Divergent Gene Expression of *Hoxb3b* in Teleost Fishes is Due to Divergence of Upstream *Cis*-Regulatory Elements

Erin Povolny and Adam Davis

Hox genes are developmental regulatory genes that function to pattern the cranial nerves that are derived from the rhombomeres (r) during vertebrate embryonic development. *Hoxb3*, in particular, has been shown to be expressed in r5-7 in several tetrapod species, including mouse (*Mus musculus*). Over the course of evolution, teleost fish have undergone a whole genome duplication, and several species have retained both duplicate *Hoxb3* genes, *hoxb3a* and *hoxb3b*. These genes are expressed differently from each other, such that while *hoxb3a* is expressed in r4-7 in many teleost fish species, *hoxb3b* is expressed solely in r4. The *cis*-regulatory elements (CREs) that are responsible for directing *hoxb3b* expression in r4 are currently unknown. We used several software programs, including VISTA and CLUSTAL, to identify conserved sequences upstream of *hoxb3b* in the Japanese medaka (*Oryzias latipes*), Nile tilapia (*Oreochromis niloticus*), Atlantic salmon (*Salmo salar*), and Japanese pufferfish (*Takifugu rubripes*). From these analyses, we observed the presence of several CREs that are similar in sequence to those that direct other *Hox* genes in r4, including *Hoxb1*, *Hoxa2*, and *Hoxb2*. We also used these software programs to understand if the conserved sequences upstream of *hoxb3b* were present for *hoxb3a* in the same teleosts mentioned above, as well as *hoxb3a* in zebrafish (*Danio rerio*), *Hoxb3* in the spotted gar, a species of bony fish that predates the teleost-specific genome duplication, and *Hoxb3* of the dogfish shark (*Scyliorhinus canicula*), coelacanth (*Latimeria chalumnae*), mouse, and human (*Homo sapiens*). Interestingly, we did not observe the presence of the teleost *hoxb3b*-specific sequences for any *Hoxb3* or *hoxb3a* gene. These results suggest that the whole genome duplication in teleost fishes has allowed for the divergence in expression and function of *hoxb3b*.