UNIVERSIDADE FEDERAL DE UBERLÂNDIA
INSTITUTO DE BIOTECNOLOGIA
PÓS-GRADUAÇÃO EM BIOTECNOLOGIA

MONIZE ANGELA DE ANDRADE

IDENTIFICAÇÃO DE CNVR ASSOCIADAS À QUALIDADE DE CARCAÇA E CARNE EM BOVINOS DA RAÇA NELORE

PATOS DE MINAS - MG
ABRIL DE 2019

MONIZE ANGELA DE ANDRADE

IDENTIFICAÇÃO DE CNVR ASSOCIADAS À QUALIDADE DE CARCAÇA E CARNE EM BOVINOS DA RAÇA NELORE

Dissertação de Mestrado apresentada ao Programa de Pós-graduação em Biotecnologia como requisito parcial para obtenção do título de Mestre em Biotecnologia.

Profa. Dra. Fernanda Marcondes de Rezende

PATOS DE MINAS – MG

ABRIL DE 2019

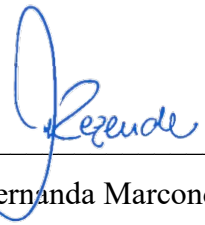
MONIZE ANGELA DE ANDRADE

IDENTIFICAÇÃO DE CNVR ASSOCIADAS À QUALIDADE DE CARCAÇA E CARNE EM BOVINOS DA RAÇA NELORE

Dissertação de Mestrado apresentada ao Programa de Pós-graduação em Biotecnologia como requisito parcial para obtenção do título de Mestre em Biotecnologia.

Aprovado em 26/04/2019

BANCA EXAMINADORA



Profa Dra Fernanda Marcondes de Rezende

Profa Dra Tatiane Cristina Seleguim Chud

Profa Dra Terezinha Aparecida Teixeira

PATOS DE MINAS – MG

ABRIL DE 2019

Dados Internacionais de Catalogação na Publicação (CIP)
Sistema de Bibliotecas da UFU, MG, Brasil.

A553i
2019

Andrade, Monize Angela de, 1993-
Identificação de CNVR associadas à qualidade de carcaça e carne em bovinos da raça nelore [recurso eletrônico] / Monize Angela de Andrade. - 2019.

Orientadora: Fernanda Marcondes de Rezende.
Dissertação (mestrado) - Universidade Federal de Uberlândia, Programa de Pós-Graduação em Biotecnologia.
Modo de acesso: Internet.
Disponível em: http://dx.doi.org/10.14393/ufu.di.2019.28
Inclui bibliografia.
Inclui ilustrações.

1. Biotecnologia. 2. Gado - Carcaças - Qualidade. 3. Nelore (Zebu). 4. Carne bovina - Qualidade. 5. Genomas - Variações. I. Rezende, Fernanda Marcondes de, 1981-, (Orient.). II. Universidade Federal de Uberlândia. Programa de Pós-Graduação em Biotecnologia. III. Título.

CDU: 60

Rejâne Maria da Silva – CRB6/1925

RESUMO

O estudo foi conduzido com o objetivo de identificar variações estruturais do genoma do tipo CNV (variações no número de cópias), e investigar a associação de CNVRs (regiões com número de cópias variável) com características de qualidade de carcaça e de carne em 658 tourinhos da raça Nelore com avaliação de peso de carcaça quente (HCW), área de olho de lombo (REA), espessura de gordura subcutânea (SBT), maciez (TD) após 7, 14 e 21 dias de maturação e teores de lipídios (IFC) e colesterol (ICC) intramuscular. Dentre esses, 407 animais foram genotipados pela plataforma Illumina Bovine beadchip HD® (777.962 SNPs). O software PennCNV foi utilizado para a identificação das CNVs, as quais foram concatenadas e associadas com as características de interesse pelo programa CNVRuler. Finalmente, os genes sobrepondo total ou parcialmente as CNVRs significativas ($p<0,05$) foram identificados por meio do pacote BioMart do R utilizando a versão UMD3.1 do genoma bovino. No total, foram identificadas 2.119 CNVs distintas, representando 1.248 duplicações únicas, 5 duplicações duplas, 794 deleções únicas e 72 deleções dupla. As CNVs foram condensadas em 475 CNVRs, representando 2,29% do genoma bovino. Destas 59 CNVRs foram significativamente associadas com as características analisadas. Alguns genes identificados nas regiões CNVs significativas apresentaram provável efeito pleiotrópico na qualidade da carcaça e da carne, sendo esses envolvidos em processos biológicos relacionados ao sistema imunológico, estrutura das membranas celulares, ligação de ATP e receptores olfativos. A identificação de CNVs ao longo do genoma bovino e a associação de CNVRs com características de qualidade da carcaça e da carne em bovinos da raça Nelore podem auxiliar no entendimento da arquitetura biológica dessas características complexas. Além de possibilitarem o desenvolvimento de novas estratégias de seleção.

Palavras chaves: *Bos primigenius indicus*, *copy number variation*, CNV, variantes estruturais.

ABSTRACT

The proposal of the study was to identify structural variants in the genome, named as CNVs (copy number variations), and investigate the association of CNVRs (copy number variation regions) with carcass and meat quality traits in 658 Nellore bulls with evaluation of hot carcass weight (HCW), rib-eye area (REA), subcutaneous backfat thickness (SBT), meat tenderness (TD) after 7, 14 and 21 days of aging, intramuscular fat content (IFC) and intramuscular cholesterol content (ICC). Among those, 407 animals were genotyped with the Illumina Bovine beadchip HD® (777,962 SNPs). The PennCNV software was used to identify CNVs, which were concatenated and associated with the traits of interest by the CNVRuler program. Finally, genes overlapping total or partially the significant CNVRs ($p<0.05$) were identified by the BioMart package from R software using the UMD3.1 version of the bovine genome. In total, 2,119 distinct CNVs, representing 1,248 single duplications, 5 double replications, 794 single deletions and 72 double deletions, were identified. The CNVs were condensed into 475 CNVRs, covering 2.29% of the bovine genome. Of those, 59 CNVRs were significantly associated with the analyzed traits. Some genes identified in the significant CNV regions showed putative pleiotropic effect on carcass and meat quality traits, being involved in biological processes related to the immune system, cellular membrane structure, ATP binding and olfactory receptors. The identification of CNVs along the bovine genome and the association of CNVRs with carcass and meat quality traits in Nellore cattle may improve our knowledge on the biological architecture of these complex traits. In addition to enabling the development of novel selection strategies.

Keywords: *Bos primigenius indicus*, *copy number variation*, CNV, structural variants.

SUMÁRIO

1 INTRODUÇÃO

O USDA (2019) prevê que a produção global de carne bovina deve crescer em 2019, principalmente com ganhos no Brasil, nos Estados Unidos e na China. O setor agropecuário é um dos principais atores da economia brasileira, contribuindo com 23 a 24% do produto interno bruto, sendo o Brasil importante produtor de proteína animal (IBGE, 2017). Em 2018, foram abatidas 31,9 milhões de cabeças bovinas, um aumento de 3,4% (1,03 milhões de cabeças) em relação a 2017 (IBGE, 2019). O mercado agropecuário vem crescendo a cada ano, com destaque para a produção de carne bovina, suína e de frango, sendo o Brasil o maior exportador, o segundo maior produtor e o terceiro maior consumidor de carne bovina (USDA, 2019).

A qualidade da carcaça e da carne depende de vários fatores, dentre estes a diferença genética entre e dentro das raças. No Brasil, a pecuária é constituída de animais de origem Zebuína, predominando a raça Nelore, que possui uma excelente adaptação ao ambiente tropical, tolerância a endo e ectoparasitas e eficiência na conversão alimentar, apresentando cortes cárneos mais tenros quando comparado com raças taurinas, precisando ser melhorada juntamente com outras características de qualidade da carne. Porém, a seleção de bovinos de corte para características de qualidade da carcaça e da carne apresenta limitações devido dificuldade e o alto custo de mensuração em larga escala (JÚNIOR, 2015). Assim, o desenvolvimento de novas biotecnologias vem permitindo o estudo do genoma e das variações genéticas existentes que influenciam características de interesse econômico.

O sequenciamento do genoma bovino permitiu a identificação de milhares de marcadores do tipo SNP (polimorfismo de nucleotídeo único) pela varredura mais ampla do genoma (MATUKUMALLI *et al.,* 2009). O desenvolvimento de painéis para a genotipagem simultânea de milhares de marcadores possibilitou a prospecção de um número maior de SNPs com um menor custo. Os SNPs são as alterações na estrutura da sequência do DNA mais estudadas, responsáveis por alterações no fenótipo dos indivíduos (INTERNATIONAL HAPMAP CONSORTIUM, 2005). Entretanto, acredita-se que outras variantes estruturais, como a variação no número de cópias dos segmentos de DNA (*copy number variation* - CNV), possam influenciar a expressão dos genes, estando também relacionadas a variações fenotípicas (HASTING *et al.,* 2009).

Redon *et al.* (2006) definiu CNV como segmento de DNA (> 1 Kb) com número de cópias variável em relação ao genoma de referência. As CNVs representam ganhos e perdas de sequências genômicas tendo efeitos potencialmente maiores em relação aos SNPs, incluindo

alterações da estrutura e dosagem dos genes, alteração da regulação gênica e exposição de alelos recessivos (BICKHART *et al.*, 2012). Desta forma o estudo e a caracterização das CNVs melhoram o entendimento da arquitetura genética dos fenótipos em características complexas.

Vários estudos vêm focando na identificação de CNVRs associadas a características complexas de valor econômico, como as características de qualidade de carcaça e carne. Berton (2017), em estudo de CNVs associadas a características qualitativas e quantitativas em 1.751 machos Nelore, encontrou 13.765 CNVs que após concatenação corresponderam a 982 CNVRs, representando 5,9% do genoma bovino. Silva *et al.* (2016), em estudo de CNVs associadas com a maciez da carne de bovinos Nelore, identificou um total de 1.155 CNVRs contendo 2.750 genes, sendo, duas CNVRs associada à maciez da carne.

O conhecimento acerca da contribuição efetiva das CNVs para o desempenho produtivo de bovinos ainda é limitado. Sendo assim, o desenvolvimento de estudos focados na identificação de variantes estruturais associadas com a expressão de características de interesse econômico possibilita não apenas melhor compreensão da estrutura genética dessas características, mas também a sua inclusão nos programas de melhoramento de bovino de corte e maior acurácia na seleção dos animais.

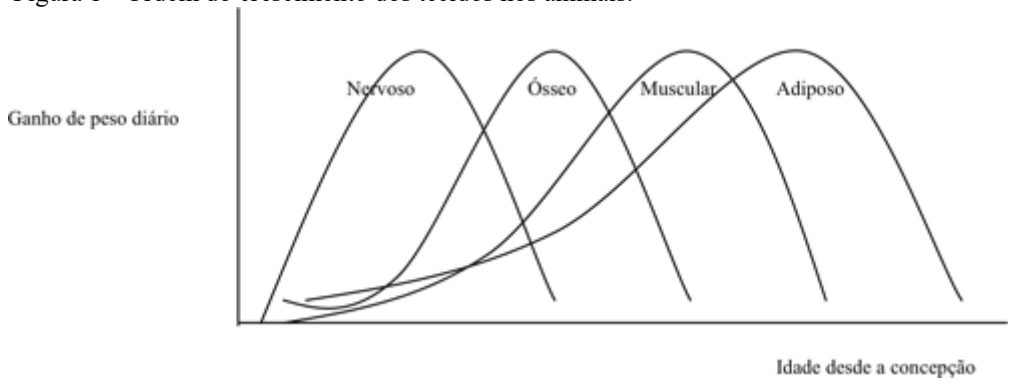
Neste sentido, o objetivo do presente estudo foi identificar CNVs no genoma de bovinos da raça Nelore e estudar a associação genética das CNVRs com área de olho de lombo, espessura de gordura subcutânea, peso de carcaça quente, maciez aos 7, 14 e 21 dias de maturação, teor de lipídio e teor de colesterol da carne.

2 REVISÃO DA LITERATURA

2.1 Características de qualidade de carcaça e carne

A qualidade da carcaça pode ser medida pelo seu rendimento, estando diretamente relacionado com a quantidade de carne comercializável. O rendimento da carcaça tem relação direta com o crescimento, sendo composta por tecido muscular, ósseo e adiposo, os tecidos de maior importância para a indústria de carne (LUCHIARI FILHO, 2000). Conforme a Figura 1 o tecido nervoso apresenta crescimento precoce e logo cessa, seguido pelo esqueleto, musculatura, e finalmente o tecido adiposo, ou seja, o teor de gordura da carcaça aumenta com a idade do animal (SAINZ; ARAUJO, 2011).

Figura 1 - Ordem do crescimento dos tecidos nos animais.



Fonte: https://www.milkpoint.com.br

Com o interesse de diminuir o ciclo de produção e com a maior demanda por carne de melhor qualidade, ocorre a necessidade de se alterar a curva de crescimento para se obter um animal com peso e acabamento de gordura adequados para o abate em uma idade cada vez menor (COUTINHO, 2014). Assim a curva pode ser alterada pela seleção para algumas características indicadoras da qualidade e produtividade da carcaça. Entre estas, as mais comuns são a área do olho de lombo (AOL) e a espessura de gordura subcutânea (EGS) medidas na altura da inserção da 12ª e 13ª costelas no músculo *Longissimus dorsi.*

A AOL é uma característica que apresenta correlação positiva com a quantidade de carne na carcaça e com o crescimento muscular. Já a EGS demostra o potencial genético do indivíduo para precocidade de acabamento tendo correlação positiva com teor de gordura na carcaça sendo indicativo da idade ao abate dos animais (SUGUISAWA, 2002).

A carne bovina possui grande mérito nutricional, fornecendo nutrientes essenciais e de alto valor biológico como proteínas, gordura, vitaminas lipossolúveis (A, D, E e K) e as hidrossolúveis do complexo B e vitamina C em pequena quantidade, minerais como ferro, fósforo, potássio, sódio, magnésio e zinco (FEIJÓ, 1999). Embora a carne possua alta contribuição nutricional, nos últimos anos, os consumidores estão mais conscientes e preocupados em relação à própria saúde e fatores como a presença de elevado teor de gordura e a sua composição têm apresentado forte influência na escolha dos alimentos (BRAGAGNOLO, 2001). Cada um dos critérios analisados pelo consumidor depende de outros fatores que influenciam na qualidade da carne, sendo importante assim, conhecer a estrutura da carne e seus constituintes que estão correlacionados com a qualidade do produto final.

Dentre as características de qualidade da carne, a maciez é considerada a característica organoléptica de maior influência na aceitação da carne por parte dos consumidores (ALVES *et al.*, 2006). A maciez da carne é dependente das características das fibras musculares, sendo afetada por diversos fatores, podendo a influência genética ser mascarada pelas variações ambientais no *post mortem* como a maturação enzimática, pH, estimulação elétrica e a temperatura de resfriamento (SIMEONI *et al*., 2014). A degradação enzimática eficaz durante o processo de *rigor mortis* resulta na maciez final da carne. Assim, o amaciamento da carne no *post mortem* é um complexo processo bioquímico que envolve a quebra das proteínas miofibrilares que mantém a integridade e estrutura das miofibrilas pelas calpaínas (HADLICH, 2003).

A maciez da carne é avaliada por método instrumental, realizado pelo aparelho *Warner Bratzler,* que avalia a força de cisalhamento medindo a resistência das fibras musculares ao corte (BORGES *et al.*, 2006). Esse processo de mensuração da maciez é de difícil operacionalização, exigindo a coleta de amostras após o abate dos animais, além de comprometer a comercialização do corte amostrado, sendo também uma medida realizada no final do ciclo produtivo, dificultando assim o processo de seleção precoce (TIZIOTO *et al.*, 2014).

A gordura da carne é um fator de preocupação devido os consumidores estarem mais conscientes com relação a saúde e o equilíbrio alimentar optando assim, por cortes cárneos com níveis adequados de gordura de cobertura, afim de manter a patabilidade, sendo que o consumo de elevados níveis de lipídios pode causar danos na saúde do homem (PROENÇA, 2010). O consumo adequado de lipídios e colesterol é fundamental por fornecerem energia, serem componente estrutural da membrana plasmática e precursores biossintéticos para o organismo (LEHNINGER, 2014). Os lipídios mais importantes são os triglicerídeos (gorduras, ceras e

óleos), fosfolipídios e esteroides. Os triglicerídeos também podem ser chamados de triacilgliceróis, gordura ou gorduras neutras estes servem como depósito de combustível metabólico e proporcionam isolamento térmico, os fosfolipídios se apresentam como componente importante das membranas e os esteroides incluem vários hormônios esteroides, sendo o de maior importância o colesterol (LEHNINGER, 2014).

Aproximadamente 70% do colesterol tem sua origem endógena, enquanto os 30% de origem exógena são provenientes da alimentação (BRAGAGNOLO, 2001), sendo assim sua ingestão em níveis controlados é importante para a saúde já que este participa de diversos processos biológicos. Adicionalmente, o colesterol necessita de lipoproteínas como transportadores para sair da corrente sanguínea e atingir os tecidos periféricos. As principais lipoproteínas são HDL (*high-density lipoprotein*), LDL (*low-density lipoprotein*) e VLDL (*very low-density lipoprotein*). O transporte de colesterol e gordura do sangue para os tecidos ocorre pelas lipoproteínas LDL e VLDL, enquanto a lipoproteína HDL retira o colesterol dos tecidos e devolve para o fígado, onde é degradado e excretado para o intestino (SCHIAVO; LUNARDELLI; OLIVEIRA, 2003). Assim, os níveis aumentados do colesterol LDL são prejudiciais para a saúde, estando associado a inúmeras doenças, como a deposição de gordura na parede dos vasos sanguíneos, doenças cardiovasculares e as síndromes metabólicas (NELSON; COX, 2011).

Devido a esses fatores, a população mais consciente vem optando por uma alimentação mais saudável com níveis reduzidos de colesterol e gordura na alimentação. Nesse sentido, as recomendações da OMS (Organização Mundial da Saúde) são focadas em dieta equilibrada, com baixo teor de lipídios, colesterol e ácidos graxos saturados e maior taxa de ácidos graxos monoinsaturados e poli-insaturados.

2.2 Variantes estruturais do genoma

As variações genéticas incluem desde mudanças nucleotídicas pontuais até o ganho ou perda de cromossomos inteiros, sendo os SNPs considerados a variação genética mais frequente no genoma (STRACHAN; READ, 2013). Os SNPs são encontrados ao longo do genoma, podendo atuar como marcadores genéticos, ocorrendo dentro ou fora de um gene ou em uma região reguladora.

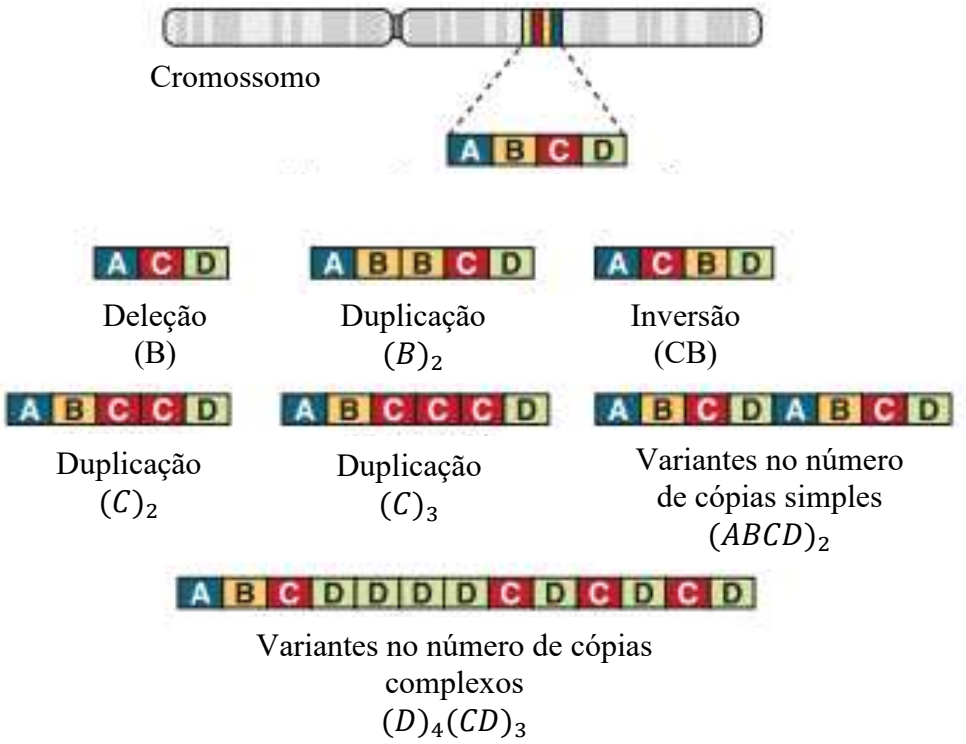
Os SNPs têm sido objetivo de diversos estudos, sendo que os pesquisadores acreditavam que estes eram os principais responsáveis pela existência de variações genéticas no genoma afetando o fenótipo (INTERNACIONAL HAPMAP CONSORTIUM, 2005). Entretanto, a

existência de variações no número de cópias do DNA tem sido foco de estudos para a compreensão genética de características complexas. Assim, centenas de CNVs foram identificadas nos últimos anos, levando os pesquisadores a acreditarem que estas são componentes importantes da diversidade genética no genoma que podem afetar o fenótipo, causando alterações em características de interesse econômico (BERTON, 2017; SILVA *et al*., 2016).

Segundo o Internacional HapMap Consortium (2005), as CNVs englobam mais conteúdo de nucleotídeos por genoma do que SNPs, ressaltando assim a importância da CNV na diversidade genética. Redon *et al.* (2006) definiu as CNVs como segmentos de DNA de um kilobase (kb) ou maior presente em um número de cópia variável em comparação com o genoma de referência, podendo estas serem de estrutura simples, como a duplicação em tandem, ou podem envolver ganhos ou perdas complexas em múltiplos locais do genoma. As CNVs são um tipo de variações estruturais cromossômicas que ocorrem em fragmento de DNA, podendo ser representadas por duplicações ou deleções (Figura 2).

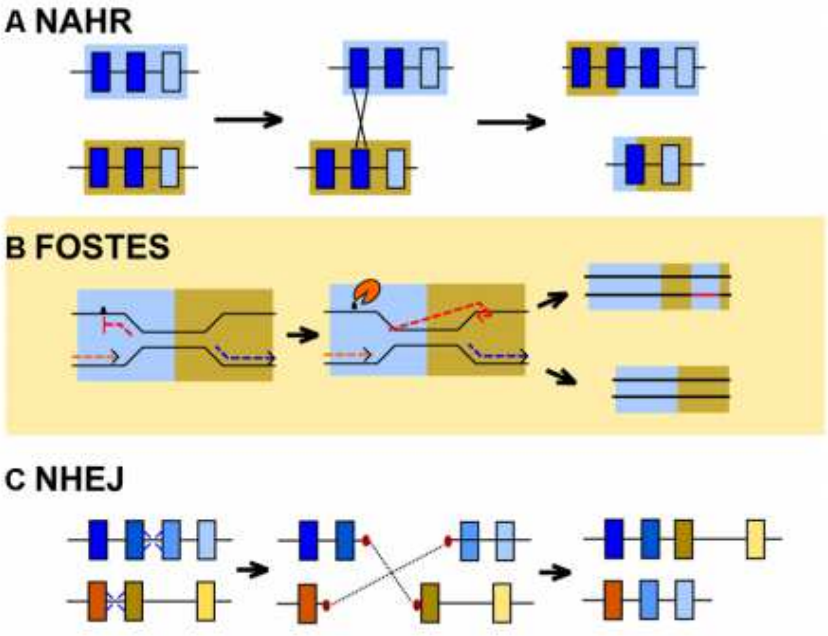
As CNVs podem ser formadas por vários mecanismos, tais como recombinação homóloga não-alélica (NAHR), parada na replicação do DNA ou troca da forquilha de replicação medidas por regiões micro-homologia (FOSTER), junção das extremidades não-homólogas (NHEJ) (Figura 3) (CLOP *et al.,* 2012). A NAHR ocorre por meio de emparelhamento entre as sequências podendo ter um evento de recombinação normal, já o FOSTER ocorre quando a maquinaria de replicação do DNA para, a fita se dissocia da polimerase e associa a fita atrasada com outra região do genoma antes que a replicação seja reiniciada (BICKHART; LIU*,* 2014). O NHEJ é um mecanismo de reparo de DNA que é iniciado em resposta a DSBs na sequência do DNA, as DSBs são identificadas, reparadas e ligadas umas às outras, em diferentes regiões do genoma (BICKHART; LIU*,* 2014).

Figura 2 - Representação das variações estruturais cromossômicas.



Fonte: Dierssen; Herault; Estivill (2007)

Figura 3 - Mecanismo de formação de variação no número de cópias (CNV)



Fonte: Bickhart; Liu (2014)

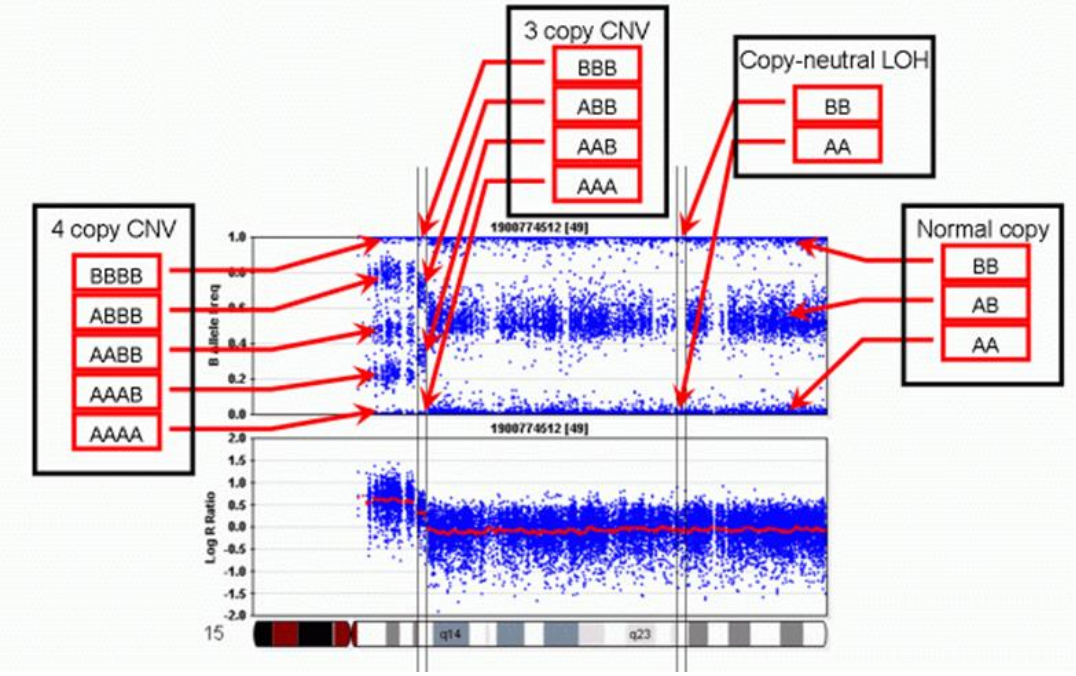
2.3 Identificação das CNVs

As CNVs podem ser identificadas por diferentes métodos, como hibridização genômica comparativa por meio de microarranjos de DNA (CGH), plataformas de genotipagem de alta densidade e sequenciamento genômico de última geração (NGS) (BICKHART; LIU, 2014). Com a disponibilidade de genomas de referência para bovinos (THE BOVINE GENOME SEQUENCE AND ANALYSIS CONSORTIUM, 2009; ZIMIN *et al*., 2009), as ferramentas para detecção de SNPs vêm sendo utilizadas para identificar as CNVs, sendo a técnica alternativa mais sensível para detecção de CNV com melhor viabilidade econômica (WANG *et al*., 2007).

A CNV é identificada usando sondas de genotipagem para analisar uma janela móvel na razão Log R e na frequência do alelo B, que representa a medida normalizada da taxa de intensidade relativa do sinal de cada alelo em relação à posição do marcador ao longo dos segmentos cromossômicos (COLELLA *et al.,* 2007; ILLUMINA, 2016). A deleção ou duplicação de uma região específica é determinada pela comparação do sinal das amostras em relação a sequência de DNA de referência, em que o aumento da intensidade do sinal da fluorescência em determinada região representa amplificações ou duplicações, e redução do sinal representa deleções (CASSESE *et al.*, 2014).

O software PennCNV tem sido amplamente utilizado para a detecção de CNV em animais domésticos utilizando a metodologia do modelo oculto de Markov, utilizando o LRR e o BAF para cada marcador SNP. Quando ocorre uma deleção, há diminuição dos valores de LRR e uma ausência de heterozigotos nos valores de BAF, já na presença de uma duplicação, há aumento nos valores de LRR e uma separação do genótipo heterozigoto em dois grupos (Figura 4).

Figura 4 - Identificação de CNV utilizando Log R e BAF



Fonte: Wang et al. (2007)

2.4 Associação de CNV com fenótipo

A associação de regiões CNVs (CNVRs) com fenótipos de interesse econômico tem sido foco de estudos na pecuária com objetivo de entender os processos biológicos, pois estes podem afetar características de produção (BICKHART *et al*., 2012). As CNVRs são identificadas quando observado ao menos um par de base de sobreposição entre as CNVs (REDON *et al*., 2006). Recomenda-se a utilização de CNVRs em estudo de associação com fenótipos, devido ao grande número de falso-positivos e a alta taxa de ruído na intensidade do sinal quando as CNVs são individualmente identificadas (CASSESE *et al*., 2014). Vários métodos estatísticos podem ser implementados, como teste chi-quadrado, teste exato de Fisher, regressão logística e regressão linear para estudo da associação dos CNVRs com os fenótipos (CHUNG; KIM, 2011).

Genome-wide CNV detection and CNVR association with carcass and meat quality traits

Monize Angela de Andrade[1], Adriana Santana do Carmo[2], Anna Carolina Fernandes[3], Tatiane Cristina Seleguim Chud[4], Marina de Nadai Bonin[5], Minos Esperândio Carvalho[6], José Bento Sterman Ferraz[6], Elisângela Chicaroni de Mattos[6], Joanir Pereira Eler[6] and Fernanda Marcondes de Rezende[1,3*]

[1]Instituto de Biotecnologia, Universidade Federal de Uberlândia, Patos de Minas, Minas Gerais, Brazil

[2]Escola de Veterinária e Zootecnia, Universidade Federal de Goiás, Goiânia, Goiás, Brazil

[3]Faculdade de Medicina Veterinária, Universidade Federal de Uberlândia, Uberlândia, Minas Gerais, Brazil

[4]Department of Animal Biosciences, University of Guelph, Guelph, Ontario, Canada

[5]Faculdade de Medicina Veterinária e Zootecnia, Universidade Federal do Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil

[6]Departamento de Medicina Veterinária, Faculdade de Engenharia de Alimentos e Zootecnia, Universidade de São Paulo, Pirassununga, São Paulo, Brazil

*Corresponding author:

Email: frezende@ufu.br (FMR)

Abstract

Copy number variants (CNVs) are another type of structure genetic variation that has been providing valuable insights of the genetic architecture and phenotypic variation of complex traits in livestock animals. CNVs were inferred from Illumina® high density SNP-chip data for a Nelore population of 407 bulls. Association analysis of CNV regions (CNVRs) and eight carcass and meat quality traits were performed applying a linear regression approach. In total, 2,119 CNVs were detected in the autosomal chromosomes and aggregated in 475 CNVRs, covering 2.29% of the bovine genome. CNVRs associated with hot carcass weight, ribeye area, subcutaneous backfat thickness, meat tenderness after 7, 14 and 21 days of aging, intramuscular fat content and intramuscular cholesterol content were identified across 22 out of the 29 bovine autosomal chromosomes. Candidate copy number variable genes (i.e. genes overlapping partially or totally significant CNVRs), such as OR gene family, TAS2R38, MGAM, RARα and TRAK1, were identified with putative pleotropic effect on carcass and meat quality traits. In addition, CNVRs in genes associated with muscle differentiation, growth and development (TPM4, USP2, HYAL1, HYAL2), cellular processes regulation (ZC3H6, SIVA1), and related to lipid (DECR2, CYP17A1) and energy metabolism (ADSSL1) were also identified. Moreover, gene-set analysis revealed terms linked with muscle physiology, protein metabolism, transmembrane transport and cell energy metabolism. These gene sets are directly implicated in muscle growth and development, muscle into meat conversion and fat deposition. Overall, this study unravels copy number variable genes and pathways affecting carcass and meat quality traits in Nelore beef cattle. These findings may improve our understanding about the genetic architecture of these traits, contributing to the

development of novel genomic strategies for improving carcass and meat quality traits in Nelore.

Keywords: beef cattle, candidate gene, Nelore, structural variants

Introduction

Carcass and meat quality are generic terms used to describe a range of attributes that are important to beef producers, retailers and consumers. Carcass weight and composition are the most important aspects to determine the economic value of the carcass. Fat amount and distribution have a direct impact on meat processing, tenderness, flavor, juiciness and chewing. Lipid content and composition have been associated with both beneficial and injurious effects on human health [1]. Clearly, these properties and perceptions of meat are important to consumer's eating satisfaction and influence the purchase decision. Understanding the genetic architecture of these traits may contribute to the development of genomic strategies to guarantee the stability and market expansion of the beef industry.

Traditional selection for these traits is limited due to the difficulty of large-scale measurement and high costs. During the last decade, genome-wide association studies (GWAS), performed primarily in *Bos taurus*, and then, in *Bos indicus* cattle, have identified regions in the genome associated with carcass and meat quality traits [2-7]. However, GWAS analysis allows the identification of genetic markers with the strongest evidence of association, and they do not give a good description of the genetic architecture of complex trait, explaining only a small proportion of the genetic variance [8]. Alternative frameworks, including other sources of genetic variations, such as copy number variants (CNVs), has been explored to explain the missing heritability and potentially provide valuable insights into the real molecular architecture of complex traits [9-12].

CNVs are defined as DNA segments ranging from kilobases to megabases in size that display variable copy number between the individuals of a population [13, 14]. These

types of structural variations, which include deletions and duplications, are important sources of genetic and phenotypic variation [15]. Moreover, copy number variation regions (CNVRs) represent the union of overlapping CNVs [13]. Compared to single nucleotide polymorphisms (SNPs), CNVs involve more total bases, appear to have higher mutation rate, and potentially greater effects, including changing gene structure and dosage, altering gene regulation and exposing recessive alleles [16]. The differences in copy number can influence directly or indirectly gene expression and explain genetic variability of important economic traits. Therefore, many studies have been successfully performed to identify CNVs in regions containing genes affecting complex traits in livestock animals [17-25]. In Nelore cattle, copy number variable genes affecting growth, production, feed efficiency, environmental adaptation and meat quality traits have been reported [26-32]. Several factors, such as technology, array platform, array density, calling algorithm and population genetic background, influence the performance of CNV screening [33-35]. In this sense, location, number, size and type of CNV calls can differ from one study to other, even within breeds, and must be take into account when comparing with previous studies.

The current study aimed to perform a genome-wide CNVR association with carcass and meat quality traits, such as hot carcass weight, ribeye area, subcutaneous fat thickness, meat tenderness, intramuscular fat and intramuscular cholesterol content.

Material and methods

Population and phenotypes

The population under study comprises 658 non-castrated Nelore young bulls from a commercial breeding program that routinely performs genetic evaluations for

104 production and reproduction traits. The animals were raised under pasture conditions
105 until 18 to 22 months of age and then fed on feedlots until slaughter, between 21 and
106 34 months of age. Animals were slaughtered at 706.44 days of age on average (SD =
107 160.75) at a commercial slaughterhouse, following all recommended protocols for
108 commercial slaughter under the Brazilian laws. First, hot carcass weight (HCW) was
109 recorded, and then, carcasses were sawed longitudinally down the middle and chilled
110 for 24 h at 2° ± 1°C. After this period, ribeye area (REA) and subcutaneous backfat
111 thickness (SBT) were measured at $12^{th}/13^{th}$ ribs, and four steaks of ~2.5 cm of
112 thickness from the *longissimus dorsi* muscle were sampled toward the tail from each
113 animal, always on the left carcass side. The steaks were individually identified and
114 vacuum packed (Selovac M160) in highly flexible Polyfilm®. The first three steaks
115 underwent an aging process in a cold chamber at 2 °C ± 1 °C for 7, 14 and 21 days,
116 respectively. Meat tenderness (TD) was evaluated after each aging period using
117 Warner–Bratzler shear force equipment and was determined as the average shear
118 force of the eight cores of 1.27 cm diameter removed per steak. Subsamples of the
119 entire area of the fourth steak were used for lipid profile analysis. Intramuscular fat
120 content (IFC) was determined based on the methodology described by Bligh & Dyer
121 [36] that uses chloroform and methanol to total lipid extraction. Finally, intramuscular
122 cholesterol extraction and quantification were made according to the method described
123 by Saldanha et al. [37], which is based on the degradation of cholesterol by the enzyme
124 cholesterol oxidase producing hydrogen peroxide that through secondary reaction
125 produces color. The color intensity produced is directly proportional to the amount of
126 cholesterol contained in the sample, hereafter called intramuscular cholesterol content
127 (ICC).
128

Genotypic data and CNV calling

Genomic DNA was extracted and purified from meat samples using the NucleoSpin® Tissue kit (Macherey-Nagel, Düren, Germany). A total of 407 young bulls were genotyped for 777,962 SNP markers with Illumina BovineHD® BeadChip assay (Illumina, Woodlands, Singapore). For CNV calling, log R ratio (LRR) and B allele frequency (BAF) from the genotype signal at each SNP provided by the GenomeStudio software (Illumina®) were used. The LRR is a normalized measure of total signal intensity of the two SNP alleles calculated from the ratio between the observed and the expected probe intensity. BAF is defined as the normalized allelic intensity ratio for each SNP and represents the proportion of B alleles in the genotype. The PennCNV algorithm incorporates the LRR, the distance between neighboring SNPs and the population frequency of the B allele into a hidden Markov model to infer CNV calls for individual genotyped animals [38]. The population frequency of the B allele (PFB) was calculated based on the BAF of each marker in this population. Only autosomal SNP markers with known position were considered in the analysis. To avoid spurious CNV calls, the LRR values were corrected for genomic wave bias caused by the guanine-cytosine (GC) content in regions located at 500 kb upstream and downstream of the SNP [39]. After CNV detection, filtering of low-quality samples was carried out with the default cutoffs for standard deviation of LRR (>0.30), BAF drift (>0.01) and waviness factor (>0.05). Samples meeting any of these three criteria were excluded. In addition, CNVs spanning fewer than 10 SNPs were also removed [40].

CNVR identification and association analysis

The CNV regions (CNVRs) were determined by aggregating CNVs identified in two or more animals that shared at least one base pair overlap (13). They were inferred by

154 CNVRuler software [41] using filtered individual CNV calls originated from the
155 PennCNV. The CNVRs were classified by the software as gain, loss or mixed. The
156 mixed type of CNVRs was defined when a genomic region presented both types of
157 gain and loss of CNVRs among the study population.
158 Association analyses using adjusted phenotypic values were performed to identify the
159 CNVRs significantly associated with eight carcass and meat quality traits. CNVRs with
160 less than 1 % allele frequency were not included in the analyses. Single trait analyses
161 were performed by MTDFREML software [42] to estimate fixed non-genetic effects
162 solutions for HCW, REA, SBT, TD7, TD14, TD21, IFC, and ICC, under animal model,
163 using the complete phenotypic data available (658 animals) and a relationship matrix
164 composed of a total of 4,065 animals. The convergence criterion used was the variance
165 of the -2Log L function obtained by the simplex method, at the level of 10^{-12} The
166 descriptive statistics of the complete data set analyzed to estimate fixed effects
167 solutions were presented in Table 1. After removing non-genetic fixed effects, the
168 adjusted phenotypes that represent the sum of direct additive plus residual portions of
169 the observed phenotypes were used as phenotypes in association analyses. Linear
170 regression was used to determine associations between CNVRs and carcass and
171 meat quality traits by CNVRuler software.
172
173 **Table 1. Summary statistics of the complete data set used to estimate fixed non-**
174 **genetic effects solutions for hot carcass weight (HCW), ribeye area (REA),**
175 **subcutaneous backfat thickness (SBT), tenderness (TD) after 7, 14 and 21 days**
176 **of aging, intramuscular fat content (IFC) and intramuscular cholesterol content**
177 **(ICC).**

Trait	N	Mean	SD	CV (%)
HCW (kg)	658	290.40	17.66	6.08

REA (cm^2)	656	73.36	7.05	9.61
SBT (mm)	654	4.38	1.99	45.50
TD7 (kg)	656	5.93	1.44	24.24
TD14 (kg)	655	4.96	1.27	25.55
TD21 (kg)	655	4.40	1.10	24.97
IFC (g/100 g of meat)	576	2.19	0.65	29.65
ICC (mg/100 g of meat)	615	56.42	8.26	14.65

N: number of observations; SD: standard deviation, CV: coefficient of variation.

Probable genes and functional enrichment in CNV regions

Genes overlapping significant CNV regions was assessed from Ensembl Genes 94 database, based on the information provided by the UMD3.1 bovine genome assembly, using Bioconductor R package BioMart [43]. Overlaps of CNVR with annotated genes were defined as at least one base pair overlap. Additionally, a three-step gene-set analysis [44] was implemented to provide insight into the functional enrichment of copy number (CN) variable genes. First, significant copy number variable genes were defined as those overlapping significant CNV regions at minimum one base pair. Next, the Gene Ontology (GO) database [45] was used to define gene sets. Finally, the association of a given gene set with carcass and meat quality traits was assessed using a hypergeometric test, also known as Fisher's exact test [46, 47]. The GO gene-set enrichment analyses were performed using R script and the Bioconductor R package BioMart [43] to retrieve GO terms from Ensembl Genes 94 database (UMD3.1). It is worth noting that a portion of the genes in the bovine genome has not been annotated or has been annotated with unknown function, which may influence the outcomes.

Results and discussion

Genome-wide CNV detection

A total of 735,294 autosomal SNP markers were used to infer 5,174 non-redundant copy number variation (CNV) events in 407 animals, representing 2,784 single copy duplications, 13 double copy duplications, 1,867 single copy deletions and 510 double copy deletions. Of those, 383 animals met the three filtering criteria, and 2,119 distinct CNV calls spanned at least 10 SNPs. Out of 3,055 CNVs excluded in quality control, 273 (8.9 %) were unique CNV calls identified in the 24 low-quality samples, which presented between 1 and 56 unique CNVs. Additionally, 6 low-frequency CNVs were also removed with those samples. A full list of the CNV calls after filtering can be found in S1 Table. The average number of filtered CNV calls per individual was 19, ranging from 7 to 76, with mean size of 178.63 kb. Single copy duplications (58.9 %) followed by single copy deletions (37.5 %) were the most frequent events in this Nelore population (Table 2). Similarly, Silva et al., [28] observed these two events as the most commons in 1,717 commercially available Nelore semen samples, accounting together for 97.3 % of the CNV calls identified.

Table 2. Number (N) of CNV events, mean, minimum (Min) and maximum (Max) CNV size in quilobases (kb), and mean, minimum (Min) and maximum (Max) number of SNPs per CNV.

CNV event	N	Mean (kb)	Min (kb)	Max (kb)	Mean SNPs	Min SNPs	Max SNPs
Single copy duplication	1,248	243.79	7.16	2,116.13	31.15	10	200
Double copy duplication	5	243.97	104.34	419.75	35.00	12	93
Single copy deletion	794	73.35	8.39	580.83	20.47	10	335
Double copy deletion	72	205.68	25.09	623.25	21.42	10	107

The distribution of the 2,119 CNVs across the bovine chromosomes is shown in Fig 1. The highest percentage of the CNV calls is located on BTA12 (10.4 %), followed by BTA15 (7.8 %), BTA7 (6.8 %) and BTA10 (6.3 %), harboring together 663 CNVs. Chromosomes BTA27 (11), BTA24 (12), BTA6 (14), BTA20 (14) had the lowest number of CNVs. No clear pattern could be observed on CNVs distribution across the autosomal chromosomes.

Fig 1. Chromosome distribution of copy number variations (CNVs) detected in Nelore cattle with high-density genotyping data.

CNV regions mapping and association analysis

Copy number variable regions (CNVRs) represent the union of overlapping CNVs. CNVRs were identified by CNVRuler software [41] using filtered individual CNV calls overlapping at least one base pair. The 2,119 distinct CNVs were grouped into 475 CNV regions covering 57,637,460 pb, which represents 2.29 % of the bovine autosomal genome (2.51 Gb, http://www.ccb.jhu.edu/bos_taurus_assembly.shtml) (S2 Table and S3 Table). The number of regions with copy loss and gain were 292 and 169, respectively. Presence of both types was observed in 14 regions. Likewise, Santana et al. [27] and Silva et al. [29] reported more losses than gain and mixed regions, opposing to Silva et al. [28] that observed more mixed regions. CNVRs length varied from 7.2 to 2,910.2 kb, with an average of 121.3 kb. The majority CNVRs had size between 7 and 100 kb (76.6 %) whereas CNVRs larger than 900 kb were rarely observed (1.5 %, Fig 2). Loss events were 1.7-fold more common than gain but had smaller sizes on average than gain events (63.2 kb vs. 161.4 kb). Mixed events showed the largest average size (850.7 kb), ranging from 106.5 kb and 2,910.2 kb.

Fig 2. Size distribution of copy number variable regions (CNVRs) detected in Nelore cattle with high-density genotyping data.

Chromosomal distribution of CNVRs revealed that BTA8 had the highest number of CNVRs (29), while at BTA24 only 4 CNVRs were detected (Fig 3). The chromosomal proportion covered by CNVRs varied from 0.7 % for BTA20 to 7.0 % for BTA12. Similarly to what was observed in CNV detection, CNVRs are non-uniformly scattered along the autosomes.

Fig 3. Chromosome distribution of copy number variable regions (CNVRs) detected in Nelore cattle with high-density genotyping data.

The CNVR with the highest frequency, observed in a total of 70.50 % of the analyzed samples (270/383), was found at BTA12 (CNVR_236: 74,840,021–76,608,564 pb), while 191 unique CNVRs were identified across all chromosomes (varying from 1 at BTA27 to 11 at BTA4, BTA8, BTA11 and BTA21). Curiously, the few long-size CNVRs (>900 kb) were among the most commons in this Nelore population, being found in average on 180 individuals (46.7 %). A total of 181 CNVRs occurred in more than 1 % of the population and were used in further analysis.

In line with the hypothesis that copy number variable regions may have important effects on phenotypes, linear regression analyses were performed to investigate the association of the 181 detected CNVRs with hot carcass weight (HCW), ribeye area (REA), subcutaneous backfat thickness (SBT), tenderness (TD) after 7, 14 and 21 days of aging, intramuscular fat content (IFC) and intramuscular cholesterol content

(ICC). There were 59 non-fixed CNV regions (29 defined as gain, 25 as loss and 5 as mixed) significantly associated (*P*-value < 0.05) with at least one trait (S4 Table). The significant region with the highest frequency (56.4 %) was found at BTA1 (CNVR_16: 93,730,576–93,819,471 pb), while the associated CNVRs with the lowest frequency (1.3 %) were localized at BTA4 (CNVR_80: 105,994,555–106,142,458 pb) and BTA16 (CNVR_301: 15,070,508–15,118,639 and CNVR_307: 52,068,803–52,115,458 pb). A total of 12, 15, 9, 8, 17, 8, 10 and 4 CNVRs were associated with HCW, REA, SBT, TD7, TD14, TD21, IFC, and ICC, respectively. Genetic correlations between carcass and meat quality traits have been widely reported in taurine and indicine beef cattle breeds [48-52]. Since these traits are not independent, it is expected that certain CNVRs may be associated with two or more traits than expected in a situation where all traits are independent. In this case, CNVRs regulating two or more traits may be considered as pleiotropic structural variants.

Gene content of significant CNV regions

CNVs encompassing functional genes can alter phenotypes by changing gene structure and dosage, altering gene regulation and exposing recessive alleles, as a consequence of naturally occurring evolutionary process [16], artificial selection and genetic drift due to a genetic bottleneck in some breeds [11]. A total of 236 genes out of 24,903 UMD3.1 bovine genome annotated genes overlapped the 59 CNVRs significantly associated with carcass and meat quality traits. These genes can be functionally classified as protein coding (*n* = 200), pseudogenes (*n* = 13), ribosomal RNA (*n* = 9), micro-RNA coding (*n* = 5), small nuclear RNA coding (*n* = 5) and small nucleolar RNA coding (*n* = 4). This set of copy number variable genes possess a wide spectrum of molecular and biological functions and provides a rich source of

294 information on the genetic basis of the phenotypic variation of carcass and meat quality
295 traits in Nelore cattle. For a complete list of CNV gene intersections, see S5 Table.
296 Interestingly, the majority of the overlapping genes (90.7 %) were completely spanned
297 by CNV regions, while for 22 genes the intersection region varied between 10.5 and
298 98.5 %.

299 Consistent with other studies in cattle [11, 14, 31, 32, 53-57], *olfactory receptors* (OR),
300 *pregnancy-associated glycoprotein* (PAG) and *bovine major histocompatibility*
301 *complex* (BoLA) gene families appeared to be copy number variable in this Nelore
302 population. Copy number variations were found in the OR gene family (CNVR_127,
303 CNVR_272, CNVR_290, CNVR_292, CNVR_293, CNVR_296, and CNVR_466)
304 affecting HCW, TD7, TD14, IFC, and ICC, in the PAG gene family (CNVR_469)
305 influencing IFC, and in the BoLA gene family (CNVR_408) associated with ICC
306 deposition.

307 The OR gene family are chemosensory receptors, members of the superfamily of G
308 protein-coupled receptors, expressed not only in the olfactory epithelium that have the
309 ability to detect a variety of chemical cues [58, 59]. The effect of OR on carcass and
310 meat quality traits can be due to their action in feeding behavior and appetite regulation
311 [60], muscle regeneration [61], energy and lipid metabolism [62], adipogenesis [63]
312 and fatty acid absorption in the duodenum [64]. Furthermore, SNP genome-wide
313 association studies of Nelore cattle identified a cluster of OR genes associated with
314 marbling and meat tenderness [4], and copy number variable genes affecting meat
315 fatty acid profile [32].

316 Pregnancy-associated glycoproteins represent one of the major trophoblast secretory
317 products that belong to the aspartic proteinase (AP) family, and are known to be
318 involved in proper placenta development and embryo-maternal interaction [65-67].

Although the catalytic mechanism is the reason for the name of aspartic acids group of enzymes, which includes pepsin, chymosin, cathepsin D and renin, PAGs are catalytic inactive as proteinases even appear to possess a cleft capable of binding peptides [68]. Given the detected CN variability in PAG genes in cattle, Bickhart et al. [69] suggested that subfunctionalization, neofunctionalization, or overdominance could play roles in diversifying these fertility-related genes. Here, PAG genes were for the first time identified influencing intramuscular fat content, nevertheless, its relation with lipid metabolism or adipogenesis have not been reported, and the role of these genes needs to be ascertained on further investigations.

The bovine *major histocompatibility complex* (MHC) genes are referred to as *bovine lymphocyte antigen* (BoLA) and are known to play a critical role in the immune system [70]. In addition, BoLA genes have been associated with meat tenderness in Nelore cattle [71], intramuscular fat deposition in Hanwoo cattle [72] and milk fat yield in Gyr [73] and Holstein dairy cattle [74]. In humans, links between innate immune system responses and cholesterol accumulation in the adipose tissue and the arterial wall were described [75]. However, there is no previous report of BoLA genes affecting intramuscular cholesterol content in beef cattle populations.

Candidate genes overlapping significant CNVRs with putative pleiotropic effect on carcass and meat quality traits in Nelore cattle will be briefly described. *Taste 2 receptor member 38* (TAS2R38) and *maltase-glucoamylase* (MGAM) genes overlapped with CNVR_80 duplication, which was significantly associated with HCW, SBT, TD7, and TD14. In humans, variations in the bitter-taste receptor gene (TAS2R38), a member of the superfamily of G protein-coupled receptors that controls the ability to taste glucosinolates, have been associated with impaired food consumption, which may lead to obesity [76, 77]. Although bovines have fewer genes

344 coding for the bitter receptors than other mammals, the bitter taste seems to have a
345 rather negative hedonic value affecting feeding behavior [78], which ultimately can
346 impact animals performance. It is well-known that maltase-glucoamylase enzyme acts
347 in the cleavage of maltose into glucose at the small intestine, and its contribution to
348 blood glucose in non-ruminants is about 40 % [79]. Although, there is a research gap
349 in the role of this intestinal disacharidase in ruminants [80], the differential expression
350 of MGAM gene observed in the jejunum of steers with high average daily gain could
351 indicate a more efficient small intestinal starch digestion, contributing to improved
352 growth and nutrient utilization [81]. Additionally, glucose is a major contributor in terms
353 of blood energy supply to tissues, and may be converted either into glycogen or
354 triacylglycerols stored within tissues, such as muscles and adipose tissues [82],
355 explaining the observed variation in tenderness and subcutaneous backfat thickness.
356 *Retinoic acid receptor alpha* (RARα), also known as NR1B1, was found as a pleiotropic
357 candidate copy number variable gene (CNVR_357) for HCW, TD14 and TD21 due to
358 its important role in controlling growth hormone expression [83] and regulating
359 adipogenesis [84]. The function of TRAK1 (*trafficking kinesin protein 1*) gene in skeletal
360 muscle has not been described. However, its higher expression in the breast muscle
361 of Pekin duck at 8 weeks compared with 2 weeks of age [85] may be associated with
362 muscle development, and could justify its association with HCW and REA (CNVR_394)
363 in Nelore cattle.
364 *Inositol polyphosphate-5-phosphatase E* (INPP5E), *SEC16 homolog A endoplasmic*
365 *reticulum export factor* (SEC16A) and *small nuclear RNA activating complex*
366 *polypeptide 4* (SNAPC4) that overlapped with CNVR_219 are candidate genes for
367 HCW. Those genes were previously reported regulating feed intake [86], integrating

368 growth factor signaling [87] and affecting intrahepatic biliary network [88] respectively,
369 which ultimately may impact carcass weight.
370 Several genes were found in CNVRs associated with REA (CNVR_121, CNVR_130,
371 CNVR_280, and CNVR_398), but only those directly involved in muscle differentiation,
372 growth and development will be described. RAB8A gene is part of the Ras superfamily
373 of small GTPases that through their effectors regulate vesicle formation, vesicle
374 movement, and membrane fusion [89]. This gene encodes a protein involved in insulin-
375 regulated GLUT4 translocation, which is a glucose transporter at the plasma
376 membrane of muscle cells and adipocytes [90]. GLUT4 transporters seem to be
377 associated with myogenesis and muscle maturation [91, 92], suggesting that RAB8A
378 may play an important role in these processes. It is well-established that cytoskeletal
379 proteins are involved in the organization of structural proteins in muscle into highly
380 ordered sarcomeres during development, regeneration and focal repair of skeletal
381 muscle fibers [93]. Tropomyosin (TPM) is a cytoskeletal protein which interacts with
382 troponin and actin, regulating skeletal muscle contraction and stabilizing the actin
383 filament [94]. Curiously, Vlahovich et al. [93] reported that elevated presence of
384 tropomyosin 4 protein (TPM4) in muscle fibers reflects active growth, regeneration and
385 repair processes, which can be the reason for the effect of TPM4 gene on REA
386 detected here. GADD45B is another interesting copy number variable gene that has
387 been implicated in cell cycle arrest and apoptosis, functioning in negative growth
388 control during myogenic differentiation [95, 96]. USP2 is a member of the family of
389 deubiquitinating enzymes expressed as two distinct isoforms with opposing effects in
390 muscle differentiation. Fusion and differentiation are stimulated by overexpression of
391 USP2a, while overexpression of USP2b inhibits these processes [97, 98]. Finally,
392 HYAL1 and HYAL2 genes encode enzymes with chondroitin sulfate (CS) degradation

activity, which forced down-regulation levels enhance myogenic differentiation [99, 100]. Although, LSMEM2 and NAA80 genes have been reported associated with muscular dystrophy and cytoskeleton structure [101, 102], further investigations with tentative links to REA are warranted.

