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The Blue Whale : Genes of Interest and Important Genetic Features

Rationale

The Blue Whale has a very interesting evolutionary history. Upon further examination of the family and the general class of organisms that fall under the category of "Baleen Whales," it became clear that the blue whale shares a lot of genetic similarities with other massive aquatic mammals, both prehistoric and modern. I want to further study the genome size of the blue whale, but in doing so I also want to see how much of the general map of the genome overlaps with other baleen whales.

Hypothesis

My hypothesis regarding the genome of the blue whale is that it is closely related to many other large aquatic mammals, and huge sections of the genetic sequence will overlap with both extinct and alive baleen whale species. My hypothesis is based on three possible reasons

1. It is well known amongst marine biologists today that blue whales are able to mate and produce offspring with fin whales, although they are an entirely different species. This suggests that the blue whale is closely related is other whale species and there is possibility for overlap in the gene sequences.
2. The concept of Sympatric speciation heavily applies to blue whales and other baleen whales. Essentially sympatric speciation is when two identical species live together in the same general geographical area, but still differentiate into two different species over time.
3. My last reason and possibly the most strange hypothesis in regards to the genome of blue whales has to do with continental drift. Over 200 million years ago, when all of the continents existed together as what is known as Pangea, the entirety of the ocean on Earth was one large entity. I feel like this lack of differentiation in the ocean on earth (unlike how it is today) may be a reason for the unique evolution of blue whales and also many other aquatic species.

Approach

Understanding the similarity of the blue whale genome in comparison with other whale species will require delving into comparative genomics. Cross species sequence comparison is definitely doable with high throughput and next gen sequencing methods. It however, is not as simple as

comparing the genetic sequence of two similar species and determining at what locations do they differ. The best method for comparing the DNA sequence of the blue whale to another species like the fin whale, for example, would be to first determine some key locations on the genome sequence that are functional. By "functional" what biologists mean is, what parts of the genome sequence are essential for an organism to live and perform vital functions. By separating these functional sequences from the non functional sequences, we can essentially remove a lot of the noise that may hinder our ability to accurately compare two genome maps.

Expected results

The results that I expect to see when doing high throughput sequencing and comparing the genomes of blue whales with other species of baleen whales, is that they won't be so different. Although the blue whale and fin whales can mate and produce offspring (like horses and donkeys, and bison and cows) this may not be the case between blue whales and other species of whales like humpback whales and sperm whales. The comparison between blue whales and fin whales is a good place to start because they have possibly the highest percentage of genomic similarity, and it would be a good idea to go down the list from there.

Anticipated Challenges

The biggest challenge in comparative genomics is determining functional vs nonfunctional sequences of genes. A human may share many sequences of genes with a mouse, but obviously since the shared sequences serve no purpose towards essential functions of the organism they are a moot point. Similarly, it may be difficult to determine what aspects of the genome of blue whales are actually shared between other baleen whales and what aspects of the genome serve no function whether or not they are identical or different. It may be a viable option to go into chromosomal and male/female differences between blue whales and other species for this reason, because most of the functional aspects of whale genomes may show up in the form of traits and differentiation between males and females of the same species

Useful Reference

Árnason, Ú., Lammers, F., Kumar, V., Nilsson, M. A., & Janke, A. (2018, April 4). Whole-genome sequencing of the blue whale and other rorquals finds signatures for introgressive gene flow. Science advances. Retrieved October 9, 2022, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5884691/