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CILIA

Customized Intelligent Life-Inspired Arrays

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**3D SHAPE DESCRIPTION OF BAT
PINNAE SPECIMENS**

Actual submission date:	February 27, 2006	
Start day of project:	September 1st, 2005	Duration: 48 months

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1. EXECUTIVE SUMMARY

All success measures set for the numbers of noseleaf and pinna shapes to be acquired by month 18 of the project have been met or surpassed: At the time of writing, the total number of species was 65 (including 14 groups of unresolved taxonomic status) and the number of species with more than three specimens 36 (including 3 groups of unresolved taxonomic status). The maximum number of individuals per species was at least 10 (it could be larger, if other specimens of the same genus were found to belong to the same species). All shapes have been digitized at resolutions found to be sufficient for the numerical acoustic simulations by error analysis using cases of known analytic solutions. Among the samples collected so far, were several with noseleaf and pinna shapes of particular interest. Besides the bat pinna, rodent and primate pinna shapes have been obtained to provide a reference for the interpretation of the bat results.



2. SUMMARY OF DATA BASE CONTENT

BATS

total number of species	51 - 65 ¹
number of species with 3 or more specimens	33 - 36 ¹
number of species with more than 10 specimens	1 (2 nd species with 8 specimens)
total number of individuals	164
total number of shape samples	329 ²

¹The first (smaller) number assumes all individuals of unclear taxonomic status belong to the same species, the second (larger) number assumes each one is a separate species.

²The total number of shape samples does not include the 5 entire heads scanned to provide context to the directivity pattern, since the pinna and noseleaf samples from these specimen are counted as samples already.

The success criteria set for the data base content are:

- at least 15 species with at least 3 individuals each; this criterion has been exceeded by more than 100%, irrespectively of the specimens of unresolved taxonomic status
- 10 specimens for at least one species; this criterion has been met with one species and a second species is close to reaching 10 specimens

RESOLUTION

The microCT machine which was acquired for the project has been verified to be capable of delivering an isometric spatial resolutions well below 5 micrometers. The success criterion of resolutions less than 10 micrometers has been met. However, error analysis has revealed that resolutions below 10 micrometers are not required for the bat noseleaf and ear shapes (they may be required for the work in the other model systems). Therefore, resolutions between 10 and 30 micrometers were chosen depending on ear size. Large ears were scanned at a lower resolution than smaller ears to keep data storage requirements and, in particular, the simulation problem sizes within a range that allows for the analysis of the large data base to be acquired in the course of the project.

INDIVIDUAL VARIABILITY

One species each belonging to the ecological groups of fm- and cf-fm bats have been selected for the acquisition of at least 10 specimens in order to study the individual variability in pinna shapes and the associated acoustic properties. The selected species are the fm-bat *Pipistrellus* sp. (mainly from the population on the campus of Shandong University) and the cf-fm bat *Rhinolophus pusillus*. The selection criteria used were high abundance, large range, and comparatively small pinna size. High abundance insures easy availability of additional samples if needed and avoids ethical problems with regard to conservation. Smaller pinna facilitate the analysis of a large sample. So far the 10 specimens set as an initial target have only been reached for the fm-bat species. For the cf-fm species only 8 specimens have been collected, the missing two specimens can be collected when convenient or immediately when the need arises. This will be determined when the methods for the analysis of natural variability currently under development are fully established.



