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Assessment of cranial neural crest proliferation patterns between the redeye tetra *Moenkhausia sanctaefilomenae* and the zebrafish *Danio rerio*

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Introduction and Background

Teleost fishes display a remarkable amount of morphological diversity. In this study we examined the development of two species of freshwater fishes, the redeye tetra *Moenkhausia sanctaefilomenae* and the zebrafish *Danio rerio* (Figure 1). Notably, the larva of *M. sanctaefilomenae* exhibit larger jaw cartilages compared to *D. rerio* (Figure 2). Consequently, our research sought to elucidate the cellular mechanisms responsible for the morphological variations observed in the ventral arch derivatives between *M. sanctaefilomenae* and *D. rerio*.

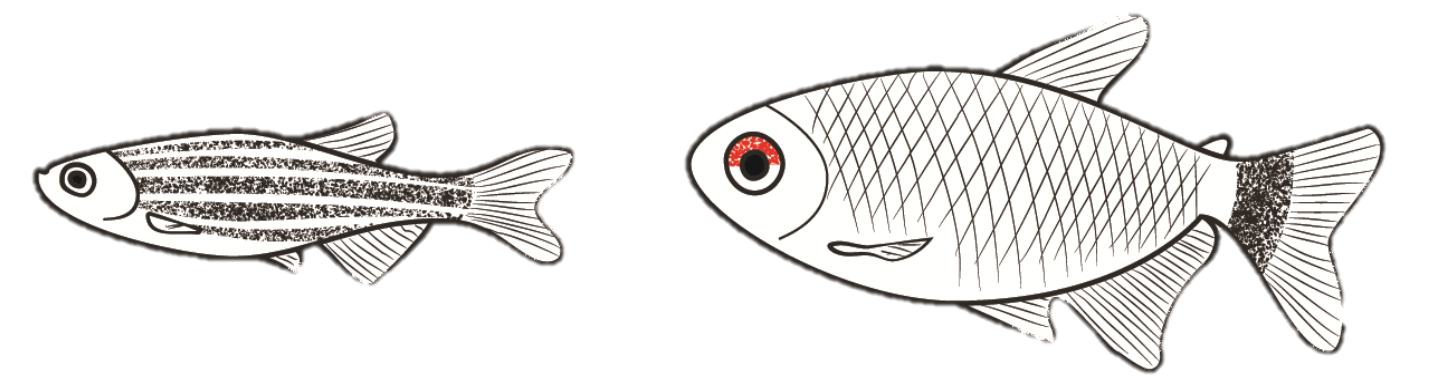


Figure 1. Sketch of *D. rerio* (left) and *M. sanctaefilomenae*.

