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Molecular epidemiological study of canine rabies in the Free State province (South Africa) and Lesotho

by

Chuene Ernest Ngoepe

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Supervisor: Prof L H Nel
Co-supervisor: Dr C T Sabeta

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I declare that the dissertation which I hereby submit for the degree MSc at the University of Pretoria, South Africa is my own work and has not been submitted for a degree at another university

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Chuene Ernest Ngoepe

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SUMMARY

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Chuene Ernest Ngoepe

Supervisor: Prof. L. H. Nel
Department of Microbiology and Plant pathology
University of Pretoria

Co-supervisor: Dr. C. T. Sabeta
Virology, Rabies Unit
Onderstepoort Veterinary Research Council

Department of Microbiology and Plant pathology
For the MSc degree (Microbiology)

There are two rabies virus biotypes recognized in southern Africa namely; the canid and mongoose rabies virus biotypes. The host vectors of canid rabies biotype in South Africa are domestic dogs, black-backed jackals and bat-eared foxes, whereas the mongoose rabies biotype is maintained by the yellow mongoose. The canid rabies virus was introduced into southern Africa from Angola (1940s) and spread within the sub-continent, firmly establishing itself in the domestic dog population in Zimbabwe (1950s) and South Africa (1960s). Canine rabies became established in the coastal regions of South Africa (KwaZulu Natal) in 1976 where it has been problematic ever since. Historical data demonstrate that canine rabies has spread from KwaZulu Natal into the north-eastern corner of Lesotho in 1982, spreading throughout the country and reaching the western border of Lesotho and South Africa (FS province) in the mid-1980s without penetrating into this region of South Africa.

In contrast, the historical evidence suggests that mongoose rabies virus existed in southern Africa in the early 1800s. Mongoose rabies was confirmed in 1928 in South Africa and since then was consistently diagnosed in the yellow mongoose with apparent spill over into domestic animals on the central plateau of South Africa. The FS province was mainly associated with mongoose rabies; however, recent studies utilizing antigenic characterization have suggested an increase of the canid rabies biotype of RABV since the late 1990s, peaking in 2002. The aim of this investigation was to better understand the molecular epidemiology of canine rabies in the FS province by establishing genetic relationships between rabies viruses obtained from FS province and Lesotho, with the purpose of determining the origin of canine rabies into the province and the radiation of mongoose rabies biotype of RABV into dog host.

The coding region of cytoplasmic domain of glycoprotein gene and G-L intergenic region of 113 rabies viruses from FS province and Lesotho was amplified and sequenced. It was found that canid rabies virus isolates from the FS province and those from Lesotho were very closely related demonstrating a mean nucleotide sequence homology of 99%. This result indicated a single overlapping epidemiological rabies cycle between the two regions. The results also confirmed that the spill over of mongoose rabies virus into dog host does not establish dog to dog transmission and therefore leads to dead end infection. Therefore parenteral vaccination of domestic dogs and cats remains an important priority in any effort to control rabies in these regions.

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LIST OF ABBREVATIONS

A	Adenosine
aa	Amino acid
ABLV	Australian Bat Lyssavirus
A.D.	Anno Domino
ATP	Adenosine triphosphate
B.C.	Before Christ
BHK	Baby Hamster Kidney cells
bp	Base pairs
cDNA	Complementary DNA
^{o}C	Degrees Celsius
CNS	Central Nervous System
CVS	Challenge virus strain
Da	Daltons
DNA	Deoxyribonucleic acid
dNTPs	Deoxyribonucleotide triphosphate
EBLV 1	European Bat Lyssavirus type 1
EBLV2	European Bat Lyssavirus type 2
EC	Eastern Cape
EDTA	Ethylene-Diamino-Tetra-Acetate
ERA	Evelyn Rokitniki Abelseth
et al	and others
FAT	Fluorescent antibody test
FS	Free State
g	Grams
GABA	Gamma Amino Butyric Acid
G	Glycoprotein
GGP	Gross geographic product
gt	Genotype
HDCV	Human diploid cell vaccine

HEP	High egg passage
i.e.	In other words
kb	Kilobase
Km	Kilometer
KZN	Kwazulu Natal
L	Polymerase protein
MEGA	Molecular Evolutionary Genetic Analysis
mRNA	Messenger ribonucleic acid
M-MLV	Moloney Murine Leukemia Virus
mABs	Monoclonal antibodies
$MgCL_2$	Magnesium Chloride
MIT	Mouse inoculation test
mm	Millimetre
mg	Milligrams
mM	milliMolar
M	Matrix protein
N	Nucleoprotein
nAChR	Acetylcholine receptor
NCAM	Neuronal cell adhesion molecule
NICD	National Institute for Communicable Diseases
NJ	Neighbour joining method
nm	Nanometer
OIE	Office International des Epizooties
OVI	Onderstepoort Veterinary Institute
P75NTR	p75 neurotrophin receptor
P	Phosphoprotein
PCEC	Purified chick embryo cell
PCR	Polymerase chain reaction
pmol	Picomolar
PV	Pasteur virus
RNP	Ribonucleoprotein

RNA	Ribonucleic acid
rNTPs	Ribonucleoside triphosphates
RABV	Rabies virus
RTCIT	Rabies tissue culture infection test
RT-PCR	Reverse transcriptase polymerase chain reaction
RNAsin	Ribonucleic acid enzymes inhibitor
SAD	Street-Alabama-Dufferin
SAG 1	Avirulent-Gif Street Alabama Dufferin type 1
SAG 2	Avirulent-Gif Street Alabama Dufferin type 2
UV	Ultraviolet
µl	Microlitre
USA	United States of America
VNAs	Virus neutralizing antibodies
VRG	Vaccinia rabies glycoprotein recombinant virus
WHO	World Health Organization
VSV	Vesicular Stomatitis Virus
WCBV	Western Caucasian Bat Virus
Ψ	Pseudo gene

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Chapter 1

General Introduction

1.1. Historical perspectives of rabies

Rabies is one of the oldest infectious diseases known to mankind and its antiquity is shown by literature or descriptions of the disease in ancient Roman times in the pre-Christian era (Steele and Fernandez, 1991). The oldest known reference to the disease comes from the pre-Mosaic Eshnunna Code of Babylon, which predates the code of Hammurabi of the 23rd century B.C., "if a dog is mad and the authorities have brought the fact to the knowledge of its owners; if he does not keep it in, bites a man and causes his death, the owner shall pay two thirds of a mina (40 shekels) of silver" (Sellers, 1954).

In Greek literature rabies was called "l*yssa*" or "l*ytta*", which meant madness and in man was referred to as hydrophobia; a description of a sick person who is tormented with thirst concurrently with fear of water (Steele and Fernandez, 1991). The Romans did not only write about the disease in dogs but also acknowledged the infectivity of the saliva of the "raging" dog, which they described as a "poison" for which the Latin name was "virus" (Steele and Fernandez, 1991; Baer, 1985).

Another description of rabies mentioned by Pliny and Ovid, was the "dog tongue worm", whereby the attachment of the tongue was cut and the fold removed (Steele and Fernandez, 1991). It was thought that the tongue contained the worm and the removal of its portion was believed to prevent rabies in ancient times (Steele and Fernandez, 1991). The idea persisted until the 19th century, when Pasteur demonstrated the cause of rabies and the development of post-exposure prophylaxis (Steele and Fernandez, 1991). From this Pasteur era, literature on rabies gradually expanded over the subsequent decades and plus much progress has been made in the control strategies, prevention or treatment of the disease (Steele and Fernandez, 1991).

1.2. Classification of lyssaviruses

Rabies is a viral zoonotic disease, which infects all warm-blooded vertebrates including domestic and wildlife carnivore species (Woldehiwet, 2005). The rabies virus is the genotype 1 species of the genus l*yssavirus* in the family R*habdoviridae* (from Greek, *rhabdos*, means "rod"). The members of this family have a wide host range, which includes plants, animals, fishes, and humans. It consists of two major genera: v*esiculovirus* (vesicular stomatis virus [VSV]) and l*yssavirus* composed of rabies and rabies-related viruses (Wunner, 1991). The Rhabdoviridae family together with the families P*aramyxoviridae*, F*iloviridae* and B*ornaviridae* constitute the order M*ononegavirales*, because all members of this order are RNA containing viruses that contain non-segmented, negative-sense, single-stranded genomes (Mayo and Pringle, 1997).

The l*yssavirus* genus was initially divided into 4 serotypes. Recently, nucleotide sequencing of the nucleoprotein (N) and glycoprotein (G) genes further extended this genus to 7 genotypes namely; classical rabies virus (1), Lagos bat virus (2), Mokola virus (3), Duvenhage virus (4), European bat lyssavirus type-1 [EBLV1] (5), European bat lyssavirus type-2 [EBLV2] (6) and Australian bat lyssavirus [ABLV] (7) (Picard-Meyer *et al*., 2004). Genotype 1 defines classical rabies virus and the other six genotypes are called rabies-related lyssaviruses.

Based on phylogeny, pathogenicity and vaccine cross protection studies, lyssaviruses have been separated into two broad proposed phylogroups (Badrane *et al*., 2001). According to this proposal, phylogroup I comprises genotypes 1, 5, 6 and 7, whereas phylogroup II consists of genotypes 2 and 3. Although it was initially shown that viruses of phylogroup I are pathogenic to mice when injected either intra-cerebrally (i.c.) or intra-muscularly (i.m.) and viruses of phylogroup II are pathogenic when injected i.c. only (Badrane *et al*., 2001), recently was shown that viruses of phylogroup II (especially genotype 2 viruses) are pathogenic to mice when injected either i.c. or i.m. (Markotter, 2007). These phylogroupings could be further simplified as more data on virus characterisation are gathered and new lyssaviruses are discovered.

There are at least four additional bat lyssaviruses that have been identified in Eurasia to date (Arai *et al.,* 2003; Kuzmin *et al*., 2003). These include Aravan virus, Khujand virus, Irkut virus and West Caucasian bat virus (WCBV). The Aravan and Khujand viruses were isolated in central Asia in 1991 and 2001 respectively (Arai *et al*., 2003; Kuzmin *et al*., 2003). Phylogenetic analysis based on nucleotide and amino acid sequences of the N gene suggested that Khujand virus was closely related to genotype 6, whereas Aravan virus was closely related to genotypes 4 , 5 and to a lesser extent to 6 (Arai *et al*, 2003; Kuzmin *et al*., 2003). In 2002, two rabies-related viruses (Irkut and West Caucasian bat viruses) were isolated in the eastern Siberia (Botvinkin *et al*., 2003). The antigenic analysis demonstrated that Irkut virus has close similarity with genotypes 4 and 5, while WCBV showed different patterns compared to other genotypes and phylogenetically WCBV was the most divergent member of l*yssavirus* genus (Botvinkin *et al*., 2003). The antigenic and genetic studies suggested that the four additional bat lyssaviruses could be considered as new putative l*yssavirus* genotypes but have not been assigned to a specific genotype (Botvinkin *et al*., 2003; Arai *et al*., 2003; Kuzmin *et al*., 2003).

1.3. The rabies virus

1.3.1 Morphology

Members of the R*habdoviridae* are cylindrical with one flattened end and the other rounded making them typically “bullet shaped” (Bacon, 1985). The fringe of finger-like projections that occur at the outer-surface appears to cover the entire surface but not the flattened end of the particle (Murphy and Harrison, 1979). The virion particle of rabies is about 180 nm long and 75 nm wide and encloses a single-stranded, non-segmented, negative sense RNA of about 12 kb in length (Tordo *et al*., 1992). The viral genome encodes five proteins whereby the polymerase (L), phosphoprotein (P) and nucleoprotein (N) associate to form the ribonucleoprotein (RNP) and the matrix protein (M) and the glycoprotein (G) form the lipid rich envelope (Levy *et al*., 1994).

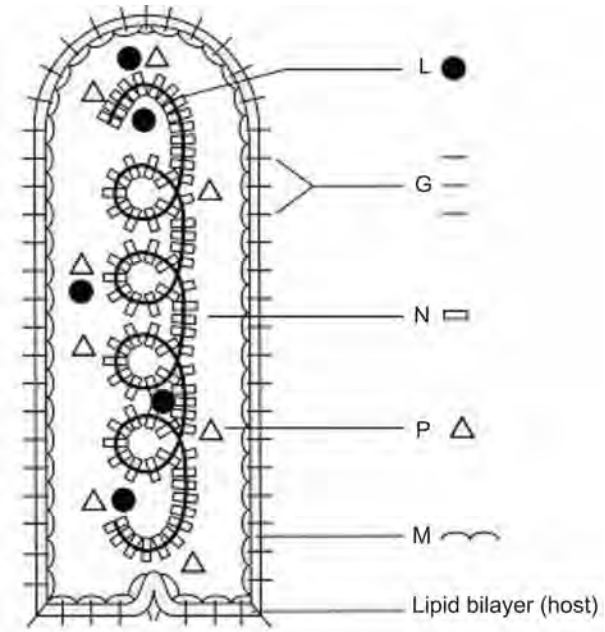


Figure 1.1. The virion structure of rabies virus indicating the proteins encoded by the genome and the acquired lipid bilayer of the infected host (www.gsbs.utmb.edu, Charles E Rupprecht).

1.3.2 Biochemical properties of the virion

The infectivity of rabies virus is destroyed by most organic solvents, oxidizing agents and surface active agents (quaternary ammonium compounds, soaps, and detergents) (Kaplan *et al*., 1986). Because the membrane envelope is mostly made up of lipids, virions are easily destroyed by these organic solvents (Kaplan *et al*., 1986). In addition the infectivity is also lost when the virus is treated with proteolytic enzymes, ultraviolet and X-irradiation and/or by exposure to extreme acid and alkaline conditions (Kaplan *et al*., 1986). The virus survives indefinitely when freeze-dried or kept at -70^{o}C. It remains stable for several days at 0-4^{o}C in saliva and it can survive for about 24 hours in temperate climates (Kaplan *et al*., 1986). It was found to have a half life of approximately 4 hours at 40^{o}C and 30 seconds at 60^{o}C (Kaplan *et al*., 1986). It was also shown that the serum proteins and chelating agents protected it against thermal inactivation (Kaplan *et al*., 1986).

1.3.3 Pathogenicity and symptoms

The most common route of transmission is through a bite or a scratch that transmits virus-containing saliva of an infected host. Virus entry into the host cell requires fusion of the viral and cellular membranes in a pH-dependent manner after endocytosis, a process whereby the cell membrane engulfs the virion particle and is then released inside the host cell (Roche and Gaudin, 2004; Gaudin, 2000). The process has been shown to be mediated by the glycoprotein (G), which recognizes and binds to the receptors on the host cell surface (Finke and Conzelmann, 2005). Several molecules including nicotinic acetylcholine receptor (nAChR), the neuronal cells adhesion molecule (NCAM) and the p75 neurotrophin receptor (p75NTR) are believed to bind rabies virus and/or facilitate its entry into the host cell in *vitro* (Lafon, 2005). The rabies virus binds to mammalian but not to avian p75NTR, an observation consistent with the lack of rabies pathogenicity in birds (Warrel and Warrel, 2004).

Two neurotransmitter receptors found in the central nervous system (CNS), N-methyl-D-aspartate subtype R1 and GABA (Gamma Amino butyric acid); have been suggested as possible receptors for the rabies virus (Gosztonyi and Ludwig, 2001). It has been shown that an infection of the CNS can occur through the attachment of the virus to the acetylcholine receptors (Burrage *et al*, 1985; Lentz *et al*, 1982). The carbohydrate moieties of the phospholipids and glycolipids of the cell membrane have also been implicated in facilitating viral entry into the host cell (Reagan and Wunner, 1985).

It was reported that after replication and budding from the plasma membrane of muscle cells, the rabies virus is taken up into unmyelinated nerve endings at the neuromuscular junctions or at the muscle spindles (Hemachudha *et al*., 2002). Other studies has shown that the rabies virus can also enter CNS without previous replication in the muscle or the skin at the time of exposure (Shankar *et al*., 1991) and migrate along peripheral nerves towards the CNS at about 50-100 mm per day via the fast axonal transport system (Tsiang, 1993). Furthermore, rabies viruses spread within the CNS, as in the peripheral nervous system, by fast axonal transport (Jackson, 2002).

From the CNS the rabies virus spreads to peripheral sites (such as salivary glands) which are essential for transmission of the virus to its natural hosts (Jackson, 2002). The time between exposure of the virus and onset of clinical signs is variable and can be from a few days to months or even years (Kaplan *et al*, 1986; Woldehiwel, 2005). The incubation period of the virus is influenced by several factors; the site of bite, the severity of the wound, virulence of the virus and the host resistance (Woldehiwel, 2005). For instance, bites on the head, face, neck and hand, particularly with bleeding, carry the highest risk and are generally associated with a shorter incubation period (Hemachudha *et al*., 2002). The highly invasiveness and neutrotropic properties make the rabies virus pathogenic.

The disease can be presented into two clinical forms, namely; encephalitic (furious) and paralytic (dump) forms. The earliest feature in furious rabies is hyperactivity, aggravated by thirst, anxiety, fever, fluctuating consciousness, inspiratory spasms and autonomic stimulation signs (Hemachudha *et al*., 2002). The paralytic forms of rabies are likely to be misdiagnosed due to the lack of aggressiveness and weakness (Warrel and Warrel, 2004). The major cardinal signs appear late and are not prominent (Hemachudha *et al*., 2002). The clinical presentations of animal and human rabies are the same, but in the later advanced stages of the disease the animal may bite vigorously and viciously at objects, including stones, other animals and humans without provocation (Wunner, 2002). Behavioural changes in wild animals include them being abnormally tame due to the paralytic form of rabies and the mental status alternates between normal and more severe agitation, depression, irritability occurs and followed by loss of consciousness, progressing to coma and finally death (Hemachudha *et al*., 2002).

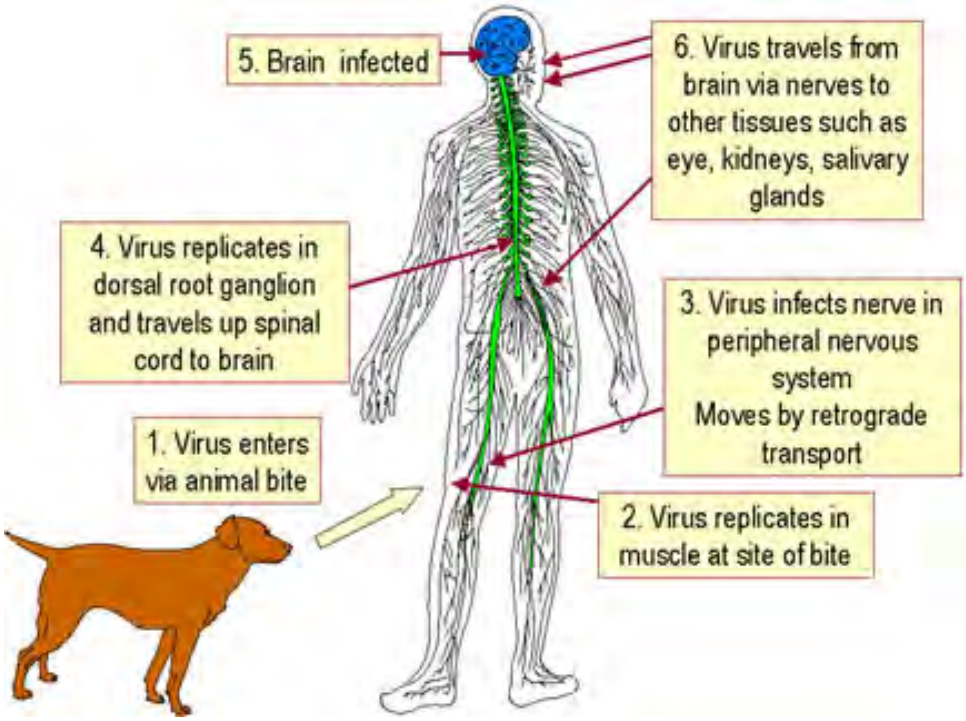


Figure 1.2. A diagram illustrating the cycle of rabies infection that begins with the viral entry at a peripheral site and proceeds through retrograde axonal transport until its shed into saliva (http://pathmicro.med.sc.edu/virol/route, Richard Hunt).

1.3.4 The structural organization of the rabies virus genome

1.3.4.1 The nucleoprotein (N)

The N protein is a 450 amino acid (aa) polypeptide and phosphorylated on a serine residue in position 389 (Dietzschold *et al*, 1987). It is a major component of the virus and the internal helical nucleocapsid (Wunner, 2002). It shows a segmented homology with the N protein of VSV, involving mainly the central part of the protein (Tordo *et al*., 1986a). The N protein encapsidates and protects the RNA genome from ribonuclease activity (Wunner, 1991) and plays a role in the switch from RNA transcription to

replication by encapsidating the *de novo* synthesized genomic RNA (Banerjee and Chattopadhyay, 1990; Blumberg *et al*., 1983).

Based on N gene sequence, lyssaviruses that share less than 80% nucleotide similarity and less than 90% amino acid similarity are classified into different genotypes (Bourhy *et al*., 1993; Kissi *et al*., 1995). The use of the N protein to dependably characterize the different lyssaviruses antigenically has been exploited at the nucleotide level by PCR techniques to elucidate the epidemiologic and evolutionary relationships between rabies and rabies-related viruses (Sacramento *et al*., 1991; Smith *et al*., 1992; Bourhy *et al*., 1993; Markotter, 2007).

1.3.4.2 The phosphoprotein (P)

This highly hydrophilic protein is 297 amino acid long (Tordo *et al.*, 1986a), well conserved (more than 90%) among genotype 1 lyssaviruses (Gupta *et al*., 2000) and possesses several serine and threonine aa residues, which anchor the phosphate residues (Tuffereau *et al*, 1985). The primary nucleotide sequence of the phosphoprotein is poorly conserved between rabies and Mokola viruses, particularly in the central part (position 55-200) (Tordo *et al*, 1986a). Two antigenic sites have been characterized along the P protein both located between position 75-901 aa residues (Tordo, 1996). The P protein in N-P complexes specifically directs N encapsidation of the viral RNA (Chenik *et al*., 1994) and P-L complexes, functions as a co-factor in transcription and replication of the viral genome (Chenik *et al*., 1994; Fu *et al*., 1994). It has been reported that the P protein stabilizes the L protein (Curran *et al*., 1995) and positions the polymerase complex on the RNA template (Mellon and Emerson, 1978).

It was shown that the rabies virus phosphoprotein interacts with the cytoplasmic dynein light chain (LC8) which has been implicated in the axonal transport of rabies virus along the neuronal microtubules (Jacob *et al*., 2000; Raux *et al*., 2000). LC8 is an important component of both the cytoplasmic dynein and myosin V, which are important in microtubule minus-end-directed organelle transport and in actin-based vesicle transport

respectively (Rasalingam *et al*., 2005). It has been shown that the LC8 binding domain is found between 138-172 aa residues of the phosphoprotein (Raux *et al*., 2000).

1.3.4.3 The Matrix protein (M)

The M protein of rabies virus is the smallest protein with about 202 aa (Tordo *et al*., 1986a). It is a multifunctional protein that interacts with the viral proteins and protein components of cellular membranes (Tordo, 1996). In addition, the M protein is responsible for recruiting RNPs to the cell membrane, their condensation into tightly coiled skeleton-like structures and budding of virus particles (Mebatsion *et al*., 1999). It is not only essential for virus budding but also acts as a regulatory protein adjusting the balance of RNP replication and mRNA synthesis (Finke *et al*., 2003; Finke and Conzelmann, 2003). The M protein is also responsible for avoiding excessive protein production and ensuring the coordinated availability of viral proteins and RNA for virus particle formation (Finke and Conzelmann, 2005). It was shown that the M protein gives the virion its characteristic bullet-like shape, regardless of whether it is located within or external to the RNP core (Barge *et al*., 1993; Lyles *et al*., 1996).

1.3.4.4 The Glycoprotein (G)

The G protein has been studied extensively at both the structural and immunological levels (Tordo and Poch, 1988). It is a 524 aa long polypeptide and contains two hydrophobic segments typical to its transmembrane nature (Tordo *et al*., 1986a). The amino terminal signal segment (first 19 residues) initiates translocation of the nascent protein through the rough endoplasmic reticulum, Golgi apparatus and plasma membrane, before being cleaved into a mature protein (Wunner, 2002). It has been shown that the translocation process continues up to the transmembrane segment (position 440-461), which remains anchored in the membrane (Gaudin *et al*., 1991).

The G protein forms trimeric spikes that extend 8.3 nm from the viral membrane (Gaudin *et al*., 1992). There are at least eight antigenic sites that have been identified on the

external domain of the G protein of different rabies virus strains (Bunschoten *et al*, 1989; Benmansour *et al*, 1991). The main function of the G protein is cellular receptor recognition (Lentz *et al*., 1986; Thoulouze *et al*., 1998) and upon attachment of the G protein to the cellular receptors, retrograde transport and viral distribution in the brain is initiated (Etessami *et al*., 2000; Mazarakis *et al*., 2001; Yan *et al*., 2002). In addition, the G protein also found to induce the production of viral neutralizing antibodies (VNAs) (Wiktor *et al*., 1973). Various monoclonal antibodies (mAbs) against the G protein have been generated, used to map antigenic epitopes and to characterize rabies virus pathogenicity (Takayama-Ito *et al*., 2006). It has been shown that a lysine or arginine residue located at position 333 in the G protein was found critical in the pathogenicity of rabies viruses in adult mice (Seif *et al*., 1985; Tuffereau *et al*., 1989; Takayama-Ito *et al*., 2006). However, other amino acids at positions 164 and 303 in the G protein of Nishigahara strain were also shown to be responsible for the pathogenic shift of rabies virus (Takayama-Ito *et al*., 2004).

1.3.4.5 The polymerase protein (L)

The L protein is the largest of the 5 rabies virus proteins and composed of 2142 amino acids (Tordo, 1996). It comprises more than half of the coding potential of the rabies virus genome (Wunner, 2002). The L protein is the catalytic component of the polymerase complex in synergy with the non-catalytic co-factor P, which is responsible for the enzymatic activities involved in viral RNA transcription and replication (Wunner, 2002). The viral RNA polymerase plays a unique role at the start of infection by initiating the primary transcription of the genomic RNA once the RNP core is released into the cytoplasm of the infected cell (Wunner, 2002). There are three essential activities encoded by L protein which are involved in the binding and utilization of ATP; the transcriptional activity that requires binding to substrate ribonucleoside triphosphates (rNTPs), polyadenylation and protein kinase activity for specific phosphorylation of the P in transcriptional activation (Sanchez *et al*., 1985). The L protein relies exclusively on its interaction with the phosphorylated P to be fully active (Wunner, 2002).

1.3.4.6 Non-coding regions of the genome

The leader and trailer RNA non-coding sequences at the 3' and 5' ends of the genome flank the structural genes that code for the rabies viral proteins (Tordo *et al*., 1986b). In addition, there are intergenic sequences between the protein coding regions of the genome with variable lengths. It was shown that the intergenic sequences between the N-P, P-M, M-G and G-L, are 2, 5, 5 and 423 nucleotides in length (Tordo *et al*., 1986b). The leader RNA is a small stretch of nucleotides (57-58 ribonucleotides), A-rich and the first to be transcribed at the 3' end of the genome (Tordo, 1996). It is believed that during transcription the leader RNA carries the promoter of encapsidation and cleaves it from the distal mRNA transcripts (Tordo, 1996). The leader RNA was implicated in the shut-off of the host cell macro-molecular synthesis in vesicular stomatitis virus (Grinnell and Wagner, 1985), an effect not usually observed during infection with the rabies virus (Tuffereau and Martinet-Edelist, 1985). Several animal rhabdoviruses are known to initiate transcription by synthesis of short plus-sense leader RNAs that are co-terminal with the 3' ends of the respective genomes (Piwnica-Worms and Keene, 1983; Giorgi *et al*., 1983).

1.4. Transcription and Replication

Transcription of the viral RNA genome is initiated in the cytoplasm once the tightly coiled transcriptionally active ribonucleoprotein (RNP) core is released from endosomal vesicles of the infected cell (Wunner, 2002). It has been shown that transcription is initiated at the 3' end of the genomic RNP and involves the sequential production of monocistronic mRNA transcripts by the viral polymerase (P and L), which is eventually translated into structural proteins (Finke and Conzelmann, 2005). Transcription is carried out by the virion associated RNA polymerase complex (L protein and the P protein) and is independent of the host cell machinery (Wunner, 2002). In contrast to VSV, transcription of individual rabies virus genes is differentially regulated by *cis*-acting sequences of the RV genome (Finke and Conzelmann, 2005). It is achieved by

modifications of non-transcribed intergenic regions located between transcriptional start and stop signals of the viral genes (Finke *et al*., 2000).

It was shown that at each intergenic region the polymerase pauses before continuing downstream of mRNA transcription and dissociates from the RNA-nucleoprotein (N) complex (Wunner, 2002). Therefore fewer polymerase molecules remain associated with the genome RNA-N protein template after each gene junction to resume transcription and the number of mRNA synthesized gradually decreases in proportion to the number of polymerase molecules that fall off (Wunner, 2002). The switch from transcription to replication occurs if the leader RNA transcripts become encapsidated by N, preventing them from acting further as initiators of genomic RNA transcription (Yang *et al*., 1998, 1999).

The viral RNA replication is dominant after transcription in the late phase of virus growth. The precise mechanism of switching from transcription to replication remains unclear though, but it is believed that viral protein synthesis is essential and the polymerase no longer recognizes subsequent intergenic events that cause transcript termination and initiation at gene junctions (Banerjee and Barik, 1992). The start of viral genome replication is the synthesis of a full length complementary copy of the genome RNA known as the antigenome or replicative intermediate RNA, which serves as the template for progeny genome RNA replication (Wunner, 2002).

After the antigenome and progeny genome RNAs are synthesized, they are co-transcriptionally encapsidated by the soluble N protein in the cytoplasm and become protected from degradation by cellular ribonucleases (Kouznetzoff *et al*., 1998; Iseni *et al*., 2000). As encapsidation is recognized by the N protein, it (encapsidation) is believed to proceed rapidly in the 5' to 3' direction along the RNA, independent of the viral sequence (Banerjee and Barik, 1992; Finke and Conzelmann, 2005). The genome and antigenome promoters at the 3' end of the respective genomic and antigenomic RNAs are required to direct both replication and encapsidation (Calain and Roux, 1995).

RNP replication relies on the constant supply of the N protein for encapsidation of the new RNA (Patton *et al*., 1984). Therefore, accurate regulation of virus gene expression and RNP replication is one of the key requirements of successful rabies virus (RABV) infection (Finke and Conzelmann, 2005). Attenuation and fine-tuning of RNA synthesis and gene expression may substantially contribute to a sustained viability of the virus in the infected host, which appears to be crucial for the RABV long distance transport through axons for manifestation of rabies virus infection in the CNS and its subsequent transmission (Finke and Conzelmann, 2005).

1.5. **The quasispecies theory**

The theory of quasispecies was introduced to describe a population of viruses that share a common origin but which have distinct genomic sequences (Smith *et al*., 1997). This theory is often used to describe the evolution of RNA viruses due to their high replication modes (Eigen *et al*., 1989), with the underlying assumption that genomes replicate conservatively, i.e. each single-stranded genome replicates by producing a new, possibly error-prone, single-stranded copy without affecting the original sequence (Brumer *et al*., 2006).

The theory predicts the existence of "error-threshold level", a threshold level whereby a mutation rate above it will result in no viable species (Smith *et al*., 1997). Moreover, this threshold mutation rate depends on the replication of the master sequence and increases with the fitness of the master sequence (Smith *et al*., 1997). The master sequence is the fittest sequence in a population and can be overwhelmed by the creation of sequences with lower fitness, although replication never affects the original sequence (Brumer *et al*., 2006). Accumulated shifts in a pool of heterogeneous populations can also lead to changes in the master sequence (Khawplod *et al*., 2006). This replication mode of RNA viruses provides a significant adaptation advantage for the rapid selection and emergence of a new variant in a changing environmental condition (Holland *et al*., 1992; Smith *et al*., 1997; Domingo *et al*., 1998).

