

**Stony Brook University
The Graduate School**

Doctoral Defense Announcement

Abstract

The Functional Morphology and Evolution of the Primate Auditory System

By

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Primates express numerous modifications on the fundamental mammalian ear morphology, and these differences have proven useful for phylogenetic classification at various taxonomic levels. However, the functional consequences related to diversity in primate auditory structure remain speculative and unproven. Although a considerable amount of research on the functional morphology of the ear has been done in other vertebrate groups, primates remain poorly studied. This dissertation sought to help fill this void by exploring the form-to-function relationships of the primate auditory system.

To address this problem, numerous structures from the outer, middle, and inner ears were measured in a broad sample of primates with known hearing capabilities. The structures investigated included the size and shape of the pinna, the areas of the tympanic membrane and stapedial footplate, the masses and lever arm lengths of the ossicles, the volumes of the middle ear cavities, and the length of the cochlea. In total, over 1400 specimens representing more than 50 genera were assayed. The methods used to obtain these data included traditional morphometric measurement techniques, high-resolution computed-tomography (CT), digital photography, latex casting, and cadaveric dissections. By identifying specific form-to-function relationships it was possible to test current theories on auditory function, evaluate inter-specific differences in hearing performance, and predict the hearing sensitivity in extinct primate taxa.

The results from these investigations demonstrate that a variety of auditory structures show significant correlations with particular aspects of hearing sensitivity. The majority of these relationships agree with expectations from acoustic theory but a few fundamental theories were not supported. For example, the idea that longer ossicular lever arms result in increased hearing sensitivity was firmly rejected. By applying the functional relationships that are theoretically sound, hearing sensitivity was estimated in four fossil species representing pivotal nodes in primate evolution. These predictions suggest that primates have been steadily reinvading the "low-frequency niche" by progressive modification of various auditory structures. They also show that these adaptations were not present in our closest extinct relatives. The data provided by this dissertation present many opportunities for future research and will help shed light on the adaptive significance of differences in hearing performance.

Date: April 23rd, 2007

Time: 10:00 am

Place: HSC Tower A, 8-025

Program: IDPAS

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