ABSTRACT

The bony fins of ray-finned fish show considerable diversity in structure, and changes to the fin skeleton necessarily underlie adaptations to different swimming strategies and other functions. Many fish have fin rays that branch one or more times, and the presence, number and position of these branches are highly variant between species. Understanding the developmental processes that determine branch position can lead to a better understanding of how evolution has shaped fin diversity. This research program aims to use the fin ray skeleton to reveal fundamental mechanisms that allow bones to establish, remember and re-create their shapes. Further, since the functional significance of fin structure is incompletely understood, this research is integrated with an undergraduate training program that will address outstanding questions about the diversity, performance and evolution of fin ray structures and branching patterns. This course will reciprocally inform and enrich the overall research effort, and will mentor students from diverse backgrounds in answering research questions of their own design. This integrated research program is anticipated to provide a better understanding of fish fin development and adaptation; will yield insights into skeleton and limb development in other organisms, including humans, with likely relevance to regenerative medicine; and will help to prepare scientists at multiple educational levels for independent careers in science.

This research uses zebrafish caudal fin rays to test a model by which proximo-distal positional identity is coordinated with fin outgrowth to specify ray morphology during both development and regeneration. Researchers will test a model in which a global endocrine factor coordinates proximate cellular and molecular processes known to underlie ray branching, further investigating the mechanisms by which positional information is stored and re-deployed during regeneration. Leveraging an investigation-based undergraduate research training course, this integrated program will further address related questions about the functional biomechanics and evolution of fin and fin ray morphology in actinopterigians. In all, this CAREER research program is expected to uncover mechanisms by which an important aspect of fish morphology is established during development and may be modulated during evolutionary adaptation.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.