In rabies virus infection cycles, the virus passes through multiple cells types: non-neuronal tissue at the bite site, neuronal tissue, salivary gland and other cell within the host, thus exposed to several environmental changes which could lead to the creation of genetic variants that form subpopulations which are eventually introduced randomly in a new host (Khawplod *et al*., 2006). Genetic variability in rabies virus populations is determined over time and these changes occur independently in different geographic regions through the generation of species-specific regional variants (Bourhy *et al*., 1999).

1.6. Rabies control

About 99% of all human rabies cases are initiated via a dog bite and children less than 15 years of age being the most common victims (Knobel *et al*., 2005; Bingham *et al*., 1999). Rabies still remains a neglected disease throughout most of the developing countries of Asia and Africa (Meslin *et al*, 1994; Warrell and Warrell, 1995). At least 55 000 human rabies cases are reported annually in these continents (WHO, 2004). Over the past two decades, a substantial epidemiological information on rabies has been assembled in relation to design the effective control measures of the vector species to prevent transmission of the disease to humans (Anderson and May, 1991).

Rabies is a preventable disease and can be eliminated by vaccination of reservoir animal populations. However, despite the availability of effective vaccines for dogs, rabies remains largely uncontrolled throughout Africa with only a few successful dog vaccination programs having been implemented in the past 20 years (Cleaveland, 1998; King, 1999). It was shown that the current rabies vaccines do not protect against the two African lyssaviruses, Lagos bat virus and Mokola virus respectively (Badrane *et al*., 2001; Nel, 2005; Hanlon *et al*., 2005).

1.6.1 Techniques for rabies diagnosis

Rabies is typically suspected when there is a history of exposure to a potentially rabid animal. The most widely used laboratory diagnostic methods for detection of rabies virus are the fluorescent antibody test (FAT) (Dean *et al*., 1996), followed by the rabies tissue-culture infection test (RTCIT), the mouse inoculation test (MIT) and indirect fluorescent antibody test using the monoclonal antibodies. The above mentioned diagnostic methods for rabies vary in terms of their efficiency, specificity and reliability (Picard-Meyer *et al*, 2004).

It has been reported that the sensitivity of FAT depends on the specimen (i.e. the animal species involved and the degree of autolysis) and on the proficiency of the diagnostic staff (OIE, 2000). It gives reliable results on fresh specimen within a few hours in 95-99% of cases (OIE, 2000). The MIT test detects the infectivity of a tissue suspension for tissue culture or in mice (OIE, 2000). It is used if the FAT gives an uncertain result or where FAT is negative in the case of known human exposure. This test is quite expensive, time consuming and it does not give rapid results compared to FAT (OIE, 2000). The mice are observed for 28 days post-inoculation and every dead mouse is examined for rabies using FAT technique (OIE, 2000). MIT has been replaced by the RTCIT, a test that was shown to be relatively easy to perform, less expensive compared to MIT and drastically reduce the time required for obtaining results in those laboratories with tissue culture capabilities (Webster and Casey, 1996). However, many laboratories, especially in Africa, do not have tissue culture facilities whereas mice may be more accessible.

In the past two decades the development of molecular biology has improved the knowledge of rabies particularly with the use of molecular techniques such as PCR and/or nucleic acid sequence techniques (OIE, 2000). To date, thousands of lyssaviruses have been evaluated and compared using molecular approaches and these studies have allowed the classification of lyssaviruses into genotypes and molecular epidemiology using different gene components of the rabies virus genome (WHO, 2004).

1.6.2 Vaccines

The crude rabies vaccine was first developed by Pasteur from nerve tissue but its efficacy when used in humans and lower animals was generally poor (Mckendrick, 1940; Webster, 1942). The vaccine was improved after the potency assays were introduced in 1940 (Habel, 1940; Seligmann, 1973). The inactivated nerve tissue vaccine was produced in sheep, goat brain or suckling mouse brain, however, the vaccine caused paralytic neuritis and encephalomyelitis in a proportion of recipients due to an auto-allergic demyelinating reaction induced by the lipoprotein myelin, present in the nerve tissue from which vaccines were prepared (Griffin and Hemachudha, 1988; Swanepoel, 1994).

Due to safety considerations, the vaccine prepared from virus cultures in embryonated duck eggs was adapted for use in humans (Held and Lopez-Adaros, 1972). Both vaccines (nerve tissue and virus cultures vaccines adapted in enbryonated duck eggs) were found to have a much higher content of rabies virus N and G protein antigens, but inactivated nerve tissue vaccines still remain in use for humans in many parts of Africa (Briggs *et al*., 2002). The production of duck embryo vaccine was discontinued in 1981 (Kuwert and Scheiermann, 1985; Kuwert *et al*, 1985) whereas nerve tissue vaccines were replaced with attenuated or modified live vaccines in the developed countries (Swanepoel, 1994). There are number of modified live vaccines evaluated as oral vaccines for domestic dogs and wildlife, these include SAD-Berne, SAD B19, ERA/BHK 21, SAG 1 and SAG 2 (Briggs *et al*., 2002).

For instance, the SAG-2 virus, is a derivative of SAD-Berne rabies virus, after two successive mutations of the arginine 333 codon were performed using selected monoclonal antibodies which was produced to improve the safety and efficacy of the vaccine (Orciari *et al*., 2001; WHO, 2004). The modified live vaccines were successfully used to control dog rabies in many western countries, but the potential danger of reversion to virulence and non-targeted species such as humans was always there (Aubert *et al*., 1994; WHO, 2004). The modified live vaccines are not recommended for parenteral vaccination because rabies can occur as a result of the vaccine strain (WHO,

2004). In addition, modified live vaccines were also associated with a small proportion of vaccination failures (Bellinger *et al*, 1983; Bunn, 1985; Bunn, 1988; Cabasso, 1962). New cell culture vaccines provided nearly 100 percent protection with a high degree of safety but were very expensive to produce (Dreesen, 1997). The new cell culture vaccines are applicable for use in both humans and animals. In humans, studies have shown that the purified chick embryo cell (PCEC) vaccine, (Rabi)^{TM}, is safe and effective together with the rabies human diploid cell vaccine (HDCV), which is currently considered the gold standard (Dreesen, 1997). Only cell-culture and purified embryonated egg vaccines should be used in humans due to their safety and efficacy (WHO, 2004). A number of experimental vaccines including DNA vaccines, recombinant viral vaccines and recombinant protein vaccines are under development for humans and animals and may provide safe, potent and less expensive alternatives (Hu *et al*., 2007).

The recombinant live vaccines for rabies (such as canine adenovirus type-2 and human adenovirus type-5) have some advantages over traditional vaccines: they are innocuous and they induce suitable humoral immune responses, however, due to host limitation and elements such as potential safety problem for human, some recombinant vaccines cannot be used in domestic cats (Brochier, *et al*., 1989; Hu *et al*., 2007). VRG is a recombinant vaccinia virus expressing the glycoprotein gene of Evelyn-Rockitnicki-Abelseth (ERA) strain and has been successfully used to control or reduce wildlife or canine rabies in a variety of animal species in Europe (Briggs, *et al*., 2002; WHO, 2004). However, despite the increased safety it remains limited to its efficacy among multiple species including skunks and mongooses (Blanton *et al*., 2006).

1.6.3 Pre and post-exposure vaccination

The most successful form of rabies prevention is pre-exposure vaccination. Pre-exposure vaccination is a prophylaxis that should be given to people who are at increased risk of exposure to rabies due to their profession, hobby, or activities (CDC, 1999; WHO, 1992). The individuals at risk include; researchers and diagnostic laboratory workers, veterinarians, animal control workers and people who handle wild animals (WHO, 2004).

It could be also offered to international travellers visiting regions where canine rabies is enzootic and immediate access to the appropriate biological is limited, difficult or impossible to access (Hatz *et al*., 1995). In addition, administration of pre-exposure vaccination should be considered for some populations at risk in developing countries, especially children, such as in India, where canine rabies is enzootic and dog bites are frequent (Sabchareon *et al*., 1998). Pre-exposure vaccination may also provide additional protection if a delay in treatment occurs or if incorrect medical advice is given during travel, as has occurred with travellers in remote areas (Krause *et al*., 1999; Arguin *et al*., 2000).

Post-exposure prophylaxis is crucial and could almost end the infection if proper treatment is given after an exposure has occurred. The decision to administer post-exposure treatment is based on an assessment of each possible exposure according to the WHO criteria (Wunner, 2002). There are factors that need to be considered when investigating a potential exposure, these include, the epidemiology of rabies in the specific area, the species of animal involved, the type of contact between the suspected rabid animal, victim, the anatomic location and severity of exposure (Moore *et al*., 2000). The treatment recommendations differ from country to country due to the differences in the epidemiology of rabies in a particular country (WHO, 2004). There are number of vaccine failures, either pre or post-exposure prophylaxis was given and such events need to be investigated (NICD, 2006; Wilde, 2007).

1.7. The epidemiology of rabies

Rabies exists in two major epidemiological forms namely; urban (canine) rabies, of which dogs are the principal vectors and is distributed globally and sylvatic rabies that involving wildlife animals (Meslin *et al*, 1994). The wildlife vector species differ geographically and include terrestrial mammals and a variety of bat species. Canine rabies occurs in geographical regions particularly where there are large populations of unrestricted or unowned dogs. Several numbers of dogs may be abandoned under certain

circumstances, as occurred during the civil war in Zimbabwe (Foggin, 1988) or disease pandemics (KZN) (Coetzee and Nel, 2007).

1.7.1 Europe and North America

In Western Europe, outbreaks of rabies involving dogs, foxes and wolves were described in the eleventh and thirteenth centuries, but urban rabies only became widespread in the eighteenth century (Brown and Crick, 1979; Johnson, 1959; Steele, 1975). Rabies in the red fox (*Vulpes vulpes*) spread steadily westwards from eastern Poland in 1935 to reach France by 1968 and many countries in Europe (Baer, 1988; Blancou, 1988). Dog rabies was still highly endemic in Western Europe in the 1940s and 1950s, but the use of increasingly effective control measures over decades reduced the annual incidence of the disease (Blancou, 1988; Kaplan, 1985).

The residual cases of rabies in domestic animals and wildlife were thought to represent the spill-over of infection from foxes (Blancou, 1988). The elimination of dog rabies has resulted in a simultaneous decrease of human rabies cases in America, Europe, recently in Mexico (Velazquez-Monroy *et al*., 2003; Nadin-Davis and Loza-Rubio, 2006), Latin America (Bellotto *et al*., 2005) and Thailand (Lumlertdacha *et al*., 2006). The red fox is the main host vector of rabies virus, but the raccoon dog (N*yctereutes procynoides*) is becoming an increasingly important vector which migrated westwards through the Baltic republics to become established in Poland and Finland (Blancou, 1988; Cherkasskiy, 1988; Nyberg *et al*., 1992; Mansfield *et al*., 2006).

Rabies currently exists in Europe but with a low and stable incidence (Bourhy *et al*., 2005). In Europe, the genotype 1 variant predominates in terrestrial animals whilst European bat lyssavirus (EBVL) types 1 and 2 in bats species (Bourhy *et al*., 1999; Davis *et al*., 2005). Today, dog rabies has been eradicated from most of the European Union countries although the disease is re-emerging in Eastern Europe (Johnson *et al*., 2007). Several epidemiologic cycles of rabies in Europe co-exist and are characterized by an animal species reservoir of a lyssavirus variant that is specifically adapted to it (Bourhy *et*

al., 2005). In general terms, the main host species involved in the transmission of rabies virus in wild animal species in Europe are the red fox (V*ulpes vulpes*) and raccoon dog (N*yctereutes procyonides*) (Davis *et al*., 2006).

In North America, rabies was first described in dogs and foxes in the mid-eighteenth century and this led to the suggestion that the disease was brought in with dogs by European colonialists (Brown and Crick, 1979; Winkler, 1975). Historically, rabies may have been introduced into North America from northern Asia during the migration of humans and other animals many years ago (Crandell, 1975; Winkler, 1975; Steele and Fernandez, 1991; Smith *et al*., 1992; Kissi *et al*., 1995). Dog rabies became widely distributed in the USA in the nineteenth century following civil war and by 1944 accounted for 86% of reported rabies cases (Starr, 1963; Brown and Crick, 1979).

The incidence of dog rabies declined in 1988, due to increasingly effective control measures in the 1940s and 1950s with no human cases reported (Anon., 1991; Starr, 1963; Nadin-Davis, *et al*., 2006). On the other hand, an increase in sylvatic rabies was observed and in 1988 wild vertebrates (mainly skunks, raccoons, bats, and foxes) accounted for 88% of cases of the disease (Beran, 1981). The first isolation of rabies virus from non-haematophagous bats were made in Trinidad in the 1930s, but aroused little interest until 1953 when it was recovered from an insectivorous bat which had attacked a child in Florida, USA (Baer, 1975; Pawan, 1936). The origin of bat rabies virus on the American continent remains uncertain (Davis *et al*., 2006). Today most human deaths in the USA are due to bat-associated rabies virus (Messenger *et al*., 2003; Davis *et al*., 2006). The bat species involved in rabies epidemiological cycles includes the insectivorous bats in North America and haematophagic bats of Latin America (Davis *et al*., 2006). The first phylogenetic investigation of bat RABV using partial N gene sequences established that there were distinct lineages of RABV associated with the different bat species (Smith *et al*., 1995).

Subsequent studies showed that rabies viruses could be easily exchanged between silver-haired bat (L*asionycteris noctivagans*) and western pipistrelle bat species (P*ipistrellus*

hesperus) perhaps due to increased infectivity (Messenger *et al*., 2003). It has been shown that in terrestrial mammals, the RABV causes an acute disease characterized by localized outbreaks or epidemics and passes from one individual to the next by biting, whereas in bats it appears to follow a more endemic pattern and that bats can survive lyssavirus infection (Almeida *et al*., 2005; Arguin *et al*., 2002; Echevarria *et al*., 2001; Lumlertdacha *et al*., 2005). In the Americas, 30% bat species have been identified to belong to 17 families of the suborder microchiroptera (Valdir, 2001). Canine rabies fell by 81% during the period 1993-2002 in the Americas, but the disease still poses a risk to people in areas of several countries of the region (Belotto *et al*., 2005). Rabies in wildlife especially raccoons is still endemic in several states in the United States (Krebs *et al*., 2001).

1.7.2 Asia and Africa

A rapid population growth and urbanization in many parts of Asia created conditions which are highly conducive to the rapid spread of urban rabies (Swanepoel, 1994). Several thousand cases of rabies in dogs are recorded each year in India, Pakistan, Indonesia, Thailand and Vietnam, while countries such as Bangladesh, Burma, Iran and Philippines, report comparatively fewer cases of animal rabies compared to human rabies cases (Blancou, 1988). India has the highest number of human rabies deaths being associated with the dog rabies in the world with an estimated value ranging from 15000 to 25000 cases per annum (Ahuja *et al*, 1985; Blancou, 1988; Reece, 2007).

Canine rabies still remains endemic in many parts of Asia today, including the Middle East, Pakistan, Afghanistan, India, Sri Lanka, Thailand, Vietnam, Bangladesh, Philippines and most former Soviet Republics (Wilde *et al*., 2005). In addition, no new Asian country has rid itself of rabies during the past decades (Wilde *et al*., 2005), and therefore not surprisingly that over 90% of the global human deaths are reported from Asia and approximately 45% of these victims are children less than the age of 15 (WHO, 2004).

It is believed that the disease has been present in the North African countries for hundreds of years, particularly in the northeast, close to the Middle East, where it has been recognized since the ninth century (Snyman, 1940; Blancou, 1988; Steele and Fernandez, 1991). The establishment of the disease in sub-Saharan Africa is uncertain (Blancou, 1988), but it is possible that rabies could have been introduced to West Africa by Europeans some time after 1500 A.D. (Smith *et. al.*, 1992).

Rabies has been in existence in Africa for a long time according to traditional folklore stories (Swanepoel *et al.*, 1993). For example, in some of the southern and eastern countries rabies was communicated (e.g. Zimbabwe and Kenya) prior to the arrival of Europeans (Edmonds, 1922; Hudson, 1944). There are at least four lyssavirus genotypes circulating in Africa today, being classical rabies (gt 1), Lagos bat virus (gt 2), Mokola virus (gt 3) and Duvhenage virus (gt 4). Classical rabies is the greatest public health threat and accounts for more than 99% of all rabies cases in the rest of Africa (Bingham *et al.*, 1999; Knobel *et al.*, 2005).

1.7.3 Southern Africa

The disease was re-introduced in the 1940s from Angola and spread throughout the dog populations of Namibia, Botswana, Zimbabwe and northern South Africa during the 1950s (Meredith, 1977; Swanepoel *et al.*, 1993). The infection then established itself in wildlife (e.g. black-backed jackals and bat-eared foxes) in South Africa in the 1950s and in Zimbabwean jackals in the 1970s (Bingham *et al.*, 1999). From the Transvaal, the infection spread into eastern Transvaal (Mansvelt, 1956) and into Mozambique (Dias *et al*, 1985) where it penetrated all the regions of the country. Subsequently, the infection was introduced in Natal (South Africa) in 1961, and disappeared due to effective control measures in that province (1968) but only to resurface in 1976 (Swanepoel *et al.*, 1993). The disease has been a constant problem in the sub-region to date.

Historically, mongoose rabies has existed in southern Africa since the early 1800s and therefore believed to be indigenous to the region (Chaparo *et al.*, 1993; von Teichman *et*

al., 1995). The first confirmed laboratory mongoose rabies case in southern Africa was made in 1928 after 2 boys were bitten by a yellow mongoose (Snyman, 1940). It was evident from distribution of rabies cases up to 1933 that the first recognized outbreak in Port Elizabeth in 1893 was not the only rabies in South Africa (Neitz and Thomas, 1932; Neitz and Marais, 1932; King *et al*., 1993). Rabies was consistently diagnosed in the yellow mongoose (C*ynictis penicillata*), with apparent spill over into domestic animals on the central plateau of South Africa, although these events occur not as frequently as previously thought (Meredith, 1977; Nel *et al*., 2005).The control of epidemiologic cycles in yellow mongooses and other H*erpestidae* were tried through control of vector and host density (Snyman, 1940) but the social behaviour of these carnivores made control very difficult.

Chapter 2

Literature review

2.1 The host species

All terrestrial mammals are susceptible to rabies virus (RABV) infection and only some can act as successful reservoirs that maintain and transmit infection cycles in a given geographic area (Rupprecht *et al*., 2002). The mammals of the orders C*arnivora* and C*hiroptera* remain important vectors of rabies and rabies related viruses (Badrane and Tordo, 2001). It was shown that carnivoran rabies was indeed a spill over of lyssaviruses from chiropters which predicted that chiropteran lyssaviruses existed long before carnivoran lyssaviruses (Badrane and Tordo, 2001). The carnivore species such as domestic dogs, foxes, coyotes, jackals, raccoon dogs, mongooses and/or skunks and American bats are the important vectors and reservoirs for genotype 1 rabies virus variants (Badrane and Tordo, 2001). RABV infection differs amongst susceptible animals, some infections results in dead end of infection such as bovine, ovine, or caprine species whilst others lead to adaptation of a virus variant in a specific host species (Niezgoda *et al*., 2002).

The order *Carnivora* emerged approximately 60 million years ago during the Palaeocene period (www.lioncrusher.com). The primitive carnivores that made up this group were called miacids, which gave rise to all dogs, bears, seals, cats, hyenas, weasels and civets (www.lioncrusher.com). The carnivores consist of between 7 to 12 living families in the two super-families of C*anoidea* (dog-like carnivores) and F*eloidea* (cat-like carnivores) which arose from the miacids about 48 million years ago (www.lioncrusher.com). The superfamily C*anoidea* consist of families such as C*anidae* (dogs), M*ephetidae* (skunks), M*ustelidae* (weasels) or P*rocyonidae* (raccoons) whereas F*eloidea* composed of F*elidae* (cats), H*erpestidae* (mongooses), V*iverridae* (civets) or H*yaenidae* (hyenas) (www.lioncrusher.com). The herpestids and viverrids were classified under one family (*Viverridae*) until recently, it was shown that the herpestids were morphologically and genetically distinct from viverrids and classified in their own family as H*erpestidae* (Wilson and Reeder, 1993).

Canids originated in the late Eocene era more than 40 million years ago and are the most ancient group of carnivores and first to evolve from miacids (www.lioncrusher.com). The family C*anidae* had three co-existing subfamilies, namely; C*aninae* (modern dogs), H*esperocyoninae* (ancient canids) and B*orophaginae* (hyena-like canines) (www.lioncrusher.com). The subfamily H*esperocyoninae* an ancient group of canids that existed 40 million years ago, originated from North America and became extinct at about 15 million years ago whilst the B*orophaginae* originated from N*othocyon* species of the H*esperocyonids* which existed about 34 million years ago and became extinct about 2.5 million years ago and only existed in North America (www.lioncrusher.com). The subfamily caninae gave rise to all the canids that are alive today and they existed at about the same time as the other two subfamilies but did not flourish until 15 million years ago when the other two subfamilies became extinct (www.lioncrusher.com). They also evolved exclusively in North America until the late Miocene (about 7 million years ago) when they were introduced into Asia (www.lioncrusher.com).

In South Africa, there are several rabies virus host species involved in the maintenance and transmission of rabies virus. These include canid host species such as the domestic dog (C*anis familiaris*), black-backed jackal (C*anis mesomelas*), bat-eared fox (O*tocyon megalotis*) and yellow mongoose (C*ynictis penicillata*) (Nel *et al*., 1993). There are two rabies biotypes recognized within genotype 1 of the genus lyssavirus in southern Africa (King *et al*., 1993; Nel *et al*., 1993). These include the canid rabies biotype that infects carnivores of the family *Canidae* and the mongoose rabies biotype, which mainly infect yellow mongoose in South Africa and slender mongoose (G*alerella sanguinea*) in Zimbabwe and Botswana (Tremlett, *et al*., 1994; Nel *et al*., 1993; Nel *et al*., 2005).

Initially, mongoose rabies biotype was called “viverrid biotype” because of the old classification of herpestids and viverrids under the same family of V*iverridae* (Skinner and Smithers, 1990; Nel *et al*., 2005). The “viverrid biotype or virus” was changed to mongoose rabies biotype or virus because of the new classification and there was no evidence for the true viverrids as maintenance host species whilst mongooses were shown to be able to maintain and transmit the rabies virus (Nel *et al*., 2005). The two rabies

biotypes are able to cross species boundaries, an event referred to as infectious "spill over" and these events are believed to be infrequent (King *et al*., 1993; Nel *et al*., 2005). Other animal species such as cattle or sheep are regarded as "dead end hosts" because of the low transmission of rabies.

2.2 Differentiation of lyssaviruses

There are two common ways to differentiate lyssaviruses namely antigenic and genetic methods. The antigenic typing method commonly uses monoclonal antibodies (MAbs) to differentiate genotypes and variants or strains of rabies virus. The resolving power of antigenic analysis is determined by, and often is proportional to, the number of MAbs used to characterise a virus (Smith, 2002). The antigenic typing method especially in the developing countries is largely complemented by precise genetic method for confirmation of the characterised lyssavirus (Sabeta *et al*., 2007; Markotter *et al*., 2006). It was reported that virus typing with MAbs provides a rapid and inexpensive method for large scale surveillance of both new lyssaviruses (Bourhy *et al*., 1992; Gould *et al*., 1998) and common variants of rabies virus (Kissi *et al*., 1995; Nadin-Davis *et al*., 2000). Antigenic typing was used to differentiate between the wild-type and vaccine strain during the oral vaccination campaigns against fox rabies in the Western Europe (Schneider *et al*., 1988).

A panel of 80 MAbs was used to differentiate the present two rabies virus biotypes in southern Africa based on the reactivity patterns produced against rabies viruses from South Africa and Namibia (King *et al*., 1993). It was shown that the canid rabies biotype had a similar reactivity pattern whereas the heterogeneous mongoose rabies viruses conformed to different reactivity patterns (King *et al*., 1993). In South Africa all lyssaviruses positive samples are further characterised into specific genotypes and variants of rabies virus [Onderstepoort veterinary Institute (OVI)]. In the past, a panel of 12 MAbs differentiated the canid rabies biotype into two strains, canid (C) 1 and 2 whilst mongoose rabies biotype into six strains, viverrid (V) 1, 2, 3, 4, 5 and 6 based on the reactivity pattern produced against rabies viruses from South Africa (Unpublished data, OVI; Appendix 2). It was found that C1, V1, V4 and V5 were the common variants

whereas C2, V2 and V6 were uncommon variants of rabies virus (Unpublished data, OVI). The variants of the rabies virus found in South Africa are now differentiated or typed into canid or mongoose rabies biotype designated C or M with a new panel of 16 MAbs (OVI unpublished data, Appendix 1, Table 1).

2.3 The intergenic sequence

There are several genes of the rabies virus genome that have been targeted for molecular epidemiological studies, including the N (Kissi *et al*., 1995) and G genes (Badrane and Tordo, 2001). Recently, the G-L intergenic region of the genome has been useful in determining the molecular epidemiology of rabies in Europe (Bourhy *et al*., 1999), the Americas (Nadin-Davis *et al*., 1999), Colombia (Páez *et al*., 2003), Zimbabwe (Sabeta *et al*., 2003) and South Africa (Coetzee and Nel, 2007). In a previous study using G-L intergenic nucleotide sequence, it was shown that South African rabies viruses comprised of two distinct populations being canid and mongoose rabies biotypes (Von Teichman, 1995).

The common feature that distinguishes intergenic regions of the rabies virus genome from that of vesicular stomatitis virus (VSV), is the variable length and composition of the intergenic sequences between the coding regions (Rose, 1980; Finke *et al*., 2000). In rabies virus the intergenic sequences between the N-P, P-M, M-G and G-L, are 2, 5, 5 and 423 nucleotides in length (Tordo *et al*., 1986a; 1986b). Since neither an mRNA transcript complementary to the sequence of the G-L region nor a short polypeptide containing this sequence has been detected, this region was denoted as a vestigial gene because it was assumed that the rabies virus does not encode an additional gene product (Wunner, 1991). This long intergenic region between G-L is called a pseudo gene (Ψ) (Tordo *et al*., 1986a).

In one other rhabdovirus genome, that of infectious haematopoietic necrosis virus of fish, a sixth gene between the G and L gene was identified and encodes a non-viral protein of approximately 12000 kda (Kurath and Leong, 1985; Kurath *et al*., 1985; Tordo *et al*.,

1992). It was shown that the Bovine ephemeral fever virus (BEFV) has an additional non-structural glycoprotein (G_{ns}) in this region (G-L) and it was proposed to have evolved by duplication of the original glycoprotein gene (Walker *et al*., 1992). In addition, small opening reading frames (alpha and beta) were found to be located between G_{ns} and the beginning of the L gene (Ravkov *et al*., 1995).

There are two transcriptional termination and polyadenylation (TTP) motifs found in this region in the Pasteur rabies virus genome (Tordo *et al*., 1986a). The first motif was found 70 nucleotides downstream from the transcription stop codon of the G gene and the beginning of Ψ gene and other was located 24 nucleotides upstream of the beginning of the L gene and at the end of Ψ region (Ravkov *et al*., 1995). The presence of both upstream and downstream TTP motifs in other rabies virus strain (SAD) suggested the existence of subsequent common gene arrangement in rabies viruses (Conzelmann *et al*., 1990). In the later studies, it was shown that two G mRNA transcripts (1.9 and 2.3kb in length) were synthesized in cells infected with the Evelyn-Rockitnicki-Abelseth (ERA) rabies virus strain (Morimoto *et al*., 1989).

It was indicated that the shorter mRNA transcript was synthesized by the use of the upstream TTP and the larger transcripts was synthesized by use of the downstream TTP motif (Ravkov *et al*., 1995). High egg passage (HEP), challenge virus strain (CVS) and Nishihagara rabies virus strains and Mokola virus have only the downstream TTP motif which implied that the upstream TTP motif was either degenerative or absent leaving only the poly-A signal at the end of the Ψ sequence (Ravkov *et al*., 1995; Sacramento *et al*., 1992; Sakamoto *et al*., 1994; Bourhy *et al*., 1993). It was shown that a long G mRNA transcript produced consisted of the coding sequence for G and the non-coding Ψ sequence (Wunner, 2002).

The Ψ region represents the most divergent area of the genome (Sacramento *et al*., 1991) and the relevance of this highly variable region of the genome for monitoring epidemiologic changes in the evolution of rabies viruses has been investigated and is now routinely used in many parts of the world for such investigations (Sacramento *et al*.,

1992). The pseudogene sequence is considered a good indicator for neural evolution of the rabies virus (Tordo *et al*., 1986a; Wunner *et al*., 1988; Sacramento *et al*., 1992).

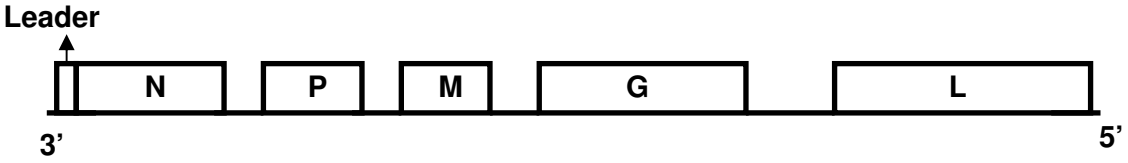


Figure 2.3.1 A schematic diagram of the rabies virus genome which encodes five viral proteins, N-nucleoprotein, P-phosphoprotein, M-matrix protein, G-glycoprotein, and L-polymerase protein, and four intergenic regions between encoding genes as well as the leader RNA (Tordo *et al*., 1986a).

2.4 Phylogenetic Methods

Molecular phylogeny serves as a tool in the study of molecular epidemiology of infectious diseases (Hall and Barlow, 2006). Molecular phylogeny could be defined as a study of evolutionary relationships amongst organisms using molecular data such as nucleotide or amino acid sequences by either distance or character based methods (Felsenstein, 1988; Miyamoto and Cracraft, 1991). A phylogenetic program uses multiple sequence alignment as the raw data from which a phylogenetic tree is reconstructed. There are two major methods used in phylogeny namely; distance and discrete methods.

The distance based methods include the neighbour joining (NJ) method (Saitou and Nei, 1987) and unweighted pair-group method using arithmetic averages (UPGMA) (Sokal and Michener, 1958). In the distance methods, the evolutionary distances between all pairs of taxa are computed, a distance matrix is generated and a phylogenetic tree is then constructed from the matrix by considering the relationships (distance) among the distance values (Page and Holmes, 1998). In contrast, discrete methods operate directly on sequence rather than on the distance matrix and it select the tree that requires the least number of evolutionary changes (Page and Holmes, 1998). The two major discrete methods are maximum parsimony (MP) and maximum likelihood (ML). Maximum parsimony chooses the tree/s that requires the fewest evolutionary changes whereas,

maximum likelihood selects that tree/s most likely to have produced the observed data (Page and Holmes, 1998).

The most popular and widely used method in phylogenetic tree reconstruction is that based on the principle of maximum parsimony. This method falls in a class of procedures that use optimality criteria to choose among the best tree amongst a set of all possible trees (Page and Holmes, 1998). Maximum likelihood uses a likelihood function to determine the optimum tree in space for a phylogenetic tree reconstruction (Felsenstein, 1981). In general, each of the methods for reconstruction of phylogenetic tree has its own advantages and disadvantages. For instance, the ML is time consuming, not appropriate for large data sets because of the limitation of computing power and it uses the entire sequence information (Ranwez and Gascuel, 2002). In contrast, NJ method has no limitations to data sets, low computational time complexity and assumes equal rates of change among lineages (Felsenstein, 1985; Saitou and Nei, 1987).

There are several mathematical models used to describe the evolution of sequences in time during phylogenetic tree construction. These include the Jukes and Cantor or Kimura two-parameters. These evolution models permit estimation of the genetic distance between two homologous sequences measured by the expected number of nucleotide substitutions per site that have occurred on the evolutionary lineages between them and their most recent common ancestor (Liò and Goldman, 2006). Such distances may be represented as branch lengths in a phylogenetic tree, whereas the ancestral sequences form the internal nodes (Liò and Goldman, 2006). The particular model selected for a data set depends on the features of the data such as the level of variation and nucleotide frequencies (Liò and Goldman, 2006). Jukes and Cantor proposed a model for DNA substitution in which all nucleotides substitutions occur at an equal rate and when nucleotide is substituted any one of the other nucleotides is equally likely to be its replacement (Jukes and Cantor, 1969). Whilst the Kimura two-parameter model utilises a relatively simple substitution matrix that allows for two different rates: one for transition and the other for transversion (Kimura, 1980; Bos and Posada, 2004).

