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Faculty of Veterinary Science

Veterinary Genetics Laboratory • Onderstepoort

Faculty of Veterinary Science

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First Newsletter of the Veterinary Genetics Laboratory

We made a decision earlier this year to keep our clients and partners informed of what we are up to in the laboratory. It has taken a bit longer than expected, but here it is, the first VGL newsletter. A number of exciting discoveries and innovations have happened during the past few years and we want to share them in order to highlight the contribution that the University of Pretoria is making in terms of animal genetics. This time we have focussed on wildlife. In future newsletters we will share developments in other species. Scientific publications related to the projects in this newsletter are available on request and DNA Test Request Forms that provide details of samples that need to be collected and costs of the tests can be requested via email vgl@up.ac.za.

We encourage feedback and questions that we could discuss in the future newsletters as well.

Colour Variants in Wildlife

Humans seem to be fascinated with creatures that differ from the general population. One of the first factors that humans select for, following domestication of a species is the appearance of the animal, particularly its colour. The mutations that cause colour variations are natural and regular events responsible for the biodiversity that we see. In wildlife we have seen the same fascination emerge. Breeders are selecting for various colour patterns and breeding these animals in order to fix the variant in a captive population.

The mode of inheritance or simply, the way in which a mutation is inherited from one generation to the next, is generally not known in many of the colour variations that occur in wildlife. The first step in understanding the outcome of a mating between specific coloured animals, is to understand how the

colour is inherited. Experience is currently the only predictor of the mode of inheritance but, unfortunately, many myths surround this.

The heated debate about the benefits or disadvantages of colour variants in wildlife could also be tempered with more scientific evidence. In order to establish the actual extent of the prevalence of colour variants in wild populations and the effect of factors such as predation level and survivability of these variants, one must be able to identify “carriers” or “splits” as they are commonly known. Knowledge of carriers combined with parentage information will also assist breeders by ensuring that the dangers of inbreeding are avoided through the selection of unrelated animals. The value of the carrier animal is also significantly more than a normal – or wild type – non carrier animal and a guarantee of this is vital to the potential buyer of coloured stock.

The VGL has been involved in the research and development of some of the currently available direct colour mutation tests in wildlife of which three are described in this newsletter.

The White Lion

In 2008 we visited the Ukutula Lodge and Lion Park near Brits. It was well known then that white lion cubs appeared in the Timbavati and surrounding lion population. Some of these lions had been removed and placed in various captive facilities where it became clear that the white colour is inherited as a recessive mutation, i.e. carriers are normal tawny lions. In order to be guaranteed of white offspring, a breeder would have to breed white with white and this would lead to inbreeding problems which are particularly severe in carnivores. Being able to identify tawny carriers would make it possible to select unrelated animals that could still produce white offspring and avoid the inbreeding problems. The VGL received samples from the breeding centre of related animals that were carriers of the white mutation or were white. In the meantime a large collaborative project was initiated in Republic of Korea to complete the genomes of the lion, tiger, white lion and snow leopard. The VGL, through Dr Steve O’Brien, assisted with this effort by providing the validation data that confirmed the mutation responsible for the white colour in the lion. This was done using the samples provided by Ukutula, for which we are very grateful. The scientific paper describing this mutation with the genome data was published in Nature Communications in 2013. The mutation occurs in the TYR gene and causes the change from tawny to white coat. The VGL provides a test for this mutation.

The King Cheetah

Similarly, through a long standing collaboration with the De Wildt Cheetah Breeding Centre of Ann van Dyk, the VGL was able to assist with the validation of the mutation responsible for the king cheetah colour pattern in cheetahs. We are again very grateful for the support from Ann and the De Wildt Cheetah Breeding Centre for their support. Dr Steve O'Brien, who was director of the Laboratory of Genomic Diversity at the National Cancer Institute in the USA and is now the director of the Theodosius Dobzhansky Centre for Genome Bioinformatics at the St Petersburg University in Russia, was again responsible for coordinating this collaboration. The information on this mutation was published in the journal Science in 2012. The king cheetah mutation is also a recessive with carriers appearing as normal spotted cats. The VGL provides a test for this mutation.

