
The newsletter of the Society for Wildlife Forensic Science

Vol. 8 No. 1 | March 2023

# SWFS NEWS

Inside this edition: Wildlife Forensics in the Czech Republic, Coral Identification, Tree Thieves & Ivory Workshop

## The First Solely Wildlife Forensics Facility in the Czech Republic

*By Pavla Rihova*

A new specialised university workplace focused on applied research of forensic methods used for evidence in cases of crime against wildlife was established on the grounds of Charles University in Prague, Czech Republic. The Centre operates as a consortium of two research institutions – the Institute for Environmental Studies of Charles University's Faculty of Science and the Nuclear Physics Institute of the Czech Academy of Sciences (CAS) cooperating with other experts from both public and private institutions. The Centre's main aim is to provide expert assistance to Czech authorities while researching and developing the most needed forensic methods. The Centre's staff involves scientists and practitioners, including judicial experts and former wildlife enforcement officicers. Such an approach interconnecting scientific capacities and applied practice enables effective research targeting and increases the quality of professional support for investigations.

All five research teams of the Centre are currently closely collaborating on the implementation of the project ForWild: Effective use of forensic evidence methods to combat wildlife crime (project n. VJ01010026), financially supported by the Ministry of the Interior of the Czech Republic within the programme Strategic Support for the Development of Security Research 2019-2025 (IMPAKT 1). The research focuses on forensic techniques in morphology, genetics, stable isotopes, radionuclides, and chemical analysis and tries to combine and standardise the methods used. The primary target research species were selected with reference to cases investigated in the Czech Republic in recent years, e.g., tiger killing and trade in tiger products (Operation Trophy, 2018), poaching and trade in trophies (Operation Hunter, 2019), trade in rhino horns (Operations Osseus, Rhino, Cube) and ivory (Operations Ebur, Mammoth), etc.

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# Welcome from the SWFS President

Dear SWFS Members,

Welcome to the March 2023 edition of the SWFS Newsletter.

I hope this newsletter finds everyone enjoying the first few months of 2023. The last six months have been busy for the wildlife forensic science community.

A few highlights include the SWFS 2022 Conference held in Ashland, OR. The inaugural SWFS meeting took place in 2010 in the same location and I have to say it was very exciting to see how the Society has grown in both membership and scientific development over the last twelve years. A very special thank you to the National Fish and Wildlife Forensic Laboratory for hosting the conference. You can read more about the SWFS conference in a couple different articles later in the Newsletter.

To start this year off the SWFS membership portal went through a major overhaul. This website project was launched to help correct a few issues that were being reported concerning membership. Primarily, members were receiving emails at random urging them to renew when their membership was in good standing. Once it became apparent that this was not an easy programming fix we hired our trusty web designer to rebuild the membership system. Though the interworking of the website is not seen by most members, every member will benefit from the changes in programming.

The last highlight I will mention is the SWFS Timber proficiency program. The timber community has been working hard with Dr. Ed Espinoza and the SWFS Proficiency Test Board to launch a proficiency test program. This was accomplished in 2022 and included participants from various disciplines including Anatomy, Machine vision, Genetics and Chemistry. Currently, interest in the 2023 test is being collected. The hope is to send the testing kits out the last week of May.



www.wildlifeforensicscience.org

# Welcome from the SWFS President

Lastly, this will be my final SWFS message as President of the Society, I would like to take the opportunity to thank every one of you who have volunteered your time to help share the news and scientific advances of SWFS. Your contributions help make our Society stronger and I thank you for that.

As always, I would like to extend my gratitude and thanks to all of you that have contributed to the SWFS Newsletters, as well as to the production team that puts this wonderful periodical together.

Gratefully,

Tasha Bauman

## IN THIS ISSUE





# The First Solely Wildlife Forensics Facility in the Czech Republic

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Carbofuran samples -photo Dominika Formanova

Lion skin - photo Zdenek Novak

The departments are equipped with advanced technologies and analytical techniques. One of the unique facilities used by the Centre's Radiocarbon research team is the first laboratory of accelerator mass spectrometry (AMS) in the Czech Republic equipped with the MILEA (Multi-Isotope Low-Energy AMS) System. This team focuses on radiocarbon dating determining the age of wildlife specimens (f. e. ivory, hunting trophies, bones…) which can help to distinguish between legal and illegal products.