Fourteen annotated genes overlapped with CNVRs exclusively associated with SBT (CNVR_334, CNVR_384, CNVR_422, and CNVR_438), but evidence of their effect on fat deposition was found for five of them. DECR2 gene is known to be involved in fatty acid metabolism regulation, which is required for triglycerides synthesis, a key factor for fat deposition [103, 104]. Indeed, a significant QTL affecting fat deposition in pigs was mapped near this gene [105]. Although the exact function or effect of the FAM234A (also known as ITFG3) gene was not entirely clear, it is shown to be of genome-wide significance for abdominal fat weight in chicken [106]. Previous studies revealed the *mitochondrial ribosomal protein L28* (MRPL28) as an important gene for abdominal fat deposition in chicken [107] and as obesity-related gene in mice [108]. This gene participates in oxidative phosphorylation, therefore changes in its expression might affect the ability to oxidize fat. TMEM8A is an orphan membrane protein with unknown function that was recently reported having circadian rhythmicity in human and baboon adipose tissues [109], which might have an impact on the regulation of lipid metabolism. Lastly, CYP17A1 gene positively regulates estrogen biosynthesis from cholesterol and has been suggested to have an impact on visceral and subcutaneous fat mass in humans [110].

Meat tenderizing process involves different proteolytic systems and their inhibitors, resulting in proteolysis of myofibrillar and associated structural proteins that cause weakening of the muscle fiber structures [111]. During post-mortem aging, muscle proteins are also subject to denaturation, and differences in protein modifications

418 between tender and tough meat samples from 0 to 21 days of aging were reported by
419 Laville et al. [112]. Here, specific candidate CN variable genes were found exclusively
420 associated with TD7, TD14, or T21. *Complement factor H* (CFH) gene was found
421 completely spanned by CNVR_297 that had a significant effect on TD7. Despite the
422 broad range of physiologic activities and phenotypes associated with CFH gene
423 variants in humans [113], its relation with muscle color in chicken [114] and its
424 differential expression in subcutaneous fat in beef cattle [115], any study investigating
425 the association of this gene with meat tenderness was found.
426 *Zinc finger CCCH-type containing 6* (ZC3H6), *adenylosuccinate synthase like 1*
427 (ADSSL1), *AKT serine/threonine kinase 1* (AKT1), *inverted formin, FH2 and WH2*
428 *domain containing* (INF2) and *SIVA1 apoptosis inducing factor* (SIVA1) genes appear
429 to be candidate genes for TD14 (CNVR_200 and CNVR_392). Zinc finger proteins
430 comprise one of the largest families of transcription factors present in the eukaryotic
431 genome, regulating various cellular processes. The CCCH-type zinc finger is the less
432 characterized class, and plays an important role especially in RNA-metabolism,
433 regulating cell proliferation, growth, differentiation, metabolism, immunity, protein-
434 protein interactions [116]. In Nelore cattle, ZC3H6 gene was higher expressed in
435 animals with high intramuscular fat estimated genomic breeding values [117].
436 Moreover, others zinc finger proteins, such as ZBTB16, ZKSCAN2, and ZHX3, have
437 been described as affecting meat tenderness [71, 118, 119]. Taking together, the zinc
438 finger protein ZC3H6 seems to be a candidate gene for TD14, but how it cooperates
439 to beef tenderness needs to be further explored. ADSSL1 gene, which is strongly
440 expressed in skeletal muscle, encodes an isozyme called adenylosuccinate synthase
441 involved in energy metabolism, functioning in the purine nucleotide cycle, along with
442 myoadenylate deaminase and adenylosuccinate lyase [120, 121]. This metabolic cycle

443 plays an important role in regulating adenine nucleotide metabolism in order to
444 maximize ATP synthesis and utilization [120]. In post-mortem muscle, the adenine
445 nucleotides are converted to inosine monophosphate (IMP) and hypoxanthine, and this
446 metabolic rate has been described significantly related to meat tenderness [122].
447 Muscle postmortem aging decreases the structural integrity of the intramuscular
448 connective tissue (IMCT), the collagen network is disintegrated and the proteoglycan
449 components are degraded, reducing the strength of IMCT and contributing to meat
450 tenderness [123]. Decorin, a multifunctional proteoglycan, plays an important role in
451 the stabilization of collagen fibrils, and some of its effects are mediated by protein
452 kinase B (AKT) and the cyclin-dependent kinase inhibitor, p21 [124, 125]. Although the
453 weakening mechanism of IMCT during postmortem aging is unclear, AKT1 can be a
454 candidate gene for TD14. Muscle fibers consist of myofibrils, which are made of thin
455 (actin) and thick (myosin) filaments. The structural integrity of myofibrils changes
456 during postmortem aging, which contributes to the tenderness of aged meat [126].
457 Moreover, Zhou et al. [127] describing changes on the arrangement and dynamics of
458 actin filaments during the conversion of muscle to meat suggested the
459 depolymerization of actin filaments as a pathway of tenderization. Curiously, the INF2
460 gene is related to polymerization and depolymerization of actin filaments [128].
461 Previous studies reported evidences supporting the onset apoptosis in post-mortem
462 muscle with impacts on rigor mortis and meat tenderizing phases [112, 129]. Here,
463 SIVA gene that encodes a proapoptotic protein containing a death domain, and which
464 overexpression in various cell lines induces apoptosis [130, 131], is suggested as a
465 candidate gene for TD14.
466 Candidate copy variable genes overlapping with CNVR_307, CNVR_395 and
467 CNVR_82 were identified for TD21. CALML6 gene belongs to the calmodulin family

that is recognized as a major calcium sensor and an important player of regulatory events interacting with many cellular proteins [132]. According to previous findings, calmodulin phosphorylates myosin to modulate the tension of skeletal muscle contraction [133] and acts as an activator protein regulating calpain activity [134], which in both cases has directly effect on meat tenderness. *LIM and cysteine rich domains 1* (LMCD1) is expressed predominantly in skeletal and cardiac muscle [135], and this is the first report of its association with meat tenderness. The LIM domain is a zinc finger structure present in several types of proteins, mediating protein-protein interactions that are crucial for many biological processes, cell growth, cell fate determination, cell differentiation and cytoskeleton organization [136]. Earlier, the muscle LIM protein (also known as cysteine and glycine-rich protein 3) was linked to meat tenderness due to its effect on myoblast terminal differentiation, resulting in hyperplasic growth [137]. The authors suggested that the additional structural scaffolding required for supporting the increased cell numbers, leading to perimysium accumulation, may be sufficient to offset the proteolytic breakdown that occurs post-mortem. Three members of *GTPase of immunity-associated proteins* family genes (GIMAP4, GIMAP7, and GIMAP8), which form a cluster on BTA4, overlapped with the CNVR_82. Previous findings reported that GIMAP4 presents a pro-apoptotic function [138], and GIMAP7 is linked to skeletal muscle variation [139], supporting their role in TD21. Any copy number variable candidate genes exclusively associated with ICF or ICC was identified.

Functional annotation of significant CNVRs

Out of the 59 CNVRs found significantly associated with carcass and meat quality traits, 15 CNVRs were mapped in genomic regions without any annotated genes and

493 17 CNVRs encompass one or more unknown genes or genes that we could not find
494 clear evidence of their effect, representing a total of 77 genes. Therefore, a gene
495 ontology (GO) analysis was performed as complementary approach to reveal the
496 biological processes and molecular mechanisms responsible for the variation of those
497 traits in Nelore animals. A panel of GO categories significantly enriched with genes
498 associated with carcass and meat quality traits is described in Table 3. For the full list
499 of copy number variable genes per GO term significantly enriched, see S6 Table.
500

501 **Table 3. Functional terms significantly enriched with copy number variable**
502 **genes associated with carcass and meat quality traits in Nelore cattle.**

GO ID	GO term	Total genes	Significant genes	P-value
GO:0000064	L-ornithine transmembrane transporter activity	4	4	3.7e-03
GO:0002504	antigen processing and presentation of peptide or polysaccharide antigen via MHC class II	4	4	3.7e-03
GO:0004190	aspartic-type endopeptidase activity	36	32	1.1e-16
GO:0004930	G-protein coupled receptor activity	207	64	1.1e-02
GO:0004984	olfactory receptor activity	195	65	1.1e-03
GO:0005549	odorant binding	78	49	3.7e-14
GO:0006508	proteolysis	46	34	5.0e-13
GO:0007165	signal transduction	219	70	2.5e-03
GO:0007186	G-protein coupled receptor signaling pathway	215	69	2.4e-03
GO:0007608	sensory perception of smell	193	65	7.5e-04
GO:0008233	peptidase activity	32	28	2.9e-14
GO:0015181	arginine transmembrane transporter activity	4	4	3.7e-03
GO:0015189	L-lysine transmembrane transporter activity	4	4	3.7e-03
GO:0016020	membrane	366	108	2.1e-03
GO:0016787	hydrolase activity	48	33	3.2e-11
GO:0030163	protein catabolic process	37	33	2.5e-17
GO:0030246	carbohydrate binding	4	4	3.7e-03
GO:0042613	MHC class II protein complex	4	4	3.7e-03
GO:0050896	response to stimulus	191	63	1.8e-03
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	195	65	1.1e-03
GO:0097638	L-arginine import across plasma membrane	4	4	3.7e-03
GO:1903352	L-ornithine transmembrane transport	4	4	3.7e-03

GO:1903401	L-lysine transmembrane transport	4	4	3.7e-03

A total of 23 GO terms were significantly enriched with 814 CN variable genes associated with carcass and meat quality traits. The most significant GO terms are closely related with muscle physiology and conversion of muscle into meat, including aspartic-type endopeptidase activity (GO:0004190), protein catabolic process (GO:0030163), peptidase activity (GO:0008233), proteolysis (GO:0006508) and hydrolase activity (GO:0016787). For instance, cathepsin D, a member of the aspartic endopeptidase family, is one of the most abundant cathepsin in skeletal muscle lysosomes and seems to be involved in the differentiation of myofiber types and apoptose [140, 141]. However, its involvement in the postmortem degradation of myofibrilar components remaining subject to debate [142-144]. On the other hand, protein metabolism acting in the muscle-to-meat conversion process is well-studied [111]. Furthermore, the vast majority of CN genes were classified into GO terms linked to olfactory receptor, stimulus perception and membrane (GO:0004984, GO:0005549, GO:0007608, GO:0050896, GO:0050911, GO:0016020). Interestingly, GO terms related with L-ornithine, arginine, L-lysine, L-arginine transmembrane transport (GO:0000064, GO:0015181, GO:0015189, GO:1903352 and GO:1903401) were enriched exclusively with four of the aforementioned uncharacterized genes, shedding a light of their biological role. Amino acids display remarkable metabolic and regulatory versatility, which is essential among others to muscle growth and development [145]. Note that most of the uncharacterized genes was found involved in the same pathways of known genes. Finally, G-protein coupled receptor signaling pathway (GO:0007186), G-protein coupled receptor activity (GO:0004930), carbohydrate binding (GO:0030246) and signal transduction (GO:0007165) terms, which are related with cell

energy metabolism [146], were also enriched with genes related with carcass and meat quality traits.

Conclusions

Our results report CNV regions spanning genes that play key roles in a wide spectrum of molecular and biological processes linked with meat and carcass quality traits, including muscle differentiation, growth and development, cellular processes regulation, and lipid and energy metabolism. Furthermore, gene-set analysis revealed functional gene sets that are directly related to muscle deposition, conversion of muscle to meat and fat deposition. All together these results reveal that changes in copy number of this set of genes could result in a wide range of phenotypic variations among animals. These findings may contribute to future studies on the development of novel genomic strategies for improving carcass and meat quality traits in Nelore.

Acknowledgement

The authors are grateful to Agro-Pecuária CFM for providing genealogical information of the experimental animals. We are also thankful to the editor and anonymous reviewers which helped to considerably improve the manuscript.

References

1. McAfee AJ, McSorley EM, Cuskelly GJ, Moss BW, Wallace JMW, Bonham MP, et al. Red meat consumption: An overview of the risks and benefits. Meat Science. 2010;84(1):1-13. https://doi.org/10.1016/j.meatsci.2009.08.029
2. Bolormaa S, Neto LRP, Zhang YD, Bunch RJ, Harrison BE, Goddard ME, et al. A genome-wide association study of meat and carcass traits in Australian cattle1. Journal of Animal Science. 2011;89(8):2297-309. https://doi.org/10.2527/jas.2010-3138

3. Lu D, Sargolzaei M, Kelly M, Vander Voort G, Wang Z, Mandell I, et al. Genome-wide association analyses for carcass quality in crossbred beef cattle. BMC genetics. 2013;14:80-. https://doi.org/10.1186/1471-2156-14-80
4. Magalhães AFB, de Camargo GMF, Fernandes GAJ, Gordo DGM, Tonussi RL, Costa RB, et al. Genome-Wide Association Study of Meat Quality Traits in Nellore Cattle. PLOS ONE. 2016;11(6):e0157845. https://doi.org/10.1371/journal.pone.0157845
5. Silva RMdO, Stafuzza NB, Fragomeni BdO, Camargo GMFd, Ceacero TM, Cyrillo JNdSG, et al. Genome-Wide Association Study for Carcass Traits in an Experimental Nelore Cattle Population. PLOS ONE. 2017;12(1):e0169860. https://doi.org/10.1371/journal.pone.0169860
6. Xia J, Qi X, Wu Y, Zhu B, Xu L, Zhang L, et al. Genome-wide association study identifies loci and candidate genes for meat quality traits in Simmental beef cattle. Mammalian Genome. 2016;27(5):246-55. https://doi.org/10.1007/s00335-016-9635-x
7. Espigolan R, Baldi F, Boligon AA, Souza FRP, Fernandes Júnior GA, Gordo DGM, et al. Associations between single nucleotide polymorphisms and carcass traits in Nellore cattle using high-density panels. Genet Mol Res. 2015;14(3):11133-44. https://doi.org/10.4238/2015.September.22.7
8. Goddard ME, Kemper KE, MacLeod IM, Chamberlain AJ, Hayes BJ. Genetics of complex traits: prediction of phenotype, identification of causal polymorphisms and genetic architecture. Proceedings of the Royal Society B: Biological Sciences. 2016;283(1835):20160569. https://doi.org/10.1098/rspb.2016.0569
9. Feuk L, Carson AR, Scherer SW. Structural variation in the human genome. Nature Reviews Genetics. 2006;7(2):85-97. https://doi.org/10.1038/nrg1767
10. Manolio TA, Collins FS, Cox NJ, Goldstein DB, Hindorff LA, Hunter DJ, et al. Finding the missing heritability of complex diseases. Nature. 2009;461(7265):747-53. https://doi.org/10.1038/nature08494
11. Hou Y, Liu GE, Bickhart DM, Cardone MF, Wang K, Kim E-s, et al. Genomic characteristics of cattle copy number variations. BMC Genomics. 2011;12(1):127. https://doi.org/10.1186/1471-2164-12-127
12. Clop A, Vidal O, Amills M. Copy number variation in the genomes of domestic animals. Animal Genetics. 2012;43(5):503-17. https://doi.org/10.1111/j.1365-2052.2012.02317.x
13. Redon R, Ishikawa S, Fitch KR, Feuk L, Perry GH, Andrews TD, et al. Global variation in copy number in the human genome. Nature. 2006;444(7118):444-54. https://doi.org/10.1038/nature05329
14. Liu GE, Hou Y, Zhu B, Cardone MF, Jiang L, Cellamare A, et al. Analysis of copy number variations among diverse cattle breeds. Genome research. 2010;20(5):693-703. https://doi.org/10.1101/gr.105403.110
15. Freeman JL, Perry GH, Feuk L, Redon R, McCarroll SA, Altshuler DM, et al. Copy number variation: New insights in genome diversity. Genome Research. 2006;16(8):949-61. https://doi.org/10.1101/gr.3677206
16. Zhang F, Gu W, Hurles ME, Lupski JR. Copy number variation in human health, disease, and evolution. Annual review of genomics and human genetics. 2009;10:451-81. https://doi.org/10.1146/annurev.genom.9.081307.164217

17. Seroussi E, Glick G, Shirak A, Yakobson E, Weller JI, Ezra E, et al. Analysis of copy loss and gain variations in Holstein cattle autosomes using BeadChip SNPs. BMC Genomics. 2010;11(1):673. https://doi.org/10.1186/1471-2164-11-673
18. Xu L, Cole JB, Bickhart DM, Hou Y, Song J, VanRaden PM, et al. Genome wide CNV analysis reveals additional variants associated with milk production traits in Holsteins. BMC Genomics. 2014;15(1):683. https://doi.org/10.1186/1471-2164-15-683
19. Wang L, Xu L, Liu X, Zhang T, Li N, Hay EH, et al. Copy number variation-based genome wide association study reveals additional variants contributing to meat quality in Swine. Scientific reports. 2015;5:12535-. https://doi.org/10.1038/srep12535
20. Yang L, Xu L, Zhou Y, Liu M, Wang L, Kijas JW, et al. Diversity of copy number variation in a worldwide population of sheep. Genomics. 2018;110(3):143-8. https://doi.org/10.1016/j.ygeno.2017.09.005
21. Bae JS, Cheong HS, Kim LH, NamGung S, Park TJ, Chun J-Y, et al. Identification of copy number variations and common deletion polymorphisms in cattle. BMC Genomics. 2010;11(1):232. https://doi.org/10.1186/1471-2164-11-232
22. Hou Y, Liu GE, Bickhart DM, Matukumalli LK, Li C, Song J, et al. Genomic regions showing copy number variations associate with resistance or susceptibility to gastrointestinal nematodes in Angus cattle. Functional & Integrative Genomics. 2012;12(1):81-92. https://doi.org/10.1007/s10142-011-0252-1
23. Zhang L, Jia S, Yang M, Xu Y, Li C, Sun J, et al. Detection of copy number variations and their effects in Chinese bulls. BMC Genomics. 2014;15(1):480. https://doi.org/10.1186/1471-2164-15-480
24. Upadhyay M, da Silva VH, Megens H-J, Visker MHPW, Ajmone-Marsan P, Bâlteanu VA, et al. Distribution and Functionality of Copy Number Variation across European Cattle Populations. Frontiers in genetics. 2017;8:108-. https://doi.org/10.3389/fgene.2017.00108
25. Letaief R, Rebours E, Grohs C, Meersseman C, Fritz S, Trouilh L, et al. Identification of copy number variation in French dairy and beef breeds using next-generation sequencing. Genetics, selection, evolution : GSE. 2017;49(1):77-. https://doi.org/10.1186/s12711-017-0352-z
26. Zhou Y, Utsunomiya YT, Xu L, Hay EHa, Bickhart DM, Alexandre PA, et al. Genome-wide CNV analysis reveals variants associated with growth traits in Bos indicus. BMC Genomics. 2016;17(1):419. https://doi.org/10.1186/s12864-016-2461-4
27. Santana MHdA, Oliveira Junior GA, Cesar ASM, Freua MC, Gomes RdC, Silva SdL, et al. Copy number variations and genome-wide associations reveal putative genes and metabolic pathways involved with the feed conversion ratio in beef cattle. Journal of Applied Genetics. 2016;57(4):495-504. https://doi.org/10.1007/s13353-016-0344-7
28. Silva JM, Giachetto PF, Silva LO, Cintra LC, Paiva SR, Yamagishi MEB, et al. Genome-wide copy number variation (CNV) detection in Nelore cattle reveals highly frequent variants in genome regions harboring QTLs affecting production traits. BMC genomics. 2016;17:454-. https://doi.org/10.1186/s12864-016-2752-9
29. Silva VHd, Regitano LCdA, Geistlinger L, Pértille F, Giachetto PF, Brassaloti RA, et al. Genome-Wide Detection of CNVs and Their Association with Meat Tenderness in Nelore Cattle. PLOS ONE. 2016;11(6):e0157711. https://doi.org/10.1371/journal.pone.0157711

30. Lemos MVA, Berton MP, Camargo GMF, Peripolli E, Silva RMdO, Olivieri BF, et al. Copy number variation regions in Nellore cattle: Evidences of environment adaptation. Livestock Science. 2018;207:51-8. https://doi.org/10.1016/j.livsci.2017.11.008
31. Geistlinger L, da Silva VH, Cesar ASM, Tizioto PC, Waldron L, Zimmer R, et al. Widespread modulation of gene expression by copy number variation in skeletal muscle. Scientific Reports. 2018;8(1):1399. https://doi.org/10.1038/s41598-018-19782-4
32. Lemos MVA, Peripolli E, Berton MP, Feitosa FLB, Olivieri BF, Stafuzza NB, et al. Association study between copy number variation and beef fatty acid profile of Nellore cattle. Journal of Applied Genetics. 2018;59(2):203-23. https://doi.org/10.1007/s13353-018-0436-7
33. Zhang D, Qian Y, Akula N, Alliey-Rodriguez N, Tang J, The Bipolar Genome S, et al. Accuracy of CNV Detection from GWAS Data. PLOS ONE. 2011;6(1):e14511. https://doi.org/10.1371/journal.pone.0014511
34. Kim YK, Moon S, Hwang MY, Kim D-J, Oh JH, Kim YJ, et al. Gene-based copy number variation study reveals a microdeletion at 12q24 that influences height in the Korean population. Genomics. 2013;101(2):134-8. https://doi.org/10.1016/j.ygeno.2012.11.002
35. Bhanuprakash V, Chhotaray S, Pruthviraj DR, Rawat C, Karthikeyan A, Panigrahi M. Copy number variation in livestock: A mini review. Veterinary world. 2018;11(4):535-41. https://doi.org/10.14202/vetworld.2018.535-541
36. Bligh EG, Dyer WJ. A rapid method of total lipid extraction and purification. Canadian Journal of Biochemistry and Physiology. 1959;37(8):911-7. https://doi.org/10.1139/o59-099
37. Saldanha T, Mazalli MR, Bragagnolo N. Avaliação comparativa entre dois métodos para determinação do colesterol em carnes e leite. Food Science and Technology. 2004;24:109-13. https://doi.org/10.1590/S0101-20612004000100020
38. Wang K, Li M, Hadley D, Liu R, Glessner J, Grant SFA, et al. PennCNV: an integrated hidden Markov model designed for high-resolution copy number variation detection in whole-genome SNP genotyping data. Genome research. 2007;17(11):1665-74. https://doi.org/10.1101/gr.6861907
39. Diskin SJ, Li M, Hou C, Yang S, Glessner J, Hakonarson H, et al. Adjustment of genomic waves in signal intensities from whole-genome SNP genotyping platforms. Nucleic acids research. 2008;36(19):e126-e. https://doi.org/10.1093/nar/gkn556
40. Lin C-F, Naj AC, Wang L-S. Analyzing copy number variation using SNP array data: protocols for calling CNV and association tests. Current protocols in human genetics. 2013;79:Unit-1.27. https://doi.org/10.1002/0471142905.hg0127s79
41. Kim J-H, Hu H-J, Yim S-H, Bae JS, Kim S-Y, Chung Y-J. CNVRuler: a copy number variation-based case–control association analysis tool. Bioinformatics. 2012;28(13):1790-2. https://doi.org/10.1093/bioinformatics/bts239
42. Boldman KG, Kriese LA, Van Vleck LD, Van Tassell CP, Kachman SD. A manual for use of MTDFREML: a set of programs to obtain estimates of variances and covariances. Nebraska: United States Department of Agriculture-Agricultural Research Service; 1995.
43. Durinck S, Moreau Y, Kasprzyk A, Davis S, De Moor B, Brazma A, et al. BioMart and Bioconductor: a powerful link between biological databases and microarray data analysis. Bioinformatics. 2005;21(16):3439-40. https://doi.org/10.1093/bioinformatics/bti525

44. Peñagaricano F, Weigel KA, Rosa GJM, Khatib H. Inferring quantitative trait pathways associated with bull fertility from a genome-wide association study. Frontiers in Genetics. 2013;3. https://doi.org/10.3389/fgene.2012.00307
45. Ashburner M, Ball CA, Blake JA, Botstein D, Butler H, Cherry JM, et al. Gene ontology: tool for the unification of biology. The Gene Ontology Consortium. Nature genetics. 2000;25(1):25-9. https://doi.org/10.1038/75556
46. Gambra R, Peñagaricano F, Kropp J, Khateeb K, Weigel K, Lucey J, et al. Genomic architecture of bovine kappa-casein and beta-lactoglobulin. Journal of Dairy Science. 2013;96(8):5333-43. https://doi.org/10.3168/jds.2012-6324
47. Abdalla E, Peñagaricano F, Byrem T, Weigel K, Rosa G. Genome-wide association mapping and pathway analysis of leukosis incidence in a US Holstein cattle population. Animal Genetics. 2016;47(4):395-407. https://doi.org/10.1111/age.12438
48. Gordo DGM, Espigolan R, Bresolin T, Fernandes Júnior GA, Magalhães AFB, Braz CU, et al. Genetic analysis of carcass and meat quality traits in Nelore cattle1. Journal of Animal Science. 2018;96(9):3558-64. https://doi.org/10.1093/jas/sky228
49. Mateescu RG, Garrick DJ, Reecy JM, Garmyn AJ, VanOverbeke DL, Mafi GG. Genetic parameters for sensory traits in longissimus muscle and their associations with tenderness, marbling score, and intramuscular fat in Angus cattle1. Journal of Animal Science. 2015;93(1):21-7. https://doi.org/10.2527/jas.2014-8405
50. Wilson DE, Willham RL, Northcutt SL, Rouse GH. Genetic parameters for carcass traits estimated from Angus field records. Journal of Animal Science. 1993;71(9):2365-70. https://doi.org/10.2527/1993.7192365x
51. Riley DG, Chase CC, Jr., Hammond AC, West RL, Johnson DD, Olson TA, et al. Estimated genetic parameters for carcass traits of Brahman cattle. Journal of Animal Science. 2002;80(4):955-62. https://doi.org/10.2527/2002.804955x
52. Sakuma H, Saito K, Kohira K, Ohhashi F, Shoji N, Uemoto Y. Estimates of genetic parameters for chemical traits of meat quality in Japanese black cattle. Animal science journal = Nihon chikusan Gakkaiho. 2017;88(2):203-12. https://doi.org/10.1111/asj.12622
53. Matukumalli LK, Lawley CT, Schnabel RD, Taylor JF, Allan MF, Heaton MP, et al. Development and Characterization of a High Density SNP Genotyping Assay for Cattle. PLOS ONE. 2009;4(4):e5350. https://doi.org/10.1371/journal.pone.0005350
54. Bickhart DM, Hou Y, Schroeder SG, Alkan C, Cardone MF, Matukumalli LK, et al. Copy number variation of individual cattle genomes using next-generation sequencing. Genome research. 2012;22(4):778-90. https://doi.org/10.1101/gr.133967.111
55. Choi J-W, Lee K-T, Liao X, Stothard P, An H-S, Ahn S, et al. Genome-wide copy number variation in Hanwoo, Black Angus, and Holstein cattle. Mammalian Genome. 2013;24(3):151-63. https://doi.org/10.1007/s00335-013-9449-z
56. Porto-Neto LR, Sonstegard TS, Liu GE, Bickhart DM, Da Silva MVB, Machado MA, et al. Genomic divergence of zebu and taurine cattle identified through high-density SNP genotyping. BMC Genomics. 2013;14(1):876. https://doi.org/10.1186/1471-2164-14-876
57. Wang MD, Dzama K, Hefer CA, Muchadeyi FC. Genomic population structure and prevalence of copy number variations in South African Nguni cattle. BMC genomics. 2015;16:894-.

https://doi.org/10.1186/s12864-015-2122-z
58. Spehr M, Munger SD. Olfactory receptors: G protein-coupled receptors and beyond. Journal of neurochemistry. 2009;109(6):1570-83. https://doi.org/10.1111/j.1471-4159.2009.06085.x
59. Lee S-J, Depoortere I, Hatt H. Therapeutic potential of ectopic olfactory and taste receptors. Nature Reviews Drug Discovery. 2019;18(2):116-38. https://doi.org/10.1038/s41573-018-0002-3
60. Connor EE, Zhou Y, Liu GE. The essence of appetite: does olfactory receptor variation play a role? Journal of animal science. 2018;96(4):1551-8. https://doi.org/10.1093/jas/sky068
61. Griffin CA, Kafadar KA, Pavlath GK. MOR23 promotes muscle regeneration and regulates cell adhesion and migration. Developmental cell. 2009;17(5):649-61. https://doi.org/10.1016/j.devcel.2009.09.004
62. Wu C, Hwang SH, Jia Y, Choi J, Kim Y-J, Choi D, et al. Olfactory receptor 544 reduces adiposity by steering fuel preference toward fats. The Journal of Clinical Investigation. 2017;127(11):4118-23. https://doi.org/10.1172/JCI89344
63. Tong T, Park J, Moon C, Park T. Regulation of Adipogenesis and Thermogenesis through Mouse Olfactory Receptor 23 Stimulated by α-Cedrene in 3T3-L1 Cells. Nutrients. 2018;10(11):1781. https://doi.org/10.3390/nu10111781
64. Primeaux SD, Braymer HD, Bray GA. High fat diet differentially regulates the expression of olfactory receptors in the duodenum of obesity-prone and obesity-resistant rats. Digestive diseases and sciences. 2013;58(1):72-6. https://doi.org/10.1007/s10620-012-2421-z
65. Xie S, Green J, Bixby JB, Szafranska B, DeMartini JC, Hecht S, et al. The diversity and evolutionary relationships of the pregnancy-associated glycoproteins, an aspartic proteinase subfamily consisting of many trophoblast-expressed genes. Proceedings of the National Academy of Sciences of the United States of America. 1997;94(24):12809-16. https://doi.org/10.1073/pnas.94.24.12809
66. Telugu BPVL, Walker AM, Green JA. Characterization of the bovine pregnancy-associated glycoprotein gene family--analysis of gene sequences, regulatory regions within the promoter and expression of selected genes. BMC genomics. 2009;10:185-. https://doi.org/10.1186/1471-2164-10-185
67. Wallace RM, Pohler KG, Smith MF, Green JA. Placental PAGs: gene origins, expression patterns, and use as markers of pregnancy. Reproduction. 2015;149(3):R115-R26. https://doi.org/10.1530/REP-14-0485
68. Davies DR. The Structure and Function of the Aspartic Proteinases. Annual Review of Biophysics and Biophysical Chemistry. 1990;19(1):189-215. https://doi.org/10.1146/annurev.bb.19.060190.001201
69. Bickhart DM, Xu L, Hutchison JL, Cole JB, Null DJ, Schroeder SG, et al. Diversity and population-genetic properties of copy number variations and multicopy genes in cattle. DNA research : an international journal for rapid publication of reports on genes and genomes. 2016;23(3):253-62. https://doi.org/10.1093/dnares/dsw013
70. Behl JD, Verma NK, Tyagi N, Mishra P, Behl R, Joshi BK. The major histocompatibility complex in bovines: a review. ISRN veterinary science. 2012;2012:872710-. https://doi.org/10.5402/2012/872710
71. Fonseca LFS, Gimenez DFJ, Dos Santos Silva DB, Barthelson R, Baldi F, Ferro JA, et al. Differences in global gene expression in muscle tissue of Nellore cattle with divergent meat tenderness. BMC genomics. 2017;18(1):945-. https://doi.org/10.1186/s12864-017-4323-0

72. Lee S-H, Gondro C, van der Werf J, Kim N-K, Lim D-J, Park E-W, et al. Use of a bovine genome array to identify new biological pathways for beef marbling in Hanwoo (Korean Cattle). BMC genomics. 2010;11:623-. https://doi.org/10.1186/1471-2164-11-623

73. Nascimento CSd, Machado MA, Martinez ML, Silva MVGBd, Guimarães MFM, Campos AL, et al. Association of the bovine major histocompatibility complex (BoLA) BoLA-DRB3 gene with fat and protein production and somatic cell score in Brazilian Gyr dairy cattle (Bos indicus). Genetics and Molecular Biology. 2006;29:641-7. https://doi.org/10.1590/S1415-47572006000400011

74. Sharif S, Mallard BA, Wilkie BN, Sargeant JM, Scott HM, Dekkers JCM, et al. Associations of the bovine major histocompatibility complex DRB3 (BoLA-DRB3) with production traits in Canadian dairy cattle. Animal Genetics. 1998;30(2):157-60. https://doi.org/10.1046/j.1365-2052.1999.00459.x

75. Tall AR, Yvan-Charvet L. Cholesterol, inflammation and innate immunity. Nature reviews Immunology. 2015;15(2):104-16. https://doi.org/10.1038/nri3793

76. Tepper BJ, Koelliker Y, Zhao L, Ullrich NV, Lanzara C, D'Adamo P, et al. Variation in the Bitter-taste Receptor Gene TAS2R38, and Adiposity in a Genetically Isolated Population in Southern Italy. Obesity. 2008;16(10):2289-95. https://doi.org/10.1038/oby.2008.357

77. Ortega FJ, Agüera Z, Sabater M, Moreno-Navarrete JM, Alonso-Ledesma I, Xifra G, et al. Genetic variations of the bitter taste receptor TAS2R38 are associated with obesity and impact on single immune traits. Molecular Nutrition & Food Research. 2016;60(7):1673-83. https://doi.org/10.1002/mnfr.201500804

78. Ginane C, Baumont R, Favreau-Peigné A. Perception and hedonic value of basic tastes in domestic ruminants. Physiology & Behavior. 2011;104(5):666-74. https://doi.org/10.1016/j.physbeh.2011.07.011

79. Nichols BL, Quezada-Calvillo R, Robayo-Torres CC, Ao Z, Hamaker BR, Butte NF, et al. Mucosal maltase-glucoamylase plays a crucial role in starch digestion and prandial glucose homeostasis of mice. The Journal of nutrition. 2009;139(4):684-90. https://doi.org/10.3945/jn.108.098434

80. Harmon DL. Understanding Starch Utilization in the Small Intestine of Cattle. Asian-Australas J Anim Sci. 2009;22(7):915-22. https://doi.org/10.5713/ajas.2009.r.08

81. Foote AP, Keel BN, Zarek CM, Lindholm-Perry AK. Beef steers with average dry matter intake and divergent average daily gain have altered gene expression in the jejunum. Journal of Animal Science. 2017;95(10):4430-9. https://doi.org/10.2527/jas2017.1804

82. Hocquette J-F, Abe H. Facilitative glucose transporters in livestock species. Reprod Nutr Dev. 2000;40(6):517-33. https://doi.org/10.1051/rnd:2000134

83. Maliza R, Fujiwara K, Tsukada T, Azuma M, Kikuchi M, Yashiro T. Effects of retinoic acid on growth hormone-releasing hormone receptor, growth hormone secretagogue receptor gene expression and growth hormone secretion in rat anterior pituitary cells. Endocrine Journal. 2016;63(6):555-61. https://doi.org/10.1507/endocrj.EJ16-0086

84. Wang B, Yang Q, Harris CL, Nelson ML, Busboom JR, Zhu M-J, et al. Nutrigenomic regulation of adipose tissue development - role of retinoic acid: A review. Meat science. 2016;120:100-6. https://doi.org/10.1016/j.meatsci.2016.04.003

85. Xu T, Huang W, Zhang X, Ye B, Zhou H, Hou S. Identification and characterization of genes related to the development of breast muscles in Pekin duck. Molecular Biology Reports. 2012;39(7):7647-55. https://doi.org/10.1007/s11033-012-1599-7

86. Bertelli DF, Araújo EP, Stoppa GR, Carvalheira JB, Saad MJA, Cesquini M, et al. Phosphoinositide-Specific Inositol Polyphosphate 5-Phosphatase IV Inhibits Inositide Trisphosphate Accumulation in Hypothalamus and Regulates Food Intake and Body Weight. Endocrinology. 2006;147(11):5385-99. https://doi.org/10.1210/en.2006-0280

87. Tillmann KD, Reiterer V, Baschieri F, Hoffmann J, Millarte V, Hauser MA, et al. Regulation of Sec16 levels and dynamics links proliferation and secretion. Journal of Cell Science. 2015;128(4):670. https://doi.org/10.1242/jcs.157115

88. Schaub M, Nussbaum J, Verkade H, Ober EA, Stainier DYR, Sakaguchi TF. Mutation of zebrafish Snapc4 is associated with loss of the intrahepatic biliary network. Developmental biology. 2012;363(1):128-37. https://doi.org/10.1016/j.ydbio.2011.12.025

89. Stenmark H, Olkkonen VM. The Rab GTPase family. Genome biology. 2001;2(5):REVIEWS3007-REVIEWS. https://doi.org/10.1186/gb-2001-2-5-reviews3007

90. Sun Y, Bilan PJ, Liu Z, Klip A. Rab8A and Rab13 are activated by insulin and regulate GLUT4 translocation in muscle cells. Proceedings of the National Academy of Sciences of the United States of America. 2010;107(46):19909-14. https://doi.org/10.1073/pnas.1009523107

91. Mitsumoto Y, Burdett E, Grant A, Klip A. Differential expression of the GLUT1 and GLUT4 glucose transporters during differentiation of L6 muscle cells. Biochemical and Biophysical Research Communications. 1991;175(2):652-9. https://doi.org/10.1016/0006-291X(91)91615-J

92. Mitsumoto Y, Klip A. Development regulation of the subcellular distribution and glycosylation of GLUT1 and GLUT4 glucose transporters during myogenesis of L6 muscle cells. Journal of Biological Chemistry. 1992;267(7):4957-62. https://doi.org/10.1016/0006-291X(91)91615-J

93. Vlahovich N, Schevzov G, Nair-Shaliker V, Ilkovski B, Artap ST, Joya JE, et al. Tropomyosin 4 defines novel filaments in skeletal muscle associated with muscle remodelling/regeneration in normal and diseased muscle. Cell Motility. 2008;65(1):73-85. https://doi.org/10.1002/cm.20245

94. Oe M, Ohnishi-Kameyama M, Nakajima I, Muroya S, Chikuni K. Muscle type specific expression of tropomyosin isoforms in bovine skeletal muscles. Meat Science. 2007;75(4):558-63. https://doi.org/10.1016/j.meatsci.2006.09.003

95. Moran JL, Li Y, Hill AA, Mounts WM, Miller CP. Gene expression changes during mouse skeletal myoblast differentiation revealed by transcriptional profiling. Physiological Genomics. 2002;10(2):103-11. https://doi.org/10.1152/physiolgenomics.00011.2002

96. Wang D, Bai X, Tian Q, Lai Y, Lin EA, Shi Y, et al. GEP constitutes a negative feedback loop with MyoD and acts as a novel mediator in controlling skeletal muscle differentiation. Cellular and molecular life sciences : CMLS. 2012;69(11):1855-73. https://doi.org/10.1007/s00018-011-0901-5

97. Park KC, Kim JH, Choi E-J, Min SW, Rhee S, Baek SH, et al. Antagonistic regulation of myogenesis by two deubiquitinating enzymes, UBP45 and UBP69. Proceedings of the National Academy of Sciences. 2002;99(15):9733. https://doi.org/10.1073/pnas.152011799

98. Wing SS. Deubiquitinases in skeletal muscle atrophy. The international journal of biochemistry & cell biology. 2013;45(10):2130-5. https://doi.org/10.1016/j.biocel.2013.05.002

99. Mikami T, Koyama S, Yabuta Y, Kitagawa H. Chondroitin sulfate is a crucial determinant for skeletal muscle development/regeneration and improvement of muscular dystrophies. The Journal of biological chemistry. 2012;287(46):38531-42.

https://doi.org/10.1074/jbc.M111.336925
100. Yamada S. Catabolism of chondroitin sulfate. Cellular and Molecular Biology Letters2015. p. 196.
https://doi.org/10.1515/cmble-2015-0011
101. Dmitriev P, Bou Saada Y, Dib C, Ansseau E, Barat A, Hamade A, et al. DUX4-induced constitutive DNA damage and oxidative stress contribute to aberrant differentiation of myoblasts from FSHD patients. Free Radical Biology and Medicine. 2016;99:244-58.
https://doi.org/10.1016/j.freeradbiomed.2016.08.007
102. Drazic A, Aksnes H, Marie M, Boczkowska M, Varland S, Timmerman E, et al. NAA80 is actin's N-terminal acetyltransferase and regulates cytoskeleton assembly and cell motility. Proceedings of the National Academy of Sciences of the United States of America. 2018;115(17):4399-404.
https://doi.org/10.1073/pnas.1718336115
103. Miinalainen IJ, Schmitz W, Huotari A, Autio KJ, Soininen R, Ver Loren van Themaat E, et al. Mitochondrial 2,4-dienoyl-CoA Reductase Deficiency in Mice Results in Severe Hypoglycemia with Stress Intolerance and Unimpaired Ketogenesis. PLOS Genetics. 2009;5(7):e1000543.
https://doi.org/10.1371/journal.pgen.1000543
104. Park SJ, Beak S-H, Jung DJS, Kim SY, Jeong IH, Piao MY, et al. Genetic, management, and nutritional factors affecting intramuscular fat deposition in beef cattle - A review. Asian-Australasian journal of animal sciences. 2018;31(7):1043-61.
https://doi.org/10.5713/ajas.18.0310
105. Varona L, Ovilo C, Clop A, Noguera JL, PÉRez-Enciso M, Coll A, et al. QTL mapping for growth and carcass traits in an Iberian by Landrace pig intercross: additive, dominant and epistatic effects. Genetical Research. 2002;80(2):145-54.
https://doi.org/10.1017/S0016672302005803
106. Wang W, Zhang T, Wang J, Zhang G, Wang Y, Zhang Y, et al. Genome-wide association study of 8 carcass traits in Jinghai Yellow chickens using specific-locus amplified fragment sequencing technology. Poultry science. 2016;95(3):500-6.
https://doi.org/10.3382/ps/pev266
107. Na W, Yu J-Q, Xu Z-C, Zhang X-Y, Yang L-L, Cao Z-P, et al. Important candidate genes for abdominal fat content identified by linkage disequilibrium and fixation index information. Poultry Science. 2018;98(2):581-9.
https://doi.org/10.3382/ps/pey426
108. Lin C, Theodorides ML, McDaniel AH, Tordoff MG, Zhang Q, Li X, et al. QTL analysis of dietary obesity in C57BL/6byj X 129P3/J F2 mice: diet- and sex-dependent effects. PloS one. 2013;8(7):e68776-e.
https://doi.org/10.1371/journal.pone.0068776
109. Christou S, Wehrens SMT, Isherwood C, Möller-Levet CS, Wu H, Revell VL, et al. Circadian regulation in human white adipose tissue revealed by transcriptome and metabolic network analysis. Scientific Reports. 2019;9(1):2641.
https://doi.org/10.1038/s41598-019-39668-3
110. Hotta K, Kitamoto A, Kitamoto T, Mizusawa S, Teranishi H, Matsuo T, et al. Genetic variations in the CYP17A1 and NT5C2 genes are associated with a reduction in visceral and subcutaneous fat areas in Japanese women. Journal Of Human Genetics. 2011;57:46.
https://doi.org/10.1038/jhg.2011.127
111. Lana A, Zolla L. Proteolysis in meat tenderization from the point of view of each single protein: A proteomic perspective. Journal of Proteomics. 2016;147:85-97.
https://doi.org/10.1016/j.jprot.2016.02.011
112. Laville E, Sayd T, Morzel M, Blinet S, Chambon C, Lepetit J, et al. Proteome Changes during Meat Aging in Tough and Tender Beef Suggest the Importance of Apoptosis and Protein Solubility for Beef Aging and Tenderization. Journal of Agricultural and Food Chemistry. 2009;57(22):10755-64.
https://doi.org/10.1021/jf901949r

113. Boon CJF, van de Kar NC, Klevering BJ, Keunen JEE, Cremers FPM, Klaver CCW, et al. The spectrum of phenotypes caused by variants in the CFH gene. Molecular Immunology. 2009;46(8):1573-94. https://doi.org/10.1016/j.molimm.2009.02.013

114. Kong HR, Anthony NB, Rowland KC, Khatri B, Kong BC. Genome re-sequencing to identify single nucleotide polymorphism markers for muscle color traits in broiler chickens. Asian-Australasian journal of animal sciences. 2018;31(1):13-8. https://doi.org/10.5713/ajas.17.0479

115. Mei C, Li S, Abbas SH, Tian W, Wang H, Li Y, et al. Performance Measurement and Comparative Transcriptome Analysis Revealed the Efforts on Hybrid Improvement of Qinchuan Cattle. Animal Biotechnology. 2018;30(1):13-20. https://doi.org/10.1080/10495398.2017.1420662

116. Liang J, Song W, Tromp G, Kolattukudy PE, Fu M. Genome-Wide Survey and Expression Profiling of CCCH-Zinc Finger Family Reveals a Functional Module in Macrophage Activation. PLOS ONE. 2008;3(8):e2880. https://doi.org/10.1371/journal.pone.0002880

117. Poleti MD, Regitano LCA, Souza GHMF, Cesar ASM, Simas RC, Silva-Vignato B, et al. Longissimus dorsi muscle label-free quantitative proteomic reveals biological mechanisms associated with intramuscular fat deposition. Journal of Proteomics. 2018;179:30-41. https://doi.org/10.1016/j.jprot.2018.02.028

118. Kee H-J, Park E-W, Lee C-K. Characterization of Beef Transcripts Correlated with Tenderness and Moisture. Mol Cells. 2008;25(3):428-37.

119. Zhao C, Tian F, Yu Y, Luo J, Mitra A, Zhan F, et al. Functional genomic analysis of variation on beef tenderness induced by acute stress in angus cattle. Comparative and functional genomics. 2012;2012:756284-. https://doi.org/10.1155/2012/756284

120. Lewis AL, Guicherit OM, Datta SK, Hanten GR, Kellems RE. Structure and Expression of the Murine Muscle Adenylosuccinate Synthetase Gene. Journal of Biological Chemistry. 1996;271(37):22647-56. https://doi.org/10.1074/jbc.271.37.22647

121. Sun H, Li N, Wang X, Chen T, Shi L, Zhang L, et al. Molecular cloning and characterization of a novel muscle adenylosuccinate synthetase, AdSSL1, from human bone marrow stromal cells. Molecular and Cellular Biochemistry. 2005;269(1):85-94. https://doi.org/10.1007/s11010-005-2539-9

122. Calkins CR, Branecky LJ, Dutson TR, Smith GC, Carpenter ZL. Postmortem Muscle Metabolism and Meat Tenderness. Journal of Food Science. 1983;48(1):23-5. https://doi.org/10.1111/j.1365-2621.1983.tb14780.x

123. Nishimura T. The role of intramuscular connective tissue in meat texture. Animal Science Journal. 2010;81(1):21-7. https://doi.org/10.1111/j.1740-0929.2009.00696.x

124. Schönherr E, Sunderkötter C, Iozzo RV, Schaefer L. Decorin, a Novel Player in the Insulin-like Growth Factor System. Journal of Biological Chemistry. 2005;280(16):15767-72. https://doi.org/10.1074/jbc.M500451200

125. Nishimura T. Role of extracellular matrix in development of skeletal muscle and postmortem aging of meat. Meat Science. 2015;109:48-55. https://doi.org/10.1016/j.meatsci.2015.05.015

126. Takahashi K. Structural weakening of skeletal muscle tissue during post-mortem ageing of meat: the non-enzymatic mechanism of meat tenderization. Meat Science. 1996;43:67-80. https://doi.org/10.1016/0309-1740(96)00056-3

127. Zhou C, Wang Y, Pan D, Sun Y, Cao J. The effect of Cytochalasin B and Jasplakinolide on depolymerization of actin filaments in goose muscles during postmortem conditioning. Food Research International. 2016;90:1-7.

https://doi.org/10.1016/j.foodres.2016.10.032
128. Gurel PS, A M, Guo B, Shu R, Mierke DF, Higgs HN. Assembly and turnover of short actin filaments by the formin INF2 and profilin. The Journal of biological chemistry. 2015;290(37):22494-506.
https://doi.org/10.1074/jbc.M115.670166
129. Ouali A, Herrera-Mendez CH, Coulis G, Becila S, Boudjellal A, Aubry L, et al. Revisiting the conversion of muscle into meat and the underlying mechanisms. Meat Science. 2006;74(1):44-58.
https://doi.org/10.1016/j.meatsci.2006.05.010
130. Prasad KV, Ao Z, Yoon Y, Wu MX, Rizk M, Jacquot S, et al. CD27, a member of the tumor necrosis factor receptor family, induces apoptosis and binds to Siva, a proapoptotic protein. Proceedings of the National Academy of Sciences of the United States of America. 1997;94(12):6346-51.
https://doi.org/10.1073/pnas.94.12.6346
131. Fortin A, MacLaurin JG, Arbour N, Cregan SP, Kushwaha N, Callaghan SM, et al. The Proapoptotic Gene SIVA Is a Direct Transcriptional Target for the Tumor Suppressors p53 and E2F1. Journal of Biological Chemistry. 2004;279(27):28706-14.
https://doi.org/10.1074/jbc.M400376200
132. Rhoads AR, Friedberg F. Sequence motifs for calmodulin recognition. The FASEB Journal. 1997;11(5):331-40.
https://doi.org/10.1096/fasebj.11.5.9141499
133. Blumenthal DK, Takio K, Edelman AM, Charbonneau H, Titani K, Walsh KA, et al. Identification of the calmodulin-binding domain of skeletal muscle myosin light chain kinase. Proceedings of the National Academy of Sciences of the United States of America. 1985;82(10):3187-91.
https://doi.org/10.1073/pnas.82.10.3187
134. DeMartino GN, Blumenthal DK. Identification and partial purification of a factor that stimulates calcium-dependent proteases. Biochemistry. 1982;21(18):4297-303.
https://doi.org/10.1021/bi00261a019
135. Bespalova IN, Burmeister M. Identification of a Novel LIM Domain Gene, LMCD1, and Chromosomal Localization in Human and Mouse. Genomics. 2000;63(1):69-74.
https://doi.org/10.1006/geno.1999.6049
136. Bach I. The LIM domain: regulation by association. Mechanisms of Development. 2000;91(1):5-17.
https://doi.org/10.1016/S0925-4773(99)00314-7
137. Zapata I, Zerby HN, Wick M. Functional Proteomic Analysis Predicts Beef Tenderness and the Tenderness Differential. Journal of Agricultural and Food Chemistry. 2009;57(11):4956-63.
https://doi.org/10.1021/jf900041j
138. Schwefel D, Arasu BS, Marino SF, Lamprecht B, Köchert K, Rosenbaum E, et al. Structural Insights into the Mechanism of GTPase Activation in the GIMAP Family. Structure. 2013;21(4):550-9.
https://doi.org/10.1016/j.str.2013.01.014
139. Ran S, Liu Y-J, Zhang L, Pei Y, Yang T-L, Hai R, et al. Genome-wide association study identified copy number variants important for appendicular lean mass. PloS one. 2014;9(3):e89776-e.
https://doi.org/10.1371/journal.pone.0089776
140. Bechet D, Tassa A, Taillandier D, Combaret L, Attaix D. Lysosomal proteolysis in skeletal muscle. The International Journal of Biochemistry & Cell Biology. 2005;37(10):2098-114.
https://doi.org/10.1016/j.biocel.2005.02.029
141. Nagano K. Alteration of cathepsin-D expression in atrophied muscles and apoptotic myofibers by hindlimb unloading in a low-temperature environment. Journal of physical therapy science. 2015;27(11):3585-91.
https://doi.org/10.1589/jpts.27.3585

142. Sentandreu MA, Coulis G, Ouali A. Role of muscle endopeptidases and their inhibitors in meat tenderness. Trends in Food Science & Technology. 2002;13(12):400-21. https://doi.org/10.1016/S0924-2244(02)00188-7
143. Herrera-Mendez CH, Becila S, Boudjellal A, Ouali A. Meat ageing: Reconsideration of the current concept. Trends in Food Science & Technology. 2006;17(8):394-405. https://doi.org/10.1016/j.tifs.2006.01.011
144. Chéret R, Delbarre-Ladrat C, Lamballerie-Anton Md, Verrez-Bagnis V. Calpain and cathepsin activities in post mortem fish and meat muscles. Food Chemistry. 2007;101(4):1474-9. https://doi.org/10.1016/j.foodchem.2006.04.023
145. Wu G. Amino acids: metabolism, functions, and nutrition. Amino Acids. 2009;37(1):1-17. https://doi.org/10.1007/s00726-009-0269-0
146. Ward PS, Thompson CB. Signaling in control of cell growth and metabolism. Cold Spring Harbor perspectives in biology. 2012;4(7):a006783-a. https://doi.org/10.1101/cshperspect.a006783

Supporting information

S1 Table. Detailed information of CNVs detected in a Nelore population using HD SNP genotyping data. (CSV)

S2 Table. Genomic position, characterization and frequency of CNVRs detected in Nelore beef cattle. (CSV)

S3 Table. Percentage of bovine chromosomes length covered by CNVRs and number of CNVRs per chromosome. (CSV)

S4 Table. CNVRs significantly associated with hot carcass weight (HCW), ribeye area (REA), subcutaneous backfat thickness (SBT), tenderness (TD) after 7, 14 and 21 days of aging, intramuscular fat content (IFC) and intramuscular cholesterol content (ICC) in Nelore cattle. (CSV)

S5 Table. CNVRs overlapping annotated *Bos taurus* genes in the UMD3.1 genome assembly. (CSV)

S6 Table. Functional terms significantly enriched with copy number variable genes associated with carcass and meat quality traits in Nelore cattle. (CSV)

Funding information

Research supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico (FMR, grant number: 478132/2013-1), Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FMR, grant number: APQ-01804-13) and Fundação de Amparo à Pesquisa do Estado de São Paulo (JBSF, grant numbers: 2014/07566-2 and 2012/50533-2).

Authors contributions

MAA and ACF conducted all analyses and drafted the manuscript; ASC, ACF and TCSC assisted on CNV and CNVR analysis; MNB, MEC, JBSF, ECM, JPE and FMR collected samples and/or generated phenotypic and genotypic data; FMR conceived the study, assisted on data analyses and manuscript preparation. All authors have read and approved the manuscript.

Data availability statement

The datasets supporting the conclusions of this manuscript are included within the article and additional files.

Supplementary information

Fig 1.

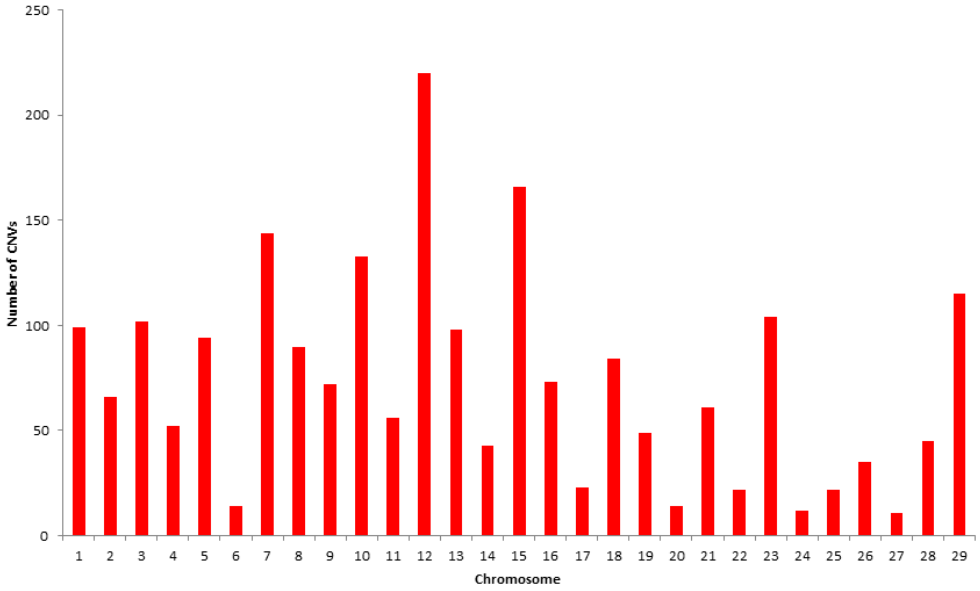


Fig 2.