3. RENDERING OF BAT DATA SET SHAPES

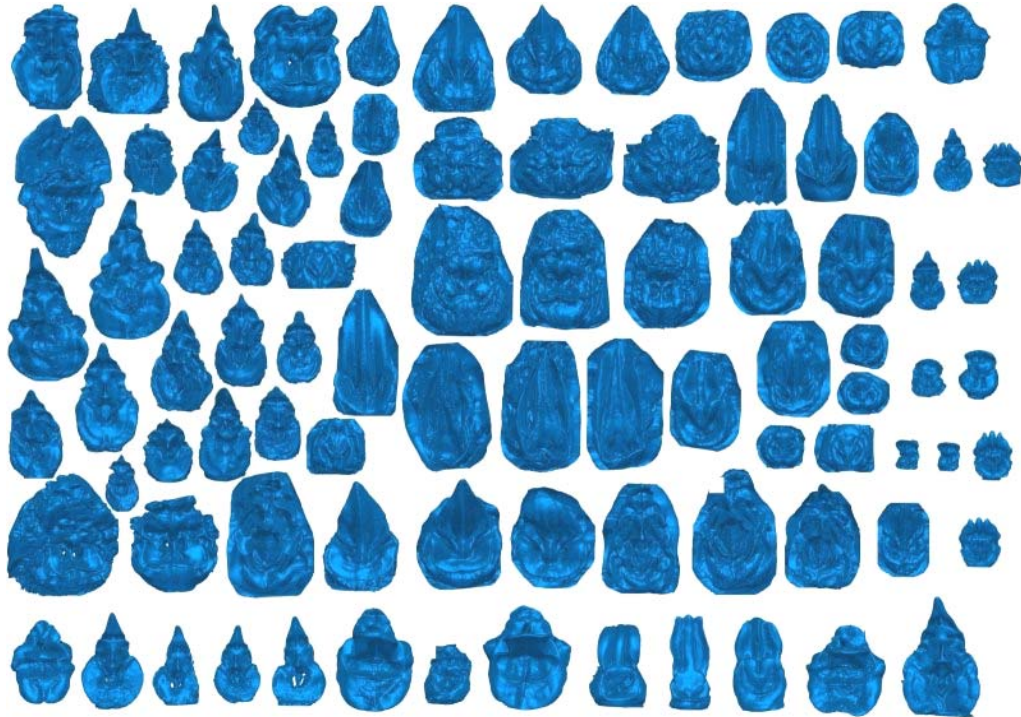


Figure 1: Rendering of all bat noseleaf shapes collected by partner SDX

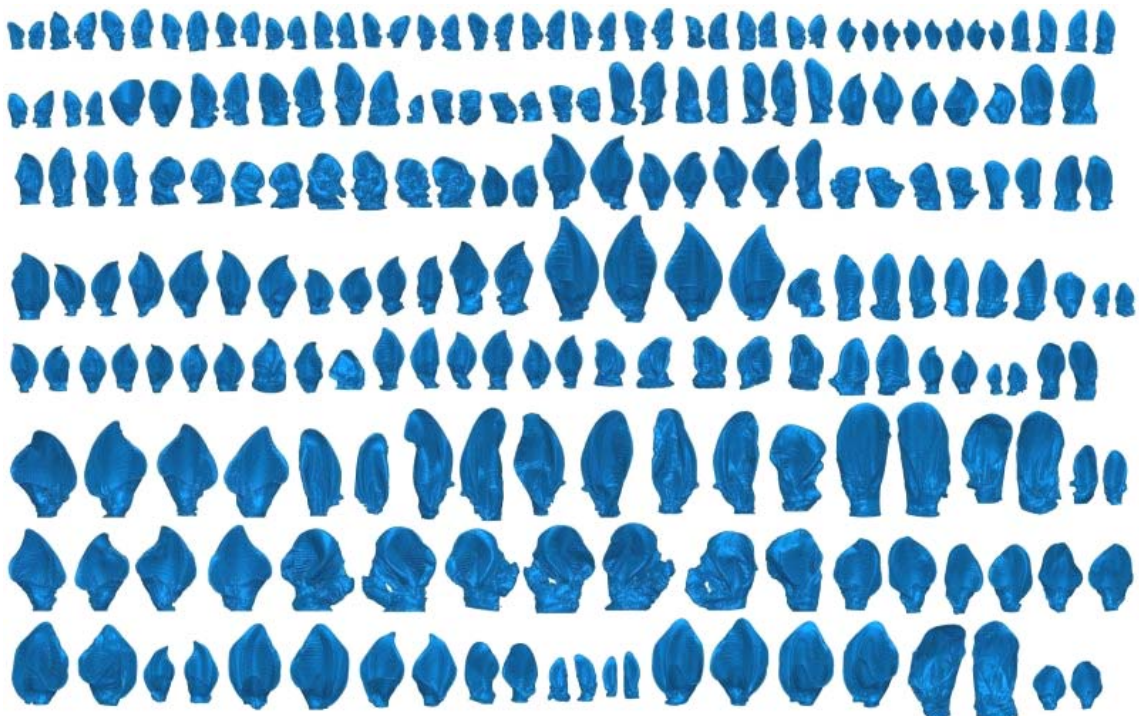


Figure 2: Rendering of all bat pinna shapes collected by partner SDX



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4. BAT SHAPE DATA

Until the end of project month 18, digital representations of the following bat noseleaf and pinna shapes have been created:

