

## Non-Standard Sources in a Standardized World: Responsible Practice and Ethics of Acquiring Turtle Specimens for Scientific Use

RUSSELL L. BURKE<sup>1</sup>, LINDA S. FORD<sup>2</sup>, EDGAR LEHR<sup>3</sup>, STEVE MOCKFORD<sup>4</sup>,  
PETER C.H. PRITCHARD<sup>5</sup>, JOSÉ P.O. ROSADO<sup>2</sup>, DARRELL M. SENNEKE<sup>6</sup>, AND BRYAN L. STUART<sup>7</sup>

<sup>1</sup>Department of Biology, Hofstra University, Hempstead, New York, 11549 USA [biorlb@hofstra.edu];

<sup>2</sup>Museum of Comparative Zoology, Harvard University, 26 Oxford Street, Cambridge, Massachusetts 02138 USA  
[lford@oeb.harvard.edu; jrosado@oeb.harvard.edu];

<sup>3</sup>Staatliche Naturhistorische Sammlung Dresden, Museum für Tierkunde,  
159 Königsbrücker Landstrasse, 01109 Dresden, Germany [elehr@ku.edu];

<sup>4</sup>Biology Department, Acadia University, Wolfville, Nova Scotia, Canada B4P 2R6 [steve.mockford@speciesatrisk.ca];

<sup>5</sup>Chelonian Research Institute, 402 South Central Avenue, Oviedo, Florida 32765 USA [chelonianri@aol.com];

<sup>6</sup>World Chelonian Trust, 4N710 Sawmill Trail, Wayne, Illinois 60184 USA [rednine@earthlink.net];

<sup>7</sup>The Field Museum, Department of Zoology, Division of Amphibians & Reptiles,  
1400 S. Lake Shore Drive, Chicago Illinois 60605 USA [bstuart@fieldmuseum.org]

**ABSTRACT.** – Many of the world’s turtle species are seriously threatened in the wild, calling in question the need to collect and preserve whole animals for research activities. However, there are new opportunities for collecting samples from non-standard sources. In this paper we define standard and non-standard materials and discuss guidelines for their ethical and responsible collection and use.

**KEY WORDS.** – Reptilia; Testudines; turtles; tortoises; ethical collecting; non-standard materials; standard materials; legal requirements; laws; regulations

Many of the world’s turtle species are seriously threatened in the wild by habitat destruction and overexploitation by humans (Thorbjarnarson et al., 2000; van Dijk et al., 2000). This decline increases the urgency for studies on the conservation, systematics, and population biology of turtles, and calls in question the need to collect whole animals for these research activities. In addition, the threatened status of some populations and species makes destructive sampling of turtles for research even more difficult to justify. The exploitative use of turtles for food, traditional medicine, religious purposes, and pets ironically creates new opportunities for collecting research samples from non-standard sources. This paper defines ‘standard’ and ‘non-standard’ material for use in scientific research on turtles, addresses ethical issues, and sets out guidelines for responsibly collecting and using these materials.

We preface this discussion with the explicit recognition that it is the responsibility of individual researchers to be aware of and to comply with the relevant laws and regulations of the jurisdictions where samples are collected and transported. We also explicitly recognize that ethical decisions are ultimately the responsibility of the researcher. Ethical issues are contentious, and even among the authors of this paper there are varying opinions on particular issues; therefore this paper represents a consensus of our opinions. We present it as a discussion of the specific issues and to offer some general guidelines for making ethical decisions.

While we advocate minimizing the sacrifice of animals for science, we are not proposing that the use of non-standard samples replace standard methods of collection in all cir-

cumstances. Non-standard samples in conjunction with standard samples can allow for greater samples sizes, especially for hard-to-find or rare species. Non-standard samples are often of limited value, but in some circumstances non-standard samples may be all that are available. For example, the Southeast Asian box turtles *Cuora mccordi*, *C. picturata*, and *C. zhoui* are known to biologists only from commercial trade specimens and remain unknown in the wild (Parham et al., 2004; Stuart and Parham, 2007).

