

## A Partnership Providing Field Data for Gap Analysis: Texas Tech Museum and Texas GAP

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Between 30,000 and 300,000 species of plants and animals (many not yet described by scientists) are thought to become extinct each year, and much greater numbers of individual populations and genetic varieties are also being lost (Lugo 1986, Wilson 1986). Erwin (1986, p. 127) concluded "Our generation will participate in an extinction process involving perhaps 20 to 30 million species." Each loss is significant and each species irreplaceable.

A partnership between the Museum of Texas Tech University and the Texas Cooperative Research Unit (TCRU) was developed to: 1) acquire and preserve examples of genetic biodiversity of fish and wildlife species from widespread geographic regions, 2) develop DNA libraries and DNA probes to be used to document biodiversity, 3) establish a computer database, accessible worldwide, of DNA fingerprints, DNA profiles, and all museum collections, including skins and skeletons, to be used by natural resource managers, researchers, and law enforcement personnel, and 4) prepare computerized databases compatible with geographic information systems (GIS) such as the National Gap Analysis Program.

Cryopreservation, the method of preserving tissue samples under ultracold conditions, provides the means to preserve in a relatively small space and at minimum expense, the genetic information of a large number of species, populations, and individuals. DNA probes using RFLP (restriction fragment length polymorphisms), microsatellites, and sequencing techniques provide powerful tools to accurately discriminate genetic differences within and among

species, subspecies, and populations. The probes allow detection and quantification of genetic diversity and can help maintain biodiversity by identifying genetic traits. Advances in image analysis and computer technology now allow, for the first time, a holistic approach to data storage, retrieval, analysis, and electronic exchange of museum collections, including natural history specimens, artifacts, cultural data, and maps of species distributions.

Landsat imagery and ancillary data are being used by the TCRU in support of the National GAP Program to map natural resources in Texas. This GIS capability, combined with specimens and cryopreserved tissue samples now in the museum, provide a spatially-based reference for genetic data and DNA for future biotechnology projects to facilitate fish and wildlife management. The voucher material (skins and bone) now in the museum is a resource of value to researchers throughout Texas, the U.S., and other countries.

Access to specimen collections, such as those at the Museum of Texas Tech University, are vital for their base line data from which trends in biological resources can be determined, trends that can impact all aspects of society, for example, human health (Baker et al. 1997). With expanding human population and increased industrialization along the Mexico-U.S. border, base line data should be established now so that future environmental changes can be compared.

## The Need

The three goals of the existing project at Texas Tech University (TTU) are: 1) to preserve samples of diverse genetic material for future generations, 2) to develop TTU as the national leader in image storage and analysis of museum collections, and 3) to provide training for technical assistants, students, faculty, visiting scientists, law enforcement, and resource management personnel. Tools developed will be used to provide genetic information necessary to properly manage fish and wildlife populations of national and international importance. Computerized data banks, including video images and numerical data of these and other collections in the museum, will become widely available through the Internet.

## The Museum

In the past, one of the major hindrances to the use of museum data in conservation studies and projects such as GAP was the relative difficulty in accessing the data. Over the past several decades, advances in computer technology have made it feasible to make extensive use of computer databases. Only in the past eight to ten years has the computing power become available to manage very large data sets on a desktop computer. Prior to that, access to a mainframe was required. In addition, database technology itself has matured to allow efficient, simple, and rapid access to data. Finally, the development of the Internet allows a simple and efficient means for data dissemination.

At TTU a relational database management system (named "WildCat") has been developed in response to increased demand for access to data and to the large influx of specimens from the faunal survey of Texas. WildCat provides for efficient storage and retrieval of specimen data and cross-referencing of basic specimen data to ancillary data such as published records, DNA fingerprints, etc., and at the same time introduces several features new to the management of collection data. Among these are bar codes used to identify specimens and increased dependence on the database for producing specimen documentation.

Currently, a unique bar code is assigned to each part (skin, skull, heart, kidney, etc.) of all specimens being added to the collection. Bar codes allow immediate access to the records in the electronic database and simplify collection management tasks. In addition to assigning bar codes to incoming specimens, a retroactive curation project is planned during which all specimens currently in the collection will be assigned bar codes.

In order to facilitate rapid specimen and data processing, specimen data are entered into the computer database when the specimens are collected. The data are verified for accuracy and completeness before being imported into the main database. Specimen documentation is generated from the database, thus consistency between specimen labels, catalogs, and the database is insured. In addition, the time required for electronic processing of data is much shorter than that required to process the same data by hand. Thus, more accurate and complete data are available in a much more timely manner than was previously possible.

In addition to WildCat, the Museum of Texas Tech is also developing an online database to serve as a resource in decision-making activities. Access to the database will be controlled at various levels. The general public will have access to very general information while scientists and public agencies will have access to more complete and specific information. This database will include not only data regarding the specimens but also information about habitat, climate, etc.

## Field Work

There are 52 Landsat scenes covering the state of Texas. At least 50, and up to 200, ground points are selected from each scene for on-site verification of the dominant plant communities. Sites are selected based upon the homogeneity of the spectral images and accessibility of the site for observation. With this level of field work, TX-GAP will include approximately 2600 geographic points identified by UTM coordinates and classified on the ground to alliance.

Typically, models of vertebrate distribution for GAP have been based on known association with alliances, habitat type, and records from the literature. The partnership among the museum, Texas Parks and Wildlife Department (TPWD), and TX-GAP provides site-specific inventories of species to develop and verify maps and models of vertebrate distribution. For example, scientists at TTU

have been compiling an electronic database of specimens and tissue to document and archive wildlife diversity on state-owned property in Texas. Although in the early stages, these studies have identified 118 species new either to the state-owned properties or to Texas counties. We find these results exciting and surprising, as the state of Texas is extraordinarily rich in mammalogical surveys. No fewer than five major works have been conducted on the mammalian fauna of Texas (Bailey 1905, Davis and Schmidly 1994, Schmidly 1977, 1983, Dalquest and Horner 1984). Countless research articles documenting the distribution and occurrence of Texas mammals have been written as well. In addition to this research, the biologists at TPWD have been conducting surveys as part of their own database and inventory programs. Clearly there remains much to learn about the mammalian fauna of the state of Texas.

Specific research projects under way or in the development stage, as joint efforts of TPWD and TCRU, include studies of scaled quail (*Callipepla squamata*), mountain lion (*Felis concolor*), and influence of habitat alterations such as grazing, burning, and agricultural practices on distribution of small mammals, amphibians, and reptiles. Data collected from these studies will be combined with remote sensing techniques and historical data to assess habitat characteristics, develop and refine distribution models, provide base line inventories, and improve the value of TX-GAP products and GIS tools in development of management plans for Texas wildlife.

## Summary

Results of the partnership between TPWD, the museum, and TCRU will benefit the Texas GAP project in several ways. Jointly collected data will provide current point data and records for evaluation. These data have been collected from 14 sites statewide over the last five years. They are among the most current and intensive data available for much of Texas. Fortunately, these data and the respective sites represent all of the geographic regions of Texas and include a majority of the biological diversity present in this state. These data will be of enormous value in testing the utility of GAP models. As these data include a variety of mammalian species and represent several geographic areas, they can be used to verify the distribution predictions of the models or to identify key variables in the equations. Lastly, these data will provide a permanent record for evaluating or fine-tuning future gap analyses.

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