As well as in radioisotopes, analyses of stable isotopes can benefit the Centre's research area. Our Stable isotopes team focuses on using stable isotopes in animal tissues to determine or exclude the declared geographical origin of animals or distinguish between captive-bred and wild-caught individuals. Moreover, the team studies how isotope analyses work in reptiles as ectothermic vertebrates, whose metabolism differs from that of mammals and birds.

The Genetics research team successfully followed up on another project named TigrisID: Applied genetic research of selected animals protected by international treaty CITES - development of forensic methods applicable as a tool against organized crime and environmental crime on national and international level (project n. VH20182021028), financially supported by the Ministry of the Interior of the Czech Republic within the Security Research Program for State Needs in the Years 2016-2021. TigrisID project was mainly focused on species determination and individual identification in live tigers and tiger products, including heavily processed products such as tiger glue. Within the ForWild project, the team expanded the spectrum of tested animal species to other selected felid species and bears.

Lynx shooted - photo Pavla Rihova

Genetic species identification can be quite pricey. As well as other previously mentioned analyses, it is used only when there is no other possibility of getting the answers. Therefore, the assessment by the Morphological team is the first examination process undergone by all seized evidence received by the Centre. Most illegal trade does not involve whole animals but only body parts, fragments, or products that lack the characteristics described in the literature. This team's research currently focuses on marks usable in the determination of mammalian osteological material and epidermal derivatives (claws, horns, teeth) of the most frequently traded species.

Moreover, the Morphological team also closely cooperates with

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# The First Solely Wildlife Forensics Facility in the Czech Republic

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Killed otter - photo Pavla Rihova

the Czech Ornithological Society (CSO), the Czech national Partner of BirdLife International. Together, they are working on another project named ForSample: The methodology of collecting forensic samples in wildlife crime cases (project n. SS05010146), financially supported by the Technology Agency of the Czech Republic within the programme Environment for Life. The project aims to develop a specialized methodology for collecting and documenting wildlife forensic samples in the Czech Republic.

The Morphological team is not the only department of the Centre that cooperates with the CSO. Every year, dozens of poisoned birds of prey, wild carnivores, domestic dogs, and cats are found in the Czech Republic. Most of them are discovered by a specialized unit of the CSO involving detection dogs. However, the clearance rate for these acts is low. The Chemistry team is trying to help to change these unsatisfying statistics. It aims to find a method that would be able to compare whether a composition of a product found at a suspect person corresponds to the product used to kill the poisoned animals. The team currently focuses on carbofuran as the most frequently used poison for such purposes in the Czech Republic.

Tiger skin during assessment and sampling
photo Vit Lukas

Morphological identification - photo Zdenek Novak

There has been no similar facility in the Czech Republic so far. The Centre implements a completely new and unique approach that reflects the requirements of the Czech Action Plan for combating illegal trade in endangered species of animals and plants approved by the Czech Government in January 2020. We are open to collaboration and exchange of experience with similar workplaces worldwide. Moreover,

Tiger skin during assessment and sampling
photo Vit Lukas

the registration of the Centre at the CITES Secretariat as scientific and forensic institution simplifies the possibility of sharing samples of CITES-protected species.

In case of interest in cooperation, do not hesitate to contact our joint contact person of the Centre - Pavla Rihova (pavla.rihova@natur.cuni.cz).

