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Abstract

Research on bird locomotion is often focused on flight, but bipedalism in combination with a more or less horizontal spine has been observed only in birds and extinct members of the dinosaur group, and is therefore a trait, beside flight with a feathered wing, specific for birds. Several approaches can be taken in hind limb studies, such as from a morphological, biomechanical, physiological or neurological point of view, involving studies of muscles, tendons, bones and innervations.

The first part of the thesis focuses on the differences between the Blackbird (Turdus merula) and the Starling (Sturnus vulgaris), two species which are similar in several aspects, but use different gaits during terrestrial foraging, namely, hopping and walking, respectively. The first paper involves the gaits used by a number of birds during ground foraging. These kinds of studies are important as a basis for comparative functional morphology. The Blackbird and the Starling were further studied to find out if there are any correlations between hind limb morphology and gaits used. Breaking experiments of the bones in both bending and twisting, show significant differences in several biomechanical variables. The femur differs less between the species than do the tibiotarsus and the tarsometatarsus, indicating that different gaits mainly affect the biomechanical properties of the distal bones. Furthermore, bending seems to have affected predominantly the tibiotarsus and twisting mainly the tarsometatarsus. Underlying reasons for the differences in biomechanical properties include differences in both external and internal morphology and material properties. The investigation of differences in external morphology of the hind limb bones of the two species from the breaking experiment was the main goal for the fifth article. The study shows that only nine of 41 measured characters differ between the species, indicating that the external morphology is not the major reason for the differences found in the breaking experiments. Further studies should include internal morphology and an analysis of material properties.

The second part of this thesis involves comparisons of groups of birds on a larger scale. The aim was to look for general trends for a large number of bird species. The *musculus tibialis cranialis* is the main flexor of the tarsometatarsus, and the length of the muscle moment arm and the tarsometatarsus both affect the speed of movement and the force production for the flexion (paper 3). We found that species affected by strong forces, tending to extend the ankle (such as the weight of a prey or the own body), have a long moment arm of the ankle flexor. Species subjected to less strong forces instead have comparatively short moment arms for leg flexion, which favours speed of movement. In paper 4 we wanted to find out if there are any correlations between the proportions of the bone lengths and the habitat/niche use in six bird groups. The mean values for the measures for most groups were indeed separable from each other, indicating that habitat/niche choice is correlated with the morphology of the hind limbs of birds.

In summary, the morphology of the hind limb long bones in birds is most probably affected by several factors, such as locomotion mode, habitat structure and the forces acting on the bones due to these factors. The results from the studies in this thesis indicate that there is a combination of factors affecting the bone morphology, which make the system complicated to analyse. More research within this field would therefore be required before any further conclusions can be made.