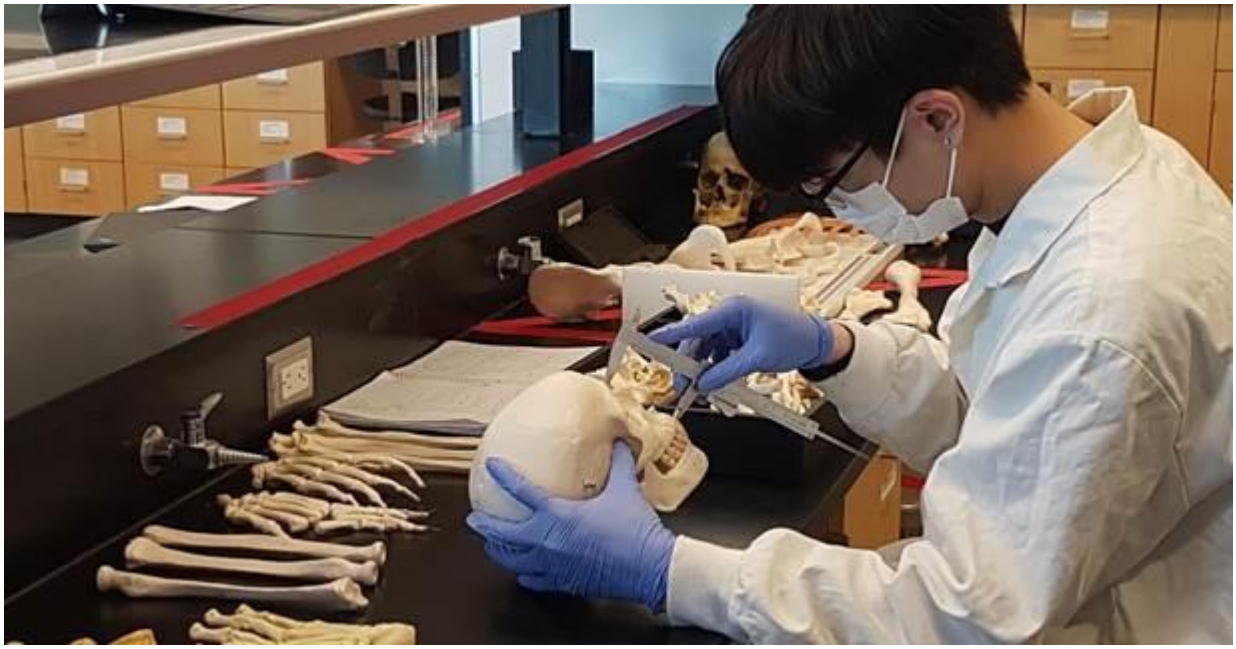
13th Annual

FORENSIC SCIENCE RESEARCH DAY



Friday April 23th, 2021

- Virtual Event -

OntarioTech UNIVERSITY

Ontario Tech Forensic Science Research Day 2021

Program Schedule

8:30 a.m.	Registration	Zoom Waiting Room
8:45 a.m.	Opening Remarks	Dr. Cecilia Hageman, *Undergraduate Program Director & Associate Teaching Professor*
8:50 a.m.	Keynote Address	Kevin Pahor, MSc *Fire Investigations Supervisor, Office of the Fire Marshal and Emergency Management*
9:05 a.m.	Session I	Chair: Dr. Hélène LeBlanc, *Associate Professor*
9:45 a.m.	Session II	Chair: Dr. Theresa Stotesbury, *Assistant Professor*
12:25 p.m.	Closing Remarks	Dr. Cecilia Hageman, *Undergraduate Program Director & Associate Teaching Professor*
	Debrief Session	Dr. Nelson Lafrenière, *Associate Teaching Professor* Bring your own snack for a fun and informal debrief session

The research conducted by our fourth-year students would not have been possible without the support and mentorship of our supervisors and mentors!

Thank you

Mission Statement

The Forensic Science program at Ontario Tech University strives to create an interdisciplinary learning environment dedicated to education, research, and contribution to the forensic community.