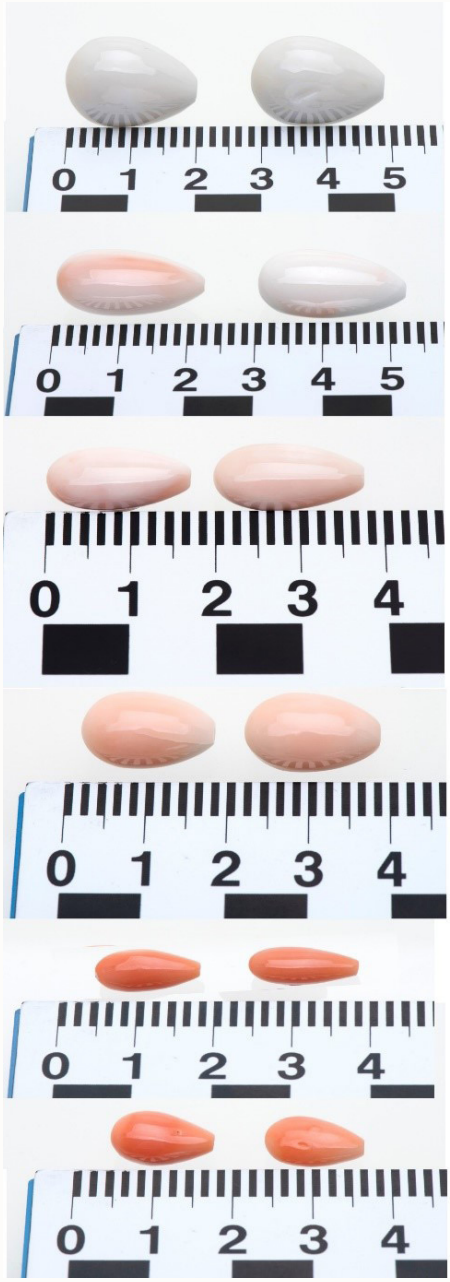
You can also take a look at our website: https://forensics.natur.cuni.cz/.

Wolf skin - photo Pavla Rihova

# Genetic identification of precious coral objects - a new tool for gemologists and law enforcement officials

*Bertalan Lendvay – Zurich Institute of Forensic Medicine, University of Zurich, Switzerland*

Corals have been used in jewelry and as carved adornments for many centuries. These biogenic gems are the cut and polished inner calcite skeleton of marine Anthozoan colonies. The most common and most valuable coral gems originate from red, pink and white deep-sea precious coral species of the Coralliidae family. It takes decades until coral colonies reach the size when they can be harvested, hence corals are slowly renewable resources. Due to their long-lasting fishing, some coral populations have declined dramatically. Among the efforts to protect coral resources, four coral species have been put on CITES Appendix III. This means that the international trade of any specimen or part of these species requires a certificate of origin issued by the management authority of the exporting country for customs clearance. Precise species identification would therefore be a prerequisite for releasing accurate CITES documentation. However, gemologists and customs officers have hitherto been doomed to rely exclusively on the objects' color to identify their species, which is a weak approach due to the similar or even identical colors of different species.



The controversies surrounding precious coral jewelry, most importantly the difficulty to identify if an object originates from a CITES listed species, have caused headache to members of the gemologist community for years. This made scientists of the renowned gemstone-testing laboratory Swiss Gemmological Institute SSEF to approach the Zurich Institute of Forensic Medicine, and the two institutes launched joint research activities to develop methodologies that allow the identification of corals from jewelry using genetic methods.

Genetic analysis of coral jewelry is a difficult task for three main reasons: (1) only the minimally necessary amount of material can be removed "quasi non-destructively" from drill-holes or back-sides of the objects, (2) coral skeletons only contain minute amounts of trace environmental DNA that were deposited decades ago, (3) precious corals are a diverse family containing cryptic- and morphospecies, and species complexes with exceptionally slowly evolving mitochondrial genome; therefore commonly used genetic markers show little or no variation.
As there were no existing protocols about how to effectively retrieve DNA from the skeleton of precious corals, we started our work by looking for a suitable DNA isolation technique that reliably yields pure DNA even from minute amounts of coral powder (less than 10 mg in weight). We compared five different candidate methods and concluded that the best one is one initially developed to recover DNA from ancient bones. This method yielded PCR products from all 25 tested samples when using 100 mg coral skeletal powder and amplifying a

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# Genetic identification of precious coral objects - a new tool for gemologists and law enforcement officials

