. The investigative team has subsequently prioritised a male suspect with whom she had had a relationship in the months immediately prior to her disappearance.

The male suspect had been arrested, questioned and subsequently released, during which time technical intelligence had been gathered from his communication devices suggesting the location of a potential area of search. This area remained rather expansive, encompassing a number of fields on either side of a small country road located a short distance outside the town where the male and female both lived.

Whilst this area remained too wide to consider any form of comprehensive search solution, it did allow for the targeted use of geophysical and geochemical search techniques to attempt to elucidate an area of burial. This technical approach was combined with overt, high-visibility police searches of field boundaries and specific areas of interest within the site parameters.

Ultimately, the high visibility techniques of police search proved more successful by indirect means. As the search progressed across the fields and got increasingly closer to the actual burial location, which had been correctly assumed to lie in a field next to the country lane, the suspect decided to attempt to move the female's body in order to prevent its discovery. This attempt by the suspect failed, and resulted in the partial uncovering and disturbance of the body before the suspect opted to hand himself in to police custody and thus trigger the securing of the scene and ultimately the recovery of the human remains and associated forensic evidence.

The search phase of this case study was fully integrated within the criminal investigation and saw the deployment of a planned sequence of police and specialist search techniques, which ultimately prompted a failed attempt by the suspect to move the remains prior to their imminent discovery by the police. Ultimately the suspect was tried and found guilty of murder.

13.3 Case Study 3

A search of an extensive detached house with an adjacent industrial yard, located in a rural area close to a busy main road, was initiated following a report that the sole female occupant of the house and majority partner in the yard's business had gone missing. Questioning of the female's business partner suggested that he may have been complicit in her disappearance, and as a consequence a search of the house and ground was instigated.

The search area was controlled by the PolSA, but with close reference to the requirements of the CSM, who ensured that the needs of the forensic strategy, particularly with regard to anti-contamination procedures and the sequential recording and examination of areas of concerted searching by police search officers. The potential for burial as an act of concealment was considered by the investigative team at an early stage in the examination, partly because of the general nature of the site, and specifically because of the presence of a mechanical excavator at the yard around the material times of the female's disappearance, and the apparent movement of earth from large piles of spoil present in the industrial yard. As a consequence, the support and advice of the forensic archaeologist was sought at a relatively early stage by the investigation team.

The nature of the site suggested a clear priority search area, which was centered on a derelict branch railway line and platform that formed part of the farthest boundary of the industrial yard. This platform was closely associated with a large deposit of soil formed into a linear embankment, which was believed to conceal beneath it a brick-lined shaft contemporary with the construction of the railway dated to the mid-late Victorian period. The soil embankment posed challenges for the deployment of specialist search techniques, in that it was comprised of uneven made ground with rubble inclusions which was poorly suited to geophysical survey, and that the ground level was raised to the extent that venting the embankment with an

augur would largely fail to penetrate the underlying 'natural' ground surface to facilitate the release of volatiles and subsequent use of cadaver search dogs. As a consequence, controlled machine and hand excavation by a police search team operating under the supervision of both the forensic archaeologist and the CSM was utilized.

Despite this clear initial focus, wider consideration of the site by the PolSA and CSM remained crucial, and a planned strategy was prepared to prioritise subsequent areas of searching, should the embankment area prove not to feature concealed human remains. This strategic planning proved to be redundant when the top of the brick shaft was first located, followed some time later by the discovery of the deposition of the body of the missing female who was located at a considerable depth at the base of the shaft.

While early identification of the industrial area to the rear of the house had been primarily driven by suspect and witness interview and by the preliminary findings of associated property searches, the development of the police search and forensic examination at the scene was the shared responsibility of the PolSA and CSM. Within this partnership arrangement, it was tacitly understood that primacy of responsibility lay with the PolSA until the location of human remains was confirmed, at which point the seniority of roles was reversed, with the CSM acting as senior decision-maker.

This search was proactive and sequential, with a clear order of investigation both across the scene as a whole, as well as with regard to specific actions taken at the primary site of interest by the railway platform. The nature of the deposition site was such that the non- or semi-invasive search techniques of geophysical survey and cadaver dog use were largely ineffective, and controlled excavation had to be almost exclusively relied upon. Crucially, this development only served to increase the importance of appropriate oversight by a forensic archaeologist, rather than preclude it.

13.4 Case Study 4

Soil analysis can be a very useful technique in both determining provenance in a law enforcement/police search and also as physical evidence to determine if an offender or item was associated with a crime or location (Dawson and Hillier 2009; Dawson and Mayes 2014). This case illustrates an example where soil information assisted in the search for a grave and also provided evidence that was presented in court. This case is an excellent example of effective team work, and illustrates interdisciplinary integration, which included police investigators, police search teams, a forensic geology ground search specialist, forensic archaeologists and soil scientists, all with particular complementary expertise.

