



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

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

Submitting subcommittee(s): Wildlife Forensics **Date Approved:** 2/3/2016

(If SAC review identifies additional subcommittees, add them to the box above.)

Background Information:

1. Description of research need:

There are many enforcement questions that are difficult to answer, such as determining the geographic origin of a given organism. Sometimes such questions are important because wildlife in one location is legal to "take," but wild animals from another location are not. Geography can also be important in trade law and seafood labeling; shrimp, for example, are subject to anti-dumping tariffs or are embargoed from many countries, and can be "laundered" or trans-shipped through countries with which trade is allowed; traditional genetic methods cannot distinguish shrimp farmed in China from Malaysian product. The actual origin of items involved in wildlife trafficking operations, such as ivory, rhino horn, or crafted products is often masked by convoluted transport routes. But there is hope that emerging technologies can help resolve such questions.

In addition to geographic origin, these emerging technologies may also discover markers to replace traditional methods such as Sanger sequencing and STRs, resulting in more efficient analysis. Grantees are encouraged to partner with an active wildlife forensic laboratory to hone the research question to the current need.

2. Key bibliographic references relating to this research need:

- ML Coghlan, J Haile, J Houston, et al. 2012. Deep Sequencing of Plant and Animal DNA Contained within Traditional Chinese Medicines Reveals Legality Issues and Health Safety Concerns. PLoS Genetics 8, e1002657.
- D R Rubenstein, KA Hobson. 2004. From birds to butterflies: animal movement patterns and stable isotopes, Trends in Ecology & Evolution. 19(5):256-263.
- S Kelly, K Heaton, J Hoogewerff. 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.
- KT Uno, J Quade, DC Fisher, 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.
- Y Yang, B Zie, J Wan. 2014. Application of Next-generation Sequencing Technology in Forensic Science. Genomics, Proteomics & Bioinformatics. 12(5):190-197.

3a. In what ways would the research results improve current laboratory capabilities?

New technologies enabling determination of geographic origin would allow enforcement of laws regarding anti-dumping, false labeling, and wildlife protection where country of origin or distinct population segments are at issue.

Stable isotopes can provide detailed information that correlates local geographic, thermal, and temporal characteristics for a point location and organisms that occupy that location over their lifespan.

Next generation sequencing technologies provide an efficient method for development of a diverse array of genetic markers (e.g. SNPs) that may enable more efficient and robust analyses, particularly of highly degraded evidence for identification of individuals, populations, or species.

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 protected plants and animals.

3b. 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, subspecies and hybrid species issues 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 undoubtedly 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 evolve faster as a scientific discipline.

3c. In what ways would the research results improve services to the criminal justice system?

More efficient 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 and development of future scientific capabilities that will inform law enforcement into the future.

4. 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.

Approvals:

Subcommittee	Approval date: <input type="text" value="2/3/16"/>
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(Approval is by majority vote of subcommittee. Once approved, forward to SAC.)

SAC	
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1. Does the SAC agree with the research need? Yes No

2. Does the SAC agree with the status assessment? Yes No

 If no, what is the status assessment of the SAC:

Approval date:

(Approval is by majority vote of SAC. Once approved, forward to NIST for posting.)