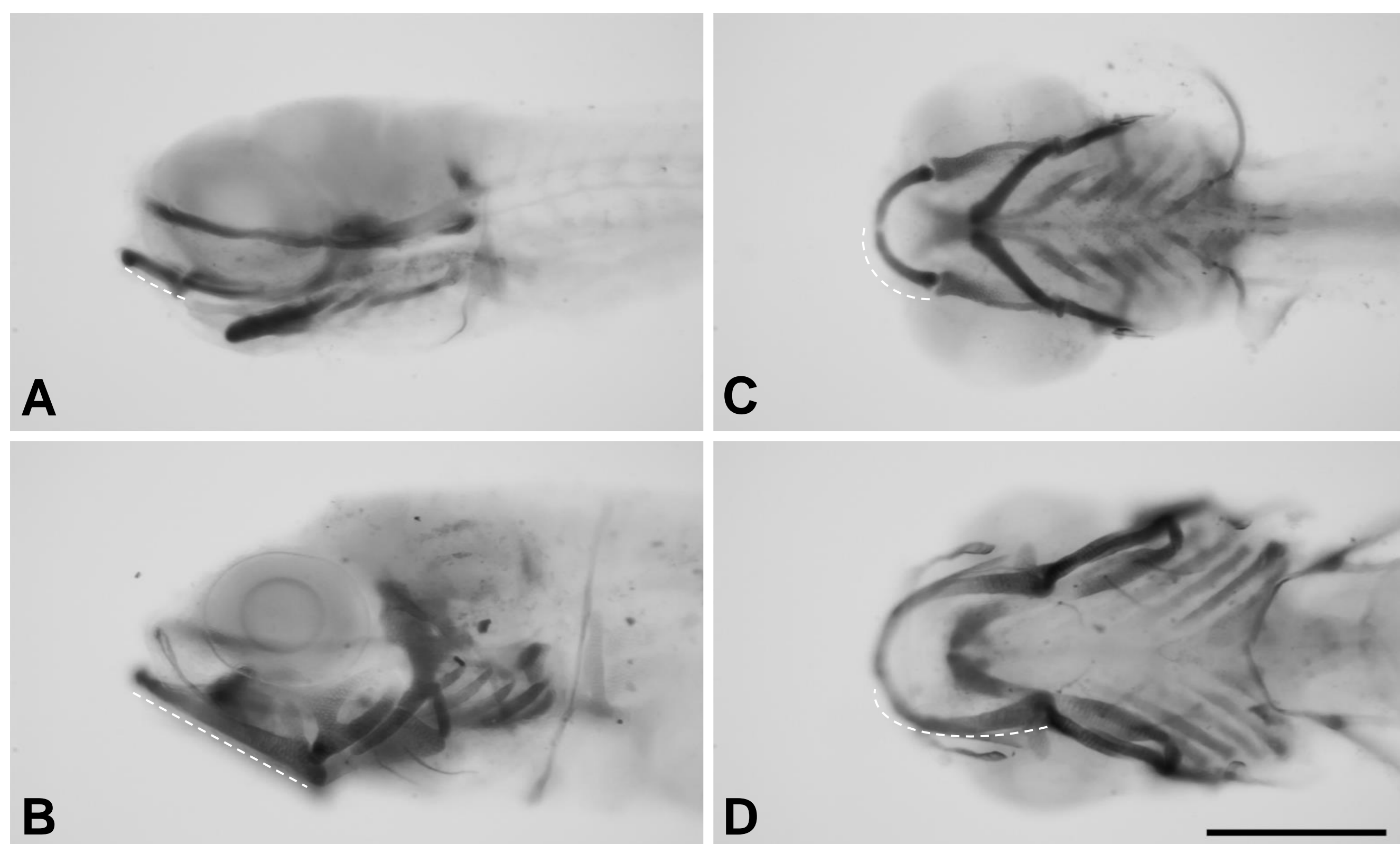


Figure 2. Developing skeletal elements of *D. rerio* (top) and *M. sanctaefilomenae* (bottom). Panels A-B depict lateral views, while panels C-D depict ventral views of the developing cartilages for each species at comparable stages. Scale bar = 0.5 mm and applies to all panels.

A specific population of cells, known as neural crest, gives rise to the jaw elements known as the Meckel's and ceratohyal cartilages. These jaw cartilages are components of the splanchnocranium and are located within the pharyngeal arches. A sequential series of developmental phenomena are known to produce these cartilages (Figure 3). Although the developmental timeframes vary for each species – and were taken into account during experimentation – the general process (proliferation, histogenesis, shaping, and growth) remains consistent.

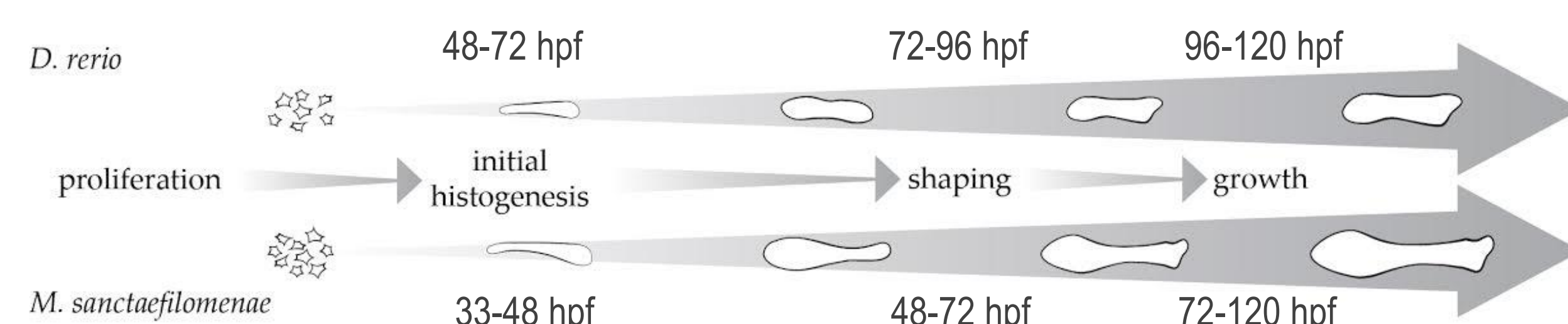


Figure 3. Developmental timeframes of skeletal element formation between two species.

