PROJECT SUMMARY

OVERVIEW: The overall goal of this project is to integrate modern morphological and phylogenomic tools to develop a complete evolutionary picture of the largest radiation of mites, Parasitengona (velvet mites, water mites, and chiggers), within the context of an intensive training program for the next generation of integrative phylogenetic biologists. We will address this goal with two *specific aims* that will bridge the many gaps apparent in Parasitengona systematics and target key elements meant to reach broader audiences. The *first aim* is to create a robust phylogenetic hypothesis for Parasitengona using phylogenomic tools. We will use an anchored hybrid enrichment protocol to sequence approximately 1000 loci across 600 taxa. The taxa sampled for this analysis will encompass all major groups, but will emphasize groups suspected to represent key moments in evolutionary history. With the resulting phylogenetic hypothesis, the unstable classification will be solidified and many evolutionary questions addressed. However, we are targeting three core events that have had the greatest impact on Parasitengona diversification: shift from predator to protelean parasite; invasion of freshwater; and evolution of parasitism. The *second aim* is to reconcile previous research on parasitengone morphology with modern approaches. The purpose will be to implement advances in taxonomy developed in recent years and bring acarology up to the standards of other fields. This objective has three foci: 1) internal morphological survey using modern non-destructive 3D imaging techniques that will yield digital interactive models; 2) external morphological survey utilizing modern techniques; and 3) integrate new findings from these surveys with legacy data into a matrix-format that will be integral to the future development of an online anatomy ontology for mites.

INTELLECTUAL MERIT: Mites are notorious for being under-studied. Lack of an evolutionary framework upon which to test hypotheses and develop research questions has relegated mites to an endless list of untested stories. This project is the most ambitious attempt at reconstructing the evolution of mites. Introducing multi-taxon, whole-genome and high-throughput sequencing to acarology will dramatically affect future efforts in unraveling the evolution of mites. Additionally, examining key morphological systems with modern tools used to create digital, dissectible, 3D models will bridge the gap between old and new research and attract new students that can be broadly trained in modern morphology and phylogenetics.

BROADER IMPACTS: Parasitengona are surprisingly charismatic and research targets for acarologists, entomologists, and parasitologists in both terrestrial and aquatic systems. More so, they are regularly observed by the public, where mites as a whole rarely achieve notice. The broader impacts are designed to reach as diverse an audience as possible using a variety of techniques. **Training:** Acarology needs a new generation of integrative phylogenetic biologists that can use the unprecedented amount of data being generated to tackle emerging issues in comparative biology. The proposed project is accomplishing this by training one post-doctorate researcher and one PhD student that will be exposed to a diversity of research areas, workshops, rotations, and public engagement. **Broad dissemination:** This project will produce and use a massive amount of original and legacy data. One of the primary objectives will be to disseminate this information to online resources (e.g., iDigBio, Morphbank, Genbank, BugGuide) where it can be made available to a diversity of users. **Citizen science:** Taking advantage of the charismatic nature of terrestrial parasitengones (velvet mites), the project will develop a citizen science program focused on introducing mites to the public and documenting velvet mite diversity. Because most mite species are currently unknown but common, incorporating citizen scientists into the effort may be the only way to attain true understanding of mite diversity. The goal of the program will not only be to engage citizens through a project website, but to foster enthusiasm for the natural world in children and help bring it back from hiding in older kids and adults. **Summer Acarology Program:** The Acarology Summer Program (The Ohio State University) is a world-renowned acarology program with multiple courses intended to train students and professionals in acarology. We will offer a two-week course in Parasitengona with the goal of reaching a broader audience and contribute to resurgence in the study of parasitengone mites.