the curved radius, and this difference was stronger in the outdoor activities vs. treadmill activities. We found greater strain magnitudes and a greater range of strain magnitudes during non-steady activity compared to treadmill activity. We also found a negative correlation between strain magnitude and loading variability for any given footfall. This appears to be related to safety factor: more variability in loading pattern and magnitude may be safe for behaviors with lower strains, whereas the higher strain events are constrained to occur with more predictable orientations to reduce the risk of bone failure.

doi:10.1016/j.cbpa.2007.01.209

A6.36
Flexural properties of the equine hoof wall

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The equine hoof wall is a hard keratinous structure which transmits forces generated when the hoof contacts the ground to the skeleton of the horse. During locomotion, the hoof capsule is known to yield under impact resulting in an inward curvature of the dorsal wall and expansion of the heels. However, whilst researchers have studied the tensile and compressive properties of the hoof wall, there is a lack of data on the flexural properties in different locations around the hoof capsule.

In this study the flexural properties and hydration status of the hoof wall was investigated, in two orthogonal directions, in different locations around the hoof capsule. The hoof was divided into three regions: the dorsal-most aspect (toe); the medial and lateral regions (quarters) and the heels caudally. Beams were cut both perpendicular and parallel to the axis of the tubules, termed transverse and longitudinal beams respectively. Differences in the mechanical properties were then investigated using three-point bending tests.

There were considerable differences in the mechanical properties around the hoof capsule; transverse beams from the toe were 81% stiffer and 28% stronger than those from the heels. This corresponded with differences in the hydration of the hoof wall; beams from the toe had a lower water content (24.1 ± 0.25%) than those from the heels (28.3 ± 0.37%). Differences in the flexural properties are thought to be largely a result of variation in the water content. Mechanical data are further discussed in relation to variation in the structure and loading of the hoof wall.

doi:10.1016/j.cbpa.2007.01.210

A6.37
The advantage of being downstream: How fish fins influence each other

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Fish oscillate their fins to produce torques that influence body position. Recent kinematic and hydrodynamic studies show that dorsal and anal fins in trout appear to produce forces that balance roll torques during swimming. Dorsal and anal fins oscillate with a large phase lag, yet the lateral jets produced by the fins have a small phase lag. This means fins release their jets at a similar time but at different points in their oscillation cycle. Differences in incident flow experienced by each fin may contribute to different jet release timings between fins. Trout have two sets of ventral paired fins located upstream of the anal fin. The wake produced by these paired fins may influence flow surrounding the anal fin. To date the kinematic or hydrodynamic function of the posterior paired pelvic fins has not been described. In this study I use particle imaging velocimetry and high-speed cameras to visualize the wake structures and kinematics of the pelvic fins in brook trout (*Salvelinus fontinalis*). I use a horizontal light sheet to visualize the entire fish belly and describe how the pelvic fin wake interacts with the anal fin during swimming. Trout oscillate their pelvic fins in phase with the tail beat cycle, one fin abducting while the contralateral fin adducts. The contralateral oscillation of the pelvic fins produces distinct lateral jets that appear to influence and contribute to the anal fin wake structure, possibly enhancing anal fin hydrodynamic function.

doi:10.1016/j.cbpa.2007.01.211

A6.38
A forward dynamics model of swimming in larval fish

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The larval stages of the more than 20000 species of teleost fish are remarkably similar. Early larval stages of the zebrafish use undulatory body motions to propel themselves through the water. Larval zebrafish can swim at 70 body lengths/s with a tail beat frequency of about 100 Hz, a remarkable performance that requires highly specialized muscle fibres. To understand the swimming mechanism of larval fish, we need to solve the mechanical interaction between tissues in the body as well as the interaction between fish and water. A 3D forward dynamics model of the locomotion system of larval fish will be presented that includes quantified descriptions of the muscular system and simplified external fluid forces on the body (but including the essential of skin friction and pressures). The predictions of the model include the shape deformations of the body and forward motion of the centre of mass during fast starts and cyclical swimming. The model was tested against actual motions of larval fish that were recorded by high-speed video (typically 1 kHz). Several essential features of larval swimming, such as turning angle during fast starts, body speed and travelling wave along the body, are predicted remarkable well by the model.

doi:10.1016/j.cbpa.2007.01.212