138-3 BALIGA, VB*; SZABO, I; ALTSHULER, DL; University of British Columbia, Vancouver; *vbaliga@zoology.ubc.ca*

Range of motion in the avian wing reflects evolutionary specialization for different flight behaviors

Birds can actively change the shape of their wings, an ability termed "wing morphing", which allows for manipulation of mechanical forces and moments. Birds also exhibit substantial differences in wing skeletal morphology, but it is unknown how these anatomical differences affect the range of motion in the wing or whether such patterns are driven by specializations for flight, allometric scaling, or phylogenetic history. We performed a functional anatomical study of range of motion using cadavers of 61 species representing 20 avian orders. Through a multi-camera setup, we recorded for each species the capability of three types of motion at skeletal joints: 1) extension or flexion, 2) elevation or depression (bending), and 3) pronation or supination (twisting). For all taxa, the range of motion of the wing is highly position-dependent with reduced freedom of movement as the wing is extended. Traditional 'static' morphometrics, including wing shape at full extension, show high phylogenetic signal and poor associations with flight behaviors or body mass. Range of motion data, however, show flight- and body mass-specific patterns along with relatively low phylogenetic signal. In particular, species that are more prone to gliding, soaring, and/or swimming underwater with their wings show more drastic constraints to range of motion. Collectively, our data demonstrate that avian wing morphing capability has a dynamic evolutionary history that shows stronger concordance with flight style and body mass than does a more traditional view of wing shape.

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Macroevolutionary insights from independent origins of cleaning behavior around the world: synthesizing morphology, ecology and biogeographic patterns

Members of an ecological guild may be expected to show morphological convergence, as similar functional demands may exert similar selective pressures on phenotypes. Nature is rife with examples, however, where taxa may instead exhibit 'incomplete' convergence or even divergence. Incorporating additional factors such as competitive displacement from other guild members or variation in ecological specialization itself may therefore be necessary to gain a more complete understanding of the factors that constrain or promote diversity. Cleaning, a behavior in which species remove and consume ectoparasites from 'clientele', has been shown to exhibit variation in specialization and has evolved in a variety of marine habitats around the globe. We use the evolution of cleaning behavior in clades within five marine fish families, Labridae, Gobiidae, Pomacanthidae, Pomacentridae, and Embiotocidae, to determine the extent to which both specialization in this tropic strategy and biogeographic overlap has affected phenotypic evolution. Here, we use a comparative geometric morphometric framework to showcase patterns of convergence and divergence in body shape and size across non-cleaning and cleaning members within these five clades. Focusing chiefly on two regions, the Indo-Pacific and the Caribbean, we find that the highly specialized, obligate cleaning evolves early, shows highly convergent morphological patterns, and is restricted to species of small body size. Facultative cleaning is a relatively younger behavior that shows a much more varied pattern, especially in geographic regions where obligate cleaning is already present.

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Hybrid fibers in the bearded seal longissimus dorsi muscle

Bearded seals (*Erignathus barbatus*) are shallow diving pinnipeds that mostly stay in depths of about 100 meters or less. Being benthic feeders, they scour the ocean floor searching for food sources like polar cod, sculpins, shrimp, spider crabs, and a variety of other invertebrate species. Their benthic habits are a unique aspect of the life of bearded seals in the Arctic, which makes their diving ability an interesting topic of study. Specifically, understanding the physiology of bearded seal locomotor muscle could provide key insights into these abilities. Thus, the goal of this study was to quantify the percentages of hybrid fibers, fibers expressing more than one myosin heavy chain, in the longissimus dorsi (LD) of bearded seals. To achieve this goal, samples of bearded seal LDs were stained for their myosin ATPase activity after alkaline pre-incubation and their reaction to two myosin heavy chain antibodies: SC-71 (type IIA - fast-twitch oxidative-glycolytic), and A4.951(type 1 - slow twitch). Then, images were taken from identical regions in each of these samples using a Zeiss Axio Imager AI microscope and AxioVision v. 4.7 software. On the images, we identified slow- and fast-twitch fibers that were staining for both A4.951 and SC-71 and determined the percentages of these fibers in the LDs of the seals. Using ImageJ, we also measured the diameters of both types of hybrid fibers. From these data, we calculated overall averages of the percentages and diameters of the slow and fast-twitch hybrid fibers. Studying the hybrid fibers in the LDs of bearded seals will give us valuable insight into the unique diving abilities of the bearded seal.

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Effects of Infauna on Sound Speed and Attenuation in Marine Sediments

Infauna alter the physical properties of marine sediments in many ways. Compact mud burrows, tubes built from shell hash, large subsurface galleries, and local changes in porosity are a few examples of these alterations. Structural changes such as these may be detectable non-invasively through their effects on the acoustic properties of sediment. Here, we investigate how infauna may affect the sound speed and attenuation in sediments using laboratory mesocosm experiments with controlled manipulations. These manipulations are intended to mimic how potentially important functional groups of infauna affect sediment structure while minimizing the variability inherent in working with live animals. In both manipulated and control mesocosms, sound speed and attenuation were measured at multiple depths and at high frequencies (100-400 kHz) with wavelengths (4-15 mm) corresponding to the scales of expected impacts of individual infaunal organisms. Manipulations include construction of tubes from shell hash to mimic *Owenia* polychaete tubes, burrowing via excavation and compaction, and sediment irrigation. Physical obstructions, like a shelly tube, were the most easily detectable manipulations, although irrigation and burrowing were still detected at higher frequencies.