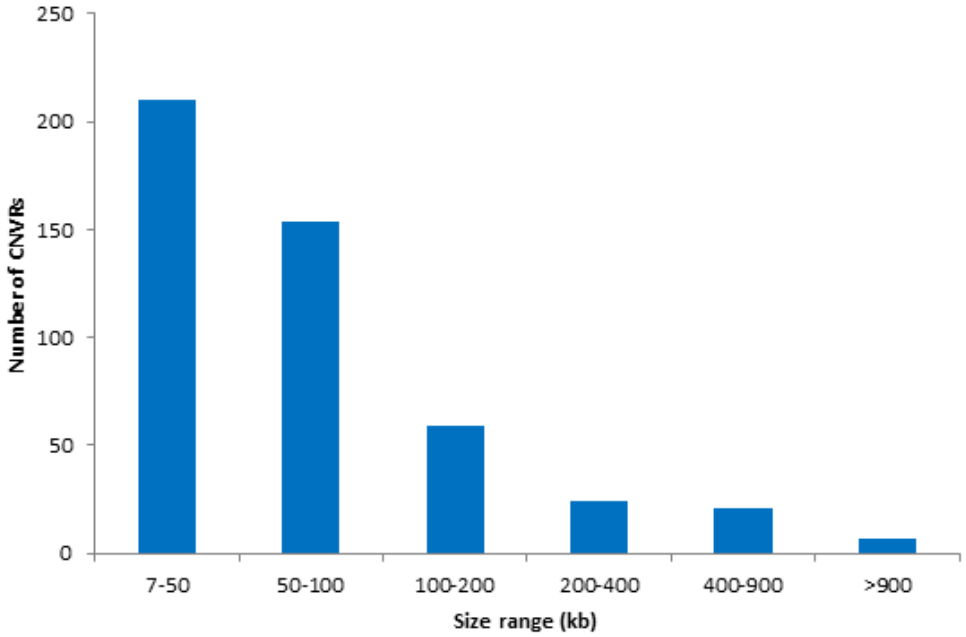
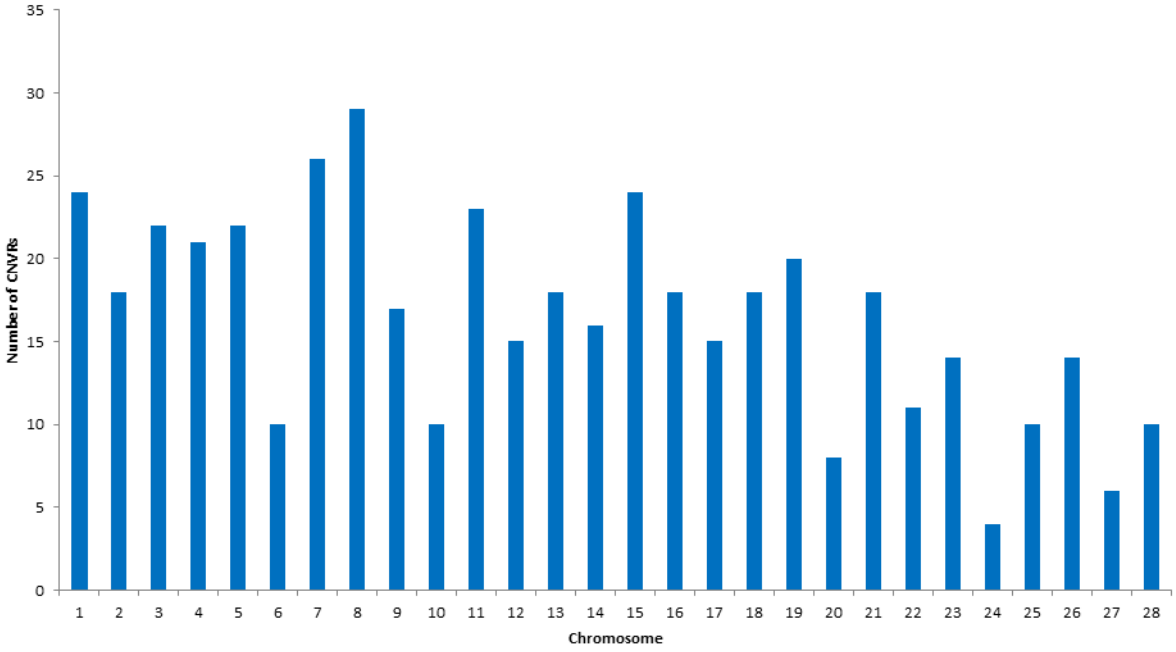

250
200
150
100
50
0
Number of CNVRs
7-50
50-100
100-200
200-400
400-900
>900
Size range (kb)

Fig 3


35
30
25
20
15
10
5
0
Number of CNVRs
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Chromosome

S1_Table

CNV	Chr	Start	End	Number_SNP	Size_pb	State	Count	Start_SNP	End_SNP
1	1	16947	127885	10	110939	5	3	BovineHD0100000005	BovineHD0100000037
2	1	16947	146011	13	129065	5	3	BovineHD0100000005	BovineHD0100000039
3	1	16947	147231	14	130285	5	3	BovineHD0100000005	BovineHD0100000040
4	1	78655	146011	10	67357	5	3	BovineHD0100000026	BovineHD0100000039
5	1	1419261	1473797	14	54537	5	3	BovineHD0100000439	BovineHD0100000450
6	1	1419261	1488431	18	69171	5	3	BovineHD0100000439	BovineHD0100000454
7	1	1419261	1557330	51	138070	5	3	BovineHD0100000439	BovineHD0100000488
8	1	1419261	1565773	57	146513	5	3	BovineHD0100000439	BovineHD0100000494
9	1	1419261	1568515	58	149255	5	3	BovineHD0100000439	BovineHD0100000495
10	1	1419261	1573264	64	154004	5	3	BovineHD0100000439	BovineHD0100000501
11	1	1419261	1581740	71	162480	5	3	BovineHD0100000439	BovineHD0100000509
12	1	1419261	1582828	73	163568	5	3	BovineHD0100000439	ARS-BFGL-NGS-105306
13	1	1419261	1588366	75	169106	5	3	BovineHD0100000439	BovineHD0100000512
14	1	1419261	1597837	77	178577	5	3	BovineHD0100000439	BovineHD0100046372
15	1	1419261	1600852	78	181592	5	3	BovineHD0100000439	BovineHD0100000515
16	1	1419261	1625471	85	206211	5	3	BovineHD0100000439	Hapmap24070-BTA-123581
17	1	1419261	1630187	86	210927	5	3	BovineHD0100000439	BovineHD0100000519
18	1	1419261	1640525	90	221265	5	3	BovineHD0100000439	BovineHD0100000523
19	1	1422523	1600852	77	178330	5	3	BovineHD0100000440	BovineHD0100000515
20	1	1428253	1597837	75	169585	5	3	BovineHD0100000441	BovineHD0100046372
21	1	1433438	1568515	55	135078	5	3	BovineHD0100000442	BovineHD0100000495
22	1	1433438	1597837	74	164400	5	3	BovineHD0100000442	BovineHD0100046372
23	1	1436503	1568515	54	132013	5	3	ARS-BFGL-NGS-62826	BovineHD0100000495
24	1	1436503	1625471	81	188969	5	3	ARS-BFGL-NGS-62826	Hapmap24070-BTA-123581

25	1	1436503	1630187	82	193685	5	3	ARS-BFGL-NGS-62826	BovineHD0100000519
26	1	1529411	1600852	41	71442	5	3	BovineHD0100000473	BovineHD0100000515
27	1	1529411	1625471	48	96061	5	3	BovineHD0100000473	Hapmap24070-BTA-123581
28	1	1533049	1600852	40	67804	5	3	BovineHD0100000474	BovineHD0100000515
29	1	1561012	1581740	20	20729	5	3	BovineHD0100000489	BovineHD0100000509
30	1	1561012	1590885	25	29874	5	3	BovineHD0100000489	BovineHD0100000513
31	1	1565090	1630187	31	65098	5	3	BovineHD0100000493	BovineHD0100000519
32	1	1588366	1630187	12	41822	5	3	BovineHD0100000512	BovineHD0100000519
33	1	1597837	1630187	10	32351	5	3	BovineHD0100046372	BovineHD0100000519
34	1	1905048	2004603	25	99556	5	3	BovineHD0100000595	BovineHD0100000615
35	1	1958832	2004603	13	45772	5	3	BovineHD0100000604	BovineHD0100000615
36	1	15984544	15996851	11	12308	2	1	BovineHD0100004867	BovineHD0100004878
37	1	17851162	17872041	13	20880	5	3	BovineHD0100005377	BovineHD0100005389
38	1	17851162	17873260	14	22099	5	3	BovineHD0100005377	BovineHD0100005390
39	1	17856986	17872041	12	15056	5	3	BovineHD0100005378	BovineHD0100005389
40	1	20210312	20302086	24	91775	2	1	BovineHD4100000117	BovineHD0100006027
41	1	20673471	20721169	14	47699	2	1	BovineHD0100006121	Hapmap45407-BTA-116763
42	1	20700573	20734822	13	34250	2	1	BovineHD0100046911	BovineHD0100006137
43	1	22761416	23178933	141	417518	5	3	BovineHD0100006716	BovineHD0100006852
44	1	59559724	59613089	20	53366	2	1	BovineHD0100016864	BovineHD0100016881
45	1	59561102	59613089	19	51988	2	1	BTB-00028136	BovineHD0100016881
46	1	59580130	59627042	19	46913	2	1	BovineHD0100016868	BovineHD0100016885
47	1	60195040	60268813	19	73774	2	1	BovineHD0100047033	BovineHD0100017032
48	1	69800636	69818543	13	17908	2	1	BovineHD0100019956	BovineHD0100019967
49	1	71255928	71269030	11	13103	2	1	BovineHD4100000410	BovineHD0100020466
50	1	84243270	84259079	10	15810	5	3	BovineHD0100024130	BovineHD0100024138
51	1	84636563	84719820	17	83258	2	1	BovineHD0100024246	BovineHD0100024260

52	1	84650093	84705979	11	55887	2	1	ARS-BFGL-NGS-16561	BovineHD0100024256
53	1	84650093	84719820	14	69728	2	1	ARS-BFGL-NGS-16561	BovineHD0100024260
54	1	84670256	84736049	13	65794	2	1	BovineHD0100024252	BovineHD0100024264
55	1	87332538	87383092	20	50555	2	1	BovineHD0100024825	BovineHD0100024845
56	1	93730576	93819471	10	88896	1	0	BovineHD0100047110	BovineHD0100026605
57	1	1,05E+08	1,05E+08	53	245492	2	1	BovineHD0100029859	BTB-02073725
58	1	1,05E+08	1,05E+08	48	199471	2	1	BTB-01995287	BovineHD0100029901
59	1	1,05E+08	1,05E+08	50	213731	2	1	BTB-01995287	BTB-01690752
60	1	1,05E+08	1,05E+08	51	230422	2	1	BovineHD0100029860	BTB-02073725
61	1	1,05E+08	1,05E+08	45	178260	2	1	BovineHD0100029861	BovineHD0100029900
62	1	1,05E+08	1,05E+08	46	185376	2	1	BovineHD0100029861	BovineHD0100029901
63	1	1,05E+08	1,05E+08	47	190995	2	1	BovineHD0100029861	BovineHD0100029902
64	1	1,05E+08	1,05E+08	48	199636	2	1	BovineHD0100029861	BTB-01690752
65	1	1,05E+08	1,05E+08	49	216362	2	1	BovineHD0100029861	BovineHD0100029903
66	1	1,05E+08	1,05E+08	50	221907	2	1	BovineHD0100029861	BTB-02073725
67	1	1,05E+08	1,05E+08	51	228182	2	1	BovineHD0100029861	BovineHD0100029904
68	1	1,07E+08	1,07E+08	32	127654	2	1	BovineHD0100030390	BovineHD0100030421
69	1	1,16E+08	1,16E+08	17	46087	2	1	BovineHD0100032865	BovineHD0100032880
70	1	1,16E+08	1,16E+08	27	60859	2	1	BovineHD0100032865	BovineHD0100032889
71	1	1,16E+08	1,16E+08	14	36926	2	1	BovineHD0100032868	BovineHD0100032880
72	1	1,16E+08	1,16E+08	24	51698	2	1	BovineHD0100032868	BovineHD0100032889
73	1	1,16E+08	1,16E+08	15	44579	2	1	BovineHD0100032915	BovineHD0100032929
74	1	1,16E+08	1,16E+08	14	43306	2	1	BovineHD0100032916	BovineHD0100032929
75	1	1,16E+08	1,16E+08	15	48667	2	1	BovineHD0100032916	BovineHD0100032931
76	1	1,16E+08	1,16E+08	13	41733	2	1	BovineHD0100032917	BovineHD0100032929
77	1	1,16E+08	1,16E+08	12	39842	2	1	BovineHD0100032918	BovineHD0100032929
78	1	1,16E+08	1,16E+08	11	34390	2	1	BovineHD0100032920	BovineHD0100032929
79	1	1,29E+08	1,29E+08	18	35090	2	1	BovineHD0100036343	BovineHD0100036360
80	1	1,45E+08	1,45E+08	22	48789	2	1	BovineHD0100041911	BovineHD0100041932

81	1	1,45E+08	1,45E+08	23	49629	2	1	BovineHD0100041911	BovineHD0100041933
82	1	1,45E+08	1,45E+08	26	54908	2	1	BovineHD0100041911	BovineHD0100041937
83	1	1,45E+08	1,45E+08	31	65488	2	1	BovineHD0100041911	BovineHD0100041941
84	1	1,45E+08	1,45E+08	35	71907	2	1	BovineHD0100041911	BovineHD0100041946
85	1	1,45E+08	1,45E+08	36	74721	2	1	BovineHD0100041911	BovineHD0100041948
86	1	1,45E+08	1,45E+08	22	48168	2	1	BovineHD0100041912	BovineHD0100041933
87	1	1,45E+08	1,45E+08	25	53447	2	1	BovineHD0100041912	BovineHD0100041937
88	1	1,45E+08	1,45E+08	15	31971	2	1	BovineHD0100041920	BovineHD0100041933
89	1	1,45E+08	1,45E+08	17	28005	2	1	BovineHD0100041929	BovineHD0100041946
90	1	1,47E+08	1,47E+08	14	20328	2	1	BovineHD0100042626	BovineHD0100042638
91	1	1,54E+08	1,54E+08	34	64707	2	1	BovineHD0100044913	BovineHD0100044944
92	1	1,54E+08	1,54E+08	32	59065	2	1	BovineHD0100044915	BovineHD0100044944
93	1	1,54E+08	1,54E+08	18	26961	2	1	BovineHD0100044918	BovineHD0100044934
94	1	1,54E+08	1,54E+08	26	37259	2	1	BovineHD0100044918	BovineHD0100044941
95	1	1,54E+08	1,54E+08	29	46165	2	1	BovineHD0100044918	BovineHD0100044944
96	1	1,54E+08	1,54E+08	31	54186	2	1	BovineHD0100044918	ARS-BFGL-NGS-4798
97	1	1,54E+08	1,54E+08	13	13656	2	1	BovineHD0100044921	BovineHD0100044934
98	1	1,54E+08	1,54E+08	24	32860	2	1	BovineHD0100044921	BovineHD0100044944
99	1	1,54E+08	1,54E+08	16	23308	2	1	BovineHD0100044930	BovineHD0100044944
100	2	6889	215742	25	208854	5	3	BovineHD0200000001	ARS-BFGL-NGS-31104
101	2	6889	225418	26	218530	5	3	BovineHD0200000001	BovineHD0200000030
102	2	4102765	4133052	23	30288	2	1	BovineHD0200001100	BovineHD0200001121
103	2	5353429	5383276	15	29848	2	1	BovineHD0200001548	BovineHD0200001561
104	2	5353429	5391905	18	38477	2	1	BovineHD0200001548	BovineHD0200001563
105	2	5353429	5397349	20	43921	2	1	BovineHD0200001548	BovineHD0200001565
106	2	18057267	18120154	29	62888	2	1	BovineHD0200005161	BovineHD0200005189
107	2	18059182	18132789	31	73608	2	1	BovineHD0200005162	BovineHD0200005192
108	2	19622274	19668723	19	46450	2	1	BovineHD0200005637	BovineHD0200005656
109	2	19629176	19668723	15	39548	2	1	BovineHD0200005641	BovineHD0200005656

110	2	39263808	39330327	16	66520	2	1	BovineHD0200011526	BovineHD0200011551
111	2	45526790	45570621	13	43832	2	1	BovineHD0200013192	BovineHD0200013203
112	2	45584050	45599741	12	15692	2	1	BovineHD0200013205	BovineHD0200013216
113	2	52272443	52328286	17	55844	2	1	BovineHD0200014925	BovineHD0200014939
114	2	52311619	52364492	19	52874	2	1	BovineHD0200014934	BovineHD0200014950
115	2	65760135	65814327	10	54193	2	1	BovineHD0200019037	BovineHD0200019055
116	2	68129258	68150651	12	21394	2	1	BovineHD0200019679	BovineHD0200019690
117	2	82502028	82541785	18	39758	5	3	BovineHD0200023631	BovineHD0200023650
118	2	82514190	82541785	14	27596	5	3	BovineHD0200023636	BovineHD0200023650
119	2	82516577	82541785	13	25209	5	3	BovineHD0200023637	BovineHD0200023650
120	2	99034078	99086526	13	52449	5	3	BovineHD0200028504	Hapmap26416-BTA-146953
121	2	1,08E+08	1,08E+08	11	49012	2	1	BovineHD0200031085	BovineHD0200031094
122	2	1,08E+08	1,08E+08	15	61380	2	1	BovineHD0200031088	BovineHD0200031101
123	2	1,26E+08	1,26E+08	11	45986	2	1	ARS-BFGL-NGS-118708	BovineHD0200036692
124	2	1,26E+08	1,26E+08	14	63655	2	1	ARS-BFGL-NGS-118708	BovineHD0200036696
125	2	1,26E+08	1,26E+08	10	47911	2	1	BovineHD0200036684	BovineHD0200036695
126	2	1,32E+08	1,32E+08	19	44451	2	1	BovineHD0200038326	BovineHD0200038344
127	2	1,32E+08	1,32E+08	11	34099	2	1	BTA-49826-no-rs	BovineHD0200038445
128	2	1,35E+08	1,36E+08	181	448266	5	3	BovineHD0200039501	BovineHD0200039674
129	2	1,35E+08	1,35E+08	26	58776	5	3	BovineHD0200039502	BovineHD0200039528
130	2	1,35E+08	1,36E+08	197	492332	5	3	BovineHD0200039502	BovineHD0200039689
131	2	1,35E+08	1,35E+08	23	48533	5	3	ARS-BFGL-NGS-115989	BovineHD0200039526
132	2	1,35E+08	1,35E+08	29	64020	5	3	ARS-BFGL-NGS-115989	BovineHD0200039532
133	2	1,35E+08	1,35E+08	67	155897	5	3	ARS-BFGL-NGS-115989	BovineHD0200039566
134	2	1,35E+08	1,35E+08	143	315728	5	3	ARS-BFGL-NGS-115989	BovineHD0200039639
135	2	1,35E+08	1,35E+08	144	325228	5	3	ARS-BFGL-NGS-115989	BovineHD0200039641
136	2	1,35E+08	1,35E+08	146	330866	5	3	ARS-BFGL-NGS-115989	BovineHD0200039643
137	2	1,35E+08	1,35E+08	172	400969	5	3	ARS-BFGL-NGS-115989	BovineHD0200039666

138	2	1,35E+08	1,36E+08	173	405001	5	3	ARS-BFGL-NGS-115989	BovineHD0200039667
139	2	1,35E+08	1,36E+08	181	444067	5	3	ARS-BFGL-NGS-115989	ARS-BFGL-NGS-108967
140	2	1,35E+08	1,36E+08	195	484622	5	3	ARS-BFGL-NGS-115989	ARS-BFGL-NGS-27654
141	2	1,35E+08	1,36E+08	196	488917	5	3	ARS-BFGL-NGS-115989	BovineHD0200039689
142	2	1,35E+08	1,36E+08	197	501184	5	3	ARS-BFGL-NGS-115989	BovineHD0200039693
143	2	1,35E+08	1,36E+08	199	504794	5	3	ARS-BFGL-NGS-115989	BovineHD0200039695
144	2	1,35E+08	1,36E+08	200	507636	5	3	ARS-BFGL-NGS-115989	BovineHD0200039696
145	2	1,35E+08	1,35E+08	14	29160	5	3	BovineHD0200039506	BovineHD0200039520
146	2	1,35E+08	1,35E+08	141	312054	5	3	BovineHD0200039506	BovineHD0200039639
147	2	1,35E+08	1,35E+08	14	22417	5	3	BovineHD0200039507	BovineHD0200039521
148	2	1,35E+08	1,36E+08	175	424111	5	3	BovineHD0200039507	BovineHD0200040828
149	2	1,35E+08	1,36E+08	193	476527	5	3	BovineHD0200039507	BovineHD0200039689
150	2	1,35E+08	1,35E+08	131	286201	5	3	BovineHD0200039517	BovineHD0200039639
151	2	1,35E+08	1,35E+08	14	31187	5	3	BovineHD0200039520	BovineHD0200039532
152	2	1,35E+08	1,35E+08	52	123064	5	3	BovineHD0200039520	BovineHD0200039566
153	2	1,35E+08	1,35E+08	23	69866	5	3	BovineHD4100001746	BovineHD0200039574
154	2	1,35E+08	1,35E+08	83	180828	5	3	BovineHD0200039560	BovineHD0200039639
155	2	1,35E+08	1,35E+08	14	37061	5	3	BovineHD0200039561	BovineHD0200039574
156	2	1,35E+08	1,35E+08	82	177708	5	3	BovineHD0200039561	BovineHD0200039639
157	2	1,35E+08	1,35E+08	107	250812	5	3	BovineHD0200039564	BovineHD0200039666
158	2	1,35E+08	1,35E+08	77	159832	5	3	BovineHD0200039566	BovineHD0200039639
159	2	1,35E+08	1,36E+08	107	249105	5	3	BovineHD0200039566	BovineHD0200039667
160	2	1,35E+08	1,35E+08	51	105803	5	3	BovineHD0200039590	BovineHD4100001748
161	2	1,35E+08	1,35E+08	44	86992	5	3	BovineHD0200039598	BovineHD4100001748
162	2	1,35E+08	1,35E+08	45	95130	5	3	BovineHD0200039598	BovineHD0200039639
163	2	1,35E+08	1,35E+08	33	85830	5	3	BovineHD0200039609	BovineHD0200039641
164	2	1,35E+08	1,35E+08	31	75024	5	3	BovineHD0200039610	BovineHD0200039639
165	2	1,36E+08	1,36E+08	19	52666	5	3	BovineHD0200039672	ARS-BFGL-NGS-27654
166	3	25683	123760	11	98078	5	3	BovineHD0300000003	BovineHD0300035905

167	3	11070431	11096525	10	26095	2	1	BovineHD0300003634	BovineHD0300003643
168	3	11070431	11097187	11	26757	2	1	BovineHD0300003634	BovineHD0300003644
169	3	11959762	12057346	10	97585	5	3	BovineHD0300003931	BovineHD0300035950
170	3	11962808	12119049	11	156242	5	3	BovineHD0300003932	BovineHD0300035954
171	3	11962808	12124072	12	161265	5	3	BovineHD0300003932	BovineHD0300003989
172	3	11967194	12119049	10	151856	5	3	BovineHD0300003933	BovineHD0300035954
173	3	11967194	12124072	11	156879	5	3	BovineHD0300003933	BovineHD0300003989
174	3	13312387	13389465	22	77079	5	3	BovineHD0300004301	BovineHD0300004333
175	3	13312387	13420896	23	108510	5	3	BovineHD0300004301	BovineHD0300004338
176	3	13312387	13428990	27	116604	5	3	BovineHD0300004301	BovineHD0300004344
177	3	13312387	13448997	35	136611	5	3	BovineHD0300004301	BovineHD0300004355
178	3	14360623	14425158	16	64536	2	1	BovineHD0300004664	BovineHD0300004680
179	3	16525687	16561484	11	35798	2	1	BovineHD0300005376	BovineHD0300005384
180	3	20790917	20825156	11	34240	2	1	BovineHD0300006561	BovineHD0300006571
181	3	20958126	20996369	11	38244	5	3	BovineHD0300006617	BovineHD0300035990
182	3	20964087	21071654	19	107568	5	3	BovineHD0300006618	BovineHD0300006659
183	3	20964087	21075487	21	111401	5	3	BovineHD0300006618	BovineHD0300006662
184	3	20966800	21075487	20	108688	5	3	BovineHD0300006620	BovineHD0300006662
185	3	20972382	21075487	19	103106	5	3	BovineHD0300006622	BovineHD0300006662
186	3	20972382	21387762	71	415381	5	3	BovineHD0300006622	BovineHD0300006741
187	3	20977874	21044568	12	66695	5	3	BovineHD0300006625	BovineHD0300006650
188	3	20977874	21066806	14	88933	5	3	BovineHD0300006625	BovineHD0300006657
189	3	20977874	21075487	18	97614	5	3	BovineHD0300006625	BovineHD0300006662
190	3	20977874	21362442	64	384569	5	3	BovineHD0300006625	BovineHD0300006736
191	3	20996369	21075487	12	79119	5	3	BovineHD0300035990	BovineHD0300006662
192	3	21040171	21387762	61	347592	5	3	BovineHD0300006647	BovineHD0300006741
193	3	21433392	21500709	11	67318	2	1	BovineHD0300006745	BovineHD0300006754
194	3	21433392	21504431	12	71040	2	1	BovineHD0300006745	BovineHD0300036003
195	3	21433392	21508129	13	74738	2	1	BovineHD0300006745	BovineHD0300006755

196	3	21433392	21517572	14	84181	2	1	BovineHD0300006745	BovineHD0300006756
197	3	21457929	21517572	13	59644	2	1	BovineHD0300006747	BovineHD0300006756
198	3	21471705	21517572	11	45868	2	1	BovineHD0300006749	BovineHD0300006756
199	3	38031952	38069297	10	37346	5	3	BovineHD0300011745	BovineHD0300011756
200	3	40950927	40983044	12	32118	2	1	BovineHD0300012467	BovineHD0300036075
201	3	45817635	45854174	12	36540	5	3	BovineHD0300013958	BovineHD0300013969
202	3	54414408	54577951	11	163544	5	3	BovineHD0300016484	BovineHD0300016523
203	3	54414408	54760562	27	346155	2	1	BovineHD0300016484	BovineHD0300016583
204	3	54414408	54822796	34	408389	5	3	BovineHD0300016484	BovineHD0300016596
205	3	54522367	54963401	39	441035	1	0	BovineHD0300036142	BovineHD0300036152
206	3	54522367	54983387	41	461021	1	0	BovineHD0300036142	BovineHD0300016628
207	3	54522367	55017187	43	494821	2	1	BovineHD0300036142	BovineHD0300035567
208	3	54541000	54801510	27	260511	2	1	BovineHD0300016503	BovineHD0300016589
209	3	54541000	54963401	38	422402	2	1	BovineHD0300016503	BovineHD0300036152
210	3	54541000	54983387	40	442388	2	1	BovineHD0300016503	BovineHD0300016628
211	3	54541000	55017187	42	476188	2	1	BovineHD0300016503	BovineHD0300035567
212	3	54545012	54968058	38	423047	2	1	BovineHD0300016505	BovineHD0300016625
213	3	54545012	55017187	41	472176	2	1	BovineHD0300016505	BovineHD0300035567
214	3	54555541	55017187	40	461647	2	1	BovineHD0300016512	BovineHD0300035567
215	3	54574215	54760562	19	186348	2	1	BovineHD0300016521	BovineHD0300016583
216	3	54574215	54872418	27	298204	2	1	BovineHD0300016521	BovineHD0300016607
217	3	54574215	54956792	30	382578	2	1	BovineHD0300016521	BovineHD0300016622
218	3	54574215	54963401	32	389187	2	1	BovineHD0300016521	BovineHD0300036152
219	3	54574215	54983387	34	409173	2	1	BovineHD0300016521	BovineHD0300016628
220	3	54574215	55017187	36	442973	2	1	BovineHD0300016521	BovineHD0300035567
221	3	54577951	54801510	19	223560	2	1	BovineHD0300016523	BovineHD0300016589
222	3	54577951	54963401	30	385451	2	1	BovineHD0300016523	BovineHD0300036152
223	3	54577951	55017187	34	439237	2	1	BovineHD0300016523	BovineHD0300035567
224	3	54587989	54760562	16	172574	2	1	BovineHD0300016526	BovineHD0300016583

225	3	54587989	54947261	26	359273	2	1	BovineHD0300016526	BovineHD0300016620
226	3	54587989	54983387	31	395399	2	1	BovineHD0300016526	BovineHD0300016628
227	3	54651458	54801510	15	150053	2	1	BovineHD0300016552	BovineHD0300016589
228	3	54651458	54983387	28	331930	2	1	BovineHD0300016552	BovineHD0300016628
229	3	54678581	54963401	25	284821	2	1	BovineHD0300016559	BovineHD0300036152
230	3	54872418	55017187	10	144770	2	1	BovineHD0300016607	BovineHD0300035567
231	3	67052465	67102276	17	49812	2	1	BovineHD0300019844	BovineHD0300019858
232	3	85137324	85176224	11	38901	2	1	BovineHD0300024311	BovineHD0300024323
233	3	86929227	86961766	14	32540	2	1	BovineHD0300024890	BovineHD0300024901
234	3	86942924	86961766	10	18843	2	1	BovineHD0300024893	BovineHD0300024901
235	3	95235866	95299019	15	63154	2	1	BovineHD0300027385	BovineHD0300027395
236	3	1,1E+08	1,1E+08	22	29516	2	1	BovineHD0300031670	BovineHD0300031689
237	3	1,1E+08	1,1E+08	20	24237	2	1	BovineHD0300031672	BovineHD0300031689
238	3	1,1E+08	1,1E+08	13	11461	2	1	BovineHD0300031678	BovineHD0300031688
239	3	1,1E+08	1,1E+08	16	15417	2	1	BovineHD0300031678	BovineHD0300031691
240	3	1,1E+08	1,1E+08	17	16553	2	1	BovineHD0300031678	BovineHD0300031692
241	3	1,1E+08	1,1E+08	13	13117	2	1	BovineHD0300031679	BovineHD0300031689
242	3	1,18E+08	1,18E+08	31	92765	2	1	BovineHD0300034319	BovineHD0300034350
243	3	1,18E+08	1,18E+08	11	39236	2	1	BovineHD0300034433	BovineHD0300034442
244	3	1,18E+08	1,18E+08	14	52408	2	1	BovineHD0300034433	BovineHD0300034444
245	3	1,18E+08	1,18E+08	15	53936	2	1	BovineHD0300034433	BovineHD0300034445
246	3	1,18E+08	1,18E+08	17	57789	2	1	BovineHD0300034433	BovineHD0300034447
247	3	1,18E+08	1,18E+08	10	36192	2	1	BovineHD0300034435	ARS-BFGL-NGS-35269
248	3	1,18E+08	1,18E+08	12	44353	2	1	BovineHD0300034435	BovineHD0300034444
249	3	1,18E+08	1,18E+08	13	45881	2	1	BovineHD0300034435	BovineHD0300034445
250	3	1,18E+08	1,18E+08	15	49734	2	1	BovineHD0300034435	BovineHD0300034447
251	3	1,2E+08	1,2E+08	49	282682	5	3	BovineHD0300035034	BovineHD0300035125
252	3	1,2E+08	1,2E+08	12	48694	5	3	BovineHD0300035035	BovineHD0300035048
253	3	1,2E+08	1,2E+08	20	82197	5	3	BovineHD0300035035	BovineHD0300035057

254	3	1,2E+08	1,2E+08	21	91909	5	3	BovineHD0300035035	BovineHD0300035705
255	3	1,2E+08	1,2E+08	38	218012	5	3	BovineHD0300035035	BovineHD0300035102
256	3	1,2E+08	1,2E+08	42	239742	5	3	BovineHD0300035035	BovineHD0300035109
257	3	1,2E+08	1,2E+08	48	281736	5	3	BovineHD0300035035	BovineHD0300035125
258	3	1,2E+08	1,2E+08	10	43258	5	3	BovineHD0300035038	BovineHD0300035048
259	3	1,2E+08	1,2E+08	46	276300	5	3	BovineHD0300035038	BovineHD0300035125
260	3	1,2E+08	1,2E+08	13	56602	5	3	BovineHD0300035043	BovineHD0300035057
261	3	1,2E+08	1,2E+08	14	66314	5	3	BovineHD0300035043	BovineHD0300035705
262	3	1,2E+08	1,2E+08	12	46560	5	3	BovineHD0300035045	BovineHD0300035057
263	3	1,2E+08	1,2E+08	13	56272	5	3	BovineHD0300035045	BovineHD0300035705
264	3	1,2E+08	1,2E+08	17	87850	5	3	BovineHD0300035045	BovineHD0300035706
265	3	1,2E+08	1,2E+08	13	86711	5	3	BovineHD0300035088	BovineHD0300035125
266	3	1,2E+08	1,2E+08	11	63725	5	3	BovineHD0300035102	BovineHD0300035125
267	3	1,2E+08	1,2E+08	12	46439	2	1	BovineHD0300035190	ARS-BFGL-NGS-11201
268	4	3803621	3827792	10	24172	2	1	BovineHD0400000955	BovineHD0400000965
269	4	5099643	5121618	17	21976	2	1	BovineHD0400001443	BovineHD0400001460
270	4	16765495	16834381	14	68887	5	3	BovineHD0400004937	BovineHD0400035878
271	4	20673638	20701989	11	28352	2	1	BovineHD0400006187	BovineHD4100002714
272	4	27069001	27106242	12	37242	2	1	BovineHD4100002742	BovineHD0400035619
273	4	36543733	36563030	10	19298	2	1	BovineHD0400010244	BovineHD0400010252
274	4	38491489	38579226	49	87738	2	1	BovineHD0400010772	BovineHD0400010819
275	4	38632043	38660809	13	28767	2	1	BovineHD0400010833	BovineHD0400010844
276	4	40036510	40081019	16	44510	5	3	BovineHD0400011104	BovineHD0400011119
277	4	55864504	55906545	11	42042	2	1	BovineHD0400015252	BovineHD0400015264
278	4	61403692	61418329	12	14638	2	1	BovineHD0400016809	BovineHD0400016819
279	4	61408015	61424375	12	16361	2	1	BovineHD0400016811	BovineHD0400016822
280	4	64303320	64355713	14	52394	2	1	BovineHD0400017609	BovineHD0400017622
281	4	83429553	83452740	12	23188	5	3	BovineHD0400023103	BovineHD0400023123
282	4	83429553	83460111	13	30559	5	3	BovineHD0400023103	BovineHD0400023124

283	4	83429553	83463128	14	33576	5	3	BovineHD0400023103	BovineHD0400023125
284	4	83429553	83468395	15	38843	5	3	BovineHD0400023103	BovineHD0400023126
285	4	83429553	83471026	17	41474	5	3	BovineHD0400023103	BovineHD0400023129
286	4	95300892	95393978	26	93087	5	3	BovineHD0400026561	BovineHD0400026582
287	4	99775747	99923879	10	148133	5	3	BovineHD0400027926	BovineHD0400027978
288	4	1,06E+08	1,06E+08	30	120902	5	3	BovineHD0400029950	BovineHD0400029995
289	4	1,06E+08	1,06E+08	22	85259	5	3	BovineHD0400029951	BovineHD0400029984
290	4	1,06E+08	1,06E+08	23	91552	5	3	BovineHD0400029962	BovineHD0400029998
291	4	1,06E+08	1,06E+08	25	80510	5	3	BovineHD0400029968	BovineHD0400030006
292	4	1,06E+08	1,06E+08	10	27003	5	3	BovineHD0400029995	BovineHD0400030009
293	4	1,08E+08	1,08E+08	13	50411	5	3	BovineHD0400030900	BovineHD0400030914
294	4	1,08E+08	1,08E+08	15	59709	5	3	BovineHD0400030900	ARS-BFGL-NGS-95772
295	4	1,08E+08	1,08E+08	18	65586	5	3	BovineHD0400030900	BovineHD0400030918
296	4	1,14E+08	1,14E+08	10	64453	5	3	BovineHD0400032774	Hapmap22875-BTA-155031
297	4	1,14E+08	1,14E+08	15	88241	5	3	BovineHD0400032774	BovineHD0400032809
298	4	1,14E+08	1,14E+08	16	93738	5	3	BovineHD0400032774	BovineHD0400032812
299	4	1,14E+08	1,14E+08	17	100273	5	3	BovineHD0400032774	BovineHD0400032814
300	4	1,14E+08	1,14E+08	18	105107	5	3	BovineHD0400032774	BovineHD0400032818
301	4	1,14E+08	1,14E+08	19	107842	5	3	BovineHD0400032774	BovineHD0400032820
302	4	1,14E+08	1,14E+08	24	138028	5	3	BovineHD0400032774	BovineHD0400032837
303	4	1,14E+08	1,14E+08	15	92967	5	3	BovineHD0400032775	BovineHD0400032812
304	4	1,14E+08	1,14E+08	17	104336	6	4	BovineHD0400032775	BovineHD0400032818
305	4	1,14E+08	1,14E+08	13	95305	5	3	BovineHD0400032779	BovineHD0400032814
306	4	1,14E+08	1,14E+08	11	86252	5	3	BovineHD0400032781	BovineHD0400032812
307	4	1,14E+08	1,14E+08	10	83606	5	3	BovineHD0400032783	BovineHD0400032812
308	4	1,14E+08	1,14E+08	11	90141	5	3	BovineHD0400032783	BovineHD0400032814
309	4	1,14E+08	1,14E+08	12	94975	5	3	BovineHD0400032783	BovineHD0400032818
310	4	1,14E+08	1,14E+08	18	127896	5	3	BovineHD0400032783	BovineHD0400032837

311	4	1,14E+08	1,14E+08	22	157190	5	3	BovineHD0400032783	BovineHD0400032846
312	4	1,14E+08	1,14E+08	12	89167	5	3	BovineHD4100003281	BovineHD0400032820
313	4	1,14E+08	1,14E+08	10	65519	5	3	BovineHD0400032792	BovineHD0400032818
314	4	1,14E+08	1,14E+08	20	136578	5	3	Hapmap22875-BTA-155031	BovineHD0400032851
315	4	1,14E+08	1,14E+08	31	353727	5	3	Hapmap22875-BTA-155031	BovineHD0400032935
316	4	1,17E+08	1,17E+08	13	14616	5	3	BovineHD0400034149	BovineHD0400034160
317	4	1,17E+08	1,17E+08	15	17019	5	3	BovineHD0400034149	BovineHD0400034162
318	4	1,17E+08	1,17E+08	11	20421	5	3	BovineHD0400034182	BovineHD0400034192
319	4	1,2E+08	1,2E+08	22	81864	5	3	ARS-BFGL-NGS-119263	BovineHD0400035100
320	5	108421	982397	188	873977	5	3	BovineHD0500000023	BovineHD0500000228
321	5	375030	492282	14	117253	5	3	BovineHD0500000070	BovineHD0500000089
322	5	375030	496857	15	121828	5	3	BovineHD0500000070	BovineHD0500035768
323	5	13505687	13519855	10	14169	5	3	BovineHD0500004073	BovineHD0500004083
324	5	35251507	35293149	10	41643	2	1	BovineHD0500010122	BovineHD0500010131
325	5	36039557	36061007	12	21451	5	3	BovineHD0500010334	BovineHD0500010343
326	5	57993463	58154111	20	160649	5	3	BovineHD0500016367	BovineHD0500016407
327	5	57993463	58293514	29	300052	5	3	BovineHD0500016367	BovineHD0500016429
328	5	57998266	58049635	11	51370	5	3	BovineHD0500016368	BovineHD0500016386
329	5	58011004	58137499	13	126496	5	3	BovineHD0500016370	BovineHD0500016403
330	5	58011004	58154111	17	143108	5	3	BovineHD0500016370	BovineHD0500016407
331	5	58011004	58184342	18	173339	5	3	BovineHD0500016370	BovineHD0500016412
332	5	58011004	58241554	22	230551	5	3	BovineHD0500016370	BovineHD0500016422
333	5	58011004	58293514	26	282511	5	3	BovineHD0500016370	BovineHD0500016429
334	5	58136437	58293514	15	157078	5	3	BovineHD0500016402	BovineHD0500016429
335	5	59066551	59215089	13	148539	2	1	BovineHD0500016609	BovineHD0500036002
336	5	59105889	59215089	10	109201	2	1	BovineHD0500035992	BovineHD0500036002
337	5	59339188	59627471	24	288284	5	3	BovineHD0500016656	BovineHD0500016691

338	5	59421039	59581140	12	160102	2	1	BovineHD0500016665	BovineHD0500016685
339	5	59421039	59598727	14	177689	2	1	BovineHD0500016665	Hapmap26488-BTA-164056
340	5	59421039	59606134	15	185096	2	1	BovineHD0500016665	BovineHD0500016688
341	5	59421039	59612173	16	191135	2	1	BovineHD0500016665	BovineHD0500016689
342	5	59421039	59619562	17	198524	2	1	BovineHD0500016665	BovineHD0500016690
343	5	59421039	59627471	18	206433	1	0	BovineHD0500016665	BovineHD0500016691
344	5	59424861	59619562	16	194702	1	0	BovineHD0500016666	BovineHD0500016690
345	5	59496240	59619562	13	123323	5	3	BovineHD0500016674	BovineHD0500016690
346	5	59496240	59627471	14	131232	5	3	BovineHD0500016674	BovineHD0500016691
347	5	59496240	59642942	15	146703	5	3	BovineHD0500016674	BovineHD0500016693
348	5	59496240	59648377	16	152138	5	3	BovineHD0500016674	BovineHD0500016694
349	5	59496240	59650955	17	154716	5	3	BovineHD0500016674	BovineHD0500016695
350	5	59503184	59627471	13	124288	5	3	BovineHD0500016675	BovineHD0500016691
351	5	59503184	59642942	14	139759	5	3	BovineHD0500016675	BovineHD0500016693
352	5	59503184	59648377	15	145194	5	3	BovineHD0500016675	BovineHD0500016694
353	5	59528762	59648377	13	119616	5	3	BovineHD0500016680	BovineHD0500016694
354	5	72691446	72722162	10	30717	2	1	ARS-BFGL-NGS-88709	BovineHD0500020564
355	5	74288348	74359489	21	71142	2	1	BovineHD0500021160	BovineHD0500021183
356	5	74390808	74439336	15	48529	2	1	BovineHD0500021189	BovineHD0500021201
357	5	75240516	75262931	16	22416	2	1	BovineHD0500021410	BovineHD0500021425
358	5	75252587	75262931	10	10345	2	1	BovineHD0500021417	BovineHD0500021425
359	5	75259542	75272725	10	13184	2	1	BovineHD4100003852	BovineHD0500021429
360	5	84235131	84264924	10	29794	2	1	BovineHD0500023847	BTA-74407-no-rs
361	5	84235131	84268844	11	33714	2	1	BovineHD0500023847	BovineHD0500023855
362	5	99334070	99363073	17	29004	2	1	BovineHD0500028366	BovineHD0500028383
363	5	99336808	99377602	18	40795	2	1	BovineHD0500028367	BovineHD0500028385
364	5	1,01E+08	1,01E+08	11	73656	5	3	BovineHD0500028809	BovineHD0500028829
365	5	1,01E+08	1,01E+08	12	76442	5	3	BovineHD0500028809	BovineHD0500028830

366	5	1,03E+08	1,03E+08	10	82360	1	0	BovineHD0500029371	BovineHD0500029396
367	5	1,03E+08	1,03E+08	13	90204	2	1	BovineHD0500029371	BovineHD0500029400
368	5	1,03E+08	1,03E+08	11	45677	2	1	BovineHD0500029388	BovineHD0500029400
369	5	1,03E+08	1,03E+08	13	91941	5	3	BovineHD0500029503	BovineHD0500029515
370	5	1,03E+08	1,03E+08	10	257436	5	3	BovineHD0500029539	BovineHD0500029573
371	5	1,03E+08	1,03E+08	13	315899	5	3	BovineHD0500029539	BovineHD0500029582
372	5	1,03E+08	1,03E+08	10	299570	5	3	BovineHD0500029544	BovineHD0500029582
373	5	1,13E+08	1,13E+08	22	80329	2	1	BovineHD0500032619	BovineHD0500032637
374	5	1,17E+08	1,17E+08	37	123510	2	1	BovineHD0500033992	BovineHD0500034031
375	5	1,17E+08	1,17E+08	24	73735	2	1	BovineHD0500034001	ARS-BFGL-NGS-96175
376	5	1,17E+08	1,17E+08	30	91797	2	1	BovineHD0500034001	BovineHD0500034031
377	5	1,17E+08	1,17E+08	23	71886	2	1	BovineHD0500034002	ARS-BFGL-NGS-96175
378	5	1,17E+08	1,17E+08	29	89948	2	1	BovineHD0500034002	BovineHD0500034031
379	5	1,17E+08	1,17E+08	25	65956	2	1	BovineHD0500034007	BovineHD0500034031
380	5	1,17E+08	1,17E+08	24	56927	2	1	BovineHD0500034008	BovineHD0500034031
381	5	1,17E+08	1,17E+08	14	40020	2	1	BovineHD0500034018	BovineHD0500034031
382	5	1,17E+08	1,17E+08	12	36474	2	1	BovineHD0500034020	BovineHD0500034031
383	5	1,17E+08	1,18E+08	40	375452	5	3	BovineHD0500034073	BovineHD0500034159
384	5	1,17E+08	1,17E+08	18	157898	5	3	BovineHD0500034077	BovineHD0500034122
385	5	1,17E+08	1,17E+08	22	180772	5	3	BovineHD0500034077	BovineHD0500034128
386	5	1,17E+08	1,17E+08	24	190812	1	0	BovineHD0500034077	BovineHD0500034130
387	5	1,17E+08	1,17E+08	25	203315	5	3	BovineHD0500034077	BovineHD0500034132
388	5	1,17E+08	1,17E+08	26	210676	1	0	BovineHD0500034077	BovineHD0500034134
389	5	1,17E+08	1,17E+08	27	215984	6	4	BovineHD0500034077	BovineHD0500036296
390	5	1,17E+08	1,18E+08	31	275744	5	3	BovineHD0500034077	BovineHD0500034148
391	5	1,17E+08	1,18E+08	36	304242	1	0	BovineHD0500034077	BovineHD0500034153
392	5	1,17E+08	1,18E+08	38	349765	5	3	BovineHD0500034077	BovineHD0500034159
393	5	1,17E+08	1,18E+08	39	358021	5	3	BovineHD0500034077	BovineHD0500034161
394	5	1,17E+08	1,17E+08	24	198299	5	3	BovineHD0500034078	BovineHD0500034132

395	5	1,17E+08	1,17E+08	16	83217	5	3	BovineHD0500034093	BovineHD0500034122
396	5	1,17E+08	1,17E+08	20	106091	5	3	BovineHD0500034093	BovineHD0500034128
397	5	1,17E+08	1,17E+08	25	141303	5	3	BovineHD0500034093	BovineHD0500036296
398	5	1,17E+08	1,18E+08	26	167635	6	4	BovineHD0500034093	BovineHD0500034144
399	5	1,17E+08	1,18E+08	28	186825	5	3	BovineHD0500034093	BovineHD0500034146
400	5	1,17E+08	1,18E+08	34	229561	1	0	BovineHD0500034093	BovineHD0500034153
401	5	1,17E+08	1,18E+08	35	235897	5	3	BovineHD0500034093	BovineHD0500034154
402	5	1,17E+08	1,18E+08	36	275084	5	3	BovineHD0500034093	BovineHD0500034159
403	5	1,17E+08	1,18E+08	32	219997	1	0	BovineHD0500034096	BovineHD0500034153
404	5	1,17E+08	1,18E+08	13	88590	5	3	BovineHD0500034120	BovineHD0500034144
405	5	1,17E+08	1,17E+08	10	58087	5	3	BovineHD0500034122	BovineHD0500036296
406	5	1,17E+08	1,18E+08	14	146451	5	3	BovineHD0500034132	BovineHD0500034159
407	5	1,17E+08	1,18E+08	11	94595	1	0	BovineHD0500036296	BovineHD0500034154
408	5	1,17E+08	1,18E+08	12	133782	5	3	BovineHD0500036296	BovineHD0500034159
409	5	1,18E+08	1,18E+08	10	68263	1	0	BovineHD0500034144	BovineHD0500034154
410	5	1,18E+08	1,18E+08	12	115706	1	0	BovineHD0500034144	BovineHD0500034161
411	5	1,18E+08	1,18E+08	11	106757	1	0	BovineHD0500034145	BovineHD0500034161
412	5	1,19E+08	1,19E+08	91	164056	5	3	BovineHD0500034473	BovineHD0500034559
413	5	1,2E+08	1,2E+08	20	50222	2	1	BovineHD0500034940	BovineHD0500034956
414	6	3164764	3208493	11	43730	5	3	BovineHD0600000791	BovineHD0600000802
415	6	3164764	3217181	12	52418	5	3	BovineHD0600000791	BovineHD0600000803
416	6	3164764	3225645	13	60882	5	3	BovineHD0600000791	BovineHD0600000804
417	6	3170707	3208493	10	37787	5	3	BovineHD0600000792	BovineHD0600000802
418	6	6502610	6652458	10	149849	5	3	BovineHD0600001420	BovineHD0600001432
419	6	38415398	38455242	11	39845	5	3	Hapmap23638-BTA-143920	BovineHD0600010643
420	6	44446202	44480062	10	33861	2	1	BovineHD4100004826	BovineHD0600012151
421	6	86009586	86101702	10	92117	5	3	BovineHD0600023640	BovineHD0600034809
422	6	1,03E+08	1,04E+08	11	23884	5	3	BovineHD0600028802	BovineHD0600028812

423	6	1,03E+08	1,04E+08	10	20779	5	3	BovineHD0600028804	BovineHD0600028813
424	6	1,08E+08	1,09E+08	114	335747	2	1	ARS-BFGL-NGS-33863	BovineHD4100005586
425	6	1,09E+08	1,09E+08	12	53114	2	1	BovineHD0600030750	BovineHD4100005587
426	6	1,17E+08	1,17E+08	10	29950	5	3	BovineHD0600033286	BovineHD0600033295
427	6	1,19E+08	1,19E+08	23	32624	2	1	BovineHD0600034140	BovineHD0600034163
428	7	2594859	2646809	17	51951	2	1	BovineHD0700000703	BovineHD0700000718
429	7	6569064	6599373	18	30310	2	1	BovineHD0700001918	BovineHD0700001935
430	7	6604091	6690607	35	86517	2	1	BovineHD0700001936	BovineHD0700001970
431	7	6644338	6669157	11	24820	2	1	BovineHD0700001955	Hapmap59438-rs29012637
432	7	6644338	6718398	22	74061	2	1	BovineHD0700001955	BovineHD0700001976
433	7	6645354	6702053	17	56700	2	1	BovineHD0700001956	BovineHD0700033493
434	7	6657788	6698584	12	40797	2	1	BovineHD0700001960	ARS-BFGL-NGS-10823
435	7	6657788	6718398	17	60611	2	1	BovineHD0700001960	BovineHD0700001976
436	7	7798579	7826979	10	28401	2	1	BovineHD0700001977	BovineHD0700001986
437	7	7798579	7832751	16	34173	2	1	BovineHD0700001977	BovineHD0700001992
438	7	7798579	7845456	19	46878	2	1	BovineHD0700001977	BovineHD0700001996
439	7	7798579	7875612	32	77034	5	3	BovineHD0700001977	ARS-BFGL-NGS-100448
440	7	7809288	7941613	48	132326	2	1	BovineHD0700001979	BovineHD0700002022
441	7	7813197	7832751	14	19555	2	1	BovineHD0700001980	BovineHD0700001992
442	7	7813197	7850410	19	37214	2	1	BovineHD0700001980	ARS-BFGL-NGS-119130
443	7	7813197	7868599	28	55403	2	1	BovineHD0700001980	BovineHD0700002006
444	7	7813197	7886713	33	73517	2	1	BovineHD0700001980	BovineHD0700002010
445	7	7816102	7865891	25	49790	2	1	BovineHD0700001981	BovineHD0700002004
446	7	7820308	7832751	12	12444	2	1	BovineHD0700001982	BovineHD0700001992
447	7	7820308	7845456	15	25149	2	1	BovineHD0700001982	BovineHD0700001996
448	7	7820308	7850410	17	30103	2	1	BovineHD0700001982	ARS-BFGL-NGS-119130
449	7	7820308	7865891	24	45584	2	1	BovineHD0700001982	BovineHD0700002004
450	7	7820308	7868599	26	48292	2	1	BovineHD0700001982	BovineHD0700002006

451	7	7820308	7883272	30	62965	2	1	BovineHD0700001982	BovineHD0700002009
452	7	7842228	7883272	17	41045	2	1	BovineHD0700001994	BovineHD0700002009
453	7	7845456	7883272	16	37817	2	1	BovineHD0700001996	BovineHD0700002009
454	7	7868599	7941613	20	73015	2	1	BovineHD0700002006	BovineHD0700002022
455	7	9409927	9504448	10	94522	5	3	BovineHD0700002448	BovineHD0700002471
456	7	9771150	9982310	11	211161	5	3	BovineHD0700002547	Hapmap33378-BTA-153539
457	7	9873696	10005283	10	131588	5	3	BovineHD0700002587	BovineHD0700033515
458	7	9873696	10095791	17	222096	5	3	BovineHD0700002587	BovineHD0700002647
459	7	10044994	10137032	16	92039	2	1	BovineHD0700002633	BovineHD0700002660
460	7	10044994	10142297	17	97304	2	1	BovineHD0700002633	BovineHD0700032920
461	7	10044994	10144881	18	99888	1	0	BovineHD0700002633	BovineHD0700002662
462	7	10065842	10120212	13	54371	2	1	BovineHD0700002636	BovineHD0700002655
463	7	10065842	10137032	15	71191	2	1	BovineHD0700002636	BovineHD0700002660
464	7	10065842	10142297	16	76456	2	1	BovineHD0700002636	BovineHD0700032920
465	7	10065842	10144881	17	79040	2	1	BovineHD0700002636	BovineHD0700002662
466	7	10065842	10150703	18	84862	2	1	BovineHD0700002636	BovineHD0700002664
467	7	10072628	10144881	15	72254	2	1	BovineHD0700002640	BovineHD0700002662
468	7	10087455	10144881	14	57427	2	1	BovineHD0700033518	BovineHD0700002662
469	7	10095791	10137032	10	41242	2	1	BovineHD0700002647	BovineHD0700002660
470	7	10095791	10142297	11	46507	2	1	BovineHD0700002647	BovineHD0700032920
471	7	10095791	10144881	12	49091	2	1	BovineHD0700002647	BovineHD0700002662
472	7	10095791	10150703	13	54913	2	1	BovineHD0700002647	BovineHD0700002664
473	7	10098448	10142297	10	43850	2	1	BovineHD0700002648	BovineHD0700032920
474	7	10099512	10144881	10	45370	2	1	BovineHD0700002649	BovineHD0700002662
475	7	10826539	10854992	11	28454	2	1	BovineHD0700002818	BovineHD0700002832
476	7	10826539	10859318	12	32780	2	1	BovineHD0700002818	BovineHD0700002835
477	7	10826539	10864906	14	38368	2	1	BovineHD0700002818	BovineHD0700002839
478	7	10826539	10867506	15	40968	2	1	BovineHD0700002818	BovineHD0700002840