species	number of specimens	type of shape
<i>Artibeus jamaicensis</i>	3	noseleaf
<i>Aselliscus stoliczkanus</i>	4	pinna & noseleaf
<i>Barbastella leucomelas</i>	3	pinna
<i>Brachyphylla cavernarum</i>	3	noseleaf
<i>Centurio senex</i>	3	face
<i>Chrotopterus auritus</i>	3	noseleaf
<i>Coelops frithii</i>	1	pinna & noseleaf
<i>Cynopterus sphinx</i>	3	pinna
<i>Desmodus rotundus</i>	3	noseleaf
<i>Eonycteris spelaea</i>	3	pinna
<i>Eptesicus fuscus</i>	2	pinna
<i>Eptesicus serotinus</i>	3	pinna
<i>Erophylla sezekorni</i>	3	noseleaf
<i>Hipposideros cineraceus</i>	2	pinna & noseleaf
<i>Hipposideros lankadiva</i>	3	noseleaf
<i>Hipposideros pomona</i>	3	pinna & noseleaf
<i>Hyposideros armiger</i>	3	pinna & noseleaf
<i>Hyposideros pratti</i>	1	pinna & noseleaf
<i>Lavia frons</i>	3	noseleaf
<i>Megaderma lyra</i>	2	pinna & noseleaf
<i>Megaderma spasma</i>	4	pinna & noseleaf
<i>Miniopterus magnater</i>	1	pinna
<i>Miniopterus schreibersi</i>	3	pinna
<i>Miniopterus</i> sp. (1)	1	pinna
<i>Murina cyclotis</i>	1	pinna



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Myotis altarium	1	pinna
Myotis nattereri	1	pinna
Myotis ricketti	1	pinna
Myotis sp (1)	1	pinna
Myotis sp (2)	1	pinna
Myotis sp (3)	1	pinna
Myotis sp (4)	1	pinna
Myotis sp (5)	1	pinna
Myotis sp (6)	1	pinna
Nyctalus noctula	4	pinna
Nyctalus plancyi	1	pinna
Phyllostomus discolor	5	noseleaf
Phyllostomus hastatus	3	noseleaf
Pipistrellus nathusii	1	pinna
Pipistrellus pipistrellus	1	pinna
Pipistrellus sp (1)	1	pinna
Pipistrellus sp (2)	1	pinna
Pipistrellus sp (3)	1	pinna
Pipistrellus sp (4)	1	pinna
Pipistrellus sp (5)	1	pinna
Pipistrellus sp (6)	1	pinna
Pipistrellus sp (7)	1	pinna
Pipistrellus sp (8)	10	pinna
Pipistrellus sp (9)	3	pinna
Plecotus auritus	4	pinna
Rhinolophus luctus	3	pinna & noseleaf
Rhinolophus affinis	3	pinna & noseleaf
Rhinolophus ferrumequinum	4	pinna & noseleaf



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Rhinolophus macrotis	2	pinna & noseleaf
Rhinolophus paradoxolophus	5	pinna & noseleaf
Rhinolophus pearsoni	4	pinna & noseleaf
Rhinolophus pusillus	8	pinna & noseleaf
Rhinolophus rouxi	2	pinna & noseleaf
Rhinolophus sinicus	3	pinna & noseleaf
Rhinolophus thomasi	3	pinna & noseleaf
Rhinolophus trifoliatus	3	noseleaf
Rousettus leschenaulti	3	pinna
Tadarida sp	1	pinna
Tadarida teniotis	3	face & pinna
Uroderma bilobatum	3	noseleaf



5. RODENT SHAPE DATA

Until the end of project month 18, digital representations of the following rodent pinna shapes have been created:

species	number of specimens
Allactagulus pygmaeus	1
Cricetulus eversmanni	1
Meriones meridianus	1
Mus musculus	1
Rattus norvegicus	1
Rhombomys opimus	1

