Intellectual Merit: The status of pollinators is increasingly becoming a matter of concern. A recent NAS study highlights the importance of removing the taxonomic impediment if we are to make definitive assessments of population trends. We propose to take one step toward removing that impediment through a study of Megachilidae (leaf-cutter, mason, and carder bees), the second largest bee family, with many important pollinators in both natural and agricultural settings. Phylogenetic relationships of megachilids at the tribal, generic and species levels are poorly understood; few genera have been adequately revised and few keys exist for species-level identification. Among the groups most in need of taxonomic study is the tribe Anthidiini, with a conservative estimate of over 1100 species. Anthidines are conspicuous and attractive pollinators, easily recognized by their distinctive white, yellow, or red markings, and with a corresponding diversity of body armature. Anthidines encompass the greatest generic diversity of both pollen-collectors and cleptoparasites in the family; over half the genera are Anthidiini. There are no recent world-wide revisions and regional revisions exist for less than half of the described species. Monophyly of some genera is doubtful and many species remain undescribed.

We propose to focus our efforts at two levels. First, we will analyze phylogenetic relationships of Megachilidae at the subfamily and tribal levels using a combination of morphological and molecular data. Second, we will focus our phylogenetic and species-level taxonomic studies on the tribe Anthidiini. We will develop a phylogenetic hypothesis for anthidiine genera and subgenera in order to establish a stable generic classification. We will produce a species level catalog for the tribe, a geo-referenced relational database of specimen data, interactive keys to species, digital images with an emphasis on types, and species accounts. These products will be made available via the web. We will revise the two largest anthidiine genera (Anthidium [169 spp.] and Stelis [97 spp.]) and poorly known African genera. Our project will benefit from our respective areas of expertise in that the molecular data will help to define monophyletic groups for revisionary studies, and the revisionary studies will further illuminate what species or genera need to be sampled for the phylogenetic analyses.

Broader Impacts: Our project will provide a model for studies of cosmopolitan pollinator taxa. The resulting phylogenies and revisions will remove substantial impediments to future studies of the biology, ecology, natural history, and biogeography of these important pollinators. Furthermore, the phylogenetic framework will provide a unique opportunity to examine the evolution of cleptoparasitism (and other biological traits) in bees. It will greatly enhance the education and training of a new generation of bee researchers (8 undergraduates, 1 graduate student, and 1 postdoc) through ample student and researcher exchange opportunities in diverse lab and field sites. Our project will build research capacity and increase international collaboration with developing African countries.

Web-accessible digital resources will result in tools that will be of considerable use to pollination and conservation biologists. Interactive, illustrated keys will enable “non-taxonomists” at remote locations to identify bees. Efforts to diversify crop pollinators and to monitor pollinator services in natural, as well as agricultural ecosystems, will be strengthened through knowledge of bee behaviors, floral preferences, nesting habits, and distributions. This project will contribute directly to the Convention on Biological Diversity’s International Pollinator Initiative, the Global Taxonomy Initiative, the Global Biodiversity Information Facility (GBIF), and the Integrated Taxonomic Information System (ITIS).