The robustness of the branch points in a phylogenetic tree can be measured as the percentage of the trees where these branch points are present (Hall and Barlow, 2006). The two resampling methods commonly used in phylogenetics are jack-knifing and bootstrapping, which determines sampling error or confidence intervals for some estimated parameters (Felsenstein, 1985). Bootstrapping is a commonly and widely used method in phylogenetic studies and determine the confidence in the branching points (Felsenstein, 1985). It involves resampling the data on which the tree was based and generates a distribution of data sets from which a new tree will be determined (Felsenstein, 1985) and assumes that sites in the alignment have evolved independently on the same phylogeny and are identically distributed (Page and Holmes, 1998). In contrast, jack-knifing subsets are selected without replacement and consequently much shorter than the original sequence (Weir, 1990). In general, bootstrap values of more than 70% are regarded as sufficiently providing evidence for phylogenetic grouping (Hills and Bull, 1993).

The molecular phylogeny approach has been proven useful in attempting to understand the epidemiological relationships between rabies and rabies-related viruses, for instance in France (Sacramento *et al*., 1992), South Africa (Coetzee and Nel, 2007) and/or Zimbabwe (Sabeta *et al*., 2003). Furthermore, the phylogenetic analysis can attempt to piece together the evolutionary relationships between related viruses (Bourhy *et al*., 1999). Prior to the study the canid rabies biotype was never been reported in the Free State province of South Africa after the first introduction in the southern Africa in 1940s from Angola. To provide further information on the rabies viruses that are circulating in Free State province of South Africa and mountain kingdom of Lesotho, the molecular phylogeny was used to study a panel of 113 RABV isolates.

2.5 Free State province

The Republic of South Africa is divided into nine provinces and of these; the Free State (FS) is the third largest province and located in the centre of South Africa, with the kingdom of Lesotho bordering on the east. The province covers an area of 129 825 square

kilometres, amounting to 10.6% of the geographical surface area of South Africa (http://www.fs.gov.za/, internet reference). The FS is geographically located between the Vaal River to the north and the Orange River in the south. The region is characterised by flat, rolling grassland and crop fields, rising to Sandstone Mountains in the northeast (http://www.fs.gov.za/). In addition, the province is the granary of South Africa with agriculture central to its economy, while mining on the rich goldfields reef is its largest employer (http://www.fs.gov.za).

Figure 2.5.1. A map of South Africa showing the geographical location of the Free State province in relation to other provinces and neighbouring Lesotho.

Of the estimated population of 2.9-million for FS two-thirds speak Sesotho, the language of neighbouring Lesotho, followed by Afrikaans and isiXhosa (www.fs.gov.za). The FS province is a summer rainfall region and can be extremely cold during the winter months, especially towards the eastern mountainous regions whilst the western and southern areas are semi-desert (www.fs.gov.za). A beautiful range of hills near Parys in the northern FS is actually part of the Vredefort Dome, the largest visible meteor-impact site in the world that was formed 2-billion years ago when a meteorite 10 kilometres wide slammed into

the earth, the Vredefort Dome is one of South Africa's seven Unesco World Heritage sites (www.fs.gov.za).

The Free State province is divided into 5 major districts, Motheo, Lejweleputswa, Thabo Mofutsanyana, Xhariep and Northern Free State respectively (www.fs.gov.za) (Figure 3). The Xhariep district comprises open grassland with extensive farming, mainly sheep and on the southern border is the Orange River, which was called Gariep by the indigenous Khoikhoi people and thus where the name Xhariep originates (www.fs.gov.za).

Figure 2.5.2. A map of the Free State province illustrating the five major districts (www.fs.gov.za).

The Motheo district comprises an open grassland with mountains in the easternmost parts and it is the trade and administrative centre of the province and boasts a university, the provincial government and the high court of South Africa (www.fs.gov.za). This district encompasses one of the largest cities in South Africa, Bloemfontein (Mangaung) and local areas such as Botshabelo and Thaba Nchu. Thabo Mofutsanyana district forms the eastern part of the province and borders the kingdom of Lesotho and another South African province, Kwazulu-Natal and is one of the most important tourist destinations in

the FS province mainly because of the Drakensberg and Maluti mountain ranges (www.fs.gov.za).

The Northern Free State district is an important agricultural production area particularly for maize and it is known as the grain basket of South Africa (www.fs.gov.za). The district offers various attraction sites such as Vredefort Dome (which is the largest meteorite site in the world, 200 km in diameter), San paintings and the Vaal dam. It has huge economic significance to the province due to the large chemical and synthetic fuels plants (Sasol plant) (www.fs.gov.za). The Lejweleputswa district is also an important agricultural area. The economy of the area is driven by the gold mining industry, followed by maize production. It is also regarded as the major contributor to the FS Gross geographic product (GGP) (www.fs.gov.za).

The highveld plateau of South Africa (the FS province), was historically associated with the mongoose rabies biotype principally maintained by the yellow mongoose (C*ynictis penicillata*). The yellow mongoose is a small indigenous herpestid living in small colonies (e.g. living in pairs or family groups) near one another with a more solitary mode of living (Snyman, 1940; Veron *et al*., 2004). This species lives in close association and communally dwell with other members of H*erpestidae* such as suricates and ground squirrels. Mongoose rabies has been reported from other parts of the world such as Asia (Smith *et al*., 1992), but it is only in the southern Africa and the Caribbean where it appears to be the manifestation of enzootic disease (Chaparro and Esterhuysen, 1993; Nel *et al*., 2005).

In South Africa (highveld plateau), historical documents suggest that mongoose rabies may have existed in the 1800s prior to canid rabies (Snyman, 1940; Swanepoel, 1994). The canid rabies biotype on the other hand, was reported in neighbouring provinces including Kwazulu-Natal, Eastern Cape and the kingdom of Lesotho in the 1970s and 1980s but without being introduced into the FS province (Swanepoel, 1994). This was mainly due to the active vaccination programs and the low dog population density in this region (Swanepoel, 1994). Sporadic rabies cases in domestic dogs were reported in the

region and speculated to be spill over infection of the mongoose rabies biotype (OVI, unpublished records).

There was a single laboratory confirmed human rabies case in the FS province in 2005, a 12 year old female from Jagersfontein area was apparently bitten by a rabid caracal (F*elis caracal*) and it is not known whether the patient had received post-exposure treatment (NICD, 2006). Antigenic characterisation of rabies viruses from FS province indicated an unexpected increase of dog rabies in the year 2002 from 10 cases up to 44 cases (OVI unpublished data, Figure 2.5.3). It was evident that the canid rabies biotype resulted in increased number of dog rabies cases in the province (Figure 2.5.3). Due to an increased number of dog rabies cases, regular monthly rabies vaccination campaigns of pets (domestic dogs and cats) were established in 2002 on a large scale (Dr. Mojapelo, personal communication). Between 2002 and 2005, a total of 132 713 domestic dogs were vaccinated in the province which resulted in a low number canine rabies cases in 2005 (Table 2.5.1).

Dog population density in the FS province is not known and no studies have been conducted. Rabies vaccination campaigns in general are hampered by other disease outbreaks of veterinary importance and competing veterinary public health priorities particularly during outbreaks of classical swine fever and/or foot and mouth disease. This was clearly demonstrated in the FS province in 2005 when rabies vaccination campaigns were stopped in order to prevent the introduction of classical swine fever into the province from neighbouring Eastern Cape Province (Dr. Mojapelo, personal communication) which effected on an increase in dog rabies cases in the following years. In this regard a sustained parenteral vaccination of domestic dogs and cats could eventually reduce canine rabies in the province.

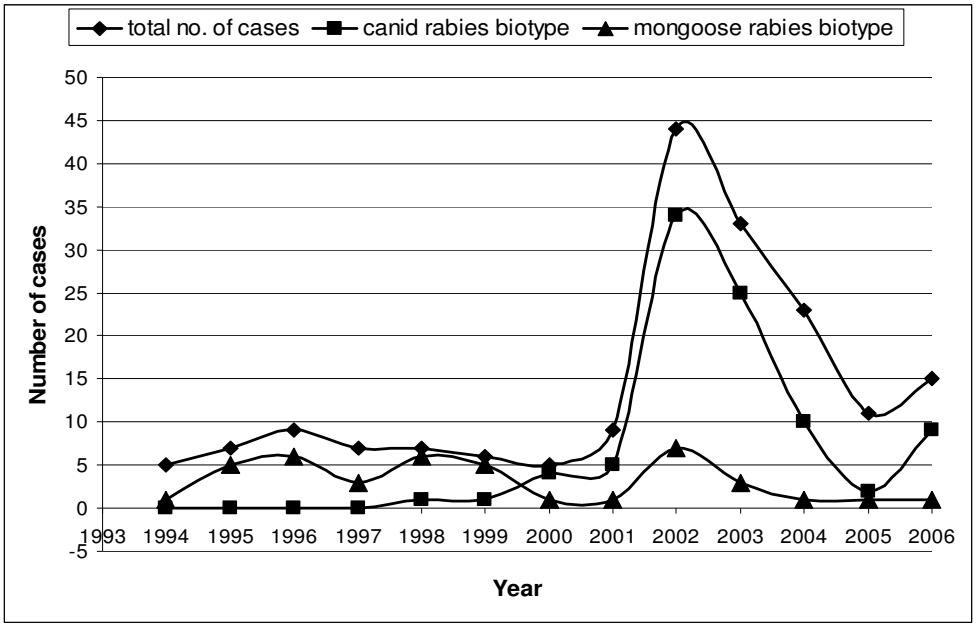


Figure 2.5.3. Reported cases of rabies in domestic dogs from the FS province of South Africa from 1994 to 2007.

Table 2.5.1. The total number of domestic dogs vaccinated between 2002 and 2005 (Department of Agriculture, FS province)

Year	Number of dogs vaccinated
2002	28 711
2003	34 030
2004	46 751
2005	23 221
Total	**132 713**

2.6 The kingdom of Lesotho

Lesotho is located in the southern Africa region and has an estimated area of approximately 335 000 km^2 (www.lesotho.gov.ls). The country is completely surrounded by the republic of South Africa (Figure 2.6.1). It borders KwaZulu-Natal to the east, Eastern Cape to the south and the Free State to the north and west. The country is arable and mountainous with subtropical climate. The mountain ranges run from the north to south and those in the central area, the extensions of the main Drakensberg called Maluti, which joins in the north, forming a high plateau varying in height from 2700 to 3400 m (www.lesotho.gov.ls). Most of the people of Lesotho are Basotho and speaks the national language Sesotho.

The appearance of Basotho as a nation occurred around 1818 when Moshoeshoe formed an alliance with tribes and chiefs of southern Sotho people who lived in the area from about 1400 AD (www.lesotho.gov.ls). Moshoeshoe was born at Menkhoaneng in Lesotho in 1786 and was the first son of Mokhachane, a chief of the Bakoteli, a branch of Koena tribe (www.lesotho.gov.ls). Moshoeshoe played an important role in expanding the Bakoteli tribe by bringing Sekake, Bafokeng and Bakoteli tribes together while still under his father chieftaincy (www.lesotho.gov.ls). Moshoeshoe became a king at the age of 34 after moving to Butha-Buthe mountain with his followers in 1820 (www.lesotho.gov.ls). In 1824 Moshoeshoe moved to the Qiloane plateau (presently known as Thaba Bosiu) after he was attacked by the Tlokoa tribe at his Butha-Buthe fortress, although king Moshoeshoe and his people were not defeated, he found Butha-Buthe not suitable as a stronghold (www.lesotho.gov.ls). In Thaba Bosiu, king Moshoeshoe and his people successfully defeated the Amangwane army in 1828, Batlokoa in 1829 and Ndebele of Mzilikazi in 1831 (www.lesotho.gov.ls). The Basotho nation grew as he gave land to his defeated enemies and was further strengthened as king Moshoeshoe chose wives from other tribes such as Bafokeng (www.lesotho.gov.ls). To date Thaba Bosiu is treated as a burial place for the kings of Lesotho (www.lesotho.gov.ls).

In the late 1820s a group of Khoikhoi known as Kora led by Dutch people came to the Moshoeshoe's tribe occupying the Mohokare valley (www.lesotho.gov.ls). King Moshoeshoe and his people felt threatened and moved up to mountain tops and in secluded rock shelters were the horses could not easily reach (www.lesotho.gov.ls). The missionaries were introduced to Basotho people after king Moshoeshoe heard the advantages of having them and hoped to obtain guns and horses with their assistance thus preventing the attack by Kora (www.lesotho.gov.ls). The French missionaries were Thomas Arbousset, Eugene Casalis and Constant Gosselin came to Thaba Bosiu in 1833 from Paris Evangelical Missionary Society (PEMS) in France (www.lesotho.gov.ls). The missionaries did not belong to any colonising white groups in southern Africa, they contributed and changed the lives of Basotho people by introducing potatoes, wheat, fruit trees and domestic cats and pigs (www.lesotho.gov.ls).

In the mid 1830s, a group of white people from the Cape colony began crossing the Orange River in large numbers and settled as farmers on the land within Moshoeshoe's kingdom. In 1843 and 1845 an agreement was made between the Governor of the Cape and Moshoeshoe which recognised white settlement on part of Moshoeshoe's land and in return he would receive $75 per year from colonial treasury (www.lesotho.gov.ls). In 1848 the British government proclaimed Orange River Sovereignty, withdrew and giving Orange Free State Republic of the Boers responsibilities in 1854 to govern Lesotho, due to the expenses of maintaining the land (www.lesotho.gov.ls). Soon after British withdrawal Lesotho became a place of war because the boundaries were left undefined (www.lesotho.gov.ls). Lesotho became a British territory again after king Moshoeshoe renewed his entreaties to the new High Commissioner for protection in 1868. King Moshoeshoe died in 1870 soon after seeing his country saved (www.lesotho.gov.ls).

British government annexed Lesotho to the cape colony in 1872 and within a few months the whole countryside was in open rebellion such as the Gun war (1880-1881) and after the war Basotho won the right to have their country administered separately from other parts of southern Africa (www.lesotho.gov.ls). In 1883, the cape government requested British government to restore rule over Lesotho and the British rule resumed in 1884

(www.lesotho.gov.ls). A partnership between the British resident commissioner [Sir Marshall Clarke (1884-1894) and Sir Godfrey Lagden (1894-1902)], the chief of Lesotho (Chief Letsie, 1870-1891) and his son Lerotholi (1891-1905) established a system of dual government and led to the establishment of political parties such as the Basutoland Congress Party in the late 1940s (BCP), Marema Tlou Party in 1957 (MTP) and Basutoland National Party in 1958 (BNP) and to the independence of Lesotho on 04 October 1966 (www.lesotho.gov.ls). It was the BNP that led Lesotho into independence after winning the second political elections in 1965 (www.lesotho.gov.ls).

Lesotho is predominantly rural areas and villages are often located high on the mountains. Each village has its own chief that falls under the main chief for that area (www.seelesotho.com). Although many Basotho people still live and work outside their country, their attachment to their local village and traditional culture is still strong (www.seelesotho.com). The respect for the elder generation by the young one is important to Basotho people (www.seelesotho.com). It is not surprising to see or meet a Basotho horseman clad in a "kobo" his traditional blanket and who will raise his hand in the traditional greeting "khotso" meaning peace (www.seelesotho.com).

Rabies was first diagnosed in Lesotho in 1982 from dogs and the disease rapidly spread throughout the country (Khomari, 1992, Swanepoel, 1994). The rabies incidence increased in 1984 in the domestic dog population and that year alone 18 human deaths were recorded. Current animal rabies control strategy is to reduce number of both human and dog cases through vaccination of domestic dogs and cats (Moleko, 2001). There are unrestricted dogs in the rural areas and semi-restricted dogs in the urban areas and it is a normal practice for households in the rural areas to have at least four dogs (Khomari, 1992). The dog population size in Lesotho is not clear, it was thought that in the rural areas it occurs in large numbers (Khomari, 1995). Factors that contribute to the high incidence of rabies in Lesotho include non-vaccination of pets resulting in free roaming dogs in the rural and semi-urban areas (Khomari, 1992). With such behaviour and practices, the rabies virus is persistently maintained within dog populations and remains a public and veterinary health hazard. It is not surprising that rabies is still endemic in

domestic dogs in Lesotho and could be spreading into the neighbouring regions of South Africa such as KZN, EC and FS (Figure 2.1.4). The lack of rabies epidemiological data from this region highlights the need for studies such as the present one.

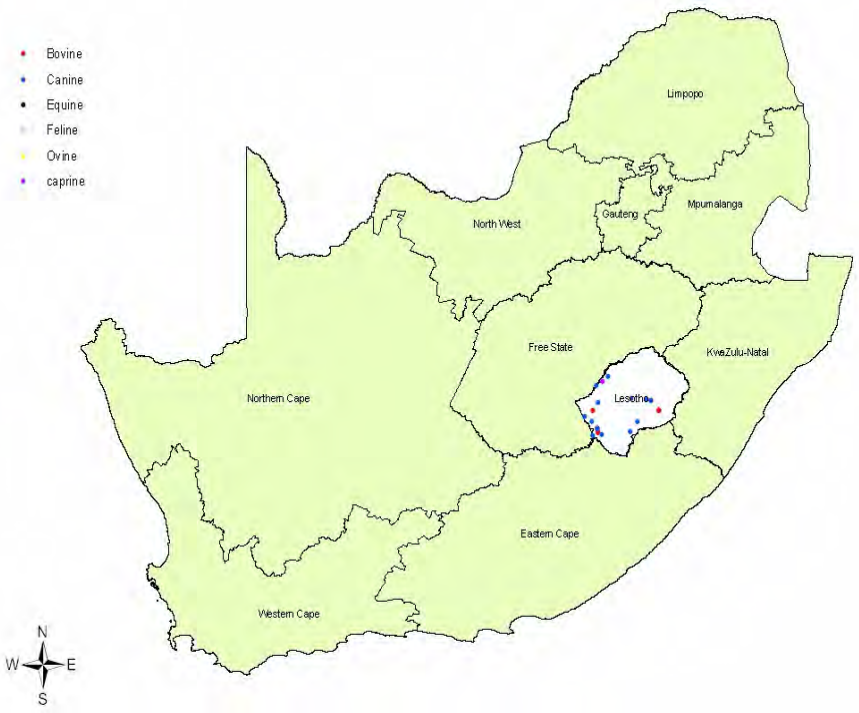


Figure 2.6.1. A map showing the location in the mountain kingdom of Lesotho and rabies outbreaks that occurred during 2006 (Department of Agriculture, South Africa).

2.7 Aims of the project

The study was performed to better understand the molecular epidemiology of canine rabies in the Free State province (South Africa) and Lesotho by establishing the genetic relationships between rabies viruses from these two geographic regions. More specifically it was the aim of the study to determine the origin of canine rabies into FS province, determine the radiation of the mongoose rabies biotype into dog host and finally to assess the public health significance of such events in the Free State province.

Chapter 3

Material and Methods

3.1. Viruses

All available rabies virus isolates/samples (between 1995 and 2007) from domestic dogs (*Canis familiaris*) originating from the Free State province (n = 96) (South Africa) and Lesotho (n = 17) were obtained from the archive at ARC-OVI. These samples were routinely submitted for rabies diagnosis at the Agricultural Research Council-Onderstepoort Veterinary Institute (ARC-OVI), Pretoria and included for genetic characterisation. The epidemiological information i.e. the year of isolation, host species and geographic origins of the virus isolates are shown in Table 3.2. All samples were shown to contain lyssavirus using the fluorescent antibody test (FAT) [Dean *et al*., 1996], antigenically typed then stored at -70^{o}C until required.

3.2. Viral RNA extraction

Total viral RNA was extracted from either lyophilized 20% mouse brain or original brain material using Tri reagent (Sigma, USA) according to manufacturer's instructions. In brief, approximately 50-100 mg of brain tissue was homogenized in 1 ml Tri reagent and incubated at room temperature (RT) [15-30^{o}C] for 5 min. The homogenate was further extracted once with 200 µl chloroform and 500 µl of the aqueous phase transferred to a sterile 1.5 ml eppendorf tube. The RNA was precipitated by addition of an equal volume of isopropanol to the aqueous phase, mixed gently and incubated for 10 min at RT. The RNA pellet was recovered by centrifugation at 13 000 rpm for 10 minutes, washed with 1 ml of 75% ethanol (in DEPC) and then centrifugation step for recovery of RNA repeated. Residual ethanol was removed and the RNA pellet air-dried for 5 min, re-suspended in 50 µl nuclease free water and solubilised at 55^{o}C for 10 min. The RNA samples were stored at -70^{o}C until required for further analysis.

3.3. cDNA synthesis

Complementary DNA (cDNA) was synthesized according to previously described protocols (Sacramento *et al*., 1991; von Teichman *et al*., 1995). The sense primer G (+) (20 pmol) was annealed to the viral RNA together with dNTP mix (2.5 mM) at 70°C for 5 min and immediately cooled on ice. A reaction mixture consisting of M-MLV reverse transcriptase (200 U), RNAsin (40 U) and 5X RT buffer were added to RNA: primer mixture and incubated at 42°C for 60 minutes (Promega, USA). The reaction mixture was inactivated at 70°C for 10 min, diluted 5-fold and then stored at –20°C until required for amplification.

3.4. Polymerase chain reaction (PCR)

PCR for the G-L intergenic region was performed as described in previous protocols (Sacramento *et al*., 1991; Von Teichman *et al*., 1995; Sabeta *et al*., 2003). Ten microlitres of 5X reaction buffer, 4 µl of dNTP mix (2.5 mM), 4 µl of each of sense primer 10 pmol G (+), antisense primer 10 pmol/µl (-), 3 µl of $MgCl_2$ (1.5 mM) and 0.25 µl Taq DNA polymerase (1.25 units) were added together in 1.5 ml eppendorf tube and made up to 50 µl with sterile distilled water. The reaction mixture was processed in a thermocycler (Eppendorf mastercycler) for 25 cycles with the following cycling parameters: 94°C for 2 minutes, 94°C for 5 minutes, 42°C for 1.3 minutes, 72°C for 2 minutes and a final extension for 7 minutes. The amplicons together with 100-bp DNA ladder were separated on 1% agarose gel stained with ethidium bromide (Sambrook *et al*., 1989) and viewed under UV transillumination.

Table 3.1. The primer set used in cDNA synthesis, PCR and sequencing reactions and the binding positions corresponding to the G-L intergenic region on the Pasteur rabies virus (PV) genome.

Primer	Primer length	Position
G (+)	GACTTGGGTCTCCCGAACTGGGG	4665 to 4687
L (-)	CAAAGGAGAGTTGAGATTGTAGTC	5543 to 5566

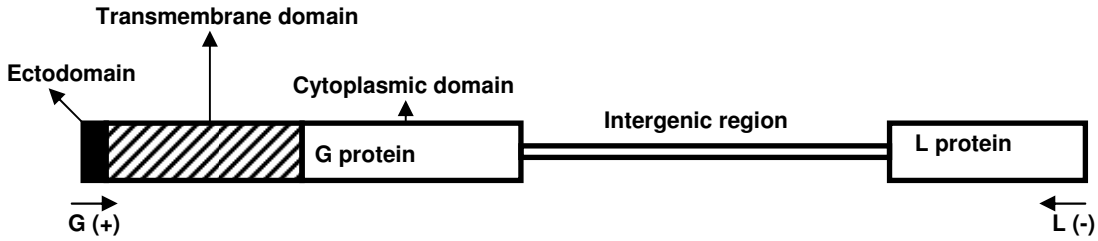


Figure 3.1. A representative diagram of the glycoprotein gene including the cytoplasmic domain of the glycoprotein (G) and the G-L intergenic region showing the annealing positions of both forward G (+) and reverse L (-) primers binding sites. The intergenic region is about 495-bp (Sacramento *et al*., 1991).

3.5. DNA purification and nucleotide sequencing

The PCR products were purified using the Wizard SV Gel and PCR clean-up system according to the manufacturer's instructions (Promega, USA). In brief, 45 µl of PCR product was mixed with an equal volume of membrane binding solution, transferred to a spin column and centrifuged at 14 000 rpm for a minute. The silica bound DNA was washed twice with membrane wash solution and eluted with 50 µl of nuclease free water. The purified DNA was quantified by agarose gel electrophoresis before nucleotide sequencing. The purified DNA (40-100 ng) was cycle sequenced in both directions using the G (+) and L (-) primer set used in the preceding RT-PCR step with the Big Dye Terminator Sequencing kit version 3.1 (Applied Biosystem, USA). In brief, 3 µl of approximately 100 ng DNA was added to a reaction mixture comprising 4 µl ready reaction mix, 4 µl Big Dye sequencing buffer 1X, 10 pmol primer G (+) or L (-) and 8 µl of sterile distilled water to make a final volume of 20 µl and mixed thoroughly. The sequencing reactions were performed in a thermal cycler using the following parameters; an initial denaturation at 96^{o}C for 1 minute, followed by (94^{o}C for 10 seconds, 50^{o}C for 5 seconds and 60^{o}C for 4) for 25 cycles.

After cycle sequencing the sequenced products were precipitated by adding the whole sequencing product to a 1.5 ml eppendorf tube containing 60 µl of absolute ethanol and 5 µl of 125 mM of EDTA. The reaction mixture was incubated at room temperature for 20 minutes and centrifuged at 14000 rpm for 30 minutes. The supernatant (containing unincorporated dNTPs) was decanted and the pellet washed with 100 µl of 75% ethanol and the centrifugation step repeated as before. The pellet was air-dried for 5 min and separated on an ABI 377 sequencer. The consensus sequence was achieved by alignment of the forward and the reverse sequences using MEGA 3.1 software package (Kumar *et al*., 2004). A total of approximately 820 bases of forward and reverse (reversed complement sequence) sequences were aligned using MEGA version 3.1. A consensus sequence was obtained by manually trimming and editing both forward and reverse complement sequences aligned together. The sequences were trimmed at start motif TCAAT and ends at poly-A tail for the canid strains whereas the mongoose strains started at TCCAT or TCCGT and also ends at poly-A tail of the sequences.

3.6. Phylogenetic analysis

Phylogenetic analysis was based on an alignment of 592-bp region of the cytoplasmic domain of the glycoprotein and the G-L intergenic region. The nucleotide sequences were trimmed to 592-bp with the use of MEGA version 3.1 (Kumar *et al*., 2004) software package and the alignments were performed using Clustal X software (Higgins and Sharp, 1989). The genetic distances were calculated by Kimura's two-parameter model (Kimura, 1980) found in MEGA version 3.1. A neighbour joining tree was constructed and the branching order of the tree was evaluated by bootstrap analysis of a 1000 replicates (Swofford, 1993). The topology of the NJ tree was confirmed with the reconstruction of a maximum parsimony tree (data not shown).

Table 3.2. The rabies viruses recovered from domestic dogs from different districts in the Free State province (South Africa) and Lesotho used in the study.

Virus number	Lab Number	Species of origin	Locality of origin	Longitude	Latitude	Biotype	Accession number
1	291/95*	Canine	Brandfort	26.14	28.47	V	EU163303
2	808/95*	Canine	Vrede	29.14	27.20	V	EU163305
3	475/96*	Canine	Odendaalsrus	26.32	27.53	V	EU163299
4	600/96*	Canine	Viljoenskroon	26.58	27.10	V	EU163302
5	749/96*	Canine	Clocolan	27.39	28.47	V	EU163300
6	1078/97*	Canine	Brandfort	26.23	28.42	V	EU163292
7	146/98*	Canine	Odendalsrus	26.35	27.53	C	EU163365
8	472/98*	Canine	Kroonstad	26.50	27.39	V	EU163371
9	559/98*	Canine	Bothaville	26.41	27.39	V	EU163301
10	828/99	Canine	Ladybrand	27.19	29.03	V	EU163304
11	756/99	Canine	Hennenman	27.01	27.54	V	EU163307
12	1003/99	Canine	Vrede	28.59	27.09	V	EU163306
13	1039/99	Canine	Odendaalsrus	26.39	27.48	V	EU163293
14	142/00	Canine	Zastron town	27.17	30.13	C	EU163289
15	549/00	Canine	Zastron town	27.01	30.01	C	EU163294
16	568/00	Canine	Kroonstad	27.14	27.39	V	EU163295
17	851/00	Canine	Wepener town	27.02	29.43	C	EU163308
18	70/01	Canine	Wepener town	27.02	29.58	C	EU163330
19	101/01	Canine	Vrede	26.58	27.40	V	EU163342
20	189/01	Canine	Wepener town	27.04	29.55	C	EU163335
21	641/01	Canine	Ladybrand	27.30	29.14	C	EU163290
22	653/01	Canine	Zastron town	27.02	30.10	C	EU163291
23	903/01	Canine	Ladybrand	27.31	29.12	C	EU163331
24	41/02	Canine	Wepener town	27.07	30.02	C	EU163339
25	53/02	Canine	Ladybrand	27.33	29.11	C	EU163343
26	114/02	Canine	Brandfort	26.30	28.48	V5	EU163334
27	229/02	Canine	Vrede	28.56	27.01	V	EU163296
28	329/02	Canine	Heilbron	28.06	27.18	V1	EU163351
29	343/02	Canine	Wepener town	27.05	29.46	C	EU163345
30	426/02	Canine	Ficksburg	27.48	28.52	C	EU163348
31	505/02	Canine	Ladybrand	27.28	29.07	C	EU163340
32	511/02	Canine	Clocolan	27.37	29.00	C	EU163297
33	544/02	Canine	Clocolan	29.20	27.35	C	EU163298
34	568/02	Canine	Senekal	27.53	28.07	V	EU163381
35	579/02	Canine	Ficksburg	28.53	27.53	C	EU163344
36	588/02	Canine	Clocolan	28.58	27.36	C	EU163349
37	591/02	Canine	Ficksburg	28.53	27.53	C	EU163346
38	616/02	Canine	Zastron town	27.06	30.16	C	EU163363
39	610/02	Canine	Ficksburg	27.27	28.52	C	EU163337
40	631/02	Canine	Ladybrand	27.31	29.12	C1	EU163376
41	648/02	Canine	Zastron town	27.05	30.19	C1	EU163364
42	651/02	Canine	Ficksburg	28.45	27.45	C	EU163354
43	687/02	Canine	Wepener town	27.04	29.45	C	EU163352
44	716/02	Canine	Ficksburg	27.75	28.75	C	EU163359
45	744/02	Canine	Wepener town	27.02	29.43	C	EU163357
46	860/02	Canine	Ladybrand	27.04	29.57	C	EU163358
47	925/02	Canine	Ficksburg	28.53	27.53	C1	EU163372
48	930/02	Canine	Ficksburg	27.88	28.90	C	EU163355