The Forensic Science program endeavours to:

- Advance the highest quality of knowledge, skills and abilities through excellence in teaching and a technologically-enhanced learning environment;
- Foster inquiry, critical thinking and scholarship in innovative research by providing access to state-of-the-art facilities and supervision by internationally recognized faculty and professional experts;
- Actively collaborate with industry to produce outstanding graduates who are consistently sought and highly valued by professional partners and employers;
- Command next-generation leaders demonstrating integrity, ethical behaviour, and professional conduct in the field of forensic science;
- Contribute to society through community participation, leadership and outreach initiatives, with the goal of inspiring youth

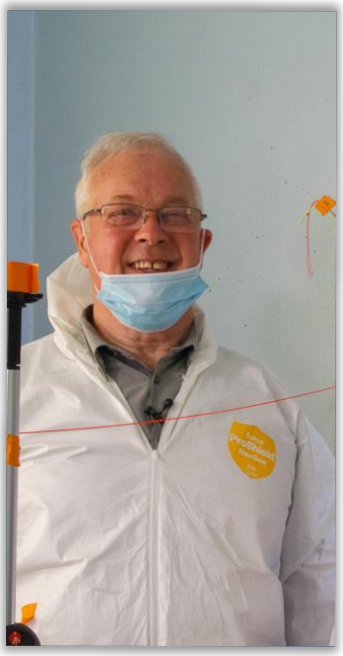
Forensic Science Program Accreditation

We are pleased to announce that our program was successful in obtaining re-Accreditation in February 2019. It is the second such program in Canada granted this distinction by the American Academy of Forensic Sciences' Forensic Education Programs Accreditation Commission (FEPAC).

Follow us on Social media!

@OT_ForensicSci @ot_forensics UOIT Forensic Science

David Robertson is retiring!



Many of you undoubtably know David Robertson. He is an Adjunct Professor in our Ontario Tech University Forensic Science Program. Before joining the program, Mr. Robertson worked for 3 years as an RCMP Special Constable and 36 years as a member of the Durham Regional Police Service.

He served the Durham Regional community in performing general policing duties, branching out into various forensic roles, including acting as a qualified breathalyser technician, a Scenes of Crime Officer, and an officer in the Forensic Identification Unit. Since his retirement in 2008, he has brought to the Ontario Tech Forensic Science Program a wealth of, and passion for, forensic investigative knowledge, scenes of crime procedures, police practices and expert witness testimony.

Over the years David has taught our Introductory Forensic Science, Crime Scene Science and Mock Practicum courses as well as the laboratory curriculum for our Criminalistics courses. David has brought a wealth of experience to the classes he has taught and we are thankful for how David made all of us better at our jobs! His signature sense of humour has never failed to entertain or educate our students. It has been an absolute pleasure working alongside David over the years, especially during mock court trials when David was at his best as a Defense Attorney.

We will miss you David - Happy 2nd Retirement!

- Cecilia, Nelson, Hélène, Kimberly, Stacey, Theresa

Schedule

8:45 **Welcome and Opening Remarks: Dr. Cecilia Hageman**

8:50 **Keynote Address: Kevin Pahor, MSc**

Kevin Pahor is a certified Fire Investigator and is currently employed as a Fire Investigations Supervisor with the Office of the Fire Marshal and Emergency Management (OFMEM). Kevin began his career with the OFMEM in 2013 as a Fire Investigator and commenced his current role in 2018. Kevin had his first experience with fire investigations when he was completing his thesis for the undergraduate Forensic Science program at Ontario Tech University where he worked alongside OFMEM Fire Investigator Greg Olsen, MSc. His interest in the field of fire investigations and partnership with the OFMEM led him to continue his research over the next 2 years where he completed a Master of Science Degree in the Applied Bioscience graduate program at Ontario Tech University, under the supervision of Dr. Shari Forbes. In January 2013 Kevin authored a research paper titled "Post-mortem detection of gasoline residues in lung tissue and heart blood of fire victims' which was published in the International Journal of Legal Medicine. Kevin has conducted over 250 fire and explosion investigations. In his role as a Fire Investigator he has been qualified as an expert witness in the determination of Origin, Cause and Circumstances of Fires and Explosions in both the Ontario and Superior Courts of Justice.

Session I Directed Studies
Chair: Dr. Hélène LeBlanc

The focus of a Directed Studies Project is to *identify* gaps in the research literature. This is achieved by conducting a thorough literature review on a particular subject. Ultimately, the goal is to review the current state of the chosen field, leaving no stone unturned and putting current research into the broader context of forensic science. Students selecting this capstone experience have the opportunity to investigate more diverse subject matter where conducting original research may be difficult. Students are expected to prepare a written document and a 3-minute oral presentation.

