

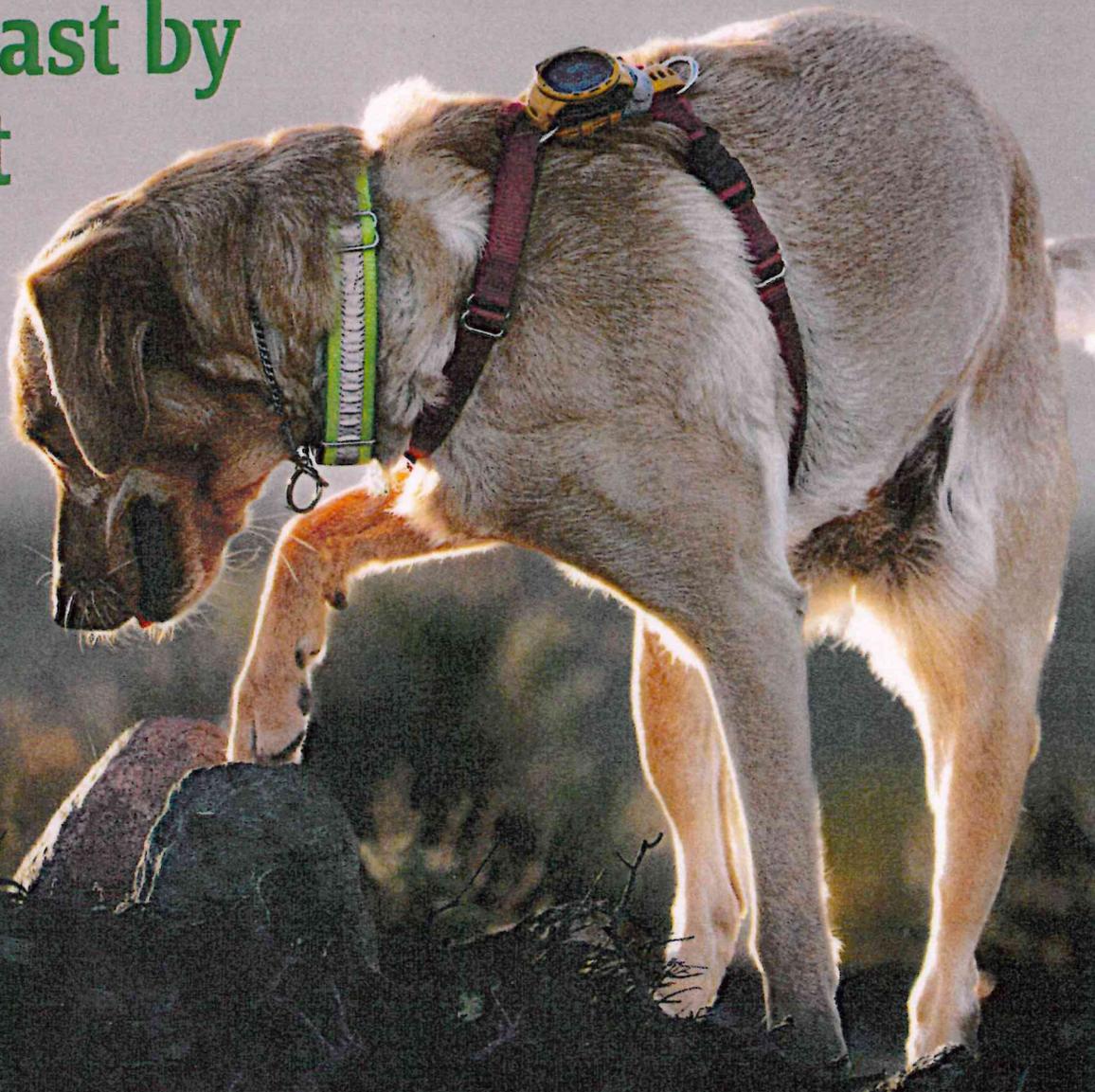
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Recovering the Past by Scent



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Detection dogs help archaeologists locate unmarked graves and guide noninvasive surveys.