49	950/02	Canine	Ficksburg	27.88	28.90	C	EU163366
50	03/03	Canine	Smithfield	27.17	30.04	C	EU163310
51	18/03	Canine	Bethlehem	28.13	28.02	V1	EU163311
52	19/03	Canine	Bethlehem	27.35	28.53	C1	EU163323
53	48/03	Canine	Bethlehem	27.48	28.44	C	EU163341
54	106/03	Canine	Welkom	26.41	28.06	V3	EU163309
55	238/03	Canine	Zastron town	27.13	30.17	C1	EU163312
56	462/03	Canine	Bethlehem	28.21	28.56	C1	EU163347
57	467/03	Canine	Smithfield	27.10	30.06	C1	EU163350
58	536/03	Canine	Bethlehem	28.30	28.12	C1	EU163367
59	570/03	Canine	Smithfields	27.00	30.00	C	EU163368
60	591/03	Canine	Ladybrand	27.11	29.27	C	EU163353
61	735/03	Canine	Ficksburg	28.14	28.18	C	EU163373
62	759/03	Canine	Smithfield	27.09	30.00	C	EU163374
63	842/03	Canine	Ficksburg	27.48	28.52	C	EU163375
64	902/03	Canine	Ficksburg	27.89	28.89	C	EU163332
65	915/03	Canine	Zastron town	30.23	27.11	C	EU163336
66	922/03	Canine	Bloemfontein	26.14	29.05	C	EU163333
67	941/03	Canine	Ficksburg	27.89	28.90	C	EU163338
68	21/04	Canine	Fouriesburg	28.42	28.13	C	EU163329
69	88/04	Canine	Bultfontein	26.20	28.1	V1	EU163318
70	106/04	Canine	Wepener town	27.00	29.59	C	EU163319
71	123/04	Canine	Wepener town	27.00	29.59	V	EU163362
72	169/04	Canine	Wepener town	27.02	29.43	C	EU163384
73	264/03	Canine	Bethlehem	27.53	28.53	C	EU163380
74	419/04	Canine	Ladybrand	27.00	29.30	C	EU163314
75	448/04	Canine	Sterkstroom	30.31	27.24	C	EU163315
76	551/04	Canine	Wepener town	27.02	29.48	C	EU163317
77	577/04	Canine	Wepener town	29.56	27.03	C	EU163313
78	589/04	Canine	Wepener town	30.02	26.53	C	EU163377
79	594/04	Canine	Wepener town	29.48	27.01	C	EU163316
80	302/05	Canine	Viljoenskroon	26.56	26.12	V	EU163320
81	319/05	Canine	Hoopstad	26.04	28.15	V	EU163321
82	327/05	Canine	Zastron town	30.05	27.09	C	EU163322
83	357/05	Canine	Winburg	27.01	28.31	V	EU163369
84	41/06	Canine	Bethlehem	28.51	28.42	C	EU163325
85	43/06	Canine	Ladybrand	27.32	29.92	C	EU163328
86	48/06	Canine	Bethlehem	28.33	28.12	C	EU1633327
87	56/06	Canine	Ficksburg	27.89	28.90	C	EU163360
88	110/06	Canine	Bethlehem	28.30	28.25	C	EU163324
89	164/06	Canine	Ladybrand	27.09	29.32	C	EU163361
90	385/06	Canine	Senekal	28.16	27.37	V	EU163326
91	425/06	Canine	Ladybrand	27.23	29.05	C	EU163356
92	779/06	Canine	Bethlehem	28.51	28.42	C	EU163378
93	790/06	Canine	Bethlehem	28.51	28.42	C	EU163383
94	1050/06	Canine	Kroonstad	27.27	27.34	V	EU163370
95	159/07	Canine	Clocolan	27.50	27.29	C	EU163379
96	183/07	Canine	Zastron town	27.14	30.21	C	EU163382
97	198/00	Canine	Mohales	27.29	31.10	C	EU163387
98	199/00	Canine	Mohales	27.29	31.10	C	EU163390
99	650//00	Canine	Mohales	27.29	30.09	C	EU163388
100	912/00	Canine	Quthing	n.k	n.k	C	EU163389
101	403/01	Canine	Maseru	27.29	29.18	C	EU163386
102	404/01	Canine	Maseru	27.29	29.18	C	EU163385
103	430/01	Canine	Maseru	28.18	27.29	C	EU163392
104	527/01	Canine	Maseru	n.k	n.k	C	EU163395

105	531/02	Canine	Maseru	n.k	n.k	C	EU163391
106	785/03	Canine	Maseru	n.k	n.k	C	EU163394
107	298/05	Canine	Maseru	n.k	n.k	C	EU163393
108	301/05	Canine	Maseru	n.k	n.k	C	EU163397
109	391/06	Canine	Maseru	n.k	n.k	C	EU163398
110	953/06	Canine	Maseru	n.k	n.k	C	EU163396
111	383/07	Canine	Maseru	n.k	n.k	C	EU163399
112	384/07	Canine	Maseru	n.k	n.k	C	EU163400
113	385/07	Canine	Maseru	28.18	27.29	C	EU163401

Key:

V: mongoose rabies biotype

C: canid rabies biotype

V1, V3 or V5: mongoose rabies biotype indicating monoclonal antibody reactivity pattern 1, 3 or 5

C1: canid rabies biotype indicating reactivity pattern 1

n.k.: not known

* Isolates: passaged once in mice. All the other samples were stored as original animal brain material stored at -70^{o}C

Chapter 4

Results

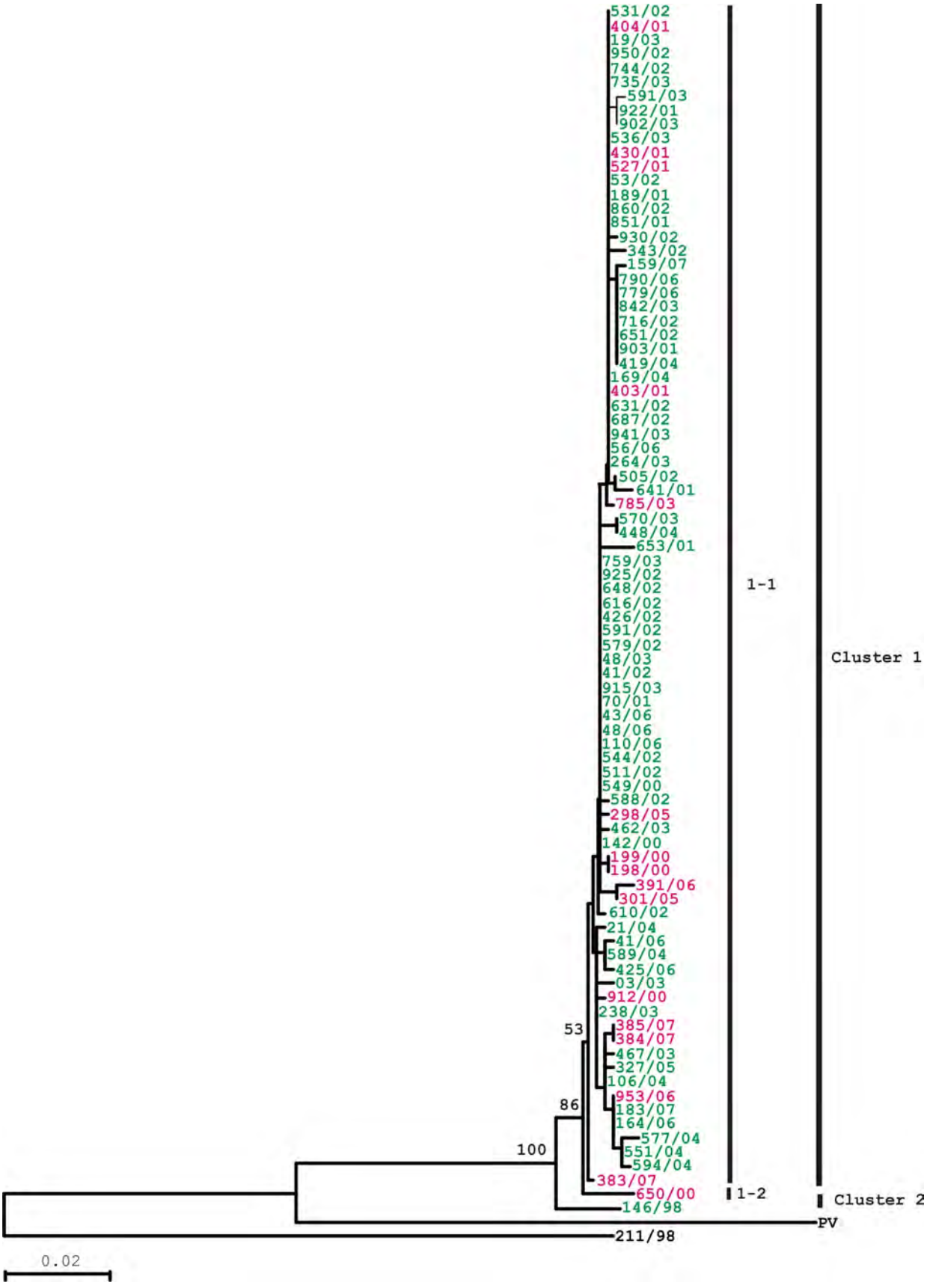
4.1 Results

A total of 113 rabies viruses, all recovered from the domestic dog (*Canis familiaris*) were included for phylogenetic analysis in this epidemiologic study. The epidemiological information of the viruses is shown in Table 3.2. The viral RNA extractions, cDNA synthesis and amplifications were performed as described in sections 3.2-3.4. The G-L primer set was used for amplification and yielded a product of approximately 850-bp in size for each isolate included in the study (data not shown). The purified PCR products were sequenced as described in section 3.5. The nucleotide sequence data was retrieved and edited manually in MEGA 3.1 in order to verify the correctness of the sequences. The nucleotide sequencing yielded approximately 820 bases nucleotide sequence data and 592 bp were used for further phylogenetic analysis. It was found that canid rabies virus isolates from the FS province and those obtained from Lesotho were very closely related with a mean nucleotide sequence homology of 99%. It was also found that canid rabies viruses had 81% nucleotide sequence homology to the Pasteur virus (PV) and 68% to mongoose rabies virus on average.

Part A: Genetic analysis of canid rabies viruses from the Free State province and the kingdom of Lesotho

In order to determine the genetic relationships of canid rabies viruses from FS province and neighbouring Lesotho; a sample consisting of 86 canid rabies viruses were compared. This was a total number of canid rabies viruses included in the study and due to the fact that mongoose rabies biotype was not identified in Lesotho; it was found appropriate to exclude mongoose rabies viruses in this analysis. The NJ tree was constructed from the nucleotide sequence alignment (Appendix 3). The canid rabies viruses included in the study could be phylogenetically divided into 2 main clusters, and designated cluster 1 and 2 (Figure 4.1). Cluster 1 could be further divided into 2 sub-clusters 1-1 and 1-2 with significant bootstrap support value (86%). Sub-cluster 1-1 was composed of 84 viruses originating from dogs from both the Free State province and Lesotho, whereas sub-cluster 1-2 consisted of a single isolate from Lesotho. Cluster 2 consisted of a single

canid rabies virus from Free State province. It was apparent from Figure 4.1 that the two clusters belong to two separate lineages with bootstrap value of 100%. It was found that canid rabies viruses from FS province and those obtained from Lesotho were closely related with a mean nucleotide sequence homology of 99%.


531/02
404/01
19/03
950/02
744/02
735/03
591/03
922/01
902/03
536/03
430/01
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53/02
189/01
860/02
851/01
930/02
343/02
159/07
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941/03
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653/01
759/03
925/02
648/02
616/02
426/02
591/02
579/02
48/03
41/02
915/03
70/01
43/06
48/06
110/06
544/02
511/02
549/00
588/02
298/05
462/03
142/00
199/00
198/00
391/06
301/05
610/02
21/04
41/06
589/04
425/06
03/03
912/00
238/03
385/07
384/07
467/03
327/05
106/04
953/06
183/07
164/06
577/04
551/04
594/04
383/07
650/00
146/98
211/98
PV
53
86
100
1-1
1-2
Cluster 1
Cluster 2
0.02

Figure 4.1. A neighbour joining tree based on 592 bp region of the G-L intergenic region sequence data illustrating the genetic relationships of canid rabies viruses from different regions in the Free State province and Lesotho. Viral sequences from dogs from the Free State are in green and Lesotho sequences are in pink respectively. Horizontal lines are proportional to the evolutionary distances between sequences and the scale bar represents nucleotide substitutions per site. Significant bootstrap values (>70%) are included in the tree. The mongoose isolate (211/98) were used as an out-group.

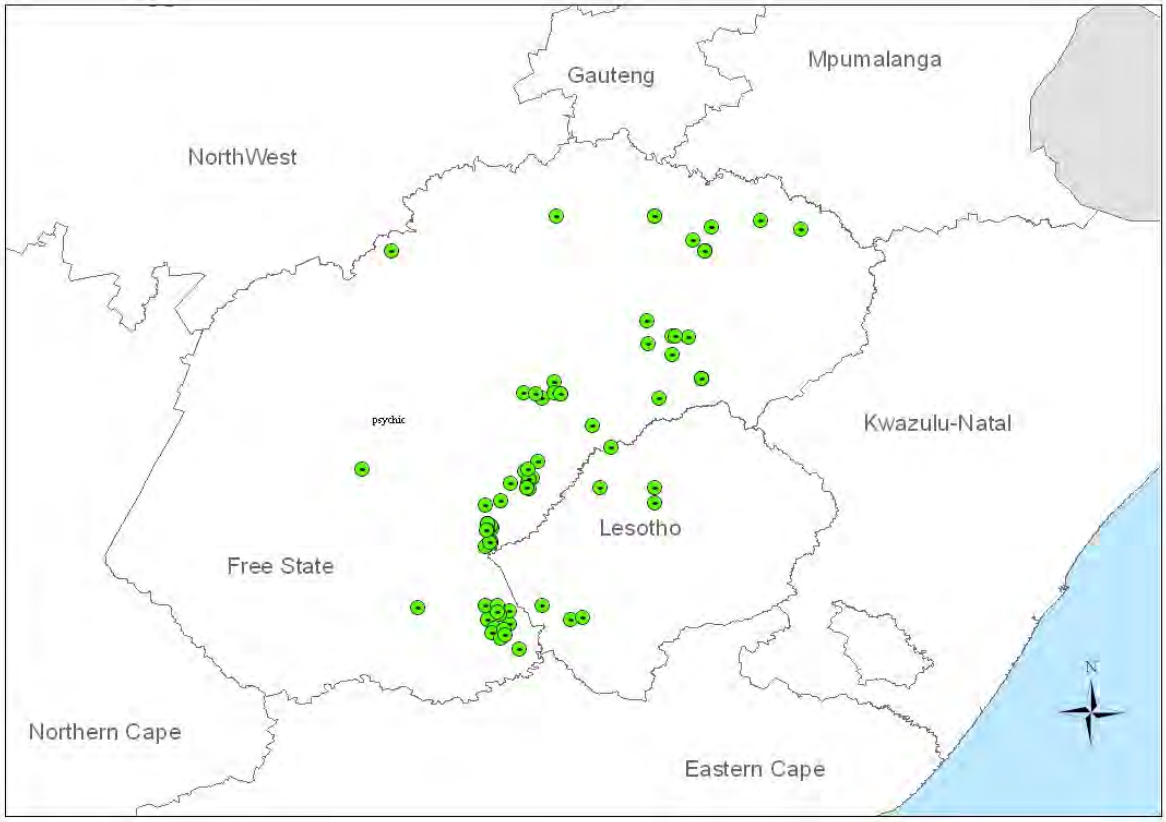


Figure 4.2 A representative map indicating different locations in the Free State province and Lesotho where canid rabies viruses in the phylogenetic tree (Figure 4.1) were recorded.

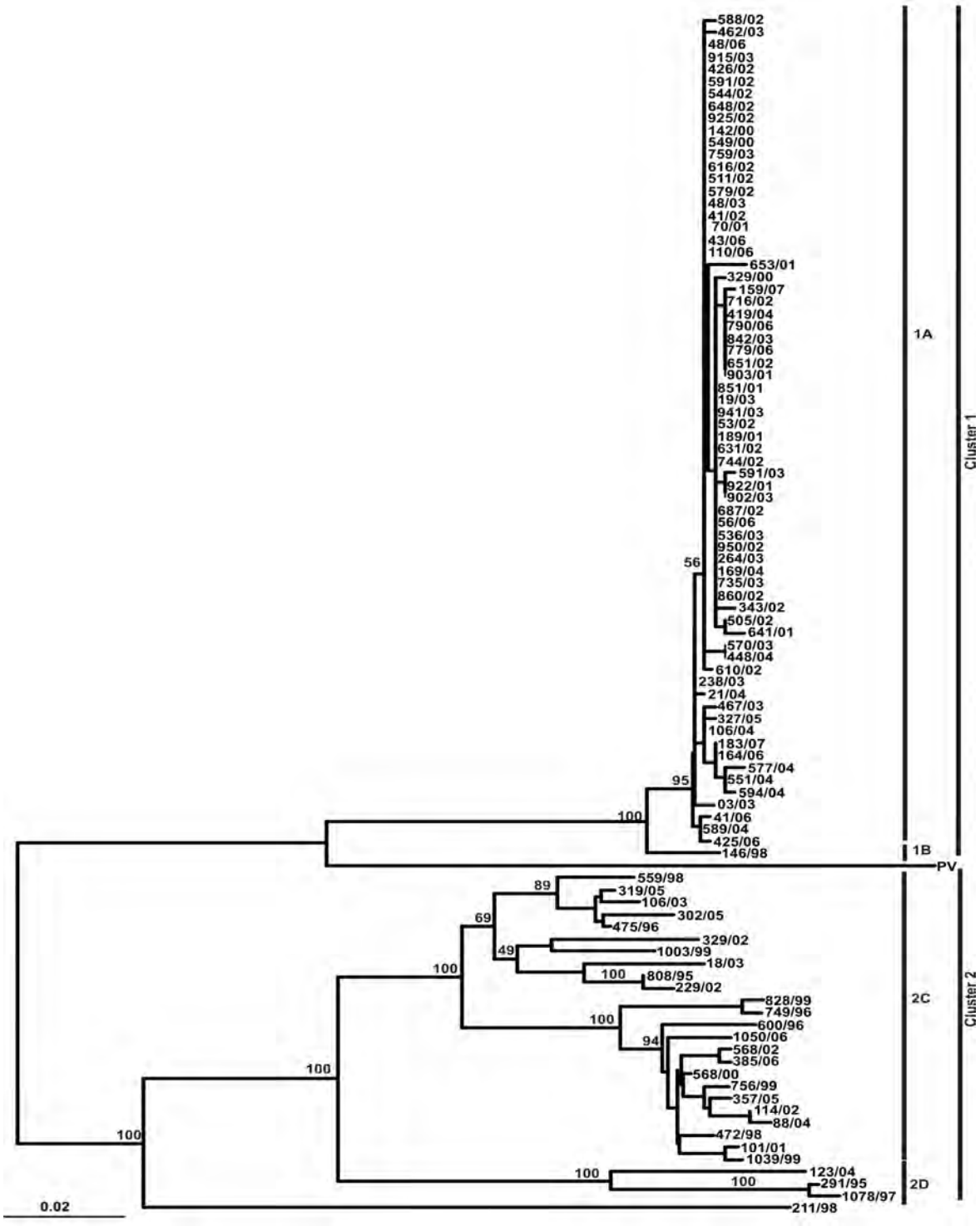
Part B: Genetic analysis of rabies viruses recovered from domestic dogs in the Free State province

In order to understand the molecular epidemiology of rabies in the Free State (FS) province, 96 rabies viruses (all rabies viruses including canid and mongoose rabies viruses from FS province excluding those from Lesotho) recovered from domestic dogs were genetically analysed. The NJ tree (Figure 4.3) was constructed from a distance matrix presented in Appendix 4. The rabies viruses recovered from domestic dogs in the Free State were divided into 2 main clusters (Figure 4.3). Cluster 1 was comprised exclusively of viruses of the canid rabies biotype whereas cluster 2 viruses belonged to the mongoose rabies biotype.

The results confirmed the presence of two rabies epidemiological cycles, one circulating in the domestic dog (canid rabies biotype) and other in C*ynictis penicillata* (mongoose rabies biotype) on the highveld plateau of the FS. Furthermore these clusters could be further divided into sub-clusters. For instance cluster 1 could be divided into two sub-clusters (1A and 1B). Sub-cluster 1A, consisted of 68 rabies viruses whereas sub-cluster 1B was composed of a single dog isolate. It was found that the rabies viruses in sub-cluster 1A have a mean nucleotide sequence homology of 99%, which demonstrates a single, recently introduced and compact lineage circulating in this region. It was evident that sub-cluster 1A and 1B were phylogenetically distinct groups with a bootstrap support value of 100% and found to have a mean nucleotide sequence diversity of 2% on average.

Cluster two could be divided into 2 sub-clusters (2C and 2D). Sub-cluster 2C was comprised of 24 rabies viruses and sub-cluster 2D consisted of 3 rabies viruses. The sub-cluster 2C could be further divided into two groups with a significant bootstrap value of 100%. Both canid and mongoose rabies viruses clustered according to their geographic origin, similar to findings in other lyssavirus studies (Bourhy *et al*., 1999; Nel *et al*., 2005). It was found that the nucleotide sequence variation between the 2 groups ranged between 9 and 17%, confirming findings of previous studies (Nel *et al*., 2005). The mean sequence diversity between mongoose rabies viruses and canid rabies viruses was 29% on average and 37% with the reference Pasteur virus strain (PV), observations in

agreement with the previously described publications (von Teichman *et al*., 1995; Coetzee and Nel, 2007). The topology of the tree was confirmed by the maximum parsimony tree (data not shown).


588/02
462/03
48/06
915/03
426/02
591/02
544/02
648/02
925/02
142/00
549/00
759/03
616/02
511/02
579/02
48/03
41/02
70/01
43/06
110/06
653/01
329/00
159/07
716/02
419/04
790/06
842/03
779/06
651/02
903/01
851/01
19/03
941/03
53/02
189/01
631/02
744/02
591/03
922/01
902/03
687/02
56/06
536/03
950/02
264/03
169/04
735/03
860/02
343/02
505/02
641/01
570/03
448/04
610/02
238/03
21/04
467/03
327/05
106/04
183/07
164/06
577/04
551/04
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03/03
41/06
589/04
425/06
146/98
559/98
319/05
106/03
302/05
475/96
329/02
1003/99
18/03
808/95
229/02
828/99
749/96
600/96
1050/06
568/02
385/06
568/00
756/99
357/05
114/02
88/04
472/98
101/01
1039/99
123/04
291/95
1078/97
211/98
56
95
100
89
69
49
100
100
100
94
100
100
100
1A
1B
PV
2C
2D
Cluster 1
Cluster 2
0.02

Figure 4.3. A neighbour-joining (NJ) tree illustrating the genetic variability of RABV in the Free State province, South Africa. The NJ tree was based on an alignment of 592 bp nucleotide sequences of the cytoplasmic domain of glycoprotein gene and G-L intergenic region. Horizontal lines are proportional to the evolutionary distances/diversity between sequences and the scale bar represents nucleotide substitution per site. The vertical lines are for clarity of presentation only. The bootstrap values of more than 70% are regarded as phylogenetically significant and included on the tree. The sequence 211/98 was included as an out group.

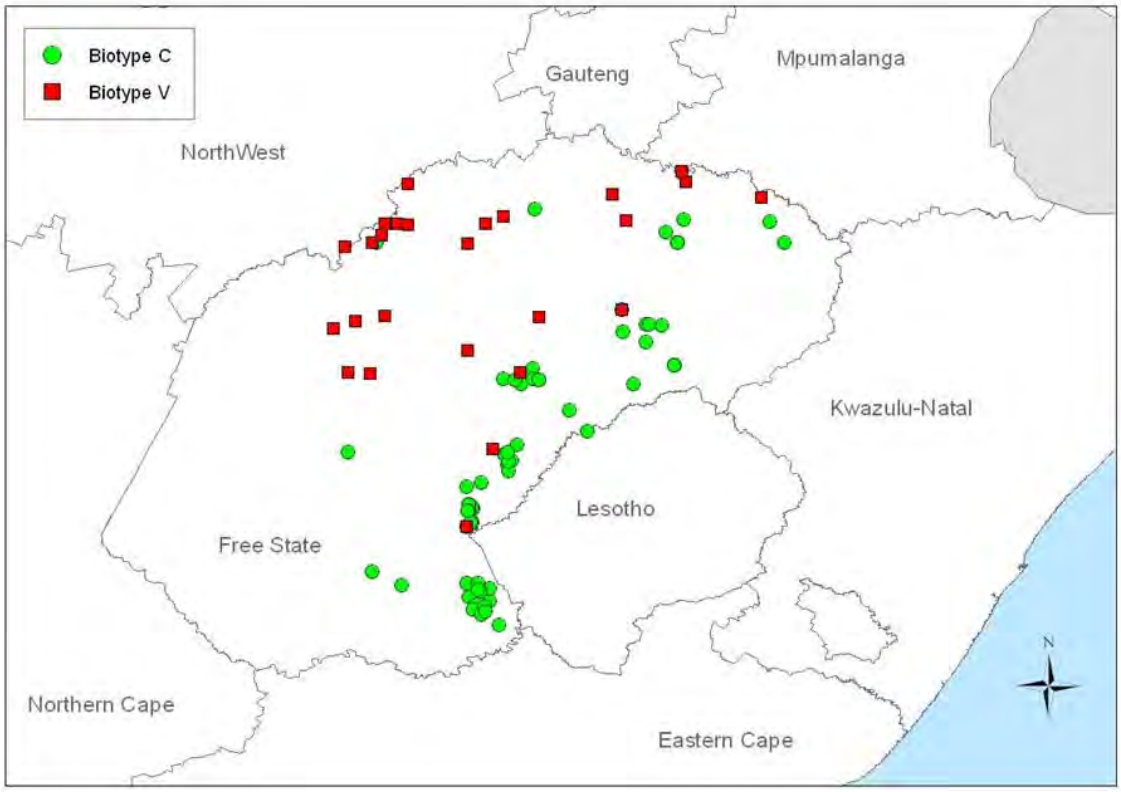


Figure 4.4. A representative map indicating plot of the various locations or districts from where the rabies viruses were recovered from domestic dogs in the Free State province.

Part C: Phylogenetic analysis of canid rabies viruses from Free State province as well as other endemic regions of South Africa and Lesotho

To determine the origin of canid rabies viruses from FS province, nucleotide sequences of canid rabies viruses from the province and those from different endemic regions of South Africa and Lesotho were compared and analysed. A phylogenetic tree based on an alignment of 45 viral nucleotide sequences (these sequences were randomly selected) from domestic dogs was constructed using the neighbour joining method (Figure 4.5). The geographic and epidemiological information of the reference sequences is presented in Table 4.1.

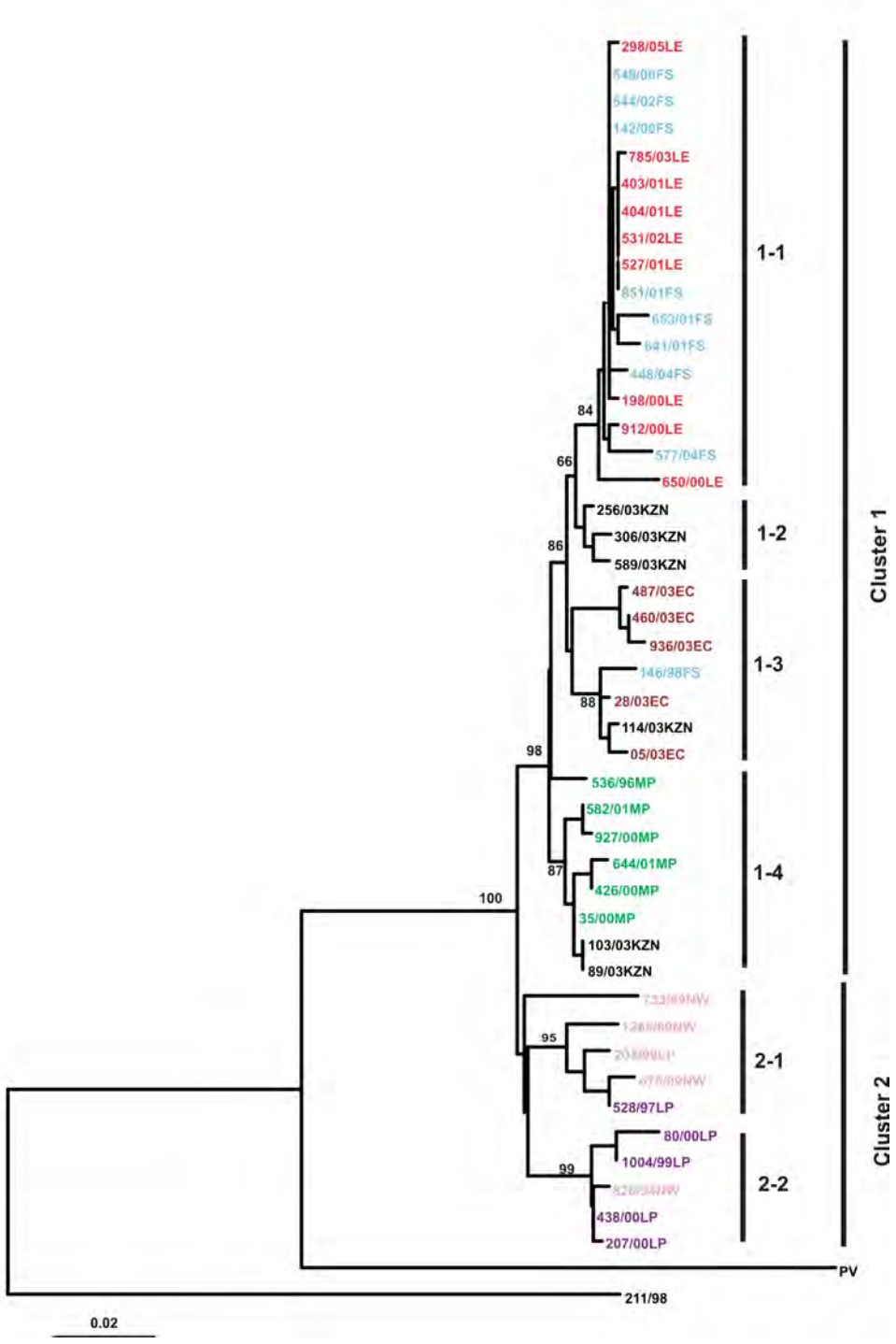
The canid rabies viruses from various regions of South Africa and Lesotho could be phylogenetically divided into 2 clusters with a statistically significant bootstrap support value of 100%. The canid rabies viruses in this panel were distant to the reference strain Pasteur rabies virus (PV) and the mongoose rabies virus (211/98). Cluster one consisted of a large number of viruses (n = 36) from different regions of South Africa and Lesotho whereas cluster 2 was composed of canid rabies viruses from the North West and Limpopo provinces of South Africa. Cluster one could be divided into 4 sub-clusters that were supported by bootstrap values of 66%, 86% and 98% respectively.

Sub-cluster 1-1 consisted exclusively of viruses from the Free State province and Lesotho. Sub-cluster 1-2 comprised canid rabies viruses from domestic dogs from Kwazulu-Natal province and sub-cluster 1-3 consisted of virus isolates from Eastern Cape, Free State and Kwazulu-Natal provinces. A single rabies virus isolate (146/98) from a dog from the Free State province clustered together with those obtained from the Eastern Cape and were very closely related with a mean nucleotide sequence homology of 98% on average. Sub-cluster 1-4 consisted of canid rabies viruses from domestic dogs from Mpumalanga and Kwazulu-Natal province.

Table 4.1. The rabies viruses in comparison of genetic relationships of rabies viruses from FS province and other endemic regions of South Africa and Lesotho.

