Behavioral and Morphological Specializations for Aerial Prey Capture in the Silver Arowana, Osteoglossum bicirrhosum

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Silver arowana Osteoglossum bicirrhosum capture prey at or just below the water’s surface and leap out of the water to capture prey. Prey capture events of O. bicirrhosum (n = 4) feeding both above and below the water’s surface were recorded at 500 fields per second by two synchronized video cameras. Timing and displacement variables of the feeding apparatus, pectoral girdle, and entire body were quantified to compare aquatic and aerial strikes. Results indicate that aerial bites generally involve shorter durations and larger excursions than aquatic bites, although strike durations were not different (~65 ms for both). Thrust generation during aerial capture is characterized by more extensive pectoral fin depression and caudal fin motion. We hypothesize that at least four behavioral and morphological attributes contribute to the ability of O. bicirrhosum to obtain prey in an otherwise unattainable environment: 1) delay of mouth opening until the fish leaves the water during aerial capture; 2) an elongate, flexible, laterally compressed body capable adopting an “S” posture; 3) large anal and second dorsal fins that contribute to body-caudal fin propulsion; and 4) a fused pectoral basal plate with an associated twisted j-shaped abductor profundus muscle that is able to rapidly pull the pectoral fins posterior-entally.

Mandibular Form and Masticatory Bone Strain in Alpacas

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Alpacas (Lama pacos) are South American selodont artiodactyls belonging to the family Camélidae. In addition, having a solidly fused mandibular symphysis, compared to other selodont artiodactyls, camels also have relatively longer symphyses anteroposteriorly and relatively wider mandibular corpora. Because these patterns indicate increased resistance to lateral transverse bending of the symphysis and corpora, respectively, it suggests that this loading regime is an important determinant of mandibular shape. Here, we present the first in vivo mandibular strain data in a camelid to better understand the nature of mandibular loading during mastication. Rosette strain gauges were attached to the mandibular corpora and symphyses of four female alpacas. Both the magnitude and direction of principal strains were calculated for the power stroke of mastication of alpaca hay. Results indicate that the working-side corpus is twisted about its long axis and/or sheared perpendicular to its long axis during the power stroke. On the balancing-side, the corpus undergoes a combination of parasagittal and, as predicted by the morphological data, lateral transverse bending. The symphysis strain data suggest that the symphysis is sheared dorsoventrally and/or twisted due to twisting of the mandibular corpus about their long axes. Consistent with the morphological data, the symphysis is also bent due to lateral transverse bending late in the power stroke of mastication.

Comparison of the Ontogeny of Prey Capture Kinematics and Feeding Morphology in Wild and Hatchery Florida largemouth Bass Micropterus salmoides floridanus

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Historically, stocking programs for the largemouth bass have poor success of fingerling survival. This study investigates this problem in light of functional morphology. Fifteen wild and hatchery bass from four size classes (20-99 mm TL) were filmed feeding on prey appropriate for their lifestyles, with hatchery bass consuming pelleted food and wild bass feeding on elusive mosquitofish. Kinematic analysis revealed that wild bass used a ram-based strategy, while hatchery bass utilized more suction. Wild individuals reached a larger maximum gape earlier, had greater and longer hyoid excursions, had a shorter duration of maximum gape, and closed their mouths more quickly than their hatchery counterparts. Analyses across size classes show that the degree of ram feeding, the distances of maximum jaw and hyoid excursions, and the lengths of timing variables typically increased as the size of wild fish increased. Similarly, as hatchery fish grew larger, they employed more suction during feeding. Trends in other kinematic variables for hatchery fish, however, were masked by atypical feeding patterns of individuals in size class 3 (60-79 mm TL). These findings are examined with regard to whether such alternate methods of prey capture translate to variations in the osteology of the feeding apparatus, as well as if behavioral plasticity can allow hatchery bass to overcome any such physical limitations postrelease.

Fleshing Out Fossils: The Present as the Key to a Very Different Past

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Fossils tend to preserve only bones and teeth, and so morphologists are challenged to reconstruct those aspects of biology that have been lost. Soft tissues are particularly important, because they not only animate the skeleton, but form the basis for broader biological inferences. Information on any unpreserved feature must come from modern taxa, most relevant being the two extant outgroups of the fossil, which form the extant phylogenetic support for inferred attributes of extinct taxa. Different levels of inference can be identified, with strong level I inferences drawing the most support and weak level III inferences drawing least. Remarkably, level III inferences are common and among the most interesting, because they represent the evolution of anatomical novelties. Inferring novelty in fossils is tractable when grounded in the extant realm. Consideration of unincorporated features (soft tissue, physiology, behavior) of extinct taxa is often necessary for extant studies because modern species have an evolutionary history and the current time plane does not sample the full range of organismal form and function. Ironically, rather than “modernizing” fossils, using the present to reconstruct the past often reveals the uniqueness of extant taxa.

What Happens to the Kype of Male Atlantic Salmon (Salmo salar) That Survive Spawning?

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The return of Atlantic salmon (Salmo salar) to their home river for spawning involves drastic skeletal alterations in both sexes. The development of a kype (hook) at the tip of the lower jaw in males is the most prominent feature. Unlike Pacific salmon that die after spawning, male Atlantic salmon that survive would have to cope with the kype throughout their life, unless the structure disappeared after spawning. To understand the fate of the kype skeleton, we compared morphological and histological features of kypes from prespawned anadromous males (obtained in the fall) with postspawned surviving males (obtained in the following spring). In the fall, the kype is supported by fast-growing needle-like skeletal structures that contain chondroid bone and thus differ substantially from regular dentary bone. In the following spring, growth of the kype skeleton has stopped and skeletal needles are resorbed distally by osteoclasts. Simultaneously, and despite the animals’ severe starvation, bone formation continues. Proximal parts of the kype skeleton are remodeled and converted into regular dentary bone. Distal resorption of the skeleton explains reports of a decrease of the kype in kels. The conversion of basal kype skeleton into regular dentary bone contributes to the elongation of the dentary and likely provides the basis for the development of a larger kype in repetitive spawning males.

Breeding Teeth in Atlantic Salmon: Fact or Fake?

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The diadromous life cycle of Atlantic salmon (Salmo salar) involves drastic skeletal alterations. Connected to the animals’ spawning migration, a toothless stage followed by the appearance of breeding teeth has been suggested. We elucidated the pattern of tooth initiation and replacement in different life stages of wild Atlantic salmon using serially sectioned and X-rayed jaws. The first teeth develop directly from the buccal epithelium. In all subsequent stages, a replacement tooth is connected to the lingual and caudal side of the enamel organ of its predecessor. In juveniles, every