Methods and Results

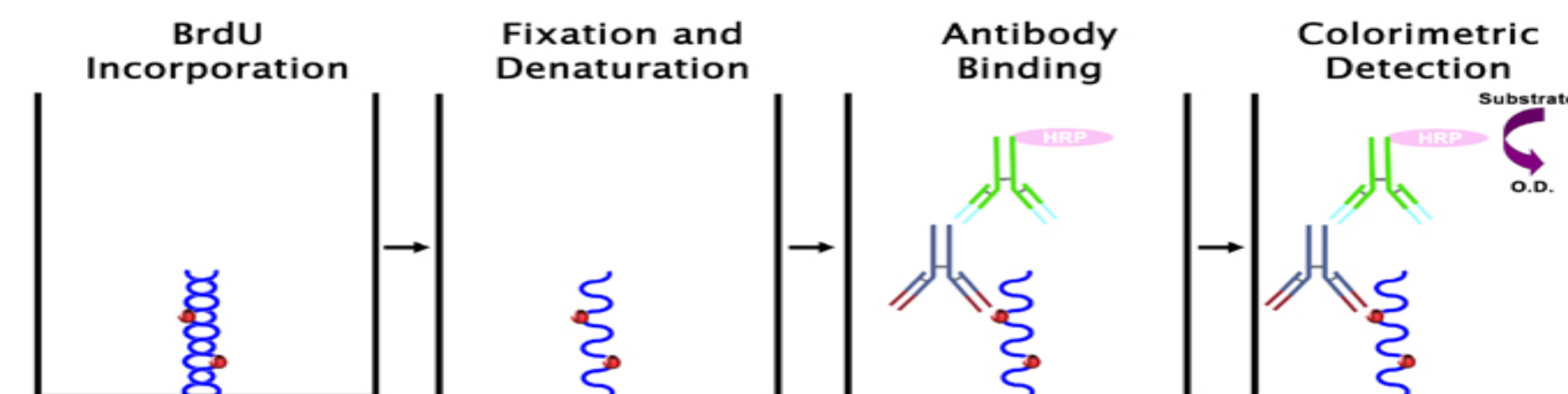


Figure 4. Schematic illustration of BrdU protocol. : www.cellbiolabs.com

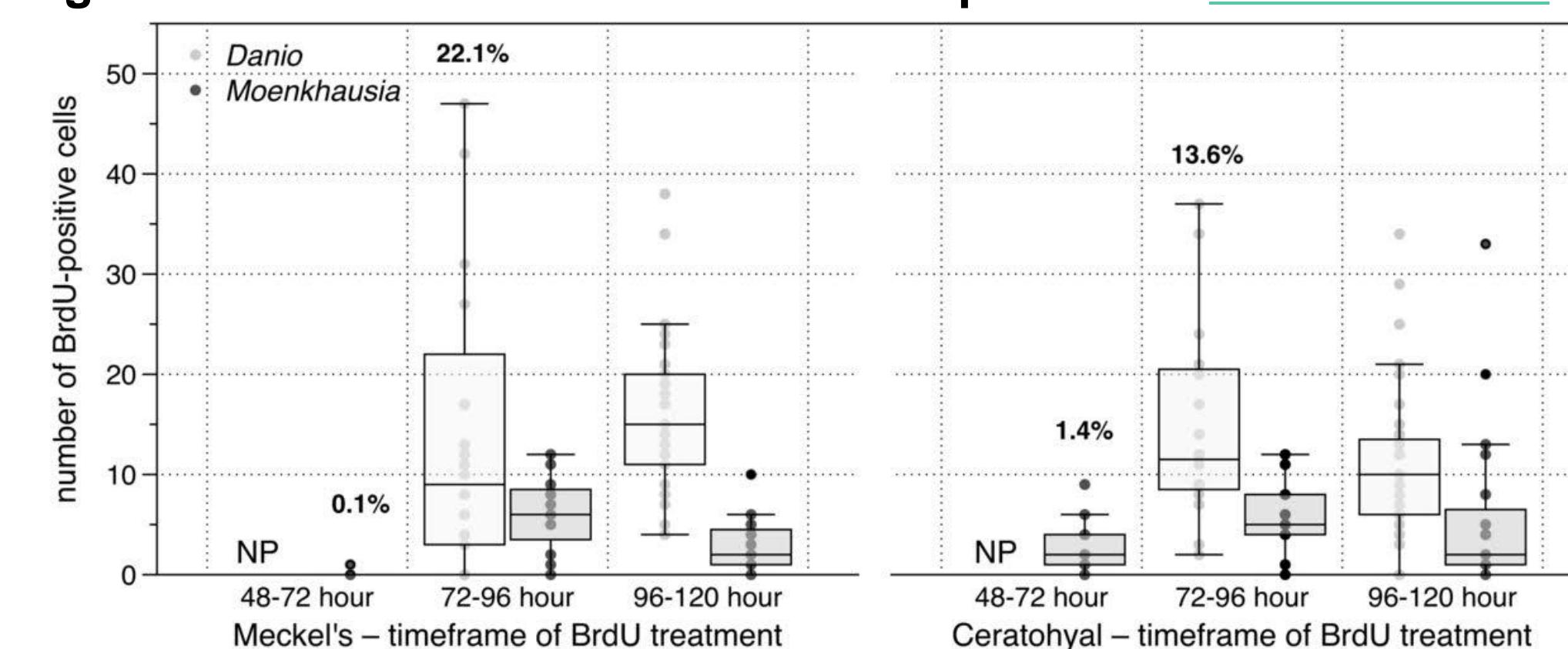


Figure 6. Numerical counts of BrdU-positive cells in the ventral arch derivatives between two species at specified time points. The percentages refer to the ratio of the average number of BrdU-positive cells to the average total number of chondrocytes within the element at the indicated timeframe.