9:05 **Cassandra Chase and Nicole Milner**

9:15 **Samuel Goodfellow**

9:20 **Melissa Marois-St Aubyn**

9:25 **Samantha Ringwood**

9:30 **Break**

Session II Thesis Research Students
Chair: Dr. Theresa Stotesbury

The focus of a thesis project is to *fill the gaps* in the research literature. This is achieved by reviewing previous studies, designing an experiment and conducting original examinations. Ultimately, the goal is to contribute novel research to a relevant field of forensic science or broader natural science. Students work closely with either internal or external supervisors who mentor them throughout the course of their work. Students selecting this capstone experience are expected to prepare a written thesis and oral presentation.

9:45 **Jawaid Amini and Tavawn Graham**

10:05 **Benoit Beaudoin**

10:20 **Alyssa Nikkel**

10:35 **Trustin Li and Brandon Matias**

11:00 **Rebecca Lobban**

11:15 **Victoria MacMillan**

11:30 **Muskan Vir**

11:45 **Earl Beleran**

12:00 **Tulsi Rajani**

12:15 **Maryam Fakhori**

12:30 **Closing Remarks: Dr. Cecilia Hageman**

Developing an Automobile Carpet Fibre Database for Ontario - Planning and Preparatory Work

Cassandra Chase [1]; Nicole Milner[1]; Hélène LeBlanc, PhD[1]

[1]Faculty of Science, Ontario Tech University
cassandra.chase@ontariotechu.net; nicole.milner@ontariotechu.net

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The Center of Forensic Sciences (CFS) handles many cases that involve the examination of fibre evidence, which includes vehicle fibres. While fibres are found in every personal vehicle, very few databases exist where vehicle fibre characteristics and manufacturer details can be referenced or used to perform comparison exclusionary analysis of fibre evidence . For this reason, the CFS approached Ontario Tech University, and other academic institutions, to form a research partnership for the planning and implementation of a vehicle fibre database that includes both fibre characteristics and manufacturing details. Therefore, the purpose of our project was to produce systemized fibre sampling methods, along with compete lists of salvage yards and vehicle manufacturers in Ontario, in preparation for the collection and development of the vehicle fibre database.

The first step in the planning process for sample collection was to understand the different types of vehicle carpets that are manufactured. Additionally, the laboratory analysis of the fibre evidence had to be considered when determining the information needed to be inputted into the database. The fibre type, the colour pattern, diameter, and birefringence, chemical composition of the fibre, and the spectrum of a dyed fibre can all be determined using different specialized microscopes. Based on the different types of vehicle carpets manufactured and the most common microscopic techniques used for fibre evidence analysis, two different carpet fibre sampling methods were planned using salvage yards and manufacturing companies.

The preparatory work and documents provided through this project will facilitate the implementation of collection of the vehicle fibres. The completion of the larger project will also include the analytical laboratory analysis of the vehicle fibres, statistical analysis and, finally, the creation of a comprehensive vehicle fibre database. The preliminary steps presented and subsequent research projects will allow the Center of Forensic Sciences to have a reliable source of reference and even increase their capacity for more vehicle carpet fibres to be processed.

A Review Paper on Footwear Impression Evidence: Where We Have Been, Where We Are, and Where We Are Walking Too

Samuel Goodfellow[1]; Hélène LeBlanc, PhD[1]

[1]Faculty of Science, Ontario Tech University
Samuel.goodfellow@ontariotechu.net

1786 was one of the first instances of footwear impression analysis being used in forensic science. Footwear impressions are everywhere, they can be made in many surfaces, such as leaving behind dust as you walk or imparting footwear characteristics into mud. It relies on feature comparison between a crime scene impression and a suspect's shoe. Based on the manufacturing and general wear characteristics, which help narrow down the possible list, and randomly acquired characteristics (RACs) to make the final identification. RACs have four main variables that differentiate them, location, shape, size, and complexity. Two reports, the first presented by the National Academy of Science in 2009 and the second by the President's Council of Advisors on Science and Technology (PCAST) in 2016; worked to bring to light the field's lack of a fundamental scientific basis for comparisons and limited to no use of statistical analysis or probabilities. Next, an academic study noted that admissibility issues have arisen in court around the methodologies used at the crime scene. These factors inspired my critical review of forensic footwear impression evidence, covering the general practices for collection of the crime scene prints, along with a look into the area of uniqueness and reliability of comparisons.