### Definitions of Standard and Non-Standard Materials

Scientific researchers sample biological material from turtles for a variety of purposes, including ecological, population genetic, systematic, and genomic studies. Typically, this material is obtained by the researcher or an agent under his/her supervision, by collecting individuals in the wild, recording data on the circumstances of collection, and depositing the material, usually in association with a voucher specimen (see Lehn et al., 2007), in a natural history repository institution where it is curated for long-term preservation, and made available to other researchers. Hereafter, such materials with clear and documented provenance are referred to as ‘standard materials’. Among other uses, such specimens are used to verify taxonomic identifications and to document where and when the species was found.

Non-standard sources of material may include live or dead turtles from the pet trade, markets, zoos, private

collections, salvage (such as trophies and trash), pharmacies, tourist items, archeological and anthropological artifacts, and other sources (see Pritchard, 2007). These might be obtained either *in-situ* (within the species' range) or *ex-situ* (outside the species' range). Two key features of non-standard specimens are that they do not always require the sacrifice of a specimen, and they may not have been collected by either the researcher or an agent of the researcher. Therefore non-standard specimens are often of unknown, uncertain, or very generalized provenance. While many non-standard materials have traditionally been accepted by museums, such materials have become significantly more important as systematic research has added molecular approaches to the traditional morphological research that historically placed greater emphasis on whole specimens (e.g., Engstrom et al., 2002).

The use of non-standard specimens is particularly important to turtle biology because of some special characteristics of turtles. Turtles are often large-bodied, making handling, preservation, and curation of whole specimens difficult. They have a relatively late age of maturity and low offspring survivorship, typically resulting in low recruitment levels and low sustainable harvest levels. These demographic characteristics typically form the basis for objections to collecting large series of specimens. Turtles are often kept in captivity for long periods, and are often sold for meat or medicinal purposes in either local or distant markets. Thus, many turtle species are now more readily available through secondary means than through direct capture in the field. These circumstances dictate that non-standard opportunities to collect specimens must be considered. Incorporating non-standard specimens into research presents the further advantage of collecting data on a species without sacrificing individuals, an important consideration for endangered, rare, and legally protected species.

### Researchers' Responsibilities

Collection of both standard and non-standard specimens entails many ethical, legal, and practical issues (Duellman, 1999). In consideration of these complicated issues and regardless of historical practices, all specimens must be obtained and transported only in compliance with all relevant regulations and laws in all pertinent jurisdictions. Regardless of the type of specimens to be collected, it is the responsibility of the researcher to be familiar with all applicable regulations and laws and to follow them completely. This task may be difficult, especially where multiple countries, states, and agencies may have jurisdiction and conflicting interests. In many cases, legal collection and possession of biological materials requires that researchers obtain permits, which often require significant time and effort in advance (Duellman, 1999). Researchers should be aware that most regulations and laws apply to parts of animals in the same way they apply to whole animals, and therefore

collecting non-standard specimens usually requires the same permitting procedures as for standard specimens. In some cases, export of non-standard materials is even more restricted than that of standard materials because of their perceived value as "genetic resources" (Duellman, 1999).

Specimens should only be collected under humane protocols, and where appropriate, previous approval should be obtained from Institutional Animal Care and Use Committees or Animal Ethic Committees. Researchers should follow professional protocols, such as the "Guidelines for Use of Live Amphibians and Reptiles in Field Research" (<http://www.asih.org/pubs/herpcoll.html>). If lethal collecting is necessary, extra effort should be made to sacrifice humanely, because turtles are very resilient (Pritchard, 2007). Finally, researchers have a responsibility to publish or otherwise disseminate their results to the people, organizations, and regulatory agencies that might make use of their results. Hopefully, this would help avoid unnecessary duplication of sampling efforts, thus minimizing impacts of research on wild populations.

