KNEE FLEXOR MUSCLE ACTIONS DURING SWIMMING IN THE TOAD, 
**BUFO MARINUS**

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During toad swimming, the hindlimbs move cyclically through extension and flexion phases. The toad accelerates as the hindlimbs extend and the toad decelerates as the hindlimbs flex and fold back into a position to repeat a swimming cycle. Limb muscles generate and control the limb movements that make up these extension and flexion phases, and a number of workers are exploring the roles specific muscles play during anuran (frog and toad) locomotion. Various studies of anuran hindlimb extensor muscles during swimming show that they all are activated simultaneously, once, right before the extension phase\textsuperscript{1,2}. However, recent observations in our lab on two knee flexor muscles, the iliofibularis and the semitendinosus, show that these muscles are activated twice per cycle\textsuperscript{3}, once during extension and again during limb flexion. To characterize the nature of this double-bursting pattern of activity in knee flexors and probe its relevance in relation to hindlimb movement during swimming, I used electromyography and sonomicrometry to simultaneously record electrical activity and length changes of the muscles. These recordings were used to measure the timing, intensity and frequency of electrical activity bursts (EMGs) in relation to muscle length changes (strain) and joint excursions at the knee. EMG data reveal that in both muscles, the double bursts of flexor activity are characterized by an initial, intense, but brief burst and a less–intense, second burst that lasts approximately 2-5 times longer than the initial burst. The short, initial burst of activity starts late in the extension phase, as the muscle is still being stretched, and the time between the onset of the burst and the onset of muscle shortening is typically brief, averaging about 70 ms. The second, longer burst begins after the onset of muscle shortening, and lasts throughout most of the flexion phase, as the muscle continues shortening. Shortening strains range between 10-20% of resting length and are greater, on average, in the semitendinosus, which inserts farther from the knee joint than the iliofibularis. These results suggest that the first burst of muscle activity is likely important for initiating the transition from extension to flexion at the knee, whereas the second burst is solely associated with continuing flexion at the knee. Hence, unlike the single burst of activity seen in extensor muscles that powerfully drive the propulsion of the toad during limb-extension, knee flexor muscles appear to have a dual role. First, they act to decelerate and reaccelerate the knee joint at the transition between the extension and flexion phases. Then they serve to continue flexion of the limb throughout the rest of the flexion phase. This dual role is reflected in the double-bursting EMG patterns of these muscles.