The general practices currently involve the use of 2D lifting techniques, physical and chemical visualization techniques, and 3D casting techniques. Within the area of uniqueness and reliability, a comparison was done between how studies approached the topic before and after the two reports were released. There was determined to be a gap in the studies before the reports, as they did not properly define or come up with criteria for uniqueness, not using statistics or probabilities based on the characteristics of RACs. Instead relying on the difference between characteristics in small populations of footwear. However, recent studies conducted after the reports were released, have changed focus onto applying algorithms and statistics to RAC databases. With the purpose of determining the likelihood of the impression having RACs with the same distribution, shape, and size, as the suspect shoe.

The Fairness and Effectiveness of Video Testimony in the Courts

Melissa Marois-St Aubyn [1]; Hélène LeBlanc, PhD[1]

[1]Faculty of Science, Ontario Tech University

melissa.maroisstaubyn@ontariotechu.net

In March 2020, due to the spread of the recently identified coronavirus, courts around the world began exploring and implementing ad hoc alternative ways of delivering court services remotely. As a result, there was significant uptake in a number of technological solutions, especially video conferencing. While the changes from physical courts to remote hearings have been extraordinary, this shift has created significant challenges for the justice system. Remote courts have never been tried before on so large a scale. The effect of going virtual for people in the court is still largely unknown. As a result, there is a large amount of scepticism on the impact of these changes on whether remote courts can maintain the fairness and effectiveness in the delivery of judicial services.

In an attempt to find answers to this question, I reviewed a number of empirical research papers, the outcomes of remote hearings court cases, a number of scholarly and Peer Reviewed articles on this subject. My research focused on four key aspects, which were:

1. what we do know about the current state of the online courts and how we can use this experience to inform future direction;
2. what we do not yet know about the impact of this shift to online courts;
3. a number of benefits that we should embrace and enhance as we move forward; and
4. the shortcomings, which if not addressed immediately could damage the core values of an efficient judicial system.

The question "Are remote courts fair and effective" – resulted in contradictory answers. These answers depended on peoples' experiences with and perceptions of the remote court systems. However, while the changes from physical courts to remote hearings have been extraordinary, it is still too early to respond with a resounding YES. Our remote courts systems were hurriedly put together to ensure continued access to justice, so it is not unreasonable to find that glitches and missteps inadvertently have some adverse consequences.

Though video conferencing technology has been a valuable tool during the COVID-19 pandemic, we do however need to be cautious about the expansion or long-term adoption of remote court proceedings. Research so far has been somewhat limited, so significantly more research and consultation with stakeholders are necessary.

Canadian Society of Forensic Science: Electronic Document Management

Hannah Bastien [1]; Kimberly Nugent, Msc[1]

[1]Faculty of Science, Ontario Tech University
Hannah.bastien@ontariotechu.net

Speaker presented their work earlier in the week and is unable to participate in today's event.

The Canadian Society of Forensic Science (CSFS) was founded in 1953 by Inspector James A. Churchman, Dr. Charles G. Farmilo, Dr. Leo Levi, Dr. Blake Coldwell, and Staff Sergeant William W. Sutherland. The purpose in forming the CSFS was to facilitate forensic scientists coming together to network with one another. The current mission of the Society is to promote research, bring more awareness of forensic science to the general public, and to support education in the various disciplines of forensic science. In its operations over the last sixty-eight years, the Society has produced a plethora of hard and soft copy materials, a natural product of its day-today activities. The objective of this project was to support the preservation and history of the Society, through the development of a document management system. Digitizing physical documents was identified as a priority for the 2020-2021 board of directors. Physical documents were obtained from the Society office and scanned using a Canon TR4500 series printer and scanner. Digitized images were of good quality and were temporarily stored in a shared electronic drive. This is just the start to bringing the Society into the twenty-first century. Next steps for this project would be to continue to digitize hardcopy materials and examine the implementation of a document management program to efficiently deal with the Society's record and documents, past-present and future.

The Canadian Society of Forensic Science: Supporting the Standing and Advisory Committees

Samantha Ringwood [1]; Kimberly Nugent, Msc[1]

[1]Faculty of Science, Ontario Tech University
Samantha.ringwood@ontariotechu.net

The Canadian Society of Forensic Science (CSFS) is composed of several committees that manage the affairs of the Society. The Society consists of Board of Directors, an Executive Committee, five Standing Committees, two Advisory Committees and ten Scientific Sections. Together the Board of Directors and the Executive Committee manage the day to day business of the organization. The five Standing Committees are the Membership Committee, Publications Committee, Finance Committee, Nominating Committee, and Awards Committee. The responsibilities of the Standing Committees are determined by the CSFS. The duties of the Advisory Committees are focused mostly outside of the CSFS. The Alcohol Test Committee and the Drugs and Driving Committee are the two Advisory committees and they are responsible for advising the Canadian Department of Justice.

