

Resource partitioning regulates epigenetic evolution among Lake Superior lake charr ecotypes



Core Question: What mechanisms allow diverse forms of lake charr to emerge and coexist in the deep waters of Lake Superior?

Lake Superior is home to a unique population of lake charr that is self-sustaining without the help of hatchery stocking. Remarkably, this species has branched out into at least four distinct ecological types, known as ecotypes, which differ in where they live and what they eat. These include the nearshore leans, the deep-dwelling siscowets with high fat content, the offshore humpers, and the recently identified redfins. Scientists believe this diversity is driven by resource partitioning, a process where different groups evolve to use different habitats and food sources to avoid direct competition.

While traditional tools like carbon and nitrogen isotopes help track diet, they often struggle to clearly distinguish between these overlapping groups. To gain a deeper understanding of different ecotypes, researchers are now looking at fatty acid profiles and advanced genetic tools. Fatty acids provide a much more detailed snapshot of a fish's resource use than standard isotopes. Recent evidence suggests that the physical differences between these ecotypes, such as head shape and fat metabolism, are likely linked to specific genetic markers.

Because Lake Superior is a relatively young ecosystem, these ecotypes may be in the early stages of speciation, or the evolutionary process by which populations evolve to become distinct, reproductively isolated species. A key part of this evolutionary puzzle is epigenetics, which involves changes in how genes are expressed without altering the underlying DNA sequence. These changes can be triggered by environmental factors like water pressure or diet and can be passed down to future generations. This research project seeks to investigate how resource partitioning regulates the epigenomes of these different ecotypes. By combining chemical tracers with epigenetic analysis, scientists hope to uncover the mechanisms that allow these diverse forms of lake charr to emerge and coexist in the deep waters of Lake Superior.

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