



### A51 The Effect of a Harsh Environment and Indirect Human Activity on the Perseverance of DNA

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After attending this presentation, attendees will have gained insight into the possibilities for recovering DNA from evidentiary samples subjected to human and environmental exposure. They will be made aware of the current theories for locating reliable evidence for DNA and given quantitative data regarding those theories.

This presentation will impact the forensic science community by demonstrating that low template DNA samples can be collected and analyzed after eighteen months by first considering the ambient environment and substrate on which the sample may have been deposited. This presentation will provide scientists with information to evaluate the currently implemented methods and adopt or modify their current protocols.

Locating reliable evidentiary samples for DNA analysis becomes more complicated as time between deposition of a biological sample and collection of sample increases. Exposure to environmental factors can also decrease the chances of obtaining a DNA profile. Certain factors such as temperature, humidity, and substrate are known to negatively affect DNA recovery, and a number of theories have been used by forensic scientists to help locate areas from which the best possible biological sample can be collected. However, a comprehensive and quantitative study regarding environmental impact and the effect of contaminating human traffic and activity on DNA profile recovery has not yet been published.

The research presented will show a comprehensive longitudinal study to determine the optimum locations at a crime scene that is best suited for biological evidence collection and to assess sample reliability for DNA analysis after eighteen months. This effort consisted of two concurrent studies: Study 1 examined DNA sample recovery by taking into account biological sample type, human traffic flow through a room, evidence placement within the room, substrate, and time; Study 2 examined DNA recovery by taking into account biological sample type, ambient environment (hot and humid or room temperature), substrate, and time.

For both studies, six replicate sets of mock evidence fluid samples: blood, semen, saliva, urine, oily fingerprints, and regular fingerprints were deposited on substrates and exposed to the environment in question for 18 months time. Study 1 had two different substrates available, and Study 2 used nine different substrates. Sample sets were collected, extracted, and analyzed after 0, 3, 6, 9, 12, and 18 months. Any DNA profile obtained was compared to the sample's known profile to calculate percent profile recovery and contamination (designated by the number of additional, unassociated alleles).

JMP<sup>®</sup>, a powerful Design of Experiments (DOE) statistics program, was used to create the test plan of both studies as well as analyze all the data and make correlations between the ability to recover the correct profile and the various factors (time, environment, and substrate) being evaluated. The JMP<sup>®</sup> software is able to analyze a response based on the effects of multiple factors. This type of experimental design and statistics capability is novel for the forensic field and allows the user to interpret a smaller data set with fewer replicates while still determining strong correlations.

After 18 months, the majority of samples were highly degraded and/or contaminated, as would be expected. However, more partial profiles were recovered from blood and oily fingerprints after the extended time period than the other sample types. This study also provides quantitative data for the best substrates from which to recover evidentiary samples, the environments most likely to maintain viable DNA sources, and relative contamination amounts for both. Lastly, this presentation demonstrates the power of JMP<sup>®</sup> Design of Experiments software, a novel tool for large scale studies within forensic-based research.

#### **DNA Recovery, Environmental Effects, Time Study**