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Deep-Pelagic Fishes and the Mid-Atlantic Ridge: Interactions and Vectoring of Gelatinous Carbon to Higher Trophic Levels?

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0694 Fish Morphology & Histology II, Salon 6&7, Saturday July 26, 2008

Ontogeny of the Fine-scale Morphology of the Tessellated Skeleton of Cartilaginous fishes

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The majority of the skeleton of elasmobranch fishes is characterized by a tessellated design in which uncalcified cartilage is overlain by a rind of mineralized and abutting hexagonal blocks (tesserae). This poses an interesting problem in that although the skeleton cannot exhibit significant remodeling, it must be able to grow in size while maintaining a continuous and integral calcified surface. We employ a diversity of imaging techniques and ontogenetic tissue series to investigate the development and ultra-scale morphology of the tessellated skeleton in a species of stingray (*Urobatis halleri*). Tesserae formation and growth is characterized by distinct changes in cell morphology and orientation. The skeletons of yolk sac embryos are not yet tessellated and chondrocytes orient randomly relative to the perichondrium. In the histotroph stage, chondrocytes flatten at the tissue periphery and are engulfed by forming tesserae, creating cell-rich laminae in the mineralized blocks with communicating passageways between entombed cell lacunae. Alignment of peripheral chondrocytes relative to tesserae is pronounced only as tesserae are forming, then becomes more random with age. Chondrocytes and tesserae continue to grow in size through adulthood, with cell density and the number of chondrocyte twins (an indirect indicator of cell division) decreasing sharply following tesseral formation. Oxytetracycline injection indicates that tesserae grow from mineral accreted on all surfaces (perichondral, chondral and intertesseral) resulting in tesserae widening and deepening by up to 5 times in adults relative to the histotroph stage. Skeletal elements are therefore growing by matrix deposition in uncalcified regions and accommodating enlargement of tesserae. Although our results show some parallels with endochondral ossification (e.g., chondrocytes decreasing in size and density with age), cells do not hypertrophy and die as in tetrapods.

0273 Fish Ecology II, Salon A&B, Monday July 28, 2008

Deep-Pelagic Fishes And The Mid-Atlantic Ridge: Interactions And Vectoring Of Gelatinous Carbon To Higher Trophic Levels?

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The assemblage structure and vertical distribution of deep-pelagic fishes relative to a mid-ocean ridge system is described from an acoustic and discrete-depth trawling survey conducted as part of the international Census of Marine Life field project MAR-ECO. A survey along the Mid-Atlantic Ridge (MAR), covering the full depth range (0 to >3000 m) with a combination of gear types, was conducted to understand the role of the pelagic fauna in ecosystem dynamics. A total of 205 fish species were

collected by midwater sampling. Depth was by far the primary assemblage composition determinant, with ridge section secondary. The dominant ichthyofaunal component was a widespread assemblage of fishes between 750-3000 m, from Iceland to the Azores. Some zonation was apparent in the northern and southern ends of this large depth stratum, with six smaller assemblages of fishes exhibiting limited distributions. Biomass per volume reached a water column maximum in the bathypelagic zone between 1500-2300 m. This stands in stark contrast to the general "open ocean" paradigm that biomass decreases exponentially from the surface downwards. As much of the summit of the MAR extends into this depth layer, a likely explanation for this midwater maximum is ridge association. Fish density within the benthic boundary layer (within 200 m of the ridge) was nearly double that of the water column and biomass was approximately 50% higher. Of the 'ridge-associating' species, two species known to consume gelata, *Bathylagus euryops* and *Scopelogadus beanii*, contributed over half of the fish biomass of this layer. These data suggest that a pelagic fish-gelata trophic linkage may be a key element of benthic-pelagic coupling over mid-ocean ridges, thus supporting enhanced nekton biomass over ridges in the absence of terrigenous nutrient input. Ongoing research to better understand this trophic linkage will be presented.

0141 Poster Session III, Sunday July 27, 2008

Developmental Morphology of the Skeleton of the Barbel, *Barbus barbus* (Linnaeus, 1758) (Ostariophysi, Cyprinidae)

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The development of the skeleton of laboratory – reared cyprinid fish *Barbus barbus* from the six stages was observed. Larvae were first sampled at 7 days after hatching, and then every four days till 29 days after hatching. They were cleared and differentially stained for cartilage and bone using a modified version of Dingerkus and Uhler (1977). In the first stage the anterior tip of the notochord did not start to ossify yet and vertebral centra did not appear. In the neurocranium the otic capsules were developing. The taeniae marginales fused medially between the eyes to form the trabecula communis. Anteromedially the trabeculae crani fused to one another and chondrified laterally to form the ethmoid plate. In the splanchnocranium the cartilaginous and ventral elements of the mandibular and hyoid arch were present. All hyoid parts were fused to form a single cartilaginous piece. Most of the bony ossifications of the splanchnocranium were present in the third stage, 20 days after hatching. The fifth ceratobranchials developed later than first four, but ossified earlier. Two separate centres of development were found in the axial skeleton, Weberian apparatus and caudal fin. In the 16^{th} day old larvae the anterior tip of the notochord started to ossify. The first vertebrae as well as the all structures of the Weberian apparatus were present. In the last stage analyzed, 29 days after hatching the skeleton of caudal fin was fully developed. Among the paired fins, as first developed the pectoral ones, while the pelvic fins were visible in the second stage, without any elements of the girdle. The dorsal fin developed first than the anal one. Lepidotrichia started to ossify 20 days after hatching. First ossification of the anal fin started late, in the sixth stage of development.