479	7	10835967	10859318	11	23352	2	1	ARS-BFGL-NGS-20506	BovineHD0700002835
480	7	10835967	10864906	13	28940	2	1	ARS-BFGL-NGS-20506	BovineHD0700002839
481	7	10835967	10867506	14	31540	2	1	ARS-BFGL-NGS-20506	BovineHD0700002840
482	7	10835967	10874375	15	38409	1	0	ARS-BFGL-NGS-20506	BovineHD0700032936
483	7	10839763	10859318	10	19556	2	1	BovineHD0700002821	BovineHD0700002835
484	7	10839763	10864906	12	25144	2	1	BovineHD0700002821	BovineHD0700002839
485	7	10839763	10867506	13	27744	2	1	BovineHD0700002821	BovineHD0700002840
486	7	11229902	11555132	41	325231	5	3	BovineHD0700002955	BovineHD0700003046
487	7	11247242	11278361	11	31120	5	3	BovineHD0700002965	BovineHD0700002981
488	7	11247242	11282468	13	35227	5	3	BovineHD0700002965	BovineHD0700002985
489	7	11247242	11437899	23	190658	5	3	BovineHD0700002965	BovineHD0700003024
490	7	11247242	11954559	43	707318	5	3	BovineHD0700002965	BovineHD0700033573
491	7	11426899	11856315	19	429417	5	3	BovineHD0700003021	BovineHD0700003098
492	7	11819446	12057433	13	237988	5	3	BovineHD0700003090	BovineHD0700003141
493	7	14793990	14854328	10	60339	5	3	BovineHD0700004013	BovineHD0700004025
494	7	14806354	14869853	15	63500	5	3	BovineHD0700004015	BovineHD0700004031
495	7	14812796	14869853	14	57058	5	3	BovineHD0700004016	BovineHD0700004031
496	7	14812796	14872712	15	59917	5	3	BovineHD0700004016	BovineHD0700004032
497	7	14812796	14875408	18	62613	5	3	BovineHD0700004016	BovineHD0700004035
498	7	14838591	14875408	14	36818	5	3	BovineHD0700004021	BovineHD0700004035
499	7	15147652	15178739	10	31088	5	3	BovineHD0700004138	BovineHD0700004147
500	7	16801933	16826853	14	24921	2	1	BovineHD0700004689	BovineHD0700004699
501	7	21249976	21293127	11	43152	2	1	ARS-BFGL-NGS-464	BovineHD0700005884
502	7	22243143	22415880	38	172738	2	1	BovineHD0700006132	BovineHD4100005833
503	7	22297518	22356706	21	59189	2	1	BovineHD0700006146	BovineHD0700006166
504	7	22311661	22415880	20	104220	2	1	BovineHD0700006149	BovineHD4100005833
505	7	22311661	22418258	21	106598	2	1	BovineHD0700006149	BovineHD0700006179
506	7	22317180	22356706	16	39527	2	1	BovineHD0700006150	BovineHD0700006166
507	7	22317180	22415880	19	98701	2	1	BovineHD0700006150	BovineHD4100005833

508	7	22317180	22418258	20	101079	2	1	BovineHD0700006150	BovineHD0700006179
509	7	22321927	22356706	15	34780	2	1	BovineHD0700006151	BovineHD0700006166
510	7	22342603	22415880	12	73278	2	1	BovineHD0700006159	BovineHD4100005833
511	7	28968161	28982348	10	14188	5	3	BovineHD0700008169	BovineHD0700008177
512	7	42736530	42788788	10	52259	1	0	BovineHD0700012437	ARS-BFGL-NGS-23938
513	7	42736530	42845260	22	108731	2	1	BovineHD0700012437	BTB-01207246
514	7	42736530	42861486	27	124957	2	1	BovineHD0700012437	BovineHD0700012465
515	7	42759373	42845260	18	85888	2	1	BovineHD0700012443	BTB-01207246
516	7	42759373	42861486	23	102114	2	1	BovineHD0700012443	BovineHD0700012465
517	7	42794656	42861486	17	66831	2	1	BovineHD0700012450	BovineHD0700012465
518	7	42829437	42861486	10	32050	2	1	BovineHD0700012456	BovineHD0700012465
519	7	42945525	42990644	12	45120	2	1	BovineHD0700012473	BovineHD0700012482
520	7	42945525	43011998	17	66474	2	1	BovineHD0700012473	BovineHD0700012486
521	7	42945525	43020066	18	74542	2	1	BovineHD0700012473	BovineHD0700012487
522	7	42945525	43047345	25	101821	2	1	BovineHD0700012473	BovineHD0700012494
523	7	42945525	43059674	27	114150	2	1	BovineHD0700012473	BovineHD0700012496
524	7	42945525	43084505	31	138981	2	1	BovineHD0700012473	BovineHD0700012503
525	7	42945525	43087430	32	141906	2	1	BovineHD0700012473	BovineHD0700012504
526	7	42945525	43097791	34	152267	2	1	BovineHD0700012473	ARS-BFGL-NGS-101873
527	7	43077701	43314609	67	236909	2	1	BovineHD0700012500	BovineHD0700012564
528	7	43077701	43327411	68	249711	2	1	BovineHD0700012500	BovineHD0700012566
529	7	43077701	43330896	69	253196	2	1	BovineHD0700012500	BovineHD0700012567
530	7	43077701	43334237	70	256537	2	1	BovineHD0700012500	BovineHD0700012568
531	7	43077701	43348310	75	270610	2	1	BovineHD0700012500	BovineHD0700033035
532	7	43077701	43353211	76	275511	2	1	BovineHD0700012500	BovineHD0700012573
533	7	43084505	43327411	65	242907	2	1	BovineHD0700012503	BovineHD0700012566
534	7	43093690	43314609	62	220920	2	1	BovineHD0700012505	BovineHD0700012564
535	7	43093690	43330896	64	237207	2	1	BovineHD0700012505	BovineHD0700012567
536	7	43093690	43348310	70	254621	2	1	BovineHD0700012505	BovineHD0700033035

537	7	43097791	43330896	63	233106	2	1	ARS-BFGL-NGS-101873	BovineHD0700012567
538	7	43097791	43353211	70	255421	2	1	ARS-BFGL-NGS-101873	BovineHD0700012573
539	7	43104370	43314609	59	210240	2	1	BovineHD0700012507	BovineHD0700012564
540	7	43104370	43334237	62	229868	2	1	BovineHD0700012507	BovineHD0700012568
541	7	43105644	43330896	60	225253	2	1	BovineHD0700012509	BovineHD0700012567
542	7	43135873	43348310	58	212438	2	1	BovineHD0700012517	BovineHD0700033035
543	7	43135873	43353211	59	217339	2	1	BovineHD0700012517	BovineHD0700012573
544	7	43613957	43670208	10	56252	2	1	BovineHD0700012636	BovineHD0700012645
545	7	43616586	43685994	11	69409	2	1	BovineHD0700012637	BovineHD0700012647
546	7	43759207	43766370	11	7164	5	3	BovineHD0700012679	BovineHD0700012688
547	7	53001042	53051556	11	50515	2	1	BovineHD0700015264	BovineHD0700015275
548	7	53949585	53977311	18	27727	2	1	BovineHD0700015570	BovineHD0700015589
549	7	53949585	53978290	19	28706	2	1	BovineHD0700015570	BovineHD0700015590
550	7	53949585	53979659	20	30075	2	1	BovineHD0700015570	BovineHD0700015591
551	7	54839973	54911407	11	71435	5	3	BovineHD0700033768	BovineHD0700033771
552	7	63979672	64013986	10	34315	2	1	BovineHD0700018502	BovineHD0700018512
553	7	64177866	64212232	13	34367	5	3	BovineHD0700018574	BovineHD0700018586
554	7	64180062	64201605	10	21544	5	3	BovineHD0700018575	BovineHD0700018584
555	7	70171046	70267774	15	96729	5	3	BovineHD0700020607	BovineHD0700020630
556	7	70175641	70241431	10	65791	5	3	BovineHD0700020609	BovineHD0700020625
557	7	70175641	70267774	13	92134	5	3	BovineHD0700020609	BovineHD0700020630
558	7	70175641	70283070	14	107430	5	3	BovineHD0700020609	BovineHD0700020635
559	7	70178506	70267774	12	89269	5	3	BovineHD0700020610	BovineHD0700020630
560	7	70191120	70267774	11	76655	5	3	BovineHD0700020613	BovineHD0700020630
561	7	70191120	70283070	12	91951	5	3	BovineHD0700020613	BovineHD0700020635
562	7	70553013	70611040	10	58028	5	3	BovineHD0700020749	BovineHD0700020770
563	7	70565654	70652269	22	86616	5	3	BovineHD0700020754	BovineHD0700033839
564	7	70565654	70735525	31	169872	5	3	BovineHD0700020754	BovineHD0700033126
565	7	70586211	70652269	19	66059	5	3	BovineHD0700033837	BovineHD0700033839

566	7	70586211	70802962	38	216752	5	3	BovineHD0700033837	BovineHD0700020837
567	7	70638297	70802962	23	164666	5	3	BovineHD0700020784	BovineHD0700020837
568	7	70724676	70802962	12	78287	5	3	BovineHD0700020814	BovineHD0700020837
569	7	70724676	70804701	13	80026	5	3	BovineHD0700020814	BTA-27273-no-rs
570	7	87556048	87612652	11	56605	5	3	Hapmap44668-BTA-119022	BovineHD0700025670
571	7	88273984	88298220	10	24237	2	1	BovineHD0700025843	BovineHD0700025851
572	8	834934	877078	20	42145	2	1	BovineHD0800000270	BovineHD0800000291
573	8	861235	883675	13	22441	2	1	BovineHD0800000281	BovineHD0800000295
574	8	1817817	1857731	12	39915	5	3	BovineHD0800000619	BovineHD0800033550
575	8	1829372	1860542	10	31171	5	3	BovineHD0800000622	BovineHD0800000631
576	8	12983574	13027664	18	44091	2	1	BovineHD0800004148	BovineHD0800004164
577	8	22687105	22810759	13	123655	5	3	BovineHD0800033617	BovineHD0800006840
578	8	22717626	22810759	11	93134	5	3	BovineHD0800006827	BovineHD0800006840
579	8	22973761	23064504	13	90744	5	3	BovineHD0800033624	BovineHD0800006913
580	8	29920981	30015545	30	94565	2	1	BovineHD0800009080	BovineHD0800009110
581	8	29939592	29981679	18	42088	2	1	BovineHD0800009085	BovineHD0800009101
582	8	30079403	30116226	15	36824	2	1	BovineHD0800009138	BovineHD0800009150
583	8	31103200	31142523	20	39324	2	1	BovineHD0800009418	BovineHD0800033197
584	8	31103951	31142523	19	38573	2	1	BovineHD0800009419	BovineHD0800033197
585	8	35297412	35326637	13	29226	2	1	BovineHD0800010484	BovineHD0800010496
586	8	35300179	35323628	10	23450	2	1	BovineHD0800010486	BovineHD0800010495
587	8	35300179	35326637	11	26459	2	1	BovineHD0800010486	BovineHD0800010496
588	8	38344313	38476077	31	131765	5	3	BovineHD0800011439	BTB-00342600
589	8	38347485	38469716	27	122232	5	3	BovineHD0800011440	BovineHD0800011465
590	8	38356510	38476077	28	119568	5	3	BovineHD0800011442	BTB-00342600
591	8	38356510	38513257	36	156748	5	3	BovineHD0800011442	BovineHD0800011476
592	8	38356510	38537300	42	180791	5	3	BovineHD0800011442	BovineHD0800011481
593	8	38356510	38543241	44	186732	5	3	BovineHD0800011442	BovineHD0800011483

594	8	38367620	38490866	28	123247	5	3	BovineHD0800011445	BovineHD0800011471
595	8	38367620	38531838	38	164219	5	3	BovineHD0800011445	BovineHD0800011480
596	8	38367620	38537300	39	169681	5	3	BovineHD0800011445	BovineHD0800011481
597	8	38367620	38543241	41	175622	5	3	BovineHD0800011445	BovineHD0800011483
598	8	38389026	38537300	34	148275	5	3	BovineHD0800011449	BovineHD0800011481
599	8	38401146	38531838	31	130693	5	3	BovineHD0800011451	BovineHD0800011480
600	8	38401146	38537300	32	136155	5	3	BovineHD0800011451	BovineHD0800011481
601	8	38412970	38537300	30	124331	5	3	BovineHD0800011453	BovineHD0800011481
602	8	38429864	38537300	26	107437	5	3	BovineHD0800011457	BovineHD0800011481
603	8	38476077	38528193	12	52117	5	3	BTB-00342600	BovineHD0800011478
604	8	39974754	39995181	11	20428	2	1	BovineHD0800011821	ARS-BFGL-NGS-54331
605	8	44044445	44070260	12	25816	2	1	BovineHD0800013147	BovineHD0800013159
606	8	44044445	44078782	17	34338	2	1	BovineHD0800013147	BovineHD0800013163
607	8	44802409	44833334	11	30926	2	1	BovineHD0800013373	BovineHD0800013383
608	8	46891003	46916455	11	25453	2	1	BovineHD0800014030	BovineHD0800014038
609	8	46893088	46916455	10	23368	2	1	BovineHD0800014031	BovineHD0800014038
610	8	46893088	46920756	11	27669	2	1	BovineHD0800014031	BovineHD0800014039
611	8	46893088	46925080	12	31993	2	1	BovineHD0800014031	BovineHD0800014040
612	8	46893088	46940217	16	47130	2	1	BovineHD0800014031	BovineHD0800014044
613	8	47077565	47106702	16	29138	2	1	BovineHD0800014089	BovineHD0800014102
614	8	54376152	54429697	15	53546	2	1	BovineHD0800016377	BovineHD0800016390
615	8	54376152	54433135	16	56984	2	1	BovineHD0800016377	BovineHD0800016391
616	8	54376152	54435508	17	59357	1	0	BovineHD0800016377	BovineHD0800016392
617	8	54394082	54433135	12	39054	2	1	BovineHD0800016381	BovineHD0800016391
618	8	54394082	54435508	13	41427	2	1	BovineHD0800016381	BovineHD0800016392
619	8	59743649	59783560	17	39912	2	1	BovineHD0800017825	BovineHD0800017839
620	8	65321429	65346903	12	25475	2	1	BovineHD0800019550	BovineHD0800019560
621	8	65899587	65989352	36	89766	5	3	BovineHD0800019727	BovineHD0800019780
622	8	65969365	65989352	10	19988	5	3	BovineHD0800019770	BovineHD0800019780

623	8	65969365	66150157	44	180793	5	3	BovineHD0800019770	BovineHD0800019845
624	8	66051984	66121965	12	69982	5	3	BovineHD0800019805	BovineHD0800019826
625	8	66103086	66150157	14	47072	5	3	BovineHD0800033266	BovineHD0800019845
626	8	66106465	66150157	13	43693	5	3	BovineHD0800019823	BovineHD0800019845
627	8	66113294	66150157	12	36864	5	3	BovineHD0800019824	BovineHD0800019845
628	8	66113294	66158103	14	44810	5	3	BovineHD0800019824	BovineHD0800019849
629	8	76530816	76610143	17	79328	2	1	ARS-BFGL-NGS-89010	BovineHD0800022971
630	8	76562256	76610143	12	47888	2	1	BovineHD0800022961	BovineHD0800022971
631	8	82933545	83004091	27	70547	2	1	BovineHD4100006964	BovineHD0800024723
632	8	84896726	84960505	11	63780	5	3	BTB-00362651	BovineHD0800025240
633	8	86319658	86342216	13	22559	2	1	BovineHD0800025619	BovineHD0800025632
634	8	88011367	88087326	22	75960	2	1	BovineHD0800026110	BovineHD0800026129
635	8	88030446	88087326	16	56881	2	1	BTB-00363889	BovineHD0800026129
636	8	95793143	95953799	13	160657	5	3	BovineHD0800028322	BovineHD0800028357
637	8	96143986	96173001	10	29016	2	1	BovineHD0800028402	BovineHD0800028412
638	8	96143986	96181815	11	37830	2	1	BovineHD0800028402	BovineHD0800028413
639	8	98684344	98727434	13	43091	2	1	BovineHD0800029158	BovineHD0800029169
640	8	1,04E+08	1,04E+08	32	119952	2	1	BovineHD0800030922	BovineHD0800030955
641	8	1,04E+08	1,04E+08	24	88132	2	1	BovineHD0800030924	BovineHD0800030948
642	8	1,04E+08	1,04E+08	27	93829	2	1	BovineHD0800030924	BTA-82403-no-rs
643	8	1,04E+08	1,04E+08	29	108423	2	1	BovineHD0800030924	BovineHD0800030954
644	8	1,04E+08	1,04E+08	30	116410	2	1	BovineHD0800030924	BovineHD0800030955
645	8	1,04E+08	1,04E+08	23	85135	2	1	BovineHD0800030925	BovineHD0800030948
646	8	1,04E+08	1,04E+08	24	87504	2	1	BovineHD0800030925	BovineHD0800030949
647	8	1,04E+08	1,04E+08	26	90832	2	1	BovineHD0800030925	BTA-82403-no-rs
648	8	1,04E+08	1,04E+08	27	101585	2	1	BovineHD0800030925	BovineHD0800030953
649	8	1,04E+08	1,04E+08	28	105426	2	1	BovineHD0800030925	BovineHD0800030954
650	8	1,04E+08	1,04E+08	29	113413	2	1	BovineHD0800030925	BovineHD0800030955
651	8	1,04E+08	1,04E+08	22	79065	2	1	BovineHD0800030926	BovineHD0800030948

652	8	1,04E+08	1,04E+08	25	84762	2	1	BovineHD0800030926	BTA-82403-no-rs
653	8	1,04E+08	1,04E+08	26	95515	2	1	BovineHD0800030926	BovineHD0800030953
654	8	1,04E+08	1,04E+08	27	99356	2	1	BovineHD0800030926	BovineHD0800030954
655	8	1,04E+08	1,04E+08	28	107343	2	1	BovineHD0800030926	BovineHD0800030955
656	8	1,04E+08	1,04E+08	18	60860	2	1	BovineHD0800030931	BovineHD0800030948
657	8	1,04E+08	1,04E+08	21	66557	2	1	BovineHD0800030931	BTA-82403-no-rs
658	8	1,04E+08	1,04E+08	23	81151	2	1	BovineHD0800030931	BovineHD0800030954
659	8	1,04E+08	1,04E+08	24	89138	2	1	BovineHD0800030931	BovineHD0800030955
660	8	1,04E+08	1,04E+08	21	71094	2	1	BovineHD0800030933	BovineHD0800030954
661	8	1,04E+08	1,04E+08	17	32972	2	1	BovineHD0800031111	BovineHD0800031128
662	9	1396924	1721741	69	324818	2	1	BovineHD0900000276	BovineHD0900000339
663	9	15284898	15435058	54	150161	5	3	BovineHD0900004032	BovineHD0900004083
664	9	15306379	15405601	40	99223	5	3	BovineHD0900004037	BovineHD0900004074
665	9	15306379	15438076	52	131698	5	3	BovineHD0900004037	BovineHD0900004086
666	9	15306379	15440446	54	134068	5	3	BovineHD0900004037	BTB-01576268
667	9	15306379	15465760	61	159382	5	3	BovineHD0900004037	Hapmap54560-rs29009707
668	9	15306379	15469154	62	162776	5	3	BovineHD0900004037	BovineHD0900004094
669	9	15306379	15484924	67	178546	5	3	BovineHD0900004037	BovineHD0900004100
670	9	15306379	15491060	68	184682	5	3	BovineHD0900004037	BovineHD0900004101
671	9	15306379	15497971	69	191593	5	3	BovineHD0900004037	BovineHD0900004102
672	9	15306379	15564406	82	258028	5	3	BovineHD0900004037	BovineHD0900004117
673	9	15309011	15336478	15	27468	5	3	BovineHD0900004038	BovineHD0900004051
674	9	15309011	15438076	51	129066	5	3	BovineHD0900004038	BovineHD0900004086
675	9	15309011	15440446	53	131436	5	3	BovineHD0900004038	BTB-01576268
676	9	15309011	15469154	61	160144	5	3	BovineHD0900004038	BovineHD0900004094
677	9	15309011	15480911	65	171901	5	3	BovineHD0900004038	BovineHD0900004099
678	9	15309011	15484924	66	175914	5	3	BovineHD0900004038	BovineHD0900004100
679	9	15309011	15491060	67	182050	5	3	BovineHD0900004038	BovineHD0900004101

680	9	15310749	15480911	64	170163	5	3	BovineHD0900004039	BovineHD0900004099
681	9	15312075	15469154	59	157080	5	3	BovineHD0900004040	BovineHD0900004094
682	9	15312075	15560340	78	248266	5	3	BovineHD0900004040	BovineHD0900004116
683	9	15350288	15425502	27	75215	5	3	BovineHD0900004054	BovineHD0900004080
684	9	15382753	15405601	10	22849	5	3	BovineHD0900004066	BovineHD0900004074
685	9	15386872	15438076	20	51205	5	3	BovineHD0900004068	BovineHD0900004086
686	9	15401468	15469154	26	67687	5	3	BovineHD4100007244	BovineHD0900004094
687	9	16413696	16914316	164	500621	5	3	BovineHD0900004418	BovineHD0900004574
688	9	16416954	16914316	161	497363	5	3	BovineHD0900004420	BovineHD0900004574
689	9	16416954	16918481	163	501528	5	3	BovineHD0900004420	BovineHD0900004576
690	9	16418828	16867238	142	448411	5	3	BovineHD0900004421	BovineHD0900004557
691	9	16418828	16871749	143	452922	5	3	BovineHD0900004421	BovineHD0900004558
692	9	16418828	16873161	144	454334	5	3	BovineHD0900004421	BovineHD0900004559
693	9	16418828	16914316	160	495489	5	3	BovineHD0900004421	BovineHD0900004574
694	9	16420855	16914316	159	493462	5	3	BovineHD0900004422	BovineHD0900004574
695	9	16420855	16918481	161	497627	5	3	BovineHD0900004422	BovineHD0900004576
696	9	16420855	16924662	164	503808	5	3	BovineHD0900004422	BovineHD0900004579
697	9	16420855	16930983	166	510129	5	3	BovineHD0900004422	BovineHD0900004581
698	9	16424135	16736271	93	312137	6	4	BovineHD0900004424	BovineHD0900004516
699	9	16424135	16913658	156	489524	5	3	BovineHD0900004424	BovineHD0900004573
700	9	16424135	16914316	157	490182	5	3	BovineHD0900004424	BovineHD0900004574
701	9	16424135	16918481	159	494347	5	3	BovineHD0900004424	BovineHD0900004576
702	9	16424135	16920467	160	496333	5	3	BovineHD0900004424	BovineHD0900004577
703	9	16424135	16924662	162	500528	5	3	BovineHD0900004424	BovineHD0900004579
704	9	16426702	16913658	154	486957	5	3	BovineHD0900004426	BovineHD0900004573
705	9	16426702	16914316	155	487615	5	3	BovineHD0900004426	BovineHD0900004574
706	9	16426702	16918481	157	491780	5	3	BovineHD0900004426	BovineHD0900004576
707	9	16737958	16914316	64	176359	5	3	BovineHD0900004517	BovineHD0900004574
708	9	28195131	28213069	13	17939	2	1	BovineHD0900007608	BovineHD0900007617

709	9	31107969	31122388	10	14420	2	1	BovineHD0900008445	BovineHD0900008453
710	9	39338543	39373700	11	35158	2	1	BovineHD0900010964	BovineHD0900010973
711	9	44351018	44433799	25	82782	2	1	BovineHD0900012323	BovineHD0900012350
712	9	64957607	65136204	43	178598	2	1	BovineHD0900017835	BovineHD0900017880
713	9	64957607	65147304	47	189698	2	1	BovineHD0900017835	BovineHD4100007527
714	9	70048837	70126195	32	77359	2	1	BovineHD0900019368	BovineHD0900019400
715	9	70072826	70126195	25	53370	2	1	BovineHD0900019375	BovineHD0900019400
716	9	70074164	70126195	24	52032	2	1	BovineHD0900019376	BovineHD0900019400
717	9	71586588	71708405	18	121818	5	3	BovineHD0900019844	BovineHD0900019892
718	9	71601685	71675033	11	73349	5	3	BovineHD0900019854	BovineHD0900019884
719	9	71608476	71675033	10	66558	5	3	BovineHD0900019858	BovineHD0900019884
720	9	80301752	80357664	11	55913	2	1	BovineHD0900022283	BovineHD0900022294
721	9	81362573	81394490	19	31918	2	1	BovineHD0900022615	BovineHD0900022632
722	9	81362573	81412832	32	50260	2	1	BovineHD0900022615	BovineHD0900022644
723	9	91637171	91708474	20	71304	2	1	BovineHD0900025863	BovineHD0900025882
724	9	94813853	94847446	11	33594	2	1	BovineHD0900026881	BovineHD0900026890
725	9	94813853	94850482	12	36630	2	1	BovineHD0900026881	BovineHD0900026891
726	9	94821392	94850482	10	29091	2	1	BovineHD0900026883	BovineHD0900026891
727	9	94821392	94853620	11	32229	2	1	BovineHD0900026883	BovineHD0900026892
728	9	94821392	94901347	21	79956	2	1	BovineHD0900026883	BovineHD0900026903
729	9	94828723	94901347	19	72625	2	1	BovineHD0900026884	BovineHD0900026903
730	9	94828723	94911366	23	82644	2	1	BovineHD0900026884	BovineHD0900026908
731	9	1E+08	1E+08	16	49558	2	1	BovineHD0900029093	BovineHD0900029108
732	9	1,01E+08	1,01E+08	11	14641	2	1	BovineHD0900029322	BovineHD0900029332
733	9	1,05E+08	1,05E+08	10	35367	2	1	Hapmap40387-BTA-107848	BovineHD0900030822
734	10	1513505	1573751	14	60247	2	1	BovineHD1000000438	BovineHD1000000451
735	10	11960722	11998905	17	38184	2	1	BovineHD1000004046	ARS-BFGL-NGS-28939
736	10	11964812	12001586	17	36775	2	1	BovineHD1000004048	BovineHD1000004062

737	10	22386910	22919982	49	533073	5	3	BovineHD1000007278	BovineHD1000007494
738	10	22393827	23160598	67	766772	5	3	BovineHD1000007280	BovineHD1000007621
739	10	22492853	23160598	52	667746	5	3	BovineHD1000007338	BovineHD1000007621
740	10	22499625	23074077	43	574453	5	3	BovineHD1000007340	BovineHD1000007580
741	10	22499625	23135553	48	635929	5	3	BovineHD1000007340	BovineHD1000007609
742	10	22499625	23222741	57	723117	5	3	BovineHD1000007340	BovineHD1000007632
743	10	22499625	23543330	67	1043706	5	3	BovineHD1000007340	BovineHD1000007717
744	10	22499625	23764200	77	1264576	5	3	BovineHD1000007340	BovineHD1000031215
745	10	22512596	22919982	31	407387	5	3	BovineHD1000007348	BovineHD1000007494
746	10	22512596	23135553	47	622958	5	3	BovineHD1000007348	BovineHD1000007609
747	10	22512596	23222741	56	710146	5	3	BovineHD1000007348	BovineHD1000007632
748	10	22512596	23764200	76	1251605	5	3	BovineHD1000007348	BovineHD1000031215
749	10	22637908	22773498	10	135591	5	3	BovineHD1000007390	BovineHD1000030557
750	10	22637908	22779817	11	141910	5	3	BovineHD1000007390	BovineHD1000007439
751	10	22637908	22808665	12	170758	5	3	BovineHD1000007390	BovineHD1000031193
752	10	22637908	23160598	48	522691	5	3	BovineHD1000007390	BovineHD1000007621
753	10	22637908	23222741	54	584834	5	3	BovineHD1000007390	BovineHD1000007632
754	10	22637908	23537520	61	899613	5	3	BovineHD1000007390	BovineHD1000007712
755	10	22637908	23764200	74	1126293	5	3	BovineHD1000007390	BovineHD1000031215
756	10	22649973	23222741	52	572769	5	3	BovineHD1000007400	BovineHD1000007632
757	10	22676890	23135553	42	458664	5	3	BovineHD1000007410	BovineHD1000007609
758	10	22676890	23222741	51	545852	5	3	BovineHD1000007410	BovineHD1000007632
759	10	22676890	23764200	71	1087311	5	3	BovineHD1000007410	BovineHD1000031215
760	10	22709100	22890003	14	180904	5	3	BovineHD1000007420	BovineHD1000007470
761	10	22709100	22919982	24	210883	2	1	BovineHD1000007420	BovineHD1000007494
762	10	22709100	22960303	28	251204	2	1	BovineHD1000007420	BovineHD1000007528
763	10	22709100	23135553	40	426454	5	3	BovineHD1000007420	BovineHD1000007609
764	10	22709100	23222741	49	513642	5	3	BovineHD1000007420	BovineHD1000007632
765	10	22709100	23654109	66	945010	5	3	BovineHD1000007420	BovineHD1000007768

766	10	22738750	22919982	23	181233	2	1	BovineHD1000007426	BovineHD1000007494
767	10	22738750	23160598	42	421849	5	3	BovineHD1000007426	BovineHD1000007621
768	10	22738750	23222741	48	483992	5	3	BovineHD1000007426	BovineHD1000007632
769	10	22770570	23135553	37	364984	5	3	BovineHD1000031190	BovineHD1000007609
770	10	22770570	23222741	46	452172	5	3	BovineHD1000031190	BovineHD1000007632
771	10	22808665	22919982	18	111318	2	1	BovineHD1000031193	BovineHD1000007494
772	10	22808665	23074077	29	265413	5	3	BovineHD1000031193	BovineHD1000007580
773	10	22808665	23135553	34	326889	5	3	BovineHD1000031193	BovineHD1000007609
774	10	22808665	23222741	43	414077	5	3	BovineHD1000031193	BovineHD1000007632
775	10	22861544	22919982	16	58439	2	1	BovineHD1000007459	BovineHD1000007494
776	10	22872499	22919982	15	47484	2	1	BovineHD1000007460	BovineHD1000007494
777	10	22872499	22960303	19	87805	2	1	BovineHD1000007460	BovineHD1000007528
778	10	22890003	22960303	15	70301	2	1	BovineHD1000007470	BovineHD1000007528
779	10	22988867	23135553	11	146687	5	3	BovineHD1000007539	BovineHD1000007609
780	10	22988867	23764200	40	775334	5	3	BovineHD1000007539	BovineHD1000031215
781	10	22993447	23135553	10	142107	5	3	BovineHD1000007543	BovineHD1000007609
782	10	22999707	23222741	18	223035	5	3	BovineHD1000007547	BovineHD1000007632
783	10	22999707	23764200	38	764494	5	3	BovineHD1000007547	BovineHD1000031215
784	10	23003955	23160598	11	156644	5	3	BovineHD1000007549	BovineHD1000007621
785	10	23003955	23222741	17	218787	5	3	BovineHD1000007549	BovineHD1000007632
786	10	23057313	23160598	10	103286	5	3	BovineHD1000007575	BovineHD1000007621
787	10	23057313	23222741	16	165429	5	3	BovineHD1000007575	BovineHD1000007632
788	10	23057313	23600571	29	543259	5	3	BovineHD1000007575	BovineHD1000007747
789	10	23057313	23654109	33	596797	5	3	BovineHD1000007575	BovineHD1000007768
790	10	23057313	23764200	36	706888	5	3	BovineHD1000007575	BovineHD1000031215
791	10	23057313	24299374	68	1242062	5	3	BovineHD1000007575	BovineHD1000007972
792	10	23057313	25173443	92	2116131	5	3	BovineHD1000007575	BovineHD1000008212
793	10	23074077	23222741	15	148665	5	3	BovineHD1000007580	BovineHD1000007632
794	10	23074077	23654109	32	580033	5	3	BovineHD1000007580	BovineHD1000007768

795	10	23074077	23764200	35	690124	5	3	BovineHD1000007580	BovineHD1000031215
796	10	23074077	23800720	36	726644	5	3	BovineHD1000007580	BovineHD1000007799
797	10	23074077	24942444	80	1868368	5	3	BovineHD1000007580	BovineHD1000031258
798	10	23109707	23222741	14	113035	5	3	BovineHD1000007599	BovineHD1000007632
799	10	23109707	23800720	35	691014	5	3	BovineHD1000007599	BovineHD1000007799
800	10	23109707	24299374	66	1189668	5	3	BovineHD1000007599	BovineHD1000007972
801	10	23125923	23222741	13	96819	5	3	BovineHD1000007603	BovineHD1000007632
802	10	23125923	23537520	20	411598	5	3	BovineHD1000007603	BovineHD1000007712
803	10	23125923	23764200	33	638278	5	3	BovineHD1000007603	BovineHD1000031215
804	10	23125923	24831598	77	1705676	5	3	BovineHD1000007603	BovineHD1000008116
805	10	23319458	23800720	21	481263	5	3	BovineHD1000007644	BovineHD1000007799
806	10	23319458	24070828	41	751371	5	3	BovineHD1000007644	BovineHD1000007900
807	10	23319458	25265627	78	1946170	5	3	BovineHD1000007644	BovineHD1000008250
808	10	23369340	23600571	11	231232	5	3	BovineHD1000007672	BovineHD1000007747
809	10	23369340	23654109	15	284770	5	3	BovineHD1000007672	BovineHD1000007768
810	10	23369340	23737113	17	367774	5	3	BovineHD1000007672	BovineHD1000007781
811	10	23369340	23764200	18	394861	5	3	BovineHD1000007672	BovineHD1000031215
812	10	23413050	23764200	17	351151	5	3	BovineHD1000007691	BovineHD1000031215
813	10	23530176	23654109	13	123934	5	3	BovineHD1000007708	BovineHD1000007768
814	10	23530176	23737113	15	206938	5	3	BovineHD1000007708	BovineHD1000007781
815	10	23530176	23764200	16	234025	5	3	BovineHD1000007708	BovineHD1000031215
816	10	23530176	24299374	48	769199	5	3	BovineHD1000007708	BovineHD1000007972
817	10	23530176	24831598	60	1301423	5	3	BovineHD1000007708	BovineHD1000008116
818	10	23600571	24299374	40	698804	5	3	BovineHD1000007747	BovineHD1000007972
819	10	23600571	24831598	52	1231028	5	3	BovineHD1000007747	BovineHD1000008116
820	10	23764200	24150282	26	386083	5	3	BovineHD1000031215	BovineHD1000007922
821	10	23764200	24299374	33	535175	5	3	BovineHD1000031215	BovineHD1000007972
822	10	23800720	23938808	16	138089	2	1	BovineHD1000007799	BovineHD1000007863
823	10	23847193	23938808	15	91616	2	1	BovineHD1000007812	BovineHD1000007863

824	10	23850258	24299374	30	449117	5	3	BovineHD1000007815	BovineHD1000007972
825	10	23869801	24299374	28	429574	5	3	BovineHD1000007823	BovineHD1000007972
826	10	23869801	24488552	30	618752	5	3	BovineHD1000007823	BovineHD1000008006
827	10	23889533	24299374	26	409842	5	3	BovineHD1000007833	BovineHD1000007972
828	10	23889533	24488552	28	599020	5	3	BovineHD1000007833	BovineHD1000008006
829	10	23889533	25063032	45	1173500	5	3	BovineHD1000007833	BovineHD1000008179
830	10	23905344	24095827	17	190484	5	3	BovineHD1000007844	BovineHD1000031230
831	10	23905344	24299374	25	394031	5	3	BovineHD1000007844	BovineHD1000007972
832	10	23905344	24942444	38	1037101	5	3	BovineHD1000007844	BovineHD1000031258
833	10	24057642	24299374	16	241733	5	3	BovineHD1000007896	BovineHD1000007972
834	10	24057642	24604106	21	546465	5	3	BovineHD1000007896	BovineHD1000008048
835	10	24057642	24831598	28	773957	5	3	BovineHD1000007896	BovineHD1000008116
836	10	24057642	24942444	29	884803	5	3	BovineHD1000007896	BovineHD1000031258
837	10	24061376	24223514	10	162139	1	0	BovineHD1000007897	BovineHD1000007947
838	10	24080880	24299374	11	218495	5	3	BovineHD1000007903	BovineHD1000007972
839	10	24275820	24942444	18	666625	5	3	BovineHD1000007959	BovineHD1000031258
840	10	24480627	24831598	12	350972	5	3	BovineHD1000008005	BovineHD1000008116
841	10	24480627	24942444	13	461818	5	3	BovineHD1000008005	BovineHD1000031258
842	10	24587769	24831598	10	243830	1	0	BovineHD1000008044	BovineHD1000008116
843	10	24587769	24942444	11	354676	5	3	BovineHD1000008044	BovineHD1000031258
844	10	24684584	25173443	19	488860	5	3	BovineHD1000008069	BovineHD1000008212
845	10	24684584	25265627	21	581044	5	3	BovineHD1000008069	BovineHD1000008250
846	10	24831598	25173443	13	341846	5	3	BovineHD1000008116	BovineHD1000008212
847	10	24942444	25265627	14	323184	5	3	BovineHD1000031258	BovineHD1000008250
848	10	25019171	25303984	15	284814	5	3	BovineHD1000008165	BovineHD1000008259
849	10	27086857	27109540	12	22684	2	1	BovineHD1000008874	BovineHD1000008883
850	10	40734273	40794738	20	60466	2	1	BovineHD1000012485	ARS-BFGL-NGS-109834
851	10	40746954	40794738	16	47785	2	1	BovineHD1000012489	ARS-BFGL-NGS-109834
852	10	40764127	40794738	12	30612	2	1	BovineHD1000012494	ARS-BFGL-NGS-109834

853	10	42436483	42467266	14	30784	2	1	BovineHD1000012858	BovineHD1000012870
854	10	42446052	42467266	13	21215	2	1	BovineHD1000012859	BovineHD1000012870
855	10	42451030	42467266	10	16237	2	1	BovineHD1000012861	BovineHD1000012870
856	10	46864248	46902850	15	38603	2	1	BovineHD1000014049	BovineHD1000031399
857	10	47693839	47721937	11	28099	2	1	BovineHD1000014349	ARS-BFGL-NGS-104551
858	10	47704775	47751227	16	46453	2	1	BovineHD1000014351	BTB-00422746
859	10	53031744	53076448	19	44705	2	1	BovineHD1000031423	BovineHD1000015872
860	10	53037548	53076448	18	38901	2	1	BovineHD1000015853	BovineHD1000015872
861	10	53041455	53076448	17	34994	2	1	ARS-BFGL-NGS-110070	BovineHD1000015872
862	10	53041455	53080510	19	39056	2	1	ARS-BFGL-NGS-110070	BTA-69301-no-rs
863	10	53045889	53076448	16	30560	2	1	BovineHD1000015854	BovineHD1000015872
864	10	53049577	53080510	16	30934	2	1	BovineHD1000015857	BTA-69301-no-rs
865	10	53055217	53080510	13	25294	2	1	BovineHD1000015861	BTA-69301-no-rs
866	10	67409125	67441337	12	32213	2	1	BovineHD1000019342	BovineHD1000019352
867	11	20031	92757	11	72727	5	3	BovineHD1100000002	BovineHD1100000014
868	11	20031	113697	16	93667	5	3	BovineHD1100000002	BovineHD1100000019
869	11	20031	118377	17	98347	5	3	BovineHD1100000002	BovineHD1100000020
870	11	5745177	5770986	14	25810	5	3	BovineHD1100002087	BovineHD1100002102
871	11	5745177	5800039	20	54863	5	3	BovineHD1100002087	BovineHD1100002109
872	11	5750278	5778054	14	27777	5	3	BovineHD1100002088	BovineHD1100002103
873	11	5758041	5770986	11	12946	5	3	BovineHD1100002092	BovineHD1100002102
874	11	5758041	5778054	12	20014	5	3	BovineHD1100002092	BovineHD1100002103
875	11	5758041	5788240	14	30200	5	3	BovineHD1100002092	BovineHD1100002105
876	11	5758041	5789855	15	31815	5	3	BovineHD1100002092	BovineHD1100002106
877	11	5758041	5800039	17	41999	5	3	BovineHD1100002092	BovineHD1100002109
878	11	5761693	5789855	12	28163	5	3	BovineHD1100002096	BovineHD1100002106
879	11	5764094	5789855	11	25762	5	3	BovineHD1100002097	BovineHD1100002106
880	11	7464692	7497550	22	32859	2	1	BovineHD1100002764	BovineHD1100002783
881	11	7465811	7490549	13	24739	2	1	BovineHD1100002765	BovineHD1100002775

882	11	13087586	13129402	25	41817	2	1	BovineHD1100004247	BovineHD1100004269
883	11	25517299	25610048	25	92750	2	1	BovineHD1100007652	BovineHD1100007676
884	11	25522368	25594491	19	72124	2	1	BovineHD1100007654	BovineHD1100007672
885	11	25544002	25590117	12	46116	2	1	ARS-BFGL-NGS-29851	BovineHD1100007671
886	11	25547538	25594491	12	46954	2	1	BovineHD1100007660	BovineHD1100007672
887	11	29417529	29436744	12	19216	2	1	ARS-BFGL-NGS-62651	BovineHD1100008757
888	11	37589887	37613246	13	23360	2	1	BovineHD1100011156	UA-IFASA-6619
889	11	45855920	45880840	13	24921	2	1	BovineHD1100013306	BovineHD1100013318
890	11	49011392	49093033	14	81642	2	1	BovineHD1100014413	BovineHD1100014441
891	11	51480322	51503959	18	23638	5	3	BovineHD1100015130	BovineHD1100015146
892	11	68381842	68442477	22	60636	2	1	BovineHD1100019323	BovineHD1100019341
893	11	69975117	70555021	334	579905	2	1	BovineHD1100019877	BovineHD1100020212
894	11	69975117	70555942	335	580826	2	1	BovineHD1100019877	BovineHD1100020213
895	11	71959349	71982539	11	23191	2	1	BovineHD1100020562	BovineHD1100020572
896	11	73357180	73453361	27	96182	2	1	BovineHD1100020991	BovineHD1100021016
897	11	83508456	83529183	10	20728	2	1	BovineHD1100024030	BovineHD1100024039
898	11	83508456	83545574	21	37119	2	1	BovineHD1100024030	BovineHD1100024051
899	11	83523154	83545574	16	22421	2	1	BovineHD1100024035	BovineHD1100024051
900	11	92560734	92630479	28	69746	2	1	BovineHD1100026915	BovineHD1100026943
901	11	92560734	92638477	31	77744	2	1	BovineHD1100026915	BovineHD1100026946
902	11	92561659	92604273	18	42615	2	1	BovineHD1100026916	BovineHD1100026934
903	11	92579154	92604273	12	25120	2	1	BovineHD1100026924	BovineHD1100026934
904	11	92588207	92638477	22	50271	2	1	BovineHD1100026926	BovineHD1100026946
905	11	1,02E+08	1,02E+08	17	40816	2	1	BovineHD1100029516	BovineHD1100029532
906	11	1,02E+08	1,02E+08	11	28976	2	1	BovineHD1100029522	BovineHD1100029532
907	11	1,02E+08	1,02E+08	10	27701	2	1	BovineHD1100029523	BovineHD1100029532
908	11	1,02E+08	1,02E+08	26	61637	2	1	BovineHD1100029592	BovineHD4100009242
909	11	1,04E+08	1,04E+08	12	47804	2	1	BovineHD1100030132	BovineHD1100030142
910	11	1,04E+08	1,04E+08	14	58791	2	1	BovineHD1100030199	BovineHD1100030209

911	11	1,04E+08	1,04E+08	10	38324	2	1	ARS-BFGL-NGS-34469	BovineHD1100030208
912	11	1,04E+08	1,04E+08	11	45253	2	1	ARS-BFGL-NGS-34469	BovineHD1100030209
913	11	1,04E+08	1,04E+08	12	52913	2	1	ARS-BFGL-NGS-34469	BovineHD1100030210
914	11	1,04E+08	1,04E+08	13	57074	2	1	ARS-BFGL-NGS-34469	BovineHD1100030211
915	11	1,04E+08	1,04E+08	33	129105	2	1	ARS-BFGL-NGS-34469	BovineHD4100009267
916	11	1,04E+08	1,04E+08	26	113513	2	1	BovineHD1100030250	BovineHD1100030269
917	11	1,04E+08	1,04E+08	15	60918	2	1	BovineHD1100030257	BovineHD1100030267
918	11	1,04E+08	1,04E+08	18	76594	2	1	BovineHD1100030257	BovineHD1100030269
919	11	1,04E+08	1,04E+08	24	102106	2	1	BovineHD1100030257	BovineHD1100030275
920	11	1,04E+08	1,04E+08	14	52987	2	1	ARS-BFGL-NGS-39566	BovineHD1100030267
921	11	1,05E+08	1,05E+08	14	44603	2	1	BovineHD1100030497	BovineHD1100030512
922	11	1,06E+08	1,06E+08	19	87533	2	1	BovineHD4100009282	BovineHD1100030711
923	12	607076	660731	14	53656	5	3	BovineHD1200000098	BovineHD1200027528
924	12	1929743	1971696	12	41954	5	3	BovineHD1200000543	BovineHD1200000553
925	12	5693314	5772578	14	79265	5	3	BovineHD1200001633	BovineHD1200001644
926	12	8902022	8926999	12	24978	5	3	BovineHD1200002439	BovineHD1200002450
927	12	18115848	18124241	10	8394	2	1	BovineHD1200005479	BovineHD1200005487
928	12	18115848	18125381	11	9534	2	1	BovineHD1200005479	BovineHD4100009423
929	12	32054331	32144594	10	90264	1	0	BovineHD1200009422	BovineHD1200009444
930	12	32054331	32162911	13	108581	1	0	BovineHD1200009422	BovineHD1200009451
931	12	32054331	32182960	16	128630	5	3	BovineHD1200009422	BovineHD1200027784
932	12	32054331	32218347	17	164017	1	0	BovineHD1200009422	BovineHD1200009462
933	12	33355222	33416366	15	61145	2	1	BovineHD1200009788	BovineHD1200009801
934	12	33365616	33416366	13	50751	2	1	BovineHD1200009789	BovineHD1200009801
935	12	44363730	44398855	14	35126	5	3	BovineHD1200012297	BovineHD1200012310
936	12	44405826	44418666	10	12841	5	3	BovineHD1200012312	BovineHD1200012323
937	12	49878698	49960646	29	81949	5	3	BovineHD1200013678	BovineHD1200013704
938	12	49878698	49962814	30	84117	5	3	BovineHD1200013678	BovineHD1200013705
939	12	49878698	49967508	32	88811	5	3	BovineHD1200013678	BovineHD1200013706

940	12	49878698	49986723	36	108026	5	3	BovineHD1200013678	BovineHD1200026987
941	12	49880801	49986723	35	105923	5	3	BovineHD1200013679	BovineHD1200026987
942	12	50855902	50895100	23	39199	2	1	BovineHD1200013973	BovineHD1200013992
943	12	70363408	71244186	52	880779	5	3	BovineHD1200028172	BovineHD1200019519
944	12	70376431	70645065	26	268635	5	3	BovineHD1200019355	BovineHD1200019402
945	12	70502845	70620665	13	117821	2	1	BovineHD1200019373	BovineHD1200019397
946	12	70502845	70645065	14	142221	2	1	BovineHD1200019373	BovineHD1200019402
947	12	70502845	70723087	18	220243	2	1	BovineHD1200019373	BovineHD1200019419
948	12	70569888	70723087	12	153200	2	1	BovineHD1200019382	BovineHD1200019419
949	12	70613749	70776064	11	162316	5	3	BovineHD1200019394	BovineHD1200019433
950	12	70613749	70789980	13	176232	5	3	BovineHD1200019394	BTB-01626292
951	12	70645065	70809607	12	164543	1	0	BovineHD1200019402	BovineHD1200019439
952	12	70848277	71274536	13	426260	5	3	BovineHD1200019450	BovineHD1200019530
953	12	70848277	72016965	34	1168689	5	3	BovineHD1200019450	BovineHD1200019777
954	12	70848277	72042304	36	1194028	5	3	BovineHD1200019450	BovineHD1200019786
955	12	71032212	71274536	11	242325	5	3	BovineHD1200019483	BovineHD1200019530
956	12	71032212	72042304	34	1010093	5	3	BovineHD1200019483	BovineHD1200019786
957	12	71032212	72063255	36	1031044	5	3	BovineHD1200019483	BovineHD1200019789
958	12	71071288	71688525	20	617238	5	3	BovineHD1200019489	BovineHD1200019671
959	12	71071288	72016965	31	945678	5	3	BovineHD1200019489	BovineHD1200019777
960	12	71071288	72042304	33	971017	5	3	BovineHD1200019489	BovineHD1200019786
961	12	71173494	72042304	31	868811	5	3	BovineHD1200019502	BovineHD1200019786
962	12	71215771	71613636	15	397866	1	0	BovineHD1200019509	BovineHD1200019647
963	12	71224710	71613636	13	388927	1	0	BovineHD1200019513	BovineHD1200019647
964	12	71268774	71613636	10	344863	1	0	BovineHD1200019528	BovineHD1200019647
965	12	71268774	71688525	12	419752	6	4	BovineHD1200019528	BovineHD1200019671
966	12	71268774	71743591	13	474818	5	3	BovineHD1200019528	BovineHD1200019693
967	12	71268774	71820348	15	551575	5	3	BovineHD1200019528	BovineHD1200019712
968	12	71268774	71899472	16	630699	5	3	BovineHD1200019528	BovineHD1200019739

969	12	71268774	71949321	22	680548	5	3	BovineHD1200019528	BovineHD1200019756
970	12	71268774	72016965	23	748192	5	3	BovineHD1200019528	BovineHD1200019777
971	12	71268774	72040735	24	771962	5	3	BovineHD1200019528	BovineHD1200019785
972	12	71268774	72042304	25	773531	5	3	BovineHD1200019528	BovineHD1200019786
973	12	71268774	72063255	27	794482	5	3	BovineHD1200019528	BovineHD1200019789
974	12	71440002	71688525	10	248524	5	3	BovineHD1200019600	BovineHD1200019671
975	12	71440002	71820348	13	380347	1	0	BovineHD1200019600	BovineHD1200019712
976	12	71440002	71899472	14	459471	5	3	BovineHD1200019600	BovineHD1200019739
977	12	71440002	71949321	20	509320	1	0	BovineHD1200019600	BovineHD1200019756
978	12	71440002	72016965	21	576964	5	3	BovineHD1200019600	BovineHD1200019777
979	12	71440002	72042304	23	602303	5	3	BovineHD1200019600	BovineHD1200019786
980	12	71440002	72063255	25	623254	1	0	BovineHD1200019600	BovineHD1200019789
981	12	71443906	71743591	10	299686	5	3	BovineHD1200019602	BovineHD1200019693
982	12	71443906	71899472	13	455567	5	3	BovineHD1200019602	BovineHD1200019739
983	12	71443906	72063255	24	619350	5	3	BovineHD1200019602	BovineHD1200019789
984	12	71453071	72042304	21	589234	5	3	BovineHD1200028206	BovineHD1200019786
985	12	71453071	72063255	23	610185	5	3	BovineHD1200028206	BovineHD1200019789
986	12	71461079	71820348	10	359270	1	0	BovineHD1200019607	BovineHD1200019712
987	12	71494540	72016965	17	522426	5	3	BovineHD1200019611	BovineHD1200019777
988	12	71494540	72063255	21	568716	5	3	BovineHD1200019611	BovineHD1200019789
989	12	71553800	72016965	16	463166	5	3	BovineHD1200019628	BovineHD1200019777
990	12	71553800	72042304	18	488505	5	3	BovineHD1200019628	BovineHD1200019786
991	12	71553800	72077746	22	523947	5	3	BovineHD1200019628	BovineHD1200019801
992	12	71610662	72016965	15	406304	5	3	BovineHD1200019645	BovineHD1200019777
993	12	71610662	72042304	17	431643	5	3	BovineHD1200019645	BovineHD1200019786
994	12	71610662	72063255	19	452594	5	3	BovineHD1200019645	BovineHD1200019789
995	12	71688525	71949321	11	260797	1	0	BovineHD1200019671	BovineHD1200019756
996	12	71688525	72042304	14	353780	5	3	BovineHD1200019671	BovineHD1200019786
997	12	71688525	72063255	16	374731	5	3	BovineHD1200019671	BovineHD1200019789

998	12	71743591	72063255	15	319665	5	3	BovineHD1200019693	BovineHD1200019789
999	12	71782049	72063255	14	281207	5	3	BovineHD1200019707	BovineHD1200019789
1000	12	71820348	72042304	11	221957	5	3	BovineHD1200019712	BovineHD1200019786
1001	12	71820348	72063255	13	242908	5	3	BovineHD1200019712	BovineHD1200019789
1002	12	71899472	72042304	10	142833	1	0	BovineHD1200019739	BovineHD1200019786
1003	12	71919682	72063255	11	143574	5	3	BovineHD1200019745	BovineHD1200019789
1004	12	72058027	72123747	12	65721	2	1	BovineHD1200019787	BovineHD1200019825
1005	12	72063255	72123747	11	60493	2	1	BovineHD1200019789	BovineHD1200019825
1006	12	72073378	72123747	10	50370	2	1	BovineHD1200019797	BovineHD1200019825
1007	12	72432362	72819475	106	387114	1	0	BovineHD1200019974	BovineHD1200028257
1008	12	72432362	72882991	107	450630	1	0	BovineHD1200019974	BovineHD1200020124
1009	12	72507076	72882991	81	375916	1	0	BovineHD1200020001	BovineHD1200020124
1010	12	72511101	72819475	78	308375	1	0	BovineHD1200020004	BovineHD1200028257
1011	12	72511101	72882991	79	371891	1	0	BovineHD1200020004	BovineHD1200020124
1012	12	72567497	72597236	11	29740	5	3	BovineHD1200020023	BovineHD1200020035
1013	12	72698598	72766413	22	67816	5	3	BovineHD1200020076	BovineHD1200020102
1014	12	72713303	73401154	43	687852	5	3	BovineHD1200020079	BovineHD1200020311
1015	12	72742881	72882991	12	140111	1	0	BovineHD1200020097	BovineHD1200020124
1016	12	72748544	72819475	10	70932	1	0	BovineHD1200020098	BovineHD1200028257
1017	12	72748544	72882991	11	134448	1	0	BovineHD1200020098	BovineHD1200020124
1018	12	72748544	73015638	13	267095	1	0	BovineHD1200020098	BovineHD1200028277
1019	12	72748544	73497775	28	749232	5	3	BovineHD1200020098	BTB-01761781
1020	12	72776383	73497775	24	721393	5	3	BovineHD1200020104	BTB-01761781
1021	12	72814214	73564769	23	750556	5	3	BovineHD1200020109	BovineHD1200020358
1022	12	72882991	73497775	18	614785	5	3	BovineHD1200020124	BTB-01761781
1023	12	72882991	73564769	20	681779	5	3	BovineHD1200020124	BovineHD1200020358
1024	12	73001857	73497775	17	495919	5	3	BovineHD1200020163	BTB-01761781
1025	12	73001857	73553506	18	551650	5	3	BovineHD1200020163	BovineHD1200020357
1026	12	73001857	73564769	19	562913	5	3	BovineHD1200020163	BovineHD1200020358

