

OSAC RESEARCH NEEDS ASSESSMENT FORM



Title of research need: Development of new technologies for discovery and characterization of forensically useful markers of relevant species' biogeography

Describe the need: Determining the geographic origin of a given organism can have important legal considerations, such as when wildlife in one location is legal to "take," but the same species from another location is not. Geographic origin can also be important in trade law and seafood labeling. For example, shrimp are subject to anti-dumping tariffs or are embargoed from many countries, but can be "laundered" or trans-shipped through countries with which trade is allowed, and traditional genetic methods cannot distinguish, for example, shrimp farmed in China from Malaysian product. Similarly, the true geographic origin of many items involved in wildlife trafficking operations, such as ivory, rhino horn, or crafted products is often masked by convoluted transport routes. There is hope that emerging technologies can help resolve such ambiguities. In addition to geographic origin, these emerging technologies may also reveal markers that can replace traditional methods such as Sanger sequencing and STR analysis, resulting in more efficient investigations. Researchers are encouraged to partner with an active wildlife forensic laboratory to hone the research question to the current need.

Keyword(s): stable isotope, next generation sequencing (NGS), genomics, geographic origin

Submitting subcommittee(s): Wildlife Forensic Biology **Date Approved:** 10/7/2022

Background Information:

1. Does this research need address a gap(s) in a current or planned standard? (ex.: Field identification system for on scene opioid detection and confirmation)

A standard is in development that defines the minimum requirements for determining geographic and/or source population assignment of wildlife using molecular genetic methods. This standard will not cover the development or application of new technology or new approaches for geographic assignment.

2. Are you aware of any ongoing research that may address this research need that has not yet been published (e.g., research presented in conference proceedings, studies that you or a colleague have participated in but have yet to be published)?

Some research groups are looking to develop or apply new technologies and approaches for geographic assignment, however these efforts are typically focused on a specific organism of interest, and are not widely applicable. Ease of implementation across platforms used by existing wildlife forensic laboratories is a desirable feature of new research products.

3. Key bibliographic references relating to this research need: (ex.: Toll, L., Standifer, K. M., Massotte, D., eds. (2019). Current Topics in Opioid Research. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88963-180-3)

[1] Finch KN, Cronn RC, Richter MCA, et al (2020). Predicting the geographic origin of Spanish Cedar (*Cedrela odorata* L.) based on DNA variation. Conservation Genetics. 21:625-639.

[2] Vlam M, de Groot GA, Boom A, et al. (2018). Developing forensic tools for an African timber: regional origin is revealed by genetic characteristics, but not by isotopic signature. Biological Conservation. 220:262-271.

[3] Yang Y, Zie B, Wan J. (2014). Application of Next-generation Sequencing Technology in Forensic Science. Genomics, Proteomics & Bioinformatics. 12(5):190-197.

[4] Uno KT, Quade J, Fisher DC, et al. (2013). Bomb-curve radiocarbon measurement of recent biologic tissues and applications to wildlife forensics and stable isotope (paleo)ecology. Proceedings of the National Academy of Sciences 110:11736-11741.

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[6] Kelly S, Heaton K, Hoogewerff J. (2005). Tracing the geographical origin of food: The application of multi-element and multi-isotope analysis, Trends in Food Science & Technology. 16(12):555-567.

[7] Rubenstein DR, Hobson KA. (2004). From birds to butterflies: animal movement patterns and stable isotopes, Trends in Ecology & Evolution. 19(5):256-263.

4. Review the annual operational/research needs published by the National Institute of Justice (NIJ) at <https://nij.ojp.gov/topics/articles/forensic-science-research-and-development-technology-working-group-operational#latest>? Is your research need identified by NIJ?

No.

5. In what ways would the research results improve current laboratory capabilities?

New technologies enabling determination of geographic origin would allow enforcement of laws regarding product dumping, false labeling, and wildlife protection where country of origin or distinct population segments are at issue. For instance, stable isotopes can provide detailed information that correlates local geographic, thermal, and temporal characteristics for a point location with organisms that occupy that location over their lifespan. Similarly, next generation sequencing technologies (NGS) provide an efficient method for development of a diverse array of genetic markers (e.g. SNPs) that may enable more efficient and robust analyses for identification of individuals, populations, or species, particularly from highly degraded or processed evidence. Development of reliable methods for environmental DNA (eDNA) and microbiome analysis, utilizing deep sequencing technology, would provide additional methods of analyzing

materials removed from their place of origin, including protected timber, bushmeat, and other protected plants and animals.

6. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

Emerging technologies provide a way to test and refine current species identification methods, however, issues regarding subspecies and hybrids are often tied to questions about geographic origin. A better understanding of geographic origin of trafficked wildlife species would provide insight into locations and species that are current targets for illegal trade, as well as information about changes in species ranges and subspecies status. The effects of climate change will further influence taxonomic species boundaries as well as species distributions, and efficient methods of evaluating geographic, temporal, and thermal characteristics of plants and animals will enable the field of wildlife forensics to nimbly evolve as a scientific discipline.

7. In what ways would the research results improve services to the criminal justice system?

More efficient and effective methods for determining geographic source of plants and animals involved in wildlife trafficking would enable law enforcement agencies to more quickly identify the source of criminal exploitation and apprehend the violators before large scale trafficking operations become established. Deep sequencing and stable isotope analysis will produce data that is applicable both to current enforcement questions as well as development of future scientific capabilities, which will inform law enforcement into the future.

8. Status assessment (I, II, III, or IV):

I

	Major gap in current knowledge	Minor gap in current knowledge
No or limited current research is being conducted	I	III
Existing current research is being conducted	II	IV

This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.

NOTE: This need was previously approved by the SAC on 3/16/2016. The references have been updated in this resubmission.