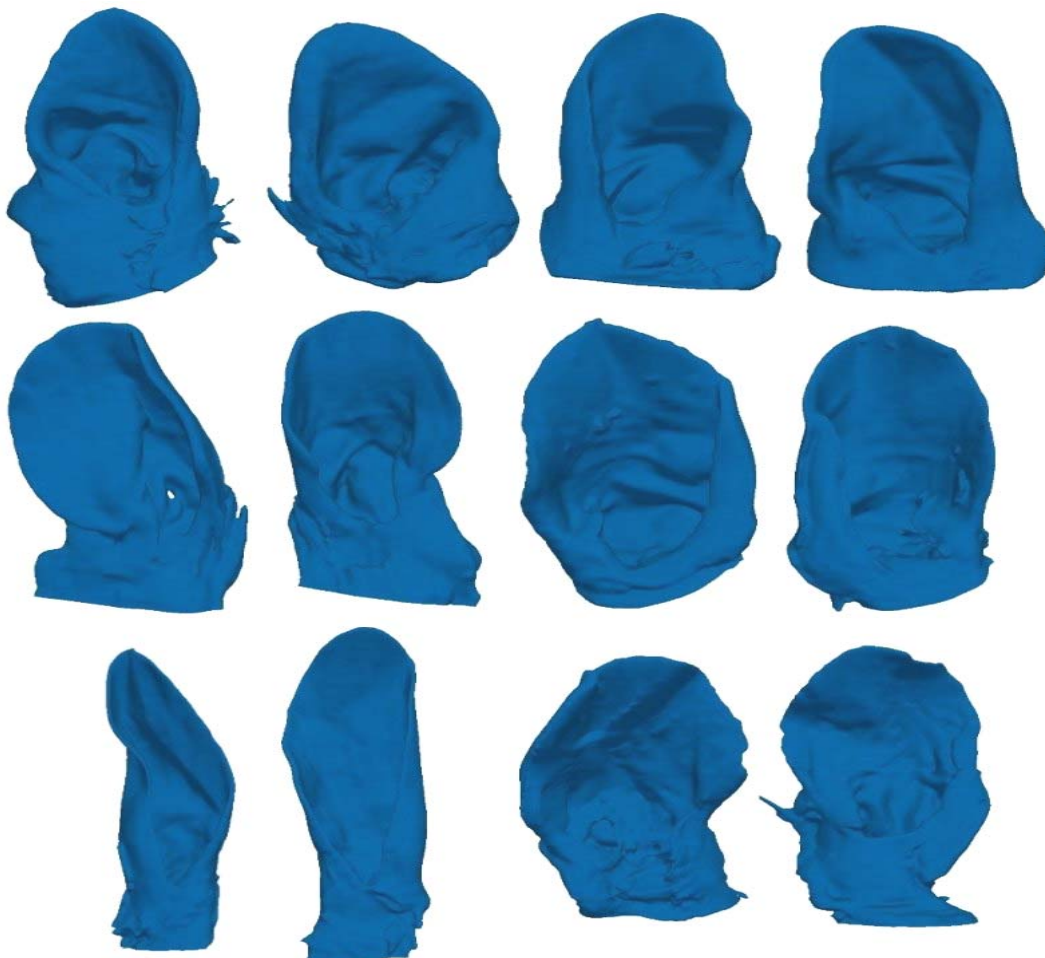


Figure 3: Rendering of the rodent pinna shapes



6. PRIMATE SHAPE DATA

Until the end of project month 18, digital representations of the following primate pinna shapes have been created from plastic moulds taken by researchers at the University of New York University Stony Brook in museum collections (the *H. sapiens* data is digital data obtained from the Chinese visible human project):

species	number of specimens
<i>Alouatta seniculus</i>	1
<i>Cebus</i> sp (1)	1
<i>Cebus</i> sp (2)	1
<i>Cercocebus</i> sp	1
<i>Homo sapiens</i>	1
<i>Macaca</i> sp	1
<i>Pongo pygmaeus</i>	1
<i>Saguinus nigricollis</i>	1
<i>Symphalangus syndactylus</i>	1
<i>Lepilemur mustelinus</i>	1
<i>Varecia variegata</i>	1

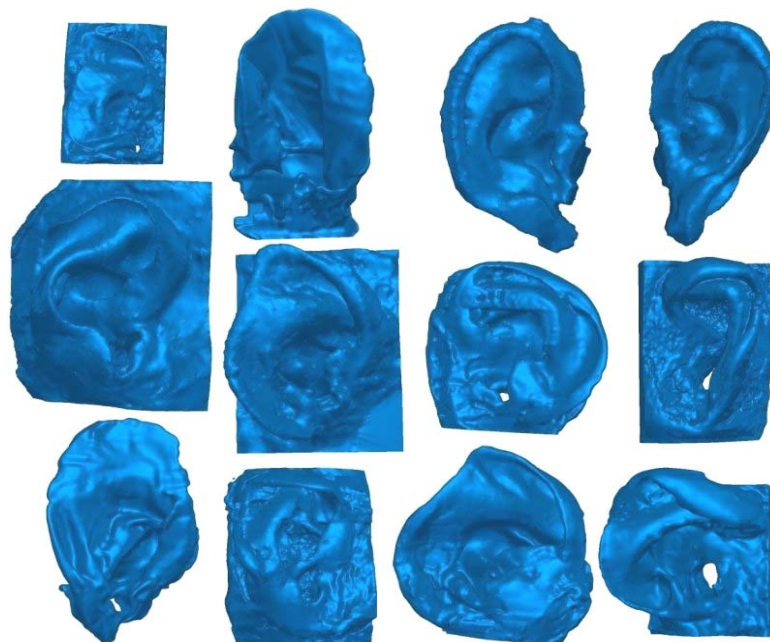


Figure 4: Renderings of the primate pinna shapes