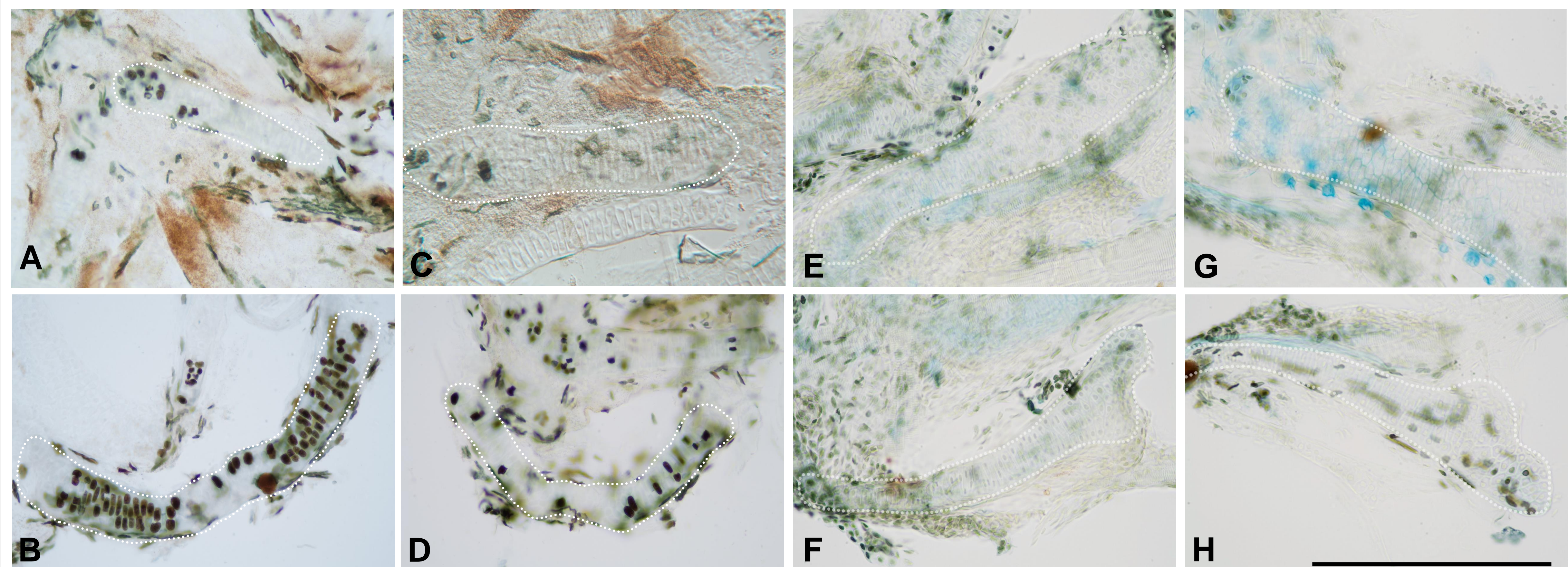


Figure 5. Comparison between BrdU-treated skeletal elements of *M. sanctaefilomenae* and *D. rerio* during various developmental timeframes. Top panels depict the ceratohyal cartilages while the bottom panels depict Meckel's cartilage. Panels A–D depict elements from *D. rerio*. A-B correspond to the period of shaping and C-D correspond to the period of growth. Panels E-H depict elements from *M. sanctaefilomenae*. E-F correspond to the period of shaping and G-H correspond to the period of growth. Scale bar = 200 μ m.

Conclusions and Future work

Our research has demonstrated that there is a distinct difference in the mechanisms used for cartilage formation between the two species. Specifically, it appears that the ventral arch derivatives in *M. sanctaefilomenae* develop from an initial pool of chondroblasts that originate prior to cartilage formation, and thus exhibit limited reliance on proliferation during histogenesis, shaping, and growth. However, the ventral arch derivatives in *D. rerio* display an opposite mechanism whereby proliferation is the primary means for development during the shaping and growth phases. Further experimentation could incorporate another closely related species to determine the prevalence of these mechanisms.