Scenting the Past

By Paula Neely

Bryn, an English Shepherd handled by Alyson Hart, trains in a historic cemetery to refine detection skills for locating burials. *Photo by Adela Morris.*

Seamus, an 8-year-old yellow labrador retriever, gazed attentively at his handler, Kathleen Connor, waiting for her signal to begin surveying a potential unmarked historical burial area at Forest Hill Park in Richmond, Virginia, last summer. As soon as Connor swept her right arm from left to right, Seamus began sniffing the ground for odor left by decomposed human remains buried almost 200 years ago. Within minutes, he sat down. Connor explained that dogs alert by sitting or lying down at the place where the odor is the most concentrated. A few hours later, Abby, a 6-year-old chocolate lab, surveyed the same area and confirmed the possible presence of human remains in the same spot Seamus had identified.

The canine surveys were conducted under the direction of Paul S. Martin, of Martin Archaeology Consulting, to help identify where people had been buried on the grounds of a plantation established by Holden Rhodes in 1836. After Rhodes' death, the property changed ownership several times, and by the 1870s, it was mostly abandoned. In the 1890s, it became an amusement park until it was acquired by the City of Richmond in 1934 and developed as a city park. The stone house built by Rhodes in

1836 was renovated for community use and the park manager's residence. Today, there are pickle ball and tennis courts, a playground, picnic shelters, and walking trails.

When Martin conducted groundpenetrating radar (GPR) in the area identified by the dogs and recorded by GPS, he discovered "what appears to be the potential for multiple child or subadult burials." He said the area was located to the west of the reserved area for the cemeteries for the Rhodes family and enslaved people described in historic documents. According to Martin, "Sometimes children were buried outside the known boundaries of a cemetery due to religious beliefs."

Using dogs to initially survey an area is more cost-effective than using ground penetrating radar to cover the same area, he noted. "You can home in on anomalies and then do GPR." Martin has used his dogs to help locate burials at numerous historic cemeteries and battlefields throughout the U.S. He also surveyed areas in the Philippines, Germany, France, and Belgium to help History Flight locate service members who were missing in action during World War II. He and his dog identified at least three burials that were exhumed and repatriated



Seamus waits for his handler, Kathleen Connor, to give the signal to begin surveying. Photo by Lynda Richardson.

to the United States. DNA confirmed their identities, and they were buried with full military honors.

Although human remains detection dogs, also known as cadaver dogs, have been used by criminal investigations and search and rescue (SAR) operations since the 1970s, dogs have only been used to detect historical and archaeological human remains since the 1990s. "The dog's olfactory system is so much more enhanced than ours. They have eight million receptors compared to our three million," Martin explained. "The portion of their brain committed to olfactory process is also 80 percent larger than ours." Dogs can distinguish hundreds of different odors that humans can't.

Canine handler Adela Morris was among the first to identify dogs' ability to detect the odor of historic and ancient human burials. About 30 years ago, when she was at a training session with her SAR dog, she saw a fenced 1906 cemetery and went inside it to see what her dog would do. Within minutes, the dog alerted on a grave.

Discovering that her dog could identify the weaker odor of historic human remains led Morris to establish the Institute for Canine Forensics (ICF) in 1997 and begin working with archaeologists to identify unmarked burial sites. The ICF works mostly with cultural resource management projects and Native American groups to identify areas developers should avoid to prevent disturbing potential burials. They also work frequently with churches to identify where people were buried outside cemetery boundaries. "Some archaeologists have mistakenly thought these dogs would dig up and chew on bones, so they don't want them at their excavations, but hundreds of other archaeologists have watched the dogs and believe in what they can do," Morris said. Martin agreed, "It's becoming more accepted and demanded from descendant communities and archaeologists." When dogs' responses are paired with geophysical tools, such as GPR, there's about a 92 percent chance of accuracy, according to Martin. But the only way to know if the dogs have accurately identified a historic human burial is to excavate, which is not usually done, to avoid disturbing burials.