Operation Sorrento was a large scale, high profile 'No-body Murder' investigation which lasted over several months, stretching from County Durham to West Yorkshire, in England, UK. During the winter of 2013, the sons of a middle-aged

woman called the Police reporting that they had not seen or heard of their mother for 5 days. Initial enquiries revealed that the last person to have seen her was her boyfriend. Due to some concerns from a comparison of the boyfriend's initial account to the Police with the account he had given to the missing woman's family, a Homicide investigation was quickly commenced, running alongside a Missing Person enquiry (MisPER). This developed through the phases of arrest, painstaking search, recovery of evidence and, in particular, the eventual recovery of the remains of the victim, to full trial and ultimately conviction.

Passive data from the suspect's mobile phone indicated wide areas of moorland which the suspect had visited in the times between the last sighting of the missing woman and the report of her being missing from home. The search and passive data strategies were intrinsically linked with other pieces of work on-going, including for example Closed Circuit Television (CCTV), forensic searches, 'house to house' and witness interviews.

There was also significant time pressure on the investigation team as early Crown Prosecution Service (CPS) charge authority had been sought and granted for a murder charge on the male only 3 days after the victim's disappearance. The search for the missing woman was one of the largest search operations ever undertaken by Durham Constabulary, supported by specialist search resources from West Yorkshire. South Yorkshire Police, Greater Manchester Police, CAST (UK Home Office, Centre for Applied Science and Technology) and other underwater assets being among the specialist teams deployed. The objective of the search was to find her body and/or evidence relating to it. A preliminary conceptual appreciation of the geology was suggested for the suspected burial site located in the central Pennines of northern England. Here, the geology is dominated by coarse, strong, well-jointed and cross-bedded sandstones of Kinderscout Grit, of Namurian age. These were interbedded with weaker shales and mudrocks that have undergone weathering and erosion to form distinct escarpments, rolling hills in a moorland topography setting. These are covered by a veneer of peat, which has accumulated over the past c. 10,000 years. The peat may reach up to about 2–3 m depth in places. In the context of a burial site, the distinct weathering of the slopes and rock exposures potentially enables navigation across the moorland landscape to perhaps facilitate the location of a possible grave. The peat can be dug with ease and a shallow grave may be dug and the peat/sub-soils and the displaced soils reinstated in a very short period of time, as determined in other search areas in this same range of hills (Donnelly and Harrison 2013). Geophysical techniques potentially deployable in these type of geological settings were advised to include ground penetrating radar, magnetic and electromagnetic methods.

This case presented particular challenges with regard to the scope of the potential area of search. While mobile phone evidence suggested an upland location close to Cragg Vale, West Yorkshire, other intelligence suggested the possibility of a link with a reservoir site. Consequently a reconnaissance report was prepared by the forensic scientists that considered geological characteristics and geomorphological features across a number of target areas in the Halifax area. In addition, the search

report identified key exhibits taken from the suspect's car that might retain linking soil traces.

Production of a reconnaissance report by the forensic archaeologist was followed by targeted soil sampling at sites supported by both case-specific intelligence and generalised models of body deposition behaviour. Target landscapes were characterised by a variety of potential contact materials (as is found on the moorland around Turvin Clough, which featured highly organic upland peat bog overlying deposits of Kinderscout Grit).

Ultimately, intelligence-led targeting of soil samples helped provide a focus for searching efforts that led to the discovery of the remains of the missing woman in a clandestine grave. Field observations by a skilled member of South Yorkshire Police's Victim Recovery Dog Team, near to the roadside, fine-tuned the geographic position of the grave. The location highlighted was a layby, which offered easy access to the moors via a wooden gate. On the right hand side of the gate was a natural steam flowing towards the roadside. The moorland was open and directly accessible on foot and had little natural visual protection from the roadside. The deposition site was dug into the banking of the stream further into the moor about 700 m away from the parking area. The location of the deposition site on the stream bank gave concealment from the road side allowing the perpetrator to cut into the banking and conceal the body without being compromised by any passers-by.

Using a dual soil analysis approach, by analysing both the inorganic (mineralogy) and the organic characteristics (hydrocarbon and alcohol fractions) of the soil, we were able to exclude certain areas as the source of the material found on the gloves from the boot of the male's vehicle (home area, other areas identified as locations where he had been parked during the initial period the woman went missing). The forensic soil scientists were also able to home in on this area as being the location that most matched the characteristics of the material on the male's gloves found in the boot of his car. In parallel to this, field search teams identified anomalies in the edge of the road that indicated disturbance with unusually Kinderscout Grit sandstone near the soil surface. The Victim Recovery Dog (VRD) Handler also noticed rocks, clay and soil, which had been deposited in the stream near to the site. On examining the distribution of the clay and boulders, these were spread over a short distance, in an arc shaped pattern as if thrown from one location. He also noticed that an elongate rock appeared to have been moved from a patch of Moss less than a metre away (it appeared to have different weathering patterns to others in the area and no lyceum was present offering a clue to the experienced PolSA). The grass and foliage around the boulder appeared to be relatively dry, compared to the surrounding foliage. The officer then took an auger sample near to the site (without interfering with the site) and noticed that the core was disrupted with subsoil located where the topsoil should have been. He then put his dog over the area and got a positive indication.