A current priority of the CSFS Board of Directors is to provide additional support to the Standing and Advisory Committees. The focus of my project was to research electronic storage options, review Canadian Privacy legislation and create policy checklists specific to each committee in order to bridge the gap between the policy manual and the day to day activities of the committees. Next steps for this project would be to present the recommended storage solution as well as the policy checklists to the Board for approval. Together the electronic storage and policy checklists should assist the CSFS committees and provide better support to their members.

Assisting in Training Biologists to Provide Quality Forensic Biological Services for the West Bank and Gaza

Jawaid Amin [1]; Tavawn Graham[1]; Cecilia Hageman, PhD, LL.M[1]

[1]Faculty of Science, Ontario Tech University;
Jawaid.amini@ontariotechu.net; Tavawn.graham@ontariotechu.net

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The training program of a forensic biology laboratory needs to meet certain requirements to promote a high standard of performance by its personnel. This is of importance when dealing with criminal casework where a person's liberty is at stake in a court of law. In this project, we assisted Valerie Blackmore and Dr. Cecilia Hageman of the Wyndham Forensic Group in a United Nations – based initiative in training biologists in the Palestinian Forensic Laboratory, with the overall goal to build capacity for forensic biological services to be performed for justice system authorities in the West Bank and Gaza.

We reviewed literature on the quality management systems and accredited standards followed by forensic laboratories around the world, as these principles can potentially be followed by forensic laboratories in the State of Palestine. Our main duties as assistors in this project were to prepare materials for training purposes in accordance with the ISO accredited standards in the training manual. Such materials included competency tests for biological fluid identification, question and answer problem sets based on lecture materials, re-write of the both the evidence handling and transfer and persistence of biological material modules of the training manual. The scientists-in-training were provided a monthly lecture schedule in which they would attend and learn the theory of DNA analysis, population genetics and body fluid identification. To accompany the theory, problem sets prepared for additional practice and assessment. Our duties also included the production of educational training videos on biological fluid identification tests. All of the laboratory work completed in this project – preparing the competency tests and educational training videos – were performed in the forensic science laboratory at Ontario Tech University. In addition to preparing materials for training purposes, we also provided teaching assistance during some of the lectures. This project reveals that remote training of scientists in another country is possible, but can be challenging.

The Extraction and Analysis of Cannabis Products Addressing Both Industrial and Law Enforcement Needs

Benoit Beaudoin [1]; Cecilia Hageman PhD, LL.M[1], Valerie Blackmore, MSc[2]

[1]Faculty of Science, Ontario Tech University, [2] Wyndham Forensic Group
benoit.beaudoin@ontariotechu.net

Rapid growth of the *Cannabis* industry through its recent legalization in Canada and many parts of the United States has led to a mostly non-standardized approach to product authentication and traceability. The explosion of Cannabis into the legal market has fast-tracked producers and growers into product delivery but left many regulatory concerns behind. Issues surrounding strain naming and product consistency have grown with limited systems in place to address them. Recent research has explored this issue through the individualization of Cannabis products utilizing either chemotyping or genotyping technology. These approaches seek to differentiate Cannabis products through either metabolomic or genetic profiles, respectively. The current study will explore a combination of these systems proposing an initial workflow for the individualization and characterization of Cannabis products through both chemotyping and genotyping analysis. Multivariate analysis of data will individualize samples through clustering supported with further characterization using phylogenetic and metabolomic data.

Furthermore, initial development of colorimetric assays addressing industrial growing and contamination concerns will be outlined. Male and female leaf samples will be differentiated through Sex-Typing assays while Powdery mildew contaminated samples will be identified. In summary, initial workflows will be outlined and tested to address developing concerns within the Cannabis industry. Cannabis products of various matrices will be individualized and tested through developmental assays and workflows for the practical use within today's industry.

A World-Wide Industry Scan of Wildlife Forensic Testing

Alyssa Nikkel[1]; Cecilia Hageman PhD, LL.M[1]

[1]Faculty of Science, Ontario Tech University
Alyssa.nikkel@ontariotechu.net

Wildlife forensics is the testing of non-human biological materials to aid in the investigation of both wildlife crimes and crimes involving domestic animal-human relations. Wildlife crime is the ill-treatment and illegal trade of both wild flora and fauna against national or international law. The illegal wildlife trade constitutes a significant part of both national and trans-national crimes. Wildlife forensic testing seeks to answer the questions of the species involved, individual animal identification, the population of origin, the sex, and in some cases the parentage of the individual animal.

