Learning from Whales: A Deep Dive in Marine Mammal Genetics

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Oxygen is an essential need of all organisms on the planet

Billions of years of evolution helped different organisms obtain different ways to acquire and conserve oxygen, without which they cannot survive.

222 min.

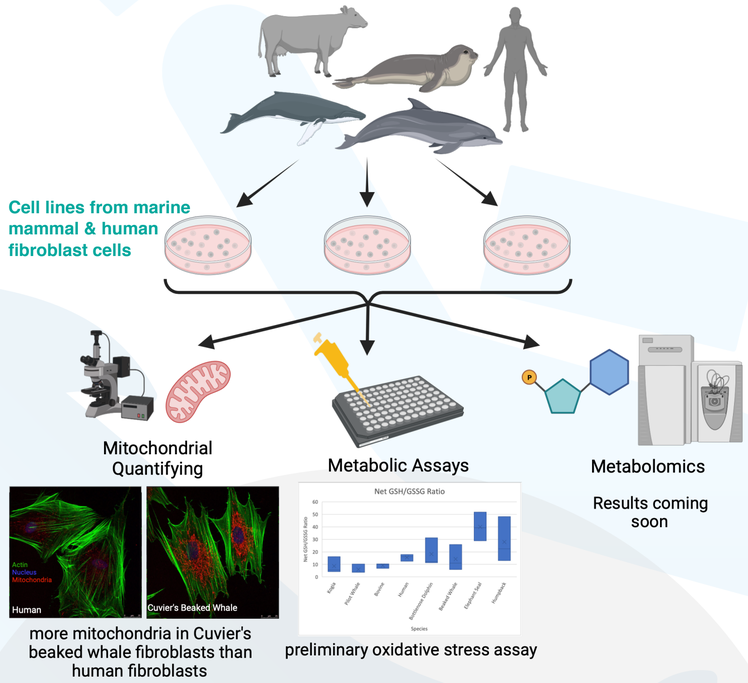
10 min.

Cuvier's beaked whales, a toothed whale, can dive for 3 hour 42 minutes without taking a breath.
The human record for breath-holding is ~10 minutes.

What kind of adaptations have marine mammals evolved to cope with low oxygen conditions (i.e. hypoxia) during long dives?
Can we use this knowledge to uncover more about hypoxia in humans?

Using molecular biology, metabolomics, and gene expression techniques, we are looking at how marine mammals cope with hypoxia at **Bass Connections: Learning from Whales.**

Cellular Adaptations of Deep Diving Marine Mammals



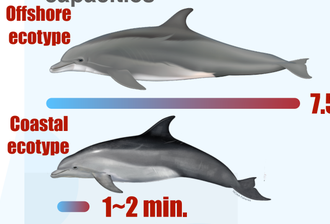
more mitochondria in Cuvier's beaked whale fibroblasts than human fibroblasts

preliminary oxidative stress assay

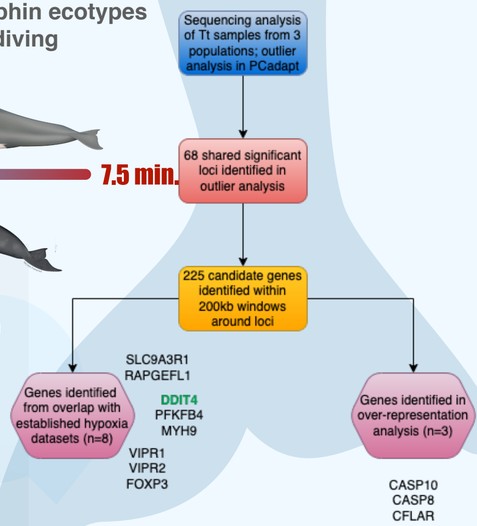
Low oxygen adaptations of deep diving marine mammals at genetic, proteomic, and metabolomic levels can be used to inform human responses to hypoxia. Through various assays and cellular imaging, the oxidative stress response of fibroblasts from six marine mammals were compared to bovine and human cell responses. Significantly more mitochondria were found in Cuvier's beaked whale fibroblasts when compared to human fibroblasts.

Identifying Candidate Hypoxia Genes in Bottlenose Dolphins

Bottlenose dolphin ecotypes have different diving capacities



This presents an ideal model system to study genetic adaptations that allow offshore dolphins to dive longer.



Using genome-wide scans of RADsequencing data, RNAseq analysis, and whole genome ReSeq data, We identified candidate genes that differ between different dolphin ecotypes: these genes play important roles in a wide range of biological functions such as: immune response, cell metabolism, inflammation and glycolysis. One of the genes we found is DDIT4, a protein evolved in anti-tumor therapy resistance, and may be related to hypoxia tolerance.