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CRISPR and Functional Genomics in Transforming the Future of Zoology

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Genome editing has offered a precise approach by using CRISPR methodology in animal models such as zebra fish, fruit flies, mice, rats, and non-human primate models used in research. CRISPR has revolutionized the future of zoology by manipulating genes to improve animal models used in laboratory experiments, safeguarding fauna, and unraveling the mysteries of animal life. This method utilizes Cas-9 enzyme to cleave DNA, guided by single guide RNA to target specific DNA sequence, and plasmid, using techniques of electroporation and lentiviral delivery to edit genome of animal models by knocking out or knocking in genes of interest, base editing for precise engineering, protein tagging, and genome wide screens to create mutation libraries for phenotypic studies. Cas-9 enzyme can also be modified as dCas-9 where catalytic activity of Cas-9 enzyme is dead, and it binds to specific DNA sequence without cleaving DNA for gene activation (CRISPRa), interference (CRISPRi), and epigenetic studies.

The CRISPR Cas-9 system has improved the ability of researchers to edit multiple genes and gene elements of animal models including Drosophila. This system has offered new ways to study genetics of wing patterns in butterflies, social behavior of insects, and migration [1,2]. It has allowed researchers to understand gene function for limb regeneration studies, and sensory networks of camouflage in corals, reptiles, amphibians, and fish [3,4]. CRISPR screens have helped researchers in developing venom antidotes to reduce the burden of snake bites. CRISPR also provides an efficient way to protect biodiversity by improving genes for animal thermal tolerance, gene editing of critically endangered species by correcting harmful mutations, using knock in and knock out studies to improve genome of animals hard to breed, targeting specific genes for pest control, and creating disease resistant livestock to improve animal health and welfare [5].

Using CRISPR can help combat global warming, ocean warming, and manipulate specific genes/alleles in aquatic animals to tolerate heavy metal pollution. Zoologists can use CRISPR system to study behavioral genetics to improve courtship behavior and parental care of animals. This technology might help wildlife zoologists and paleontologists understand habitat and de-extinction by precise gene and base editing. Similarly, evolutionary studies of animals can be improved using CRISPR dcas-9 system, as it does not alter DNA sequence and can be used to understand ancestral dating, circadian rhythm, oxygen and temperature regulation.

Now the tools like CRISPR are spilling over; zoologists can shift the research by balancing scientific curiosity and transparency within ethical concerns and policies. Genome editing used responsibly can shape the future of animal models used in research, animal diversity, evolution, conservation, wildlife, and give a new direction to zoological research.

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