Virus number	Lab number	Species of origin	Locality	Biotype	Province	Longitude	Latitude	Accession number
1	207/00	Canine	Potgitersrus	C	LP	29.19	22.48	EF686063
2	1004/99	Canine	Pietersburg	C	LP	29.14	23.43	EF686052
3	438/00	Canine	Soutpansberg	C	LP	29.50	23.25	EF686060
4	208/99	Canine	Waterberg	C	LP	28.21	24.35	EF686061
5	528/97	Canine	Thabazimbi	C	LP	26.49	24.43	EF686062
6	927/00	Canine	Piet Retief	C	MP	30.35	27.18	n.k
7	536/96	Canine	Carolina	C	MP	30.33	25.57	EF686057
8	426/00	Canine	Barberton	C	MP	31.50	25.53	EF686071
9	582/01	Canine	Piet Retief	C	MP	30.48	27.42	EF686072
10	35/00	Canine	Barberton	C	MP	31.47	25.45	EF686077
11	644/01	Canine	Barberton	C	MP	31.35	25.37	EF686078
12	820/94	Canine	Vryburg	C	NW	24.45	26.08	AF177118
13	675/99	Canine	Mankwe	C	NW	27.23	25.06	AF303071
14	733/99	Canine	Brits	C	NW	27.33	25.16	AF303067
15	1265/80	Canine	Brits	C	NW	29.34	25.22	EF686047
16	05/03	Canine	Elliot	C	EC	26.51	31.20	DQ841404
17	28/03	Canine	Lupapasi	C	EC	27.20	31.32	DQ841406
18	460/03	Canine	Pomona	C	EC	28.12	31.10	n.k
19	487/03	Canine	Umtata	C	EC	25.30	30.40	n.k
20	936/03	Canine	Butterworth	C	EC	28.10	32.20	DQ841422
21	89/03	Canine	Pongola	C	KZN	31.25	27.20	DQ841427
22	103/03	Canine	Pongola	C	KZN	31.23	27.22	DQ841425
23	114/03	Canine	Mount Currie	C	KZN	29.24	30.39	DQ841430
24	256/03	Canine	Pinetown	C	KZN	30.53	29.46	DQ841464
25	306/03	Canine	Lower Umfolozi	C	KZN	31.54	28.46	DQ841476
26	589/03	Canine	Vryheid	C	KZN	31.12	28.12	DQ841538
27	146/98	Canine	Odendaalsrus	C	FS	26.35	27.53	EU163365
28	142/00	Canine	Zastron town	C	FS	27.17	30.13	EU163289
29	549/00	Canine	Zastron town	C	FS	27.10	30.01	EU163294
30	641/01	Canine	Ladybrand	C	FS	27.30	29.14	EU163290
31	653/01	Canine	Zastron town	C	FS	27.02	30.10	EU163291
32	851/00	Canine	Wepener town	C	FS	27.02	29.43	EU163308
33	544/02	Canine	Clocolan	C	FS	29.20	27.35	EU163298
34	448/04	Canine	Sterkstroom	C	FS	30.31	27.24	EU163315
35	577/04	Canine	Wepener town	C	FS	29.56	27.03	EU163313
36	198/00	Canine	Mohale	C	LE	27.29	31.10	EU163387
37	650/00	Canine	Mohale	C	LE	27.29	30.09	EU163388
38	912/00	Canine	Quthing	C	LE	n.k	n.k	EU163389
39	404/01	Canine	Maseru	C	LE	27.29	29.18	EU163385
40	430/01	Canine	Maseru	C	LE	28.18	27.29	EU163392
41	527/01	Canine	Maseru	C	LE	n.k	n.k	EU163395
42	531/02	Canine	Maseru	C	LE	n.k	n.k	EU163391
43	298/05	Canine	Maseru	C	LE	n.k	n.k	EU163393
44	391/06	Canine	Maseru	C	LE	n.k	n.k	EU163398
45	953/06	Canine	Maseru	C	LE	n.k	n.k	EU163396

Key note: C: canid biotype, LP: Limpopo province, MP: Mpumalanga, EC: Eastern Cape, NW: North West province, FS: Free State province, LE: Lesotho, n.k.: not known


298/05LE
549/98FS
544/02FS
142/00FS
785/03LE
403/01LE
404/01LE
531/02LE
527/01LE
851/01FS
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641/01FS
448/04FS
198/00LE
912/00LE
577/04FS
650/00LE
256/03KZN
306/03KZN
589/03KZN
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460/03EC
936/03EC
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582/01MP
927/00MP
644/01MP
426/00MP
35/00MP
103/03KZN
89/03KZN
528/97LP
80/00LP
1004/99LP
438/00LP
207/00LP
PV
211/98
0.02
1-1
1-2
1-3
1-4
2-1
2-2
Cluster 1
Cluster 2
84
66
86
88
98
87
100
95
99

Figure 4.5. A neighbour joining tree constructed from an alignment of nucleotide sequences of selected isolates from the study sample from Free State province as well as other isolates from rabies endemic regions of South Africa and Lesotho. The sequences are designated as e.g. 198/00 Le, 198/00 being the laboratory reference number and the suffix the locality of origin (e.g. Le-Lesotho). The horizontal lines are equivalent to the evolutionary distances between sequences and vertical lines are provided for clarity. The scale bar indicates nucleotide substitutions per site. The mongoose rabies virus (211/98) was used as out-group.

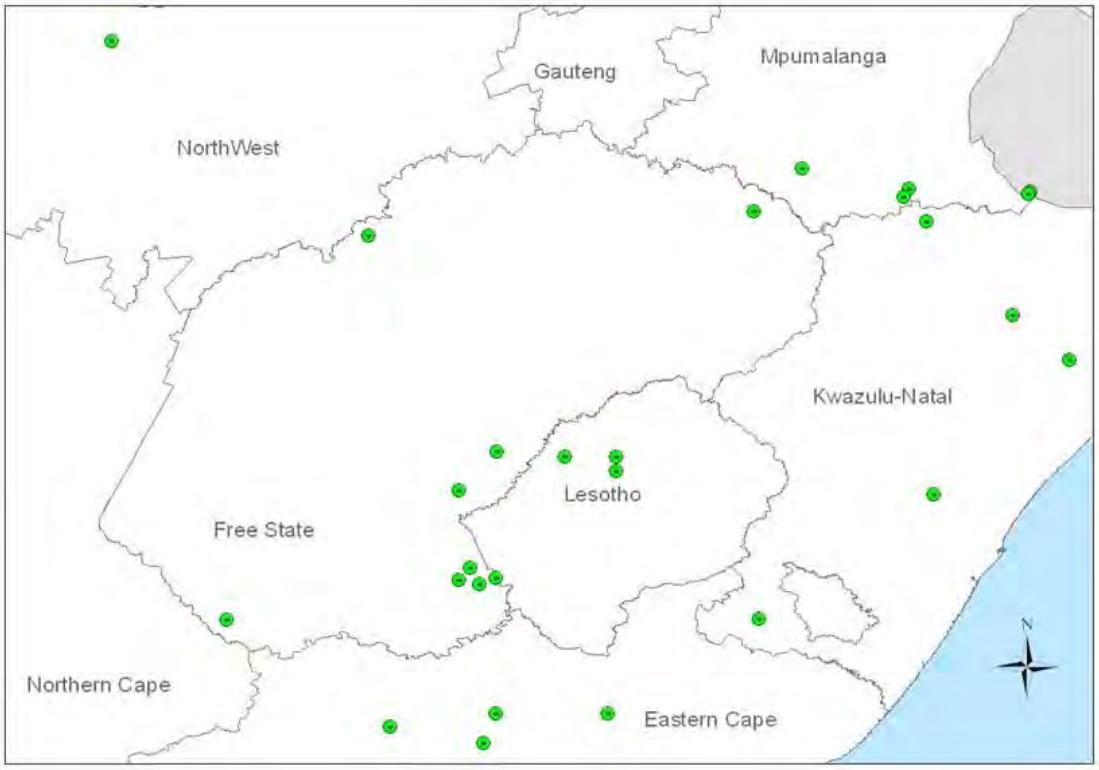

Figure 4.6. A representative map illustrating the geographical distribution of the rabies viruses recovered from dogs from various localities in South Africa and Lesotho.

Chapter 5

Discussion

5.1 Discussion

In this investigation the genetic relationships of 113 rabies viruses recovered from domestic dogs from the FS province and Lesotho was investigated with the following aims; trace the movement of canine rabies into the FS province, determine the radiation of mongoose rabies biotype into dog host and to assess the public health treat of the mongoose rabies biotype (in dog host). This investigation has demonstrated that the newly introduced canine rabies lineage in the FS province is surpassing the historic endemic mongoose rabies with a great impact in the highveld plateau of South Africa.

The first wave of canine rabies was introduced into southern Africa in the 1940s from Angola and spread in the dog population of the sub-continent (Swanepoel *et al*., 1993). The canine rabies virus is opportunistic, still spreading into new regions where it was never been reported and in the process it is also finding new and alternative canid host species available. This canine rabies lineage is able to adapt and sustain prolonged cycles in whatever canid hosts species available (Sabeta *et al*., 2003). Canine rabies viruses in southern Africa have been shown to be very closely related indicating a recent and common ancestor (Swanepoel *et al*., 1993). The data generated from this investigation suggested a similar canine rabies variant circulating in both the FS province and in the kingdom of Lesotho. The free exchange of rabies virus across national borders is not unique here, but has been shown in certain areas such as in the northern regions of South Africa and southern Zimbabwe (Cohen, *et al*., 2007).

It could be speculated that the natural exchange of viruses between canid host species in this geographical domain (Lesotho and FS province) occurs fairly frequently through which human movement between these 2 regions may be attributed to the introduction of the infected host species between the two distant (approximately 150 km apart) geographic localities. The problem was further complicated by a large number of “unowned” and “semi-owned” domestic dogs reported in the rural and urban areas of Lesotho, which are reservoirs for maintaining and transmitting the rabies virus to susceptible animals in the districts of Lesotho (Khomari, 1992). Since canine rabies was

endemic in Lesotho, the likelihood of spread within and to neighbouring regions such as FS province (South Africa) was obvious. The lack of surveillance in the kingdom of Lesotho indicates the lack of research and low priority given to rabies here. The reduction of "unowned" and "semi-owned" dogs, restriction of movement of animals and vaccination of street dogs in Lesotho will result in the reduction of rabies cases and lessen the public and veterinary health burden of this disease.

An animal birth control (ABC) approach (a concept of mass sterilisation and vaccination of street dogs) was shown to be effective in reducing human rabies incidence in India (Reece, 2007). The female dogs were collected and taken to an animal hospital for ovariohysterectomy and rabies vaccination, where after they were released back to where they were caught (Reece, 2007). To maintain the ratio of sexually active and increased proportion of dogs vaccinated, the prepubescent male dogs were also caught, neutered and vaccinated (Reece, 2007). Such approaches could be adopted in areas where street dogs occurs in large numbers, to reduce rabies transmission and stabilizing the street dog population.

The results obtained by phylogenetic analysis based on the nucleotide sequence of the genomic region under investigation confirmed the presence of two rabies epidemiological cycles in the FS province mentioned by previous studies and observation (von Teichman, *et al*., 1995). It was evident that the canid rabies virus lineage was a new introduction into the FS province and could probably have been introduced in the late 1990s most likely from the neighbouring kingdom of Lesotho. With the recent introduction of canine rabies into the FS province, the public and veterinary health burden is further enhanced. This canine rabies lineage is still spreading in the domestic dog population of FS province whilst other lineages are re-emerging in the other parts of the South Africa such as Limpopo province (Cohen *et al*., 2007). The spread and high incidence of canine rabies lineage is a significant public health threat to both humans and animals of the FS province. In 2006, it was estimated that at least 50 human deaths occurred in South Africa and almost 99% were of dog rabies (NICD, 2006), which demonstrates that whilst the disease is diminishing in Europe, it remains and poses a major threat in Africa.

Sustained parenteral and oral vaccination campaigns of the domestic dog population will eventually control and prevent the spread of the disease in specific localities. According to the WHO (2004), a vaccination coverage of 70% has been shown to be sufficient to control canine rabies in several settings but the exact level of coverage required clearly varies according to the demographic, behavioural and spatial characteristics of the dog population. Although the ministries of Health and Agriculture of the FS province are working together to control and reduce number of rabies cases in the province, the vaccination percentage coverage is far less than the recommended 70% (Dr. Mojapelo, personal communication). For instance, in 2004 the veterinary services of the FS province only vaccinated 18% of dog population. Continuation of these events will eventually reduce canine rabies and lower the public and veterinary health burden of the disease in the FS province. However, it must be emphasized that this should be done in collaboration with other provincial governments or countries.

In the early 1900s it was believed that the mongoose rabies virus only infected mongoose species and the canid biotype only the canid hosts. However, in 1928, 2 schoolboys were bitten by a yellow mongoose and succumbed to rabies (Snyman, 1940). The identification of rabies viruses of the mongoose biotype in dogs confirmed spill over events between H*erpestidae* and canid species (Nel *et al*., 2005; King *et al*., 1993). A genetic study conducted earlier (Nel *et al*., 2005) delineated a panel of 80 mongoose rabies viruses (from South Africa and Zimbabwe) into 5 distinct clusters, these conforming to specific geographic localities from which the isolates were obtained. Two of these clusters consisted of viruses from host species from the FS province, indicating two distant clusters circulating in the yellow mongoose population. The data generated from this investigation revealed a confirmation of the historical view that the infection of dogs with the mongoose rabies biotype leads to dead end infections and this variant does not establish dog to dog transmission.

Our data further support the hypothesis that mongoose rabies, unlike canid rabies, is indigenous to southern Africa and due to the large genetic variations, this biotype has been circulating in the region for at least 150 years (Snyman, 1940; Nel *et al*., 2005). In

this regard, the clustering of the mongoose rabies viruses recovered from domestic dogs included in this investigation, were also found to conform to a pattern consistent with geographic origin (Nel *et al*., 2005). It was apparent that the branch lengths of the mongoose clusters are longer indicating greater genetic diversity within this biotype. With the attempted eradication or control of vector and host density (Snyman, 1940) epidemiological cycles of mongoose rabies still exist in the yellow mongoose and other herpestids. Control measures such as destruction of host vectors by poisonous gases are not feasible on ecological, economic or ethical grounds, whilst mass vaccination resulted in elimination of canine rabies (at least parts of Western Europe), parenteral administration in wildlife is not feasible. However, oral rabies vaccination using candidates such as ERA or VRG led to a virtual elimination of the disease in red foxes in Western Europe as well as other carnivores in North America (Blanton *et al*., 2007; Rupprecht *et al*., 2006). In South Africa, similar approaches could be adopted in an effort to control canine rabies.

Oral vaccination is one such approach that was used to control rabies in red foxes and raccoons in the Western Europe achieved a reduction in wildlife rabies (Cliquet and Aubert, 2004). In South Africa, though mongoose rabies is less of a public health threat than canid rabies, the social or habitat behaviour of the yellow mongooses may explain the spill over events to susceptible host species. Vaccine failures in humans have been reported against mongoose rabies virus strain after appropriate post-exposure prophylaxis (NICD, 2006). In the previous studies, it was reported that the current rabies vaccine does protect against rabies variants within phylogroup I (Hanlon *et al*., 2005; Nel, 2005), therefore vaccine failures against mongoose rabies variant which belongs to genotype 1 need to be investigated.

Canid rabies viruses recovered from domestic dogs from the FS province, Kwazulu-Natal, Eastern Cape, Mpumalanga and Lesotho were all shown to belong to a single genetic lineage, distinct to other lineages circulating in the northern regions of South Africa. The data generated from this study provided a clear evidence of a possible entry point of canine rabies from Lesotho into the FS province. Our findings highlights the

trans-border nature of rabies and that attention should be given to this during formulation of control strategies. Such trans-border transmission events involving hosts such as jackals or domestic dogs are particularly common in the eastern regions of South Africa across the border regions of Mozambique and Swaziland (Swanepoel *et al*., 1993). This suggests that similar cross border transmission events were responsible for the emergence of canid rabies biotype in the FS province. During the period of the study there was no evidence for the movement of infected animals between KZN (rabies endemic region) and the FS province. It was speculated that the Drakensburg and Maluti mountain ranges which divide the two provinces may act as barriers and prevent the movement of infected animals from KZN to FS province. If topographical features such as mountains and rivers have been shown to prevent the spread of rabies, such features could provide a valuable asset in the development of elimination strategies of rabies such as those successfully used to eliminate the disease from mountain valleys in Switzerland (Wandeler *et al*., 1988; Johnson *et al*., 2007). In this study it was shown that it took dog rabies approximately 12 years to spread from mountainous areas of Lesotho into the FS province of South Africa implying that the physical barrier provided by mountains between these two regions prevented the spread of the disease.

Chapter 6

Concluding Remarks

6.1 Conclusion

This study has contributed to the understanding of the molecular epidemiology of canine rabies and its spread into the FS province of South Africa. The data generated from this project has helped to clarify rabies epidemiology, however, in the future it could be pivotal in the formulation of surveillance and control strategies of the disease. The characterisation of rabies viruses demonstrated the close genetic relationships between viral isolates obtained from domestic dogs from the FS province and mountain kingdom of Lesotho suggesting one common epidemiological cycle in both regions. The new genetically compact canid rabies lineage in the FS province can easily spread between the 2 regions (FS province and Lesotho) via transportation or natural movement of infected animals. With the introduction of the new canid lineage and the close relationship between domestic dogs and humans in both rural and urban areas of the FS province, the public health burden to manage potential human exposures has increased.

Urbanisation and the movement of people across international borders especially in African countries due to socio-economical and political activities might play a pivotal role in the spread and transmission of the rabies virus where infected wildlife animals are not involved. Therefore strict control measures at the entry point of international borders as well as within a country are recommended to prevent such movements for purpose of controlling zoonotic diseases such as rabies. For instance, in South Africa in terms of transportation of pets a valid and most recent vaccination certificate should be provided when requested by veterinary personnel. This will eventually eliminate the transportation of infected animals across the borders or within provinces or states of a specific country. This study demonstrated free movement of pets or animals between borders and the value of multinational surveillance in understanding the epidemiology of rabies in a defined region of southern Africa.

The major findings of the project study

It was found that the unexpected increase of dog rabies cases was mainly due to an increased number of canid rabies viruses confirming observations of the antigenic characterisation and observation studies (OVI, unpublished data). It was also demonstrated that this compact canid rabies biotype was a new introduction into the FS province. It was concluded that canid rabies viruses from both FS province and those obtained from Lesotho belonged to one epidemiological cycle. The data suggested that the mountain kingdom of Lesotho was the entry point of canine rabies into the FS province which is still spreading and adapting in the domestic dogs of the FS province.

The study showed that the spill over of heterogeneous mongoose rabies biotype into dog host occurred infrequently and lead to dead end infection confirming the findings of previous studies (Nel *et al*., 2005; King *et al*., 1993). Therefore mongoose rabies remains of lesser veterinary public health priority in comparison to canid rabies biotype.

Recommended future studies

Sustained studies of molecular epidemiology are highly recommended in the future to monitor the new rabies virus lineages or variants that could emerge in the FS province. The dog ecology study could play an essential role in the control of rabies. The WHO (2004) reported that 70% vaccination coverage of dog population was shown to be sufficient to control and reduce the number of rabies cases in a particular locality. With this regard the dog population size in both FS province and Lesotho is not known and such studies are recommended.

A molecular epidemiological study of rabies in the mountain kingdom of Lesotho is suggested. The results obtained from this study showed that canid rabies viruses from both FS province and Lesotho have a mean nucleotide sequence homology of 99% indicating a single lineage circulating in both regions. Phylogenetic tree (Figure 4.1) showed two sub-clusters of cluster 1 as described in results section (part A) and sub-

cluster 1-2 consisted of a single isolate from Lesotho supported by a bootstrap of 86% suggesting a separate lineage. Therefore more rabies virus nucleotide sequences are required from this region to better understand the rabies epidemiology that will contribute in the formulation of control strategies of the disease in this region.

Although the results from this study indicated that mongoose rabies biotype is of lesser public and veterinary health importance than the canid rabies biotype, there are aspects of mongoose rabies that warrant further studies such as pathogenicity, vaccine failure and/or adaptation into dog host.

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APPENDIXES

Appendix 1. A panel of 16 antinucleocapsid monoclonal antibodies (N-MAbs) (Centre of Expertise for Rabies, Canadian Food Inspection Agency, Nepean, Ontario, Canada) for antigenic typing of rabies and rabies-related viruses identified in South Africa (table 1) and the reactivity patterns of mongoose and canid rabies biotypes (table 2).

Table 1. The monoclonal antibody panel (16 monoclonal antibody) for differentiating the rabies and rabies related viruses occurring in South Africa.

Monoclonal antibody	Canid	Mongoose	Lagos bat	Mokola	Duvenhage
1C5	-	-	-	-	-
26AB7	+++	var	-	-	-
26BE2	+++	var	-	-	-
32GD12	var	var	-	-	-
38HF2	+++	+++	+++	+++	+++
M612	-	-	+++	-	-
M837	-	-	-	-	+++
M850	-	var	-	-	+++
M853	+++	-	-	-	+++
M1001	-	-	-	+++	-
M1335	-	var	-	var	-
M1386	-	+++	-	-	-
M1400	-	var	-	-	-
M1407	+++	var	-	-	-
M1412	+++	var	-	-	-
M1494	-	var	-	-	+++

Table 2. The monoclonal antibody reactivity patterns differentiating between canid and mongoose rabies biotypes

Monoclonal antibody	425/06	327/05	357/05	418/06	593/06	956/06
1C5	-	-	-	-	-	-
26AB7	+++	+++	+++	+++	-	+++
26BE2	+++	+++	+++	+++	-	+++
32GD12	+++	+++	-	-	-	+++
38HF2	+++	+++	+++	+++	+++	+++
M612	-	-	-	-	-	-
M837	-	-	-	-	-	-
M850	-	-	-	+++	-	-
M853	+++	+++	-	-	-	-
M1001	-	-	-	-	-	-
M1335	-	-	-	-	+++	+++
M1386	-	-	+++	+++	+++	+++
M1400	-	-	+++	+++	+++	+++
M1407	+++	+++	+++	+++	-	+++
M1412	+++	+++	+++	+++	-	+++
M1494	-	-	+++	+++	+++	+++
Biotype	Canid	Canid	Mongoose	Mongoose	Mongoose	Mongoose

Key note: +++: positive reaction, - : no reaction, var: variable (sometimes the monoclonal antibody give either positive reaction or negative depending on rabies virus strain.

Appendix 2: Reactivity patterns of 12 antinucleocapsid monoclonal antibodies (N-MAbs) (Centre of Expertise for Rabies, Canadian Food Inspection Agency, Nepean, Ontario, Canada) for antigenic typing of rabies and rabies-related viruses. An old monoclonal antibodies panel used at OVI to differentiate lyssaviruses identified in southern Africa.

Biotype		**38HF2**	**M850**	**24FF11**	**26AB7**	**32GD1**	**32HD2**	**1C5**	**M853**	**M867**	**M879**	**M1005**	**M1407**
Canid	1	+++		+++	+++	+++	+++	-	+++	+++	+++	-	+++
	2	+++	-	+++	+++	-	+++	-	+++	+++	+++	-	+++
Herpestid	1	+++	-	+++	+++	-	+++	-	-	-	-	-	+++
	2	+++	-	+++	+++	+++	+++	-	-	-	-	-	+++
	3	+++	-	+++	-	-	+++	-	-	-	-	-	-
	4	+++	+	+++	+++	-	+++	-	-	-	-	-	+++
	5	+++	+++	+++	+++	-	+++	-	-	-	-	-	+++
	6	+++	+++	+++	+++	-	+++	-	-	-	-	-	-
Lagos bat		+++	-	-	-	-		-	-	-	-	+++	-
Mokola		+++	-	-	-	-		-	-	v	v	+++	-
Duvenhage		+++	+++	-	-	-	+++	-	+++	+++	+++	+++	-
SAD/SAG2		+++	-	+++	+++	+++	++	-	+++	-	-	-	-
CVS		+++	-	+++	+++	+++	+++	-	+++	-	-	-	-

Key note: +++: positive reaction, ++ or +: weak reaction, - : no reaction with particular monoclonal antibody, v: variable (sometimes the monoclonal antibody give either positive reaction or negative depending on rabies virus strain.

Appendix 3. Multiple sequence alignment of 592-bp nucleotide sequences of canid rabies viruses originating from Free State province South Africa and Lesotho. The nucleotide sequences starts at position 4665 to 5566 in relation to the binding positions of the primer set on the PV strain genome. Key note: green-canid rabies viruses from Free State province and pink-canid rabies viruses from Lesotho. This distance matrix was used to construct neighbour joining tree presented in Figure 4.1. The dots indicate positions of identity between the aligned sequences and reference sequence (PV).

PV	TCA	ATC	GAT	CGG	AAC	CTA	CAC	AAC	ACA	ATC	TCA	GAG	GGA	CAG	GGA	GGG
211/98	..C	G..	..C	.AA	.GT	.C.	.G.	...	...	G..	..G	...	...	...	.A.	T.A
142/00	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
641/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
653/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
549/00	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
511/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
544/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
851/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
03/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	.C.	..A
238/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
577/04	...	...	..C	.A.	.GT	...	.GA	...	G.C	G..	..G	...	...	...	...	..A
419/04	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
448/04	...	...	..C	.A.	..T	...	.GA	...	G..	G..	..G	...	...	...	...	..A
594/04	...	...	..C	.A.	.GT	...	.GA	...	G.C	G..	..G	...	...	...	...	..A
551/04	...	...	..C	.A.	.GT	...	.GA	...	G.C	G..	..G	...	...	...	...	..A
106/04	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
327/05	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
19/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
110/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
41/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
48/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
43/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
21/04	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
70/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
903/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
902/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
922/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
189/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
915/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
610/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
941/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
41/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
505/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
48/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
53/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
579/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
343/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
591/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
462/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
426/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
588/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
467/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
687/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
591/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
651/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
930/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
425/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
744/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
860/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
716/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
56/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
164/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
616/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
648/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
146/98	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
950/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
536/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
570/03	...	...	..C	.A.	..T	...	.GA	...	G..	G..	..G	...	...	...	...	..A
925/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
735/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
759/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
842/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A

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589/04 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
779/06 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
159/07 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
264/03 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
183/07 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
790/06 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
169/04 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
404/01 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
403/01 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
198/00 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
650/00 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
912/00 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
199/00 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
531/02 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
430/01 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
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785/03 ... ... ..C .A. .TT ... .GA ... G.. G.. ..G ... ... ... ... ..A
527/01 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
953/06 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
301/05 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
391/06 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
383/07 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
384/07 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A
385/07 ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A

PV     AGG TGT CAG TCA CTC CCC AAA GCG GGA AGA TCA TAT CTT CAT GGG AAT
211/98 ... ... ... ... ... ... ... ... .A. .AG ... ... ... .C. ... .G.
142/00 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
641/01 G.. ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
653/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
549/00 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
511/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
544/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
851/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
03/03  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
238/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
577/04 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
419/04 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
448/04 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
594/04 ... ... .G. ... ..T ... ... ... .-. ..G ..G ... ... ... ... .G.
551/04 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
106/04 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
327/05 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
19/03  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
110/06 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
41/06  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
48/06  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
43/06  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
21/04  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
70/01  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
903/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
902/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
922/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
189/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
915/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
610/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
941/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
41/02  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
505/02 G.. ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
48/03  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
53/02  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
579/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
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343/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
591/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
462/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
426/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
588/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
467/03 ... ... .G. ... ..T G.. ... ... ... ..G ..G ... ... ... ... .G.
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425/06 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
744/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
860/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
716/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
56/06  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
164/06 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
616/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
648/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
146/98 ... ... .G. ... ..T ... ..G ... ... ..G ... ... ... ... ... .G.
950/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
536/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
570/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
925/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
735/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
759/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
842/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
631/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
589/04 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
779/06 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
159/07 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
264/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
183/07 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
790/06 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
169/04 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
404/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
403/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
198/00 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
650/00 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
912/00 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
199/00 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
531/02 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
430/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
298/05 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
785/03 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
527/01 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
953/06 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
301/05 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
391/06 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
383/07 ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
384/07 ... ... .G. ... ..T ... ... ... ... ..G .TG ... ... ... ... .G.
385/07 ... ... .G. ... ..T ... ... ... ... ..G .TG ... ... ... ... .G.

PV     CAT ACA AGA GCG GGG GTG AGA CCG GAC TGT GAG AGC TGG CCG TCC TTT
211/98 ... .T. ... AA. .A. ... ... ..C ... ... ... G.. CT. T.. .T. ...
142/00 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
641/01 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
653/01 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
549/00 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
511/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
544/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
851/01 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
03/03  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
238/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
```

```
577/04 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
419/04 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
448/04 .T. .T. .A. .T. ... -.. ... .TA ... ... A.A ... ... T.A ... ...
594/04 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
551/04 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
106/04 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
327/05 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
19/03  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
110/06 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
41/06  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
48/06  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
43/06  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
21/04  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
70/01  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
903/01 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
902/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
922/01 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
189/01 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
915/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
610/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
941/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
41/02  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
505/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
48/03  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
53/02  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
579/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
343/02 .T. .T. .A. .T. ... ... ... .TA A.. ... A.A ... ... T.A ... ...
591/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
462/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
426/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
588/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
467/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
687/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
591/03 .T. .T. .A. ... ... ... ... .TA ... ... A.A ... ... T.A ... ...
651/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
930/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
425/06 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
744/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
860/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
716/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
56/06  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
164/06 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
616/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
648/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
146/98 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
950/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
536/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
570/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
925/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
735/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
759/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
842/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
631/02 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
589/04 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
779/06 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
159/07 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... C.. T.A ... ...
264/03 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
183/07 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
790/06 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
169/04 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
404/01 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
403/01 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
198/00 .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
```

650/00	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
912/00	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
199/00	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
531/02	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
430/01	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
298/05	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
785/03	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
527/01	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
953/06	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
301/05	.T.	.T.	.A.	.T.	.A.	...	...	.TA	...	...	A.A	...	...	T.A	...	...
391/06	.T.	.T.	.A.	.T.	.A.	...	...	.TA	...	...	A.A	...	...	T.A	...	...
383/07	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
384/07	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
385/07	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...

PV	CAA	CGA	TCC	AAG	TCC	TGA	AGA	TCA	CCT	CCC	CTT	GGG	GGG	TTC	-TT	TTT
211/98	.GG	...	.TT	..A	.AT	C..	...	C.G	...	...	AA.	...	ATC	AGA	TGG	GAA
142/00	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
641/01	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
653/01	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
549/00	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
511/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
544/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
851/01	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
03/03	...	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
238/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
577/04	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAG
419/04	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
448/04	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
594/04	.G.	..C	.T.	...	GT.	...	..G	...	...	...	..-	...	.TT	GGG	-GG	GAG
551/04	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAG
106/04	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
327/05	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
19/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
110/06	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
41/06	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	ATT	GGG	-GG	GAA
48/06	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
43/06	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
21/04	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
70/01	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
903/01	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
902/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
922/01	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
189/01	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
915/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
610/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
941/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
41/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
505/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
48/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
53/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
579/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
343/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
591/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
462/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
426/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
588/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
467/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
687/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
591/03	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
651/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
930/02	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	-GG	GAA
425/06	.G.	..C	.T.	...	.TT	...	..G	...	...	...	...	...	ATT	GGG	-GG	GAA

```
744/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
860/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
716/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
56/06  .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
164/06 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAG
616/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
648/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
146/98 .G. ..C .T. ... .T. ... ..G ... ... ..T ... ... .TT GGG -GG GAA
950/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
536/03 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
570/03 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
925/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
735/03 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
759/03 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
842/03 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
631/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
589/04 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... ATT GGG -GG GAA
779/06 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
159/07 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
264/03 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
183/07 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAG
790/06 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
169/04 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
404/01 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
403/01 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
198/00 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
650/00 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
912/00 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
199/00 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
531/02 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
430/01 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
298/05 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
785/03 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
527/01 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
953/06 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAG
301/05 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
391/06 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
383/07 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
384/07 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA
385/07 .G. ..C .T. ... .T. ... ..G ... ... ... ... ... .TT GGG -GG GAA

PV     GAA CTG GGT TCA ATA GTC CTC CTT GAA CTC CAT GCA ACT GGG TAG ATT
211/98 TCC .C. A.. ... ... .AT T.. ..C A.. ..T .G. .TG ..A .AA .G. ...
142/00 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
641/01 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
653/01 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
549/00 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
511/02 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
544/02 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
851/01 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
03/03  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
238/03 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
577/04 CCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
419/04 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
448/04 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
594/04 CCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
551/04 CCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
106/04 CCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
327/05 CCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
19/03  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
110/06 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
41/06  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
48/06  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
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```
43/06  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
21/04  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
70/01  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
903/01 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
902/03 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
922/01 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
189/01 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
915/03 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
610/02 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
941/03 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
41/02  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
505/02 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
48/03  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
53/02  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
579/02 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
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588/02 TCT ... A.C ... .C. ... ... ... ... ... ... ... ..A ... ... ...
467/03 CCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
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56/06  TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
164/06 CCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
616/02 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
648/02 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
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430/01 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
298/05 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... G.. ...
785/03 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
527/01 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
953/06 CCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
301/05 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
391/06 TCT ... A.. ... .C. ... ... ... ... ... ... ... ..A ... ... ...
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383/07	TCT	...	A..	...	.C.	...	...	...	...	...	...	...	..A	...	...	...
384/07	CCT	...	A..	...	.C.	...	...	...	...	...	...	...	..A	...	...	...
385/07	CCT	...	A..	...	.C.	...	...	...	...	...	...	...	..A	...	...	...