### Ethics of Non-Standard Material Collection

Although standard specimens usually provide the most complete information for use in research, in some circumstances using non-standard specimens presents ethical advantages over standard specimens. Examples of this approach include collecting salvage material from refuse sites or DNA from captive specimens, which might reduce the need to remove individuals from vulnerable wild populations. Obtaining turtles from meat or pet markets may provide opportunities to build assurance colonies, thus allowing these individuals to make genetic contributions to future generations. Non-standard sources such as markets may be valuable sources of natural history information, and also may present opportunities for scientists to present the case for conservation (Shine et al., 1998, 1999; Pritchard 2007). In all such cases, we encourage authors to be explicit about circumstances of acquisition of specimens utilized in research, for example, pet trade or wildlife trade specimens should be identified as such in publications.

Many museums have accepted market-collected specimens in the past, and this practice will probably become more common as markets become more prominent sources of specimens. Researchers should make every effort to avoid paying for specimens because of the possibility that they might stimulate either *in-situ* or *ex-situ* markets, thus negatively impacting wild populations. This risk might be reduced if the source is an already existing market, rather than a situation where the purchase of a sample may create a new market. It is important to note that market-obtained specimens are subject to laws that regulate collection for scientific purposes and international transport, even though the same materials may be legally sold locally for consumption or other uses, or sold illegally but without significant enforcement effort. Another limitation of market-collected speci-

mens is the lack of quality collection data. For example, the unreliability of locality data associated with turtle specimens allegedly purchased in markets has led to the erroneous assumption that some captive-produced hybrids represented naturally occurring species, thus confounding conservation efforts (Parham et al., 2001; Stuart and Thorbjarnarson, 2003).

Researchers may be tempted to conclude that if a species is sold in large quantities in markets, it must be abundant in the wild. This is not necessarily true—rare species are sometimes temporarily common in markets because a few centers of abundance have been discovered and exploited unsustainably by commercial interests. For example, *Leucocephalon yuwonoi*, endemic to the island of Sulawesi in Indonesia, appeared in large numbers in Chinese markets for a short period of time before becoming commercially extinct (Lau and Shi, 2000). Conversely, common species may be rare in markets because of low demand.

One ethical issue associated with non-standard materials is the consideration of whether there are any circumstances under which illegally collected specimens may be used in scientific research. For example, scientifically valuable photographs of specimens of uncertain provenance may become available, or illegal specimens may be widely and openly available in markets, and the researcher must make ethical decisions as to whether any kinds of data, including strictly observational, may be obtained. It might be argued that when a researcher acts without malice and does not stimulate markets, it is wasteful not to make use of available specimens, especially when it does not entail further losses from wild populations. A contrasting viewpoint is that once a specimen is collected illegally, its scientific value must be ignored so as not to encourage further illegal activities. We could not come to consensus on this issue, however, it should be noted that for liability reasons, many museums can only accept specimens with demonstrable legality.

Sometimes a researcher may subsample a specimen (such as taking a small amount of tissue for DNA analysis) while knowing that the specimen is likely to be maintained in captivity. In such cases the researcher should make every effort to ensure that the individual animal is photographed and uniquely marked for future identification, so that upon its death, it can be deposited in an appropriate museum as a voucher. Data associated with the previously collected subsample should be provided to the museum; in this way the non-standard and standard materials are linked.

### **Ethics of Standard Material Collection**

There are situations where sacrificing turtles may be necessary. For example, type specimens of named taxa should be deposited in a permanent collection where they may be examined by other researchers. In other circumstances, it may be acceptable to conduct research that

requires sacrifice of a few hatchlings, since they are often available in large numbers and have low survivorship in the wild. In some cases it is possible to estimate the number of required specimens statistically on the basis of a pilot study, thus reducing over-exploitation (Still, 1982; Eckblad, 1991).

