Antifreeze protein evolution: recent and often

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Antifreeze proteins (AFPs) are proving to be a structurally diverse group of proteins that appear sporadically in the phylogeny. The four types of fish AFPs, are clearly derived from different progenitors, and their scattered distribution - where closely related fish have radically different AFP types - led us to propose that they evolved recently (<20-30 mya) in response to sea-level glaciations (Scott et al., 1968). In addition, similar AFPs also appear in highly divergent fish species. For example, the alanine-rich alpha-helical type I AFP appears in three different teleost orders and, like the antifreeze glycoprotein, provides an example of convergent evolution of a repetitive sequence. The more complex globular, non-repetitive type II (lectin-like) AFP is also found in three orders. Rather than being related by descent from a common ancestor, accompanied by gene loss from numerous species, the type II AFPs are thought to have been transferred laterally between species (see poster by Graham *et al*.). The appearance of five (and counting) different AFP types in six-legged arthropods such as insects and springtails demonstrates that AFP evolution on land is equally scattered. For example, there are two different AFP types (plus a polysaccharide-based antifreeze) in beetles, and two in moths. The situation in other kingdoms appears to be the same: reflecting independent origins of different types with the possibility of some dispersal by lateral gene transfer.

Funded by CIHR and NSERC