PV	CAA	GAG	TCA	TGA	GAT	TTT	CAT	TAA	TCC	TCT	CAG	TTG	ATC	AAG	CAA	GAT
211/98	.C.	...	...	C..	.G.	...	.T.	C..	..A	...	...	...	...	.GA	.TT	.G.
142/00	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
641/01	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
653/01	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
549/00	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
511/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
544/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
851/01	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
03/03	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
238/03	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
577/04	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
419/04	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
448/04	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
594/04	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
551/04	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
106/04	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
327/05	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
19/03	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
110/06	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
41/06	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
48/06	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
43/06	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
21/04	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
70/01	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
903/01	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
902/03	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
922/01	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
189/01	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
915/03	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
610/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
941/03	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
41/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
505/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
48/03	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
53/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
579/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
343/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
591/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
462/03	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
426/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
588/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
467/03	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
687/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
591/03	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
651/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
930/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
425/06	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
744/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
860/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
716/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
56/06	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
164/06	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
616/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
648/02	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
146/98	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
950/02	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
536/03	...	...	...	.A.	..C	...	...	...	..A	...	...	...	...	..A	...	.G.
570/03	...	...	...	...	..C	...	...	...	..A	...	...	...	...	..A	...	.G.

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925/02 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
735/03 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
759/03 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
842/03 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
631/02 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
589/04 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
779/06 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
159/07 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
264/03 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
183/07 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
790/06 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
169/04 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
404/01 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
403/01 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
198/00 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
650/00 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
912/00 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
199/00 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
531/02 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
430/01 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
298/05 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
785/03 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
527/01 ... ... ... .A. ..C ... ... ... ..A ... ... ... ... ..A ... .G.
953/06 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
301/05 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
391/06 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
383/07 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
384/07 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.
385/07 ... ... ... ... ..C ... ... ... ..A ... ... ... ... ..A ... .G.

PV     CAT GTA GAT TCT CAT AAT AGG GGA GAT CTT CTA GCA GTT TCA GTG ACT
211/98 ... ... .T. ... G.. ... .CA A.. AGC ... ..G ... AC. G.. T.. .TC
142/00 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
641/01 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
653/01 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
549/00 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
511/02 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
544/02 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
851/01 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
03/03  ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
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419/04 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
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536/03 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
570/03 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
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735/03 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
759/03 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
842/03 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
631/02 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
589/04 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
779/06 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
159/07 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
264/03 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
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404/01 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
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531/02 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
430/01 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C
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385/07 ... ..T ... ... ... ... .C. ... A.. ... ... ... ... ... ... ..C

PV     AAC GGT GCT TTC ATT CTC CAG GAA CTG ACA CCA ACA GTT GTA GAC AAA
211/98 ... ... ... ... ..C ... ..A ..G TGA .GG T.. .AG ..C ..G ... .GG
142/00 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
641/01 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
653/01 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
549/00 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
511/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
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544/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
851/01 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
03/03  ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
238/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
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19/03  ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
110/06 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
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21/04  ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
70/01  ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
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922/01 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
189/01 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
915/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
610/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
941/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
41/02  ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
505/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
48/03  ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
53/02  ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
579/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
343/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
591/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
462/03 ... ... ... ... ... ... .G. .G. ... .T. T.. .AG ... ... ... GGG
426/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
588/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
467/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
687/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
591/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
651/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
930/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
425/06 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
744/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
860/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
716/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
56/06  ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
164/06 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
616/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
648/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
146/98 ... ... ... ... ... ... ... .G. ... .TT T.. .AG ... ... ... TGG
950/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
536/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
570/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
925/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
735/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
759/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
842/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
631/02 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
589/04 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
779/06 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
159/07 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
264/03 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
183/07 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
790/06 ... ... ... ... ... ... ... .G. ... .T. T.. .AG ... ... ... GGG
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169/04	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
404/01	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
403/01	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
198/00	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
650/00	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
912/00	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
199/00	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
531/02	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
430/01	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
298/05	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
785/03	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
527/01	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
953/06	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
301/05	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
391/06	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
383/07	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
384/07	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG
385/07	...	...	...	...	...	...	...	.G.	...	.T.	T..	.AG	...	...	...	GGG

PV	TCA	CGG	GGT	GTC	TCA	GGT	GAT	TCT	GCG	CTT	GGG	CAC	AGA	CAA	AGG	TCA
211/98	C..	G..	...	A.T	G..	.A.	...	...	..A	..C	C..	...	.AG	..G	..A	.TG
142/00	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
641/01	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
653/01	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
549/00	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
511/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
544/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
851/01	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
03/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
238/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
577/04	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
419/04	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
448/04	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	T..	...	...	..G	..G	...	...
594/04	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
551/04	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
106/04	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
327/05	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	.GG	...	...
19/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
110/06	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
41/06	C..	A..	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
48/06	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
43/06	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
21/04	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
70/01	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
903/01	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
902/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	..C	...	...	..G	..G	...	...
922/01	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	..C	...	...	..G	..G	...	...
189/01	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
915/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
610/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
941/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
41/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
505/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
48/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
53/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
579/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
343/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
591/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
462/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
426/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
588/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...
467/03	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	...	..G	...	...
687/02	C..	A.A	...	A.T	..G	.A.	..C	..C	.T.	...	...	...	..G	..G	...	...

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591/03 C.. A.A ... A.T ..G .A. ..C ..C .T. ..C ... ... ..G ..G ... ...
651/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
930/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
425/06 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
744/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
860/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
716/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
56/06  C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
164/06 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
616/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
648/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
146/98 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
950/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
536/03 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
570/03 C.. A.A ... A.T ..G .A. ..C ..C .T. T.. ... ... ..G ..G ... ...
925/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
735/03 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
759/03 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
842/03 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
631/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
589/04 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
779/06 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
159/07 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
264/03 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
183/07 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
790/06 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
169/04 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
404/01 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
403/01 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
198/00 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
650/00 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
912/00 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
199/00 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
531/02 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
430/01 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
298/05 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
785/03 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
527/01 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ..G ..G ... ...
953/06 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
301/05 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... .TG ..G ... ...
391/06 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... .TG ..G ... ...
383/07 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
384/07 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...
385/07 C.. A.A ... A.T ..G .A. ..C ..C .T. ... ... ... ... ..G ... ...

PV     TGG TGT GTT CCA TGA TAG CGG ACT CAG GAT GAG TTA ATT GAG AGA GGC
211/98 .A. ..C A.C ..C ... .G. .AA ... ..A T.C ... .C. G.. ... .AG ...
142/00 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
641/01 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
653/01 .A. .AC .CC ..C .A. ... .A. ... ..A ... ... .CG ... ... ... ...
549/00 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
511/02 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
544/02 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
851/01 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
03/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
238/03 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
577/04 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
419/04 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... .G. ... ...
448/04 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
594/04 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
551/04 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
106/04 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
327/05 .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
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19/03   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
110/06  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
41/06   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
48/06   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
43/06   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
21/04   .A. .AC ..C ... .C. ... .A. ... ..A ... ... .CG ... ... ... ...
70/01   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
903/01  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... .G. ... ...
902/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
922/01  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
189/01  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
915/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
610/02  .A. .AC ..C ... ... ... .A. ... ..A ... ... .CG ... ... ... ...
941/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
41/02   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
505/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
48/03   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
53/02   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
579/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
343/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
591/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
462/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
426/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
588/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
467/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
687/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
591/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
651/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... .G. ... ...
930/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
425/06  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
744/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
860/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
716/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... .G. ... ...
56/06   .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
164/06  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
616/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
648/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
146/98  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... .A. ...
950/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
536/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
570/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
925/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
735/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
759/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
842/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... .G. ... ...
631/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
589/04  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
779/06  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... .G. ... ...
159/07  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... .G. ... ...
264/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
183/07  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
790/06  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... .G. ... ...
169/04  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
404/01  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
403/01  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
198/00  .A. .AC ..C ... .A. ... ... ... ..A ... ... .CG ... ... ... ...
650/00  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
912/00  .A. .AC A.C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
199/00  .A. .AC ..C ... .A. ... ... ... ..A ... ... .CG ... ... ... ...
531/02  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
430/01  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
298/05  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
785/03  .A. .AC ..C ... .A. ... .A. ... ..A ... ... .CG ... ... ... ...
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527/01	.A.	.AC	..C	...	.A.	...	.A.	...	..A	...	...	.CG	...	...	...	...
953/06	.A.	.AC	..C	...	.A.	...	.A.	...	..A	...	...	.CG	...	...	...	...
301/05	.A.	.AC	..C	...	.A.	...	.A.	...	..A	...	...	.CG	...	...	...	...
391/06	.A.	..C	..C	...	.A.	...	.A.	..C	..A	...	...	.CG	...	...	...	...
383/07	.A.	.AC	..C	...	.A.	...	.A.	...	..A	...	...	.CG	...	...	...	...
384/07	.A.	.AC	..C	...	.A.	...	.A.	...	..A	...	...	.CG	...	...	...	...
385/07	.A.	.AC	..C	...	.A.	...	.A.	...	..A	...	...	.CG	...	...	...	...

PV	AAT	CTT	CCT	CCC	GTG	AAG	GAC	ACA	AGC	AGT	AGC	TCA	CAA	TCA	TCT	CGT
211/98	.CC	T.G	..G	...	A..	...	.G.	.T.	...	CA.	..A	...	...	...	..G	T.C
142/00	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
641/01	...	..G	...	...	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
653/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
549/00	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
511/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
544/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
851/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
03/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
238/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
577/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	..C	.T.	T.C
419/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
448/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
594/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
551/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
106/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
327/05	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
19/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
110/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
41/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
48/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
43/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
21/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
70/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
903/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
902/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
922/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
189/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
915/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
610/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
941/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
41/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
505/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
48/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
53/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
579/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
343/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
591/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
462/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
426/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
588/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
467/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
687/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
591/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
651/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
930/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
425/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
744/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
860/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
716/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
56/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
164/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
616/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
648/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C

146/98	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	..C	T.C
950/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
536/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
570/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
925/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
735/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
759/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
842/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
631/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
589/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
779/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
159/07	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
264/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
183/07	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
790/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
169/04	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
404/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
403/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
198/00	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
650/00	...	.CG	...	..A	A..	...	...	...	...	.AC	...	...	TG.	...	.TC	T.C
912/00	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
199/00	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
531/02	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
430/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
298/05	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
785/03	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
527/01	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
953/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
301/05	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
391/06	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
383/07	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
384/07	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C
385/07	...	..G	...	..A	A..	...	...	.T.	...	.A.	...	...	TG.	...	.T.	T.C

PV	GTT	TCA	GCA	AAG	TGT	GCA	TAA	TTA	TAA	AGT	GCT	GGG	TCA	TCT	AAG	CTT
211/98	A.C	...	T..	...	C..	...	...	C..	C..	..G	...	...	...	C..	.GA	...
142/00	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
641/01	A.C	.T.	..G	..T	...	...	...	...	...	..G	...	...	..-	...	...	...
653/01	A.C	.T.	..G	.GT	...	...	...	...	...	..G	...	...	...	...	...	...
549/00	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
511/02	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
544/02	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
851/01	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
03/03	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
238/03	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
577/04	T.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
419/04	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
448/04	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
594/04	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
551/04	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
106/04	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
327/05	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
19/03	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
110/06	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
41/06	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
48/06	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
43/06	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
21/04	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
70/01	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
903/01	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
902/03	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
922/01	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...
189/01	A.C	.T.	...	..T	...	...	...	...	...	..G	...	...	...	...	...	...

```
915/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
610/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
941/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
41/02  A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
505/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
48/03  A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
53/02  A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
579/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
343/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
591/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
462/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
426/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
588/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
467/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
687/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
591/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
651/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
930/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
425/06 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
744/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
860/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
716/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
56/06  A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
164/06 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
616/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
648/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
146/98 A.C ... ... ..T ... ... ... ... ... ..G ... ... A.. ... ... ...
950/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
536/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
570/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
925/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
735/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
759/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
842/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
631/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
589/04 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
779/06 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
159/07 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
264/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
183/07 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
790/06 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
169/04 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
404/01 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
403/01 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
198/00 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
650/00 A.C ... ... ..T ... ... C.. .C. C.. ..G ... ... ... ... ... ...
912/00 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
199/00 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
531/02 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
430/01 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
298/05 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
785/03 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
527/01 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
953/06 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
301/05 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
391/06 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
383/07 A.C ... ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
384/07 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
385/07 A.C .T. ... ..T ... ... ... ... ... ..G ... ... ... ... ... ...
```

PV	TTC	AGT	CGA	GAA	AAA	A-
211/98	.C.	.AC	...	...	...	.A
142/00	...	...	...	...	...	.A
641/01	...	...	...	...	...	.A
653/01	...	...	...	...	...	.A
549/00	...	...	...	...	...	.A
511/02	...	...	...	...	...	.A
544/02	...	...	...	...	...	.A
851/01	...	...	...	...	...	.A
03/03	...	...	...	...	...	.A
238/03	...	...	...	...	...	.A
577/04	...	...	...	...	...	.A
419/04	...	...	...	...	...	.A
448/04	...	...	...	...	...	.A
594/04	...	...	...	...	...	.A
551/04	...	...	...	...	...	.A
106/04	...	...	...	...	...	.A
327/05	...	...	...	...	...	.A
19/03	...	...	...	...	...	.A
110/06	...	...	...	...	...	.A
41/06	...	...	...	...	...	.A
48/06	...	...	...	...	...	.A
43/06	...	...	...	...	...	.A
21/04	...	...	...	...	...	.A
70/01	...	...	...	...	...	.A
903/01	...	...	...	...	...	.A
902/03	.-.	...	...	...	...	.A
922/01	...	...	...	...	...	.A
189/01	...	...	...	...	...	.A
915/03	...	...	...	...	...	.A
610/02	...	...	...	...	...	.A
941/03	...	...	...	...	...	.A
41/02	...	...	...	...	...	.A
505/02	...	...	...	...	...	.A
48/03	...	...	...	...	...	.A
53/02	...	...	...	...	...	.A
579/02	...	...	...	...	...	.A
343/02	...	...	...	...	...	.A
591/02	...	...	...	...	...	.A
462/03	...	...	...	...	...	.A
426/02	...	...	...	...	...	.A
588/02	...	...	...	...	...	.A
467/03	...	...	...	...	...	.A
687/02	...	...	...	...	...	.A
591/03	...	...	...	...	...	.A
651/02	...	...	...	...	...	.A
930/02	...	...	...	...	...	.A
425/06	...	...	...	...	...	.A
744/02	...	...	...	...	...	.A
860/02	...	...	...	...	...	.A
716/02	...	...	...	...	...	.A
56/06	...	...	...	...	...	.A
164/06	...	...	...	...	...	.A
616/02	...	...	...	...	...	.A
648/02	...	...	...	...	...	.A
146/98	...	...	.A.	...	...	.A
950/02	...	...	...	...	...	.A
536/03	...	...	...	...	...	.A
570/03	...	...	...	...	...	.A
925/02	...	...	...	...	...	.A
735/03	...	...	...	...	...	.A
759/03	...	...	...	...	...	.A
842/03	...	...	...	...	...	.A

```
631/02 ... ... ... ... ... .A
589/04 ... ... ... ... ... .A
779/06 ... ... ... ... ... .A
159/07 ... ... ... ... ... .A
264/03 ... ... ... ... ... .A
183/07 ... ... ... ... ... .A
790/06 ... ... ... ... ... .A
169/04 ... ... ... ... ... .A
404/01 ... ... ... ... ... .A
403/01 ... ... ... ... ... .A
198/00 ... ... ... ... ... .A
650/00 ... ... ... ... ... .A
912/00 ... ... ... ... ... .A
199/00 ... ... ... ... ... .A
531/02 ... ... ... ... ... .A
430/01 ... ... ... ... ... .A
298/05 ... ... ... ... ... .A
785/03 ... ... ... ... ... .A
527/01 ... ... ... ... ... .A
953/06 ... ... ... ... ... .A
301/05 ... ... ... ... ... .A
391/06 ... ... ... ... ... .A
383/07 ... ... ... ... ... .A
384/07 ... ... ... ... ... .A
385/07 ... ... ... ... ... .A
```

Appendix 4. A multiple sequence alignment of 592-bp nucleotide sequences of rabies viruses originating from different districts in the Free State province. The nucleotide sequences starts at position 4665 to 5566 in relation to the binding positions of the primer set on the PV strain genome. This distance matrix was used to construct a phylogenetic tree presented in Figure 4.4. The dots indicates positions of identity between the aligned sequences and the reference sequence (PV).

PV	TCA	ATC	GAT	CGG	AAC	CTA	CAC	AAC	ACA	ATC	TCA	GAG	GGA	CAG	GGA	GGG	AGG	TGT
211/98	..C	G..	..C	.AA	.GT	.C.	.G.	...	...	G..	..G	...	...	...	.A.	T.A	...	...
475/96	..C	...	..C	GA.	..T	.C.	A..	...	...	G..	.T.	...	...	...	A..	..A	...	...
749/96	..C	...	..C	GA.	..T	.C.	A..	...	...	G..	...	...	.A.	...	A..	..A	...	...
559/98	..C	...	..C	GA.	..T	.C.	A..	...	...	G..	.T.	...	...	...	A..	..A	...	...
600/96	..C	...	..C	GA.	GGT	.C.	A..	...	...	G..	...	...	...	...	A..	..A	...	...
291/95	..C	G..	..C	.A.	...	.C.	A..	...	..C	GC.	...	...	...	...	A..	A.A	...	..G
828/99	..C	...	..C	GA.	..T	.C.	A..	...	...	G..	...	...	.A.	...	A..	..A	...	...
808/95	..C	...	..C	GA.	.GT	.C.	AG.	...	...	G..	...	...	...	...	A..	..A	...	...
1003/99	..C	...	..C	GA.	..T	.C.	AG.	...	...	G..	...	...	...	...	A..	..A	...	...
756/99	..C	...	..C	GA.	..T	.C.	AG.	...	...	G..	...	...	...	...	A..	..A	...	...
142/00	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
641/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	G..	...
653/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
1078/97	..C	G..	..C	.A.	...	.C.	A..	...	..C	GC.	...	...	...	...	A..	A.A	...	..G
1039/99	..C	...	..C	GA.	..T	.C.	AG.	G..	...	G..	...	...	...	...	A..	..A	...	...
549/00	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
568/00	..C	...	..C	GA.	..T	.C.	AG.	...	...	G..	...	...	...	...	A..	..A	...	...
229/02	..C	...	..C	GA.	.GT	.C.	AG.	...	...	G..	...	...	...	...	A..	..A	...	...
511/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
544/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
851/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
106/03	..C	...	..C	GA.	..T	.C.	A..	...	...	G..	.T.	...	...	...	A..	..A	...	...
03/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	.C.	..A	...	...
18/03	..C	...	..C	G..	.GT	.C.	A..	...	...	G..	...	...	...	...	A..	..A	...	...
238/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
577/04	...	...	..C	.A.	.GT	...	.GA	...	G.C	G..	..G	...	...	...	...	..A	...	...
419/04	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
448/04	...	...	..C	.A.	..T	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
594/04	...	...	..C	.A.	.GT	...	.GA	...	G.C	G..	..G	...	...	...	...	..A	...	...
551/04	...	...	..C	.A.	.GT	...	.GA	...	G.C	G..	..G	...	...	...	...	..A	...	...
88/04	..C	...	..C	GA.	..T	.C.	AG.	C..	...	G..	...	...	...	...	A..	..A	...	...
106/04	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
302/05	..T	...	T.C	GA.	..T	.C.	A..	...	...	G..	.T.	...	...	...	A..	..A	...	...
319/05	..C	...	..C	GA.	..T	.C.	A..	...	...	G..	.T.	...	...	...	A..	..A	...	...
327/05	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
19/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
110/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
41/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
385/06	..C	...	..C	GA.	..T	.C.	AG.	...	...	G..	...	...	...	.G.	A..	..A	...	...
48/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
43/06	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
21/04	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
70/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
903/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
902/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
922/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
114/02	..C	...	..C	GA.	..T	.C.	AG.	C..	...	G..	...	...	...	...	A..	..A	...	...
189/01	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
915/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
610/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
941/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
41/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
505/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	G..	...
48/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
53/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
101/01	..C	...	..C	GA.	..T	.C.	A..	G..	...	G..	...	...	...	...	A..	..A	...	...
579/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
343/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
591/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
462/03	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
426/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...
588/02	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A	...	...

```
467/03   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
329/02   ..C ... ..C GA. ..T .C. A.. ... ... G.T .T. ... ... ... A.. ..A ... ...
687/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
591/03   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
651/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
930/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
425/06   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
744/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
860/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
716/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
56/06    ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
164/06   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
123/04   ..C ... ..C .A. ... .C. A.. ... ..C GC. ... ... A.. ... A.. ..A ... ..G
616/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
648/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
146/98   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
950/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
536/03   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
570/03   ... ... ..C .A. ..T ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
357/05   ..C ... ..C GA. .GT .C. AG. ... ... G.. ... ... ... ... A.. ..A ... ...
1050/06  ..C ... ..C GA. ..T .C. A.. ... ... G.. ... ... ... ... A.. ..A ... ...
472/98   ..C ... ..C GA. ..T .C. A.. ... ... G.. ... ... ... ... A.. ..A ... ...
925/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
735/03   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
759/03   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
842/03   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
631/02   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
589/04   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
779/06   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
159/07   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
264/03   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
568/02   ..C ... ..C GA. ..T .C. AG. ... ... G.. ... ... ... .G. A.. ..A ... ...
183/07   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
790/06   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...
164/04   ... ... ..C .A. .GT ... .GA ... G.. G.. ..G ... ... ... ... ..A ... ...

PV       CAG TCA CTC CCC AAA GCG GGA AGA TCA TAT CTT CAT GGG AAT CAT ACA AGA GCG
211/98   ... ... ... ... ... ... .A. .AG ... ... ... .C. ... .G. ... .T. ... AA.
475/96   .G. ... .CT ... ... -.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
749/96   .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
559/98   .G. ... .CT ... ... A.. .A. .AG C.. ... .C. ... ... .G. ... ... ... A..
600/96   .G. ... .AT ..A ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
291/95   .G. ... .C. ... ... ... .A. .AG C.. ... .C. .C. ... .G. ... ... ... A..
828/99   .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
808/95   .G. ... TCT ... ... A.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
1003/99  .G. ... .CT ... ... A.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... ATA
756/99   .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
142/00   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
641/01   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
653/01   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
1078/97  .G. ... .C. ... ... ... .A. .AG C.. ... .C. .C. ... .G. ... ... ... A..
1039/99  .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
549/00   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
568/00   .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
229/02   .G. ... TCT ... ... A.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
511/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
544/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
851/01   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
106/03   .G. ... .CT .T. ... A.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
03/03    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
18/03    .G. ... TCT ... ... A.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
238/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
577/04   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
```

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419/04   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
448/04   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
594/04   .G. ... ..T ... ... ... .-. ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
551/04   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
88/04    .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
106/04   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
302/05   .G. ... .CT ... ... A.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
319/05   .G. ... ..T ... ... A.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
327/05   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
19/03    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
110/06   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
41/06    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
385/06   .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
48/06    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
43/06    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
21/04    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
70/01    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
903/01   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
902/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
922/01   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
114/02   .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
189/01   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
915/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
610/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
941/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
41/02    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
505/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
48/03    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
53/02    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
101/01   .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
579/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
343/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
591/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
462/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
426/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
588/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
467/03   .G. ... ..T G.. ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
329/02   .G. ... .CT ... ... A.. .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
687/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
591/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. ...
651/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
930/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
425/06   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
744/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
860/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
716/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
56/06    .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
164/06   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
123/04   .G. .T. .CT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... ... ... A..
616/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
648/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
146/98   .G. ... ..T ... ..G ... ... ..G ... ... ... ... ... .G. .T. .T. .A. .T.
950/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
536/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
570/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
357/05   .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
1050/06  .G. ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
472/98   ... ... .AT ... ... ... .A. .AG C.. ... .C. ... ... .G. ... .T. ... A..
925/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
735/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
759/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
842/03   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
631/02   .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G. .T. .T. .A. .T.
```

589/04	.G.	...	..T	...	...	...	...	..G	..G	...	...	...	...	.G.	.T.	.T.	.A.	.T.
779/06	.G.	...	..T	...	...	...	...	..G	..G	...	...	...	...	.G.	.T.	.T.	.A.	.T.
159/07	.G.	...	..T	...	...	...	...	..G	..G	...	...	...	...	.G.	.T.	.T.	.A.	.T.
264/03	.G.	...	..T	...	...	...	...	..G	..G	...	...	...	...	.G.	.T.	.T.	.A.	.T.
568/02	.G.	...	.AT	...	...	...	.A.	.AG	C..	...	.C.	...	...	.G.	...	.T.	...	A..
183/07	.G.	...	..T	...	...	...	...	..G	..G	...	...	...	...	.G.	.T.	.T.	.A.	.T.
790/06	.G.	...	..T	...	...	...	...	..G	..G	...	...	...	...	.G.	.T.	.T.	.A.	.T.
164/04	.G.	...	..T	...	...	...	...	..G	..G	...	...	...	...	.G.	.T.	.T.	.A.	.T.

PV	GGG	GTG	AGA	CCG	GAC	TGT	GAG	AGC	TGG	CCG	TCC	TTT	CAA	CGA	TCC	AAG	TCC	TGA
211/98	.A.	...	...	..C	...	...	...	G..	CT.	T..	.T.	...	.GG	...	.TT	..A	.AT	C..
475/96	..A	...	.A.	..A	..A	...	...	G..	...	T.A	.T.	...	.G.	T.C	.AT	T..	.TT	..G
749/96	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	..C	AG.	T.C	.TT	T..	..T	..G
559/98	..A	...	.C.	..A	..A	...	...	G..	...	T.A	.T.	...	.G.	T.C	.TT	T..	.TT	..G
600/96	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.T	.TT	T..	..T	..G
291/95	...	...	...	..A	..A	...	...	G..	C..	T..	CT.	...	.G.	..C	.TT	...	..T	.AG
828/99	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	..C	AG.	T.C	.TT	T..	.TT	..G
808/95	..A	...	.C.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.C	.TT	T.T	..T	..G
1003/99	..A	...	.C.	..A	..A	...	..A	G..	C..	T.A	.T.	...	.G.	T.C	.TT	T.T	..T	..G
756/99	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.C	.TT	C..	..T	..G
142/00	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
641/01	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
653/01	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
1078/97	...	...	...	..A	..A	...	...	G..	C..	T..	CT.	...	.G.	..C	.TT	...	..T	.AG
1039/99	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.C	.TT	T..	..T	..G
549/00	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
568/00	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.C	.TT	T..	..T	..G
229/02	..A	...	.C.	..A	..A	...	...	G..	CA.	T.A	.T.	...	.G.	T.C	.TT	T.T	..T	..G
511/02	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
544/02	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
851/01	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
106/03	..A	...	.A.	..A	..A	...	...	G..	..A	T.A	.T.	...	.G.	T.C	.TT	T..	.TT	..G
03/03	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	...	..C	.T.	...	.T.	...
18/03	..A	...	.C.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.C	.TT	T.T	..T	..G
238/03	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
577/04	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
419/04	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
448/04	...	-..	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
594/04	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	GT.	...
551/04	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
88/04	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.C	.TT	T..	..T	..G
106/04	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
302/05	..A	...	.A.	..A	..A	...	...	G..	...	T.A	.T.	...	.G.	T.C	.TT	T..	.TT	..G
319/05	..A	...	.A.	..A	..A	...	...	G..	...	T.A	.T.	...	.G.	T.C	.TT	T..	.TT	..G
327/05	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
19/03	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
110/06	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
41/06	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
385/06	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.C	.TT	T..	..T	..G
48/06	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
43/06	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
21/04	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
70/01	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
903/01	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
902/03	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
922/01	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
114/02	..A	...	.A.	..A	..A	...	...	G..	C..	T.A	.T.	...	.G.	T.C	.TT	T..	..T	..G
189/01	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
915/03	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
610/02	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
941/03	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
41/02	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...
505/02	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...	.G.	..C	.T.	...	.T.	...

```
48/03    ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
53/02    ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
101/01   ..A ... .A. ..A ..A ... ... G.. C.. T.A .T. ... .G. T.C .TT T.. ..T ..G
579/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
343/02   ... ... ... .TA A.. ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
591/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
462/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
426/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
588/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
467/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
329/02   ..A ... .C. ..A ..A ... ... G.. CT. T.A .T. .C. .G. T.C .TT T.T ... ..G
687/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
591/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
651/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
930/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
425/06   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .TT ...
744/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
860/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
716/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
56/06    ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
164/06   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
123/04   ... ... .A. ..A ..A ... ... G.. CA. T.. .T. ... .G. ..C .TT ... ..T .AG
616/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
648/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
146/98   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
950/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
536/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
570/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
357/05   ..A ... .A. ..A ..A ... ... G.. C.. ..A .T. ... .G. T.C .TT T.. ..T ..G
1050/06  ..A ... .A. ..A ..A ... ... G.. C.. T.A .T. ... .G. T.C .TT T.. ..T ..G
472/98   ..A ... .A. ..A ..A ... ... G.. C.. T.A .T. ... .G. T.C .TT T.. ..T ..G
925/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
735/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
759/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
842/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
631/02   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
589/04   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
779/06   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
159/07   ... ... ... .TA ... ... A.A ... C.. T.A ... ... .G. ..C .T. ... .T. ...
264/03   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
568/02   ..A ... .A. ..A ..A ... ... G.. C.. T.A .T. ... .G. T.C .TT T.. ..T ..G
183/07   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
790/06   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...
164/04   ... ... ... .TA ... ... A.A ... ... T.A ... ... .G. ..C .T. ... .T. ...

PV       AGA TCA CCT CCC CTT GGG GGG TTC TTT --T TGA ACT GGG TTC AAT AGT CCT CCT
211/98   ... C.G ... ... AA. ... ATC AGA .GG G-A ATC C.C .A. ... ... ..A TT. ...
475/96   ..G ... TT. ... TC. ... .TT AAG GGG G-A ATC T.A .A. ... ..C .AA ... ...
749/96   ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
559/98   ..G ... ... ... .C. ... ATT AAG GGG GAA ATC T.A .A. ... ..C .AA ... ...
600/96   ..G ... T.. ... .C. .A. .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
291/95   ..G .T. T.. .A. .C. ..A .TT AAG GGG --A GTC T.A .A. ... ... ..A ... .T.
828/99   ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
808/95   ..G ... T.. ... .C. ... .TT AAG GGG GGA ACC T.A .A. ... TG. .AA ... ...
1003/99  ..G ... T.. ... .C. ... .TT AAG .GG GGA ATC T.A .A. C.T ... GAA ... ...
756/99   ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
142/00   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
641/01   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
653/01   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
1078/97  ..G .T. T.. .A. .C. ..A .TT AAG GGG --A GTC T.A .A. ... ... ..A ... .T.
1039/99  ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
549/00   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
568/00   ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
```

```
229/02  ..G ... T.. ... .C. ... .TT AAG GGG GGA ACC T.A .A. ... TG. .AA ... ...
511/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
544/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
851/01  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
106/03  ..G ... TT. ... TC. ... .TT AAG GGG G-A ATC T.A .A. ... ..C .AA ... ...
03/03   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
18/03   ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... ... .AA ... ...
238/03  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
577/04  ..G ... ..C T.. ... ... .TT GGG GGG --A GCC T.. .A. ... ..C ... ... ...
419/04  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
448/04  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
594/04  ..G ... ..- T.. .C. ... .TT GGG GGG --A GCC T.. .A. ... ..C ... ... ...
551/04  ..G ... ... ... ... ... .TT GGG GGG --A GCC T.. .A. ... ..C ... ... ...
88/04   ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
106/04  ..G ... ... ... ... ... .TT GGG GGG --A ACC T.. .A. ... ..C ... ... ...
302/05  ..G ... TT. ... TC. ... .TT AAG GGG GGA ATC T.A .A. ... ..C .AA ... ...
319/05  ..G ... TT. ... TC. ... .TT AAG GGG GGA ATC T.A .A. ... ..C .AA ... ...
327/05  ..G ... ... ... ... ... .TT GGG GGG --A ACC T.. .A. ... ..C ... ... ...
19/03   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
110/06  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
41/06   ..G ... ... ... ... ... ATT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
385/06  ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.C .AA ... ...
48/06   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
43/06   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
21/04   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
70/01   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
903/01  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
902/03  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
922/01  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
114/02  ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
189/01  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
915/03  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
610/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
941/03  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
41/02   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
505/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
48/03   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
53/02   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
101/01  ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
579/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
343/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
591/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
462/03  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
426/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
588/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. C.. ..C ... ... ...
467/03  ..G ... ... ... ... ... .TT GGG GGG --A ACC T.. .A. ... ..C ... ... ...
329/02  ..G ... T.C ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... ... .AA ... ...
687/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
591/03  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
651/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
930/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ..C ... ...
425/06  ..G ... ... ... ... ... ATT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
744/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
860/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
716/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
56/06   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
164/06  ..G ... ... ... ... ... .TT GGG GGG --A GCC T.. .A. ... ..C ... ... ...
123/04  ..G .T. T.. ... .C. ... .TT AAG GGG --A GTC TTA .A. ... ... ..A ... ...
616/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
648/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
146/98  ..G ... ... ..T ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
950/02  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
536/03  ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
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570/03   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
357/05   ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
1050/06  ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
472/98   ..G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.. .AA ... ...
925/02   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
735/03   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
759/03   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
842/03   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
631/02   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
589/04   ..G ... ... ... ... ... ATT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
779/06   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
159/07   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
264/03   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
568/02   G.G ... T.. ... .C. ... .TT AAG GGG GGA ATC T.A .A. ... G.C .AA ... ...
183/07   ..G ... ... ... ... ... .TT GGG GGG --A GCC T.. .A. ... ..C ... ... ...
790/06   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...
164/04   ..G ... ... ... ... ... .TT GGG GGG --A ATC T.. .A. ... ..C ... ... ...

