Editing Elephant Tusk Length: Genome Editing

Elephants are known to be the largest land walking mammals on the planet. The elephantidae specie has lived on this planet going back 5-10 million years where they have spread throughout Africa and Asia. As they are known for their long pointy external teeth or tusks, elephants are the most poached species in the world. The existing population to date is 500,000 where it is estimated that 50,000 are killed per year. The most effective way of saving elephants without having to take away their tusks, is to genetically edit the gene in an elephants DNA that codes for their own tusk length.

Genome editing is not as easy as it seems even though you are inserting, deleting, or changing certain DNA strands, but are really changing the outcome of a certain species by getting into their personnel makeup and fiddling with it. Clustered regularly interspaced short palindromic repeats (CRISPR)-Cas9 is regarded as the most effective tool in this scientific field as it efficiently does what genome editing is and does it at the cell level. The eukaryotic cell is target in its DNA editing method where CRISPR acts as a, "'molecular scalpul'", where it shortly does the work that would take longer by humans.

This piece of advanced technology edits a cell by having a special RNA strand guide an enzyme called Cas9 to the DNA segment where it will do its job in editing a signal point out of all the others. If it were to be replacing a piece of genetic information, it will cut out a tiny piece of DNA information forming a place for the new DNA information to be put. CRISPR-Cas9 has been used on yeast, nematodes, fruit flies, mice, and monkeys and has been used for the purposes of producing pest-resistant plants and many more with one of them being the protection of endangered species.

Francisco Mojica is the one who discovered CRISPR when working with Haloferax mediterranei a microbe and had found sequences of 30 base pairs being apart from each other by 36 bases that don't connect to other microbes. He saw that the code in the microbe connected to many viruses. He began to use CRISPR as a platform for based immunity acts where they lead to successful offspring resistance. After Francisco Mojica's paper was published, Luciano Marraffini a PhD student at the University of Chicago and Erik Sontheimer a biochemist discovered that CRISPR was programmable and believed that it could edit the genome.

Soon enough, in April 2015 researchers in China used the understanding of CRISPR to genetically edit human embryos but received harsh criticism over the fact of how it will affect sperm and egg cells. Theories of after effects were made by other scientist because since CRISPR makes precise incisions and replaces it with the new gene, it could cause a defect to develop. Premature aging in mice was found after blocking the gene that permits cancer. The use of CRISPR is not illegal in the field of genetics, but is the best method of editing the gene that codes for elephant tusk length even if there are critical down sides.

Many species exist in the animal kingdom and ideas/approaches at editing a unique group are already made like the idea of editing the avian or bird species. The typical idea of how editing the genome works is said not applicable to avian species via sperm and egg cells. What is recommended is vitro culturing primordial germ cells (PGCs) which go through the embryonic

circulatory system and plant themselves in the gonad or egg cell of a bird. PGCs have been successful in editing the genome of chickens in how it moves through the vasculature and heads to the gonad creating sperm like cells. The low aspect of using PGCs is that it doesn't work across all kinds of birds causing the need to look into other creative methods.

Other methods that are believed to work with chickens are zinc finger nucleases (ZFNs), transcription activator-like effector nucleases (TALON), and CRISPR. ZFNs work by the use of three to four zinc fingers connected to a nucleases named FokI where the zinc fingers contain 30 amino acids that find certain trinucleotides. No tests on chickens with ZFN have been performed. TALENs is somewhat similar to ZFNs where instead of zinc fingers its TALEs which are 33-35 amino acid blocks in a repetitive order, isolate a single nucleotide. Chicken studies have actually happened with the use of TALEN and resulted in a 10% effectiveness. CRISPR as well works with chickens where encoded Cas9 and guide RNAs lowered PAX7 a transcription factor by 80% to 90% in E3.5 embryos rather than normal ones.

PGCs are the most effective way to genetically modify chicken species but other ideas need to be formed as agricultural reasons and model bird species get in the way. STAGE or sperm transfection assisted genome editing is the injecting of Cas9 mRNA and guide RNA into a chicken sperm. This is to target the early zygote of a chicken and cause mutations within the first generation. RNA pieces are used as a base for STAGE as bird oocytes and beginning embryos as well as other species versions are transcriptionally quiescent. Many gene mutation tests with STAGE resulted in more positive mutations than CRISPR/Cas9 and works with other species. Genome editing of avian species and the methods used are successful which provide an understanding that editing elephant tusk length across all its species is scientifically possible.

Elephant heritage is enormous as well as its family tree because elephants widely spread out in their individual groups, but all come back to one single point. As birds consist of many species, elephants go the same way with three current living species of elephants, the African savannah, African forest, and Asian. Mammuthus or mammoths are apart of the extinct group where it branches into two kinds, the woolly mammoth and the North American Columbian mammoth. Genetic searches into elephant DNA heritage has been done involving 14 genomes of elephants with 2 coming from the American mastodon and 12 from extinct and existing. Pre-studies of elephant evolution were represented by bifurcating trees where others have gone deeper by showing interspecie hybridization in elephants.

To begin with, savannah and forest elephants are two different species based on their lineage and nuclear genome as this has been a constant debate. A tree of elephant heritage shows how the three current groups of elephants are separated by the American mastodons, straight tusked elephants, and mammoths. As each group is separate, straight tusk elephants though (which today are extinct) are more closely related to almost all of the other elephant groups possibly do to hybridization. Split times goes deeper into elephant diversity where all elephants split 5.6 million years ago (Mya) with forest and savannah splitting 2 Mya and Asian and mammoths 2.5 Mya. The heterozygosity (the similarity in alleles) in each elephant group varies due to the time of split of each one. There are higher levels between mammoths, straight tusks, and Asians with less from savannahs. Similarities in all elephant types is astronomical as the gene flow is unidirectional which creates admixed elephants meaning that the ability to edit elephant tusk length gene won't be different among all.

As life evolves to overcome obstacles that may end its species, some elephants have already

gotten past the problem of poachers by developing not to have tusks. The elephants in the Gorongosa National Park in Mozambique don’t have tusks due to poaching, but much more specifically because of how a man-made natural selection began. A civil war rose in Mozambique from the 1970’s to the 1980’s where older elephants were killed for their tusks to gain money to buy weapons and armaments. Out of the total percentage of elephants, 90% were killed where the remaining rest weren’t because they had no tusks causing this trait to be passed down. Females in this situation were more likely to be tuskless than males as it is super rare. Scientists have not been able to single out the gene that codes for tusk length and how it is allowing no tusks, but find the question of how is elephant social life impacted by no tusks. A solution to elephant poaching has already been given by nature itself, which means finding the gene that codes for elephant tusk length is already easier than it seems.

Elephants with tusks and without both have their negative sides and editing the genome of an elephant is a scientific way to save them. CRISPR/Cas9 is known to be the most efficient genome editing tool as it narrows done to a precise point out of millions of others. The use of it and other methods like STAGE are proven successful with other animals and ideas into editing a species is already in mind as the elephant species is very spread out. Elephants who don’t have tusks genetically, makes this idea look pointless, but is good in how elephants can keep their tusks as tusks play a major role in their lives. This general idea may not seem important to some people as there are conservative actions already in place and that genetically editing an entire species is just wrong. Genome editing is still an uncharted realm as there is still much to it, but for elephants right now, the best way to keep them safe is to protect them.