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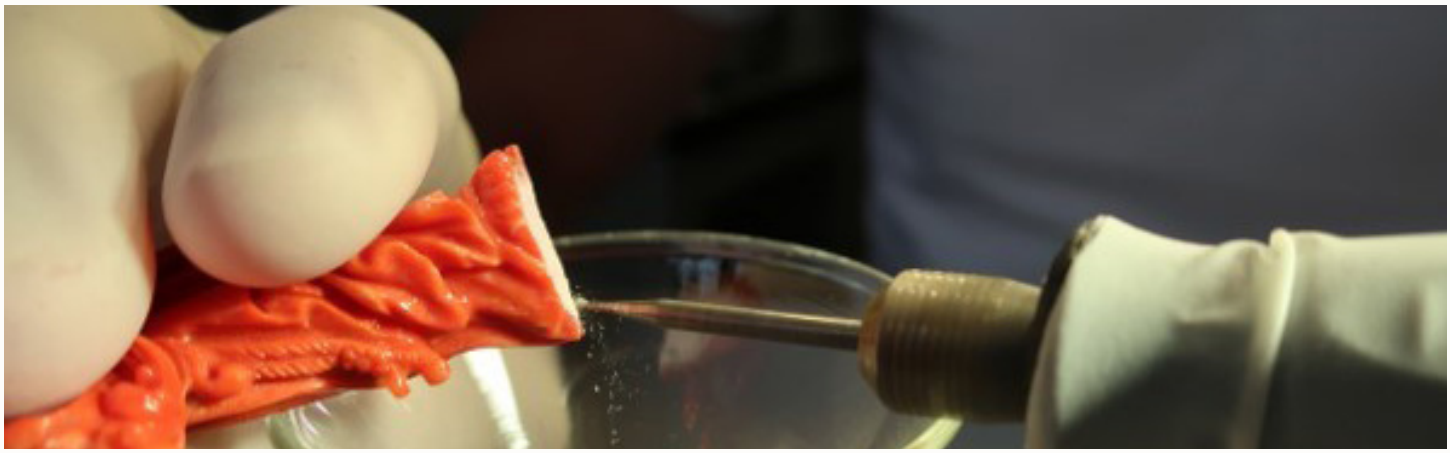


short mitochondrial gene fragment. Results of quantitative PCR showed that in several samples extremely few, less than 10 DNA copies per microliter DNA isolate were present. When applying quasi non-destructive sampling, we had amplification in two-third of the cases. The very low DNA concentration in a part of the samples is not surprising as a significant fraction of corals are fished already dead and degraded.

In the next phase of our research, we developed and validated a genetic method for distinguishing CITES-listed species from non-CITES-listed species. We defined six genetic groups that are possible to distinguish based on a single short DNA sequence. The mitochondrial genomes of three CITES-listed species are identical to different non-CITES-listed species over several kilo-base long fragments meaning that these species are genetically not distinguishable. However, these species can still be presumptively identified with high confidence based their color and geographic distribution.

We tested our method on 20 precious coral objects confiscated by the Swiss customs authorities and applied it on several jewelry objects submitted by clients to the SSEF for testing. We see a two-fold application of coral testing: firstly, for wildlife forensic casework, and secondly, for jewelry companies and owners for origin certification. Both ways, we hope that our method will contribute to the responsible use and trade of precious coral material. From a geneticist's point of view, the specialties of this analysis are the sampling and the sensitivity of the analyses. The coral objects need to be handled with great care during sample collection not to compromise their market value. The collected coral powder can be considered extremely low copy-number samples and we use 50 amplification cycles by default, which also means that special attention has to be paid all times not to introduce contamination.

For further reading:

Lendvay et al. (2020) DNA fingerprinting: an effective tool for taxonomic identification of precious corals in jewelry. Scientific Reports 10: 8287

Lendvay et al. (2022) Coral-ID: A forensically validated genetic test to identify precious coral material and its application to objects seized from illegal traffic. FSI: Genetics, in press

# Conference Overview

Author: Shane Sturrock, Institute of Environmental Science and Research Limited (ESR)

SWFS 2022 gave a fascinating view of the varied issues and solutions facing our field. With around 70 presentations this year, covering morphological, DNA and protein species identifications, along with methods based on various mass spec techniques and stable isotope analyses, talks demonstrated innovative approaches to the issues presented in forensic science in general, but with the added complications of dealing with wildlife materials from many species, frequently highly endangered and protected, that have been processed in ways that make our work extremely diverse. From the first keynote on the restoration and protection of condor whose population had declined to just 22 individuals in the 1980's, each presentation represented examples of the variety of work from groups being challenged by poaching, illegal trafficking, or the processes of decomposition and insects associated with it.