1027	12	73001857	73583291	20	581435	5	3	BovineHD1200020163	BovineHD1200020366
1028	12	73001857	73673865	24	672009	5	3	BovineHD1200020163	BovineHD1200020407
1029	12	73001857	73811041	31	809185	5	3	BovineHD1200020163	BovineHD1200020475
1030	12	73015638	73673865	23	658228	5	3	BovineHD1200028277	BovineHD1200020407
1031	12	73015638	73779660	29	764023	5	3	BovineHD1200028277	BovineHD1200020457
1032	12	73150029	73401154	13	251126	5	3	BovineHD1200028289	BovineHD1200020311
1033	12	73150029	73497775	15	347747	5	3	BovineHD1200028289	BTB-01761781
1034	12	73150029	73564769	17	414741	5	3	BovineHD1200028289	BovineHD1200020358
1035	12	73150029	73583291	18	433263	5	3	BovineHD1200028289	BovineHD1200020366
1036	12	73150029	73673865	22	523837	5	3	BovineHD1200028289	BovineHD1200020407
1037	12	73150029	74111618	38	961590	5	3	BovineHD1200028289	BovineHD1200020565
1038	12	73233249	73401154	12	167906	5	3	BovineHD1200020259	BovineHD1200020311
1039	12	73233249	73497775	14	264527	5	3	BovineHD1200020259	BTB-01761781
1040	12	73233249	73564769	16	331521	5	3	BovineHD1200020259	BovineHD1200020358
1041	12	73233249	73673865	21	440617	5	3	BovineHD1200020259	BovineHD1200020407
1042	12	73233249	73754154	23	520906	5	3	BovineHD1200020259	BovineHD1200020442
1043	12	73233249	74509354	48	1276106	5	3	BovineHD1200020259	BovineHD1200020707
1044	12	73319626	73401154	10	81529	2	1	BovineHD1200028309	BovineHD1200020311
1045	12	73319626	73497775	12	178150	5	3	BovineHD1200028309	BTB-01761781
1046	12	73319626	73564769	14	245144	1	0	BovineHD1200028309	BovineHD1200020358
1047	12	73319626	74241667	36	922042	5	3	BovineHD1200028309	BovineHD1200020612
1048	12	73335507	73497775	10	162269	5	3	BovineHD1200020289	BTB-01761781
1049	12	73335507	73553506	11	218000	5	3	BovineHD1200020289	BovineHD1200020357
1050	12	73335507	73564769	12	229263	5	3	BovineHD1200020289	BovineHD1200020358
1051	12	73335507	73666963	16	331457	5	3	BovineHD1200020289	BovineHD1200028327
1052	12	73335507	73673865	17	338359	5	3	BovineHD1200020289	BovineHD1200020407
1053	12	73335507	73754154	19	418648	2	1	BovineHD1200020289	BovineHD1200020442
1054	12	73335507	74098496	32	762990	5	3	BovineHD1200020289	BovineHD1200020562
1055	12	73335507	74111618	33	776112	5	3	BovineHD1200020289	BovineHD1200020565

1056	12	73363460	73564769	10	201310	5	3	BovineHD1200028311	BovineHD1200020358
1057	12	73387202	73863425	20	476224	5	3	BovineHD1200027111	BovineHD1200020490
1058	12	73387202	74111618	27	724417	5	3	BovineHD1200027111	BovineHD1200020565
1059	12	73492233	73779660	15	287428	5	3	BovineHD1200020343	BovineHD1200020457
1060	12	73492233	73811041	16	318809	5	3	BovineHD1200020343	BovineHD1200020475
1061	12	73492233	73863425	18	371193	5	3	BovineHD1200020343	BovineHD1200020490
1062	12	73492233	74111618	25	619386	5	3	BovineHD1200020343	BovineHD1200020565
1063	12	73492233	74302958	27	810726	5	3	BovineHD1200020343	BovineHD1200020632
1064	12	73553506	73767537	10	214032	1	0	BovineHD1200020357	BovineHD1200020448
1065	12	73553506	74111618	23	558113	5	3	BovineHD1200020357	BovineHD1200020565
1066	12	73657824	73779660	10	121837	1	0	BovineHD1200020401	BovineHD1200020457
1067	12	73657824	73811041	11	153218	5	3	BovineHD1200020401	BovineHD1200020475
1068	12	73657824	73863425	13	205602	5	3	BovineHD1200020401	BovineHD1200020490
1069	12	73657824	74098496	19	440673	5	3	BovineHD1200020401	BovineHD1200020562
1070	12	73657824	74111618	20	453795	5	3	BovineHD1200020401	BovineHD1200020565
1071	12	73657824	74478293	29	820470	5	3	BovineHD1200020401	BovineHD1200028386
1072	12	73657824	74493207	30	835384	5	3	BovineHD1200020401	BovineHD1200020699
1073	12	73745994	73892476	10	146483	5	3	BovineHD1200020439	BovineHD1200020495
1074	12	73745994	73961078	11	215085	5	3	BovineHD1200020439	BovineHD1200020521
1075	12	73745994	74111618	16	365625	5	3	BovineHD1200020439	BovineHD1200020565
1076	12	73745994	74241667	17	495674	5	3	BovineHD1200020439	BovineHD1200020612
1077	12	73745994	74302958	18	556965	5	3	BovineHD1200020439	BovineHD1200020632
1078	12	73745994	74369927	22	623934	5	3	BovineHD1200020439	BovineHD1200020661
1079	12	73745994	74421681	24	675688	5	3	BovineHD1200020439	BovineHD1200028382
1080	12	73745994	74478293	25	732300	5	3	BovineHD1200020439	BovineHD1200028386
1081	12	73745994	74493207	26	747214	5	3	BovineHD1200020439	BovineHD1200020699
1082	12	73745994	74509354	27	763361	5	3	BovineHD1200020439	BovineHD1200020707
1083	12	73745994	74533189	28	787196	5	3	BovineHD1200020439	BovineHD1200020725
1084	12	73767537	74241667	15	474131	5	3	BovineHD1200020448	BovineHD1200020612

1085	12	73767537	74493207	24	725671	5	3	BovineHD1200020448	BovineHD1200020699
1086	12	73779660	74111618	11	331959	5	3	BovineHD1200020457	BovineHD1200020565
1087	12	73779660	74241667	12	462008	5	3	BovineHD1200020457	BovineHD1200020612
1088	12	73811041	74111618	10	300578	5	3	BovineHD1200020475	BovineHD1200020565
1089	12	73811041	74369927	16	558887	5	3	BovineHD1200020475	BovineHD1200020661
1090	12	73811041	74421681	18	610641	5	3	BovineHD1200020475	BovineHD1200028382
1091	12	73961078	74509354	17	548277	5	3	BovineHD1200020521	BovineHD1200020707
1092	12	74014764	74369927	10	355164	5	3	BovineHD1200020538	BovineHD1200020661
1093	12	74098496	74578587	15	480092	5	3	BovineHD1200020562	BovineHD1200020745
1094	12	74241667	74509354	11	267688	5	3	BovineHD1200020612	BovineHD1200020707
1095	12	74241667	74578587	13	336921	5	3	BovineHD1200020612	BovineHD1200020745
1096	12	74302958	74509354	10	206397	1	0	BovineHD1200020632	BovineHD1200020707
1097	12	74302958	74589404	13	286447	5	3	BovineHD1200020632	BovineHD1200020752
1098	12	74327005	74589404	12	262400	1	0	BovineHD1200020644	BovineHD1200020752
1099	12	74359566	74578587	10	219022	5	3	BovineHD1200028373	BovineHD1200020745
1100	12	74840021	74942860	10	102840	1	0	BovineHD1200020836	BovineHD1200020874
1101	12	74840021	75080248	16	240228	1	0	BovineHD1200020836	BovineHD1200027123
1102	12	74840021	75141024	17	301004	1	0	BovineHD1200020836	BovineHD1200020915
1103	12	74840021	75193156	18	353136	1	0	BovineHD1200020836	BovineHD1200020930
1104	12	74840021	75238779	19	398759	1	0	BovineHD1200020836	BovineHD1200020945
1105	12	74862280	75017633	10	155354	5	3	BovineHD1200020847	BovineHD1200020892
1106	12	74862280	75061575	12	199296	5	3	BovineHD1200020847	BovineHD1200020902
1107	12	74862280	75080248	13	217969	5	3	BovineHD1200020847	BovineHD1200027123
1108	12	74866531	75193156	14	326626	1	0	BovineHD1200020850	BovineHD1200020930
1109	12	74894950	75080248	10	185299	5	3	BovineHD1200020862	BovineHD1200027123
1110	12	74930625	75193156	11	262532	1	0	BovineHD1200020869	BovineHD1200020930
1111	12	75238779	75379717	44	140939	5	3	BovineHD1200020945	BovineHD1200021030
1112	12	75238779	75462926	51	224148	5	3	BovineHD1200020945	BovineHD1200028439
1113	12	75238779	75517838	59	279060	5	3	BovineHD1200020945	BovineHD1200021104

1114	12	75246806	75400054	47	153249	5	3	BovineHD1200020947	BovineHD1200021040
1115	12	75246806	75404936	48	158131	5	3	BovineHD1200020947	BovineHD1200028434
1116	12	75246806	75417228	49	170423	5	3	BovineHD1200020947	BovineHD1200028436
1117	12	75328043	75502589	23	174547	5	3	BovineHD1200020997	BovineHD1200021091
1118	12	75334764	76608564	41	1273801	5	3	BovineHD1200021002	BovineHD1200021571
1119	12	75338843	75471626	15	132784	5	3	BovineHD1200021004	BovineHD1200021067
1120	12	75348811	75579245	21	230435	5	3	BovineHD1200021010	BovineHD1200021134
1121	12	75374251	75462926	10	88676	5	3	BovineHD1200021025	BovineHD1200028439
1122	12	75374251	75471626	11	97376	5	3	BovineHD1200021025	BovineHD1200021067
1123	12	75374251	75579245	19	204995	5	3	BovineHD1200021025	BovineHD1200021134
1124	12	75378406	75471626	10	93221	5	3	BovineHD1200021029	BovineHD1200021067
1125	12	75398067	75517838	13	119772	5	3	BovineHD1200021039	BovineHD1200021104
1126	12	75398067	75579245	14	181179	5	3	BovineHD1200021039	BovineHD1200021134
1127	12	75400054	75946247	20	546194	5	3	BovineHD1200021040	BovineHD1200028476
1128	12	75404936	75579245	12	174310	5	3	BovineHD1200028434	BovineHD1200021134
1129	12	75417228	75579245	11	162018	5	3	BovineHD1200028436	BovineHD1200021134
1130	12	75462926	75579245	10	116320	5	3	BovineHD1200028439	BovineHD1200021134
1131	12	75462926	75946247	17	483322	5	3	BovineHD1200028439	BovineHD1200028476
1132	12	75462926	76074162	18	611237	5	3	BovineHD1200028439	BovineHD1200021338
1133	12	75462926	76608564	27	1145639	5	3	BovineHD1200028439	BovineHD1200021571
1134	12	75497057	75946247	15	449191	1	0	BovineHD1200021086	BovineHD1200028476
1135	12	75497057	76154619	18	657563	5	3	BovineHD1200021086	BovineHD1200021378
1136	12	75497057	76191654	19	694598	5	3	BovineHD1200021086	BovineHD1200021397
1137	12	75500319	75946247	14	445929	5	3	BovineHD1200021089	BovineHD1200028476
1138	12	75770032	76191654	11	421623	5	3	BovineHD1200021214	BovineHD1200021397
1139	12	75770032	76270340	12	500309	5	3	BovineHD1200021214	BovineHD1200021440
1140	12	76074162	76608564	10	534403	5	3	BovineHD1200021338	BovineHD1200021571
1141	12	78367374	78402287	19	34914	2	1	ARS-BFGL-NGS-110479	BovineHD1200022324
1142	12	78367374	78412067	21	44694	2	1	ARS-BFGL-NGS-110479	BovineHD1200022325

1143	13	2102273	2138145	16	35873	2	1	BovineHD1300000552	BovineHD1300000567
1144	13	2102273	2141495	18	39223	2	1	BovineHD1300000552	BovineHD1300000570
1145	13	7963451	8001486	16	38036	2	1	BovineHD1300002105	BovineHD4100009880
1146	13	7963451	8009711	19	46261	2	1	BovineHD1300002105	BovineHD1300002122
1147	13	7963451	8013473	20	50023	2	1	BovineHD1300002105	BovineHD1300002123
1148	13	10508131	10536898	10	28768	2	1	ARS-BFGL-NGS-32505	BovineHD1300002882
1149	13	12543348	12799194	70	255847	5	3	BovineHD1300003541	BovineHD1300003607
1150	13	12543348	12820186	78	276839	5	3	BovineHD1300003541	BovineHD1300003616
1151	13	12543348	12822615	79	279268	5	3	BovineHD1300003541	BovineHD1300003617
1152	13	12544693	12774276	60	229584	5	3	BovineHD1300003542	BovineHD1300003598
1153	13	12544693	12790226	66	245534	5	3	BovineHD1300003542	BovineHD1300003604
1154	13	12544693	12792963	68	248271	5	3	BovineHD1300003542	BovineHD1300003606
1155	13	12544693	12799194	69	254502	5	3	BovineHD1300003542	BovineHD1300003607
1156	13	12544693	12804669	72	259977	5	3	BovineHD1300003542	BovineHD1300003610
1157	13	12544693	12820186	77	275494	5	3	BovineHD1300003542	BovineHD1300003616
1158	13	12552408	12792963	66	240556	5	3	BovineHD1300024867	BovineHD1300003606
1159	13	12565055	12784454	58	219400	5	3	BovineHD1300003546	BovineHD1300003601
1160	13	12565055	12786850	59	221796	5	3	BovineHD1300003546	BovineHD1300003602
1161	13	12565055	12792963	63	227909	5	3	BovineHD1300003546	BovineHD1300003606
1162	13	12565055	12799194	64	234140	5	3	BovineHD1300003546	BovineHD1300003607
1163	13	12565055	12804669	67	239615	5	3	BovineHD1300003546	BovineHD1300003610
1164	13	12565055	12820186	72	255132	5	3	BovineHD1300003546	BovineHD1300003616
1165	13	12584552	12633900	18	49349	5	3	BovineHD1300003553	BovineHD1300003568
1166	13	12584552	12820186	64	235635	5	3	BovineHD1300003553	BovineHD1300003616
1167	13	12584552	12822615	65	238064	5	3	BovineHD1300003553	BovineHD1300003617
1168	13	12595623	12792963	50	197341	5	3	BovineHD1300003556	BovineHD1300003606
1169	13	12595623	12804669	54	209047	5	3	BovineHD1300003556	BovineHD1300003610
1170	13	12595623	12822615	60	226993	5	3	BovineHD1300003556	BovineHD1300003617
1171	13	12605430	12790226	46	184797	5	3	BovineHD1300003558	BovineHD1300003604

1172	13	12622743	12752130	29	129388	5	3	BovineHD1300003564	BovineHD1300003592
1173	13	12622743	12792181	42	169439	5	3	BovineHD1300003564	BovineHD1300003605
1174	13	12622743	12804669	47	181927	5	3	BovineHD1300003564	BovineHD1300003610
1175	13	12622743	12820186	52	197444	5	3	BovineHD1300003564	BovineHD1300003616
1176	13	12622743	12822615	53	199873	5	3	BovineHD1300003564	BovineHD1300003617
1177	13	12625622	12792963	42	167342	5	3	BovineHD1300003565	BovineHD1300003606
1178	13	12625622	12804669	46	179048	5	3	BovineHD1300003565	BovineHD1300003610
1179	13	12625622	12820186	51	194565	5	3	BovineHD1300003565	BovineHD1300003616
1180	13	12626523	12820186	50	193664	5	3	BovineHD4100009935	BovineHD1300003616
1181	13	12628175	12792963	40	164789	5	3	BovineHD1300003566	BovineHD1300003606
1182	13	12628175	12799194	41	171020	5	3	BovineHD1300003566	BovineHD1300003607
1183	13	12633900	12792963	38	159064	5	3	BovineHD1300003568	BovineHD1300003606
1184	13	12633900	12804669	42	170770	5	3	BovineHD1300003568	BovineHD1300003610
1185	13	12640230	12804669	41	164440	5	3	BovineHD1300003569	BovineHD1300003610
1186	13	12645130	12804669	40	159540	5	3	BovineHD1300003570	BovineHD1300003610
1187	13	12667083	12820186	40	153104	5	3	BovineHD1300003577	BovineHD1300003616
1188	13	12667083	12822615	41	155533	5	3	BovineHD1300003577	BovineHD1300003617
1189	13	12688200	12804669	32	116470	5	3	BovineHD1300003579	BovineHD1300003610
1190	13	12701419	12799194	26	97776	5	3	BovineHD1300003583	BovineHD1300003607
1191	13	12701419	12804669	29	103251	5	3	BovineHD1300003583	BovineHD1300003610
1192	13	12701419	12820186	34	118768	5	3	BovineHD1300003583	BovineHD1300003616
1193	13	12708929	12784454	19	75526	5	3	BovineHD1300003584	BovineHD1300003601
1194	13	12708929	12792963	24	84035	5	3	BovineHD1300003584	BovineHD1300003606
1195	13	12708929	12820186	33	111258	5	3	BovineHD1300003584	BovineHD1300003616
1196	13	19909378	19946082	17	36705	2	1	BovineHD1300005797	BovineHD1300005810
1197	13	33407009	33477797	20	70789	2	1	BovineHD1300009748	BovineHD1300009767
1198	13	33423542	33457495	10	33954	2	1	BovineHD1300009753	BovineHD1300009761
1199	13	33423542	33470830	14	47289	2	1	BovineHD1300009753	BovineHD1300009765
1200	13	33423542	33477797	16	54256	2	1	BovineHD1300009753	BovineHD1300009767

1201	13	37415567	37458688	11	43122	5	3	BovineHD1300010810	BovineHD1300010819
1202	13	37415567	37479958	14	64392	5	3	BovineHD1300010810	BovineHD1300010823
1203	13	37415567	37495897	19	80331	5	3	BovineHD1300010810	BovineHD1300010829
1204	13	37434887	37479958	10	45072	5	3	BovineHD1300010813	BovineHD1300010823
1205	13	37448217	37495897	13	47681	5	3	BovineHD1300010815	BovineHD1300010829
1206	13	43654009	43795538	19	141530	5	3	ARS-BFGL-NGS-109512	BovineHD1300012791
1207	13	43707745	43776717	10	68973	5	3	BTB-01794883	BovineHD1300012788
1208	13	43907827	43949298	11	41472	5	3	BTA-122758-no-rs	BovineHD1300012830
1209	13	46887454	46912555	13	25102	2	1	BovineHD1300013734	BovineHD1300013746
1210	13	46896813	46912555	10	15743	2	1	BovineHD1300013737	BovineHD1300013746
1211	13	53933240	53980281	17	47042	1	0	BovineHD1300015289	BovineHD1300015305
1212	13	53933240	53982995	19	49756	1	0	BovineHD1300015289	BovineHD1300015307
1213	13	53934586	53982995	18	48410	1	0	BovineHD1300015290	BovineHD1300015307
1214	13	53945164	53982995	12	37832	2	1	BovineHD1300015296	BovineHD1300015307
1215	13	53949454	53982995	11	33542	2	1	BovineHD1300015297	BovineHD1300015307
1216	13	53949454	53990117	15	40664	2	1	BovineHD1300015297	BovineHD1300015312
1217	13	54065496	54080230	10	14735	5	3	BovineHD1300015341	BovineHD1300015353
1218	13	54065496	54114946	18	49451	5	3	BovineHD1300015341	BovineHD1300015362
1219	13	61758700	61829559	20	70860	2	1	BovineHD1300017677	BovineHD1300017696
1220	13	61764038	61810469	13	46432	2	1	BovineHD1300017678	BovineHD1300017691
1221	13	61764038	61816652	16	52615	2	1	BovineHD1300017678	ARS-BFGL-NGS-102886
1222	13	61764038	61819687	17	55650	2	1	BovineHD1300017678	BovineHD1300017694
1223	13	61764038	61832961	20	68924	2	1	BovineHD1300017678	BovineHD1300017697
1224	13	61764038	61838708	21	74671	2	1	BovineHD1300017678	BovineHD1300017698
1225	13	61767478	61816652	15	49175	2	1	BovineHD1300017679	ARS-BFGL-NGS-102886
1226	13	61888486	61950689	16	62204	2	1	BovineHD1300017710	BovineHD1300017726
1227	13	61894132	61950689	14	56558	2	1	BovineHD1300017712	BovineHD1300017726
1228	13	67275766	67385717	27	109952	2	1	BovineHD1300019064	BovineHD1300019104
1229	13	71850682	71924455	20	73774	2	1	BovineHD1300020619	BovineHD1300020636

1230	13	71850682	71925908	21	75227	2	1	BovineHD1300020619	BovineHD1300020637
1231	13	71850682	71928909	22	78228	2	1	BovineHD1300020619	BovineHD1300020638
1232	13	71850682	71931812	23	81131	2	1	BovineHD1300020619	BovineHD1300020639
1233	13	71888562	71928909	14	40348	2	1	BovineHD1300020626	BovineHD1300020638
1234	13	71888562	71931812	15	43251	2	1	BovineHD1300020626	BovineHD1300020639
1235	13	71895797	71924455	11	28659	2	1	BovineHD1300020627	BovineHD1300020636
1236	13	71895797	71931812	14	36016	2	1	BovineHD1300020627	BovineHD1300020639
1237	13	74388010	74430302	13	42293	2	1	BovineHD1300021471	BovineHD1300021482
1238	13	74631978	74669059	21	37082	5	3	BovineHD1300021546	BovineHD1300021563
1239	13	74631978	74675560	23	43583	5	3	BovineHD1300021546	BovineHD1300021565
1240	13	74639395	74675560	19	36166	5	3	BovineHD1300021550	BovineHD1300021565
1241	14	645256	1189341	20	544086	5	3	BovineHD1400000041	BovineHD1400000091
1242	14	645256	1226863	21	581608	5	3	BovineHD1400000041	BovineHD1400000098
1243	14	645256	1351133	29	705878	5	3	BovineHD1400000041	BovineHD1400000128
1244	14	645256	1385301	31	740046	5	3	BovineHD1400000041	BovineHD1400024343
1245	14	707397	1385301	28	677905	5	3	BovineHD1400000048	BovineHD1400024343
1246	14	1099104	1385301	18	286198	5	3	BovineHD1400000074	BovineHD1400024343
1247	14	1099104	1410699	20	311596	5	3	BovineHD1400000074	BovineHD1400000139
1248	14	1139087	1351133	11	212047	5	3	BovineHD1400000081	BovineHD1400000128
1249	14	1139087	1379063	12	239977	5	3	BovineHD1400000081	BovineHD1400000132
1250	14	1139087	1385301	13	246215	5	3	BovineHD1400000081	BovineHD1400024343
1251	14	1139087	1407415	14	268329	5	3	BovineHD1400000081	BovineHD1400000138
1252	14	1189341	1351133	10	161793	5	3	BovineHD1400000091	BovineHD1400000128
1253	14	1189341	1379063	11	189723	5	3	BovineHD1400000091	BovineHD1400000132
1254	14	1189341	1385301	12	195961	5	3	BovineHD1400000091	BovineHD1400024343
1255	14	1189341	1407415	13	218075	5	3	BovineHD1400000091	BovineHD1400000138
1256	14	1189341	1410699	14	221359	5	3	BovineHD1400000091	BovineHD1400000139
1257	14	1260498	1385301	10	124804	5	3	BovineHD1400024034	BovineHD1400024343
1258	14	1260498	1407415	11	146918	5	3	BovineHD1400024034	BovineHD1400000138

1259	14	1308359	1407415	10	99057	5	3	BovineHD1400024339	BovineHD1400000138
1260	14	1308359	1410699	11	102341	5	3	BovineHD1400024339	BovineHD1400000139
1261	14	1324152	1410699	10	86548	5	3	BovineHD1400024342	BovineHD1400000139
1262	14	2015554	2057629	10	42076	2	1	BovineHD1400000274	BovineHD1400000283
1263	14	2022413	2069181	10	46769	2	1	BovineHD1400000276	BovineHD1400000286
1264	14	2022413	2089613	14	67201	2	1	BovineHD1400000276	BovineHD1400000290
1265	14	2046297	2089613	10	43317	2	1	BovineHD1400000281	BovineHD1400000290
1266	14	2395671	2472363	19	76693	2	1	BovineHD1400000358	BovineHD1400000372
1267	14	3493171	3504269	12	11099	5	3	BovineHD1400000669	BovineHD1400000682
1268	14	3996353	4068825	29	72473	5	3	BovineHD4100010590	Hapmap24986-BTC-065021
1269	14	4100475	4129472	13	28998	2	1	BovineHD4100010603	BovineHD1400000867
1270	14	4200701	4369830	61	169130	5	3	BovineHD1400000886	BovineHD1400000961
1271	14	20742574	20818621	23	76048	2	1	BovineHD1400005938	BovineHD1400005962
1272	14	22500478	22553028	18	52551	2	1	BovineHD1400006487	BovineHD1400006504
1273	14	22503089	22544496	14	41408	2	1	BovineHD1400006488	BTB-01252028
1274	14	22505415	22547813	15	42399	2	1	BovineHD1400006489	BovineHD1400006503
1275	14	30326407	30377174	16	50768	5	3	BovineHD1400008766	BovineHD1400008779
1276	14	42385696	42427570	11	41875	2	1	BovineHD1400012070	BovineHD1400012082
1277	14	60496215	60514091	11	17877	5	3	BovineHD1400016783	BovineHD1400016793
1278	14	63811066	63838459	10	27394	2	1	BovineHD1400017707	BovineHD1400017714
1279	14	67434915	67489095	11	54181	2	1	BovineHD1400018837	BovineHD1400018846
1280	14	68834757	68860420	17	25664	2	1	BovineHD1400019267	BovineHD1400019281
1281	14	81841283	81878266	11	36984	5	3	BovineHD1400023105	ARS-BFGL-NGS-15424
1282	14	81841283	81881644	13	40362	5	3	BovineHD1400023105	ARS-BFGL-NGS-104251
1283	14	81841283	81883661	14	42379	5	3	BovineHD1400023105	BovineHD1400023116
1284	15	43737	124293	13	80557	5	3	BovineHD1500000003	BovineHD1500025525
1285	15	43737	133025	14	89289	5	3	BovineHD1500000003	BovineHD1500000017
1286	15	43737	192584	21	148848	5	3	BovineHD1500000003	BovineHD1500024991

1287	15	43737	248692	27	204956	5	3	BovineHD1500000003	BovineHD1500000047
1288	15	43737	258140	28	214404	5	3	BovineHD1500000003	BovineHD1500000048
1289	15	43737	420389	55	376653	5	3	BovineHD1500000003	BovineHD1500000078
1290	15	43737	508576	71	464840	5	3	BovineHD1500000003	BovineHD1500000095
1291	15	68422	124293	11	55872	5	3	BovineHD1500000006	BovineHD1500025525
1292	15	68422	133025	12	64604	5	3	BovineHD1500000006	BovineHD1500000017
1293	15	68422	258140	26	189719	5	3	BovineHD1500000006	BovineHD1500000048
1294	15	70433	133025	11	62593	5	3	BovineHD1500000007	BovineHD1500000017
1295	15	395791	449431	12	53641	5	3	BovineHD1500000071	BovineHD1500025529
1296	15	547375	773505	87	226131	5	3	BovineHD1500000106	BovineHD1500000203
1297	15	547375	779340	88	231966	5	3	BovineHD1500000106	BovineHD1500000204
1298	15	547375	787417	92	240043	5	3	BovineHD1500000106	BovineHD1500000208
1299	15	553342	766174	83	212833	5	3	BovineHD1500000107	BovineHD1500000200
1300	15	553342	807686	93	254345	5	3	BovineHD1500000107	BovineHD1500000210
1301	15	560099	773505	84	213407	5	3	BovineHD1500000109	BovineHD1500000203
1302	15	650515	661789	10	11275	5	3	BovineHD1500000152	BovineHD1500000164
1303	15	659186	689592	12	30407	5	3	BovineHD1500000162	BovineHD1500000175
1304	15	660091	684098	10	24008	5	3	BovineHD1500000163	BovineHD1500000172
1305	15	660091	689592	11	29502	5	3	BovineHD1500000163	BovineHD1500000175
1306	15	1255932	1315478	16	59547	5	3	BovineHD1500000295	BovineHD1500000317
1307	15	1328622	1363910	15	35289	5	3	BovineHD1500000318	BovineHD1500000339
1308	15	1328622	1374762	16	46141	5	3	BovineHD1500000318	BovineHD1500000344
1309	15	1328622	1391302	19	62681	5	3	BovineHD1500000318	BovineHD1500000348
1310	15	1328622	1392890	20	64269	5	3	BovineHD1500000318	BovineHD1500000349
1311	15	1328622	1395380	22	66759	5	3	BovineHD1500000318	BovineHD1500000351
1312	15	1332473	1392890	19	60418	5	3	BovineHD1500000319	BovineHD1500000349
1313	15	1332473	1395380	21	62908	5	3	BovineHD1500000319	BovineHD1500000351
1314	15	1341474	1374762	11	33289	5	3	BovineHD1500000327	BovineHD1500000344
1315	15	1341474	1392890	15	51417	5	3	BovineHD1500000327	BovineHD1500000349

1316	15	1343024	1385504	12	42481	5	3	BovineHD1500000329	BovineHD1500000346
1317	15	1343024	1396987	17	53964	5	3	BovineHD1500000329	BovineHD1500000352
1318	15	1346590	1392890	12	46301	5	3	BovineHD1500000333	BovineHD1500000349
1319	15	10941005	11038486	18	97482	5	3	BovineHD1500002808	BovineHD1500002831
1320	15	16732787	17124155	88	391369	2	1	BovineHD1500004275	BovineHD1500004360
1321	15	16919913	17149627	64	229715	2	1	BovineHD1500004302	BovineHD1500004364
1322	15	24714021	24735563	10	21543	2	1	BovineHD1500006501	BovineHD1500006510
1323	15	25012657	25060263	14	47607	2	1	BovineHD1500006594	BovineHD1500006607
1324	15	30446720	30489674	14	42955	2	1	BovineHD1500008122	BovineHD1500008130
1325	15	30453374	30489674	13	36301	2	1	BovineHD1500008123	BovineHD1500008130
1326	15	30456511	30489674	12	33164	2	1	BovineHD1500025111	BovineHD1500008130
1327	15	40487632	40521052	12	33421	2	1	BovineHD1500011131	BovineHD1500011141
1328	15	40487632	40529240	14	41609	2	1	BovineHD1500011131	BovineHD1500011143
1329	15	40488346	40516854	10	28509	2	1	BovineHD1500011132	BovineHD1500011140
1330	15	40488346	40529240	13	40895	2	1	BovineHD1500011132	BovineHD1500011143
1331	15	41690512	41727594	16	37083	2	1	BovineHD1500011419	BovineHD1500011434
1332	15	45470174	45541604	35	71431	2	1	BovineHD1500012754	BovineHD1500012795
1333	15	45470174	45542956	36	72783	1	0	BovineHD1500012754	BovineHD1500012796
1334	15	45475858	45530760	26	54903	2	1	BovineHD1500012757	BovineHD1500012786
1335	15	45475858	45533361	28	57504	2	1	BovineHD1500012757	BovineHD1500012788
1336	15	45475858	45534014	29	58157	2	1	BovineHD1500012757	BovineHD1500012789
1337	15	45475858	45538373	32	62516	2	1	BovineHD1500012757	BovineHD1500012792
1338	15	45475858	45540133	33	64276	2	1	BovineHD1500012757	BovineHD1500012794
1339	15	45475858	45541604	34	65747	2	1	BovineHD1500012757	BovineHD1500012795
1340	15	45475858	45542956	35	67099	1	0	BovineHD1500012757	BovineHD1500012796
1341	15	45482819	45533361	23	50543	2	1	BovineHD1500012761	BovineHD1500012788
1342	15	45482819	45534014	24	51196	2	1	BovineHD1500012761	BovineHD1500012789
1343	15	45482819	45538373	27	55555	2	1	BovineHD1500012761	BovineHD1500012792
1344	15	45482819	45540133	28	57315	2	1	BovineHD1500012761	BovineHD1500012794

1345	15	45482819	45541604	29	58786	2	1	BovineHD1500012761	BovineHD1500012795
1346	15	45482819	45542956	30	60138	2	1	BovineHD1500012761	BovineHD1500012796
1347	15	45485037	45538373	25	53337	2	1	BovineHD1500012763	BovineHD1500012792
1348	15	45485037	45540133	26	55097	2	1	BovineHD1500012763	BovineHD1500012794
1349	15	45485037	45541604	27	56568	2	1	BovineHD1500012763	BovineHD1500012795
1350	15	45487683	45541604	26	53922	2	1	BovineHD1500012764	BovineHD1500012795
1351	15	45503972	45533361	14	29390	2	1	BovineHD1500012771	BovineHD1500012788
1352	15	45503972	45540133	19	36162	2	1	BovineHD1500012771	BovineHD1500012794
1353	15	45503972	45541604	20	37633	2	1	BovineHD1500012771	BovineHD1500012795
1354	15	45516207	45533361	10	17155	2	1	BovineHD1500012777	BovineHD1500012788
1355	15	45516207	45534014	11	17808	2	1	BovineHD1500012777	BovineHD1500012789
1356	15	45516207	45538373	14	22167	2	1	BovineHD1500012777	BovineHD1500012792
1357	15	45516207	45540133	15	23927	2	1	BovineHD1500012777	BovineHD1500012794
1358	15	45516207	45541604	16	25398	2	1	BovineHD1500012777	BovineHD1500012795
1359	15	45516207	45542956	17	26750	2	1	BovineHD1500012777	BovineHD1500012796
1360	15	46539222	46651173	25	111952	5	3	BovineHD1500013170	BovineHD1500013243
1361	15	46539222	46694068	33	154847	5	3	BovineHD1500013170	BovineHD1500013274
1362	15	46539222	46975690	55	436469	5	3	BovineHD1500013170	BovineHD1500013399
1363	15	46539222	46987386	57	448165	5	3	BovineHD1500013170	BovineHD1500013407
1364	15	46539222	47013774	60	474553	5	3	BovineHD1500013170	BovineHD1500013413
1365	15	46571384	46683210	29	111827	5	3	BovineHD1500013180	BovineHD1500013263
1366	15	46571384	46694068	32	122685	5	3	BovineHD1500013180	BovineHD1500013274
1367	15	46571384	46975690	54	404307	5	3	BovineHD1500013180	BovineHD1500013399
1368	15	46605212	46623335	15	18124	5	3	BovineHD1500013202	BovineHD1500013219
1369	15	46605212	46651173	17	45962	5	3	BovineHD1500013202	BovineHD1500013243
1370	15	46605212	46694068	25	88857	5	3	BovineHD1500013202	BovineHD1500013274
1371	15	46605212	46935735	41	330524	5	3	BovineHD1500013202	BovineHD1500025797
1372	15	46605212	46975690	47	370479	5	3	BovineHD1500013202	BovineHD1500013399
1373	15	46621486	46683210	10	61725	5	3	BovineHD1500013217	BovineHD1500013263

1374	15	46621486	46694068	13	72583	5	3	BovineHD1500013217	BovineHD1500013274
1375	15	46651173	46975690	31	324518	5	3	BovineHD1500013243	BovineHD1500013399
1376	15	46666188	46975690	30	309503	5	3	BovineHD1500013248	BovineHD1500013399
1377	15	46676693	46975690	27	298998	5	3	BovineHD1500013256	BovineHD1500013399
1378	15	46776660	46975690	20	199031	5	3	BovineHD1500013334	BovineHD1500013399
1379	15	46776660	47013774	25	237115	5	3	BovineHD1500013334	BovineHD1500013413
1380	15	46805089	46987386	21	182298	5	3	BovineHD1500013344	BovineHD1500013407
1381	15	46809853	46975690	16	165838	5	3	BovineHD1500013347	BovineHD1500013399
1382	15	46838495	46975690	14	137196	5	3	BovineHD1500013357	BovineHD1500013399
1383	15	46898690	46975690	11	77001	5	3	BovineHD1500013374	BovineHD1500013399
1384	15	46898690	46987386	13	88697	5	3	BovineHD1500013374	BovineHD1500013407
1385	15	46898690	46991080	14	92391	5	3	BovineHD1500013374	BovineHD1500013408
1386	15	46898690	47013774	16	115085	5	3	BovineHD1500013374	BovineHD1500013413
1387	15	46906029	47013774	15	107746	5	3	BTB-01926941	BovineHD1500013413
1388	15	46960682	47013774	10	53093	5	3	BovineHD1500013394	BovineHD1500013413
1389	15	47993124	48047397	10	54274	5	3	BovineHD1500013768	BovineHD1500013779
1390	15	47993124	48054165	11	61042	5	3	BovineHD1500013768	BovineHD1500013780
1391	15	47993124	48079198	19	86075	5	3	BovineHD1500013768	BovineHD1500013788
1392	15	47993124	48084049	20	90926	5	3	BovineHD1500013768	BovineHD1500013789
1393	15	47993124	48085137	21	92014	5	3	BovineHD1500013768	BovineHD1500013790
1394	15	48009469	48079198	16	69730	5	3	BovineHD1500013774	BovineHD1500013788
1395	15	48009469	48084049	17	74581	5	3	BovineHD1500013774	BovineHD1500013789
1396	15	50351188	50416349	11	65162	5	3	BovineHD1500014520	BovineHD1500014540
1397	15	50619664	50652851	11	33188	5	3	BovineHD1500014603	BovineHD1500014613
1398	15	50619664	50780834	31	161171	5	3	BovineHD1500014603	BovineHD1500014654
1399	15	50744716	50905892	20	161177	5	3	BovineHD1500014644	BovineHD1500014688
1400	15	50744716	50908580	21	163865	5	3	BovineHD1500014644	BovineHD1500014689
1401	15	57265349	57285101	14	19753	2	1	BovineHD1500016483	BovineHD1500016496
1402	15	67280359	67308302	12	27944	5	3	BovineHD1500019375	BovineHD1500019386

1403	15	79263122	79298902	16	35781	2	1	BovineHD1500023110	BovineHD1500023128
1404	15	79263122	79317375	18	54254	2	1	BovineHD1500023110	BovineHD1500023132
1405	15	79269130	79298902	14	29773	2	1	BovineHD1500023113	BovineHD1500023128
1406	15	79608073	79690026	10	81954	5	3	BovineHD1500023217	BovineHD1500023233
1407	15	79744750	79925053	51	180304	5	3	BovineHD1500023252	BovineHD1500023311
1408	15	79763209	79785494	10	22286	5	3	BovineHD1500023255	ARS-BFGL-NGS-69079
1409	15	79763209	79893803	43	130595	5	3	BovineHD1500023255	BovineHD1500023305
1410	15	79819433	79883423	17	63991	5	3	BovineHD1500023277	BovineHD1500023296
1411	15	79820699	79925053	29	104355	5	3	BovineHD1500023278	BovineHD1500023311
1412	15	79849334	79925053	22	75720	5	3	BovineHD1500023288	BovineHD1500023311
1413	15	79858131	79893803	16	35673	5	3	BovineHD1500025314	BovineHD1500023305
1414	15	79868463	79893803	13	25341	5	3	BovineHD1500023290	BovineHD1500023305
1415	15	79868463	79925053	18	56591	5	3	BovineHD1500023290	BovineHD1500023311
1416	15	79868463	79974613	40	106151	5	3	BovineHD1500023290	BovineHD1500023335
1417	15	79877015	79893803	12	16789	5	3	BovineHD1500023291	BovineHD1500023305
1418	15	79877015	79925053	17	48039	5	3	BovineHD1500023291	BovineHD1500023311
1419	15	79883423	79925053	14	41631	5	3	BovineHD1500023296	BovineHD1500023311
1420	15	79888253	79925053	10	36801	5	3	BovineHD1500023300	BovineHD1500023311
1421	15	79948471	79974613	10	26143	5	3	BovineHD1500023325	BovineHD1500023335
1422	15	80254337	81043410	82	789074	5	3	BovineHD1500023386	BovineHD1500023585
1423	15	80266292	80296244	10	29953	5	3	BovineHD1500023392	BovineHD1500023402
1424	15	80266292	80299924	12	33633	5	3	BovineHD1500023392	BovineHD1500023404
1425	15	80266292	80329011	16	62720	5	3	BovineHD1500023392	BovineHD1500023413
1426	15	80275724	80329011	13	53288	5	3	BovineHD1500023396	BovineHD1500023413
1427	15	80280182	80329011	12	48830	5	3	BovineHD1500023397	BovineHD1500023413
1428	15	80573351	81043410	54	470060	5	3	BovineHD1500023455	BovineHD1500023585
1429	15	80597666	80743769	12	146104	5	3	BovineHD1500026027	BovineHD1500023491
1430	15	80614861	80743769	10	128909	5	3	BovineHD1500026029	BovineHD1500023491
1431	15	80638664	80939701	25	301038	5	3	BovineHD1500023467	BovineHD1500023541

1432	15	80717128	80939701	21	222574	5	3	BTB-00619057	BovineHD1500023541
1433	15	80717128	81043410	45	326283	5	3	BTB-00619057	BovineHD1500023585
1434	15	80717128	81117711	71	400584	5	3	BTB-00619057	BovineHD1500023619
1435	15	80873701	81043410	33	169710	5	3	BovineHD1500023519	BovineHD1500023585
1436	15	80892780	81042709	30	149930	5	3	BovineHD1500023526	BovineHD1500023584
1437	15	80900882	81043410	29	142529	5	3	BovineHD1500023528	BovineHD1500023585
1438	15	80921274	81042709	27	121436	5	3	BovineHD1500023533	BovineHD1500023584
1439	15	80921274	81121829	57	200556	5	3	BovineHD1500023533	BovineHD1500023623
1440	15	80963521	81042709	20	79189	5	3	BovineHD1500023552	BovineHD1500023584
1441	15	80994261	81042709	10	48449	5	3	BovineHD1500023566	BovineHD1500023584
1442	15	80994261	81043410	11	49150	5	3	BovineHD1500023566	BovineHD1500023585
1443	15	81090121	81117711	10	27591	5	3	BovineHD1500023605	BovineHD1500023619
1444	15	81090121	81121829	13	31709	5	3	BovineHD1500023605	BovineHD1500023623
1445	15	81090121	81131105	15	40985	5	3	BovineHD1500023605	BovineHD1500023625
1446	15	81288563	81437542	31	148980	5	3	BovineHD1500023664	BovineHD1500023702
1447	15	83415031	83527066	12	112036	5	3	BovineHD1500024474	BovineHD1500024495
1448	15	83417751	83527066	11	109316	5	3	BovineHD1500024475	BovineHD1500024495
1449	15	83417751	83534599	13	116849	5	3	BovineHD1500024475	BovineHD4100012253
1450	16	24074	152185	21	128112	5	3	BovineHD1600000001	BovineHD1600000019
1451	16	24074	188138	29	164065	5	3	BovineHD1600000001	ARS-BFGL-NGS-41332
1452	16	24074	498301	65	474228	5	3	BovineHD1600000001	BovineHD1600000076
1453	16	99900	188138	18	88239	5	3	BovineHD1600000011	ARS-BFGL-NGS-41332
1454	16	132486	188138	13	55653	5	3	BovineHD1600000015	ARS-BFGL-NGS-41332
1455	16	364952	459197	11	94246	5	3	BovineHD1600000045	BovineHD1600000058
1456	16	364952	469723	12	104772	5	3	BovineHD1600000045	BovineHD1600000060
1457	16	364952	485203	15	120252	5	3	BovineHD1600000045	BovineHD1600000064
1458	16	364952	490887	17	125936	5	3	BovineHD1600000045	BovineHD1600000067
1459	16	364952	493245	19	128294	5	3	BovineHD1600000045	BovineHD1600000070
1460	16	387363	485203	13	97841	5	3	BovineHD1600000049	BovineHD1600000064

1461	16	387363	490887	15	103525	5	3	BovineHD1600000049	BovineHD1600000067
1462	16	423184	490887	11	67704	5	3	BovineHD1600023895	BovineHD1600000067
1463	16	5439901	5523107	11	83207	5	3	BovineHD1600001532	BovineHD1600024264
1464	16	5447029	5523107	10	76079	5	3	BTB-01927506	BovineHD1600024264
1465	16	5447029	5554428	12	107400	5	3	BTB-01927506	BovineHD1600001553
1466	16	5447029	5574114	13	127086	5	3	BTB-01927506	BovineHD1600001559
1467	16	5447029	5581530	14	134502	5	3	BTB-01927506	BovineHD1600001562
1468	16	5453891	5574114	12	120224	5	3	BovineHD1600001533	BovineHD1600001559
1469	16	5453891	5581530	13	127640	5	3	BovineHD1600001533	BovineHD1600001562
1470	16	5479265	5581530	10	102266	5	3	BovineHD1600001538	BovineHD1600001562
1471	16	5489090	5768249	52	279160	5	3	BovineHD1600001541	BovineHD1600001641
1472	16	5709256	5752883	11	43628	5	3	BovineHD1600001617	BovineHD1600001635
1473	16	5709256	5764281	13	55026	5	3	BovineHD1600001617	BovineHD1600001638
1474	16	5709256	5768249	15	58994	5	3	BovineHD1600001617	BovineHD1600001641
1475	16	5709256	6027593	48	318338	5	3	BovineHD1600001617	BovineHD1600001740
1476	16	5713711	5768249	14	54539	5	3	BovineHD1600001618	BovineHD1600001641
1477	16	5715970	5812501	25	96532	5	3	BovineHD1600001619	BovineHD1600023912
1478	16	5720213	5768249	12	48037	5	3	BovineHD1600001621	BovineHD1600001641
1479	16	5720213	6027593	45	307381	5	3	BovineHD1600001621	BovineHD1600001740
1480	16	5720213	6125517	48	405305	5	3	BovineHD1600001621	BovineHD1600001778
1481	16	5732398	5768249	10	35852	5	3	BovineHD1600001626	BovineHD1600001641
1482	16	5799919	5916075	14	116157	5	3	BovineHD1600001651	BovineHD1600001703
1483	16	5799919	6027593	26	227675	5	3	BovineHD1600001651	BovineHD1600001740
1484	16	5799919	6125517	29	325599	5	3	BovineHD1600001651	BovineHD1600001778
1485	16	5808617	5916075	11	107459	5	3	BovineHD1600001655	BovineHD1600001703
1486	16	5808617	6027593	23	218977	5	3	BovineHD1600001655	BovineHD1600001740
1487	16	5808617	6125517	26	316901	5	3	BovineHD1600001655	BovineHD1600001778
1488	16	5846840	6135133	25	288294	5	3	BovineHD1600001667	BovineHD1600001782
1489	16	5865918	6027593	17	161676	5	3	BovineHD1600001674	BovineHD1600001740

1490	16	5868810	6027593	16	158784	5	3	BovineHD1600001676	BovineHD1600001740
1491	16	5908813	6027593	14	118781	5	3	BovineHD1600001698	BovineHD1600001740
1492	16	5916075	6027593	13	111519	5	3	BovineHD1600001703	BovineHD1600001740
1493	16	5931793	6027593	12	95801	5	3	BovineHD1600024274	BovineHD1600001740
1494	16	5953988	6027593	10	73606	5	3	BovineHD1600001714	BovineHD1600001740
1495	16	5953988	6125517	13	171530	5	3	BovineHD1600001714	BovineHD1600001778
1496	16	7901886	7948314	10	46429	5	3	BovineHD1600002261	BovineHD1600002277
1497	16	7901886	7963357	14	61472	5	3	BovineHD1600002261	BovineHD1600002281
1498	16	7918041	7963357	10	45317	5	3	BovineHD1600002266	BovineHD1600002281
1499	16	8741216	8836744	20	95529	2	1	BovineHD1600002423	BovineHD1600002438
1500	16	11758931	11792218	16	33288	2	1	BovineHD1600003138	BovineHD1600003149
1501	16	11767503	11792218	14	24716	2	1	BovineHD1600003139	BovineHD1600003149
1502	16	15070508	15118639	19	48132	2	1	BovineHD1600004085	BovineHD1600004105
1503	16	15178806	15243100	15	64295	2	1	BovineHD1600004128	BovineHD1600004140
1504	16	17412930	17447956	10	35027	5	3	BovineHD1600004729	BovineHD1600004739
1505	16	37013472	37054825	11	41354	2	1	BovineHD1600010601	BovineHD1600010610
1506	16	39050441	39089869	14	39429	2	1	BovineHD1600011199	BovineHD1600011211
1507	16	51728922	51843116	27	114195	2	1	BovineHD1600014387	BovineHD1600014409
1508	16	52068803	52115458	11	46656	2	1	BovineHD1600014460	BovineHD1600014468
1509	16	52075019	52115458	10	40440	2	1	ARS-BFGL-NGS-12838	BovineHD1600014468
1510	16	52946703	53004392	14	57690	2	1	BovineHD1600024571	BovineHD1600014638
1511	16	60462670	60498766	23	36097	5	3	BovineHD1600016942	BovineHD1600016962
1512	16	60462670	60502932	24	40263	5	3	BovineHD1600016942	BovineHD1600016963
1513	16	60470098	60498766	20	28669	5	3	BovineHD1600016945	BovineHD1600016962
1514	16	60470098	60502932	21	32835	5	3	BovineHD1600016945	BovineHD1600016963
1515	16	60474542	60498766	17	24225	5	3	BovineHD1600016948	BovineHD1600016962
1516	16	60474542	60502932	18	28391	5	3	BovineHD1600016948	BovineHD1600016963
1517	16	66849373	66876462	11	27090	2	1	BovineHD1600018968	BovineHD1600018976
1518	16	66855994	66876462	10	20469	2	1	BovineHD1600018969	BovineHD1600018976

1519	16	72983578	73009611	10	26034	2	1	ARS-BFGL-NGS-3559	BovineHD1600020750
1520	16	72985334	73016945	11	31612	2	1	BovineHD1600020744	BovineHD1600020752
1521	16	77217657	77246724	11	29068	2	1	BovineHD1600022343	BovineHD1600022352
1522	16	80959245	80974876	12	15632	5	3	BovineHD1600023655	BovineHD1600023666
1523	17	18631496	18692126	12	60631	2	1	BovineHD1700005409	BovineHD1700005420
1524	17	18631496	18699101	13	67606	2	1	BovineHD1700005409	BovineHD1700005421
1525	17	18781200	18901031	26	119832	2	1	BovineHD1700005438	BovineHD1700005458
1526	17	21819921	21839985	15	20065	2	1	BovineHD1700006284	BovineHD1700006299
1527	17	27315502	27345431	10	29930	2	1	BovineHD1700007726	BovineHD1700007734
1528	17	27322771	27349210	11	26440	2	1	BovineHD1700007727	BovineHD1700007736
1529	17	27322771	27351471	12	28701	2	1	BovineHD1700007727	BovineHD1700007737
1530	17	40307312	40332091	12	24780	5	3	BovineHD1700011044	BTA-40892-no-rs
1531	17	40584371	40621694	11	37324	2	1	BovineHD1700011147	BovineHD1700011158
1532	17	53122583	53139710	10	17128	2	1	BovineHD1700014991	BovineHD1700015000
1533	17	55244711	55271553	10	26843	2	1	BovineHD1700015662	BovineHD1700015670
1534	17	55247896	55290523	24	42628	2	1	BovineHD1700015663	BovineHD1700015686
1535	17	58410638	58438656	11	28019	2	1	BovineHD1700016558	BTA-25627-no-rs
1536	17	63154532	63192909	21	38378	5	3	BovineHD1700018085	BovineHD1700018105
1537	17	64813262	64858435	11	45174	2	1	BovineHD1700018667	BovineHD1700018676
1538	17	71089525	71240044	49	150520	2	1	BovineHD1700020678	BovineHD1700020721
1539	17	72870233	73093737	41	223505	5	3	BovineHD1700022390	BovineHD1700021374
1540	17	72929942	73023888	20	93947	5	3	BovineHD1700021314	BovineHD1700021348
1541	17	73004371	73093737	26	89367	5	3	BovineHD1700021338	BovineHD1700021374
1542	17	73878627	73892454	14	13828	5	3	BovineHD1700021593	BovineHD1700021607
1543	17	74878327	74915529	12	37203	2	1	BovineHD1700021858	BovineHD1700021865
1544	17	74878327	74929102	14	50776	2	1	BovineHD1700021858	BovineHD1700021867
1545	17	74878327	74944074	17	65748	2	1	BovineHD1700021858	BovineHD1700021870
1546	18	1468948	1528564	14	59617	2	1	BovineHD1800000310	BovineHD1800000324
1547	18	1480653	1528564	11	47912	2	1	BovineHD1800000313	BovineHD1800000324

1548	18	10544352	10573635	11	29284	2	1	BovineHD1800003763	BovineHD1800003770
1549	18	13365474	13445868	32	80395	5	3	BovineHD1800004416	BovineHD1800019251
1550	18	13370006	13442089	30	72084	5	3	BovineHD1800004417	BovineHD1800004444
1551	18	13372279	13417056	21	44778	5	3	BovineHD1800004418	BovineHD1800004437
1552	18	13372279	13419491	22	47213	5	3	BovineHD1800004418	BovineHD1800004438
1553	18	13372279	13442089	29	69811	5	3	BovineHD1800004418	BovineHD1800004444
1554	18	13372279	13445868	30	73590	5	3	BovineHD1800004418	BovineHD1800019251
1555	18	13372279	13455012	33	82734	5	3	BovineHD1800004418	ARS-BFGL-NGS-114438
1556	18	13374264	13442089	28	67826	5	3	BovineHD1800004419	BovineHD1800004444
1557	18	13388207	13417056	15	28850	5	3	BovineHD1800004422	BovineHD1800004437
1558	18	13388207	13419491	16	31285	5	3	BovineHD1800004422	BovineHD1800004438
1559	18	13388207	13439223	22	51017	5	3	BovineHD1800004422	BovineHD1800019517
1560	18	13388207	13442089	23	53883	5	3	BovineHD1800004422	BovineHD1800004444
1561	18	13388207	13445868	24	57662	5	3	BovineHD1800004422	BovineHD1800019251
1562	18	13388207	13455012	27	66806	5	3	BovineHD1800004422	ARS-BFGL-NGS-114438
1563	18	13394151	13417056	12	22906	5	3	BovineHD1800004425	BovineHD1800004437
1564	18	13396915	13439223	18	42309	5	3	ARS-BFGL-NGS-36246	BovineHD1800019517
1565	18	13396915	13445868	20	48954	5	3	ARS-BFGL-NGS-36246	BovineHD1800019251
1566	18	25135026	25281274	47	146249	5	3	BovineHD1800007744	BovineHD1800007789
1567	18	48664714	48717504	25	52791	2	1	BovineHD1800019736	BovineHD1800014378
1568	18	48673836	48717504	23	43669	2	1	BovineHD1800014359	BovineHD1800014378
1569	18	49074618	49109287	18	34670	1	0	BovineHD1800014465	BovineHD1800014482
1570	18	49078895	49105418	12	26524	2	1	BovineHD1800014467	BovineHD1800014478
1571	18	49078895	49106712	14	27818	2	1	BovineHD1800014467	BovineHD1800014480
1572	18	49090018	49105418	11	15401	2	1	Hapmap39652-BTA-43608	BovineHD1800014478
1573	18	49090018	49106712	13	16695	2	1	Hapmap39652-BTA-43608	BovineHD1800014480