We believe that ethical collecting is that which has no impact on the survival prospects of the population or species and does not needlessly cause injury or death to individual turtles. With the availability of non-standard specimens, it is appropriate to re-evaluate standard specimen collecting for some types of research on turtles. For example, 50 years ago diet studies were accomplished by collecting large series of turtles and examining their stomach contents by dissection. Today stomach flushing and fecal sample analysis are standard practice, reducing the need for lethal collecting for such studies. We recommend taking as few individual turtles as necessary for the scientific purpose intended, especially for vulnerable and threatened species. When possible, collecting of reproductive females should be minimized because of their value to the population. Before lethal collecting is undertaken, it should be determined that a non-standard specimen will not suffice for the scientific purpose intended, that the samples needed are not already available in collections, and if not, that a secure repository for the specimens to be collected is identified. Those few museums that restrict themselves entirely to turtles (including the Nanjing Turtle Museum in China, the Chulalongkorn University Turtle Lab and Museum in Thailand, the Leatherback Turtle Museum at Playa Grande, Costa Rica, and the Chelonian Research Institute collection in Oviedo, Florida) have a uniform policy of not sacrificing live turtles, yet some have large holdings that are extremely valuable for many kinds of scientific research.

While it is essential that researchers adhere to applicable laws, this is not always easy to accomplish and can be frustrating. We have experienced situations where laws are broadly stated, and therefore open to multiple interpretations and practice; where they conflict with common sense; where multiple agencies have seemingly conflicting regulations; and where regulations to protect resources inadvertently and nonproductively impede scientific inquiries. For example, one of us (RLB) recently began a research project with the goal of establishing the population of origin of diamondback terrapins (*Malaclemys terrapin*) sold in food markets in Chinatown, New York City. This research necessitated collecting tissue samples from terrapins that were legally purchased in markets by a third party. A wildlife conservation officer later informed RLB that while the purchase of the live terrapins for food was legal, taking blood samples from the purchased terrapins required a permit “just to be safe”. Another of us is aware of situations where collecting whole animals is relatively easily permitted, but collecting tissue samples for genetic research requires additional permits that are difficult to obtain. In some countries it is currently legal to export animals for

the pet or wildlife trade, but illegal to export standard or non-standard specimens for scientific research. Also, the Museum National d’Histoire Naturelle (Paris) has a number of important turtle specimens, including the type specimens of both *Emys geoffroyana* and *Testudo gigantea*, that were taken from the King of Portugal’s collection by Napoleon’s forces nearly 200 years ago (Wilcken, 2004). By modern standards, these specimens are not “legal”, but they are invaluable nevertheless and cannot be ignored.

Furthermore, situations exist where scientific collecting is prohibited but regulation of large-scale commercial consumption is not enforced. Species will continue to decline in the face of protective regulation if those regulations do not target the major sources of population decline and are not uniformly applied. We recognize the necessity of intelligent discretion at the point of application of conservation law, but too often we observe that activities genuinely harmful to the persistence of populations or species have *de facto* exemption.

### **Our Influence and Recommendations on Existing Regulations and Laws**

Many turtle researchers have played important roles in the development of laws, regulations, and treaties designed to protect wildlife in general and turtles in particular. We hope to continue to influence these regulations in an atmosphere of mutual respect. We wish to emphasize the non-commercial nature of our work, and would point out to regulators charged with protecting natural resources that we share their goals. Unfortunately, regulations concerning biological samples often block legitimate research without advancing species protection, and are sometimes unnecessary. We believe authorities should make all efforts to make confiscated material available to the scientific community, rather than destroy it. Similar consideration also should be given to material that may have been held by individuals or in private collections that is later being offered for scientific use, though the legality of the original acquisition of such material should be ascertained.

We believe that collecting for scientific purposes should not require permits more elaborate than those for collecting for commercial purposes. Permits for sampling that does not involve removing or threatening individuals in the wild should be granted readily for accredited research.

