Evolution of a Contraceptive for Sea Lamprey

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Findings may help rescue Great Lakes fisheries

In addition to providing fundamental insights into the early evolution of the estrogen receptor, research by a team at the University of California, San Diego School of Medicine may lead to a contraceptive for female lampreys – a jawless fish considered an invasive pest species in the Great Lakes region of the United States. This could prove important to the Great Lakes region, where lampreys aggressively consume trout, salmon, sturgeon and other game fish.

"Since the introduction of sea lamprey to the Great Lakes, the fisheries have been devastated, and as a result, there is much interest in finding new methods to control the lamprey population," said Michael E. Baker, PhD, professor in UC San Diego's Department of Medicine, Division of Nephrology-Hypertension. "Our research could lead to a contraceptive for female lamprey, providing a method to control their reproduction in the Great Lakes." The researchers' findings will be published by PloS ONE on June 25.

Lampreys evolved about 450 million years ago, before the appearance of sharks. In contrast to sharks, fish and land vertebrates, lampreys have no jaw. They feed on fish by attaching themselves to the fish and sucking their body fluids. Their aggressive consumption of game fish has eliminated many natural predators of the alewife, another invasive species on the Great Lakes. This has allowed the alewife population to explode, with adverse effects on many native fish species.

photo credit: Ted Lawrence, GLFC

As part of a program to understand the evolution of steroid hormone signaling, the UC San Diego researchers characterized the estrogen-binding site on the estrogen receptor in the sea lamprey. To accomplish this, Baker – along with David Chang, student in the UC San Diego Department of Biology, and Charlie Chandsawangbhuwana, graduate student of Bioengineering in UC San Diego's Jacobs School of Engineering – constructed a 3-D model of the structure of the lamprey estrogen receptor.

The active estrogen in lamprey is unknown, although recent research in the field suggested that lamprey estrogens contain a 15alpha-hydroxyl group, which is lacking in other types of vertebrate estrogen. The model developed by the UC San Diego research team uncovered a unique interaction between 15alpha-hydroxy-estradiol and an amino acid called methionine, found only in lamprey estrogen receptors.

"The unique aspect of this interaction suggests that there are compounds that can bind specifically to the lamprey estrogen receptor, but not to estrogen receptors in other animals," said Baker, adding that some of these compounds could interfere with estrogen action and act as contraceptives in female lamprey, providing a method to control their numbers.

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