1574	18	49090018	49109287	15	19270	2	1	Hapmap39652-BTA-43608	BovineHD1800014482
1575	18	49091643	49105418	10	13776	2	1	BovineHD1800014468	BovineHD1800014478
1576	18	49091643	49106712	12	15070	2	1	BovineHD1800014468	BovineHD1800014480
1577	18	49091643	49109287	14	17645	2	1	BovineHD1800014468	BovineHD1800014482
1578	18	49352081	49396303	12	44223	2	1	ARS-BFGL-NGS-88249	ARS-BFGL-NGS-113564
1579	18	50025733	50053279	10	27547	2	1	ARS-BFGL-NGS-87001	BovineHD1800014728
1580	18	57101952	57194210	34	92259	5	3	BovineHD1800016645	BovineHD1800016673
1581	18	57148095	57194210	20	46116	5	3	BovineHD1800016656	BovineHD1800016673
1582	18	57159020	57194210	14	35191	5	3	BovineHD1800016661	BovineHD1800016673
1583	18	57165530	57194210	11	28681	5	3	BovineHD1800016664	BovineHD1800016673
1584	18	58452729	58509437	10	56709	5	3	BovineHD1800017025	BovineHD1800017035
1585	18	58478126	58559347	11	81222	5	3	Hapmap23557-BTA-132578	BovineHD1800017040
1586	18	58478126	58625879	21	147754	5	3	Hapmap23557-BTA-132578	BovineHD1800017052
1587	18	58751697	58811905	10	60209	5	3	BovineHD1800017120	BovineHD1800017139
1588	18	59154291	59327463	21	173173	5	3	BovineHD1800017191	BovineHD1800017233
1589	18	59154291	59459056	32	304766	5	3	BovineHD1800017191	BovineHD1800017269
1590	18	59154291	59890631	72	736341	5	3	BovineHD1800017191	BovineHD1800017340
1591	18	59182962	59327463	18	144502	5	3	BovineHD1800017205	BovineHD1800017233
1592	18	59182962	59444647	26	261686	5	3	BovineHD1800017205	BovineHD1800017261
1593	18	59182962	59459056	29	276095	5	3	BovineHD1800017205	BovineHD1800017269
1594	18	59182962	59682560	58	499599	5	3	BovineHD1800017205	BovineHD1800017314
1595	18	59182962	59890631	69	707670	5	3	BovineHD1800017205	BovineHD1800017340
1596	18	59229142	59327463	14	98322	5	3	BovineHD1800017214	BovineHD1800017233
1597	18	59284273	59441716	13	157444	5	3	BovineHD1800017224	BovineHD1800017259
1598	18	59284273	59444647	14	160375	5	3	BovineHD1800017224	BovineHD1800017261
1599	18	59284273	59459056	17	174784	5	3	BovineHD1800017224	BovineHD1800017269

1600	18	59302760	59599864	32	297105	5	3	BovineHD1800017227	BovineHD1800017297
1601	18	59302760	59890631	55	587872	5	3	BovineHD1800017227	BovineHD1800017340
1602	18	59457523	59545076	11	87554	5	3	BovineHD1800017268	BovineHD1800017285
1603	18	59674352	59890631	14	216280	5	3	BovineHD1800017310	BovineHD1800017340
1604	18	60430622	60683611	24	252990	5	3	BovineHD1800017464	BovineHD1800017506
1605	18	60463129	60683611	20	220483	5	3	BovineHD1800017472	BovineHD1800017506
1606	18	60466654	60632563	16	165910	5	3	BovineHD1800017475	BovineHD1800017500
1607	18	60466654	60683611	18	216958	5	3	BovineHD1800017475	BovineHD1800017506
1608	18	60478436	60632563	14	154128	5	3	BovineHD1800017477	BovineHD1800017500
1609	18	60506726	60683611	12	176886	5	3	BovineHD1800017481	BovineHD1800017506
1610	18	60506726	60718816	14	212091	5	3	BovineHD1800017481	BovineHD1800017513
1611	18	60524323	60756196	16	231874	5	3	BovineHD1800017484	BovineHD1800017518
1612	18	60539885	60726352	10	186468	5	3	BovineHD1800019857	BovineHD1800017514
1613	18	60569760	60824427	16	254668	5	3	BovineHD1800017491	BovineHD1800017523
1614	18	60859779	60939823	11	80045	5	3	BovineHD1800017531	BovineHD1800017543
1615	18	60859779	60993719	21	133941	5	3	BovineHD1800017531	BovineHD1800017554
1616	18	60928049	60993719	13	65671	5	3	BovineHD1800017540	BovineHD1800017554
1617	18	60939823	60993719	11	53897	5	3	BovineHD1800017543	BovineHD1800017554
1618	18	61638038	61835029	19	196992	5	3	BovineHD1800017779	BovineHD1800017816
1619	18	61674257	61835029	17	160773	5	3	BovineHD1800017792	BovineHD1800017816
1620	18	61674257	61929947	36	255691	5	3	BovineHD1800017792	BovineHD1800017841
1621	18	61699066	61857145	23	158080	5	3	BovineHD4100013803	BovineHD1800017826
1622	18	61704935	61835029	13	130095	5	3	BovineHD1800017797	BovineHD1800017816
1623	18	61714389	61835029	12	120641	5	3	BovineHD1800017798	BovineHD1800017816
1624	18	61825210	61857145	11	31936	5	3	BovineHD1800017812	BovineHD1800017826
1625	18	61894649	61929947	11	35299	5	3	BovineHD1800019875	BovineHD1800017841
1626	18	62813257	62886264	39	73008	5	3	BovineHD1800018139	BovineHD1800018177
1627	18	64545513	64577452	11	31940	5	3	BovineHD1800018709	BovineHD1800018720
1628	18	64546948	64577452	10	30505	5	3	BovineHD1800018710	BovineHD1800018720

1629	18	64728690	64760454	14	31765	5	3	BovineHD1800018785	BovineHD1800018800
1630	19	1591038	1638822	10	47785	2	1	BovineHD1900000335	BovineHD1900000346
1631	19	1591038	1640135	11	49098	2	1	BovineHD1900000335	BovineHD1900000347
1632	19	1591038	1643585	14	52548	2	1	BovineHD1900000335	BovineHD1900000350
1633	19	1591038	1651670	17	60633	2	1	BovineHD1900000335	BovineHD1900000353
1634	19	1591038	1672139	18	81102	2	1	BovineHD1900000335	BovineHD1900000354
1635	19	1591038	1679507	19	88470	2	1	BovineHD1900000335	BovineHD1900000355
1636	19	1591038	1683625	22	92588	2	1	BovineHD1900000335	BovineHD1900000358
1637	19	1598059	1643585	13	45527	2	1	BovineHD1900000336	BovineHD1900000350
1638	19	2270929	2344351	12	73423	1	0	Hapmap27040-BTA-25119	BovineHD1900000524
1639	19	6239670	6324535	12	84866	2	1	BovineHD1900001593	BovineHD1900001624
1640	19	10531387	10633597	33	102211	2	1	BovineHD1900002865	BovineHD1900002893
1641	19	18792038	18827910	16	35873	2	1	BovineHD1900005366	BovineHD1900005381
1642	19	18796647	18827910	15	31264	2	1	BovineHD1900005367	BovineHD1900005381
1643	19	18805798	18827910	11	22113	2	1	BovineHD1900005371	BovineHD1900005381
1644	19	18806955	18839754	11	32800	2	1	BovineHD1900005372	BovineHD1900005382
1645	19	19566531	19589821	10	23291	2	1	Hapmap24813-BTA-132803	BovineHD1900005560
1646	19	19566531	19599812	14	33282	2	1	Hapmap24813-BTA-132803	BovineHD1900005564
1647	19	21384990	21464417	27	79428	2	1	BovineHD1900006134	BovineHD1900006160
1648	19	21396331	21459264	17	62934	2	1	BovineHD1900006140	BovineHD1900006158
1649	19	21396331	21470659	22	74329	2	1	BovineHD1900006140	BovineHD1900006162
1650	19	21396331	21569741	35	173411	2	1	BovineHD1900006140	UA-IFASA-7043
1651	19	21425816	21542475	25	116660	2	1	BovineHD1900006150	BovineHD1900006175
1652	19	21432466	21470659	13	38194	2	1	BovineHD1900006151	BovineHD1900006162
1653	19	21432466	21569741	26	137276	2	1	BovineHD1900006151	UA-IFASA-7043
1654	19	21450550	21542475	19	91926	2	1	BovineHD1900006157	BovineHD1900006175

1655	19	23288170	23306455	11	18286	2	1	BovineHD1900006687	BovineHD1900006697
1656	19	24548362	24582735	10	34374	5	3	BovineHD1900007129	BovineHD1900007141
1657	19	24560909	24590915	11	30007	5	3	BovineHD1900007133	BovineHD1900007146
1658	19	39238521	39260247	15	21727	2	1	BovineHD1900011294	BovineHD1900011306
1659	19	41200141	41241029	10	40889	2	1	BovineHD1900011728	BovineHD1900011736
1660	19	41204591	41245524	10	40934	2	1	ARS-BFGL-NGS-12214	ARS-BFGL-NGS-111180
1661	19	45431747	45504567	18	72821	2	1	BovineHD1900012759	BovineHD1900012774
1662	19	48801884	48856177	24	54294	2	1	ARS-BFGL-NGS-115719	BovineHD1900013592
1663	19	50863908	51035766	11	171859	5	3	BovineHD1900014204	BovineHD1900014256
1664	19	51166632	51222728	17	56097	2	1	BovineHD1900014310	BovineHD1900014325
1665	19	51172157	51225658	16	53502	2	1	BovineHD1900014313	BovineHD1900014326
1666	19	51934105	52025851	22	91747	2	1	ARS-BFGL-NGS-29662	BovineHD1900014546
1667	19	51939268	51976234	10	36967	2	1	BovineHD1900014523	BovineHD1900014534
1668	19	51939268	51980475	11	41208	2	1	BovineHD1900014523	BovineHD1900014535
1669	19	52179673	52236397	24	56725	2	1	BovineHD1900014588	BovineHD1900014609
1670	19	52185877	52234974	20	49098	2	1	BovineHD1900014591	ARS-BFGL-NGS-77313
1671	19	52188749	52234974	19	46226	2	1	BovineHD1900014592	ARS-BFGL-NGS-77313
1672	19	52188749	52236397	20	47649	2	1	BovineHD1900014592	BovineHD1900014609
1673	19	52215894	52236397	10	20504	2	1	BovineHD1900014601	BovineHD1900014609
1674	19	54189867	54239006	16	49140	2	1	BovineHD1900015172	Hapmap54297-rs29013561
1675	19	54193942	54239006	13	45065	2	1	BovineHD1900015175	Hapmap54297-rs29013561
1676	19	54201520	54239006	12	37487	2	1	BovineHD1900015176	Hapmap54297-rs29013561
1677	19	55102419	55123565	10	21147	5	3	BovineHD1900015498	BovineHD1900015512
1678	19	55176470	55233519	18	57050	2	1	BovineHD1900015530	BovineHD1900015545
1679	20	5496038	5566639	18	70602	2	1	BovineHD2000001712	BovineHD2000001728
1680	20	11361136	11391220	14	30085	2	1	BovineHD2000003655	BovineHD2000003668

1681	20	12473693	12548876	39	75184	2	1	BovineHD2000003989	BovineHD2000004024
1682	20	15492357	15564781	26	72425	5	3	BovineHD2000004676	BovineHD2000004701
1683	20	39593945	39691234	46	97290	2	1	BovineHD2000011287	ARS-BFGL-NGS-14869
1684	20	45918839	45967820	15	48982	2	1	BovineHD4100014735	BovineHD2000013010
1685	20	45918839	45969221	16	50383	2	1	BovineHD4100014735	BovineHD2000013011
1686	20	45918839	45977245	18	58407	2	1	BovineHD4100014735	BovineHD2000013013
1687	20	45918839	45985255	20	66417	2	1	BovineHD4100014735	BovineHD2000013016
1688	20	45920843	45979994	18	59152	2	1	BovineHD2000012996	BovineHD2000013015
1689	20	45927253	45969221	14	41969	2	1	BovineHD2000012999	BovineHD2000013011
1690	20	60447656	60496754	14	49099	5	3	BTB-01341053	BovineHD2000016979
1691	20	62782658	62823045	25	40388	2	1	BovineHD2000017778	BovineHD2000017802
1692	20	62802141	62823045	15	20905	2	1	BovineHD2000017789	BovineHD2000017802
1693	21	975606	1101370	15	125765	5	3	BovineHD2100000113	BovineHD2100000130
1694	21	975606	1150360	22	174755	5	3	BovineHD2100000113	BovineHD2100000137
1695	21	975606	1739689	56	764084	5	3	BovineHD2100000113	BovineHD2100000211
1696	21	975606	1977535	70	1001930	5	3	BovineHD2100000113	BovineHD2100000250
1697	21	975606	2085345	73	1109740	5	3	BovineHD2100000113	BovineHD2100000258
1698	21	1300053	1739689	27	439637	5	3	BovineHD2100000155	BovineHD2100000211
1699	21	1339388	1739689	24	400302	5	3	BovineHD2100000160	BovineHD2100000211
1700	21	1382868	1662836	19	279969	5	3	BovineHD2100000166	BovineHD2100000203
1701	21	1382868	1739689	23	356822	5	3	BovineHD2100000166	BovineHD2100000211
1702	21	1382868	2085345	40	702478	5	3	BovineHD2100000166	BovineHD2100000258
1703	21	1526125	1739689	11	213565	5	3	BovineHD2100000188	BovineHD2100000211
1704	21	1526125	1900577	22	374453	5	3	BovineHD2100000188	BovineHD2100000240
1705	21	1526125	1977535	25	451411	5	3	BovineHD2100000188	BovineHD2100000250
1706	21	1658789	1869181	16	210393	5	3	BTA-121305-no-rs	BovineHD2100000236
1707	21	7330545	7400647	23	70103	2	1	BovineHD2100001590	Hapmap38507-BTA-52931
1708	21	7754357	7791640	13	37284	2	1	BovineHD2100001670	BovineHD2100001680

1709	21	14474236	14605574	28	131339	2	1	BovineHD2100020944	ARS-BFGL-NGS-86644
1710	21	14492680	14574887	18	82208	2	1	BovineHD2100003820	BovineHD2100003836
1711	21	15345488	15357042	13	11555	2	1	ARS-BFGL-NGS-10830	BovineHD2100004130
1712	21	20062038	20129619	10	67582	1	0	BovineHD2100005798	BovineHD2100005821
1713	21	20062038	20143245	12	81208	1	0	BovineHD2100005798	BovineHD2100005829
1714	21	20062038	20157713	13	95676	1	0	BovineHD2100005798	BovineHD2100005834
1715	21	20079777	20143245	10	63469	1	0	BovineHD2100005806	BovineHD2100005829
1716	21	20079777	20157713	11	77937	1	0	BovineHD2100005806	BovineHD2100005834
1717	21	20097872	20157713	10	59842	5	3	BovineHD2100005812	BovineHD2100005834
1718	21	20097872	20164126	11	66255	5	3	BovineHD2100005812	BovineHD2100005836
1719	21	20097872	20190573	14	92702	5	3	BovineHD2100005812	BovineHD2100005843
1720	21	20099739	20190573	13	90835	5	3	BovineHD2100005813	BovineHD2100005843
1721	21	20104871	20178454	10	73584	5	3	BovineHD2100005815	BovineHD2100005837
1722	21	20196212	20231373	30	35162	5	3	BovineHD2100005846	BovineHD2100005876
1723	21	26504335	26534891	10	30557	5	3	BovineHD2100007640	BovineHD2100007647
1724	21	28159596	28253296	37	93701	2	1	BovineHD2100008156	BovineHD2100008192
1725	21	28178720	28214825	17	36106	2	1	BovineHD2100008167	BovineHD2100008182
1726	21	28178720	28220611	18	41892	2	1	BovineHD2100008167	BovineHD2100008183
1727	21	28180402	28200514	10	20113	2	1	BovineHD2100008168	BovineHD2100008176
1728	21	28180402	28207976	14	27575	2	1	BovineHD2100008168	BovineHD2100008180
1729	21	28180402	28214825	16	34424	2	1	BovineHD2100008168	BovineHD2100008182
1730	21	28180402	28220611	17	40210	2	1	BovineHD2100008168	BovineHD2100008183
1731	21	35328865	35454532	73	125668	5	3	BovineHD2100010187	BovineHD2100010265
1732	21	35328865	35458695	74	129831	5	3	BovineHD2100010187	BovineHD2100010266
1733	21	35331062	35454532	71	123471	5	3	BovineHD2100010189	BovineHD2100010265
1734	21	35331062	35463366	73	132305	5	3	BovineHD2100010189	BovineHD2100010267
1735	21	35337957	35454532	65	116576	5	3	BovineHD2100010196	BovineHD2100010265
1736	21	35340185	35454532	64	114348	5	3	BovineHD2100010198	BovineHD2100010265
1737	21	35365423	35400366	15	34944	5	3	BovineHD2100010208	BovineHD2100010223

1738	21	35424722	35454532	25	29811	5	3	BovineHD2100010241	BovineHD2100010265
1739	21	35425763	35454532	24	28770	5	3	BovineHD2100010242	BovineHD2100010265
1740	21	37915701	38289858	100	374158	5	3	BovineHD2100011034	BovineHD2100011128
1741	21	39036938	39153858	25	116921	5	3	Hapmap50996-BTA-52226	BovineHD2100011305
1742	21	46007188	46069814	15	62627	2	1	BovineHD2100013232	BovineHD2100013244
1743	21	46018333	46069814	13	51482	2	1	ARS-BFGL-NGS-107391	BovineHD2100013244
1744	21	56706639	56774987	20	68349	2	1	BovineHD2100016344	BovineHD2100016361
1745	21	60514625	60594860	15	80236	5	3	BovineHD2100017578	BovineHD2100021400
1746	21	61050744	61088436	19	37693	5	3	BovineHD4100015308	BovineHD2100017703
1747	21	66713232	66761317	19	48086	2	1	BovineHD2100019584	BovineHD2100019602
1748	21	70803573	70847840	12	44268	2	1	BovineHD4100015391	BovineHD2100020738
1749	21	70803573	70850353	13	46781	2	1	BovineHD4100015391	BovineHD2100021446
1750	21	70806337	70850353	12	44017	2	1	BovineHD2100020731	BovineHD2100021446
1751	21	70810033	70847840	10	37808	2	1	BovineHD2100020732	BovineHD2100020738
1752	21	70810033	70850353	11	40321	2	1	BovineHD2100020732	BovineHD2100021446
1753	21	70810033	70891033	21	81001	2	1	BovineHD2100020732	BovineHD2100021447
1754	22	5475849	5536270	17	60422	5	3	BovineHD2200001576	BovineHD2200001598
1755	22	5475849	5548263	20	72415	5	3	BovineHD2200001576	BovineHD2200001600
1756	22	5482578	5536270	16	53693	5	3	BovineHD2200001577	BovineHD2200001598
1757	22	5482578	5548263	19	65686	5	3	BovineHD2200001577	BovineHD2200001600
1758	22	15056590	15105709	18	49120	2	1	BovineHD2200004406	BovineHD2200004423
1759	22	15056590	15114988	23	58399	2	1	BovineHD2200004406	ARS-BFGL-NGS-73816
1760	22	15074325	15096616	10	22292	2	1	BovineHD2200004409	BovineHD2200004419
1761	22	15074325	15105709	14	31385	2	1	BovineHD2200004409	BovineHD2200004423
1762	22	15074325	15114988	19	40664	2	1	BovineHD2200004409	ARS-BFGL-NGS-73816
1763	22	17992618	18018757	11	26140	2	1	BovineHD2200005182	BovineHD2200005189
1764	22	17995303	18018757	10	23455	2	1	BovineHD2200005183	BovineHD2200005189
1765	22	21708597	21740799	19	32203	2	1	BovineHD2200006280	BovineHD2200006299

1766	22	35059005	35163091	42	104087	2	1	BovineHD2200010004	BovineHD2200010045
1767	22	50594496	50652412	12	57917	2	1	BovineHD2200014437	Hapmap60583-rs29027190
1768	22	50600741	50652412	11	51672	2	1	BovineHD2200014439	Hapmap60583-rs29027190
1769	22	51216484	51283351	22	66868	2	1	BovineHD2200014625	ARS-BFGL-NGS-28042
1770	22	51240717	51283351	15	42635	2	1	BovineHD2200014631	ARS-BFGL-NGS-28042
1771	22	52305473	52372850	10	67378	2	1	BovineHD2200018114	BovineHD2200014872
1772	22	52305473	52383330	12	77858	2	1	BovineHD2200018114	BovineHD2200014874
1773	22	56757151	56772708	10	15558	2	1	BovineHD2200016300	BovineHD2200016308
1774	22	59345821	59370397	10	24577	2	1	BovineHD2200017242	BovineHD2200017250
1775	22	60420003	60466907	24	46905	2	1	BovineHD2200017577	BovineHD2200017598
1776	23	10121	608174	87	598054	5	3	BovineHD2300000001	BovineHD2300015445
1777	23	10121	821833	127	811713	5	3	BovineHD2300000001	BovineHD2300000121
1778	23	34690	820560	123	785871	5	3	BovineHD2300015440	BovineHD2300000120
1779	23	169267	471774	40	302508	5	3	BovineHD2300000028	BovineHD2300000062
1780	23	214278	471774	36	257497	5	3	BovineHD2300000032	BovineHD2300000062
1781	23	3275618	3316943	11	41326	2	1	BovineHD2300000669	BovineHD2300000679
1782	23	3275618	3328639	14	53022	2	1	BovineHD2300000669	BovineHD2300000681
1783	23	3283391	3379170	27	95780	2	1	BovineHD2300015467	BovineHD2300000695
1784	23	3364476	3419701	26	55226	2	1	BovineHD2300000688	BovineHD2300000710
1785	23	7798522	7816490	11	17969	2	1	BovineHD2300001970	BovineHD2300001978
1786	23	7798522	7823509	13	24988	2	1	BovineHD2300001970	BovineHD2300001980
1787	23	19239332	19280958	22	41627	2	1	BovineHD2300004882	BovineHD2300004902
1788	23	25335659	25417035	10	81377	5	3	BovineHD2300007040	BovineHD2300007057
1789	23	25353488	25442124	15	88637	2	1	BovineHD2300007051	BovineHD2300007067
1790	23	25417035	25440853	11	23819	2	1	BovineHD2300007057	BovineHD2300007066
1791	23	25417035	25442124	12	25090	1	0	BovineHD2300007057	BovineHD2300007067
1792	23	25425442	25440853	10	15412	2	1	BovineHD2300007058	BovineHD2300007066

1793	23	25425442	25442124	11	16683	2	1	BovineHD2300007058	BovineHD2300007067
1794	23	26905056	26926532	11	21477	5	3	BovineHD2300007301	BovineHD2300007316
1795	23	26907964	26929522	13	21559	5	3	BovineHD2300007303	BovineHD2300007319
1796	23	28431174	28494393	13	63220	2	1	BovineHD2300007996	BovineHD2300015634
1797	23	28435313	28487275	10	51963	2	1	BovineHD2300007999	BovineHD2300008020
1798	23	28439058	28494393	10	55336	2	1	BovineHD2300008001	BovineHD2300015634
1799	23	28980942	29041704	11	60763	5	3	BovineHD2300008232	BovineHD2300008250
1800	23	29010903	29099453	11	88551	5	3	BovineHD2300008244	BovineHD2300008264
1801	23	29010903	29113538	12	102636	5	3	BovineHD2300008244	BovineHD2300008267
1802	23	29024901	29099453	10	74553	5	3	BovineHD2300008247	BovineHD2300008264
1803	23	29024901	29113538	11	88638	5	3	BovineHD2300008247	BovineHD2300008267
1804	23	29032579	29113538	10	80960	5	3	BovineHD2300008248	BovineHD2300008267
1805	23	30441844	30472870	14	31027	2	1	BovineHD2300008787	BovineHD2300008801
1806	23	30445227	30472870	11	27644	2	1	BovineHD2300008791	BovineHD2300008801
1807	23	31451136	31499002	16	47867	2	1	BovineHD2300009085	BovineHD2300009099
1808	23	31455873	31527723	26	71851	2	1	BovineHD2300009087	BovineHD2300009112
1809	23	31455873	31646894	51	191022	2	1	BovineHD2300009087	BovineHD2300009136
1810	23	34496662	34698858	23	202197	5	3	BovineHD2300010131	BovineHD2300015663
1811	23	34496662	34786889	29	290228	5	3	BovineHD2300010131	BovineHD2300010182
1812	23	34496662	34801450	34	304789	5	3	BovineHD2300010131	BovineHD2300010187
1813	23	34496662	34810671	36	314010	5	3	BovineHD2300010131	BovineHD2300010191
1814	23	34496662	34866601	43	369940	5	3	BovineHD2300010131	BovineHD2300010200
1815	23	34496662	34907428	47	410767	5	3	BovineHD2300010131	BovineHD2300010209
1816	23	34496662	34935332	53	438671	5	3	BovineHD2300010131	Hapmap42253-BTA-56436
1817	23	34504692	34580012	11	75321	5	3	BovineHD2300010134	BovineHD2300010150
1818	23	34504692	34698858	22	194167	5	3	BovineHD2300010134	BovineHD2300015663
1819	23	34504692	34801450	33	296759	5	3	BovineHD2300010134	BovineHD2300010187
1820	23	34504692	34810671	35	305980	5	3	BovineHD2300010134	BovineHD2300010191

1821	23	34504692	34829519	38	324828	5	3	BovineHD2300010134	BovineHD2300010194
1822	23	34504692	34841196	39	336505	5	3	BovineHD2300010134	BovineHD2300010196
1823	23	34504692	34845418	40	340727	5	3	BovineHD2300010134	BovineHD2300010197
1824	23	34504692	34866601	42	361910	5	3	BovineHD2300010134	BovineHD2300010200
1825	23	34504692	34887979	43	383288	5	3	BovineHD2300010134	BovineHD2300010205
1826	23	34504692	34907428	46	402737	5	3	BovineHD2300010134	BovineHD2300010209
1827	23	34504692	35011159	62	506468	5	3	BovineHD2300010134	BovineHD4100016170
1828	23	34509994	34866601	40	356608	5	3	BovineHD2300010137	BovineHD2300010200
1829	23	34509994	34887979	41	377986	5	3	BovineHD2300010137	BovineHD2300010205
1830	23	34516184	34810671	31	294488	5	3	ARS-BFGL-NGS-113689	BovineHD2300010191
1831	23	34516184	34829519	34	313336	5	3	ARS-BFGL-NGS-113689	BovineHD2300010194
1832	23	34516184	34845418	36	329235	5	3	ARS-BFGL-NGS-113689	BovineHD2300010197
1833	23	34516184	34866601	38	350418	5	3	ARS-BFGL-NGS-113689	BovineHD2300010200
1834	23	34516184	35011159	58	494976	5	3	ARS-BFGL-NGS-113689	BovineHD4100016170
1835	23	34518850	34801450	28	282601	5	3	BovineHD2300010141	BovineHD2300010187
1836	23	34518850	34810671	30	291822	5	3	BovineHD2300010141	BovineHD2300010191
1837	23	34518850	34829519	33	310670	5	3	BovineHD2300010141	BovineHD2300010194
1838	23	34518850	34841196	34	322347	5	3	BovineHD2300010141	BovineHD2300010196
1839	23	34518850	34866601	37	347752	5	3	BovineHD2300010141	BovineHD2300010200
1840	23	34518850	34907428	41	388579	5	3	BovineHD2300010141	BovineHD2300010209
1841	23	34575024	34724303	15	149280	5	3	Hapmap30604-BTA-163136	BovineHD2300015310
1842	23	34575024	34801450	24	226427	5	3	Hapmap30604-BTA-163136	BovineHD2300010187
1843	23	34575024	34810671	26	235648	5	3	Hapmap30604-BTA-163136	BovineHD2300010191
1844	23	34575024	34829519	29	254496	5	3	Hapmap30604-BTA-163136	BovineHD2300010194
1845	23	34575024	34866601	33	291578	5	3	Hapmap30604-BTA-163136	BovineHD2300010200

1846	23	34603634	34801450	19	197817	5	3	BovineHD2300010155	BovineHD2300010187
1847	23	34603634	34810671	21	207038	5	3	BovineHD2300010155	BovineHD2300010191
1848	23	34603634	34829519	24	225886	5	3	BovineHD2300010155	BovineHD2300010194
1849	23	34603634	34845418	26	241785	5	3	BovineHD2300010155	BovineHD2300010197
1850	23	34603634	34866601	28	262968	5	3	BovineHD2300010155	BovineHD2300010200
1851	23	34622569	34841196	24	218628	5	3	BovineHD2300010158	BovineHD2300010196
1852	23	34622569	34866601	27	244033	5	3	BovineHD2300010158	BovineHD2300010200
1853	23	34634275	34845418	24	211144	5	3	BovineHD2300015662	BovineHD2300010197
1854	23	34634275	34866601	26	232327	5	3	BovineHD2300015662	BovineHD2300010200
1855	23	34673581	34801450	14	127870	5	3	BTB-02011393	BovineHD2300010187
1856	23	34673581	34845418	21	171838	5	3	BTB-02011393	BovineHD2300010197
1857	23	34673581	34866601	23	193021	5	3	BTB-02011393	BovineHD2300010200
1858	23	34779270	34845418	15	66149	5	3	BovineHD2300010180	BovineHD2300010197
1859	23	34779270	34866601	17	87332	5	3	BovineHD2300010180	BovineHD2300010200
1860	23	34786889	34866601	15	79713	5	3	BovineHD2300010182	BovineHD2300010200
1861	23	34786889	34887979	16	101091	5	3	BovineHD2300010182	BovineHD2300010205
1862	23	34791510	34841196	10	49687	5	3	BovineHD2300010184	BovineHD2300010196
1863	23	34791510	34866601	13	75092	5	3	BovineHD2300010184	BovineHD2300010200
1864	23	34793393	34866601	12	73209	5	3	BovineHD2300010185	BovineHD2300010200
1865	23	34793393	34935332	22	141940	5	3	BovineHD2300010185	Hapmap42253-BTA-56436
1866	23	34800163	34866601	11	66439	5	3	BovineHD2300010186	BovineHD2300010200
1867	23	39348688	39366704	10	18017	2	1	BovineHD2300011368	BovineHD2300011378
1868	23	48563085	48586299	10	23215	5	3	ARS-BFGL-NGS-35107	BovineHD2300014103
1869	23	48563085	48594824	11	31740	5	3	ARS-BFGL-NGS-35107	BovineHD2300014104
1870	23	48563085	48597495	12	34411	5	3	ARS-BFGL-NGS-35107	ARS-BFGL-NGS-118579
1871	23	48563085	48603083	13	39999	5	3	ARS-BFGL-NGS-35107	BovineHD2300014106
1872	23	48564538	48594824	10	30287	5	3	BovineHD2300014095	BovineHD2300014104
1873	23	48564538	48603083	12	38546	5	3	BovineHD2300014095	BovineHD2300014106

1874	23	52258805	52465632	46	206828	5	3	BovineHD2300015177	BovineHD2300015236
1875	23	52263461	52380189	15	116729	5	3	BTB-01891394	BovineHD2300015204
1876	23	52263461	52465632	45	202172	5	3	BTB-01891394	BovineHD2300015236
1877	23	52363277	52406622	12	43346	5	3	BovineHD2300015198	BovineHD2300015210
1878	23	52363277	52465632	36	102356	5	3	BovineHD2300015198	BovineHD2300015236
1879	23	52374382	52465632	33	91251	5	3	BovineHD2300015202	BovineHD2300015236
1880	24	54398	163641	14	109244	5	3	BovineHD2400000002	BovineHD2400000025
1881	24	54398	240874	18	186477	5	3	BovineHD2400000002	BovineHD2400000038
1882	24	7902607	7959874	26	57268	5	3	BovineHD2400002224	BovineHD2400002247
1883	24	7906908	7959874	25	52967	5	3	BovineHD2400002225	BovineHD2400002247
1884	24	7906908	7965952	26	59045	5	3	BovineHD2400002225	BovineHD2400002248
1885	24	7910936	7959874	24	48939	5	3	BovineHD2400002226	BovineHD2400002247
1886	24	7924382	7959874	23	35493	5	3	BovineHD2400002227	BovineHD2400002247
1887	24	8570091	8627996	29	57906	2	1	BovineHD2400002416	BovineHD2400002442
1888	24	8582939	8627996	25	45058	2	1	BovineHD2400002419	BovineHD2400002442
1889	24	19193737	19215679	16	21943	5	3	BovineHD2400005025	BovineHD2400005040
1890	24	19196373	19220121	16	23749	5	3	BovineHD2400005026	BovineHD2400005041
1891	24	19197148	19215679	14	18532	5	3	BovineHD2400005027	BovineHD2400005040
1892	25	271849	366996	27	95148	2	1	BovineHD2500000048	BovineHD2500000072
1893	25	271849	383915	30	112067	2	1	BovineHD2500000048	BovineHD2500000074
1894	25	271849	389521	31	117673	2	1	BovineHD2500000048	BovineHD2500000075
1895	25	271849	395688	33	123840	2	1	BovineHD2500000048	BovineHD2500000077
1896	25	290846	366996	22	76151	2	1	BovineHD2500000052	BovineHD2500000072
1897	25	290846	383915	25	93070	2	1	BovineHD2500000052	BovineHD2500000074
1898	25	298104	383915	22	85812	2	1	BovineHD2500000055	BovineHD2500000074
1899	25	1401564	1450644	14	49081	5	3	BovineHD2500000297	BovineHD2500000305
1900	25	1404930	1450644	13	45715	5	3	ARS-BFGL-BAC-44214	BovineHD2500000305
1901	25	2797108	2821003	12	23896	5	3	BovineHD2500000620	BovineHD2500000630

1902	25	3508578	3529726	11	21149	2	1	BovineHD4100016933	Hapmap30114-BTC-017562
1903	25	3515949	3533841	10	17893	2	1	BovineHD4100016934	BovineHD4100016937
1904	25	3519791	3536406	10	16616	2	1	BovineHD2500000750	BovineHD2500000755
1905	25	20076039	20135624	16	59586	2	1	BovineHD2500005559	BovineHD2500005573
1906	25	34851458	34929267	19	77810	2	1	ARS-BFGL-NGS-79064	BovineHD2500009618
1907	25	37121234	37175069	10	53836	5	3	BovineHD2500010293	BovineHD2500010305
1908	25	37121234	37180827	11	59594	5	3	BovineHD2500010293	BovineHD2500010306
1909	25	37121234	37184089	12	62856	5	3	BovineHD2500010293	BovineHD2500010307
1910	25	37557915	37593814	14	35900	2	1	BovineHD2500010399	BovineHD2500010414
1911	25	41250992	41324679	20	73688	2	1	BovineHD4100017553	BovineHD2500011644
1912	25	41264590	41302852	11	38263	2	1	BovineHD2500011632	BovineHD4100017557
1913	25	42777451	42879707	12	102257	5	3	BovineHD4100017605	BovineHD2500011993
1914	26	1397450	1595966	37	198517	5	3	BovineHD2600000189	BovineHD2600000224
1915	26	1400864	1619118	39	218255	5	3	BovineHD2600000190	BovineHD2600000226
1916	26	2698467	2768799	12	70333	2	1	BovineHD2600000437	BovineHD2600000448
1917	26	2939882	2976918	14	37037	5	3	BovineHD2600000506	BovineHD2600000518
1918	26	2954591	2970404	10	15814	5	3	BovineHD2600000509	BovineHD2600000517
1919	26	2954591	2976918	11	22328	5	3	BovineHD2600000509	BovineHD2600000518
1920	26	3239867	3275704	16	35838	5	3	BovineHD2600000561	BovineHD2600000574
1921	26	7923592	7980702	15	57111	5	3	BovineHD2600001933	BovineHD2600001948
1922	26	23154429	23162528	10	8100	5	3	BovineHD2600005914	BovineHD2600005923
1923	26	23633113	23690266	12	57154	5	3	BovineHD2600006093	BovineHD2600006110
1924	26	23633113	23722803	17	89691	5	3	BovineHD2600006093	BovineHD2600006117
1925	26	23668006	23690266	10	22261	5	3	BovineHD2600006099	BovineHD2600006110
1926	26	24382256	24451160	31	68905	2	1	BovineHD2600006266	BovineHD2600006295
1927	26	24393583	24479131	27	85549	2	1	BovineHD2600006278	BovineHD2600006303
1928	26	24401843	24451160	17	49318	2	1	ARS-BFGL-NGS-102845	BovineHD2600006295
1929	26	24417980	24462757	17	44778	2	1	BovineHD2600006282	BovineHD2600006299

1930	26	24417980	24479131	21	61152	2	1	BovineHD2600006282	BovineHD2600006303
1931	26	24417980	24507253	28	89274	2	1	BovineHD2600006282	ARS-BFGL-NGS-31501
1932	26	24419077	24479131	20	60055	2	1	BovineHD2600006283	BovineHD2600006303
1933	26	24422250	24451160	12	28911	2	1	BovineHD2600006284	BovineHD2600006295
1934	26	24507253	24563742	19	56490	2	1	ARS-BFGL-NGS-31501	BovineHD4100017789
1935	26	25115642	25158178	25	42537	2	1	BovineHD2600006498	BovineHD2600006522
1936	26	26417634	26494822	33	77189	5	3	BovineHD2600007024	BovineHD2600007055
1937	26	44535684	44616273	32	80590	2	1	BovineHD2600012536	BovineHD2600012569
1938	26	44895103	44972992	26	77890	2	1	BovineHD2600012619	BovineHD2600012638
1939	26	44952680	45016154	18	63475	2	1	ARS-BFGL-NGS-119754	BovineHD2600012646
1940	26	46930040	46945920	11	15881	5	3	BovineHD4100018047	BovineHD2600013405
1941	26	51131518	51286609	39	155092	2	1	BovineHD2600014767	BovineHD2600014805
1942	26	51146223	51238255	22	92033	2	1	BovineHD2600014771	BovineHD2600014792
1943	26	51146223	51286609	35	140387	2	1	BovineHD2600014771	BovineHD2600014805
1944	26	51181758	51238255	19	56498	2	1	ARS-BFGL-NGS-106724	BovineHD2600014792
1945	26	51181758	51284945	31	103188	2	1	ARS-BFGL-NGS-106724	BovineHD2600014804
1946	26	51193009	51238255	14	45247	2	1	BovineHD2600014780	BovineHD2600014792
1947	26	51193009	51284945	26	91937	2	1	BovineHD2600014780	BovineHD2600014804
1948	26	51229114	51284945	15	55832	2	1	BovineHD2600014790	BovineHD2600014804
1949	27	309276	327206	11	17931	2	1	BovineHD2700000114	BovineHD2700000123
1950	27	6682457	6718085	20	35629	2	1	BovineHD2700002102	BovineHD2700002120
1951	27	6707759	6751068	19	43310	2	1	BovineHD2700002116	BovineHD4100018151
1952	27	6709968	6748979	17	39012	2	1	BTA-62769-no-rs	BovineHD2700002130
1953	27	6710782	6732838	10	22057	2	1	BovineHD2700002117	BovineHD2700002126
1954	27	14532319	14565056	14	32738	2	1	BovineHD2700004218	BTB-00957110
1955	27	14534255	14559269	11	25015	2	1	BovineHD2700004219	BovineHD2700004230
1956	27	19913335	20065987	39	152653	5	3	BovineHD2700005664	BovineHD4100018239
1957	27	19924425	20065987	37	141563	5	3	BovineHD2700005666	BovineHD4100018239
1958	27	21164500	21215732	15	51233	5	3	BovineHD2700006015	BovineHD2700006029

1959	27	27034067	27069527	13	35461	2	1	BovineHD2700007587	BovineHD2700013598
1960	28	1598731	1658610	16	59880	5	3	BovineHD2800000595	BovineHD2800000611
1961	28	1644820	1663594	11	18775	5	3	BovineHD2800000603	BovineHD2800000614
1962	28	1647062	1663594	10	16533	5	3	BovineHD2800000604	BovineHD2800000614
1963	28	1647062	1671851	13	24790	5	3	BovineHD2800000604	BovineHD2800000618
1964	28	1648309	1671851	12	23543	5	3	BovineHD2800000605	BovineHD2800000618
1965	28	1648309	1689914	14	41606	5	3	BovineHD2800000605	BovineHD2800000623
1966	28	1656391	1676288	10	19898	5	3	BovineHD2800000609	BovineHD2800000621
1967	28	1656391	1689914	11	33524	5	3	BovineHD2800000609	BovineHD2800000623
1968	28	1657433	1689914	10	32482	5	3	BovineHD2800000610	BovineHD2800000623
1969	28	1895637	2796204	182	900568	5	3	BovineHD2800000658	BovineHD2800000884
1970	28	1910106	2831697	186	921592	5	3	BovineHD2800000659	BovineHD2800000890
1971	28	1939216	2860512	181	921297	5	3	BovineHD2800000667	BovineHD2800000894
1972	28	1975216	2860512	161	885297	5	3	BovineHD2800000690	BovineHD2800000894
1973	28	2290987	2322619	10	31633	5	3	BovineHD2800000788	BovineHD2800000799
1974	28	2300752	2353230	10	52479	5	3	BovineHD2800013512	BovineHD2800000805
1975	28	2300752	2403958	13	103207	5	3	BovineHD2800013512	BovineHD2800000816
1976	28	2300752	2410947	14	110196	5	3	BovineHD2800013512	BovineHD2800000818
1977	28	2300752	2412723	16	111972	5	3	BovineHD2800013512	BovineHD2800000820
1978	28	2468624	2638563	24	169940	1	0	BovineHD2800000833	BTB-02032980
1979	28	2468624	2758221	35	289598	5	3	BovineHD2800000833	BovineHD2800000878
1980	28	2468624	2831697	42	363074	5	3	BovineHD2800000833	BovineHD2800000890
1981	28	2499843	2638563	19	138721	1	0	BovineHD2800000840	BTB-02032980
1982	28	2538813	2638563	14	99751	1	0	BovineHD2800000846	BTB-02032980
1983	28	2544117	2638563	13	94447	5	3	BovineHD2800000847	BTB-02032980
1984	28	2544117	2758221	24	214105	5	3	BovineHD2800000847	BovineHD2800000878
1985	28	2548007	2758221	23	210215	5	3	BovineHD2800000848	BovineHD2800000878
1986	28	2556672	2638563	11	81892	5	3	BovineHD2800000849	BTB-02032980
1987	28	2556672	2758221	22	201550	5	3	BovineHD2800000849	BovineHD2800000878

1988	28	2572926	2758221	20	185296	5	3	BovineHD2800000853	BovineHD2800000878
1989	28	2577607	2758221	19	180615	5	3	BovineHD2800000854	BovineHD2800000878
1990	28	2590728	2758221	18	167494	5	3	BovineHD2800000856	BovineHD2800000878
1991	28	2590728	2831697	25	240970	5	3	BovineHD2800000856	BovineHD2800000890
1992	28	16657715	16713711	13	55997	2	1	BovineHD2800004651	BovineHD2800004667
1993	28	28462492	28482939	10	20448	2	1	BovineHD2800007595	BovineHD2800007604
1994	28	28462492	28526115	23	63624	2	1	BovineHD2800007595	BovineHD2800007616
1995	28	28467422	28526115	21	58694	2	1	BovineHD4100018617	BovineHD2800007616
1996	28	29657271	29734099	16	76829	2	1	BovineHD2800007873	BovineHD2800007888
1997	28	29675895	29735364	11	59470	2	1	BovineHD2800007880	BovineHD2800007889
1998	28	30210288	30238686	18	28399	5	3	BovineHD2800008027	BovineHD2800008044
1999	28	35016127	35053502	19	37376	2	1	BovineHD2800009486	BovineHD2800009509
2000	28	35193683	35220597	20	26915	2	1	BovineHD2800009551	BovineHD2800009570
2001	28	35204905	35241968	15	37064	2	1	BovineHD2800009560	BovineHD2800009574
2002	28	41642278	41672155	16	29878	2	1	BovineHD2800011719	BovineHD2800011733
2003	28	41653832	41672155	11	18324	2	1	BovineHD2800011723	BovineHD2800011733
2004	28	43882947	43921177	18	38231	2	1	BovineHD2800012573	ARS-BFGL-NGS-44352
2005	29	16860	482750	19	465891	5	3	BTB-02087390	BovineHD2900000036
2006	29	16860	586782	30	569923	5	3	BTB-02087390	BovineHD2900000054
2007	29	348944	586782	20	237839	5	3	ARS-BFGL-NGS-80365	BovineHD2900000054
2008	29	369932	586782	19	216851	5	3	BovineHD2900000024	BovineHD2900000054
2009	29	482750	586782	12	104033	5	3	BovineHD2900000036	BovineHD2900000054
2010	29	4510055	4576246	19	66192	2	1	BovineHD2900001293	BovineHD2900001310
2011	29	4515928	4576246	18	60319	2	1	BovineHD2900001294	BovineHD2900001310
2012	29	11800467	11841751	18	41285	2	1	BovineHD2900003421	BovineHD2900003440
2013	29	11800467	11845269	19	44803	2	1	BovineHD2900003421	BovineHD2900003441
2014	29	11801377	11845269	18	43893	2	1	BovineHD2900003422	BovineHD2900003441
2015	29	11811081	11845269	12	34189	2	1	BovineHD2900003428	BovineHD2900003441
2016	29	21873578	22025147	40	151570	5	3	BovineHD2900006264	BovineHD2900006303

2017	29	27711080	27773278	24	62199	5	3	BovineHD2900008136	BovineHD2900008167
2018	29	27711080	27776072	25	64993	5	3	BovineHD2900008136	BovineHD2900008168
2019	29	27723816	27773278	18	49463	5	3	BovineHD2900008144	BovineHD2900008167
2020	29	27749740	27776072	10	26333	5	3	BTB-01896192	BovineHD2900008168
2021	29	27749740	27820784	24	71045	5	3	BTB-01896192	BovineHD2900008185
2022	29	27749740	27821993	25	72254	5	3	BTB-01896192	BovineHD2900008186
2023	29	27789172	27820784	11	31613	5	3	BovineHD2900008175	BovineHD2900008185
2024	29	27811232	27844168	10	32937	5	3	BovineHD2900008181	BovineHD2900008192
2025	29	28068846	28088730	11	19885	5	3	BovineHD2900008280	BovineHD2900008290
2026	29	29522417	29549824	15	27408	5	3	BovineHD2900008713	BovineHD2900008728
2027	29	38341163	38713186	65	372024	5	3	BovineHD2900011580	BovineHD2900011716
2028	29	38351576	38629958	48	278383	5	3	BovineHD2900011581	BovineHD2900011688
2029	29	38351576	38713186	64	361611	5	3	BovineHD2900011581	BovineHD2900011716
2030	29	38351576	39739323	151	1387748	5	3	BovineHD2900011581	BovineHD2900011990
2031	29	38412665	38629958	38	217294	5	3	BovineHD2900011606	BovineHD2900011688
2032	29	38469769	38920839	61	451071	5	3	BovineHD2900011632	BovineHD2900011764
2033	29	38492748	38612202	17	119455	5	3	BovineHD2900011640	BovineHD2900011680
2034	29	38584926	38629958	10	45033	5	3	BovineHD2900015504	BovineHD2900011688
2035	29	38584926	38635100	11	50175	5	3	BovineHD2900015504	BovineHD2900011691
2036	29	38584926	38713186	26	128261	5	3	BovineHD2900015504	BovineHD2900011716
2037	29	38584926	39739323	113	1154398	5	3	BovineHD2900015504	BovineHD2900011990
2038	29	38840946	39739323	75	898378	5	3	BovineHD2900011752	BovineHD2900011990
2039	29	38880484	39739323	73	858840	5	3	BovineHD2900011757	BovineHD2900011990
2040	29	39032143	39613214	42	581072	5	3	BovineHD2900011788	BovineHD2900011934
2041	29	39043214	39506078	26	462865	5	3	BovineHD2900015512	BovineHD2900011895
2042	29	39043214	39613214	41	570001	5	3	BovineHD2900015512	BovineHD2900011934
2043	29	39043214	39736061	55	692848	5	3	BovineHD2900015512	BovineHD2900011987
2044	29	39043214	39739323	57	696110	5	3	BovineHD2900015512	BovineHD2900011990
2045	29	39043214	39766845	61	723632	5	3	BovineHD2900015512	BovineHD2900012000

2046	29	39043214	39796110	69	752897	5	3	BovineHD2900015512	BovineHD2900012011
2047	29	39087970	39613214	39	525245	5	3	BovineHD2900015513	BovineHD2900011934
2048	29	39087970	39736061	53	648092	5	3	BovineHD2900015513	BovineHD2900011987
2049	29	39099998	39382851	12	282854	5	3	BovineHD2900015514	BovineHD2900011852
2050	29	39099998	39487962	21	387965	5	3	BovineHD2900015514	BovineHD2900011890
2051	29	39099998	39506078	23	406081	5	3	BovineHD2900015514	BovineHD2900011895
2052	29	39099998	39613214	38	513217	5	3	BovineHD2900015514	BovineHD2900011934
2053	29	39099998	39739323	54	639326	5	3	BovineHD2900015514	BovineHD2900011990
2054	29	39156095	39382851	11	226757	5	3	BovineHD2900011812	BovineHD2900011852
2055	29	39156095	39464798	17	308704	5	3	BovineHD2900011812	BovineHD2900011883
2056	29	39156095	39466397	18	310303	5	3	BovineHD2900011812	BovineHD2900011884
2057	29	39156095	39479494	19	323400	5	3	BovineHD2900011812	BovineHD2900011886
2058	29	39156095	39487962	20	331868	5	3	BovineHD2900011812	BovineHD2900011890
2059	29	39156095	39491097	21	335003	5	3	BovineHD2900011812	BovineHD2900011892
2060	29	39156095	39506078	22	349984	5	3	BovineHD2900011812	BovineHD2900011895
2061	29	39156095	39521770	24	365676	5	3	BovineHD2900011812	BovineHD2900011902
2062	29	39156095	39550634	29	394540	5	3	BovineHD2900011812	BovineHD2900011911
2063	29	39156095	39613214	37	457120	5	3	BovineHD2900011812	BovineHD2900011934
2064	29	39156095	39739323	53	583229	5	3	BovineHD2900011812	BovineHD2900011990
2065	29	39218128	39466397	15	248270	5	3	BovineHD2900011822	BovineHD2900011884
2066	29	39218128	39506078	19	287951	5	3	BovineHD2900011822	BovineHD2900011895
2067	29	39218128	39766845	54	548718	5	3	BovineHD2900011822	BovineHD2900012000
2068	29	39375098	39487962	11	112865	5	3	BovineHD2900011849	BovineHD2900011890
2069	29	39375098	39506078	13	130981	5	3	BovineHD2900011849	BovineHD2900011895
2070	29	39375098	39613214	28	238117	5	3	BovineHD2900011849	BovineHD2900011934
2071	29	39375098	39739323	44	364226	5	3	BovineHD2900011849	BovineHD2900011990
2072	29	39382851	39487962	10	105112	5	3	BovineHD2900011852	BovineHD2900011890
2073	29	39382851	39491097	11	108247	5	3	BovineHD2900011852	BovineHD2900011892
2074	29	39382851	39613214	27	230364	5	3	BovineHD2900011852	BovineHD2900011934

2075	29	39443183	39506078	10	62896	5	3	BovineHD2900011873	BovineHD2900011895
2076	29	39443183	39613214	25	170032	5	3	BovineHD2900011873	BovineHD2900011934
2077	29	39443183	39739323	41	296141	5	3	BovineHD2900011873	BovineHD2900011990
2078	29	39462983	39550634	14	87652	5	3	BovineHD2900011882	BovineHD2900011911
2079	29	39464798	39739323	37	274526	5	3	BovineHD2900011883	BovineHD2900011990
2080	29	39549192	39739323	26	190132	5	3	BovineHD2900011910	BovineHD2900011990
2081	29	39699057	39736061	11	37005	5	3	BovineHD2900011965	BovineHD2900011987
2082	29	39707691	39766845	15	59155	5	3	BovineHD2900011969	BovineHD2900012000
2083	29	39728476	39796110	18	67635	5	3	BovineHD2900011982	BovineHD2900012011
2084	29	39944693	40085902	23	141210	5	3	BovineHD2900012075	ARS-BFGL-NGS-109507
2085	29	39944693	40115143	24	170451	5	3	BovineHD2900012075	BovineHD2900012129
2086	29	40010283	40085902	14	75620	5	3	BovineHD2900012094	ARS-BFGL-NGS-109507
2087	29	40034122	40085902	11	51781	5	3	BovineHD2900012097	ARS-BFGL-NGS-109507
2088	29	40034122	40115143	12	81022	5	3	BovineHD2900012097	BovineHD2900012129
2089	29	41683317	41725223	15	41907	2	1	BovineHD2900012590	BovineHD2900012603
2090	29	41693354	41725223	13	31870	2	1	BovineHD2900012591	BovineHD2900012603
2091	29	42437944	42474752	11	36809	5	3	BovineHD2900012762	BovineHD2900012781
2092	29	42450038	42532912	18	82875	5	3	BovineHD2900012768	BovineHD2900012811
2093	29	42450038	42567601	23	117564	5	3	BovineHD2900012768	BovineHD2900012822
2094	29	42450979	42485247	11	34269	5	3	BovineHD2900012769	BovineHD2900012789
2095	29	42450979	42492207	12	41229	5	3	BovineHD2900012769	BovineHD2900012792
2096	29	42450979	42532912	17	81934	5	3	BovineHD2900012769	BovineHD2900012811
2097	29	42450979	42567601	22	116623	5	3	BovineHD2900012769	BovineHD2900012822
2098	29	42455680	42485247	10	29568	5	3	Hapmap30761-BTA-123384	BovineHD2900012789
2099	29	42455680	42567601	21	111922	5	3	Hapmap30761-BTA-123384	BovineHD2900012822
2100	29	42469761	42532912	12	63152	5	3	BovineHD2900015539	BovineHD2900012811
2101	29	42473562	42510767	10	37206	5	3	BovineHD2900012780	BovineHD2900012801

2102	29	42473562	42532912	11	59351	5	3	BovineHD2900012780	BovineHD2900012811
2103	29	42473562	42567601	16	94040	5	3	BovineHD2900012780	BovineHD2900012822
2104	29	42492207	42567601	11	75395	2	1	BovineHD2900012792	BovineHD2900012822
2105	29	44273061	44347324	29	74264	2	1	BovineHD2900013264	BovineHD2900013291
2106	29	44275910	44304550	10	28641	2	1	BovineHD2900013265	BovineHD2900013273
2107	29	44275910	44317369	18	41460	2	1	BovineHD2900013265	BovineHD2900013281
2108	29	44275910	44337439	26	61530	2	1	BovineHD2900013265	BovineHD2900013289
2109	29	44275910	44347324	28	71415	2	1	BovineHD2900013265	BovineHD2900013291
2110	29	44284773	44317369	16	32597	2	1	BovineHD2900013267	BovineHD2900013281
2111	29	44284773	44347324	26	62552	2	1	BovineHD2900013267	BovineHD2900013291
2112	29	44301156	44347324	20	46169	2	1	BovineHD2900013272	BovineHD2900013291
2113	29	44311366	44347324	15	35959	2	1	BovineHD2900013277	BovineHD2900013291
2114	29	44313150	44347324	14	34175	2	1	BovineHD2900013278	BovineHD2900013291
2115	29	48234047	48276737	11	42691	2	1	BovineHD2900014243	BovineHD2900014254
2116	29	50230041	50296573	16	66533	2	1	BovineHD2900014701	ARS-BFGL-NGS-40378
2117	29	50230041	50307491	18	77451	2	1	BovineHD2900014701	BovineHD4100019168
2118	29	50235440	50296573	15	61134	2	1	BovineHD2900014702	ARS-BFGL-NGS-40378
2119	29	50235440	50307491	17	72052	2	1	BovineHD2900014702	BovineHD4100019168