We hope that journal editors and peer reviewers will work to encourage legal compliance in the publishing of scientific works, in an effort discourage those who break the law, and we recommend that authors be required to state that materials utilized in submitted papers were acquired legally to the best of their knowledge. For example, the instructions for submissions to the journal *Herpetologica* require that article submissions be accompanied by letters indicating that “the authors have observed appropriate ethical and legal guidelines and regulations... when obtaining subjects, especially endangered species (e.g., proper collecting permits or

use of reputable dealers)”. Furthermore, “Submitted studies that obviously deviate from acceptable practices, when noted by the editorial staff, are subject to rejection.” In many cases these goals can be accomplished by requiring museum accession numbers for specimens, given that most museums now require legal documentation before accepting specimens. Another positive outcome of this recommendation would be that specimens would be deposited in museums before results are accepted for publication. Finally, while we recognize the growing relevance of intellectual property rights issues to this discussion, we feel it is beyond the scope of our discussion.

### **Recommendations**

1. Every researcher must make his/her best effort to be aware of all laws and regulations (LARs) relevant to his/her research. We are aware that some relevant LARs may be relatively unknown, and we describe examples where LARs are confusing and even contradictory, but LAR investigation should be considered part of field research.

2. Some of us felt that it was reasonable to collect specimens in some cases where LARs are confusing, contradictory, or even grossly unfair. These authors pointed out that in these circumstances it is not possible to identify a procedure by which all LARs can be followed meticulously, and that therefore some options can be considered permissible while others are not. Some of us felt that following both the spirit and the letter of LARs was necessary, because non-compliance with any part of the LARs leaves the researcher and associated institution open to legal consequences. These authors felt that where LARs were not clear, field research was not advisable until LARs were clarified officially. All of us recommend that scientists advise and work with regulators to clarify LARs so that these ambiguities are resolved.

A case in point is the opportunistic discovery of rare salvage material of obvious value to science, but where collection of such material is illegal under comprehensive bans on wildlife collecting of any kind. Authorities and institutions in such countries may be able to receive such material once it has been explained what the material is and why it is valuable. Where LARs are confusing, contradictory, or appear to unfairly discriminate against scientific collecting, we encourage scientists to work with relevant authorities to correct these problems. We point out that, at least theoretically, regulatory agencies and scientists share important goals, and this should provide common ground for resolving difficulties.

3. We strongly encourage the use of non-lethal collection wherever this will provide appropriate materials for research. Adult turtles are especially important to the persistence of wild populations, and therefore removal or sacrifice of adults, especially adult females, is to be particularly discouraged.

4. We recommend that editors and reviewers require that authors state the source of their specimens (both standard and non-standard material) where practical, that au-

thors list permits for any collections made, and that scientific works discussing specimens be required to publish museum accession/catalog numbers. These recommendations necessarily involve museums in the process of verifying that researchers have obtained appropriate permits.

5. We recommend that editors and reviewers require that authors verify that relevant approvals from Institutional Animal Care and Use Committees or other official bodies were obtained prior to field work.

6. Whenever non-standard or standard materials are collected, we recommend that researchers make every effort to deposit voucher material in the permanent collection of a recognized museum or similar institution along with all appropriate field data. We encourage the use of photographs of specimens in the field and/or in life as part of the deposited field data.

*Acknowledgments.* — This paper is a result of discussions held at the Freshwater Turtle/Tortoise Genetics Workshop in August 2005, organized by H. Bradley Shaffer, Arthur Georges, Nancy FitzSimmons, and Phillip Spinks. We are all grateful for invitations to the workshop, the freedom to follow our own inclinations, and the push to produce this product. We are also grateful to James Hanken and Anders Rhodin for providing excellent meeting and discussion conditions. B. Bock, N. FitzSimmons, A. Georges, J. Iverson, F. Janzen, and H.B. Shaffer made helpful suggestions on earlier drafts of this work. This material is based upon work supported by the NSF under grant # DEB-0507916 for the Turtle Genetics workshop held from 7–12 August, 2005 at Harvard University. Additional financial support for the workshop came from the Museum of Comparative Zoology (Harvard University), Chelonian Research Foundation, and Conservation International.

