

Title:

Evolution of type III antifreeze proteins in Zoarcoidei

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Abstract:

The repeated invasion of organisms into polar seas and their associated adaptive evolution has fascinated biologists for over 75 years. Like in most ectotherms, freezing is nearly always lethal in teleost fishes. But life in frequently near-freezing conditions has driven the evolution of one of teleost's signature adaptations: antifreeze proteins (AFPs). AFPs bind the leading edge of ice crystals, restricting their growth and reducing the cellular freezing point. Multiple types of AFPs have been identified, and each varies in protein sequence and structure. The evolution of AFPs is also marked by instances of independent evolution, and at least one case of convergence in unrelated and geographically distant taxa (e.g., Antarctic notothenioids and Arctic cod). When evolutionary mechanisms could be investigated, AFP innovations appear to result from gene duplications, neofunctionalizations, and nucleotide substitutions. Here we explore the evolution of Type III AFPs in the globally distributed suborder Zoarcoidei through whole genome sequencing and comparative genomics. We assembled genomes of 15 Zoarcoidei species with varying distributions to analyze the relationship between latitude and AFP gene copy number. We compare the local genome structure among species with Arctic, temperate, and Antarctic distributions to show the rapid evolution of AFPs upon invasion of polar oceans. We found that Type III AFP gene copy number is correlated to latitude and that the expansion of the tandem array is likely facilitated by repetitive elements in the region.

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