Canine responses were tested by excavations at Síí Túupentak,



Abby, a 6-year-old chocolate lab, surveys an area for a possible presence of human remains. *Photo by Lynda Richardson.*



Canine Kayle alerting to a Native American burial at Síf Túpentak, a San Francisco Bay Area site (formerly a village of the Muwekma Ohlone Tribe). Burials at this site were removed before the construction of a new building. Photo by Shannon DeArmond / Far Western.

a major Ohlone ancestral site, occupied 600 to 145 years ago, in the southeastern San Francisco Bay area in California. Leaders of the Muwekma Ohlone Tribe (the descendant community) entered into an agreement with the San Francisco Public Utilities Commission to allow the construction of the Alameda Creek Watershed Center, a major educational facility, on land adjacent to the historic Sunol Water Temple. Fragments of human remains had previously been discovered at the site, and the tribe requested that three dogs from the ICF be employed to sniff out the possible location of ancestral remains in the areas that could potentially be impacted by the construction. Archaeologist Brian Byrd, Far Western Anthropological Research Group, Inc., served as the principal investigator for the project. An enrolled citizen of the Shawnee Tribe, Byrd noted that not

all tribes accept the use of dogs. "Some find it disrespectful," he said. Each nation will have its own perspective, he said.

The dogs searched a 69-by-46-foot area and identified seven possible burial locations. Archaeologists then conducted GPR and excavated the entire area. Eight burials were recovered in the survey area along with three burials adjacent to it at depths of 4 to 39 inches beneath the surface. The remains were dated to A.D. 1425–1568 and returned to the tribe.

"The dogs were relatively accurate," Byrd said. "Their alerts weren't random. They were within 0.3 to 3.5 meters (about a foot to 11 feet) of the burials." Alerts to the locations of older, deeper burials were consistently farther away than alerts to the more recent, more shallow burials. He noted that false positives were less likely than no alerts.



Paul S. Martin, of Martin Archaeology, uses ground penetrating radar at a site canines have previously searched. *Photo by Lynda Richardson.*

Dogs find odors, not burials, according to Ronda Bowser, ICF canine trainer. When a human body decomposes, its oils seep into the bones and surrounding soil and roots. The path of the odor does not always follow a straight line from the burial to the surface. “It takes the path of least resistance,” she said. For example, it might travel upward through rodent tunnels or roots, or it’s moved away from remains by flowing groundwater. ICF estimates that alerts are generally within a 13-foot radius of human remains, based on surveys in historic cemeteries.

Ground and air temperature, humidity, soil, moisture, and wind all play a role in the dogs’ ability to detect odor. Barometric pressure is also a factor, according to handler Melissa Kindt, Martin Archaeology. “Sometimes the odor isn’t available to the
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dogs if a high barometric pressure is holding the odor molecules below the surface. After the pressure lifts, if we take the dogs back to that same area, they can smell it because the release of the atmospheric pressure has allowed the odor molecules to disperse into the air column again,” she said. Byrd said the use of canines is a good starting point “for thinking about the impacts on an area.” “Archaeologists are not looking to dig up burials. It’s more a question of avoidance,” Byrd said. “Cemeteries and burial grounds are something we always want to avoid.” Using canines is not hugely expensive, and it’s better to have more input than less, he said. Depending on the project, it costs anywhere from \$500 to \$3,000 per day for two dog and handler teams plus travel expenses, according to Morris and Martin.

So far, the oldest remains identified by ICF detection dogs are 9,000 years old. They were identified at a coastal site in San Diego County, California, prior to a construction project. (The descendant community has requested that the location not be directly disclosed.) Six different dogs searched the site and located 14 possible Native American burials. Despite warnings from Native American monitors, a burial was disturbed during construction that five of the six dogs had identified. The remains were recovered and are consistent with other remains at the site that date to about 9,000 years ago based on radiocarbon dates.

