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Written Assignment 3

Throughout the history of the world there have been many adaptations and events that have led to evolution in a species. Not only can these changes occur phenotypically but it also comes down to the mutations in the genome. Some can loss while others gain genes which both can be either a pro or con depending on its environment. While mutations are random, the environment a species lives in can play a major factor on how it adapts and what's important for survival. In this article researched by Liu, A. et al. you can see how the environment can completely change what a species can gain or lose in their genes. When it comes down to senses, the ability to smell plays a huge role and greatly differs among species. It can provide pleasant sensations and help certain species find food, avoid danger, or even help with mating. The study done by Liu, A. et al. compares terrestrial mammals and marine mammal's genes to see the difference in evolution when it comes to smell. This ability is due to olfactory receptors which bind odor molecules, and many changes can be seen in the OR genes among species. With different amino acid sequences and sites, it can determine the specificity of these receptors. There are class I proteins that can be seen in many fish species and tends to bind water-soluble odor molecules or class II proteins which bind hydrophobic odor molecules. These are seen in amphibians and mammals. Since these genes show a high family expansion or contraction its shown that new OR genes can be gained by gene duplication whereas the loss of these OR genes can be shown by pseudogenization. The evolution of mammals has shown great diversity by having different lineages of common ancestry both living in terrestrial environments and aquatic environments. By using mammals to compare terrestrial environments to marine environments and the evolution of these genes, this study proved to show how the marine mammals have lost many of these OR genes due to the aquatic environment. This study included three methods towards the data which were sequence identification, alignment, and evolutionary analysis. Identifying over 10,00 members of the OR genes in these mammals they were able to classify them into 830 orthologous gene groups. This genomic data used came from 11 marine mammals with three independent origins and then 11 terrestrial mammals related to these three lineages. Now came the identification of the OR genes in the genome. Using mouse and human OR genes that were identified, they were able to sweep the genome and extract specific sequences. This allowed them to align and discard any sequences not needed for the experiment and only focus on the loci that provided OR gene functions. To do this they constructed phylogenic trees and aligned the sequences from each species. To make sure they had the correct genes they used the human and mouse sequences to locate these intact OR genes. Also considering that the remaining genes are ether pseudogenes or nonsense OR genes. Liu, A. et al. were able to identify 12,711 intact OR genes from the collected data within the mammals. Using this they created an evolutionary tree among the mammals to help show the gains and losses among these species. It is clear in the data that even with shared ancestry as time goes by within each specific environment the marine mammal's loss many of these intact genes. While most terrestrial mammals showed high numbers in comparison while still losing some overtime. In comparison the numbers of intact OR genes in terrestrial mammals were more than triple of those in marine

environments. These results show that due to the aquatic environment there has been olfactory degradation since it was not heavily relied on. Instead, marine mammals utilize touch and hearing a lot more in these environments which they slowly adapted to over time than in comparison to its terrestrial lineage. Thus, showing how the environment plays a major role in adaptation among different organisms with common ancestry and can completely change the genomic makeup of a species. This will lead to better chances at survival and overtime shows the evidence of evolution.

Citation

Liu, A. et al. Convergent degeneration of olfactory receptor gene repertories in marine mammals. *BMC Genomics* **20**, 977 (2019).