#### LITERATURE CITED

- DUELLMAN, W.E. 1999. Perils of permits: Procedures and pitfalls. *Herpetological Review* 30:12-16.
- ECKBLAD, J.W. 1991. How many samples should be taken? *Bio-science* 41:346-348
- ENGSTROM, T.N., H.B. SHAFFER, AND W.P. MCCORD. 2002. Phylogenetic diversity of endangered and critically endangered south-east Asian softshell turtles (Trionychidae: Chitra). *Biological Conservation* 104:173-179.
- LAU, M. AND SHI, H. 2000. Conservation and trade of terrestrial and freshwater turtles and tortoises in the People's Republic of China. In: van Dijk, P.P., Stuart, B.L., and Rhodin, A.G.J. (Eds.). *Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia*. Chelonian Research Monographs 2:30-38.
- LEHN, C., DAS, I., FORSTNER, M.R.J., AND BROWN, R.M. 2007. Responsible vouchering in turtle research: an introduction and recommendations. *Chelonian Research Monographs* 4:147-156.
- PARHAM, J. F., SIMISON, W. B., KOZAK, K. H., FELDMAN, C. R., AND SHI, H. 2001. New Chinese turtles: endangered or invalid? A reassessment of two species using mitochondrial DNA, allozyme electrophoresis and known-locality specimens. *Animal Conservation* 4(4): 357-367.
- PARHAM, J. F., B. L. STUART, R. BOUR, AND U. FRITZ. 2004. The evolutionary distinctiveness of the extinct Yunnan box turtle (*Cuora yunnanensis*) revealed by DNA from an old museum specimen. *Proceedings of the Royal Society of London, Series B (Biology Letters Suppl.)* 271: S391-394.
- PRITCHARD, P.C.H. 2007. To kill or not to kill. In: Pritchard, P.C.H. *Tales from the Thébaïde*. Krieger Publ., Inc. Melbourne, Florida, pp. 315-330.
- SHINE, R., AMBARIYANTO, P.S. HARLOW, AND MUMPUNI. 1998. Ecological traits of commercially harvested water monitors, *Varanus salvator*, in northern Sumatra. *Wildlife Research* 25: 437-447.
- SHINE, R., AMBARIYANTO, P.S. HARLOW, AND MUMPUNI. 1999. Reticulated pythons in Sumatra: biology, harvesting and sustainability. *Biological Conservation* 87: 349-357.
- STILL, A.W. 1982. On the number of subjects used in animal behaviour experiments. *Animal Behaviour* 30:873-880.
- STUART, B.L. AND PARHAM, J.F. 2007. Recent hybrid origin of three rare Chinese turtles. *Conservation Genetics* 8:169-175.
- STUART, B. L. AND J. THORBJARNARSON. 2003. Biological prioritization of Asian countries for turtle conservation. *Chelonian Conservation and Biology* 4(3): 642-647.
- THORBJARNARSON, J., LAGUEUX, C. J., BOLZE, D., KLEMENS, M. W., AND MEYLAN, A.B. 2000. Human use of turtles: A worldwide perspective. pp. 33-84. In Klemens, M. W. (Ed.). *Turtle Conservation*. Smithsonian Institution Press, Washington and London. 334 pages.
- VAN DIJK, P.P., B.L. STUART, AND A.G.J. RHODIN (Eds.). 2000. *Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia*. Chelonian Research Monographs No. 2, 164 pages.
- WILCKEN, P. 2004. *Empire Adrift. The Portuguese Court in Rio de Janeiro, 1808-1821*. London: Bloomsbury Press, 306 pp.