This review presents and considers information from current scientific literature, governmental bodies, and both national and international corporations to establish the current practices within the wildlife forensic discipline. The information shows an increase and improvements in the number of new testing techniques, standardized kits, and quality assurance measures. New testing techniques include metabarcoding using validated next generation sequencing procedures. Validated commercial kits for the purpose of individual identification and parentage testing have been made available for canine, cattle, and equine species. A push towards standardized methodology within the discipline has been started by the Organization of Scientific Area Committees Wildlife Forensic Biology Subcommittee who have nine standards published by a Standard Developing Organization and another eight standards under development.

The Development of Interactive Practical Curriculum for an Undergraduate Forensic Science Program

Trustin Li[1]; Brandon Matias[1]; Nelson Lafrenière, PhD[1]; Kimberly Nugent, MSc[1]

[1]Faculty of Science, Ontario Tech University
king.li@ontariotechu.net; brandon.matias@ontariotechu.net

With the onset of the COVID-19 pandemic, many institutions have shifted their focus to providing high quality remote education opportunities. There is a severe lack of compelling, interactive online educational resources available for undergraduate forensic science programs. To meet this glaring need, a learning resource with interactive elements was created.

A mock crime scene scenario was developed, and subsequently digitized using photogrammetry and laser scanning technology. Using a Nikon DSLR D7200 and a FARO 3D Scanner, three-dimensional models of Ontario Tech University's Crime Scene House as well as several crime scene elements (e.g. knife, mannequin, shoes, bloodstains) were created. These elements are to be used in conjunction with photographs, original technical videos, worksheets, and other demonstrative aids in order to teach students the necessary skills required within the field of forensic science.

When packaged together, these assets will provide users an opportunity to explore the crime scene house through 57 perspectives; five of which were for the master bedroom where the mock crime occurred. Through the completion of this learning object, students will be able to hone and reinforce their practical skills in a virtual environment. Future incorporation of bloodstain pattern analysis may further enhance the learning resource to better supplement forensic science curriculum. Collection of anecdotal and empirical data regarding user satisfaction and learning may also help determine whether or not a virtual platform is capable of providing educational content to the standards and guidelines set by professional organizations such as the Organization of Scientific Area Committees for Forensic Science.

Forensic Experts in Canadian Criminal Courts – A Critical and Statistical Analysis

Rebecca Lobban[1]; Cecilia Hageman PhD, LL.M[1]

[1]Faculty of Science, Ontario Tech University
Rebeccamarie.lobban@ontariotechu.net

Expert witness testimony can be crucial to the outcome of a criminal case, possibly even the difference between conviction and acquittal. Still, little is actually known about key metrics concerning the use of forensic experts in the Canadian legal system. While it is understood that experts are used, the questions become; What are they testifying about? Where are they coming from? What types of cases are they testifying in? This study was completed to begin this kind of research on forensic expert testimony in Canada.

Qualitative and quantitative analysis was used to explore criminal cases for information on the use of expert testimony. The CanLII search engine was used to find suitable Canadian criminal cases from Alberta, British Columbia, Nova Scotia and Ontario within the past 20 years. After analyzing the cases and extracting relevant expert witness data, statistical analyses were performed to determine potential data trends and areas of future research.

Toxicology showed its prominence and versatility in the legal system with it accounting for 31% of all expert testimonies. Other notable disciplines included biology at 19% and entomology at just 0.1%. Traffic crimes (48%) represented the top category in expert usage but when grouped into categories, the violent crimes – murder, assault, sex crimes – accounted for 48% of cases. Another important detail was where these experts came from. The research revealed, for the four presented provinces, 17 different expert sources and of these, the Centre of Forensic Sciences in Ontario contributed the majority of expert witnesses (24%).

These data present a snapshot of the current use of expert witness testimony in Canada. It is an informative look into the importance of experts, and their evidence, on the outcome of criminal cases. These results have the potential to be very useful in future decisions on forensics as a career and an education. The next step could be to complete this research in the remaining Canadian provinces and territories to obtain more inclusive data for the country.

