C1-22. Modelling acoustic individual distinctiveness in lemurs from vocal tract morphology

Marco Gamba University of Torino, Dept. of Life Sciences and Systems Biology
L. Favaro Department of Life Sciences and Systems Biology, University of Turin, Italy
O. Friard Department of Life Sciences and Systems Biology, University of Turin, Italy

Individual variation in vocalizations is a prerequisite for recognition and may have facilitated the evolution of large complex animal societies. Lemurs have conspicuous vocal repertoires, and species-specific utterances can be interpreted in the light of the source-filter theory. Lemur utterances are individually distinctive and formants play a crucial role in determining this distinctiveness. We investigated the relation of vocal tract morphology to formants variation in lemurs. We used computational models based on three real vocal tract casts to generate simulated formant patterns. The length of the different parts of the vocal tract showed a coefficient of variation of 7% for the back cavity, 5% for the nasopharynx, 18% for the oral cavity, and 4% percent for the nostrils. The shape of the tract was reconstructed using cross-sectional areas measured at an increasing, fixed distance from the glottis. The areas of the back cavity showed an average variation of 25% while the nasopharynx and nostrils 36%. The changes in the morphology of the vocal tract accounted for a 7% average variation in the formant response of the vocal tract models based on the original cast showing that F1 and F4 had a higher potential for individual recognition. The models were subsequently modified to understand how changes in the vocal tract cross-sectional areas may affect formant patterns. Models showed that both vocal tract length (influenced by the body size) and the shape of the tract (an important determinant of volume) played a role in determining resonances. This study provided the first clear evidence linking morphological variation of the lemur vocal tract, formant patterns of the acoustic output and the potential for vocal individual recognition in non-human primates.