PV       TGA ACT CCA TGC AAC TGG GTA GAT TCA AGA GTC ATG AGA TTT TCA TTA ATC CTC
211/98   CA. ... T.G ..T G.. A.A A.G ... ..C ... ... .C. ..G ... ..T .C. ... A..
475/96   CA. ... T.G ..T ... A.. ... ... ..C ... ... .C. .AG ... ..T .C. ... A..
749/96   CA. ... TTG ..T ... A.. .C. ... ..C .A. A.. .C. .AG ... ..C .C. ... A..
559/98   CA. ... T.G ..T ... A.. .G. ... ..C ... ... .C. .AG ... ..T .C. ... A..
600/96   CA. ... TTG ..T ... A.. ... ... ..C .A. A.. .C. .AG ... ..T .C. ... A..
291/95   CA. ... T.G ..T C.. A.. ... ... ..C ... ... .C. ..G ... ..T .C. ... A..
828/99   CA. ... TTG ..T ... A.. ... ... ..C .A. A.. .C. .AG ... ..C .C. ... A..
808/95   CAG ... T.G ..T ... A.. ... ... .TC ... ... .C. .AG ... ..T .C. ... A..
1003/99  CA. G.. T.G ..T ... A.. ... ... ..C ... ... .C. .AG C.. ..T .C. ... A..
756/99   CA. ..C TTG ..T ... A.. ... ... ..C GA. A.. .C. .AG ... ..T .C. ... A..
142/00   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
641/01   ... ... ... ... ... A.. ... ... ... ... ... ..A ... C.. ... ... ... A..
653/01   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
1078/97  CA. ... T.G ..T C.. A.. ... ... ..C ... ... .C. ..G ... ..T .C. ... A..
1039/99  CA. ... TTG C.T ... A.. ... ... ..C GA. A.. .C. .AG ... ..T .C. ... A..
549/00   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
568/00   CA. ... TTG ..T ... A.. ... ... ..C GA. A.. .C. .AG ... ..T .C. ... A..
229/02   CAG ... T.G ..T ... A.. ... ... .TC ... ... .C. .AG ... ..T .C. ... A..
511/02   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
544/02   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
851/01   ... ... ... ... ... A.. ... ... ... ... ... ..A ... C.. ... ... ... A..
106/03   CA. ... T.G ..T ... A.. ... ... ..T ... ... .C. .AG ... ..T .C. ... A..
03/03    ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
18/03    CAG ... T.G ..T ... A.. ... ... ..C ... ... .C. .AG .C. ..T .C. ... A..
238/03   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
577/04   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
419/04   ... ... ... ... ... A.. ... ... ... ... ... ..A ... C.. ... ... ... A..
448/04   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
594/04   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
551/04   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
88/04    CA. ..C TTG ..T ... A.. ... ... ..C GA. A.. .C. .AG ... ..T .C. ... A..
106/04   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
302/05   CA. ... T.G ..T ... A.. ... ... ..C ... ... .C. .AG ... ..T .C. ... A..
319/05   CA. ... T.G ..T ... A.. ... ... ..C ... ... .C. .AG ... ..T .C. ... A..
327/05   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
19/03    ... ... ... ... ... A.. ... ... ... ... ... ..A ... C.. ... ... ... A..
110/06   ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
41/06    ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
385/06   CA. ... TTG ..T ... A.. ... ... ..C GA. A.. .C. GAG ... ..T .C. ... A..
48/06    ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
43/06    ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
21/04    ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
70/01    ... ... ... ... ... A.. ... ... ... ... ... ... ... C.. ... ... ... A..
903/01   ... ... ... ... ... A.. ... ... ... ... ... ..A ... C.. ... ... ... A..
```

902/03	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
922/01	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
114/02	CA.	..C	TTG	..T	...	A..	...	...	..C	GA.	A..	.C.	.AG	...	..T	.C.	...	A..
189/01	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
915/03	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
610/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
941/03	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
41/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
505/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
48/03	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
53/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
101/01	CA.	...	TTG	C.T	...	A..	...	...	..C	GA.	A..	.C.	.AG	...	..T	.C.	...	A..
579/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
343/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
591/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
462/03	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
426/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
588/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
467/03	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
329/02	CA.	...	T.G	...	...	A..	...	...	..C	...	...	GC.	.AG	...	..T	.C.	...	A..
687/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
591/03	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
651/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
930/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
425/06	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
744/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
860/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
716/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
56/06	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
164/06	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
123/04	CA.	...	TT.	.AT	..T	A..	...	...	..T	...	...	.C.	..G	..C	..T	.C.	...	A..
616/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
648/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
146/98	C..	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
950/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
536/03	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
570/03	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
357/05	CA.	..C	TTG	..T	...	A..	...	...	..C	GA.	A..	.C.	.AG	...	..T	.C.	...	A..
1050/06	CA.	...	TTG	..T	...	A..	...	...	..C	GA.	A..	.C.	.AG	...	..T	.C.	...	A..
472/98	CA.	...	TTG	..T	...	A..	...	...	..C	.A.	A..	.C.	.AG	...	..T	.C.	...	A..
925/02	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
735/03	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
759/03	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
842/03	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
631/02	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
589/04	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
779/06	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
159/07	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
264/03	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
568/02	CA.	...	TTG	..T	...	A..	...	...	..C	GA.	A..	.C.	GAG	...	..T	.C.	...	A..
183/07	...	...	...	...	...	A..	...	...	...	...	...	...	...	C..	...	...	...	A..
790/06	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..
164/04	...	...	...	...	...	A..	...	...	...	...	...	..A	...	C..	...	...	...	A..

PV	TCA	GTT	GAT	CAA	GCA	AGA	TCA	TGT	AGA	TTC	TCA	TAA	TAG	GGG	AGA	TCT	TCT	AGC
211/98	...	...	...	..G	A.T	T.G	...	...	..T	...	.G.	...	..C	AA.	.AG	C..	...	G..
475/96	...	...	...	..G	A..	G.G	...	...	...	...	.T.	..G	..C	.A.	.A.	...	...	G..
749/96	...	...	...	..G	A..	..G	..G	...	...	...	.T.	..G	..C	.A.	.A.	...	...	G..
559/98	...	...	...	..G	A..	..G	..G	...	...	...	.T.	..G	..C	.A.	.A.	...	...	G..
600/96	...	...	...	..G	A..	..G	...	...	...	..T	.T.	..G	..C	.A.	.A.	...	...	G..
291/95	...	...	...	..G	A..	..G	...	...	...	...	.T.	...	..C	AA.	.AG	C..	...	G..
828/99	...	...	...	..G	A..	..G	..G	...	...	...	.T.	..G	..C	.A.	.A.	...	...	G..
808/95	...	...	...	..G	A..	..G	..G	...	G..	...	.T.	..G	..C	.A.	.A.	...	...	G..

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1003/99 ... ... ... ..G A.. ..G ..G ... ... ... .T. ..G ..C .A. .A. ... ... G..
756/99  ... ... ... ..G A.. ..G ..G ... ... ..T .T. ..G ..C .A. .A. ... ... G..
142/00  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
641/01  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
653/01  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
1078/97 ... ... ... ..G A.. ..G ... ... ... ... .T. ... ..C AA. .AG C.. ... G..
1039/99 ... ... ... ..G A.. ..G ..G ... ... ..T .T. ..G ..C .A. .A. ... ... G..
549/00  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
568/00  ... ... ... ..G A.. ..G ..G ... ... ..T .T. ..G ..C .A. .A. ... ... G..
229/02  ... ... ... ..G A.. ..G ..G ... G.. ... .T. ..G ..C .A. .A. ... ... G..
511/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
544/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
851/01  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
106/03  ... ... ... ..G A.. G.G ..G ... ... ... .T. ..G ..C .A. .A. ... ... G..
03/03   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
18/03   .T. ... ... ..G A.. ..G ..G ... ... ... .T. ..G ..C .A. .A. ... ... G..
238/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
577/04  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
419/04  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
448/04  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
594/04  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
551/04  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
88/04   ... ... ... ..G AA. ..G ..G ... ... ..T .T. ..G ..C .A. GA. ... ... G..
106/04  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
302/05  ... ... ... ..G A.. G.G ..T ... ... ... .T. ..G ..C TA. .A. ... ... G..
319/05  ... ... ... ..G A.. G.G ..G ... ... ... .T. ..G ..C .A. .A. ... ... G..
327/05  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
19/03   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
110/06  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
41/06   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
385/06  ... ... ... ..G A.. ..G ..G ... ... ..T .T. ..G ..C .A. .A. ..A ..A G..
48/06   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
43/06   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
21/04   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
70/01   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
903/01  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
902/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
922/01  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
114/02  ... ... ... ..G AA. ..G ..G ... ... ..T .T. ..G ..C .A. GA. ... ... G..
189/01  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
915/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
610/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
941/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
41/02   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
505/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
48/03   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
53/02   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
101/01  ... ... ... ..G A.. ..G ..G ... ... ..T .T. ..G ..C .A. .A. ... ... G..
579/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
343/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
591/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
462/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
426/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
588/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
467/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
329/02  ... ... ... ..G A.. ..G ..G ... ... ... .T. ..G ..C .A. .A. ... ... G..
687/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
591/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
651/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
930/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
425/06  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
744/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
860/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
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716/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
56/06   ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
164/06  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
123/04  C.. ... ... ..G A.. ..G ..G ... ... ..T .T. ... ..C AA. .AG C.. ... G..
616/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
648/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
146/98  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
950/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
536/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
570/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
357/05  ... ... ... ..G A.. ..G ..G ... ... ..T .T. ..G ..C .A. GA. ... ... G..
1050/06 ... ... ... ..G A.. ..G ... ... ... ..T .T. ..G ..C .A. .A. ... .T. G..
472/98  ... ... ... ..G A.. G.G ..G ... ... ..T .T. ..G ..C .A. .A. ... ... G..
925/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
735/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
759/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
842/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
631/02  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
589/04  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
779/06  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
159/07  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
264/03  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
568/02  ... ... ... ..G A.. ..G ..G ... ... ..T .T. ..G ..C .A. .A. ..A ... G..
183/07  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
790/06  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...
164/04  ... ... ... ... A.. ..G ... ... T.. ... ... ... ..C ... .A. ... ... ...

PV      AGT TTC AGT GAC TAA CGG TGC TTT CAT TCT CCA GGA ACT GAC ACC AAC AGT TGT
211/98  .AC .G. .T. ..T C.. ... ... ... ... C.. ... A.. GTG A.G GT. ..A G.. C..
475/96  ... .G. C.. ..T C.. ... ... ... ... ... .T. A.. ... ..G G.. ..A G.. C..
749/96  ... .G. C.. ..T C.. ... ... ..G ... ... ... A.G ... A.G G.. .GA G.. C..
559/98  ... .G. C.. ..T C.. ... ... ... ... ... .T. A.. ... ..G G.. ..A G.. C..
600/96  ... .G. C.. ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
291/95  ... .G. ... ..T C.. ... ... ... ... C.. .T. ... .A. ..G GT. ..A C.. C..
828/99  ... .G. C.. ..T C.. ... ... ..G A.. ... ... A.G ... A.G G.. .GA GA. C..
808/95  ... .G. C.. ..T C.. ... ... ... ... ... AT. A.. ... A.G G.. ..A G.. ...
1003/99 ... .G. C.. ..T C.. ... ... ... ... ... .T. A.. ... A.G G.. ..A GA. C..
756/99  ... .G. C.C ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
142/00  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
641/01  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
653/01  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
1078/97 ... .G. ... ..T C.. ... ... ... ... C.. .T. ... .A. .GG GT. ..A C.C C..
1039/99 ... .G. C.. ..T C.. ... ... ... T.C ... ... ..G ... A.G G.. ..A GA. C..
549/00  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
568/00  ... .G. C.. ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
229/02  ... .G. C.. ..T C.. ... ... ... ... ... AT. A.. ... A.G G.. ..A G.. ...
511/02  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
544/02  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
851/01  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
106/03  ... .G. C.. ..T C.. ... ... ... ... ... .T. A.. ... ..G G.. ..A G.. C..
03/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
18/03   ... .G. C.. ..T C.. ... ... ... ... ... AT. A.. ... A.G G.. ..A G.. ...
238/03  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
577/04  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
419/04  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
448/04  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
594/04  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
551/04  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
88/04   ... .G. C.. ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
106/04  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
302/05  ... .G. C.. ..T C.. ... C.. ... ... ... .T. A.. ... ..G G.. ..A G.. C..
319/05  ... .G. C.. ..T C.. ... ... ... ... ... .T. A.. ... ..G G.. ..A G.. C..
327/05  ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
```

```
19/03    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
110/06   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
41/06    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
385/06   ... .G. C.. ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
48/06    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
43/06    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
21/04    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
70/01    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
903/01   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
902/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
922/01   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
114/02   ... .G. C.. ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
189/01   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
915/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
610/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
941/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
41/02    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
505/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
48/03    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
53/02    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
101/01   ... .G. C.. ..T C.. ... ... ... T.C ... ... ..G ... A.G G.. ..A GA. C..
579/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
343/02   ... ... T.. ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
591/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
462/03   ... ... ... ... C.. ... ... ... ... ... ..G ..G ... ..T .T. ..A G.. ...
426/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
588/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
467/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
329/02   ... .G. CT. ..T C.. ... ... ... ... ... .T. A.. ... A.G G.. ..A G.. C..
687/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
591/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
651/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
930/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
425/06   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
744/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
860/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
716/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
56/06    ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
164/06   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
123/04   ... .G. ... ..T C.. ... ... ... ... C.. .T. ... ... ..G GT. ..A C.. C..
616/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
648/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
146/98   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T TT. ..A G.. ...
950/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
536/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
570/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
357/05   ... .G. C.. ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
1050/06  ... .G. C.. ..T C.. ... ... ... ..A ... ... ..G .T. A.G G.. ..A GA. C..
472/98   ... .G. C.. ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
925/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
735/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
759/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
842/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
631/02   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
589/04   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
779/06   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
159/07   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
264/03   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
568/02   ... .G. C.. ..T C.. ... ... ... ..C ... ... ..G ... A.G G.. ..A GA. C..
183/07   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
790/06   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
164/04   ... ... ... ... C.. ... ... ... ... ... ... ..G ... ..T .T. ..A G.. ...
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PV	AGA	CAA	ATC	ACG	GGG	TGT	CTC	AGG	TGA	TTC	TGC	GCT	TGG	GCA	CAG	ACA	AAG	GTC
211/98	G..	..G	GC.	.G.	...	.A.	TG.	..A	...	...	...	A..	CC.	...	..A	G..	G..	A.T
475/96	G..	...	GC.	.A.	...	.A.	AG.	G.A	...	...	A..	AT.	...	...	.G.	...	G.A	..T
749/96	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	.GA	...	G.A	..T
559/98	G..	...	GC.	.G.	...	.A.	AG.	G.A	...	...	AC.	AT.	.A.	...	.G.	...	G.A	..T
600/96	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	TGA	...	GGA	..T
291/95	G..	A..	GCT	.G.	...	CA.	.GA	G.A	...	...	A..	CT.	...	...	TG.	...	G..	..T
828/99	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	.GA	...	G.A	..T
808/95	G..	...	GC.	.G.	...	.A.	TG.	..A	...	...	A..	AT.	...	...	.G.	...	G.A	..T
1003/99	G..	G..	GC.	.G.	...	.A.	.G.	G.A	...	...	A..	AT.	C..	...	.G.	...	G.A	..T
756/99	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	.GA	...	GGA	..T
142/00	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
641/01	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
653/01	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
1078/97	G..	A..	GCT	.G.	...	CA.	.GA	G.A	...	...	A..	CT.	...	...	TG.	...	G..	..T
1039/99	G..	...	GCT	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	.GA	...	GGA	...
549/00	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
568/00	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	.GA	...	GGA	..T
229/02	G..	...	GC.	.G.	...	.A.	TGT	..A	G..	...	A..	AT.	...	...	.G.	...	G.A	..T
511/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
544/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
851/01	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
106/03	G..	...	GC.	.A.	...	.A.	AG.	G.A	...	...	A..	AT.	...	...	.G.	...	G.A	..T
03/03	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	...	G..	...
18/03	G..	...	GC.	.G.	...	.A.	TG.	..A	...	...	A..	AT.	...	...	TG.	...	G.A	..T
238/03	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	...	G..	...
577/04	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	...	G..	...
419/04	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
448/04	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	.T.	...	...	...	G..	G..	...
594/04	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	...	G..	...
551/04	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	...	G..	...
88/04	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	TGA	.T.	GGA	..T
106/04	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	...	G..	...
302/05	G..	...	GC.	.A.	...	.A.	AG.	G.A	...	...	A..	AT.	...	...	.G.	...	G.A	A.T
319/05	G..	...	GC.	.A.	...	.A.	AG.	G.A	...	...	A..	AT.	...	...	.G.	...	G.A	..T
327/05	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	..G	G..	...
19/03	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
110/06	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
41/06	...	.GG	GC.	.A.	...	.A.	T..	G.A	...	C..	C.T	...	...	...	...	...	G..	...
385/06	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	.GA	...	GGA	..T
48/06	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
43/06	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
21/04	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	...	G..	...
70/01	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
903/01	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
902/03	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	C..	...	...	G..	G..	...
922/01	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	C..	...	...	G..	G..	...
114/02	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	TGA	...	GGA	..T
189/01	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
915/03	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
610/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
941/03	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
41/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
505/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
48/03	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
53/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
101/01	G..	...	GC.	.G.	...	.A.	.G.	G.A	...	C..	A..	ATG	...	...	.GA	...	GGA	...
579/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
343/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
591/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
462/03	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
426/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...
588/02	...	.GG	GC.	.A.	A..	.A.	T..	G.A	...	C..	C.T	...	...	...	...	G..	G..	...

```
467/03  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... ... G.. ...
329/02  G.. ... G.. .G. .A. .A. .G. G.A ... ... A.. AT. C.. ... .G. ... G.A ..T
687/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
591/03  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... C.. ... ... G.. G.. ...
651/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
930/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
425/06  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... ... G.. ...
744/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
860/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
716/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
56/06   ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
164/06  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... ... G.. ...
123/04  G.. AG. GC. .G. ... CA. .GA G.A ... ... A.. CT. ... ... .G. ... G.. ..T
616/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
648/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
146/98  ... .TG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... ... G.. ...
950/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
536/03  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
570/03  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T .T. ... ... ... G.. G.. ...
357/05  G.. ... GC. .G. ... .A. .G. G.A ... C.. A.. ATG ... ... .GA ... GGA ..T
1050/06 G.. ... GC. .G. ... .A. .A. G.A ... C.. A.. ATG ... ... .GA .A. GGA ..T
472/98  G.. ... GC. .G. ... .A. .G. G.A ... C.. A.. ATG ... ... .GA ... GGA ..T
925/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
735/03  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
759/03  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
842/03  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
631/02  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
589/04  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... ... G.. ...
779/06  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
159/07  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
264/03  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
568/02  G.. ... GC. .G. ... .A. .G. G.A ... C.. A.. ATG ... ... .GA ... GGA ..T
183/07  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... ... G.. ...
790/06  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...
164/04  ... .GG GC. .A. A.. .A. T.. G.A ... C.. C.T ... ... ... ... G.. G.. ...

PV      ATG GTG TGT TCC ATG ATA GCG GAC TCA GGA TGA GTT AAT TGA GAG AGG CAA TCT
211/98  G.A ... CA. C.. C.. ..G ..A A.. ... AT. C.. ..C .G. ... ..A G.. ..C CT.
475/96  ..A ... CAC C.. C.. ... ..A A.. .T. AC. CA. ..C .G. ... ..A G.. ..C C..
749/96  G.A ... CAC C.. C.. ... .TA A.. CG. AC. CAG ..C .G. ... ..A G.A ..T ...
559/98  ..A ... CAC C.. C.. ... ..A A.. .T. AC. CA. ..C .G. ... ..A G.. ..C C..
600/96  G.A ... CAC CT. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
291/95  GCA ... CAC C.. C.. ... ... A.. .TG AC. C.. ..C .T. ... ..A G.. ..T C..
828/99  G.A ... CAC C.. C.. ... .TA A.. CG. AC. CAG ..C .G. ... ..A G.A ..T ...
808/95  ..A ... CAC C.. C.. ... ..A ... .T. AC. CA. ..C .G. ... ..A G.. ..C ...
1003/99 ..A ... CAC C.. C.A ... ..A A.. .T. AC. CA. ..C .G. ... ..A G.. ..C ...
756/99  G.A ... CAC C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
142/00  ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
641/01  ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
653/01  ..A ..A C.C C.. C.A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
1078/97 GCA ... CAC C.. C.. ... ... A.. .TG AC. C.. ..C .T. ... ... G.. ..T C..
1039/99 G.A ... CAC C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
549/00  ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
568/00  G.A ..A CAC C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
229/02  ..A ... CAC C.. C.. ... ..A ... .T. AC. CA. ..C .G. ... ..A G.. ..C ...
511/02  ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
544/02  ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
851/01  ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
106/03  ..A ... CAC C.. C.. ... ..A A.. .T. AC. CA. ..C .G. ... ..A G.. ..C C..
03/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
18/03   ..A ... CAC C.. CC. ... ..T ... .T. AC. CA. ..C .G. ... ... G.A ..C C..
238/03  ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
577/04  ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
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419/04   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ..G ... ... ... ...
448/04   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
594/04   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
551/04   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
88/04    G.A ... CA. C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
106/04   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
302/05   ..A ... CAC C.. C.. ... ..A A.. .T. AC. CA. ..C .G. ... ..A G.. ..C C..
319/05   ..A ... CAC C.. C.. ... ..A A.. .T. AC. CA. ..C .G. ... ..A G.. ..C C..
327/05   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
19/03    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
110/06   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
41/06    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
385/06   G.A ... CAC C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
48/06    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
43/06    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
21/04    ..A ..A C.. C.. ..C ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
70/01    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
903/01   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ..G ... ... ... ...
902/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
922/01   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
114/02   G.A ... CA. C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
189/01   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
915/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
610/02   ..A ..A C.. C.. ... ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
941/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
41/02    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
505/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
48/03    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
53/02    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
101/01   G.A ... CAC C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
579/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
343/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
591/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
462/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
426/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
588/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
467/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
329/02   ..A ... CAC C.. C.. ... ..A A.. .T. AC. CA. ..C .G. ... ..A G.. ..C C..
687/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
591/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
651/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ..G ... ... ... ...
930/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
425/06   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
744/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
860/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
716/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ..G ... ... ... ...
56/06    ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
164/06   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
123/04   GCA ..A CAC C.. CA. .C. ..A A.. .T. AC. CA. ... GT. ... ..A G.. ..T C.G
616/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
648/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
146/98   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ..A ... ... ...
950/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
536/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
570/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
357/05   G.A ... CAC C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
1050/06  G.A ... CAC C.. T.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
472/98   G.A ... CAC C.. C.. ... ..A A.. CT. AC. CAG ..C .G. ... ..A G.. ..C ...
925/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
735/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
759/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
842/03   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ..G ... ... ... ...
631/02   ..A ..A C.. C.. ..A ... ..A ... ... A.. ... ..C G.. ... ... ... ... ...
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589/04	..A	..A	C..	C..	..A	...	..A	...	...	A..	...	..C	G..	...	...	...	...	...
779/06	..A	..A	C..	C..	..A	...	..A	...	...	A..	...	..C	G..	..G	...	...	...	...
159/07	..A	..A	C..	C..	..A	...	..A	...	...	A..	...	..C	G..	..G	...	...	...	...
264/03	..A	..A	C..	C..	..A	...	..A	...	...	A..	...	..C	G..	...	...	...	...	...
568/02	G.A	...	CAC	C..	C..	...	..A	A..	CT.	AC.	CAG	..C	.G.	...	..A	G..	..C	...
183/07	..A	..A	C..	C..	..A	...	..A	...	...	A..	...	..C	G..	...	...	...	...	...
790/06	..A	..A	C..	C..	..A	...	..A	...	...	A..	...	..C	G..	..G	...	...	...	...
164/04	..A	..A	C..	C..	..A	...	..A	...	...	A..	...	..C	G..	...	...	...	...	...

PV	TCC	TCC	CGT	GAA	GGA	CAC	AAG	CAG	TAG	CTC	ACA	ATC	ATC	TCG	TGT	TTC	AGC	AAA
211/98	G..	G..	.A.	...	..G	..T	...	.CA	...	A..	...	...	...	GT.	CA.	C..	.T.	...
475/96	G..	...	.A.	...	...	...	...	.CA	...	A..	...	...	.C.	CT.	CA.	C..	GTT	...
749/96	G..	..A	T..	...	...	T.T	...	.CA	...	A..	...	...	...	CT.	CA.	C..	.TT	...
559/98	G..	...	.A.	...	...	...	...	.CA	...	A..	...	...	.C.	CT.	CA.	C..	GTT	...
600/96	G..	..A	...	...	...	T.T	...	.CA	...	A..	...	...	...	CT.	CA.	C..	..T	G..
291/95	G..	...	TA.	...	...	..T	...	TCA	...	A..	...	G.T	G..	C..	CA.	CC.	.TT	...
828/99	G..	..A	T..	...	...	T.T	...	.CA	...	A..	...	...	...	CT.	CA.	C..	.TT	...
808/95	G..	...	...	...	...	..T	...	.CA	...	A..	...	...	...	CT.	CA.	C..	GTT	...
1003/99	G..	...	.A.	...	...	..T	...	.CA	...	A..	...	...	...	CT.	CA.	C..	GTT	...
756/99	G..	..A	...	...	...	T.T	...	.CA	...	A..	...	...	..T	CT.	CA.	C..	..T	...
142/00	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
641/01	G..	...	.A.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	G..
653/01	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	G.G
1078/97	G..	...	TA.	...	...	..T	...	TCA	...	A..	...	G.T	G..	C..	CA.	CC.	.TT	...
1039/99	G.T	..A	...	...	...	T.T	...	.CA	...	A..	...	...	..T	CT.	CA.	C..	..T	...
549/00	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
568/00	G..	..A	...	...	...	T.T	...	.CA	...	A..	...	...	..T	CT.	CA.	C..	..T	...
229/02	G..	...	...	...	...	..T	...	.CA	...	A..	...	...	...	CT.	CA.	C..	GTT	...
511/02	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
544/02	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
851/01	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
106/03	G..	...	TA.	...	...	...	...	.CA	...	A..	...	...	.C.	CT.	CA.	C..	GTT	...
03/03	G..	...	AA.	...	...	..T	...	..A	...	.C.	.TG	...	..T	.T.	CA.	C.T	...	...
18/03	G..	...	T..	...	.A.	..T	...	.CA	...	A..	...	...	...	C..	CA.	C..	GTT	...
238/03	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
577/04	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	C.T	.T.	CT.	C.T	...	...
419/04	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
448/04	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
594/04	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
551/04	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
88/04	G..	..A	...	...	...	T.T	...	.CA	...	A..	...	...	..T	CT.	CA.	...	..T	...
106/04	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
302/05	G..	...	.A.	...	...	...	...	.CA	...	A..	T..	...	.C.	CT.	CA.	C..	GTT	...
319/05	G..	...	TA.	...	...	...	...	.CA	...	A..	...	...	.C.	CT.	CA.	C..	GTT	...
327/05	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
19/03	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
110/06	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
41/06	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
385/06	G..	..A	...	...	...	T.T	...	.CA	...	A..	...	...	..T	CT.	CA.	C..	..T	...
48/06	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
43/06	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
21/04	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
70/01	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
903/01	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
902/03	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
922/01	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
114/02	G..	..A	...	...	...	T.T	...	.CA	...	A..	...	...	..T	CT.	CA.	C..	..T	...
189/01	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
915/03	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
610/02	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
941/03	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
41/02	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...
505/02	G..	...	AA.	...	...	..T	...	..A	...	...	.TG	...	..T	.T.	CA.	C.T	...	...

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48/03    G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
53/02    G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
101/01   G.T ..A ... ... ... T.T ... .CA ... A.. ... ... ..T CT. CA. C.. ..T ...
579/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
343/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
591/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
462/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
426/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
588/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
467/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
329/02   G.. ... .A. ... ... ..T ... .CA ... A.. ... ... ... CT. CA. C.. GTT ...
687/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
591/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
651/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
930/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
425/06   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
744/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
860/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
716/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
56/06    G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
164/06   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
123/04   G.. ... TA. ... ... ..T ... .CA ... A.. ... G.T G.. C.. CA. CC. .TT ...
616/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
648/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
146/98   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ... CT. CA. C.. ... ...
950/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
536/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
570/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
357/05   G.. ..A ... ... ... T.T ... .CA ... A.. ... ... ..T CT. CA. C.. ..T ...
1050/06  G.. ..A ... ... ... T.T ... .CA ... A.. ... ... ..T CT. CA. C.. ..T ...
472/98   G.. ..A ... ... ... T.T ... .CA ... A.. ... ... ..T CT. CA. C.. ..T ...
925/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
735/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
759/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
842/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
631/02   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
589/04   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
779/06   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
159/07   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
264/03   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
568/02   G.. ..A ... ... ... T.T ... .CA ... A.. ... ... ..T CT. CA. C.. ..T ...
183/07   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
790/06   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...
164/04   G.. ... AA. ... ... ..T ... ..A ... ... .TG ... ..T .T. CA. C.T ... ...