Of course, we're still seeing issues with insufficient reference data and needing validated sources suitable for court cases, not to mention a number of organisations creating their own proprietary databases although this is largely driven by the lack of available high quality public sources.

Some talks looked at using technologies like high throughput sequencing but there's still a lot of Sanger out there which isn't surprising given how conservative forensics can often be, and yet the interesting thing is how these new technologies can transform our ability to sequence and identify material. There's also the issue of not just species identification, but also individual animals and talks looked at how sample collection can allow forensic scientists to ensure the correct individual has been found through the use of saliva on clothes from animal attacks for example.

Timber poaching and tree identification was particularly notable with the extraction of DNA from heart wood being a challenge possibly solved through the use of non-thermal ultrasonic acoustic cavitation getting comparable amounts of DNA more quickly than conventional methods. A particular use case example being DNA pulled from tree stumps and compared with logs from illegal activity.

In addition to the talks, other activities included a visit to the National Fish & Wildlife Forensic Laboratory in Ashland where vistors were shown the new mobile lab capable of identifying wood through the use of a DART TOFMS machine, but also inexpensive hand held devices. Attendees were also treated to a tour of the facilities and seeing the Xylarium where they keep a library of wood samples as a reference set and the collection of various collected samples of ivory, animals, birds and so on.

It wasn't all work of course as Halloween in Ashland is amazing to those of us who don't normally experience it and much of the town dressed up for a large parade through the streets. The meet and greet at the local Caldera brewing company got the ball rolling too and we all grabbed our best finery for the masquerade banquet.

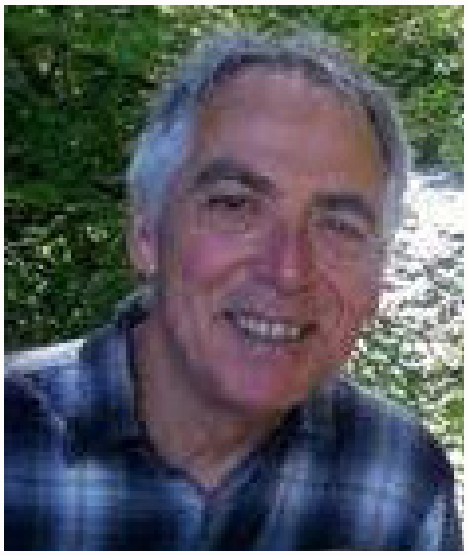
With participants from all over the world, the conference was well attended, full of high points and I'm very much looking forward to the next one.

# Lifetime Achievement Award

By: Kim Frazier

In November of 2009, Dee Dee Hawk from the Wyoming Game and Fish Department Wildlife Forensic and Fish Health Laboratory and Dr. Ed Espinoza from the US Fish and Wildlife Service National Forensic Laboratory conceived of and brought into being the Society for Wildlife Forensic Science (SWFS). To honor this accomplishment, the SWFS board created the Hawk and Espinoza lifetime achievement award.

Dee Dee Hawk



Ed Espinoza

Creating a brand new society from scratch was not an easy feat. It took Dee Dee and Ed several months of research and planning to create the groundwork for setting up the Society. The inaugural meeting was held in April of 2010 in Ashland, OR and consisted of two full days of presentations and five workshops and approximately 105 attendees. In the words of Dee Dee in the welcome note of the first meeting "The formation of this Society has been an act of love for Wildlife Forensic Science and an act of devotion for all those who have tirelessly helped make this dream come true." Fast forward twelve years to our most recent meeting that hosted approximately 140 attendees from twenty countries with 71 scientific presentations and four workshops and one roundtable. The Society now boasts 187 members from 29 countries. This award was created to honor this great accomplishment and honor all those who have dedicated their careers to protecting wildlife through the field of wildlife forensics. Dee Dee and Ed's devotion to the field has been demonstrated throughout their careers and it is for this reason the award was created in their names and that Dee Dee and Ed are the inaugural winners.