The Black Impala

The VGL recently identified the mutation responsible for the black phenotype in the impala and has developed a test for this mutation. The test makes it possible to identify carriers / splits for the black variant. Black is carried as a recessive mutation and carriers do not express black in the coat, but appear as normal red impala. The direct test provides the breeder with the guarantee that their breeding stock carries the mutation which makes it possible to select high quality carriers from a wider genetic pool at a lower cost. Red offspring from 2 carrier matings can be tested and the wild types (non carriers) removed from the breeding herd. This direct test will also make it possible to determine the prevalence of the black mutation in the wild impala population which will have direct implications on the role and management of these colour variants in the natural population.

The following figure shows the inheritance of a recessive mutation when two carriers (splits) are mated. From such a mating there is a 25% chance of producing the colour variant, a 50% chance of producing another carrier and 25% chance of producing a wild type animal, which does not carry the mutation at all.

Black split / carrier		
Black split / carrier	B	W
B	BB	BW
W	BW	WW

The results of the black impala test are provided as follows;

BB: Carries 2 copies of the black mutation and is black

BW: Carries 1 copy of the black mutation (is a black split)

WW: Does not carry the black mutation and is a wild type or red impala

An update on the Rhinoceros DNA Project or RhODIS®, the Rhino DNA Index System

A successful project in 2009 resulted in the VGL developing a method to extract DNA from rhinoceros horn and produce an individual DNA profile from the horn. This method has subsequently been validated and is now used routinely in the VGL to individually identify rhinoceros horns from stockpiles for security purposes and to link recovered horns to individual poaching cases, thereby linking a horn trafficker to a poaching incident or a poacher caught with horns in his possession with the carcass of an individual rhinoceros. It also provides a tool to differentiate legal and illegal horns in stockpiles and can be utilized to trace horn recovered in consumer countries to their origin in African countries.

Figure showing that DNA evidence can be used to link horns and other items back to a poached rhinoceros

The DNA evidence provided by RhODIS® has been utilized in several successful cases since June 2010 when the database was launched. There are currently over 11 000 animals on the RhODIS® database and over 1700 forensic cases have been submitted to the VGL. The rhino include South African black and white rhinos from the national parks, provincial parks and private sector as well as rhinos from Namibia, Zimbabwe, Botswana, Malawi and Kenya.

The stringent quality requirements of RhODIS® extend to the collection of field samples to ensure that the integrity of any data used in court cannot be questioned. This has been done by the development and distribution of a RhODIS® sample collection kit. The kit has been developed in collaboration with the SAPS Forensic Science Laboratory in Pretoria and the Environmental Crime Investigating Unit of SANParks.

The sampling of rhinoceros and rhinoceros horns using the RhODIS® kits has been included in the Amendments to the National Environmental Management: Biodiversity Act 10 of 2004, which state that samples for DNA profiling must be taken from all rhinoceros when the animals are translocated, captured or hunted and all rhinoceros horn stockpiles must be sampled using the RhODIS® kits and samples submitted to the VGL for addition to the RhODIS® database. These kits can be ordered directly from the VGL.

The VGL also recently launched eRhODIS™ which is an android based app. The app supports the collection of the field data and is used with the kits to ensure that field data is accurate and immediately available in electronic format to the laboratory. The VGL with Samsung has distributed a number of tablets to various provinces and the Kruger National Park for the field implementation of the app and it has been very successful.

We will continue to provide updates on the RhODIS® project and highlight particularly the valuable contribution of the sponsors of this project in future newsletters. This is one of the ways in which the VGL has utilized its expertise and time to support the efforts to fight rhino poaching

Other News:

Our staff is the core that drives the VGL. It is definitely a team effort and each person plays an integral role and is fully committed to making a success of the VGL.

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