Genomic Biodiversity

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The advancement of genomics has brought us to a new understanding of the diversity of life. Rising from a subfield of molecular biology and genetics, genomics is now regarded as a field unto itself. For scientists, it is hard to keep pace because complete genomes are being sequenced at such a high rate.

Studies involving genomes are opening up new insights into the organization and evolution of living systems. A total of ten nuclear genomes are currently known for vertebrate animals, including the prized human genome, which serves as the driving force behind the growth of the field.

The development of new therapies to improve human health has been the traditional mission of genomics. The human genome project expanded and took on the challenge of sequencing the genomes of yeast, fish, frogs, birds, rats, and chimpanzees. Comparative genomics quickly emerged as a means to develop medicines, understand pathogens, study the inheritance of genes and gene families, and infer evolutionary relatedness. The comparison of complete genomes has now led to the creation of subfields like conservation and biodiversity genomics.

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Plants and animals in the collections of the San Diego Natural History Museum also serve as source materials for research in genomics. The biological diversity represented in the Museum's research collections is the expression of hundred of thousands of genomes that are products of millions of years of evolution.The collections provide an immense resource to be used to study the expressed morphology of organisms or to be directly used in genetic studies.

One example of such use in our collections was provided by Phil Unitt, Curator of Birds and Mammals. Several years ago, Nick Mundy, then at UCSD, came to use the Museum's bird collection in his study of the genetics of the Loggerhead Shrike on San Clemente Island. To get samples of DNA from bird specimens, Nick suggested pulling feathers. As a less destructive alternative, Phil suggested slicing a bit of skin from the sole of the bird's foot, a part of a bird that is never used in other studies or as an identifying characteristic. The skin from the sole turned out to give results so much better than do feathers that sampling DNA from the soles of bird feet is now the standard technique when the sample must be taken from preserved specimens rather than from the blood of live birds.

To study natural history questions, snippets of DNA are sequenced to investigate the genetics of small isolated populations threatened with extinction, study species boundaries, and reveal broader patterns of evolutionary relationships. Comparing the patterns of genetic history across multiple organisms helps identify regional commonalities. Scientists are identifying so-called evolutionary crucibles, places where biological lineages are born. Our region includes dozens of crucibles where species diversification emerges. With the help of genomics, the natural history of our region is being revealed like never before.

Discovering the origin of plants and animals in our region is one of the central missions of the San Diego Natural History Museum. Each genome by itself is interesting, but comparative genomics is providing the most profound findings. Questions about our flora and fauna will help us understand the place we live in, yet genomics has also unlocked new philosophical ideas. The recent completion of the chimpanzee genome, one of our closest relatives, is providing a direct comparison to our own genome. Through other studies, we know that the human genome is about 98% similar to the chimpanzee. As research progresses, we will soon learn which genes are highly conserved, and precisely how we differ. Comparisons to other mammals, tetrapods, vertebrates, and animals will quickly follow. The original mission of genomics to develop new therapies and medicines is developing into broader questions about biodiversity and even what defines humanity.

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