This award is intended to reward SWFS members, including former members, with at least ten years of documented accomplishments in the field of wildlife forensic science. The recipient should have had a significant impact in improving the field and helping the individuals who work in it. Nominees' impact can be demonstrated in many ways, including:

- Influence on projects they have worked on
- Meaningful contributions to the wildlife forensic community in the form of education, presentations, publications, books, etc.
- Service and mentorship provided through leadership

A call for nominees will be made two months prior to a SWFS meeting and SWFS members may nominate any member who meet the criteria above. Self-nominations are not accepted and the final award decision will be made by the SWFS board.

Prior to the next SWFS meeting, remember to nominate an individual eligible for this award. With so many passionate professionals in our field, the SWFS board may have a difficult time in the decision making process and I am confident there will be several nominees to choose from.

Congratulations again to Ed and Dee Dee for creating the Society and for their continued contributions to the field (even in retirement for Dee Dee).

# Tree Thieves: Crime and Survival in North America's Woods

*By: Lyndsie Bourgon, Oral Historian*

When I first began reporting on timber poaching, now a decade ago, I expected a law enforcement-heavy narrative to unfold before my eyes. The case that had sparked my interest was that of an 800-year-old cedar, rooted within the confines of a provincial park in British Columbia, which had been poached in a two-part operation. That case – I presumed – would make an interesting story of a boots-on-the-ground investigation, starting with a stump and weaving through log yards and mills.

Soon, that tight narrative was blown right open. As I wrote about the cedar poaching case and interviewed natural resource officers and park rangers involved in its investigation, I heard instead how difficult it was to catch poachers in the thickets of coastal Pacific Northwest forest. Due to the location and bounty of the crime, law enforcement found it challenging to build cases against, and subsequently prosecute, poachers. In most cases, by the time a stump had been located and reported to them, the tree's body had long since entered the market. Poached wood from the Pacific Northwest often ended up bucked-up and sold as firewood. Sometimes, it was sold to a mill who turned a blind eye to forged paperwork – from there, it could end up being used for furniture or building supplies. Once it had been sold, the chances of matching that wood to a stump became very unlikely.

I found myself plunging deep into the world of timber poaching investigations, and so it became inevitable that I would eventually write about wildlife forensics. By the time I visited the U.S. Fish & Wildlife Forensics Lab in Ashland, OR, I had sold a book about timber poaching in the Pacific Northwest and around the world (TREE THIEVES: CRIME AND SURVIVAL IN NORTH AMERICA'S WOODS). In order to understand both the domestic and global illegal timber trade—and to write about the ways in which it was being countered—I travelled to Ashland, where the forensics lab operates from an unassuming building nestled at the foot of the Siskiyou and Cascade mountain ranges.

The illegal timber trade makes up a staggering amount of the global illegal wildlife trade: the World Bank and Interpol have estimated that the global scale of illegal logging generates somewhere between $51 billion and $157 billion annually. Thirty per cent of the world's wood trade is illegal – most of the wood that's logged in Cambodia and the Amazon is illegally felled, and that wood builds our homes, furnishes it, surrounds us. The poached wood that arrives at the forensics lab comes primarily from Africa, South America, Asia and eastern Europe.

Bourgon-Burl slabs

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# Tree Thieves: Crime and Survival in North America's Woods

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Madagascan rosewood, for example, is the most trafficked tree in the world. Mahogany, cypress, teak, beech: all are poached, manufactured into items, and shipped to North America where, if luck prevails, the forensics lab blocks it from entering the market. All these species are listed in the CITES Appendices, which list endangered species traded on the global black market.

Guided by those appendices, the lab's labyrinthine hallways and rooms are now filled with items such as guitars, rare violin pegs, and watch faces. The team there is working to fill their warehouse with "standards" of each tree and animal species list in the Appendices. Alongside those standards, the team is working to compile a database of DNA "fingerprints" – so to speak – which will make it easier to process and identify species of timber, even after it's been manufactured.