From the soil organic marker analysis it was also clear that of the reference samples collected and analysed, one sample was very similar to that sample collected from the glove brushings. Furthermore, the organic marker characteristics (alkanes, alcohols, aldehydes, ketones) of the sample from the glove differed greatly from the

other reference samples. On the basis of soil mineralogy, a number of sample locations were excluded as locations for the source of the material examined from the glove. There were also clear differences in mineralogy between both sample locations and the victim's house at Chester-le-Street; these two locations were subsequently excluded as being the source of the material on the gloves found in the boot of the male's vehicle and these were eliminated from the search as being the source of soil on the gloves. One sample location was the location found to be very similar in terms of mineralogy and organic characteristics to the soil on glove. The missing woman's body was found within 700 m of this location by police dogs once the area was further narrowed down through field observations. Soil samples were then collected at the grave, including contact point samples where the perpetrator would have stood and would have dug. The suspect vehicle was forensically sampled and traces of soil were found in the foot wells of the suspect's car. These evidential soil samples were analysed in the same way as were the samples examined in the search phase of this operation.

In court, under the UK adversarial system with a judge and a jury, the strength of evidence that the soil-like material found on the gloves originated from the grave site location was moderately strong for both organic and mineral soil characteristics. This evidence suggests that the person who was wearing the gloves had been in contact with an upland moorland environment in northern England, as was characterised at the grave site location. In addition, the strength of the evidence that the soil-like material found in some of the footwell mats of the suspect's vehicle originated from both the organic and mineral horizons of the grave site location was moderately strong for organic characteristics. Signs of mottling and deciduous *Molinia* grass also provided additional common characteristics between the soil from the vehicle and the grave site location.

The soil and plant evidence suggested that there was transfer of soil to the suspect's vehicle from an upland moorland environment as was characterised at the grave site location. In addition, evidence was presented that indicated that the suspect's fingerprint had been transferred to flowers found within the grave, and CCTV imagery and phone records linked to the dates and times of the missing woman's disappearance.

The suspect was found guilty of manslaughter and was sentenced to 18 years in prison.

13.5 Conclusion

Over the past 20 years, the numerous types of forensic scientist involved in the location of buried and concealed remains have grown used to considering themselves part of a multidisciplinary effort. Forensic geoscientists, palynologists, entomologists, geophysical search specialists and forensic archaeologists are generally happier to conceive of themselves as forming part of a suite of methods broadly classified under the banner of 'forensic ecology', and that rather than any one

specialism offering superior capability, their functions are frequently complementary and are at their most effective when coordinated as an ensemble (Davenport et al. 1992). Each case is individual and depending on that case context, a different suite of specialists will be required.

Whilst the application of these various natural sciences to forensic search scenes is not new[3], their formal affiliation with one another in the syncretic science of forensic ecology is new, and not always straightforward, despite their shared stated goals. Despite this, the various disciplines of forensic ecology have made progress in consolidation, particularly in the last decade[4]. This development appears to be two-pronged; deriving simultaneously from a small number of academic authors with an interest in forensic search (Ruffell and McKinley 2004; Roberts and Márquez-Grant 2012; Pirrie et al. 2013) and from the maintenance of a range of forensic ecology provision solutions offered by a number of UK Forensic Service Providers (FSPs).

There is another side to multidisciplinary working which has thus far attracted less attention from either academic authors or FSPs, but which this chapter has attempted to consider and exemplify in some detail; the integration of the forensic ecologist within the structure of the police investigation and specifically alongside police search officers and CSIs in the context of no-body murder search and location operations. It is arguable that the forensic ecologist present at such scenes has longer and more in-depth contact with the police than their counterparts who work primarily as laboratory-based analysts. No body murder cases frequently represent some of the longest and most complex investigations, with greater initial reliance on human and technical intelligence than most other responses to major crime outside of the arena of counter-terrorism. Within this context, the forensic ecologist must retain their independence and objectivity to ensure they meet the robust requirements of the court whilst being able to facilitate the specialist needs of the police investigation.

As a consequence of this, it behoves the forensic ecologist engaged in body search and location to not only possess an intimate understanding of the general processes of forensic examination, but in addition to have an awareness of the requirements and capabilities of police search professionals, and furthermore to understand the processes that underpin the workings of the Major Incident Room. The optimization of confidence in any police search supported by forensic ecology requires a sequential, analytical approach informed by scientific best practice as a *sine qua non*, and the continuing development of scene and laboratory quality standards in forensic science will assist greatly in underpinning this axiom. Further to this, however, a secondary challenge to optimal searches lies in the manner in which the various agents of police major investigations interact with and reflect on the advice and work of the forensic ecologist, and *vice versa*. Such a complex and multifaceted challenge is not so easily nor so comprehensively addressed through academic writing or forensic service provision as the conceptualisation and branding of the science of forensic ecology, but it remains just as critical to its eventual maturity. Effective cooperation between the forensic experts, the investigation teams and the criminal justice system should better enable justice to prevail.

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