If remains become disarticulated and disturbed, the smell of individual fragments is weaker than buried remains. Dogs can find the area, but it can be difficult for them to identify specific spots of concentrated odor, Bowser said. For example, when canine handler and ICF historian

John Grebenkemper used dogs to search for human remains to help identify the lost location of the Donner winter camps at Alder Creek in Donner Memorial State Park, it was challenging. Only 45 of 81 people in the ill-fated wagon train led, by George Donner, survived when they were trapped in the Sierra Nevada Mountains on their way to California during heavy snowstorms in the winter of 1846–1847. When their food supplies were depleted, many of the survivors resorted to cannibalism, eating the remains of those who had died of cold and starvation. The snow was over 10 feet deep, so the dead were buried in the snow. After the snow melted, their remains were left to decompose on the ground surface and were scattered by foraging animals. About 60 of the emigrants settled in cabins 8 miles away from the Donner camps near what is now called Donner Lake. The

cabin sites have been identified, but the Donner camps have been lost for over a century and a half.

Based on a 1927 photograph of tall tree stumps that were 6 to 10 feet above ground when they were cut by people standing on top of the deep snow, and a description of a tree that formed one side of the George Donner camp, according to the writings of Donner's daughters, Grebenkemper estimated the possible location of the Donner camps, where the remains of at least five people were discovered, to be "somewhere near the trees." He reasoned that people weakened by starvation would not have walked any farther than necessary in deep snow to cut wood, or to bury their dead. After his dog alerted in the area, he asked other handlers to bring their dogs to the site. Over the next several years, 12 different dogs surveyed 32 acres at Alder Creek with 80 alerts. "It was not like identifying a burial," he said. "The remains were scattered everywhere by animal activity." He has since analyzed the alert locations and identified three areas where the alerts were concentrated. One of the areas is near the location of four tall tree stumps, and two areas are located next to a creek that no longer exists. According to historical accounts, George and Jacob Donner's camps were located on the

same creek. The evidence is circumstantial, but this may be the possible location of at least two of the camps in Alder Creek, Grebenkemper said.

ICF detection dogs were also used to help search for the remains of pilot Amelia Earhart, who famously disappeared in July 1937, near the end of a flight around the world. After leaving New Guinea, Earhart and navigator Fred Noonan were unable to locate Howland Island, one of the last legs of the trip. The International Group for Historic Aircraft Recovery (TIGHAR) believes that they landed instead on the remote island of Nikumaroro, an uninhabited island about 1,000 miles north of Fiji. According to TIGHAR, they could have landed on a flat reef during low tide. The aviators transmitted distress signals for several days on the plane's radio, but within a week, the messages stopped. The plane was probably swept off the reef by tides and surf into the ocean, according to Ric Gillespie, TIGHAR executive director. TIGHAR launched an expedition to search for Earhart's remains on Nikumaroro in 2017 with support from the National Geographic Society.

Clues about Earhart's possible presence on the island include the skull, mandible, and 11 other bones of a castaway



Ronda Bowser, and Kelpie mix, Badger, investigate an unmarked burial plot to ensure that repairs to a fallen retaining wall do not disturb any graves. *Photo by Adela Morris.*



ICF canine handler, Lynne Engelbert, watches as canine Piper alerts on the odor of human remains. Piper and Lynne were one of four canine teams sent to search for pilot Amelia Earhart's remains on the remote island of Nikumaroro. *Photo by Adela Morris.*

discovered in 1940 near a Ren tree on the edge of a lagoon on Nikumaroro by British subjects, who were temporarily working on a coconut plantation on the island. The bones were sent to the Western Pacific High Command in Fiji, where they were measured and recorded, but they have since disappeared. Recent analysis of the recorded bone measurements revealed that they matched Earhart's skeletal measurements, according to TIGHAR. Other artifacts discovered at the lagoon site possibly associated with Earhart include a portion of the sole of a woman's shoe, a Benedictine liqueur bottle, a freckle cream jar, a Talon zipper slider that dates between 1933 and 1936, and a double-bladed jack knife, according to Gillespie. The remains of a campfire with remnants of a 1936 American beer bottle, a 1930s liniment bottle, and a 1933 bottle made in New Jersey, were also discovered in addition to bones of fish, birds, and turtles.