The database is being populated by data gathered using mass spectrometry and a DART machine. On the day that I visit the lab, I spot a chess set on the table, its pieces waiting to be fed into the DART, its DNA analyzed. The DART sends the sample's chemical composition data to a linked computer, where it is mapped along a vector that captures a unique pattern for every species of tree. Those standard patterns can then be referred to anytime a shipment of wood is thought to be suspicious – all the lab will need to determine the imported wood's true species is a tiny sliver of the item itself.

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For park rangers and other law enforcement, this opens new avenues to match seized wood with possible poaching sites. And it makes poaching increasingly more risky, the chances of being caught more acute.

# Ivory Workshop

*By: Edgard Espinoza*

The 2022 SWFS sponsored Ivory Workshop was a great success. The roughly 35 participants represented about 15 institutions from 10 countries. The workshop was led by staff from the National Fish and Wildlife Forensic Laboratory and the California Fish and Game Forensic Laboratory.

Participants were able to hold, examine and analyze over 1000 ivory objects from all the taxa found in legal and illegal trade. The single exceptional feature of this workshop was participants ability to become familiar with the diagnostics features of the many ivory taxa which allowed each participant to develop the "eye" for recognizing the species source of evidence items. We did notice a time or two when folks who live in the genetics domain had an awakening morphological moment.

The workshop coincidentally was held on the Halloween festival and participants costumes were amazing. Participants voted for the best costume and the prize was awarded to the Loch Ness Sirens, from… where else… the Scottish "Wildlife DNA Forensics Diagnostics, Wildlife & Molecular Biology Laboratory, SASA.

# Technical Working Group Update

*By Greta Frankham*

After saying farewell to everyone who attended the 2022 SWFS meeting in Ashland, the SWFS Technical Working Group (TWG) stayed behind for a few extra days to hold their first in person meeting for many years. A welcome change from online meetings, especially as TWG members are found across numerous time zones, too many to hold a single online meeting! The nine member group plus three associate members representing six different countries spent two days at the US Fish and Wildlife Forensics laboratory discussing ongoing projects and determining new priorities for the TWG to explore.

Our first order of business was to hand over the duties of the Chair, I have recently taken over from Dr Lucy Webster who has done an incredible job over the years as Chair, so I thank her for all her hard work.

Over the two days, we took the chance to update our charter and also discussed improvements to communication between the general membership and the TWG. Future changes to the SWFS website will hopefully help facilitate this. In the meantime, members are always welcome to get in contact with the TWG with any technical questions you may have. The SWFS community is a great resource and help is only an email away! Any questions can be directed to either myself greta.frankham@australian.museum or the SWFS Board.

In addition to this, the TWG spent time developing a How to Guide for Validation of Species ID (using DNA sequencing as an example) for new labs working in this space, which we hope will be published when completed and be a useful guide for all disciplines. Following on from the really interesting discussion that was had at the report writing roundtable held during the conference, the TWG continued discussing issues around results reporting, including the use of verbal scales, the use (or not) of statistics and how do we gauge uncertainty in wildlife forensic science. We hope to produce some resources and guides around these topics in the future to assist the general membership, which will be accessible on the updated website.

Finally, we continued discussions about the development of a wildlife forensic sequence database for the SWFS community, possible platforms to host this database and metadata requirements for sequences that are uploaded to such a database. We will keep you posted as this develops.

The TWG would like to thank the members who took part in the general survey that was distributed during the conference. The feedback assisted greatly with our discussions. This survey will be distributed to all SWFS members so you can have your say on what is important to you!

# The Society for Wildlife Forensic Science has two very exciting opportunities for you.

## 1. Opportunity to join the Board in a Directors role

The success of the SWFS efforts to develop and promote wildlife forensic science into a comprehensive, integrated and mature discipline depends on the collaboration and dedication of volunteers who have expertise in the field.

Do you want to participate as a board member and make an impact on the wildlife forensic science community? Complete and submit the SWFS's online application form to be considered for a Board Position.

**General Description**

- SWFS is seeking an applicant to fill one open Board of Directors position.
- This position will work with current Board members to keep website content updated and help coordinate the SWFS newsletter twice a year.
- Application will close 24 March 2023.

