A16.106 EXTREME JAW PROTRUSION IN THE SIX-GILLED STINGRAY, HEXATRYGON

Thursday 9th July 2026 15:50

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Extreme jaw protrusion is comparatively common in bony fishes, but only a few described examples exist for sharks and rays, despite movement of the jaws being largely uncoupled from the braincase. We describe a novel jaw protrusion mechanism in the sixgilled stingray (*Hexatrygon*), a deepwater species inhabiting the soft bottoms of upper continental slopes, thought to feed largely on benthic crustaceans.*Hexatrygon* is exceptionally soft-bodied, with a large mouth but non-robust skeleton. In fresh specimens, the jaws can be manually protruded, extending anteroventrally in a massive boxy tube, >300% of resting body thickness. CT and MRI scans demonstrate that this reconfiguration of the feeding apparatus is accomplished by some ventral rotation of the hyomandibular cartilage, but mostly from the unspooling of a massively long hyomandibular-mandibular ligament, which collapses on itself when the jaws return to resting position. This is in stark contrast to other sharks and rays with extreme jaw protrusion, where the hyoid arch is the primary driver pushing jaws forward. The lack of skeletal support and of muscles that could ballistically jettison the jaws off of the hyoid argue that extreme throat expansion is largely passive, the "loose" protrusion mechanism allowing the baglike pharynx to be loaded with fluidized sediment. Coupled with jaw retraction muscles, we argue this would allow the stingray to cyclically sift food from sand, supporting its benthic ecology. We discuss this bizarre jaw suspension relative to other stingrays and the biomechanical decouplings that drive evolution of extreme jaw protrusion in sharks and rays.

A16.105 IMAGE-BASED RECONSTRUCTION OF FLYING SQUID FLIGHT POSTURE AND WIND TUNNEL ANALYSIS OF ITS FLIGHT PERFORMANCE

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Some squid species, including the flying squid, leap from the ocean surface and glide through the air to evade predators, suggesting that they have evolved morphologies suited for aerial locomotion. Their in-flight configuration resembles a canard-type arrangement and lacks a distinct vertical tail, making the mechanisms of flight stability unclear. In this study, a life-sized three-dimensional model of a flying squid in its gliding posture was reconstructed based on photographic and video data. Wind tunnel experiments were conducted to measure aerodynamic forces and moments, with particular focus on pitching and yawing stability. The results showed that specific body configurations generate restoring moments against pitch and yaw perturbations, indicating positive static stability under certain flight conditions. In particular, the drag acting on the larger posterior lifting surface may play a key role in producing stabilizing yawing moments, thereby compensating for the absence of a conventional vertical stabilizer. These findings clarify the aerodynamic mechanisms underlying squid gliding flight and provide new insights into bio-inspired aerial vehicle design based on unconventional body configurations.

POSTER SESSIONS

Wednesday 8th July 2026 18:00-20:00

A16.41 PUFFERFISH INFLATION: DRIVERS OF AXIAL AND HOOP SKIN STRAIN AND REGIONAL VARIATION ACROSS THE BODY

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Pufferfish possess deformable armour that is activated upon gulping water or air into their highly extensible stomach. As their body approximately triples in volume, their soft skin stretches and hard dermal spines rotate, transforming the fish from an ellipsoid into a large prickly sphere. With aims to quantify biaxial skin strain while avoiding the challenges of preserving complex 3D geometry and natural multiaxial strain during ex vivo testing, and to describe the relationship between stomach pressure, body volume, and skin strain. Biplanar x-ray imaging with stomach pressure recordings, x-ray reconstruction of moving morphology (XROMM), fluoromicrometry, and dynamic digital endocasts were carried out. We found no significant difference ($p<0.05$) in peak pressures (1.3-4.6 kPa, n=13 trials) and maximum volumes (157.41–262.66 cm^3 , n=22 trials) between in vivo and ex vivo inflation trials in three individuals. Ratios between body dimensions, dorsoventral height, craniocaudal length and mediolateral width generally converged towards a 1:1 by the end of inflation behaviour. Axial skin strain (craniocaudal directionality) did not differ amongst dorsal (0.34±0.26 (mean±sd)), lateral (0.33±0.19) and ventral (0.31±0.24) body regions. Whereas hoop strain (dorsoventral directionality) was greatest amongst the ventral (0.64±0.45) body region, followed by the lateral (0.48±0.22) then dorsal (0.33±0.17) body regions. Our findings may provide insight for existing hypothesises on how volume and pressure are linked to skin structure and behaviour. As well as provide direct in vivo measurements for application in biomimetic design such as, the development of soft robots composed of materials with contrasting mechanical properties.