Evolution of Globin Genes in Red-blooded and White-blooded Antarctic Notothenioid Fish

- Undergraduate research project -

Supervisors: Thomas Desvignes, PhD; Research Associate
John H. Postlethwait, PhD; Professor, Biology

Project breadth:

Full independent research project, with the ultimate goal of publishing a scientific paper.

Project background:

Antarctic Notothenioids form a diverse group of fish that inhabit the freezing waters of the Southern Ocean, an impossible habitat for most species. Antarctic waters are also highly saturated in oxygen, thus increasing oxidative stress on organisms. Icefishes are the best known Notothenioids and, unique among vertebrates, are white-blooded because they lack hemoglobin, the universal vertebrate oxygen transporting protein. Several species of icefishes also lost cardiac myoglobin; all Notothenioids, however, possess the other recently described globin genes: *cytoglobin 1* (*cygb1*), *cytoglobin 2* (*cygb2*), *globin x* (*gbx*), and *neuroglobin* (*ngb*). The functions of these genes are still poorly understood but are supposed to be involved in oxygen transport and protection against oxidative stress. We therefore want to investigate whether these other globin genes evolved to protect against oxidative stress following the cold adaptation in Notothenioids and to facilitate oxygen transport following the loss of hemoglobin and myoglobin in icefishes.

Project objectives:

The project will involve bioinformatic and lab bench analyses. Bioinformatically, genes (hemoglobin, myoglobin, cytoglobins, neuroglobin, and globin x) will be studied for their genomic conservation among Notothenioids, their gene and protein sequence evolution using phylogenetic tree reconstructions, and for signs of relaxed or purifying selection to understand their rate of evolution. In addition, lab bench work will involve studying the gene expression patterns of each gene by quantitative RT-PCR in a panel of tissues from temperate Notothenioids species, Antarctic red-blooded notothenioids, and Antarctic white-blooded icefishes.

Potential benefits to student:

- The project explores unknown evolutionary trajectories, and will teach the student lab skills in molecular genetics and bioinformatic skills in genomic analyses.
- Potential project for a Clark Honors College thesis or a Biology Honors thesis
- Academic research credits

Prerequisites and commitments:

- Basic knowledge in genetics.
- Interest in genetics, developmental biology, ecology, or evolution
- Strong motivation to learn independently and solve complex problems
- Professionalism, dependability, enthusiasm, and integrity
- Willingness to devote ~8 hours of work per week and commit to at least three consecutive academic terms for 2019-2020 (Fall, Winter, Spring)

Application procedure:

Email Thomas Desvignes (desvignes@uoneuro.uoregon.edu) and John Postlethwait (jpostle@uoneuro.uoregon.edu), including a C.V. or resume (which should include your previous research experience and any relevant coursework) and a personal statement outlining why you would be a good candidate for this position.

Qualified applicants will be contacted directly for further information and a follow-up interview.