ICF canine handler Lynne Engelbert and her dog, Piper, a border collie, were among the four canine teams that searched the site. Two of the dogs alerted where they smelled historic human remains. Archaeologists excavated the area, but Gillespie said they didn't find any bones. He said it's possible that Earhart's remains were eaten by rats and coconut crabs, the world's largest land crabs that grow up to 3 feet in diameter. He suggested the crabs may have taken her bones deep into the coral.

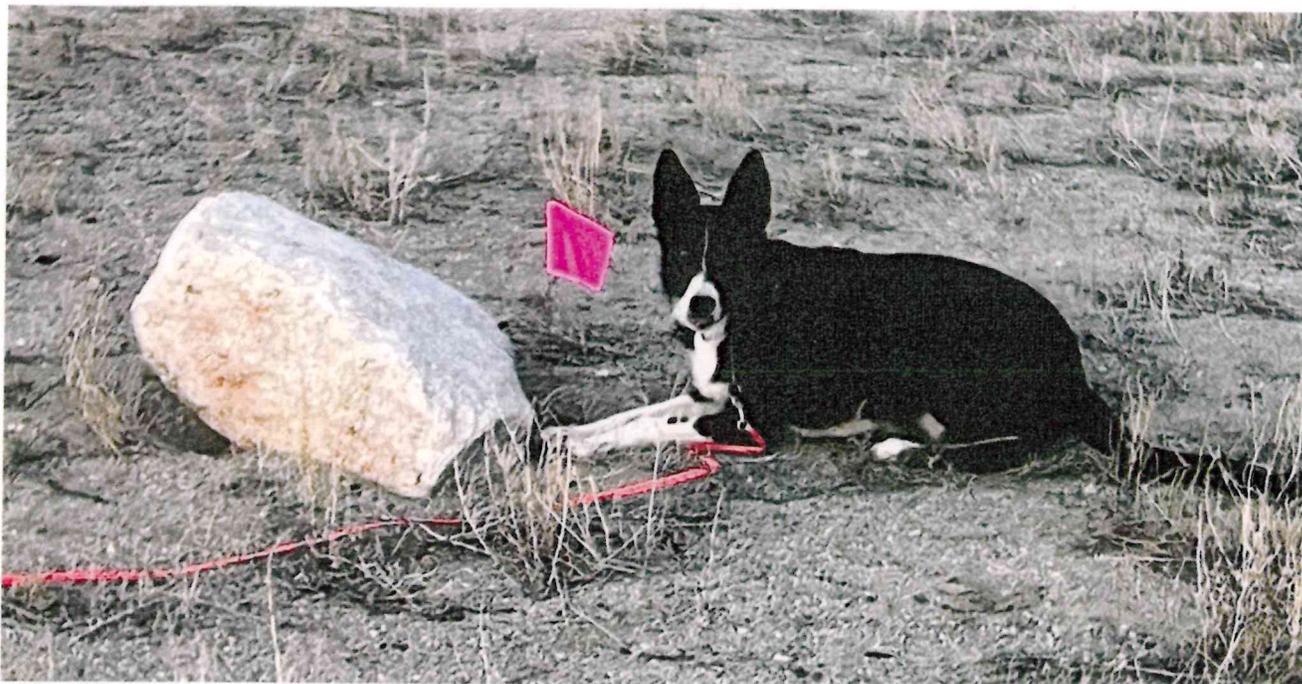
According to Engelbert, the archaeologists took samples of tree roots in an attempt to obtain human DNA. She explained

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that even if the bones are gone, the oils may still be in the surrounding soil and roots. Unfortunately, while DNA was indeed found, it was too degraded to be useful.