The Application of Force Plate Technology for the Forensic Examination of Stamping Devices

Victoria MacMillan[1]; Kimberly Nugent, MSc[1], Ryan Foley, MSc[2], Tobin Tanaka[3]

[1]Faculty of Science, Ontario Tech University, [2]Faculty of Health Science, Ontario Tech University, [3] Government of Canada – Canada Border Services Agency
Victoria.macmillan@ontariotechu.net

Stamp impression examination has been an important part of forensic document investigation for many years. However, there is very little research documenting the force application on stamping devices and the corresponding effects on impression quality. The goal of this study was to investigate the resultant forces from stamped impressions using force plates. The application of force plate technology was successful in quantitatively determining the forces applied in both horizontal and vertical axes of the stamping process. Different conditions such as stamp types (traditional hand stamp and self-inking), hand positions and application techniques were evaluated to assess their influence on resultant forces. Qualitative characteristics including die edges, rebound and partial missing ink were also assessed to determine the quality of each stamp impression.

Force ranges for creating expected ideal impressions were able to be determined for most trials tested. The self-inking stamp did not produce any nonideal impressions when maximum force was inflicted on the stamping device. The largest traditional hand stamp produced the largest force range for creating ideal impressions from 9.98 ± 5.32 N to 80.4 ± 10.6 N. The different conditions tested correspond to different resulting force ranges. Reproducibility tests were performed over three days to determine if the forces required to produce a stamped impression can be considered consistent. All tests resulted in significantly different results under all conditions. The smallest traditional hand stamp produced the highest probability of reproducing an ideal impression.

Can a 3D Printed Rubber Stamp Recreate an Original Rubber Stamp Impression

Muskan Vir[1]; Kimberly Nugent, MSc[1], Tobin Tanaka[2]

[1]Faculty of Science, Ontario Tech University, [2] Government of Canada – Canada Border Services Agency

Muskan.vir@ontariotechu.net

Stamp impression examination is an element of questioned document examination where the unique characteristics and defects on rubber stamps play an important role in stamp impression examination. Current research is lacking in cloning stamps and whether it is possible to replicate a stamp's impression using a 3D printer using only the original inked impression. This research will investigate if duplicating a stamp using 3D printing is possible. A control stamp's impression was taken and scanned using a HP Deskjet 1513. A 3D model was generated using Ultimaker Cura 4.8.0. The 3D model was printed using thermoplastic polyurethane and the model was adhered to a plastic handle. Ink was applied to the 3D printed stamp surface and was stamped on white paper on various surfaces. Results were recorded using a modified 5-point Likert scale. It was observed that while it is possible to create a 3D printed stamp from a stamp impression, the material used to 3D print plays an important role in how well the ink is transferred from the stamp onto the paper. Further research should explore using a variety of 3D printing materials and inks to determine which combinations yields optimal results.

The Effects of Post-Mortem Interval (PMI) on *Sus domesticus scrofus* Concealed in Different Types of Vehicles

Earl Beleran[1]; Angela Skopyk, BSc[1], Hélène LeBlanc, PhD[1]

[1]Faculty of Science, Ontario Tech University
earl.beleran@ontariotechu.net

During death investigations, forensic entomology is used to help determine the minimum post-mortem interval after conventional pathology methods are no longer reliable.

Although there have been extensive studies on cadaver decomposition in an open environment, there are limited publications with reporting the decomposition process and insect succession in an enclosed environment (i.e. a vehicle). Decomposition in the trunk of a vehicle will result in a delay of insect colonization due to limited access points for the insects to the body, this enclosed environment will also generate temperatures different to those in an open environment, which results in an altered rate of decomposition.

This study was conducted in southern Ontario, Canada, by three Ontario Tech University research students, for two consecutive summers using pig (*sus scrofa domesticus*) carcasses of similar biomass (25-27 kg). Two different vehicle models were used for each summer, a 1996 Volkswagen Jetta and a 1996 Pontiac Sunfire. For both experiments, the experimental pig carcass was placed in the trunk of the vehicle and a control carcass was positioned 20 metres from the vehicle on the soil in an open field with no shelter. Data loggers were placed inside the vehicles to record trunk and cabin temperatures as well as humidity. Moreover, ambient temperatures, humidity, and rainfall were obtained from a weather station located near the control carcass. To prevent the introduction of insects into the vehicle, sampling methods were developed to investigate the delay of insect colonization, insect succession patterns, and the general decomposition process of the carcasses.