PV       GTG TGC ATA ATT ATA AAG TGC TGG GTC ATC TAA GCT TTT CAG TCG AGA AAA AA-
211/98   .C. ... ... .C. .C. ... G.. ... ... .C. ..G A.. ..C ..A C.. ... ... ..A
475/96   ... ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
749/96   ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
559/98   ... ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
600/96   ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
291/95   ..T ... .C. .C. ... ... G.. ... T.. ... .G. A.. C.. ..A ..A ... ... ..A
828/99   ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
808/95   T.. ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
1003/99  ... ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
756/99   ... ... .C. .C. C.. ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
142/00   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
641/01   T.. ... ... ... ... ... G.. ... ... -.. ... ... ... ... ... ... ... ..A
653/01   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
1078/97  ..T ... .C. .C. ... ... G.. ..T T.. ... .G. A.. C.. ..A ..A ... ... ..A
1039/99  ... ... .C. .C. ... ... G.. ..C TC. ... C.. A.. C.. ..A ... ... ... ..A
549/00   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
568/00   ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
```

```
229/02  T.. ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
511/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
544/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
851/01  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
106/03  A.. ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
03/03   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
18/03   T.. ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
238/03  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
577/04  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
419/04  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
448/04  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
594/04  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
551/04  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
88/04   ... ... .C. .C. C.. ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
106/04  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
302/05  ... ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
319/05  ... ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
327/05  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
19/03   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
110/06  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
41/06   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
385/06  ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
48/06   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
43/06   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
21/04   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
70/01   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
903/01  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
902/03  T.. ... ... ... ... ... G.. ... ... ... ... ... ..- ... ... ... ... ..A
922/01  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
114/02  ... ... .C. .C. C.. ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
189/01  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
915/03  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
610/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
941/03  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
41/02   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
505/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
48/03   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
53/02   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
101/01  ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
579/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
343/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
591/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
462/03  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
426/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
588/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
467/03  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
329/02  ... ... .C. .C. ... ... G.. ..T TC. ... ... A.. C.. ..A ... ... ... ..A
687/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
591/03  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
651/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
930/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
425/06  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
744/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
860/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
716/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
56/06   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
164/06  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
123/04  ... ... .C. .C. ... ... G.. ... T.. ... .G. A.. CC. ..A ..A ... ... ..A
616/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
648/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
146/98  T.. ... ... ... ... ... G.. ... .A. ... ... ... ... ... ..A ... ... ..A
950/02  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
536/03  T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
```

```
570/03   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
357/05    ... ... .C. .C. C.. ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
1050/06 ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
472/98    ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
925/02   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
735/03   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
759/03   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
842/03   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
631/02   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
589/04   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
779/06   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
159/07   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
264/03   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..-
568/02    ... ... .C. .C. ... ... G.. ..T TC. ... C.. A.. C.. ..A ... ... ... ..A
183/07   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
790/06   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
164/04   T.. ... ... ... ... ... G.. ... ... ... ... ... ... ... ... ... ... ..A
```

Appendix 5. A multiple sequence alignment of 591-bp nucleotide sequences of rabies viruses originating from different regions of South Africa including Free State province and Lesotho. The nucleotide sequences starts at position 4665 to 5566 in relation to the binding positions of the primer set on the PV strain genome. The distance matrix was used in the construction of neighbour joining tree shown in Figure 4.5. The dots indicates positions of identity between the aligned sequences and the reference sequence (PV).

PV	TCA	ATC	GAT	CGG	AAC	CTA	CAC	AAC	ACA	ATC	TCA	GAG	GGA	CAG	GGA	GGG
211/98	..C	G..	..C	.AA	.GT	.C.	.G.	...	...	G..	..G	...	...	...	.A.	T.A
528/97LP	...	...	..C	.A.	..T	...	.G.	...	G..	G..	...	...	...	...	...	..A
208/99LP	...	...	..C	.A.	..T	...	.G.	...	G..	G..	..G	...	...	...	...	..A
1004/99LP	...	...	..C	.A.	..T	...	.G.	..T	G..	G..	..G	...	...	...	...	..A
207/00LP	...	...	..C	.A.	..T	...	.G.	..T	G..	G..	..G	...	...	...	...	..A
438/00LP	...	...	..C	.A.	..T	...	.G.	..T	G..	G..	..G	...	...	...	...	..A
536/96MP	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
35/00MP	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
426/00MP	...	...	..C	.A.	.GT	...	..A	...	G..	G..	..G	...	...	...	...	..A
927/00MP	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
582/01MP	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
644/01MP	...	...	..C	.A.	.GT	...	..A	...	G..	G..	..G	...	...	...	...	..A
1265/80NW	...	...	..C	.A.	..T	...	.G.	...	G..	G..	..G	...	...	...	...	..A
820/94NW	...	...	..C	.A.	..T	...	...	..T	G..	G..	..G	...	...	...	...	..A
675/99NW	...	...	..C	.A.	..T	...	.G.	...	G..	G..	...	...	...	...	...	..A
733/99NW	...	...	..C	.A.	..T	...	.G.	...	G..	G..	...	...	...	...	...	..A
142/00FS	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
549/00FS	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
851/00FS	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
641/01FS	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
653/01FS	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
544/02FS	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
448/04FS	...	...	..C	.A.	..T	...	.GA	...	G..	G..	..G	...	...	...	...	..A
577/04FS	...	...	..C	.A.	.GT	...	.GA	...	G.C	G..	..G	...	...	...	...	..A
198/00LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
650/00LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
912/00LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
404/01LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
430/01LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
527/01LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
531/02LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
298/05LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
391/06LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
953/06LE	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
89/03KZN	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
103/03KZN	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
114/03KZN	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
256/03KZN	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
306/03KZN	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
589/03KZN	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
05/03EC	...	...	..C	.A.	.GT	...	.GA	...	G.C	G..	..G	...	...	...	...	..A
28/03EC	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
460/03EC	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
487/03EC	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A
936/03EC	...	...	..C	.A.	.GT	...	.GA	...	G..	G..	..G	...	...	...	...	..A

PV	AGG	TGT	CAG	TCA	CTC	CCC	AAA	GCG	GGA	AGA	TCA	TAT	CTT	CAT	GGG	AAT
211/98	...	...	...	...	...	...	...	...	.A.	.AG	...	...	...	.C.	...	.G.
528/97LP	...	...	...	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
208/99LP	...	...	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
1004/99LP	...	G..	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
207/00LP	...	G..	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
438/00LP	...	G..	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
536/96MP	...	...	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
35/00MP	...	...	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
426/00MP	...	...	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
927/00MP	...	...	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
582/01MP	...	...	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
644/01MP	...	...	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
1265/80NW	...	...	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
820/94NW	...	G..	.G.	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.
675/99NW	...	...	...	...	..T	...	...	...	...	..G	...	...	...	...	...	.G.

```
733/99NW  ... ... ... ... ..T ... ... ... ... ..G ... ... ... ... ... .G.
142/00FS  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
549/00FS  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
851/00FS  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
641/01FS  G.. ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
653/01FS  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
544/02FS  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
448/04FS  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
577/04FS  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
198/00LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
650/00LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
912/00LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
404/01LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
430/01LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
527/01LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
531/02LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
298/05LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
391/06LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
953/06LE  ... ... .G. ... ..T ... ... ... ... ..G ..G ... ... ... ... .G.
89/03KZN  ... ... .G. ... ..T ... ... ... ... ..G ... ... ... ... ... .G.
103/03KZN ... ... .G. ... ..T ... ... ... ... ..G ... ... ... ... ... .G.
114/03KZN ... ... .G. ... ..T ... ... ... ... ..G ... ... ... ... ... .G.
256/03KZN ... ... .G. ... ..T ... ... .T. ... ..G ... ... ... ... ... .G.
306/03KZN ... ... .G. ... ..T ... ... ... ... ..G ... ... ... ... ... .G.
589/03KZN ... A.. .G. ... ..T ... ... ... ... ..G ... ... ... ... ... .G.
05/03EC   ... ... .G. ... ..T ... ... ... ... ..G ... ... ... ... ... .G.
28/03EC   ... ... .G. ... ..T ... ... ... ... ..G ... ... ... ... ... .G.
460/03EC  ... ... .G. ... ..T ... .G. ... ... ..G ... ... ... ... ... .G.
487/03EC  ... ... .G. ... ..T ... .G. ... ... ..G ... ... ... ... ... .G.
936/03EC  ... ... .G. ... ..T ... .G. ... ... ..G ... ... ... ... ... .G.

PV        CAT ACA AGA GCG GGG GTG AGA CCG GAC TGT GAG AGC TGG CCG TCC TTT
211/98    ... .T. ... AA. .A. ... ... ..C ... ... ... G.. CT. T.. .T. ...
528/97LP  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
208/99LP  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
1004/99LP ... .T. .A. .T. ... ... ... .TA ..T ... A.A ... ... T.A ... ...
207/00LP  ... .T. .A. .T. ... ... ... .TA ..T ... A.A ... ... T.A ... ...
438/00LP  ... .T. .A. .T. ... ... ... .TA ..T ... A.A ... ... T.A ... ...
536/96MP  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ..A
35/00MP   ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
426/00MP  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
927/00MP  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
582/01MP  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
644/01MP  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
1265/80NW ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
820/94NW  ... .T. .A. .T. ... ... ... .TA ..T ... A.A ... ... T.A ... ...
675/99NW  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
733/99NW  ... .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
142/00FS  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
549/00FS  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
851/00FS  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
641/01FS  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
653/01FS  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
544/02FS  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
448/04FS  .T. .T. .A. .T. .-. ... ... .TA ... ... A.A ... ... T.A ... ...
577/04FS  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
198/00LE  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
650/00LE  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
912/00LE  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
404/01LE  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
430/01LE  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
527/01LE  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
531/02LE  .T. .T. .A. .T. ... ... ... .TA ... ... A.A ... ... T.A ... ...
```

298/05LE	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
391/06LE	.T.	.T.	.A.	.T.	.A.	...	...	.TA	...	...	A.A	...	...	T.A	...	...
953/06LE	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
89/03KZN	...	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
103/03KZN	...	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
114/03KZN	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
256/03KZN	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
306/03KZN	.T.	.T.	.A.	AT.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
589/03KZN	.T.	.T.	.A.	AT.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
05/03EC	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
28/03EC	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
460/03EC	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
487/03EC	.T.	.T.	...	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...
936/03EC	.T.	.T.	.A.	.T.	...	...	...	.TA	...	...	A.A	...	...	T.A	...	...

PV	CAA	CGA	TCC	AAG	TCC	TGA	AGA	TCA	CCT	CCC	CTT	GGG	GGG	TTC	TTT	TTG
211/98	.GG	...	.TT	..A	.AT	C..	...	C.G	...	...	AA.	...	ATC	AGA	GGG	AAT
528/97LP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AGT
208/99LP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AGT
1004/99LP	.G.	..C	.T.	...	.T.	...	..G	...	.T.	...	...	...	.TT	GGG	GGG	AAT
207/00LP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
438/00LP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
536/96MP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
35/00MP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
426/00MP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
927/00MP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
582/01MP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
644/01MP	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
1265/80NW	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AGT
820/94NW	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
675/99NW	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	GGT
733/99NW	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	GGT
142/00FS	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
549/00FS	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
851/00FS	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
641/01FS	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
653/01FS	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
544/02FS	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
448/04FS	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
577/04FS	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AGC
198/00LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
650/00LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
912/00LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
404/01LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
430/01LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
527/01LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
531/02LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
298/05LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
391/06LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
953/06LE	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AGC
89/03KZN	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
103/03KZN	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
114/03KZN	.G.	..C	.T.	...	.T.	...	..G	...	...	..T	...	...	.TT	GGG	GGG	AAT
256/03KZN	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
306/03KZN	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	A..	.TT	GGG	GGG	AAT
589/03KZN	.G.	..C	.T.	...	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
05/03EC	.G.	..C	.T.	...	.T.	...	..G	...	...	..T	...	...	.TT	GGG	GGG	AAT
28/03EC	.G.	..C	.T.	...	.T.	...	..G	...	...	..T	...	...	.TT	GGG	GGG	AAT
460/03EC	.G.	..C	.T.	G..	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
487/03EC	.G.	..C	.T.	G..	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT
936/03EC	.G.	..C	.T.	G..	.T.	...	..G	...	...	...	...	...	.TT	GGG	GGG	AAT

PV	AAC	TGG	GTT	CAA	TAG	TCC	TCC	TTG	AAC	TCC	ATG	CAA	CTG	GGT	AGA	TTC
211/98	CC.	C.A	...	...	...	ATT	...	.CA	...	.T.	G..	TG.	.A.	AA.	G..	...
528/97LP	CTT	..A	...	T..	CG.	...	...	...	...	...	...	...	.A.	...	...	...
208/99LP	CTT	..A	...	T..	CG.	...	...	...	...	...	...	...	.A.	...	...	...
1004/99LP	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	..G	...	...
207/00LP	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
438/00LP	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
536/96MP	CT.	..A	...	...	C..	...	...	...	...	...	C..	...	.A.	...	...	...
35/00MP	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
426/00MP	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
927/00MP	CT.	..A	...	...	C..	...	...	...	...	...	...	T..	.A.	...	...	...
582/01MP	CT.	..A	...	...	C..	...	...	...	...	...	...	T..	.A.	...	...	...
644/01MP	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
1265/80NW	CTT	..A	.C.	...	CG.	...	...	...	...	...	...	...	.A.	...	...	...
820/94NW	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
675/99NW	CTT	..A	...	T..	CG.	...	...	...	...	...	...	...	.A.	...	...	...
733/99NW	CTT	..A	...	T..	CG.	...	...	...	...	...	...	...	.A.	...	...	...
142/00FS	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
549/00FS	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
851/00FS	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
641/01FS	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
653/01FS	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
544/02FS	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
448/04FS	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
577/04FS	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
198/00LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
650/00LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
912/00LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
404/01LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
430/01LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
527/01LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
531/02LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
298/05LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	..G	...	...
391/06LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
953/06LE	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
89/03KZN	CT.	..A	A..	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
103/03KZN	CT.	..A	A..	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
114/03KZN	CT.	..A	...	...	C..	...	...	.CA	...	...	...	...	.A.	...	...	...
256/03KZN	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
306/03KZN	CT.	..A	...	...	C..	...	...	...	G..	...	...	...	.A.	...	...	...
589/03KZN	CT.	..A	...	...	C..	...	...	...	...	...	...	...	.A.	...	...	...
05/03EC	CT.	..A	...	...	C..	...	...	.CA	...	...	...	...	.A.	...	...	...
28/03EC	CT.	..A	...	...	C..	...	...	.C.	...	...	...	...	.A.	...	...	...
460/03EC	CT.	..A	...	...	C..	...	...	...	...	...	..T	...	.A.	...	...	...
487/03EC	CT.	..A	...	...	C..	...	...	...	...	...	..T	...	.A.	...	...	...
936/03EC	CT.	..A	...	...	C..	...	...	...	...	...	..T	...	.A.	...	...	...

PV	AAG	AGT	CAT	GAG	ATT	TTC	ATT	AAT	CCT	CTC	AGT	TGA	TCA	AGC	AAG	ATC
211/98	C..	...	..C	...	G..	...	T.C	...	.A.	...	...	...	...	GA.	TT.	G..
528/97LP	...	G..	...	...	.C.	...	..C	...	.A.	...	...	...	...	.A.	...	G..
208/99LP	...	G..	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
1004/99LP	.G.	G..	...	..A	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
207/00LP	.G.	...	...	..A	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
438/00LP	.G.	...	...	..A	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
536/96MP	..A	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
35/00MP	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
426/00MP	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
927/00MP	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
582/01MP	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
644/01MP	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
1265/80NW	...	G..	...	...	.C.	...	...	C..	.A.	...	...	...	...	.A.	...	G..
820/94NW	.G.	...	...	..A	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
675/99NW	...	G..	...	...	.C.	...	..C	...	.A.	.C.	...	...	...	.A.	...	G..

733/99NW	...	G..	...	...	.C.	...	..C	...	.A.	.C.	...	...	...	.A.	...	G..
142/00FS	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
549/00FS	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
851/00FS	...	...	...	A..	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
641/01FS	...	...	...	A..	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
653/01FS	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
544/02FS	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
448/04FS	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
577/04FS	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
198/00LE	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
650/00LE	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
912/00LE	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
404/01LE	...	...	...	A..	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
430/01LE	...	...	...	A..	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
527/01LE	...	...	...	A..	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
531/02LE	...	...	...	A..	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
298/05LE	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
391/06LE	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
953/06LE	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
89/03KZN	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
103/03KZN	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
114/03KZN	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
256/03KZN	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
306/03KZN	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
589/03KZN	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
05/03EC	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
28/03EC	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
460/03EC	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
487/03EC	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..
936/03EC	...	...	...	...	.C.	...	...	...	.A.	...	...	...	...	.A.	...	G..

PV	ATG	TAG	ATT	CTC	ATA	ATA	GGG	GAG	ATC	TTC	TAG	CAG	TTT	CAG	TGA	CTA
211/98	...	...	T..	..G	...	...	CAA	..A	GC.	...	.G.	..A	C.G	..T	...	TC.
528/97LP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
208/99LP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.CG
1004/99LP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
207/00LP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
438/00LP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
536/96MP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
35/00MP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
426/00MP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
927/00MP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
582/01MP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
644/01MP	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
1265/80NW	...	.T.	...	...	...	...	C..	A.A	...	...	.G.	...	...	...	...	.C.
820/94NW	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
675/99NW	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
733/99NW	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
142/00FS	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
549/00FS	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
851/00FS	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
641/01FS	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
653/01FS	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
544/02FS	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
448/04FS	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
577/04FS	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
198/00LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
650/00LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
912/00LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
404/01LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
430/01LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
527/01LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
531/02LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.

298/05LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
391/06LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
953/06LE	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
89/03KZN	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
103/03KZN	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
114/03KZN	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
256/03KZN	...	.T.	...	...	...	...	C..	..A	...	...	.G.	...	...	...	...	.C.
306/03KZN	...	.T.	...	...	...	...	C..	..A	...	...	.G.	...	...	...	...	.C.
589/03KZN	...	.T.	...	...	...	...	CA.	..A	...	...	.G.	...	...	...	...	.C.
05/03EC	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	...	.C.
28/03EC	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	...	C..	.C.
460/03EC	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	T..	...	.C.
487/03EC	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	T..	...	.C.
936/03EC	...	.T.	...	...	...	...	C..	..A	...	...	...	...	...	T..	...	.C.

PV	ACG	GTG	CTT	TCA	TTC	TCC	AGG	AAC	TGA	CAC	CAA	CAG	TTG	TAG	ACA	AAT
211/98	...	...	...	...	.C.	...	.A.	.GT	GA.	GGT	...	AG.	.C.	.G.	...	GGC
528/97LP	...	...	...	...	...	...	...	...	...	TGT	...	AG.	...	...	..G	GGC
208/99LP	...	...	...	...	...	...	...	...	..G	TGT	...	AG.	...	...	..G	GGC
1004/99LP	...	...	...	...	...	...	...	...	...	G.T	..C	AG.	...	...	..G	GGC
207/00LP	...	...	...	...	...	...	...	...	...	G.T	..C	AG.	...	...	..G	GGC
438/00LP	...	...	...	...	...	...	...	...	...	G.T	..C	AG.	...	...	..G	GGC
536/96MP	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
35/00MP	...	...	...	...	...	...	...	G..	...	T.T	..G	AG.	.C.	...	..G	GGC
426/00MP	...	...	...	...	...	...	...	G..	...	T.T	..G	AG.	.C.	...	..G	GGC
927/00MP	...	...	...	...	...	...	...	G..	...	T.T	..G	AG.	.C.	...	..G	GGC
582/01MP	...	...	...	...	...	...	...	G..	...	T.T	..G	AG.	.C.	...	..G	GGC
644/01MP	...	...	...	...	...	...	...	G..	...	..T	..G	AG.	.C.	...	..G	GGC
1265/80NW	...	...	...	...	...	...	...	...	...	T.T	...	AG.	...	...	..G	GGC
820/94NW	...	...	...	...	...	...	...	...	...	G.T	..C	AG.	...	...	..G	GGC
675/99NW	...	...	...	...	...	...	...	...	...	TGT	...	AG.	...	...	..G	GGC
733/99NW	...	...	...	...	...	...	...	...	...	TGT	...	AG.	...	...	..G	GGC
142/00FS	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
549/00FS	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
851/00FS	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
641/01FS	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
653/01FS	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
544/02FS	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
448/04FS	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
577/04FS	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
198/00LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
650/00LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
912/00LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
404/01LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
430/01LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
527/01LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
531/02LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
298/05LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
391/06LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
953/06LE	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
89/03KZN	...	...	...	...	...	...	...	G..	...	T.T	..G	AG.	.C.	...	..G	GGC
103/03KZN	...	...	...	...	...	...	...	G..	...	T.T	..G	AG.	.C.	...	..G	GGC
114/03KZN	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..T	GGC
256/03KZN	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
306/03KZN	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
589/03KZN	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
05/03EC	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..T	GGC
28/03EC	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..T	GGC
460/03EC	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
487/03EC	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC
936/03EC	...	...	...	...	...	...	...	G..	...	T.T	...	AG.	...	...	..G	GGC

PV	CAC	GGG	GTG	TCT	CAG	GTG	ATT	CTG	CGC	TTG	GGC	ACA	GAC	AAA	GGT	CAT
211/98	..G	...	..A	.TG	...	A..	...	...	.A.	.CC	...	...	AG.	.G.	.A.	TG.
528/97LP	..A	.A.	..A	.T.	.G.	...	.C.	.C.	T..	...	...	...	...	.G.	...	...
208/99LP	.TA	.A.	..A	.T.	.G.	...	.C.	.C.	T..	...	...	...	...	.G.	...	...
1004/99LP	..A	.A.	..A	.T.	.G.	...	.C.	.C.	T..	..A	...	...	...	.G.	...	...
207/00LP	..A	.A.	..A	.T.	.G.	...	.C.	.C.	T..	..A	..A	...	...	.G.	...	...
438/00LP	..A	.A.	..A	.T.	.G.	...	.C.	.C.	T..	..A	...	...	...	.G.	...	...
536/96MP	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	...
35/00MP	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	.A.	...	...	...	.G.	...	...
426/00MP	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	.A.	...	...	...	.G.	...	...
927/00MP	..A	.AA	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	.G.
582/01MP	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	.G.
644/01MP	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	.A.	...	...	...	.G.	...	...
1265/80NW	..A	.A.	..A	.T.	.G.	...	.C.	...	T..	...	...	...	...	.G.	...	...
820/94NW	..A	.A.	..A	.T.	.G.	...	.C.	.C.	T..	..A	...	...	...	.G.	...	...
675/99NW	..A	.A.	..A	.T.	.G.	...	.C.	.C.	T..	...	...	...	...	.G.	...	...
733/99NW	..A	.A.	..A	.T.	.G.	...	.C.	.C.	T..	...	...	...	...	.G.	...	...
142/00FS	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
549/00FS	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
851/00FS	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
641/01FS	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
653/01FS	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
544/02FS	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
448/04FS	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T.T	...	...	...	.G.	.G.	...	...
577/04FS	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	...
198/00LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
650/00LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
912/00LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	...
404/01LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
430/01LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
527/01LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
531/02LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
298/05LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	.G.	.G.	...	...
391/06LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	TG.	.G.	...	...
953/06LE	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	...
89/03KZN	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	.A.	...	...	...	.G.	...	...
103/03KZN	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	.A.	...	...	...	.G.	...	...
114/03KZN	..A	.A.	..A	.T.	.G.	A..	.CC	.C.	T..	...	...	...	...	.G.	...	...
256/03KZN	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	...
306/03KZN	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	...
589/03KZN	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	...
05/03EC	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	.T.	...	.G.	...	...
28/03EC	..A	.A.	..A	.T.	.G.	A..	.C.	.C.	T..	...	...	...	...	.G.	...	...
460/03EC	..A	.A.	.CA	.T.	.G.	A.A	.C.	.C.	T..	...	...	...	...	.G.	...	...
487/03EC	..A	.A.	..A	.T.	.G.	A.A	.C.	.C.	T..	...	...	...	...	.G.	...	...
936/03EC	..A	.A.	.CA	.T.	.G.	A.A	.C.	.C.	T..	...	...	...	...	.G.	...	...

PV	GGT	GTG	TTC	CAT	GAT	AGC	GGA	CTC	AGG	ATG	AGT	TAA	TTG	AGA	GAG	GCA
211/98	A..	.CA	.C.	.C.	...	G..	AA.	...	.AT	.C.	...	C.G	...	...	AG.	...
528/97LP	A..	AC.	.C.	.C.	A..	...	A..	...	.AC	...	...	CG.	...	...	A..	...
208/99LP	A..	AC.	.C.	.C.	A..	...	A..	...	.AC	...	...	CG.	...	...	A..	...
1004/99LP	A..	AC.	.C.	...	A..	...	A..	...	.AC	...	...	CG.	...	...	A..	...
207/00LP	A..	AC.	.C.	...	A..	...	A..	...	.AC	...	...	CG.	...	...	A..	...
438/00LP	A..	AC.	.C.	...	A..	...	A..	...	.AC	...	...	CG.	...	...	A..	...
536/96MP	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CT.	...	...	A..	...
35/00MP	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
426/00MP	A..	AC.	.C.	...	A..	...	A..	...	GA.	...	...	CG.	...	...	A..	...
927/00MP	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
582/01MP	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
644/01MP	A..	AC.	.C.	...	A..	...	A..	...	GA.	...	...	CG.	...	...	A..	...
1265/80NW	A..	AC.	.C.	.C.	A..	...	A..	...	.AC	...	G..	CG.	...	...	A..	...
820/94NW	A..	AC.	.C.	..C	A..	...	A..	...	.AC	...	...	CG.	...	...	A..	...
675/99NW	A..	AC.	.C.	.C.	A..	...	A..	...	.AC	...	...	CG.	...	...	A..	...

733/99NW	A..	AC.	.C.	.C.	A..	...	A..	...	.AC	...	...	CG.	...	...	A..	...
142/00FS	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
549/00FS	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
851/00FS	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
641/01FS	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
653/01FS	A..	AC.	CC.	.C.	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
544/02FS	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
448/04FS	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
577/04FS	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
198/00LE	A..	AC.	.C.	...	A..	...	...	...	.A.	...	...	CG.	...	...	...	...
650/00LE	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
912/00LE	A..	ACA	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
404/01LE	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
430/01LE	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
527/01LE	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
531/02LE	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
298/05LE	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
391/06LE	A..	.C.	.C.	...	A..	...	A..	.C.	.A.	...	...	CG.	...	...	...	...
953/06LE	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
89/03KZN	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
103/03KZN	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
114/03KZN	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
256/03KZN	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
306/03KZN	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
589/03KZN	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	...	...
05/03EC	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
28/03EC	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
460/03EC	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
487/03EC	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	A..	...
936/03EC	A..	AC.	.C.	...	A..	...	A..	...	.A.	...	...	CG.	...	...	AG.	...

PV	ATC	TTC	CTC	CCG	TGA	AGG	ACA	CAA	GCA	GTA	GCT	CAC	AAT	CAT	CTC	GTG
211/98	CCT	.G.	.G.	..A	...	...	G..	T..	..C	A..	.A.	...	...	...	.GT	.CA
528/97LP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
208/99LP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
1004/99LP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
207/00LP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
438/00LP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
536/96MP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
35/00MP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
426/00MP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
927/00MP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
582/01MP	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
644/01MP	...	.G.	...	.AA	...	.T.	...	T..	...	A..	...	...	G..	...	..T	.CA
1265/80NW	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
820/94NW	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
675/99NW	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
733/99NW	...	.G.	...	.AA	...	...	...	T..	...	A..	...	...	G..	...	..T	.CA
142/00FS	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
549/00FS	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
851/00FS	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
641/01FS	...	.G.	...	..A	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
653/01FS	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
544/02FS	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
448/04FS	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
577/04FS	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	.C.	T.T	.CT
198/00LE	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
650/00LE	...	CG.	...	.AA	...	...	...	...	...	AC.	...	..T	G..	...	TCT	.CA
912/00LE	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
404/01LE	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
430/01LE	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
527/01LE	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA
531/02LE	...	.G.	...	.AA	...	...	...	T..	...	A..	...	..T	G..	...	T.T	.CA

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298/05LE  ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... T.T .CA
391/06LE  ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... T.T .CA
953/06LE  ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... T.T .CA
89/03KZN  ... .G. ... .AA ... ... ... T.. ... A.. ... ... G.. ... ..T .CA
103/03KZN ... .G. ... .AA ... ... ... T.. ... A.. ... ... G.. ... ..T .CA
114/03KZN ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... .CT .CA
256/03KZN ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... ..T .CA
306/03KZN ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... ..T .CA
589/03KZN ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... ..T .CA
05/03EC   ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... .CT .CA
28/03EC   ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... .CT .CA
460/03EC  ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... ..T .CA
487/03EC  ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... ..T .CA
936/03EC  ... .G. ... .AA ... ... ... T.. ... A.. ... ..T G.. ... ..T .CA

PV        TTT CAG CAA AGT GTG CAT AAT TAT AAA GTG CTG GGT CAT CTA AGC TTT
211/98    .C. ..T ... ..C ... ... ..C ..C ... .G. ... ... ..C ... GA. ...
528/97LP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
208/99LP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
1004/99LP .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
207/00LP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
438/00LP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
536/96MP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
35/00MP   .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
426/00MP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
927/00MP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
582/01MP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
644/01MP  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
1265/80NW .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
820/94NW  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
675/99NW  .C. ... ... .T. ... ... ... ... ... .G. ... .T. ... ... ... ...
733/99NW  .C. ... ... .T. ... ... ... ... ... .G. ... .T. ... ... ... ...
142/00FS  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
549/00FS  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
851/00FS  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
641/01FS  .C. T.. .G. .T. ... ... ... ... ... .G. ... ... .-. ... ... ...
653/01FS  .C. T.. .G. GT. ... ... ... ... ... .G. ... ... ... ... ... ...
544/02FS  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
448/04FS  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
577/04FS  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
198/00LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
650/00LE  .C. ... ... .T. ... ..C ... C.C ... .G. ... ... ... ... ... ...
912/00LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
404/01LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
430/01LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
527/01LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
531/02LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
298/05LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
391/06LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
953/06LE  .C. T.. ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
89/03KZN  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
103/03KZN .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
114/03KZN .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
256/03KZN .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
306/03KZN .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
589/03KZN .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
05/03EC   .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
28/03EC   .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
460/03EC  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
487/03EC  .C. ... ... .T. ... ... ... ... ... .G. ... ... ... ... ... ...
936/03EC  .C. ... ... .TA ... ... ... ... ... .G. ... ... ... ... ... ...
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PV	TCA	GTC	GAG	AAA	AAA
211/98	C..	AC.	...	...	...
528/97LP	...	...	...	...	...
208/99LP	...	...	...	...	...
1004/99LP	...	...	...	...	...
207/00LP	...	...	...	...	...
438/00LP	...	...	...	...	...
536/96MP	...	...	...	...	...
35/00MP	...	...	...	...	...
426/00MP	...	...	...	...	...
927/00MP	...	...	...	...	...
582/01MP	...	...	...	...	...
644/01MP	...	...	...	...	...
1265/80NW	...	...	...	...	...
820/94NW	...	...	...	...	...
675/99NW	...	...	...	...	...
733/99NW	...	...	...	...	...
142/00FS	...	...	...	...	...
549/00FS	...	...	...	...	...
851/00FS	...	...	...	...	...
641/01FS	...	...	...	...	...
653/01FS	...	...	...	...	...
544/02FS	...	...	...	...	...
448/04FS	...	...	...	...	...
577/04FS	...	...	...	...	...
198/00LE	...	...	...	...	...
650/00LE	...	...	...	...	...
912/00LE	...	...	...	...	...
404/01LE	...	...	...	...	...
430/01LE	...	...	...	...	...
527/01LE	...	...	...	...	...
531/02LE	...	...	...	...	...
298/05LE	...	...	...	...	...
391/06LE	...	...	...	...	...
953/06LE	...	...	...	...	...
89/03KZN	...	...	...	...	...
103/03KZN	...	...	...	...	...
114/03KZN	...	...	...	...	...
256/03KZN	...	...	...	...	...
306/03KZN	...	...	...	...	...
589/03KZN	...	...	...	...	...
05/03EC	...	...	...	...	...
28/03EC	...	...	...	...	...
460/03EC	...	...	A..	...	...
487/03EC	...	...	A..	...	...
936/03EC	...	...	A..	...	...

COMMUNICATIONS

Oral presentations

Nel L H., Ngoepe C E., Sabeta T C., Spread of canid rabies in the Free State province: A molecular epidemiology analysis. The XVIII International conference Rabies in the Americas. Mexico. 28 September to 4 October 2007.

Ngoepe C E. Spread of canid rabies in the Free State province: A molecular epidemiology analysis. Molecular and cell biology (MCBG) meeting. University of Pretoria, South Africa. 17 October 2007.

Ngoepe C E. Spread of canid rabies in the Free State province of South Africa. 13th International symposium for the world association of Veterinary Laboratory Diagnosticians. Melbourne, Australia. 11-14 November 2007.

Poster presentation

Ngoepe C E. Molecular epidemiological study of canine rabies in the Free State province (South Africa) and Lesotho. International meeting on emerging diseases and surveillance (IMED). Hilton Hotel, Vienna, Austria. 23-25 February 2007.

PUBLICATIONS:

Article in preparation

Ngoepe, C. E., Sabeta, C. T., Nel, L. H., Spread of canine rabies into the Free State province of South Africa: A molecular epidemiology analysis. To be submitted to Virus Research journal.