Biological Applications

The field of forensic science employs many concepts and biological information that DNA provides. DNA has been used in many cases to identify a victim or killer using samples of biological material left at a crime scene. Blood, hair, nail and other human tissues can serve as unique markers of individuals, and if these samples are preserved correctly, even cold cases can be solved (National Institute of Justice, 2002). Another application of DNA in forensic science is linking different crime scenes together or identifying the range of where a crime occurs via the matching of DNA plant and animal material within an area (Mott, 2006). Perhaps one of the most interesting applications of DNA in forensic cases, is proving the likelihood of a person committing a crime because of their mental health issues. This can be done via the detection of certain genotypes and expression of particular phenotypes that may be associated with some particular mental health issue (Hughes, 2014). This has raised major concern on the ethics of determining the predisposition of people to particular negative behaviors and condition.

Population evolution and microbial life are a major component in biological applications today. Microbial life is being discovered everywhere and these microbes can have major positive and impacts on society. Some microbes can promote increased human immunity to certain diseases like Cancer (Green and Ariyan 2014) or can potentially decrease the human aging process (Ghose 2014). For example, current clinic trials are now using microbes to help increase the rate at which T-cells can respond to the presence of cancer cells (Green and Ariyan 2014). We are also discovering how microbes contribute to our ocean animal populations and how they influence ocean health (Woods Hole Oceanographic Institution 2014), both positively and negatively. Some microbes can actually aid in the clean-up of oil spills as they ingest and breakdown parts of oil,

and others can help us determine how climate change is altering how water quality (Woods Hole Oceanographic Institution 2014).

One of the most fascinating applications of biology are within the topics of biological diversity and evolution. Numerous studies are being conducted to determine how biological diversity and evolution are changing with respect to how we utilize our lands for agricultural practices (EPA 2013). As we cultivate our lands, the way that water runs throughout them has changed greatly, and as a result the organisms in these areas are likely adapting to these water changes if they are surviving. There is also a diversity of research being done to better understand how human biological diversity is evolving and has evolved. These studies use complicated phylogenetic analyses to determine how and why humans have evolved the way we have, and these studies are now occurring on fine scales (Wade 2014). As we better understand the planet's biological diversity and evolution, scientists are even seeking to understand how our planet's diversity and evolution compares and contrast with those of other planets, like Mars (NASA Astrobiology 2015). Planetary scientists are currently interested in understanding how organisms in earth desert and lake environments may share evolutionary strategies with those found in similar habitats on Mars (NASA Astrobiology 2015).

Plant and animal evolution play a fundamental role in a plethora of biological applications. Many researchers and farmers are studying how plants evolve in response to genetic modification and/or to pest-reduction processes (Qui 2013). Some plant genomes are quickly and naturally changing so that new pests do not harm them, while other plant researchers are manipulating genomes so that the plants may become resistant to these pests. This is particularly important since many people lead a plant-based diet and we utilize plants in many of our economies. As humans seek alternative food resources, numerous facilities are looking into how wild-caught versus

culture-raised plants and animals differ nutritionally, too (Kirkpatrick 2014). While many would say wild organisms are healthier than cultured organisms, this is not true in all cases, and is very circumstantial. One of these circumstances, on a very broad scale is that researchers and farmers are trying to understand how plants and animals are evolving as our planet undergoes climate change (Marris 2014). Extreme weather events and delayed seasonality are influencing plant and animal range and evolution, but again the trends researchers are observing are inconsistent and are dependent on the particular organisms and ecosystems one is studying (Marris 2014).

It's no wonder we look to better understanding biodiversity, plant, and animal evolution, as our population grows and the need for more food and water resources becomes apparent. Population growth is an incredibly interesting topic that is currently being used to project the world's future needs. Across the world, scientists have found patterns of increased water usage and scarcity with growing populations, and are trying to come up with ways to support our growing population (Lall 2010). Some journalists and scientists suggest that humans are at the tipping point and have reached a maximum carrying capacity (Lall 2010). As our human populations are growing, are increased use of plant and animal populations is becoming strained, and researchers are trying to find the balance between cultivating forest for agricultural land and saving populations of old-growth trees (Bourne 2009). With these changes in human use and modification to land resources, biodiversity may vastly change. It may be reduced or its composition may just change in general. Overall, our ever-increasing populations of humans increases our demands on nature and numerous companies are trying to find the balance between conservation and consumption via technologies and eco-conscious practices (Clark 2013). Many of these practices begin at home with simple strategies like reducing electric usage and scale up to large changes by requiring commercial offices to use alternative types of energy like wind and solar power. Other

companies derived in food production are using better water consumption practices to increase their yield and decrease their net effect on wasting water (Clark 2013).

Every day we are learning more about the biological diversity of our world and consequently trying to understand how each piece fits within the greater puzzle. Most biomes and ecosystems have now had some studies conducted on them with regards to their diversity, environmental significance, and utilitarian purpose. New species of frogs and other animals are being discovered frequently, and even in ecosystems we thought we well knew (Griggs 2014). This demonstrates that nature is complex, ever changing, and consequently evolving. We are also discovering how ecosystems are changing with regards to land development and human impact, most of which is negative (EPA 2012). Areas with lots of development and nearby to water ways have increased sediment and run-off in their water. This affects drinking water quality and the health of the organisms living and using that water. Since our ecosystems are undergoing a lot of risk and change that is brought about from human changes, many biomes and ecosystems are now being looked at with special concern. In fact, many ecosystems and biomes are now being protected under numerous protection plans. President Obama just recently founded the largest ocean reserve in the world to not only protect the ocean ecosystems, but their plant and animal biodiversity, too (Howard 2014). There is hope that such a system will increase the biodiversity of the organisms in the sea and also help fuel our fisheries economy in the long-term. The impacts of such lofty regulations will surely lead to positive changes, but it may take a very long time to see the positive changes.

Despite our vast endeavors to understand all our biological applications, there is so much more for us to learn. Biological applications can be found in nearly every facet of life, making it very difficult to understand the scope of how biology integrates into every part of society. The

examples described above are only a small glimpse into how biological applications influence the world in which we live.

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