

A Workshop to Plan the Strategy to Conduct an All Taxon Biological Diversity Inventory of the White-throated Woodrat -- *Neotoma albigula* –The Woodrat ATBI–

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Documenting the diversity of life on our planet remains one of the grand challenges of the 21st century. Despite the technological and conceptual advances made in science and engineering, our knowledge of the animals and plants with which we share this planet remains dismally incomplete. Not only do we lack descriptions for the vast majority of species, there is not a single place on earth where all life is known.

All taxon biological inventories (ATBIs) have been proposed for at least three sites in North and Central America but none have yet succeeded. Part of the difficulty with attempting to identify all the species in a particular complex habitat has been the size of the task, but we submit that the main obstacle has been the general lack of knowledge on how to proceed at the many scales required. Although most major species of vertebrates are relatively well-known at various localities, invertebrates and other less conspicuous forms are practically unknown, save some studies on the nematode worms associated with the rhizosol of wild grapes in California and those of the dry valleys of the Antarctic Continent.

We propose that part of the reason that all ATBIs so far have been unsuccessful is because they have underestimated the problem of scale. There is no team of experts in the world that, within a lifetime, could determine all of the species of organisms present in a given biome. The use of the biome as the unit of study has proven to be too inclusive and beyond the capabilities of current technology and person power (there have just not been enough people dedicated to the huge task at hand). However, the need for a form of ATBI that may serve as a “unit of measure” for future bioprospecting still exists. We submit that the need for the identification of a proper scale at which to conduct such an ATBI is a *sine qua non* condition if such an endeavor is to be attempted with any hope for success. Alternative scales are numerous and thus the difficulty.

We propose to investigate the complexity of this problem by holding a workshop in which the participants will work together to formulate a successful plan to identify all species of organisms that occur in, on and around an individual of a single species of mammal, *Neotoma albigula* or the White-throated Woodrat.

Why an ATBI on a single organism?

We estimate that a single individual mammal may serve as home to between 100 and 300 species of organisms and viruses. We think that with the appropriate team of experts, discovering these species can be accomplished rapidly and economically. The results and lessons learned will then be scalable to larger areas and more species.

Why the woodrat?

The white-throated woodrat (*Neotoma albigula*) is distributed throughout many kinds of habitats throughout the arid regions of Southwestern North America. It appears that *Neotoma albigula* will be an excellent choice for this study because of the following reasons.

- It is a medium sized rodent that is large enough to allow for easy exploration but small enough to offer a flora and fauna that can be described rapidly.
- The biological characteristics of the species is fairly well known.
- They are common and easy to obtain within their range.
- The species is known to be important medically serving as a reservoir for zoonoses and hosting numerous pathogens of humans and domestic livestock.
- The species has public appeal.

What will we get from the woodrat ATBI workshop?

- An outline and working model on how to complete a survey of an “average” woodrat, at one place, at one time.
- An empirical understanding of the magnitude of diversity associated with a well know species from a relatively well-studied part of the world.
- An outline of logistical problems and relative costs associated with species discovery.
- The first complete survey of all species from any location on earth.
- Extensive visibility for the bigger problem.

Plan of Action

We will assemble a team of 20 - 30 individual researchers who will provide estimates needed to study the complete biological diversity of a single woodrat. Actually, because the techniques that are needed to study the bacterial, protistan, acarine, helminth, and viral associates, we feel that from 10 to 20 individual woodrats all collected from the same locality at the same time may be studied, but this needs to be outlined during the workshop.

Why only one species of mammal and why only a single individual or “average” individual?

We want to demonstrate how complex an actual ATBI would be. Again, our estimates conservatively place the associated organisms that exist on a single woodrat at over 100 species. However, we are guessing at some of the numbers, because it has never before been done. That is, researchers have never before tried to describe and count ALL of the actual associated organisms on a single individual mammal.

Why not just propose the ATBI and conduct the study?

The problem is so complex that no single researcher or even known combinations of researchers can come up with all of the techniques that need to be worked out to provide estimates of the diversity of organisms associated with a single species of mammal.

First White-throated Woodrat ATBI Planning Workshop

The action plan and a more accurate estimate of the cost of an ATBI will be worked out at the first white-throated woodrat ATBI planning workshop. The workshop will be held at the University of New Mexico's Sevilleta field station in September 2002.

Expected Products

The workshop participants will create a web-site that will outline the methods, techniques, and procedures that are developed and proposed. The web site will be created dynamically with the assistance of both the computational resources of the Manter Laboratory of Parasitology (running UNIX servers) and the Sevilleta Long Term Ecological Research Site. All products will be available on line within two weeks of the completion of the workshop. Products will be available in both .pdf and .XML formats for maximum utility of use by the biological community.

PARTIAL EXPECTED TAXONOMIC LIST.

Parasites of the Parasites - Hyper parasites.

Viruses of mammalian tissues: RNA and DNA viruses.

Viruses of protists: RNA and DNA viruses.

Viruses of the rod-shaped bacteria, and the spirochetes (phages, etc.).

Viruses of the helminth parasites of the woodrat including; Nemata, Cestoda, Trematoda, Acanthocephala.

Bacteria in the helminths, including the Nemata, Cestoda, Acanthocephala, and Trematoda

Viruses and Bacteria of Ectoparasites

Endosymbionts and endoparasites.

Protists - apicomplexans, coccidians in the intestinal epithelium

Flagellates, ciliates, sarcodines - bladder, genital tracts, large intestine and cecum

Bacteria in the large intestine and cecum

Endoparasites.

Bacteria (ricketsial and other forms); intercellular, intracellular - transmitted by arthropods (*Ehrlichia*, *Babesia*, *Trypanosoma* and other genera, etc.), rodent malaras and other coccidians.

Helminths: Nematodes of tissues and GI, and urinary tracts; cestodes in the tissues and GI tract.

Trematodes of the GI tract and other tissues.

Endoparasitic acarines nasal and lung mites, subcutaneous mites, subdermal mites, follicular mites, intestinal mites.

Ectoparasitic acarines.

Mites of the pinnae, eyelashes, anal hairs, etc.

Ticks, external, attached to the skin.

Fungi.

Skin, respiratory tract, gastrointestinal tract.

Diptera.

Subdermal warbles, ectoparasitic forms.

Phlebotomus and other species.

Hemiptera.

Ectoparasitic *Cimex* bugs.

Burrow and Nest Inquilines.

Coleoptera, Hemiptera, other arthropods.

Siphonaptera.

Fleas.

This is a partial list expected to be greatly expanded by the workshop participants of the Woodrat ATBI.

The planning workshop will allow us to make better estimates of the types of sampling protocols and time lines for completion of the various tasks. The participants of the workshop will work together to do the following.

- Develop protocols for conducting the woodrat ATBI
Develop a plan for publication of methods and formulate strategies for rapid publication during the ATBI
- Develop or adopt new or well-tested data archival methods
Develop techniques and methods of Species Archival – American Type Culture Collection (live material), Museums (preserved and cryopreserved material)
- Timetable
- Estimate of total cost of project

Products – What we will produce in the workshop.

- A list of all species of symbionts that may occur in, on, or around the woodrat.
- Preliminary web pages with taxonomic data showing up in real time for viewers.
Graphical web diagrams showing levels of interconnectedness of the species associated with the woodrat.
- Plans for optimized and normalized internet connected databases that will link all the species found with the exact location in or on the host animal.
- Plans for development of new universal primers to amplify DNA and RNA viruses of the woodrat and of the symbionts of the woodrat.

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