The results from both studies exhibited a delay of insect colonization of the pig carcasses inside the trunk of the vehicles of up to five days and the diversity of species has greatly reduced throughout the decomposition process. Elevated temperatures recorded inside the trunk and the accumulation of ammonia gas, this resulted in the high mortality of insects. Although similar vehicle models were used (sedan), differences in colonization delays were present on the experimental pigs. Therefore, it is important to consider the vehicle model when conducting such a study.

Analysis of Volatile Organic Compounds Associated with the Decay of *Sus scrofa domesticus*

Tulsi Rajani[1]; Angela Skopyk, BSc[1], Hélène LeBlanc, PhD[1]

[1]Faculty of Science, Ontario Tech University

tulsi.rajani@ontariotechu.net

Volatile organic compounds (VOCs) play a key role in the study of taphonomy as the compounds that are evolved during the decomposition of organic materials. The process of decomposition is complex, and its understanding is guided by VOC research which allows insight into the specific processes that occur. Some of these compounds act as semiochemicals that influence the behaviour of necrophagous flies that often lay eggs on organic tissues. Therefore, VOC research is important in understanding decomposition and insect succession patterns onto remains, which have implications in forensic entomology and the detection of cadaveric remains. Decomposition is classified into five stages that allow for categorization of the processes that occur: fresh, bloat, active decay, advanced decay, and skeletonization. This project is an analysis of the VOC profiles collected from the headspace of *Sus scrofa domesticus* from two previous studies. Study 1 occurred in September 2016 and included two pigs, and Study 2 took place in September 2019 and included 3 pigs. The VOC profiles collected will be analyzed and compared to each other as well as information from the literature. Headspace samples were collected over the process of decomposition and analyzed with gas chromatography mass spectrometry to identify the chemical species and the time during decomposition when they were produced.

These profiles showed key differences in the type of compounds produced during decomposition. In the comparison of the two studies, there were large differences in temperatures. The compounds that were identified in Study 1 showed greater prevalence of different types of nitrogenous compounds and alcohols that was not seen in Study 2. In addition, the pigs in Study 2 never reached the skeletonization stage and instead remained in the advanced decay stage until the analysis terminated, which is likely the reason why the greatest number of compounds were detected in this stage in Study 2. Similar to the literature, the largest ranges of compounds in Study 1 were detected from the onset of the bloat stage through to the end of active decay. The most prevalent semiochemicals were dimethyl disulphide (DMDS) and dimethyl trisulphide (DMTS), which were first detected in the bloat stage, which is as seen in previous studies. Overall, variations between the two studies are attributed to differences in temperature that affected the decomposition process. In addition, the quantity of semiochemicals evolved were measured, showing patterns consistent with literature.

Volatile Organic Compounds Released from Degrading Bloodstains Created Using Bovine Blood

Maryam Fakhori[1]; Theresa Stotesbury PhD[1]

[1]Faculty of Science, Ontario Tech University
Maryam.refaatfakhori@ontariotechu.net

This research explores the untargeted analysis of volatile organic compounds (VOCs) using solid-phase microextraction-gas chromatography- mass spectrometry (SPME-GC-MS) of bloodstains created using bovine blood. Prior to VOC analysis, the fluid properties of the bovine blood were measured. Viscosity, packed cell volume (PCV%), viscosity and surface tension and were found to be comparable to the reported ranges for human blood at 37°C with slightly lower values surface tension and relative density. The SPME-GC-MS method optimized for this experiment used a 65 μm DVB/PDMS fiber exposed to 1 mL of bovine blood for 60 minutes at 40°C. The GC oven ramp method started at an initial temperature of 35°C held for 1 minute then was ramped to 80°C at 3°C/min followed by another ramp to 250°C at 20°C/min. Upon method development for bovine blood samples VOC profiles were collected from bloodstains allowed to degrade in ambient conditions over the course of 240 hours. VOCs were identified using NIST 20 Mass Spectral Data Base. A total of 28 tentatively identified VOCs were monitored in a triplicate time study. Persistence profiles of the identified VOCs were assessed. The degraded bloodstains present a more complex VOC profile in comparison to fresh bovine blood as many chemical species evolved over time as well as increased in relative abundance. For example, degraded bovine bloodstains contained more alcohols and aldehydes while fresh blood presented a VOC profile consisting of mainly chained hydrocarbons, aromatics, and ketones. This study supports future forensic research in building time series models to determine time since deposition (TSD) of bloodstains. We recommend continued research in VOC analysis in order to full assess the acceptability of bovine blood as a human blood simulant for research and training.

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