**Board Commitment and Requirements**

- Must be a current SWFS member
- Board positions have four-year terms and are eligible for reappointment to a second four-year term.
- Board members will conduct business meetings through virtual and in-person meetings. Virtual meetings typically occur every other month and require approximately two hours of time commitment. Board members are also expected to participate in the SWFS biennial meeting that generally runs 3-4 days with a Board meeting and Business meeting component.
- SWFS board members are required to review, discuss and vote on SWFS matters as they arise.
- The position will start 1 June 2023.

## 2. Host the SWFS 2024 Conference

SWFS is seeking a volunteer host lab for the 2024 Conference.

If you and your organization are interested in working with the SWFS Board to host the next meeting, complete and submit the online request form to be considered as the host lab.

Request Overview

- Request deadline is 24 March 2023.
- Ideally, the 2024 meeting will be outside the United States, however all requests will be reviewed.
- Be as specific as possible with the request questions.
- The host lab will work with the SWFS Board to secure a venue, accommodations, meals, entertainment and keynote speakers.

# Recent publications:

In this section we provide a list of recent wildlife forensic publications pulled from the online database, Web of Science. This list covers the period from January 2017 to July 2017. We aren't commenting on their quality or advocating their application, hopefully you will have you own opinions on this. If you know we've missed something, particularly one of your papers, please let us know and we'll include it in the next edition.

Brown AO, Ueland M, Stuart BH, Frankham GJ. A forensically validated genetic toolkit for the species and lineage identification of the highly trafficked shingleback lizard (Tiliqua rugosa). Forensic Science International-Genetics. 2023;62:102784. Available from: http://dx.doi.org/10.1016/j.fsigen.2022.102784

Ganz TR, DeVivo MT, Reese EM, Prugh LR. Wildlife whodunnit: forensic identification of predators to inform wildlife management and conservation. Wildlife Society Bulletin. 2022:e1386. Available from: http://dx.doi.org/10.1002/wsb.1386

Mitchell B, Welch ME, van den Burg MP. Forensic genetic analyses of melanistic iguanas highlight the need to monitor the iguanid trade. Animals. 2022;12(19):2660. Available from: http://dx.doi.org/10.3390/ani12192660

Chen JS, Wang P, Tian YB, Zhang R, Sun JJ, Zhang ZQ, Gao J. Identification of blood species based on surface-enhanced Raman scattering spectroscopy and convolutional neural network. Journal of Biophotonics. 2022. Available from: http://dx.doi.org/10.1002/jbio.202200254

Maccagnan F, Di Benedetto L, Rosa G, Fico R. Threats to the reintroduction program of the Northern Bald Ibis (Geronticus eremita) in Italy: A Forensic Investigation. Animals. 2023;13(1):66. Available from: http://dx.doi.org/10.3390/ani13010066

Elyasigorji Z, Izadpanah M, Hadi F, Zare M. Mitochondrial genes as strong molecular markers for species identification. Nucleus-India. 2022. Available from: http://dx.doi.org/10.1007/s13237-022-00393-4

Turkmen Z, Zengin S, Genc MK, Yayla M, Bulbul TT, Mercan S. The role of forensic veterinary toxicology in pet custody cases. Journal of Analytical Toxicology. 2023;46(9):E239-E242. Available from: http://dx.doi.org/10.1093/jat/bkac088

Hatten CER, Tilley HB, Hadiprakarsa Y, Dingle C. Three birds with one stone? Sex ratios of seized critically endangered helmeted hornbill casques reveal illegal hunting of males, females and juveniles. Animal Conservation. 2022. Available from: http://dx.doi.org/10.1111/acv.12838

Giordani G, Tuccia F, Martin-Vega D, Angell CS, Pradelli J, Vanin S. Morphological and molecular characterization of puparia of Piophilidae species of forensic relevance. Medical and Veterinary Entomology. 2023. Available from: http://dx.doi.org/10.1111/mve.12635

Mohammed ESI, Madkour FA, Zayed M, Radey R, Ghallab A, Hassan R. Comparative histological analysis of the skin for forensic investigation of some animal species. Excli Journal. 2022;21:1286-1298. Available from: http://dx.doi.org/10.17179/excli2022-5335

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# Recent publications:

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