Other projects have included searching for Chinese immigrant burials in Hawthorne, Nevada, where they died while building a railroad. A portion of their pay was withheld to cover the cost of returning their bones to China if they died, Engelbert said. "They believed that their souls would not rest until their remains were back in China," she said. Men who died were buried, and after a year, their bones were to be exhumed, cleaned, and shipped back to their families in China. "Most were never returned," she said. ICF dogs have identified the boundaries of an unmarked graveyard in downtown Hawthorne near the railroad so that graves can be marked and protected.

Engelbert said ICF has experience searching five Native American boarding school and residential school sites in the U.S. and Canada for the unmarked burials of children who died at the schools. More than 500 schools were government-funded and often run by churches between 1869 and 1960. "We found unmarked graves at all of the sites we surveyed," she said. Many Indigenous children in the United States were removed—often forcibly—from their families and sent to off-reservation boarding schools located hundreds or thousands of miles from their homes. These institutions pursued assimilation into European-American culture, imposing English-only policies and



Jazz alerts on a burial at an abandoned Chinese cemetery in Hawthorne, Nevada. Photo by Lynne Engelbert.

prohibiting Indigenous languages and spiritual practices. Archival records and survivor testimony document emotional, physical, and sexual abuse at some schools, as well as student deaths. In numerous cases, parents were not notified of their children's whereabouts, circumstances, or burial locations.

Dog teams have also been asked to help search for cremains lost in homes destroyed by wildfires in California and Oregon. In 2017, after the Tubbs Fire in Santa Rosa, California, a man whose house had burned down asked ICF to help recover the cremated remains of his parents that were buried under rubble. Engelbert volunteered to survey the site and her dog alerted her to a location where the cremains were buried under ashes. She was surprised that the odor could still be detected after the remains had been burned at about 2,200 degrees. Since then, volunteer handlers have located 450 cremains lost in homes destroyed by wildfires. Engelbert explained that after a safety inspection, the researchers cordon off a 10-by-20-foot area where the homeowners think the cremains might be. Then a dog team surveys the area, and flags are placed at the location of alerts. Archaeologists excavate within 6 to 8 feet of those areas to locate the cremains, which have a very distinctive texture and may contain teeth and bone fragments. A nonprofit organization, the Alta Heritage Foundation, altaf.org, now handles requests for locating cremains lost in wildfires.

According to Bowser, any breed of dog can potentially be trained as a historic human remains detection dog, but they need to have focus, intensity, and the ability to work for a long time without getting frustrated or stressed. Handlers must be able to focus, she said. They must also recognize behavior changes and know when their dogs are about to alert. The training begins by introducing the dog to the odor and rewarding them. Bowser said research by chemists and

cadaver detection dog studies have identified 400 to 500 volatile organic compounds (VOC) in decomposing human remains. "The heart, liver, and brain all have different odors," she said. The ICF focuses on 30 to 50 of these reproducible VOCs, and dogs are exposed to as many VOCs as possible until they've experienced the full gamut of odors available.

Dogs and handlers then practice finding bones and teeth hidden on the ground. Some bones and teeth can be purchased from bone stores such as Skulls Unlimited. Martin said that he places gauze pads inside boxes of archaeological human remains to absorb odor. Dogs are also trained at historic cemeteries, where some grave markers still exist, and at archaeological projects with certified dogs. Training can be complete when dogs are about 3 years old. To be certified, dogs and handlers must pass several assessments, which includes finding all the bones hidden in the testing area and at least 10 teeth in 15 minutes. They must clear a blank area where there are no target odors. GPS is used to ensure that dogs have covered the entire area.

Archaeologist Russell Skowronek, of the University of Texas Rio Grande Valley, has used dogs on several projects, and he's helped introduce the concept to other archaeologists since the 1990s. "With the right soil conditions and if it's not too hot or windy, dogs can tell you if there is the scent of human remains. To have that at an archaeological site can be very valuable," he said.

PAULA NEELY is a contributor based in Virginia. She has written for National Geographic Magazine and the Richmond Times-Dispatch.

FURTHER READING

- Institute for Canine Forensics, icfk9.org
- Martin Archaeology Consulting, martinarchaeology.com