S2_Table

CNVR_ID	Chr	Start	End	Size_pb	Type	Freq_n	Freq_%
CNVR_1	1	16947	147231	130285	GAIN	58	15.1
CNVR_2	1	1419261	1640525	221265	GAIN	61	15.9
CNVR_3	1	1905048	2004603	99556	GAIN	3	0.8
CNVR_4	1	15984544	15996851	12308	LOSS	16	4.2
CNVR_5	1	17851162	17873260	22099	GAIN	12	3.1
CNVR_6	1	20210312	20302086	91775	LOSS	1	0.3
CNVR_7	1	20673471	20734822	61352	LOSS	2	0.5
CNVR_8	1	22761416	23178933	417518	GAIN	1	0.3
CNVR_9	1	59559724	59627042	67319	LOSS	5	1.3
CNVR_10	1	60195040	60268813	73774	LOSS	1	0.3
CNVR_11	1	69800636	69818543	17908	LOSS	1	0.3
CNVR_12	1	71255928	71269030	13103	LOSS	1	0.3
CNVR_13	1	84243270	84259079	15810	GAIN	1	0.3
CNVR_14	1	84636563	84736049	99487	LOSS	11	2.9
CNVR_15	1	87332538	87383092	50555	LOSS	1	0.3
CNVR_16	1	93730576	93819471	88896	LOSS	216	56.4
CNVR_17	1	1,05E+08	1,05E+08	251767	LOSS	41	10.7
CNVR_18	1	1,07E+08	1,07E+08	127654	LOSS	1	0.3
CNVR_19	1	1,16E+08	1,16E+08	60859	LOSS	16	4.2
CNVR_20	1	1,16E+08	1,16E+08	49940	LOSS	7	1.8
CNVR_21	1	1,29E+08	1,29E+08	35090	LOSS	1	0.3
CNVR_22	1	1,45E+08	1,45E+08	74721	LOSS	16	4.2
CNVR_23	1	1,47E+08	1,47E+08	20328	LOSS	1	0.3
CNVR_24	1	1,54E+08	1,54E+08	72728	LOSS	15	3.9
CNVR_25	2	6889	225418	218530	GAIN	2	0.5
CNVR_26	2	4102765	4133052	30288	LOSS	1	0.3
CNVR_27	2	5353429	5397349	43921	LOSS	10	2.6
CNVR_28	2	18057267	18132789	75523	LOSS	2	0.5
CNVR_29	2	19622274	19668723	46450	LOSS	3	0.8
CNVR_30	2	39263808	39330327	66520	LOSS	2	0.5
CNVR_31	2	45526790	45570621	43832	LOSS	1	0.3
CNVR_32	2	45584050	45599741	15692	LOSS	1	0.3
CNVR_33	2	52272443	52364492	92050	LOSS	2	0.5
CNVR_34	2	65760135	65814327	54193	LOSS	1	0.3
CNVR_35	2	68129258	68150651	21394	LOSS	1	0.3
CNVR_36	2	82502028	82541785	39758	GAIN	5	1.3
CNVR_37	2	99034078	99086526	52449	GAIN	6	1.6
CNVR_38	2	1,08E+08	1,08E+08	71446	LOSS	3	0.8
CNVR_39	2	1,26E+08	1,26E+08	63655	LOSS	3	0.8
CNVR_40	2	1,32E+08	1,32E+08	44451	LOSS	1	0.3
CNVR_41	2	1,32E+08	1,32E+08	34099	LOSS	1	0.3

CNVR_42	2	1,35E+08	1,36E+08	514558	GAIN	52	13.6
CNVR_43	3	25683	123760	98078	GAIN	1	0.3
CNVR_44	3	11070431	11097187	26757	LOSS	3	0.8
CNVR_45	3	11959762	12124072	164311	GAIN	9	2.3
CNVR_46	3	13312387	13448997	136611	GAIN	8	2.1
CNVR_47	3	14360623	14425158	64536	LOSS	1	0.3
CNVR_48	3	16525687	16561484	35798	LOSS	1	0.3
CNVR_49	3	20790917	20825156	34240	LOSS	1	0.3
CNVR_50	3	20958126	21387762	429637	GAIN	32	8.4
CNVR_51	3	21433392	21517572	84181	LOSS	11	2.9
CNVR_52	3	38031952	38069297	37346	GAIN	7	1.8
CNVR_53	3	40950927	40983044	32118	LOSS	2	0.5
CNVR_54	3	45817635	45854174	36540	GAIN	1	0.3
CNVR_55	3	54414408	55017187	602780	MIXED	51	13.3
CNVR_56	3	67052465	67102276	49812	LOSS	1	0.3
CNVR_57	3	85137324	85176224	38901	LOSS	3	0.8
CNVR_58	3	86929227	86961766	32540	LOSS	3	0.8
CNVR_59	3	95235866	95299019	63154	LOSS	1	0.3
CNVR_60	3	1,1E+08	1,1E+08	27103	LOSS	6	1.6
CNVR_61	3	1,18E+08	1,18E+08	92765	LOSS	1	0.3
CNVR_62	3	1,18E+08	1,18E+08	57789	LOSS	20	5.2
CNVR_63	3	1,2E+08	1,2E+08	282682	GAIN	31	8.1
CNVR_64	3	1,2E+08	1,2E+08	46439	LOSS	1	0.3
CNVR_65	4	3803621	3827792	24172	LOSS	2	0.5
CNVR_66	4	5099643	5121618	21976	LOSS	1	0.3
CNVR_67	4	16765495	16834381	68887	GAIN	1	0.3
CNVR_68	4	20673638	20701989	28352	LOSS	13	3.4
CNVR_69	4	27069001	27106242	37242	LOSS	1	0.3
CNVR_70	4	36543733	36563030	19298	LOSS	2	0.5
CNVR_71	4	38491489	38579226	87738	LOSS	1	0.3
CNVR_72	4	38632043	38660809	28767	LOSS	1	0.3
CNVR_73	4	40036510	40081019	44510	GAIN	1	0.3
CNVR_74	4	55864504	55906545	42042	LOSS	2	0.5
CNVR_75	4	61403692	61424375	20684	LOSS	3	0.8
CNVR_76	4	64303320	64355713	52394	LOSS	1	0.3
CNVR_77	4	83429553	83471026	41474	GAIN	76	19.8
CNVR_78	4	95300892	95393978	93087	GAIN	1	0.3
CNVR_79	4	99775747	99923879	148133	GAIN	1	0.3
CNVR_80	4	1,06E+08	1,06E+08	147904	GAIN	5	1.3
CNVR_81	4	1,08E+08	1,08E+08	65586	GAIN	4	1.0
CNVR_82	4	1,14E+08	1,14E+08	418179	GAIN	93	24.3
CNVR_83	4	1,17E+08	1,17E+08	17019	GAIN	2	0.5
CNVR_84	4	1,17E+08	1,17E+08	20421	GAIN	1	0.3
CNVR_85	4	1,2E+08	1,2E+08	81864	GAIN	1	0.3

CNVR_86	5	108421	982397	873977	GAIN	9	2.3
CNVR_87	5	13505687	13519855	14169	GAIN	1	0.3
CNVR_88	5	35251507	35293149	41643	LOSS	1	0.3
CNVR_89	5	36039557	36061007	21451	GAIN	1	0.3
CNVR_90	5	57993463	58293514	300052	GAIN	16	4.2
CNVR_91	5	59066551	59215089	148539	LOSS	2	0.5
CNVR_92	5	59339188	59650955	311768	MIXED	242	63.2
CNVR_93	5	72691446	72722162	30717	LOSS	1	0.3
CNVR_94	5	74288348	74359489	71142	LOSS	1	0.3
CNVR_95	5	74390808	74439336	48529	LOSS	1	0.3
CNVR_96	5	75240516	75272725	32210	LOSS	3	0.8
CNVR_97	5	84235131	84268844	33714	LOSS	4	1.0
CNVR_98	5	99334070	99377602	43533	LOSS	2	0.5
CNVR_99	5	1,01E+08	1,01E+08	76442	GAIN	9	2.3
CNVR_100	5	1,03E+08	1,03E+08	90204	LOSS	23	6.0
CNVR_101	5	1,03E+08	1,03E+08	91941	GAIN	1	0.3
CNVR_102	5	1,03E+08	1,03E+08	315899	GAIN	14	3.7
CNVR_103	5	1,13E+08	1,13E+08	80329	LOSS	1	0.3
CNVR_104	5	1,17E+08	1,17E+08	123510	LOSS	29	7.6
CNVR_105	5	1,17E+08	1,18E+08	383708	MIXED	151	39.4
CNVR_106	5	1,19E+08	1,19E+08	164056	GAIN	1	0.3
CNVR_107	5	1,2E+08	1,2E+08	50222	LOSS	1	0.3
CNVR_108	6	3164764	3225645	60882	GAIN	8	2.1
CNVR_109	6	6502610	6652458	149849	GAIN	1	0.3
CNVR_110	6	38415398	38455242	39845	GAIN	2	0.5
CNVR_111	6	44446202	44480062	33861	LOSS	1	0.3
CNVR_112	6	86009586	86101702	92117	GAIN	1	0.3
CNVR_113	6	1,03E+08	1,04E+08	26582	GAIN	8	2.1
CNVR_114	6	1,08E+08	1,09E+08	335747	LOSS	1	0.3
CNVR_115	6	1,09E+08	1,09E+08	53114	LOSS	1	0.3
CNVR_116	6	1,17E+08	1,17E+08	29950	GAIN	1	0.3
CNVR_117	6	1,19E+08	1,19E+08	32624	LOSS	1	0.3
CNVR_118	7	2594859	2646809	51951	LOSS	2	0.5
CNVR_119	7	6569064	6599373	30310	LOSS	1	0.3
CNVR_120	7	6604091	6718398	114308	LOSS	7	1.8
CNVR_121	7	7798579	7941613	143035	MIXED	21	5.5
CNVR_122	7	9409927	9504448	94522	GAIN	4	1.0
CNVR_123	7	9771150	10150703	379554	MIXED	88	23.0
CNVR_124	7	10826539	10874375	47837	LOSS	66	17.2
CNVR_125	7	11229902	12057433	827532	GAIN	14	3.7
CNVR_126	7	14793990	14875408	81419	GAIN	10	2.6
CNVR_127	7	15147652	15178739	31088	GAIN	6	1.6
CNVR_128	7	16801933	16826853	24921	LOSS	1	0.3
CNVR_129	7	21249976	21293127	43152	LOSS	4	1.0

CNVR_130	7	22243143	22418258	175116	LOSS	24	6.3
CNVR_131	7	28968161	28982348	14188	GAIN	1	0.3
CNVR_132	7	42736530	42861486	124957	LOSS	42	11.0
CNVR_133	7	42945525	43353211	407687	LOSS	82	21.4
CNVR_134	7	43613957	43685994	72038	LOSS	2	0.5
CNVR_135	7	43759207	43766370	7164	GAIN	4	1.0
CNVR_136	7	53001042	53051556	50515	LOSS	1	0.3
CNVR_137	7	53949585	53979659	30075	LOSS	6	1.6
CNVR_138	7	54839973	54911407	71435	GAIN	1	0.3
CNVR_139	7	64177866	64212232	34367	GAIN	2	0.5
CNVR_140	7	70171046	70283070	112025	GAIN	23	6.0
CNVR_141	7	70553013	70804701	251689	GAIN	14	3.7
CNVR_142	7	87556048	87612652	56605	GAIN	1	0.3
CNVR_143	7	88273984	88298220	24237	LOSS	1	0.3
CNVR_144	8	834934	883675	48742	LOSS	3	0.8
CNVR_145	8	1817817	1860542	42726	GAIN	4	1.0
CNVR_146	8	12983574	13027664	44091	LOSS	1	0.3
CNVR_147	8	22687105	22810759	123655	GAIN	2	0.5
CNVR_148	8	22973761	23064504	90744	GAIN	1	0.3
CNVR_149	8	29920981	30015545	94565	LOSS	2	0.5
CNVR_150	8	30079403	30116226	36824	LOSS	1	0.3
CNVR_151	8	31103200	31142523	39324	LOSS	2	0.5
CNVR_152	8	35297412	35326637	29226	LOSS	4	1.0
CNVR_153	8	38344313	38543241	198929	GAIN	25	6.5
CNVR_154	8	39974754	39995181	20428	LOSS	1	0.3
CNVR_155	8	44044445	44078782	34338	LOSS	2	0.5
CNVR_156	8	44802409	44833334	30926	LOSS	1	0.3
CNVR_157	8	46891003	46940217	49215	LOSS	31	8.1
CNVR_158	8	47077565	47106702	29138	LOSS	2	0.5
CNVR_159	8	54376152	54435508	59357	LOSS	26	6.8
CNVR_160	8	59743649	59783560	39912	LOSS	1	0.3
CNVR_161	8	65321429	65346903	25475	LOSS	1	0.3
CNVR_162	8	65899587	66158103	258517	GAIN	13	3.4
CNVR_163	8	76530816	76610143	79328	LOSS	2	0.5
CNVR_164	8	82933545	83004091	70547	LOSS	1	0.3
CNVR_165	8	84896726	84960505	63780	GAIN	1	0.3
CNVR_166	8	86319658	86342216	22559	LOSS	3	0.8
CNVR_167	8	88011367	88087326	75960	LOSS	2	0.5
CNVR_168	8	95793143	95953799	160657	GAIN	5	1.3
CNVR_169	8	96143986	96181815	37830	LOSS	2	0.5
CNVR_170	8	98684344	98727434	43091	LOSS	1	0.3
CNVR_171	8	1,04E+08	1,04E+08	119952	LOSS	73	19.1
CNVR_172	8	1,04E+08	1,04E+08	32972	LOSS	1	0.3
CNVR_173	9	1396924	1721741	324818	LOSS	1	0.3

CNVR_174	9	15284898	15564406	279509	GAIN	74	19.3
CNVR_175	9	16413696	16930983	517288	GAIN	48	12.5
CNVR_176	9	28195131	28213069	17939	LOSS	1	0.3
CNVR_177	9	31107969	31122388	14420	LOSS	3	0.8
CNVR_178	9	39338543	39373700	35158	LOSS	1	0.3
CNVR_179	9	44351018	44433799	82782	LOSS	1	0.3
CNVR_180	9	64957607	65147304	189698	LOSS	2	0.5
CNVR_181	9	70048837	70126195	77359	LOSS	3	0.8
CNVR_182	9	71586588	71708405	121818	GAIN	3	0.8
CNVR_183	9	80301752	80357664	55913	LOSS	1	0.3
CNVR_184	9	81362573	81412832	50260	LOSS	2	0.5
CNVR_185	9	91637171	91708474	71304	LOSS	1	0.3
CNVR_186	9	94813853	94901347	87495	LOSS	12	3.1
CNVR_187	9	1E+08	1E+08	49558	LOSS	2	0.5
CNVR_188	9	1,01E+08	1,01E+08	14641	LOSS	1	0.3
CNVR_189	9	1,05E+08	1,05E+08	35367	LOSS	1	0.3
CNVR_190	10	1513505	1573751	60247	LOSS	2	0.5
CNVR_191	10	11960722	12001586	40865	LOSS	2	0.5
CNVR_192	10	22393827	25303984	2910158	MIXED	254	66.3
CNVR_193	10	27086857	27109540	22684	LOSS	2	0.5
CNVR_194	10	40734273	40794738	60466	LOSS	33	8.6
CNVR_195	10	42436483	42467266	30784	LOSS	48	12.5
CNVR_196	10	46864248	46902850	38603	LOSS	1	0.3
CNVR_197	10	47693839	47751227	57389	LOSS	2	0.5
CNVR_198	10	53031744	53080510	48767	LOSS	12	3.1
CNVR_199	10	67409125	67441337	32213	LOSS	1	0.3
CNVR_200	11	20031	118377	98347	GAIN	6	1.6
CNVR_201	11	5745177	5800039	54863	GAIN	56	14.6
CNVR_202	11	7464692	7497550	32859	LOSS	2	0.5
CNVR_203	11	13087586	13129402	41817	LOSS	1	0.3
CNVR_204	11	25517299	25610048	92750	LOSS	5	1.3
CNVR_205	11	29417529	29436744	19216	LOSS	1	0.3
CNVR_206	11	37589887	37613246	23360	LOSS	1	0.3
CNVR_207	11	45855920	45880840	24921	LOSS	1	0.3
CNVR_208	11	49011392	49093033	81642	LOSS	1	0.3
CNVR_209	11	51480322	51503959	23638	GAIN	1	0.3
CNVR_210	11	68381842	68442477	60636	LOSS	2	0.5
CNVR_211	11	69975117	70555942	580826	LOSS	12	3.1
CNVR_212	11	71959349	71982539	23191	LOSS	1	0.3
CNVR_213	11	73357180	73453361	96182	LOSS	1	0.3
CNVR_214	11	83508456	83545574	37119	LOSS	6	1.6
CNVR_215	11	92560734	92638477	77744	LOSS	7	1.8
CNVR_216	11	1,02E+08	1,02E+08	40816	LOSS	4	1.0
CNVR_217	11	1,02E+08	1,02E+08	61637	LOSS	3	0.8

CNVR_218	11	1,04E+08	1,04E+08	47804	LOSS	1	0.3
CNVR_219	11	1,04E+08	1,04E+08	142643	LOSS	18	4.7
CNVR_220	11	1,04E+08	1,04E+08	139025	LOSS	6	1.6
CNVR_221	11	1,05E+08	1,05E+08	44603	LOSS	1	0.3
CNVR_222	11	1,06E+08	1,06E+08	87533	LOSS	1	0.3
CNVR_223	12	607076	660731	53656	GAIN	1	0.3
CNVR_224	12	1929743	1971696	41954	GAIN	1	0.3
CNVR_225	12	5693314	5772578	79265	GAIN	1	0.3
CNVR_226	12	8902022	8926999	24978	GAIN	1	0.3
CNVR_227	12	18115848	18125381	9534	LOSS	2	0.5
CNVR_228	12	32054331	32218347	164017	MIXED	48	12.5
CNVR_229	12	33355222	33416366	61145	LOSS	2	0.5
CNVR_230	12	44363730	44398855	35126	GAIN	1	0.3
CNVR_231	12	44405826	44418666	12841	GAIN	1	0.3
CNVR_232	12	49878698	49986723	108026	GAIN	15	3.9
CNVR_233	12	50855902	50895100	39199	LOSS	1	0.3
CNVR_234	12	70363408	72123747	1760340	MIXED	132	34.5
CNVR_235	12	72432362	74589404	2157043	MIXED	265	69.2
CNVR_236	12	74840021	76608564	1768544	MIXED	270	70.5
CNVR_237	12	78367374	78412067	44694	LOSS	2	0.5
CNVR_238	13	2102273	2138145	35873	LOSS	2	0.5
CNVR_239	13	7963451	8013473	50023	LOSS	5	1.3
CNVR_240	13	10508131	10536898	28768	LOSS	1	0.3
CNVR_241	13	12543348	12822615	279268	GAIN	57	14.9
CNVR_242	13	19909378	19946082	36705	LOSS	1	0.3
CNVR_243	13	33407009	33477797	70789	LOSS	4	1.0
CNVR_244	13	37415567	37495897	80331	GAIN	6	1.6
CNVR_245	13	43654009	43795538	141530	GAIN	2	0.5
CNVR_246	13	43907827	43949298	41472	GAIN	2	0.5
CNVR_247	13	46887454	46912555	25102	LOSS	4	1.0
CNVR_248	13	53933240	53990117	56878	LOSS	69	18.0
CNVR_249	13	54065496	54114946	49451	GAIN	2	0.5
CNVR_250	13	61758700	61838708	80009	LOSS	11	2.9
CNVR_251	13	61888486	61950689	62204	LOSS	2	0.5
CNVR_252	13	67275766	67385717	109952	LOSS	1	0.3
CNVR_253	13	71850682	71931812	81131	LOSS	28	7.3
CNVR_254	13	74388010	74430302	42293	LOSS	2	0.5
CNVR_255	13	74631978	74675560	43583	GAIN	9	2.3
CNVR_256	14	645256	1410699	765444	GAIN	115	30.0
CNVR_257	14	2015554	2089613	74060	LOSS	28	7.3
CNVR_258	14	2395671	2472363	76693	LOSS	1	0.3
CNVR_259	14	3493171	3504269	11099	GAIN	1	0.3
CNVR_260	14	3996353	4068825	72473	GAIN	1	0.3
CNVR_261	14	4100475	4129472	28998	LOSS	1	0.3

CNVR_262	14	4200701	4369830	169130	GAIN	1	0.3
CNVR_263	14	20742574	20818621	76048	LOSS	1	0.3
CNVR_264	14	22500478	22553028	52551	LOSS	3	0.8
CNVR_265	14	30326407	30377174	50768	GAIN	1	0.3
CNVR_266	14	42385696	42427570	41875	LOSS	1	0.3
CNVR_267	14	60496215	60514091	17877	GAIN	1	0.3
CNVR_268	14	63811066	63838459	27394	LOSS	3	0.8
CNVR_269	14	67434915	67489095	54181	LOSS	1	0.3
CNVR_270	14	68834757	68860420	25664	LOSS	2	0.5
CNVR_271	14	81841283	81883661	42379	GAIN	6	1.6
CNVR_272	15	43737	508576	464840	GAIN	32	8.4
CNVR_273	15	547375	807686	260312	GAIN	13	3.4
CNVR_274	15	1255932	1315478	59547	GAIN	1	0.3
CNVR_275	15	1328622	1396987	68366	GAIN	16	4.2
CNVR_276	15	10941005	11038486	97482	GAIN	1	0.3
CNVR_277	15	16732787	17149627	416841	LOSS	2	0.5
CNVR_278	15	24714021	24735563	21543	LOSS	1	0.3
CNVR_279	15	25012657	25060263	47607	LOSS	1	0.3
CNVR_280	15	30446720	30489674	42955	LOSS	6	1.6
CNVR_281	15	40487632	40529240	41609	LOSS	10	2.6
CNVR_282	15	41690512	41727594	37083	LOSS	1	0.3
CNVR_283	15	45470174	45542956	72783	LOSS	185	48.3
CNVR_284	15	46539222	47013774	474553	GAIN	139	36.3
CNVR_285	15	47993124	48085137	92014	GAIN	29	7.6
CNVR_286	15	50351188	50416349	65162	GAIN	4	1.0
CNVR_287	15	50619664	50908580	288917	GAIN	5	1.3
CNVR_288	15	57265349	57285101	19753	LOSS	2	0.5
CNVR_289	15	67280359	67308302	27944	GAIN	1	0.3
CNVR_290	15	79263122	79317375	54254	LOSS	8	2.1
CNVR_291	15	79608073	79690026	81954	GAIN	1	0.3
CNVR_292	15	79744750	79974613	229864	GAIN	76	19.8
CNVR_293	15	80254337	81131105	876769	GAIN	166	43.3
CNVR_294	15	81288563	81437542	148980	GAIN	1	0.3
CNVR_295	15	83415031	83534599	119569	GAIN	9	2.3
CNVR_296	16	24074	498301	474228	GAIN	27	7.0
CNVR_297	16	5439901	6135133	695233	GAIN	104	27.2
CNVR_298	16	7901886	7963357	61472	GAIN	14	3.7
CNVR_299	16	8741216	8836744	95529	LOSS	2	0.5
CNVR_300	16	11758931	11792218	33288	LOSS	83	21.7
CNVR_301	16	15070508	15118639	48132	LOSS	5	1.3
CNVR_302	16	15178806	15243100	64295	LOSS	1	0.3
CNVR_303	16	17412930	17447956	35027	GAIN	1	0.3
CNVR_304	16	37013472	37054825	41354	LOSS	1	0.3
CNVR_305	16	39050441	39089869	39429	LOSS	1	0.3

CNVR_306	16	51728922	51843116	114195	LOSS	1	0.3
CNVR_307	16	52068803	52115458	46656	LOSS	5	1.3
CNVR_308	16	52946703	53004392	57690	LOSS	2	0.5
CNVR_309	16	60462670	60502932	40263	GAIN	12	3.1
CNVR_310	16	66849373	66876462	27090	LOSS	2	0.5
CNVR_311	16	72983578	73016945	33368	LOSS	2	0.5
CNVR_312	16	77217657	77246724	29068	LOSS	2	0.5
CNVR_313	16	80959245	80974876	15632	GAIN	1	0.3
CNVR_314	17	18631496	18699101	67606	LOSS	2	0.5
CNVR_315	17	18781200	18901031	119832	LOSS	1	0.3
CNVR_316	17	21819921	21839985	20065	LOSS	1	0.3
CNVR_317	17	27315502	27351471	35970	LOSS	8	2.1
CNVR_318	17	40307312	40332091	24780	GAIN	1	0.3
CNVR_319	17	40584371	40621694	37324	LOSS	1	0.3
CNVR_320	17	53122583	53139710	17128	LOSS	1	0.3
CNVR_321	17	55244711	55290523	45813	LOSS	2	0.5
CNVR_322	17	58410638	58438656	28019	LOSS	1	0.3
CNVR_323	17	63154532	63192909	38378	GAIN	1	0.3
CNVR_324	17	64813262	64858435	45174	LOSS	1	0.3
CNVR_325	17	71089525	71240044	150520	LOSS	1	0.3
CNVR_326	17	72870233	73093737	223505	GAIN	3	0.8
CNVR_327	17	73878627	73892454	13828	GAIN	5	1.3
CNVR_328	17	74878327	74944074	65748	LOSS	5	1.3
CNVR_329	18	1468948	1528564	59617	LOSS	3	0.8
CNVR_330	18	10544352	10573635	29284	LOSS	1	0.3
CNVR_331	18	13365474	13455012	89539	GAIN	41	10.7
CNVR_332	18	25135026	25281274	146249	GAIN	1	0.3
CNVR_333	18	48664714	48717504	52791	LOSS	3	0.8
CNVR_334	18	49074618	49109287	34670	LOSS	16	4.2
CNVR_335	18	49352081	49396303	44223	LOSS	1	0.3
CNVR_336	18	50025733	50053279	27547	LOSS	2	0.5
CNVR_337	18	57101952	57194210	92259	GAIN	19	5.0
CNVR_338	18	58452729	58625879	173151	GAIN	4	1.0
CNVR_339	18	58751697	58811905	60209	GAIN	1	0.3
CNVR_340	18	59154291	59890631	736341	GAIN	28	7.3
CNVR_341	18	60430622	60824427	393806	GAIN	12	3.1
CNVR_342	18	60859779	60993719	133941	GAIN	11	2.9
CNVR_343	18	61638038	61929947	291910	GAIN	18	4.7
CNVR_344	18	62813257	62886264	73008	GAIN	1	0.3
CNVR_345	18	64545513	64577452	31940	GAIN	6	1.6
CNVR_346	18	64728690	64760454	31765	GAIN	1	0.3
CNVR_347	19	1591038	1683625	92588	LOSS	51	13.3
CNVR_348	19	2270929	2344351	73423	LOSS	4	1.0
CNVR_349	19	6239670	6324535	84866	LOSS	1	0.3

CNVR_350	19	10531387	10633597	102211	LOSS	1	0.3
CNVR_351	19	18792038	18839754	47717	LOSS	10	2.6
CNVR_352	19	19566531	19599812	33282	LOSS	4	1.0
CNVR_353	19	21384990	21569741	184752	LOSS	14	3.7
CNVR_354	19	23288170	23306455	18286	LOSS	1	0.3
CNVR_355	19	24548362	24590915	42554	GAIN	12	3.1
CNVR_356	19	39238521	39260247	21727	LOSS	1	0.3
CNVR_357	19	41200141	41245524	45384	LOSS	14	3.7
CNVR_358	19	45431747	45504567	72821	LOSS	1	0.3
CNVR_359	19	48801884	48856177	54294	LOSS	1	0.3
CNVR_360	19	50863908	51035766	171859	GAIN	2	0.5
CNVR_361	19	51166632	51225658	59027	LOSS	2	0.5
CNVR_362	19	51934105	52025851	91747	LOSS	3	0.8
CNVR_363	19	52179673	52236397	56725	LOSS	8	2.1
CNVR_364	19	54189867	54239006	49140	LOSS	5	1.3
CNVR_365	19	55102419	55123565	21147	GAIN	1	0.3
CNVR_366	19	55176470	55233519	57050	LOSS	1	0.3
CNVR_367	20	5496038	5566639	70602	LOSS	1	0.3
CNVR_368	20	11361136	11391220	30085	LOSS	1	0.3
CNVR_369	20	12473693	12548876	75184	LOSS	1	0.3
CNVR_370	20	15492357	15564781	72425	GAIN	1	0.3
CNVR_371	20	39593945	39691234	97290	LOSS	1	0.3
CNVR_372	20	45918839	45985255	66417	LOSS	8	2.1
CNVR_373	20	60447656	60496754	49099	GAIN	1	0.3
CNVR_374	20	62782658	62823045	40388	LOSS	2	0.5
CNVR_375	21	975606	2085345	1109740	GAIN	40	10.4
CNVR_376	21	7330545	7400647	70103	LOSS	1	0.3
CNVR_377	21	7754357	7791640	37284	LOSS	1	0.3
CNVR_378	21	14474236	14605574	131339	LOSS	2	0.5
CNVR_379	21	15345488	15357042	11555	LOSS	1	0.3
CNVR_380	21	20062038	20190573	128536	MIXED	58	15.1
CNVR_381	21	20196212	20231373	35162	GAIN	1	0.3
CNVR_382	21	26504335	26534891	30557	GAIN	1	0.3
CNVR_383	21	28159596	28253296	93701	LOSS	21	5.5
CNVR_384	21	35328865	35463366	134502	GAIN	10	2.6
CNVR_385	21	37915701	38289858	374158	GAIN	1	0.3
CNVR_386	21	39036938	39153858	116921	GAIN	1	0.3
CNVR_387	21	46007188	46069814	62627	LOSS	2	0.5
CNVR_388	21	56706639	56774987	68349	LOSS	1	0.3
CNVR_389	21	60514625	60594860	80236	GAIN	1	0.3
CNVR_390	21	61050744	61088436	37693	GAIN	1	0.3
CNVR_391	21	66713232	66761317	48086	LOSS	1	0.3
CNVR_392	21	70803573	70891033	87461	LOSS	16	4.2
CNVR_393	22	5475849	5548263	72415	GAIN	17	4.4

CNVR_394	22	15056590	15114988	58399	LOSS	14	3.7
CNVR_395	22	17992618	18018757	26140	LOSS	11	2.9
CNVR_396	22	21708597	21740799	32203	LOSS	1	0.3
CNVR_397	22	35059005	35163091	104087	LOSS	1	0.3
CNVR_398	22	50594496	50652412	57917	LOSS	24	6.3
CNVR_399	22	51216484	51283351	66868	LOSS	2	0.5
CNVR_400	22	52305473	52383330	77858	LOSS	3	0.8
CNVR_401	22	56757151	56772708	15558	LOSS	1	0.3
CNVR_402	22	59345821	59370397	24577	LOSS	1	0.3
CNVR_403	22	60420003	60466907	46905	LOSS	1	0.3
CNVR_404	23	10121	821833	811713	GAIN	7	1.8
CNVR_405	23	3275618	3419701	144084	LOSS	4	1.0
CNVR_406	23	7798522	7823509	24988	LOSS	4	1.0
CNVR_407	23	19239332	19280958	41627	LOSS	1	0.3
CNVR_408	23	25335659	25442124	106466	MIXED	90	23.5
CNVR_409	23	26905056	26929522	24467	GAIN	2	0.5
CNVR_410	23	28431174	28494393	63220	LOSS	3	0.8
CNVR_411	23	28980942	29113538	132597	GAIN	72	18.8
CNVR_412	23	30441844	30472870	31027	LOSS	6	1.6
CNVR_413	23	31451136	31646894	195759	LOSS	6	1.6
CNVR_414	23	34496662	35011159	514498	GAIN	192	50.1
CNVR_415	23	39348688	39366704	18017	LOSS	1	0.3
CNVR_416	23	48563085	48603083	39999	GAIN	35	9.1
CNVR_417	23	52258805	52465632	206828	GAIN	9	2.3
CNVR_418	24	54398	240874	186477	GAIN	3	0.8
CNVR_419	24	7902607	7965952	63346	GAIN	43	11.2
CNVR_420	24	8570091	8627996	57906	LOSS	2	0.5
CNVR_421	24	19193737	19220121	26385	GAIN	3	0.8
CNVR_422	25	271849	395688	123840	LOSS	12	3.1
CNVR_423	25	1401564	1450644	49081	GAIN	2	0.5
CNVR_424	25	2797108	2821003	23896	GAIN	1	0.3
CNVR_425	25	3508578	3536406	27829	LOSS	3	0.8
CNVR_426	25	20076039	20135624	59586	LOSS	1	0.3
CNVR_427	25	34851458	34929267	77810	LOSS	2	0.5
CNVR_428	25	37121234	37184089	62856	GAIN	11	2.9
CNVR_429	25	37557915	37593814	35900	LOSS	1	0.3
CNVR_430	25	41250992	41324679	73688	LOSS	2	0.5
CNVR_431	25	42777451	42879707	102257	GAIN	1	0.3
CNVR_432	26	1397450	1619118	221669	GAIN	2	0.5
CNVR_433	26	2698467	2768799	70333	LOSS	7	1.8
CNVR_434	26	2939882	2976918	37037	GAIN	3	0.8
CNVR_435	26	3239867	3275704	35838	GAIN	2	0.5
CNVR_436	26	7923592	7980702	57111	GAIN	1	0.3
CNVR_437	26	23154429	23162528	8100	GAIN	1	0.3

CNVR_438	26	23633113	23722803	89691	GAIN	20	5.2
CNVR_439	26	24382256	24563742	181487	LOSS	9	2.3
CNVR_440	26	25115642	25158178	42537	LOSS	2	0.5
CNVR_441	26	26417634	26494822	77189	GAIN	1	0.3
CNVR_442	26	44535684	44616273	80590	LOSS	1	0.3
CNVR_443	26	44895103	45016154	121052	LOSS	2	0.5
CNVR_444	26	46930040	46945920	15881	GAIN	1	0.3
CNVR_445	26	51131518	51286609	155092	LOSS	8	2.1
CNVR_446	27	309276	327206	17931	LOSS	1	0.3
CNVR_447	27	6682457	6751068	68612	LOSS	4	1.0
CNVR_448	27	14532319	14565056	32738	LOSS	2	0.5
CNVR_449	27	19913335	20065987	152653	GAIN	2	0.5
CNVR_450	27	21164500	21215732	51233	GAIN	2	0.5
CNVR_451	27	27034067	27069527	35461	LOSS	2	0.5
CNVR_452	28	1598731	1689914	91184	GAIN	23	6.0
CNVR_453	28	1895637	2860512	964876	MIXED	193	50.4
CNVR_454	28	16657715	16713711	55997	LOSS	1	0.3
CNVR_455	28	28462492	28526115	63624	LOSS	26	6.8
CNVR_456	28	29657271	29735364	78094	LOSS	2	0.5
CNVR_457	28	30210288	30238686	28399	GAIN	2	0.5
CNVR_458	28	35016127	35053502	37376	LOSS	1	0.3
CNVR_459	28	35193683	35220597	26915	LOSS	1	0.3
CNVR_460	28	41642278	41672155	29878	LOSS	3	0.8
CNVR_461	28	43882947	43921177	38231	LOSS	1	0.3
CNVR_462	29	16860	586782	569923	GAIN	8	2.1
CNVR_463	29	4510055	4576246	66192	LOSS	8	2.1
CNVR_464	29	11800467	11845269	44803	LOSS	70	18.3
CNVR_465	29	21873578	22025147	151570	GAIN	1	0.3
CNVR_466	29	27711080	27844168	133089	GAIN	14	3.7
CNVR_467	29	28068846	28088730	19885	GAIN	1	0.3
CNVR_468	29	29522417	29549824	27408	GAIN	2	0.5
CNVR_469	29	38341163	39796110	1454948	GAIN	108	28.2
CNVR_470	29	39944693	40115143	170451	GAIN	10	2.6
CNVR_471	29	41683317	41725223	41907	LOSS	13	3.4
CNVR_472	29	42437944	42567601	129658	MIXED	50	13.1
CNVR_473	29	44273061	44347324	74264	LOSS	32	8.4
CNVR_474	29	48234047	48276737	42691	LOSS	1	0.3
CNVR_475	29	50230041	50307491	77451	LOSS	18	4.7

S3_Table

Chr	Chr_size_pb	Total_CNVR_size_pb	CNVR_size%	CNVR_n
1	1,58E+08	2176097	1.4	24
2	1,37E+08	1528809	1.1	18
3	1,21E+08	2474118	2.0	22
4	1,21E+08	1509729	1.2	21
5	1,21E+08	3347755	2.8	22
6	1,19E+08	854571	0.7	10
7	1,13E+08	3301727	2.9	26
8	1,13E+08	2002808	1.8	29
9	1,06E+08	2025327	1.9	17
10	1,04E+08	3302176	3.2	10
11	1,07E+08	1933172	1.8	23
12	91163125	6360362	7.0	15
13	84240350	1315362	1.6	18
14	84648390	1586634	1.9	16
15	85296676	4110701	4.8	24
16	81724687	1951949	2.4	18
17	75158596	933690	1.2	15
18	66004023	2502250	3.8	18
19	64057457	1380600	2.2	20
20	72042655	501490	0.7	8
21	71599096	2658010	3.7	18
22	61435874	582927	0.9	11
23	52530062	2355290	4.5	14
24	62714930	334114	0.5	4
25	42904170	636743	1.5	10
26	51681464	1193607	2.3	14
27	45407902	358628	0.8	6
28	46312546	1414574	3.1	10
29	51505224	3004240	5.8	14

S4_Table

CNVR_ID	Chr	Start	End	Size	Freq_n	Freq_%	Type	HCW	REA	SBT	TD7	TD14	TD21	IFC	ICC
CNVR_1	1	16947	147231	130285	58	15.1	GAIN	0.0496	0.503	0.679	0.664	0.369	0.734	0.559	0.835
CNVR_2	1	1419261	1640525	221265	61	15.9	GAIN	0.4142	0.002	0.009	0.697	0.748	0.277	0.413	0.789
CNVR_5	1	17851162	17873260	22099	12	3.1	GAIN	0.6360	0.236	0.611	0.129	0.016	0.639	0.939	0.866
CNVR_16	1	93730576	93819471	88896	216	56.4	LOSS	0.4830	0.003	0.260	0.855	0.459	0.401	0.503	0.364
CNVR_17	1	1,05E+08	1,05E+08	251767	41	10.7	LOSS	0.0488	0.308	0.862	0.911	0.329	0.352	0.358	0.747
CNVR_27	2	5353429	5397349	43921	10	2.6	LOSS	0.6558	0.795	0.701	0.706	0.582	0.028	0.597	0.750
CNVR_42	2	1,35E+08	1,36E+08	514558	52	13.6	GAIN	0.7160	0.036	0.965	0.960	0.552	0.403	0.271	0.386
CNVR_45	3	11959762	12124072	164311	9	2.3	GAIN	0.1701	0.040	0.036	0.294	0.727	0.531	0.567	0.615
CNVR_68	4	20673638	20701989	28352	13	3.4	LOSS	0.8916	0.629	0.393	0.844	0.550	0.755	0.040	0.493
CNVR_80	4	1,06E+08	1,06E+08	147904	5	1.3	GAIN	0.0105	0.933	0.018	0.014	0.005	0.564	0.263	0.872
CNVR_82	4	1,14E+08	1,14E+08	418179	93	24.3	GAIN	0.9962	0.461	0.330	0.482	0.237	0.046	0.972	0.091
CNVR_99	5	1,01E+08	1,01E+08	76442	9	2.3	GAIN	0.5606	0.184	0.039	0.680	0.135	0.654	0.047	0.369
CNVR_105	5	1,17E+08	1,18E+08	383708	151	39.4	MIXED	0.6607	0.896	0.615	0.021	0.002	0.037	0.082	0.084
CNVR_120	7	6604091	6718398	114308	7	1.8	LOSS	0.8795	0.644	0.004	0.166	0.073	0.849	0.042	0.969
CNVR_121	7	7798579	7941613	143035	21	5.5	MIXED	0.0674	0.004	0.098	0.490	0.968	0.450	0.710	0.108
CNVR_127	7	15147652	15178739	31088	6	1.6	GAIN	0.6724	0.776	0.896	0.681	0.568	0.213	0.076	0.001
CNVR_130	7	22243143	22418258	175116	24	6.3	LOSS	0.9164	0.028	0.829	0.270	0.248	0.652	0.887	0.844
CNVR_194	10	40734273	40794738	60466	33	8.6	LOSS	0.2803	0.001	0.494	0.931	0.693	0.372	0.859	0.281
CNVR_195	10	42436483	42467266	30784	48	12.5	LOSS	0.0971	0.242	0.722	0.863	0.002	0.905	0.732	0.749
CNVR_200	11	20031	118377	98347	6	1.6	GAIN	0.5109	0.126	0.476	0.630	0.050	0.076	0.297	0.840
CNVR_219	11	1,04E+08	1,04E+08	142643	18	4.7	LOSS	0.0508	0.504	0.173	0.093	0.637	0.555	0.172	0.532
CNVR_234	12	70363408	72123747	1760340	132	34.5	MIXED	0.4161	0.041	0.629	0.176	0.461	0.723	0.914	0.932
CNVR_253	13	71850682	71931812	81131	28	7.3	LOSS	0.8440	0.934	0.298	0.008	0.001	0.128	0.648	0.309
CNVR_255	13	74631978	74675560	43583	9	2.3	GAIN	0.0472	0.191	0.287	0.233	0.309	0.780	0.034	0.976
CNVR_271	14	81841283	81883661	42379	6	1.6	GAIN	0.0056	0.004	0.719	0.336	0.116	0.149	0.820	0.079
CNVR_272	15	43737	508576	464840	32	8.4	GAIN	0.8520	0.721	0.916	0.650	0.893	0.601	0.034	0.165

CNVR_275	15	1328622	1396987	68366	16	4.2	GAIN	0.7747	0.533	0.914	0.366	0.534	0.244	0.031	0.192
CNVR_280	15	30446720	30489674	42955	6	1.6	LOSS	0.1015	0.017	0.926	0.494	0.876	0.917	0.809	0.537
CNVR_290	15	79263122	79317375	54254	8	2.1	LOSS	0.0817	0.597	0.573	0.554	0.040	0.592	0.121	0.628
CNVR_292	15	79744750	79974613	229864	76	19.8	GAIN	0.0236	0.989	0.385	0.070	0.518	0.800	0.789	0.010
CNVR_293	15	80254337	81131105	876769	166	43.3	GAIN	0.2756	0.096	0.174	0.007	0.456	0.767	0.161	0.125
CNVR_296	16	24074	498301	474228	27	7.0	GAIN	0.9495	0.603	0.571	0.447	0.035	0.121	0.028	0.267
CNVR_297	16	5439901	6135133	695233	104	27.2	GAIN	0.9668	0.445	0.766	0.028	0.704	0.423	0.575	0.177
CNVR_298	16	7901886	7963357	61472	14	3.7	GAIN	0.0103	0.183	0.058	0.158	0.520	0.796	0.531	0.216
CNVR_300	16	11758931	11792218	33288	83	21.7	LOSS	0.1549	0.056	0.727	0.842	0.052	0.181	0.868	0.070
CNVR_301	16	15070508	15118639	48132	5	1.3	LOSS	0.4694	0.762	0.277	0.008	0.002	0.005	0.667	0.833
CNVR_307	16	52068803	52115458	46656	5	1.3	LOSS	0.5094	0.225	0.876	0.340	0.326	0.008	0.782	0.927
CNVR_334	18	49074618	49109287	34670	16	4.2	LOSS	0.1087	0.277	0.044	0.332	0.124	0.124	0.215	0.869
CNVR_343	18	61638038	61929947	291910	18	4.7	GAIN	0.1674	0.027	0.488	0.232	0.543	0.666	0.244	0.161
CNVR_351	19	18792038	18839754	47717	10	2.6	LOSS	0.3266	0.086	0.053	0.449	0.016	0.450	0.308	0.959
CNVR_357	19	41200141	41245524	45384	13	3.4	LOSS	0.0146	0.845	0.846	0.082	0.022	0.039	0.471	0.724
CNVR_375	21	975606	2085345	1109740	40	10.4	GAIN	0.6834	0.273	0.341	0.803	0.427	0.040	0.095	0.539
CNVR_384	21	35328865	35463366	134502	10	2.6	GAIN	0.6354	0.273	0.002	0.202	0.155	0.506	0.867	0.919
CNVR_392	21	70803573	70891033	87461	16	4.2	LOSS	0.6875	0.160	0.384	0.487	0.041	0.505	0.585	0.945
CNVR_393	22	5475849	5548263	72415	17	4.4	GAIN	0.4667	0.525	0.666	0.605	0.044	0.989	0.000	0.516
CNVR_394	22	15056590	15114988	58399	14	3.7	LOSS	0.0329	0.030	0.428	0.195	0.551	0.429	0.314	0.161
CNVR_395	22	17992618	18018757	26140	11	2.9	LOSS	0.9162	0.989	0.310	0.618	0.117	0.015	0.585	0.847
CNVR_398	22	50594496	50652412	57917	24	6.3	LOSS	0.2730	0.016	0.610	0.501	0.473	0.860	0.991	0.937
CNVR_408	23	25335659	25442124	106466	90	23.5	MIXED	0.9590	0.5962	0.446	0.103	0.954	0.259	0.157	0.031
CNVR_416	23	48563085	48603083	39999	35	9.1	GAIN	0.5529	0.8935	0.843	0.036	0.169	0.775	0.190	0.551
CNVR_422	25	271849	395688	123840	12	3.1	LOSS	0.8371	0.795	0.047	0.628	0.589	0.150	0.388	0.076
CNVR_428	25	37121234	37184089	62856	11	2.9	GAIN	0.0721	0.048	0.119	0.025	0.003	0.810	0.558	0.710
CNVR_438	26	23633113	23722803	89691	20	5.2	GAIN	0.4594	0.875	0.051	0.688	0.338	0.739	0.461	0.394
CNVR_439	26	24382256	24563742	181487	9	2.3	LOSS	0.0431	0.162	0.077	0.576	0.654	0.633	0.581	0.550
CNVR_452	28	1598731	1689914	91184	23	6.0	GAIN	0.8453	0.683	0.878	0.151	0.047	0.064	0.864	0.843

CNVR_463	29	4510055	4576246	66192	8	2.1	LOSS	0.0349	0.108	0.494	0.661	0.188	0.756	0.450	0.335
CNVR_466	29	27711080	27844168	133089	14	3.7	GAIN	0.9384	0.534	0.087	0.437	0.192	0.451	0.031	0.021
CNVR_469	29	38341163	39796110	1454948	108	28.2	GAIN	0.4380	0.953	0.702	0.636	0.463	0.368	0.014	0.105
CNVR_472	29	42437944	42567601	129658	50	13.1	MIXED	0.0719	0.001	0.894	0.106	0.053	0.458	0.323	0.651

S5_Table

CNVR ID	Chr	Start	End	Freq %	Ensembl gene_id	Entrez gene	External Gene name	Description	Gene start	Gene end	Gene biotype	Overlaping
CNVR_1	1	16947	147231	15.1	ENSBTAG00000046619		RF00001		19774	19899	rRNA	100.0
CNVR_1	1	16947	147231	15.1	ENSBTAG00000001753	507243	CLIC6	Chloride intracellular channel 6	124849	179713	protein_coding	40.8
CNVR_1	1	16947	147231	15.1	ENSBTAG00000006858				34627	35558	pseudogene	100.0
CNVR_1	1	16947	147231	15.1	ENSBTAG00000039257				69695	71121	protein_coding	100.0
CNVR_1	1	16947	147231	15.1	ENSBTAG00000035349				83323	84281	pseudogene	100.0
CNVR_120	7	6604091	6718398	1.8	ENSBTAG00000047589				6703832	6705051	protein_coding	100.0
CNVR_121	7	7798579	7941613	5.5	ENSBTAG00000013329	504310	AP1M1	Adaptor related protein complex 1 subunit mu 1	7820650	7850254	protein_coding	100.0
CNVR_121	7	7798579	7941613	5.5	ENSBTAG00000016179	539263	CIB3	Calcium and integrin binding family member 3	7873255	7883711	protein_coding	100.0
CNVR_121	7	7798579	7941613	5.5	ENSBTAG00000046846	508634	FAM32A	Family with sequence similarity 32 member A	7854536	7861328	protein_coding	100.0
CNVR_121	7	7798579	7941613	5.5	ENSBTAG00000038154	100848273	HSH2D	Hematopoietic SH2 domain containing	7886059	7894496	protein_coding	100.0
CNVR_121	7	7798579	7941613	5.5	ENSBTAG00000038696	100125881	RAB8A	Member RAS oncogene family	7899037	7919167	protein_coding	100.0
CNVR_121	7	7798579	7941613	5.5	ENSBTAG00000042477		RF00619		7809394	7809519	snRNA	100.0
CNVR_121	7	7798579	7941613	5.5	ENSBTAG00000004553	535277	TPM4	Tropomyosin 4	7923143	7948265	protein_coding	73.5

CNVR_127	7	15147652	15178739	1.6	ENSBTAG00000047799	787445	OR7E24	Olfactory receptor	15151349	15153336	protein_coding	100.0
CNVR_130	7	22243143	22418258	6.3	ENSBTAG00000025462	618405	GADD45B	Growth arrest and DNA damage inducible beta	22411968	22414079	protein_coding	100.0
CNVR_130	7	22243143	22418258	6.3	ENSBTAG00000007644	618399	GNG7	G protein gamma 7	22200650	22338566	protein_coding	69.2
CNVR_130	7	22243143	22418258	6.3	ENSBTAG00000024041				22368335	22368762	protein_coding	100.0
CNVR_130	7	22243143	22418258	6.3	ENSBTAG00000045755				22384884	22385179	protein_coding	100.0
CNVR_17	1	1,05E+08	1,05E+08	10.7	ENSBTAG00000025847				105226965	105228019	protein_coding	100.0
CNVR_17	1	1,05E+08	1,05E+08	10.7	ENSBTAG00000027213				105171799	105172518	protein_coding	100.0
CNVR_2	1	1419261	1640525	15.9	ENSBTAG00000021819	282257	IFNAR1	Interferon alpha and beta receptor subunit 1	1467704	1496151	protein_coding	100.0
CNVR_2	1	1419261	1640525	15.9	ENSBTAG00000015212	282258	IFNAR2	Interferon alpha and beta receptor subunit 2	1593295	1627137	protein_coding	100.0
CNVR_2	1	1419261	1640525	15.9	ENSBTAG00000019404	767864	IL10RB	Interleukin 10 receptor subunit beta	1563137	1591758	protein_coding	100.0
CNVR_200	11	20031	118377	1.6	ENSBTAG00000020646	506237	ZC3H6	Zinc finger CCCH-type containing 6	65466	111276	protein_coding	100.0
CNVR_200	11	20031	118377	1.6	ENSBTAG00000038257				25404	26705	protein_coding	100.0
CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000006572	768054	CARD9	Caspase recruitment domain-containing protein 9	103876015	103883072	protein_coding	100.0
CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000023064		CCDC187	Coiled-coil domain containing 187	103802443	103822759	protein_coding	73.1
CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000012880	100848156	DNLZ	DNL-type zinc finger	103874072	103875832	protein_coding	100.0

CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000001352	513180	ENTR1	Endosome associated trafficking regulator 1	103910385	103916652	protein_coding	100.0
CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000018799	100139799	GPSM1	G-protein signaling modulator 1	103840005	103869617	protein_coding	100.0
CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000001354	506349	INPP5E	Inositol polyphosphate-5-phosphatase E	103928312	103936269	protein_coding	100.0
CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000001353	767847	PMPCA	Mitochondrial-processing peptidase subunit alpha	103916755	103926395	protein_coding	100.0
CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000023933	519689	SEC16A	SEC16 homolog A. endoplasmic reticulum export factor	103939070	103964031	protein_coding	46.0
CNVR_219	11	1,04E+08	1,04E+08	4.7	ENSBTAG00000000054		SNAPC4	Small nuclear RNA activating complex polypeptide 4	103884749	103905548	protein_coding	100.0
CNVR_234	12	70363408	72123747	34.5	ENSBTAG00000045751		LOC520016	Multidrug resistance-associated protein 4-like	72065148	72204484	protein_coding	42.1
CNVR_234	12	70363408	72123747	34.5	ENSBTAG00000047383				71822642	71987841	protein_coding	100.0
CNVR_255	13	74631978	74675560	2.3	ENSBTAG00000039693				74669485	74692955	protein_coding	25.9
CNVR_27	2	5353429	5397349	2.61	ENSBTAG00000019177		BIN1	Bridging integrator 1	5350576	5407880	protein_coding	76.6
CNVR_272	15	43737	508576	8.4	ENSBTAG00000046228				182645	183853	protein_coding	100.0
CNVR_272	15	43737	508576	8.4	ENSBTAG00000040016				206552	207487	pseudogene	100.0
CNVR_272	15	43737	508576	8.4	ENSBTAG00000035803				232041	232974	pseudogene	100.0
CNVR_272	15	43737	508576	8.4	ENSBTAG00000038319	509895			212769	213701	protein_coding	100.0

CNVR_272	15	43737	508576	8.4	ENSBTAG00000045558	100299084	LOC100299084	Olfactory receptor	248025	248981	protein_coding	100.0
CNVR_272	15	43737	508576	8.4	ENSBTAG00000040008	781264	LOC781264	Olfactory receptor	362684	363613	protein_coding	100.0
CNVR_272	15	43737	508576	8.4	ENSBTAG00000048221				415571	416485	protein_coding	100.0
CNVR_280	15	30446720	30489674	1.6	ENSBTAG00000027766	614671	C1QTNF5	C1q and TNF related 5	30448399	30450337	protein_coding	100.0
CNVR_280	15	30446720	30489674	1.6	ENSBTAG00000009748	522979	MFRP	Membrane frizzled-related protein	30450602	30455935	protein_coding	100.0
CNVR_280	15	30446720	30489674	1.6	ENSBTAG00000009749	522980	USP2	Ubiquitin specific peptidase 2	30464926	30487308	protein_coding	100.0
CNVR_290	15	79263122	79317375	2.1	ENSBTAG00000008379				79284951	79285849	pseudogene	100.0
CNVR_290	15	79263122	79317375	2.1	ENSBTAG00000048031				79293430	79294440	pseudogene	100.0
CNVR_290	15	79263122	79317375	2.1	ENSBTAG00000031030	781504	LOC104968488	Olfactory receptor 4C45-like	79267160	79268059	protein_coding	100.0
CNVR_290	15	79263122	79317375	2.1	ENSBTAG00000012549	614652	OR4C3	Olfactory receptor	79276428	79277363	protein_coding	100.0
CNVR_290	15	79263122	79317375	2.1	ENSBTAG00000031032	100848076	LOC513151	Olfactory receptor-like	79315293	79316222	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000046251				79972834	79974879	pseudogene	87.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000018890				79791488	79792452	pseudogene	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000014594	787428	LOC787428	Olfactory receptor	79873735	79874785	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000048141				79933396	79935009	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000007944	538864	OR5I1	Olfactory receptor	79774520	79775464	protein_coding	100.0

CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000020746	787543	LOC787543	Olfactory receptor	79811632	79812585	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000015876	787522	OR10AG1	Olfactory receptor	79824624	79825547	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000005087	787446	OR5T1	Olfactory receptor	79852685	79853677	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000003056				79864248	79865213	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000046471	787385	LOC787385	Olfactory receptor	79895419	79896363	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000023511	788874	LOC788874	Olfactory receptor	79921913	79922869	protein_coding	100.0
CNVR_292	15	79744750	79974613	19.8	ENSBTAG00000005874	785930			79958958	79959914	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000040330	788130	OR5M11	Olfactory receptor	81067188	81068141	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000039182	513633	OR5M3	Olfactory receptor	81042867	81043799	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000045739	100299808	OR5R1	Olfactory receptor	80990805	80991764	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000046285	100300545	OR8I2	Olfactory receptor	80254691	80256208	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000039348	785680			80685809	80686821	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000038049	104969845			80695336	80696395	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000014513				80715053	80715995	pseudogene	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000046167				80827951	80829405	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000038479				80933345	80935697	protein_coding	100.0

CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000023542	782555			81105854	81107065	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000046187				81119009	81119949	pseudogene	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000045709	514057			80389094	80390035	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000035988	785944			80420321	80421262	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000035986				80477852	80478754	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000035985	513114			80484654	80485613	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000046710	100336901			80502821	80503741	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000046274	615824			80507650	80508576	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000035059	522150			80515014	80515961	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000022858				80555499	80556455	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000023310	785406			80586288	80587247	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000024423	785470			80602080	80603051	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000046845	520399			80647002	80647943	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000035990	519317			80661499	80662446	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000035989	506891			80737480	80738442	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000045723	785914			80807806	80808747	protein_coding	100.0

CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000035031	790274			80842358	80843299	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000035029				80856241	80857182	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000047721	100336916			80882784	80883710	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000046801	100300446			80920112	80921056	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000039110	100299725			80949244	80950203	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000016146	618091			81091987	81092922	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000001291	617362			80288368	80289306	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000014309	515598			80314082	80314987	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000037878				80338056	80338526	protein_coding	100.0
CNVR_293	15	80254337	81131105	43.3	ENSBTAG00000046278	528502			80371554	80372495	protein_coding	100.0
CNVR_296	16	24074	498301	7.0	ENSBTAG00000015517	524282	LOC524282	Olfactory receptor-like protein OLF2	353116	354883	protein_coding	100.0
CNVR_296	16	24074	498301	7.0	ENSBTAG00000047603				415781	416614	protein_coding	100.0
CNVR_296	16	24074	498301	7.0	ENSBTAG00000046445				424692	425632	pseudogene	100.0
CNVR_296	16	24074	498301	7.0	ENSBTAG00000035659	511893	OR5L1	Olfactory receptor	297300	298235	protein_coding	100.0
CNVR_296	16	24074	498301	7.0	ENSBTAG00000039944	787642	LOC787642	Olfactory receptor-like protein OLF2	382697	383632	protein_coding	100.0
CNVR_297	16	5439901	6135133	27.2	ENSBTAG00000039995	280816	CFH	Complement factor H	6052925	6122550	protein_coding	100.0

CNVR_297	16	5439901	6135133	27.2	ENSBTAG00000023177	100336868			5517505	5574559	protein_coding	100.0
CNVR_297	16	5439901	6135133	27.2	ENSBTAG00000024647	781004			5600155	5959906	protein_coding	100.0
CNVR_297	16	5439901	6135133	27.2	ENSBTAG00000047228				5614463	5614980	pseudogene	100.0
CNVR_297	16	5439901	6135133	27.2	ENSBTAG00000040409	790886			5847772	5876373	protein_coding	100.0
CNVR_307	16	52068803	52115458	1.3	ENSBTAG00000024508		CALML6	Calmodulin like 6	52086276	52086936	protein_coding	100.0
CNVR_307	16	52068803	52115458	1.3	ENSBTAG00000000215	281201	GNB1	G protein subunit beta 1	52106960	52184132	protein_coding	11.0
CNVR_307	16	52068803	52115458	1.3	ENSBTAG00000043783		LOC112441930	U6 spliceosomal RNA	52099563	52099668	snRNA	100.0
CNVR_307	16	52068803	52115458	1.3	ENSBTAG00000024509		TMEM52	Transmembrane protein 52	52083968	52085908	protein_coding	100.0
CNVR_307	16	52068803	52115458	1.3	ENSBTAG00000005231		CFAP74	Cilia and flagella associated protein 74	52023631	52076607	protein_coding	14.7
CNVR_307	16	52068803	52115458	1.3	ENSBTAG00000024510				52078217	52081782	protein_coding	100.0
CNVR_334	18	49074618	49109287	4.2	ENSBTAG00000012590	521171	ACP7	Acid phosphatase 7. tartrate resistant (putative)	49094425	49108117	protein_coding	100.0
CNVR_343	18	61638038	61929947	4.7	ENSBTAG00000002290				61680432	61686814	protein_coding	100.0
CNVR_343	18	61638038	61929947	4.7	ENSBTAG00000009364	514552	LOC514552	Cationic amino acid transporter 3	61714020	61719354	protein_coding	100.0
CNVR_343	18	61638038	61929947	4.7	ENSBTAG00000013345				61832253	61835027	protein_coding	100.0
CNVR_343	18	61638038	61929947	4.7	ENSBTAG00000015987	525820	LOC525820	Cationic amino acid transporter 3	61849212	61855551	protein_coding	100.0

CNVR_351	19	18792038	18839754	2.6	ENSBTAG00000029955		bta-mir-193a		18824221	18824301	miRNA	100.0
CNVR_351	19	18792038	18839754	2.6	ENSBTAG00000045149		bta-mir-2333		18813556	18813618	miRNA	100.0
CNVR_351	19	18792038	18839754	2.6	ENSBTAG00000029914		bta-mir-365-2		18811262	18811372	miRNA	100.0
CNVR_351	19	18792038	18839754	2.6	ENSBTAG00000047797				18811425	18811513	miRNA	100.0
CNVR_357	19	41200141	41245524	3.4	ENSBTAG00000012500	534280	RAR?	Retinoic acid receptor alpha	41210900	41249293	protein_coding	90.2
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000044247		RF00001		1594958	1595061	rRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000046780		RF00001		1309835	1309954	rRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000046925		RF00001		2018203	2018322	rRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000047328		RF00001		1306299	1306417	rRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000048284		RF00001		1883667	1883785	rRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000035268		RF00001		1666053	1666171	rRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000029086		RF00001		1302798	1302923	rRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000042140		RF00026		1410450	1410555	snRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000042316		RF00026		1600479	1600585	snRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000046055		RF00026		1291700	1291806	snRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000047044		RF00108		2075526	2075618	snoRNA	100.0

CNVR_375	21	975606	2085345	10.4	ENSBTAG00000047252		RF00108		2078254	2078346	snoRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000046568		RF00108		2081015	2081105	snoRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000046093		RF00108		2083792	2083885	snoRNA	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000006621				1492040	1508578	protein_coding	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000023079				1632141	1649614	protein_coding	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000006648				1746233	1751043	protein_coding	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000013567				1852998	1854799	protein_coding	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000035333				1899414	1917513	protein_coding	100.0
CNVR_375	21	975606	2085345	10.4	ENSBTAG00000039698				1050189	1050299	miRNA	100.0
CNVR_384	21	35328865	35463366	2.6	ENSBTAG00000021291	534718	STXBP6	Syntaxin binding protein 6	35415163	35655955	protein_coding	20.0
CNVR_392	21	70803573	70891033	4.2	ENSBTAG00000017616	784089	ADSSL1	Adenylosuccinate synthase like 1	70845971	70861972	protein_coding	100.0
CNVR_392	21	70803573	70891033	4.2	ENSBTAG00000017636	280991	AKT1	AKT serine/threonine kinase 1	70878138	70895537	protein_coding	74.1
CNVR_392	21	70803573	70891033	4.2	ENSBTAG00000007187		INF2	Inverted formin. FH2 and WH2 domain containing	70827525	70839732	protein_coding	100.0
CNVR_392	21	70803573	70891033	4.2	ENSBTAG00000017622	617931	SIVA1	SIVA1 apoptosis inducing factor	70870027	70874415	protein_coding	100.0
CNVR_394	22	15056590	15114988	3.7	ENSBTAG00000016076	531649	TRAK1	Trafficking kinesin protein 1	15084213	15160669	protein_coding	40.3
CNVR_395	22	17992618	18018757	2.9	ENSBTAG00000005431	540474	LMCD1	LIM and cysteine rich domains 1	17961211	18018234	protein_coding	44.9

CNVR_398	22	50594496	50652412	6.3	ENSBTAG00000000483	515397	HYAL1	Hyaluronidase 2	50600489	50601799	protein_coding	100.0
CNVR_398	22	50594496	50652412	6.3	ENSBTAG00000000484	281838	HYAL2	Hyaluronidase 1	50592324	50597462	protein_coding	57.7
CNVR_398	22	50594496	50652412	6.3	ENSBTAG00000000480	767939	IFRD2	Interferon related developmental regulator 2	50610662	50637639	protein_coding	100.0
CNVR_398	22	50594496	50652412	6.3	ENSBTAG00000000478	616532	LSMEM2	Leucine rich single-pass membrane protein 2	50638075	50640896	protein_coding	100.0
CNVR_398	22	50594496	50652412	6.3	ENSBTAG00000038084		NAA80	N(alpha)-acetyltransferase 80. NatH catalytic subunit	50604477	50605424	protein_coding	100.0
CNVR_398	22	50594496	50652412	6.3	ENSBTAG00000047200				50608457	50609166	protein_coding	100.0
CNVR_408	23	25335659	25442124	23.5	ENSBTAG00000009656	282535	BOLA-DQA2	Bovine major histocompatibility complex	25351283	25356959	protein_coding	100.0
CNVR_408	23	25335659	25442124	23.5	ENSBTAG00000038128	282494	BOLA-DQA5	Bovine major histocompatibility complex	25404020	25411643	protein_coding	100.0
CNVR_408	23	25335659	25442124	23.5	ENSBTAG00000021077	282495	BOLA-DQB	Bovine major histocompatibility complex	25375270	25388620	protein_coding	100.0
CNVR_408	23	25335659	25442124	23.5	ENSBTAG00000003352				25423551	25424597	protein_coding	100.0
CNVR_408	23	25335659	25442124	23.5	ENSBTAG00000037605				25426330	25430097	protein_coding	100.0
CNVR_42	2	1,35E+08	1,36E+08	13.6	ENSBTAG00000006438	528048	ACTL8	Actin like 8	135418586	135422028	protein_coding	100.0
CNVR_42	2	1,35E+08	1,36E+08	13.6	ENSBTAG00000000684	529043	ARHGEF10L	Rho guanine nucleotide exchange factor 10 like	135557345	135672091	protein_coding	40.4

CNVR_422	25	271849	395688	3.1	ENSBTAG00000027854	613745	ARHGDIG	Rho GDP dissociation inhibitor gamma	307203	309684	protein_coding	100.0
CNVR_422	25	271849	395688	3.1	ENSBTAG00000016577	504357	AXIN1	Axin 1	313214	347325	protein_coding	100.0
CNVR_422	25	271849	395688	3.1	ENSBTAG00000026429	768256	DECR2	Dienoyl-CoA reductase 2	387897	395807	protein_coding	98.5
CNVR_422	25	271849	395688	3.1	ENSBTAG00000016571	507493	FAM234A	Family with sequence similarity 234 member A	282554	290839	protein_coding	100.0
CNVR_422	25	271849	395688	3.1	ENSBTAG00000016581	508216	MRPL28	Mitochondrial ribosomal protein L28	361740	364295	protein_coding	100.0
CNVR_422	25	271849	395688	3.1	ENSBTAG00000016590	789324	NME4	NME/NM23 nucleoside diphosphate kinase 4	383468	386626	protein_coding	100.0
CNVR_422	25	271849	395688	3.1	ENSBTAG00000016575	504356	PDIA2	Protein disulfide isomerase family A member 2	309841	312520	protein_coding	100.0
CNVR_422	25	271849	395688	3.1	ENSBTAG00000046883		RF00001		305837	305956	rRNA	100.0
CNVR_422	25	271849	395688	3.1	ENSBTAG00000016574	521040	RGS11	Regulator of G protein signaling 11	292324	299280	protein_coding	100.0
CNVR_422	25	271849	395688	3.1	ENSBTAG00000016588	508215	TMEM8A	Transmembrane protein 8A	365646	374631	protein_coding	100.0
CNVR_428	25	37121234	37184089	2.9	ENSBTAG00000047379	507988	CYP3A4	Cytochrome P450. subfamily IIIA. polypeptide 4	37125929	37175162	protein_coding	100.0
CNVR_438	26	23633113	23722803	5.2	ENSBTAG00000014335	112444495	CYP17A1	Cytochrome P450 Family 17 Subfamily A Member 1	23694362	23700404	protein_coding	100.0
CNVR_438	26	23633113	23722803	5.2	ENSBTAG00000014336		WBP1L	WW domain binding protein 1-like	23674348	23684808	protein_coding	100.0
CNVR_439	26	24382256	24563742	2.3	ENSBTAG00000003741	510334	NEURL1	Neuralized E3 ubiquitin protein ligase 1	24330861	24403159	protein_coding	28.9

CNVR_439	26	24382256	24563742	2.3	ENSBTAG00000044153		SH3PXD2A	SH3 and PX domains 2A	24413186	24469653	protein_coding	100.0
CNVR_45	3	11959762	12124072	2.3	ENSBTAG00000038263	781011	CD1A	T-cell surface glycoprotein CD1a-like	11993523	11997024	protein_coding	100.0
CNVR_45	3	11959762	12124072	2.3	ENSBTAG00000039993	516046	CD1D	CD1D antigen. d polypeptide	12109821	12113234	protein_coding	100.0
CNVR_452	28	1598731	1689914	6.0	ENSBTAG00000048153				16811116	1764828	protein_coding	10.5
CNVR_466	29	27711080	27844168	3.7	ENSBTAG00000046665	516940	LOC516940	Olfactory receptor	27716012	27718456	protein_coding	100.0
CNVR_466	29	27711080	27844168	3.7	ENSBTAG00000037623	787625	LOC787625	Olfactory receptor Olr1242-like	27770678	27771721	protein_coding	100.0
CNVR_466	29	27711080	27844168	3.7	ENSBTAG00000040250	510984	LOC510984	Olfactory receptor	27786854	27787786	protein_coding	100.0
CNVR_466	29	27711080	27844168	3.7	ENSBTAG00000035631	112445551	LOC787694	Olfactory receptor	27820502	27821434	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000037784	518205	MGC157405	Pregnancy-associated glycoproteins	39731524	39740647	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000047892	517463	MGC157408	Pregnancy-associated glycoproteins	39457513	39466695	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000037908	281964	PAG1	Pregnancy-associated glycoproteins	39180301	39189626	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000048133	337909	PAG15	Pregnancy-associated glycoproteins	38659682	38668543	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000039970	337910	PAG16	Pregnancy-associated glycoproteins	38951945	38961304	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000026016	337912	PAG17	Pregnancy-associated glycoproteins	39626771	39635792	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000039036	337911	PAG18	Pregnancy-associated glycoproteins	38428102	38437106	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000046398	337913	PAG19	Pregnancy-associated glycoproteins	39261026	39270024	protein_coding	100.0

CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000036172	337914	PAG20	Pregnancy-associated glycoproteins	39004039	39013165	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000040340	337915	PAG21	Pregnancy-associated glycoproteins	39049999	39059075	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000036277	337898	PAG4	Pregnancy-associated glycoproteins	38793756	38802922	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000046127	337899	PAG5	Pregnancy-associated glycoproteins	38363514	38372267	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000047141	337901	PAG7	Pregnancy-associated glycoproteins	38518914	38624602	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000047145	504812			38398957	38407842	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000007849				38567091	38571882	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000045670				38594536	38600471	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000046038				38727387	38734969	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000040140				38838947	38844641	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000046497				38880449	38892585	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000047989	337908			38920418	38929107	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000039045				38966855	38973520	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000047758				39110430	39115394	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000048202				39223563	39226528	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000047419				39326703	39397241	protein_coding	100.0

CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000034244				39345959	39355136	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000048073				39390100	39397241	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000035736	614287			39541478	39550943	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000038918				39594293	39605710	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000046085				39662643	39669751	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000046686				39705826	39708801	protein_coding	100.0
CNVR_469	29	38341163	39796110	28.2	ENSBTAG00000038506				39784352	39790880	protein_coding	100.0
CNVR_472	29	42437944	42567601	13.1	ENSBTAG00000037645				42445012	42451969	protein_coding	100.0
CNVR_472	29	42437944	42567601	13.1	ENSBTAG00000011019	618367			42478123	42495303	protein_coding	100.0
CNVR_80	4	1,06E+08	1,06E+08	1.3	ENSBTAG00000020453	615201	CLEC5A	C-type lectin domain family 5. member A	106059820	106070381	protein_coding	100.0
CNVR_80	4	1,06E+08	1,06E+08	1.3	ENSBTAG00000046152	100336421	MGAM	Maltase-glucoamylase	106123753	106206190	protein_coding	22.7
CNVR_80	4	1,06E+08	1,06E+08	1.3	ENSBTAG00000024065	787789	TAS2R38	Taste 2 receptor member 38	106103110	106104018	protein_coding	100.0
CNVR_80	4	1,06E+08	1,06E+08	1.3	ENSBTAG00000003664	519161			106050918	106051862	protein_coding	100.0
CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000046257	510751	GIMAP4	GTPase IMAP family member 4	113866800	113874303	protein_coding	100.0
CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000009850	614871	GIMAP7	GTPase IMAP family member 7	113720919	113729756	protein_coding	100.0
CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000030940	510988	GIMAP7	GTPase IMAP family member 7	113910742	113941457	protein_coding	100.0

CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000001198	530031	GIMAP7	GTPase IMAP family member 7	113780811	113781704	protein_coding	100.0
CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000014402	531516	GIMAP8	GTPase IMAP family member 8	113675460	113697512	protein_coding	100.0
CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000039588	511617			113763391	113768447	protein_coding	100.0
CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000011240				113929347	113930227	pseudogene	100.0
CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000040331	512867			113952126	113959951	protein_coding	100.0
CNVR_82	4	1,14E+08	1,14E+08	24.3	ENSBTAG00000039928	768255			114032643	114038805	protein_coding	100.0
CNVR_99	5	1,01E+08	1,01E+08	2.3	ENSBTAG00000006851	509972	LOC617565	C-type lectin domain family 2 member D11	100570907	100588613	protein_coding	100.0
CNVR_99	5	1,01E+08	1,01E+08	2.3	ENSBTAG00000012026	784451	LOC784451	C-type lectin domain family 2 member H	100623083	100641927	protein_coding	100.0

S6_Table

GO_ID	GO_term	P-value	CNVR_ID	Chr	Start	End	Ensembl_gene_id	Entrezgene	External_gene_name	Gene_start	Gene_end	Gene_biotype
GO:0000064	L-ornithine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000015987	525820		61849212	61855551	protein_coding
GO:0000064	L-ornithine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000009364	514552		61714020	61719354	protein_coding
GO:0000064	L-ornithine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000002290	NA		61680432	61686814	protein_coding
GO:0000064	L-ornithine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000013345	NA		61832253	61835027	protein_coding
GO:0002504	antigen processing and presentation of peptide or polysaccharide antigen via MHC class II	0.0036548	CNVR_408	23	25335659	25442124	ENSBTAG00000037605	NA		25426330	25430097	protein_coding
GO:0002504	antigen processing and presentation of peptide or polysaccharide antigen via MHC class II	0.0036548	CNVR_408	23	25335659	25442124	ENSBTAG00000038128	282494	BOLA-DQA5	25404020	25411643	protein_coding
GO:0002504	antigen processing and presentation of peptide or polysaccharide antigen via MHC class II	0.0036548	CNVR_408	23	25335659	25442124	ENSBTAG00000021077	282495	BOLA-DQB	25375270	25388620	protein_coding
GO:0002504	antigen processing and presentation of peptide or polysaccharide antigen via MHC class II	0.0036548	CNVR_408	23	25335659	25442124	ENSBTAG00000009656	282535	BOLA-DQA2	25351283	25356959	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000046127	337899	PAG5	38363514	38372267	protein_coding

GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000039036	337911	PAG18	38428102	38437106	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000047141	337901	PAG7	38518914	38624602	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000007849	NA		38567091	38571882	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000047145	504812		38398957	38407842	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000046497	NA		38880449	38892585	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000047989	337908		38920418	38929107	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000039970	337910	PAG16	38951945	38961304	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000039045	NA		38966855	38973520	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000036172	337914	PAG20	39004039	39013165	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000040340	337915	PAG21	39049999	39059075	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000047758	NA		39110430	39115394	protein_coding

GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000037908	281964	PAG1	39180301	39189626	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000045670	NA		38594536	38600471	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000048133	337909	PAG15	38659682	38668543	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000046038	NA		38727387	38734969	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000036277	337898	PAG4	38793756	38802922	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000040140	NA		38838947	38844641	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000047892	517463	MGC157408	39457513	39466695	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000035736	614287		39541478	39550943	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000038918	NA		39594293	39605710	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000026016	337912	PAG17	39626771	39635792	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000046085	NA		39662643	39669751	protein_coding

GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000046686	NA		39705826	39708801	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000037784	518205	MGC157405	39731524	39740647	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000038506	NA		39784352	39790880	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000048202	NA		39223563	39226528	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000046398	337913	PAG19	39261026	39270024	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000047419	NA		39326703	39397241	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000034244	NA		39345959	39355136	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_469	29	38341163	39796110	ENSBTAG00000048073	NA		39390100	39397241	protein_coding
GO:0004190	aspartic-type endopeptidase activity	1.06E-16	CNVR_472	29	42437944	42567601	ENSBTAG00000037645	NA		42445012	42451969	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_120	7	6604091	6718398	ENSBTAG00000047589	NA		6703832	6705051	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_127	7	15147652	15178739	ENSBTAG00000047799	787445		15151349	15153336	protein_coding

GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_200	11	20031	118377	ENSBTAG00000038257	NA		25404	26705	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_272	15	43737	508576	ENSBTAG00000048221	NA		415571	416485	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_272	15	43737	508576	ENSBTAG00000040008	781264		362684	363613	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_272	15	43737	508576	ENSBTAG00000045558	1E+08		248025	248981	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_272	15	43737	508576	ENSBTAG00000046228	NA		182645	183853	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_272	15	43737	508576	ENSBTAG00000038319	509895		212769	213701	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_290	15	79263122	79317375	ENSBTAG00000031030	781504		79267160	79268059	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_290	15	79263122	79317375	ENSBTAG00000031032	1,01E+08		79315293	79316222	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_290	15	79263122	79317375	ENSBTAG00000012549	614652		79276428	79277363	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_292	15	79744750	79974613	ENSBTAG00000015876	787522		79824624	79825547	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding

GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_292	15	79744750	79974613	ENSBTAG00000005087	787446		79852685	79853677	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_292	15	79744750	79974613	ENSBTAG00000014594	787428		79873735	79874785	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_292	15	79744750	79974613	ENSBTAG00000020746	787543		79811632	79812585	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_292	15	79744750	79974613	ENSBTAG00000048141	NA		79933396	79935009	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNV_293	15	80254337	81131105	ENSBTAG00000039348	785680		80685809	80686821	protein_coding

GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000038049	1,05E+08		80695336	80696395	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding

GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding

GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_296	16	24074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_296	16	24074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_296	16	24074	498301	ENSBTAG00000047603	NA		415781	416614	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_296	16	24074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding

GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_466	29	27711080	27844168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_466	29	27711080	27844168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_466	29	27711080	27844168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000024065	787789	TAS2R38	1,06E+08	1,06E+08	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000003664	519161		1,06E+08	1,06E+08	protein_coding
GO:0004930	G-protein coupled receptor activity	0.01087392	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_1	1	16947	147231	ENSBTAG00000039257	NA		69695	71121	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_120	7	6604091	6718398	ENSBTAG00000047589	NA		6703832	6705051	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_127	7	15147652	15178739	ENSBTAG00000047799	787445		15151349	15153336	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_200	11	20031	118377	ENSBTAG00000038257	NA		25404	26705	protein_coding

GO:0004984	olfactory receptor activity	0.00105487	CNVR_272	15	43737	50857	ENSBTAG00000048221	NA		415571	416485	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_272	15	43737	50857	ENSBTAG00000040008	781264		362684	363613	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_272	15	43737	50857	ENSBTAG00000045558	1E+08		248025	248981	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_272	15	43737	50857	ENSBTAG00000046228	NA		182645	183853	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_272	15	43737	50857	ENSBTAG00000038319	509895		212769	213701	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_290	15	79263122	79317375	ENSBTAG00000031030	781504		79267160	79268059	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_290	15	79263122	79317375	ENSBTAG00000031032	1,01E+08		79315293	79316222	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_290	15	79263122	79317375	ENSBTAG00000012549	614652		79276428	79277363	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000015876	787522		79824624	79825547	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding

GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000005087	787446		79852685	79853677	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000014594	787428		79873735	79874785	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000020746	787543		79811632	79812585	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000048141	NA		79933396	79935009	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000039348	785680		80685809	80686821	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding

GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000038049	1,05E+08		80695336	80696395	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding

GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000037878	NA		80338056	80338526	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding

GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_296	16	24074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_296	16	24074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_296	16	24074	498301	ENSBTAG00000047603	NA		415781	416614	protein_coding
GO:0004984	olfactory receptor activity	0.00105487	CNVR_296	16	24074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding

GO:0004984	olfactory receptor activity	0.00105487 2	CNVR_466	29	27711080	27844168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0004984	olfactory receptor activity	0.00105487 2	CNVR_466	29	27711080	27844168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding
GO:0004984	olfactory receptor activity	0.00105487 2	CNVR_466	29	27711080	27844168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding
GO:0004984	olfactory receptor activity	0.00105487 2	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0004984	olfactory receptor activity	0.00105487 2	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000003664	519161		1,06E+08	1,06E+08	protein_coding
GO:0004984	olfactory receptor activity	0.00105487 2	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_1	1	16947	147231	ENSBTAG00000039257	NA		69695	71121	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_272	15	43737	5085 76	ENSBTAG00000045558	1E+08		248025	248981	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_272	15	43737	5085 76	ENSBTAG00000046228	NA		182645	183853	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_272	15	43737	5085 76	ENSBTAG00000038319	509895		212769	213701	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding

GO:0005549	odorant binding	3.67E-14	CNVR_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding

GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000037878	NA		80338056	80338526	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding

GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding

GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_296	16	240074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_296	16	240074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_296	16	240074	498301	ENSBTAG00000047603	NA		415781	416614	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_296	16	240074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_466	29	27711080	27844168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_466	29	27711080	27844168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_466	29	27711080	27844168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0005549	odorant binding	3.67E-14	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding

GO:0006508	proteolysis	4.99E-13	CNVR_219	11	1,04E+08	1,04E+08	ENSBTAG00000001353	767847	PMPCA	1,04E+08	1,04E+08	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_280	15	30446720	30489674	ENSBTAG00000009749	522980	USP2	30464926	30487308	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000046127	337899	PAG5	38363514	38372267	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000039036	337911	PAG18	38428102	38437106	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000047141	337901	PAG7	38518914	38624602	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000007849	NA		38567091	38571882	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000047145	504812		38398957	38407842	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000046497	NA		38880449	38892585	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000047989	337908		38920418	38929107	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000039970	337910	PAG16	38951945	38961304	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000039045	NA		38966855	38973520	protein_coding

GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000036172	337914	PAG20	39004039	39013165	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000040340	337915	PAG21	39049999	39059075	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000047758	NA		39110430	39115394	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000037908	281964	PAG1	39180301	39189626	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000045670	NA		38594536	38600471	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000048133	337909	PAG15	38659682	38668543	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000046038	NA		38727387	38734969	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000036277	337898	PAG4	38793756	38802922	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000040140	NA		38838947	38844641	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000047892	517463	MGC157408	39457513	39466695	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000035736	614287		39541478	39550943	protein_coding

GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000038918	NA		39594293	39605710	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000026016	337912	PAG17	39626771	39635792	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000046085	NA		39662643	39669751	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000046686	NA		39705826	39708801	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000037784	518205	MGC157405	39731524	39740647	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000038506	NA		39784352	39790880	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000048202	NA		39223563	39226528	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000046398	337913	PAG19	39261026	39270024	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000047419	NA		39326703	39397241	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000034244	NA		39345959	39355136	protein_coding
GO:0006508	proteolysis	4.99E-13	CNVR_469	29	38341163	39796110	ENSBTAG00000048073	NA		39390100	39397241	protein_coding

GO:0006508	proteolysis	4.99E-13	CNVR_472	29	42437944	42567601	ENSBTAG00000037645	NA		42445012	42451969	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_1	1	16947	147231	ENSBTAG00000039257	NA		69695	71121	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_120	7	6604091	6718398	ENSBTAG00000047589	NA		6703832	6705051	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_121	7	7798579	7941613	ENSBTAG00000038154	1,01E+08	HSH2D	7886059	7894496	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_127	7	15147652	15178739	ENSBTAG00000047799	787445		15151349	15153336	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_130	7	22243143	22418258	ENSBTAG00000007644	618399	GNG7	22200650	22338566	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_200	11	20031	118377	ENSBTAG00000038257	NA		25404	26705	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_272	15	43737	508576	ENSBTAG00000048221	NA		415571	416485	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_272	15	43737	508576	ENSBTAG00000040008	781264		362684	363613	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_272	15	43737	508576	ENSBTAG00000045558	1E+08		248025	248981	protein_coding
GO:0007165	signal transduction	0.00250533 4	CNVR_272	15	43737	508576	ENSBTAG00000046228	NA		182645	183853	protein_coding

GO:0007165	signal transduction	0.00250534	CNVR_272	15	43737	508576	ENSBTAG00000038319	509895		212769	213701	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_290	15	79263122	79317375	ENSBTAG00000031030	781504		79267160	79268059	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_290	15	79263122	79317375	ENSBTAG00000031032	1,01E+08		79315293	79316222	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_290	15	79263122	79317375	ENSBTAG00000012549	614652		79276428	79277363	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000015876	787522		79824624	79825547	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000005087	787446		79852685	79853677	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000014594	787428		79873735	79874785	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding

GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000020746	787543		79811632	79812585	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_292	15	79744750	79974613	ENSBTAG00000048141	NA		79933396	79935009	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_293	15	80254337	81131105	ENSBTAG00000039348	785680		80685809	80686821	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding

GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000038049	1,05E+08		80695336	80696395	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000037878	NA		80338056	80338526	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding

GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding

GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_296	16	24074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_296	16	24074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_296	16	24074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_307	16	52068803	52115458	ENSBTAG00000000215	281201	GNB1	52106960	52184132	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_357	19	41200141	41245524	ENSBTAG00000012500	534280	RARA	41210900	41249293	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_422	25	271849	395688	ENSBTAG00000016577	504357	AXIN1	313214	347325	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_466	29	27711080	27844168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0007165	signal transduction	0.00250533	CNVR_466	29	27711080	27844168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding

GO:0007165	signal transduction	0.00250534	CNVR_466	29	27711080	27844168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000024065	787789	TAS2R38	1,06E+08	1,06E+08	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000003664	519161		1,06E+08	1,06E+08	protein_coding
GO:0007165	signal transduction	0.00250534	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210	CNVR_1	1	16947	147231	ENSBTAG00000039257	NA		69695	71121	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210	CNVR_120	7	6604091	6718398	ENSBTAG00000047589	NA		6703832	6705051	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210	CNVR_127	7	151477652	151778739	ENSBTAG00000047799	787445		151511349	151533336	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210	CNVR_130	7	22243143	22418258	ENSBTAG00000007644	618399	GNG7	22200650	22338566	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210	CNVR_200	11	20031	118377	ENSBTAG00000038257	NA		25404	26705	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210	CNVR_272	15	43737	508576	ENSBTAG00000048221	NA		415571	416485	protein_coding

GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_272	15	43737	508576	ENSBTAG00000040008	781264		362684	363613	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_272	15	43737	508576	ENSBTAG00000045558	1E+08		248025	248981	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_272	15	43737	508576	ENSBTAG00000046228	NA		182645	183853	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_272	15	43737	508576	ENSBTAG00000038319	509895		212769	213701	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_290	15	79263122	79317375	ENSBTAG00000031030	781504		79267160	79268059	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_290	15	79263122	79317375	ENSBTAG00000031032	1,01E+08		79315293	79316222	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_290	15	79263122	79317375	ENSBTAG00000012549	614652		79276428	79277363	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000015876	787522		79824624	79825547	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding

GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000005087	787446		79852685	79853677	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000014594	787428		79873735	79874785	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000020746	787543		79811632	79812585	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_292	15	79744750	79974613	ENSBTAG00000048141	NA		79933396	79935009	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000039348	785680		80685809	80686821	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding

GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000038049	1,05E+08		80695336	80696395	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding

GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000037878	NA		80338056	80338526	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding

GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_296	16	24074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_296	16	24074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_296	16	24074	498301	ENSBTAG00000047603	NA		415781	416614	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_296	16	24074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241211	CNVR_307	16	52068803	52115458	ENSBTAG00000000215	281201	GNB1	52106960	52184132	protein_coding

GO:0007186	G-protein coupled receptor signaling pathway	0.00241210 1	CNVR_422	25	271849	395688	ENSBTAG00000016574	521040	RGS11	292324	299280	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210 1	CNVR_466	29	27711080	27844168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210 1	CNVR_466	29	27711080	27844168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210 1	CNVR_466	29	27711080	27844168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210 1	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210 1	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000024065	787789	TAS2R38	1,06E+08	1,06E+08	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210 1	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000003664	519161		1,06E+08	1,06E+08	protein_coding
GO:0007186	G-protein coupled receptor signaling pathway	0.00241210 1	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding
GO:0007608	sensory perception of smell	0.00074726 9	CNVR_1	1	16947	147231	ENSBTAG00000039257	NA		69695	71121	protein_coding
GO:0007608	sensory perception of smell	0.00074726 9	CNVR_120	7	6604091	6718398	ENSBTAG00000047589	NA		6703832	6705051	protein_coding
GO:0007608	sensory perception of smell	0.00074726 9	CNVR_127	7	15147652	15178739	ENSBTAG00000047799	787445		15151349	15153336	protein_coding

GO:0007608	sensory perception of smell	0.000747269	CNVR_200	11	20031	118377	ENSBTAG00000038257	NA		25404	26705	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_272	15	43737	508576	ENSBTAG00000048221	NA		415571	416485	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_272	15	43737	508576	ENSBTAG00000040008	781264		362684	363613	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_272	15	43737	508576	ENSBTAG00000045558	1E+08		248025	248981	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_272	15	43737	508576	ENSBTAG00000046228	NA		182645	183853	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_272	15	43737	508576	ENSBTAG00000038319	509895		212769	213701	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_290	15	79263122	79317375	ENSBTAG00000031030	781504		79267160	79268059	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_290	15	79263122	79317375	ENSBTAG00000031032	1,01E+08		79315293	79316222	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_290	15	79263122	79317375	ENSBTAG00000012549	614652		79276428	79277363	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000015876	787522		79824624	79825547	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding

GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000005087	787446		79852685	79853677	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000014594	787428		79873735	79874785	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000020746	787543		79811632	79812585	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_292	15	79744750	79974613	ENSBTAG00000048141	NA		79933396	79935009	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000039348	785680		80685809	80686821	protein_coding

GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000038049	1,05E+08		80695336	80696395	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding

GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000037878	NA		80338056	80338526	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding

GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_296	16	24074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_296	16	24074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0007608	sensory perception of smell	0.000747269	CNVR_296	16	24074	498301	ENSBTAG00000047603	NA		415781	416614	protein_coding

GO:0007608	sensory perception of smell	0.00074726	CNVR_296	16	24074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding
GO:0007608	sensory perception of smell	0.00074726	CNVR_466	29	27711080	27844168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0007608	sensory perception of smell	0.00074726	CNVR_466	29	27711080	27844168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding
GO:0007608	sensory perception of smell	0.00074726	CNVR_466	29	27711080	27844168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding
GO:0007608	sensory perception of smell	0.00074726	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0007608	sensory perception of smell	0.00074726	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000003664	519161		1,06E+08	1,06E+08	protein_coding
GO:0007608	sensory perception of smell	0.00074726	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_219	11	1,04E+08	1,04E+08	ENSBTAG00000001353	767847	PMPCA	1,04E+08	1,04E+08	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_280	15	30446720	30489674	ENSBTAG00000009749	522980	USP2	30464926	30487308	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000046127	337899	PAG5	38363514	38372267	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000039036	337911	PAG18	38428102	38437106	protein_coding

GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000047141	337901	PAG7	38518914	38624602	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000047145	504812		38398957	38407842	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000046497	NA		38880449	38892585	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000047989	337908		38920418	38929107	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000039970	337910	PAG16	38951945	38961304	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000039045	NA		38966855	38973520	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000036172	337914	PAG20	39004039	39013165	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000040340	337915	PAG21	39049999	39059075	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000037908	281964	PAG1	39180301	39189626	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000048133	337909	PAG15	38659682	38668543	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000046038	NA		38727387	38734969	protein_coding

GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000036277	337898	PAG4	38793756	38802922	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000040140	NA		38838947	38844641	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000047892	517463	MGC157408	39457513	39466695	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000035736	614287		39541478	39550943	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000038918	NA		39594293	39605710	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000026016	337912	PAG17	39626771	39635792	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000046085	NA		39662643	39669751	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000046686	NA		39705826	39708801	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000037784	518205	MGC157405	39731524	39740647	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000038506	NA		39784352	39790880	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000046398	337913	PAG19	39261026	39270024	protein_coding

GO:0008233	peptidase activity	2.86E-14	CNVR_469	29	38341163	39796110	ENSBTAG00000048073	NA		39390100	39397241	protein_coding
GO:0008233	peptidase activity	2.86E-14	CNVR_472	29	42437944	42567601	ENSBTAG00000037645	NA		42445012	42451969	protein_coding
GO:0015181	arginine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000015987	525820		61849212	61855551	protein_coding
GO:0015181	arginine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000009364	514552		61714020	61719354	protein_coding
GO:0015181	arginine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000002290	NA		61680432	61686814	protein_coding
GO:0015181	arginine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000013345	NA		61832253	61835027	protein_coding
GO:0015189	L-lysine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000015987	525820		61849212	61855551	protein_coding
GO:0015189	L-lysine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000009364	514552		61714020	61719354	protein_coding
GO:0015189	L-lysine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000002290	NA		61680432	61686814	protein_coding
GO:0015189	L-lysine transmembrane transporter activity	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000013345	NA		61832253	61835027	protein_coding
GO:0016020	membrane	0.00214757 8	CNVR_1	1	16947	147231	ENSBTAG00000039257	NA		69695	71121	protein_coding

GO:0016020	membrane	0.002147578	CNVR_1	1	16947	147231	ENSBTAG00000001753	507243		124849	179713	protein_coding
GO:0016020	membrane	0.002147578	CNVR_120	7	6604091	6718398	ENSBTAG00000047589	NA		6703832	6705051	protein_coding
GO:0016020	membrane	0.002147578	CNVR_2	1	1419261	1640525	ENSBTAG00000015212	282258	IFNAR2	1593295	1627137	protein_coding
GO:0016020	membrane	0.002147578	CNVR_2	1	1419261	1640525	ENSBTAG00000019404	767864	IL10RB	1563137	1591758	protein_coding
GO:0016020	membrane	0.002147578	CNVR_2	1	1419261	1640525	ENSBTAG00000021819	282257	IFNAR1	1467704	1496151	protein_coding
GO:0016020	membrane	0.002147578	CNVR_234	12	70363408	72123747	ENSBTAG00000045751	NA		72065148	72204484	protein_coding
GO:0016020	membrane	0.002147578	CNVR_234	12	70363408	72123747	ENSBTAG00000047383	NA		71822642	71987841	protein_coding
GO:0016020	membrane	0.002147578	CNVR_27	2	53353429	53973349	ENSBTAG00000019177	NA	BIN1	53505576	54077880	protein_coding
GO:0016020	membrane	0.002147578	CNVR_121	7	7798579	7941613	ENSBTAG00000013329	504310	AP1M1	7820650	7850254	protein_coding
GO:0016020	membrane	0.002147578	CNVR_121	7	7798579	7941613	ENSBTAG00000038696	1E+08	RAB8A	7899037	7919167	protein_coding
GO:0016020	membrane	0.002147578	CNVR_127	7	15147652	15178739	ENSBTAG00000047799	787445		15151349	15153336	protein_coding

GO:0016020	membrane	0.00214757	CNVR_130	7	22243143	22418258	ENSBTAG00000007644	618399	GNG7	22200650	22338566	protein_coding
GO:0016020	membrane	0.00214757	CNVR_200	11	20031	118377	ENSBTAG00000038257	NA		25404	26705	protein_coding
GO:0016020	membrane	0.00214757	CNVR_219	11	1,04E+08	1,04E+08	ENSBTAG00000023933	519689	SEC16A	1,04E+08	1,04E+08	protein_coding
GO:0016020	membrane	0.00214757	CNVR_219	11	1,04E+08	1,04E+08	ENSBTAG00000001353	767847	PMPCA	1,04E+08	1,04E+08	protein_coding
GO:0016020	membrane	0.00214757	CNVR_272	15	43737	50857 6	ENSBTAG00000048221	NA		415571	416485	protein_coding
GO:0016020	membrane	0.00214757	CNVR_272	15	43737	50857 6	ENSBTAG00000040008	781264		362684	363613	protein_coding
GO:0016020	membrane	0.00214757	CNVR_272	15	43737	50857 6	ENSBTAG00000045558	1E+08		248025	248981	protein_coding
GO:0016020	membrane	0.00214757	CNVR_272	15	43737	50857 6	ENSBTAG00000046228	NA		182645	183853	protein_coding
GO:0016020	membrane	0.00214757	CNVR_272	15	43737	50857 6	ENSBTAG00000038319	509895		212769	213701	protein_coding
GO:0016020	membrane	0.00214757	CNVR_280	15	30446720	30489674	ENSBTAG00000027766	614671	C1QTNF5	30448399	30450337	protein_coding
GO:0016020	membrane	0.00214757	CNVR_280	15	30446720	30489674	ENSBTAG00000009748	522979	MFRP	30450602	30455935	protein_coding

GO:0016020	membrane	0.002147578	CNVR_290	15	79263122	79317375	ENSBTAG00000031030	781504		79267160	79268059	protein_coding
GO:0016020	membrane	0.002147578	CNVR_290	15	79263122	79317375	ENSBTAG00000031032	1,01E+08		79315293	79316222	protein_coding
GO:0016020	membrane	0.002147578	CNVR_290	15	79263122	79317375	ENSBTAG00000012549	614652		79276428	79277363	protein_coding
GO:0016020	membrane	0.002147578	CNVR_292	15	79744750	79974613	ENSBTAG00000015876	787522		79824624	79825547	protein_coding
GO:0016020	membrane	0.002147578	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding
GO:0016020	membrane	0.002147578	CNVR_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding
GO:0016020	membrane	0.002147578	CNVR_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding
GO:0016020	membrane	0.002147578	CNVR_292	15	79744750	79974613	ENSBTAG00000005087	787446		79852685	79853677	protein_coding
GO:0016020	membrane	0.002147578	CNVR_292	15	79744750	79974613	ENSBTAG00000014594	787428		79873735	79874785	protein_coding
GO:0016020	membrane	0.002147578	CNVR_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding
GO:0016020	membrane	0.002147578	CNVR_292	15	79744750	79974613	ENSBTAG00000020746	787543		79811632	79812585	protein_coding

GO:0016020	membrane	0.00214757	CNVR_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0016020	membrane	0.00214757	CNVR_292	15	79744750	79974613	ENSBTAG00000048141	NA		79933396	79935009	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000039348	785680		80685809	80686821	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding
GO:0016020	membrane	0.00214757	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding

GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000038049	1,05E+08		80695336	80696395	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000037878	NA		80338056	80338526	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding
GO:0016020	membrane	0.002147578	CNV_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding

GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding

GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0016020	membrane	0.00214757	CNV_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0016020	membrane	0.00214757	CNV_296	16	24074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0016020	membrane	0.00214757	CNV_296	16	24074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0016020	membrane	0.00214757	CNV_296	16	24074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding
GO:0016020	membrane	0.00214757	CNV_307	16	52068803	52115458	ENSBTAG00000000215	281201	GNB1	52106960	52184132	protein_coding
GO:0016020	membrane	0.00214757	CNV_307	16	52068803	52115458	ENSBTAG00000024509	NA	TMEM52	52083968	52085908	protein_coding
GO:0016020	membrane	0.00214757	CNV_384	21	35328865	35463366	ENSBTAG00000021291	534718	STXBP6	35415163	35655955	protein_coding
GO:0016020	membrane	0.00214757	CNV_398	22	50594496	50652412	ENSBTAG00000000484	281838	HYAL2	50592324	50597462	protein_coding
GO:0016020	membrane	0.00214757	CNV_398	22	50594496	50652412	ENSBTAG00000000483	515397	HYAL1	50600489	50601799	protein_coding
GO:0016020	membrane	0.00214757	CNV_398	22	50594496	50652412	ENSBTAG00000000478	616532	LSMEM2	50638075	50640896	protein_coding

GO:0016020	membrane	0.002147578	CNVR_408	23	25335659	25442124	ENSBTAG00000037605	NA		25426330	25430097	protein_coding
GO:0016020	membrane	0.002147578	CNVR_408	23	25335659	25442124	ENSBTAG00000038128	282494	BOLA-DQA5	25404020	25411643	protein_coding
GO:0016020	membrane	0.002147578	CNVR_408	23	25335659	25442124	ENSBTAG00000021077	282495	BOLA-DQB	25375270	25388620	protein_coding
GO:0016020	membrane	0.002147578	CNVR_408	23	25335659	25442124	ENSBTAG00000009656	282535	BOLA-DQA2	25351283	25356959	protein_coding
GO:0016020	membrane	0.002147578	CNVR_422	25	271849	395688	ENSBTAG00000016588	508215	TMEM8A	365646	374631	protein_coding
GO:0016020	membrane	0.002147578	CNVR_422	25	271849	395688	ENSBTAG00000027854	613745	ARHGDIG	307203	309684	protein_coding
GO:0016020	membrane	0.002147578	CNVR_422	25	271849	395688	ENSBTAG00000016571	507493	FAM234A	282554	290839	protein_coding
GO:0016020	membrane	0.002147578	CNVR_438	26	236333113	237222803	ENSBTAG00000014336	NA	WBP1L	23674348	23684808	protein_coding
GO:0016020	membrane	0.002147578	CNVR_466	29	277101080	278404168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0016020	membrane	0.002147578	CNVR_466	29	277101080	278404168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding
GO:0016020	membrane	0.002147578	CNVR_466	29	277101080	278404168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding

GO:0016020	membrane	0.002147578	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0016020	membrane	0.002147578	CNVR_469	29	38341163	39796110	ENSBTAG00000048202	NA		39223563	39226528	protein_coding
GO:0016020	membrane	0.002147578	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000024065	787789	TAS2R38	1,06E+08	1,06E+08	protein_coding
GO:0016020	membrane	0.002147578	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000020453	615201	CLEC5A	1,06E+08	1,06E+08	protein_coding
GO:0016020	membrane	0.002147578	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000046152	1E+08	MGAM	1,06E+08	1,06E+08	protein_coding
GO:0016020	membrane	0.002147578	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000003664	519161		1,06E+08	1,06E+08	protein_coding
GO:0016020	membrane	0.002147578	CNVR_82	4	1,14E+08	1,14E+08	ENSBTAG00000039588	511617		1,14E+08	1,14E+08	protein_coding
GO:0016020	membrane	0.002147578	CNVR_82	4	1,14E+08	1,14E+08	ENSBTAG00000040331	512867		1,14E+08	1,14E+08	protein_coding
GO:0016020	membrane	0.002147578	CNVR_343	18	61638038	61929947	ENSBTAG00000015987	525820		61849212	61855551	protein_coding
GO:0016020	membrane	0.002147578	CNVR_343	18	61638038	61929947	ENSBTAG00000009364	514552		61714020	61719354	protein_coding
GO:0016020	membrane	0.002147578	CNVR_343	18	61638038	61929947	ENSBTAG00000002290	NA		61680432	61686814	protein_coding

GO:0016020	membrane	0.002147578	CNVR_343	18	61638038	61929947	ENSBTAG00000013345	NA		61832253	61835027	protein_coding
GO:0016020	membrane	0.002147578	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding
GO:0016020	membrane	0.002147578	CNVR_375	21	975606	2085345	ENSBTAG00000006621	NA		1492040	1508578	protein_coding
GO:0016020	membrane	0.002147578	CNVR_428	25	37121234	37184089	ENSBTAG00000047379	507988	CYP3A4	37125929	37175162	protein_coding
GO:0016020	membrane	0.002147578	CNVR_45	3	11959762	12124072	ENSBTAG00000038263	781011	CD1A	11993523	11997024	protein_coding
GO:0016020	membrane	0.002147578	CNVR_45	3	11959762	12124072	ENSBTAG00000047988	516046	CD1D	12109821	12113234	protein_coding
GO:0016020	membrane	0.002147578	CNVR_99	5	1,01E+08	1,01E+08	ENSBTAG00000012026	784451		1,01E+08	1,01E+08	protein_coding
GO:0016020	membrane	0.002147578	CNVR_99	5	1,01E+08	1,01E+08	ENSBTAG00000006851	509972		1,01E+08	1,01E+08	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_219	11	1,04E+08	1,04E+08	ENSBTAG00000001353	767847	PMPCA	1,04E+08	1,04E+08	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_219	11	1,04E+08	1,04E+08	ENSBTAG00000001354	506349	INPP5E	1,04E+08	1,04E+08	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_280	15	30446720	30489674	ENSBTAG00000009749	522980	USP2	30464926	30487308	protein_coding

GO:0016787	hydrolase activity	3.20E-11	CNVR_334	18	49074618	49109287	ENSBTAG00000012590	521171	ACP7	49094425	49108117	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_398	22	50594496	50652412	ENSBTAG00000000484	281838	HYAL2	50592324	50597462	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_398	22	50594496	50652412	ENSBTAG00000047200	NA		50608457	50609166	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_398	22	50594496	50652412	ENSBTAG00000000483	515397	HYAL1	50600489	50601799	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000046127	337899	PAG5	38363514	38372267	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000039036	337911	PAG18	38428102	38437106	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000047141	337901	PAG7	38518914	38624602	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000047145	504812		38398957	38407842	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000046497	NA		38880449	38892585	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000047989	337908		38920418	38929107	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000039970	337910	PAG16	38951945	38961304	protein_coding

GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000039045	NA		38966855	38973520	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000036172	337914	PAG20	39004039	39013165	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000040340	337915	PAG21	39049999	39059075	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000037908	281964	PAG1	39180301	39189626	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000048133	337909	PAG15	38659682	38668543	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000046038	NA		38727387	38734969	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000036277	337898	PAG4	38793756	38802922	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000040140	NA		38838947	38844641	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000047892	517463	MGC157408	39457513	39466695	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000035736	614287		39541478	39550943	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000038918	NA		39594293	39605710	protein_coding

GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000026016	337912	PAG17	39626771	39635792	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000046085	NA		39662643	39669751	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000046686	NA		39705826	39708801	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000037784	518205	MGC157405	39731524	39740647	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000038506	NA		39784352	39790880	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000046398	337913	PAG19	39261026	39270024	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_469	29	38341163	39796110	ENSBTAG00000048073	NA		39390100	39397241	protein_coding
GO:0016787	hydrolase activity	3.20E-11	CNVR_472	29	42437944	42567601	ENSBTAG00000037645	NA		42445012	42451969	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_392	21	70803573	70891033	ENSBTAG00000017636	280991	AKT1	70878138	70895537	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000046127	337899	PAG5	38363514	38372267	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000039036	337911	PAG18	38428102	38437106	protein_coding

GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000047141	337901	PAG7	38518914	38624602	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000007849	NA		38567091	38571882	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000047145	504812		38398957	38407842	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000046497	NA		38880449	38892585	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000047989	337908		38920418	38929107	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000039970	337910	PAG16	38951945	38961304	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000039045	NA		38966855	38973520	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000036172	337914	PAG20	39004039	39013165	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000040340	337915	PAG21	39049999	39059075	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000047758	NA		39110430	39115394	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000037908	281964	PAG1	39180301	39189626	protein_coding

GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000045670	NA		38594536	38600471	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000048133	337909	PAG15	38659682	38668543	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000046038	NA		38727387	38734969	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000036277	337898	PAG4	38793756	38802922	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000040140	NA		38838947	38844641	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000047892	517463	MGC157408	39457513	39466695	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000035736	614287		39541478	39550943	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000038918	NA		39594293	39605710	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000026016	337912	PAG17	39626771	39635792	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000046085	NA		39662643	39669751	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000046686	NA		39705826	39708801	protein_coding

GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000037784	518205	MGC157405	39731524	39740647	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000038506	NA		39784352	39790880	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000048202	NA		39223563	39226528	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000046398	337913	PAG19	39261026	39270024	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000047419	NA		39326703	39397241	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000034244	NA		39345959	39355136	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_469	29	38341163	39796110	ENSBTAG00000048073	NA		39390100	39397241	protein_coding
GO:0030163	protein catabolic process	2.55E-17	CNVR_472	29	42437944	42567601	ENSBTAG00000037645	NA		42445012	42451969	protein_coding
GO:0030246	carbohydrate binding	0.0036548	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000020453	615201	CLEC5A	1,06E+08	1,06E+08	protein_coding
GO:0030246	carbohydrate binding	0.0036548	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000046152	1E+08	MGAM	1,06E+08	1,06E+08	protein_coding
GO:0030246	carbohydrate binding	0.0036548	CNVR_99	5	1,01E+08	1,01E+08	ENSBTAG00000012026	784451		1,01E+08	1,01E+08	protein_coding
GO:0030246	carbohydrate binding	0.0036548	CNVR_99	5	1,01E+08	1,01E+08	ENSBTAG00000006851	509972		1,01E+08	1,01E+08	protein_coding

GO:0042613	MHC class II protein complex	0.0036548	CNVR_408	23	25335659	25442124	ENSBTAG00000037605	NA		25426330	25430097	protein_coding
GO:0042613	MHC class II protein complex	0.0036548	CNVR_408	23	25335659	25442124	ENSBTAG00000038128	282494	BOLA-DQA5	25404020	25411643	protein_coding
GO:0042613	MHC class II protein complex	0.0036548	CNVR_408	23	25335659	25442124	ENSBTAG00000021077	282495	BOLA-DQB	25375270	25388620	protein_coding
GO:0042613	MHC class II protein complex	0.0036548	CNVR_408	23	25335659	25442124	ENSBTAG00000009656	282535	BOLA-DQA2	25351283	25356959	protein_coding
GO:0050896	response to stimulus	0.00183771 5	CNVR_120	7	6604091	6718398	ENSBTAG00000047589	NA		6703832	6705051	protein_coding
GO:0050896	response to stimulus	0.00183771 5	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding
GO:0050896	response to stimulus	0.00183771 5	CNVR_127	7	15147652	15178739	ENSBTAG00000047799	787445		15151349	15153336	protein_coding
GO:0050896	response to stimulus	0.00183771 5	CNVR_200	11	20031	118377	ENSBTAG00000038257	NA		25404	26705	protein_coding
GO:0050896	response to stimulus	0.00183771 5	CNVR_272	15	43737	508576	ENSBTAG00000048221	NA		415571	416485	protein_coding
GO:0050896	response to stimulus	0.00183771 5	CNVR_272	15	43737	508576	ENSBTAG00000040008	781264		362684	363613	protein_coding
GO:0050896	response to stimulus	0.00183771 5	CNVR_272	15	43737	508576	ENSBTAG00000045558	1E+08		248025	248981	protein_coding

GO:0050896	response to stimulus	0.00183771	CNVR_272	15	43737	508576	ENSBTAG00000046228	NA		182645	183853	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_272	15	43737	508576	ENSBTAG00000038319	509895		212769	213701	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_290	15	79263122	79317375	ENSBTAG00000031030	781504		79267160	79268059	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_290	15	79263122	79317375	ENSBTAG00000031032	1,01E+08		79315293	79316222	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_290	15	79263122	79317375	ENSBTAG00000012549	614652		79276428	79277363	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000015876	787522		79824624	79825547	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000005087	787446		79852685	79853677	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000014594	787428		79873735	79874785	protein_coding

GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000020746	787543		79811632	79812585	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_292	15	79744750	79974613	ENSBTAG00000048141	NA		79933396	79935009	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000039348	785680		80685809	80686821	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding

GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000038049	1,05E+08		80695336	80696395	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding

GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding

GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_296	16	24074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_296	16	24074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_296	16	24074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_466	29	27711080	27844168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_466	29	27711080	27844168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_466	29	27711080	27844168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0050896	response to stimulus	0.00183771	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000024065	787789	TAS2R38	1,06E+08	1,06E+08	protein_coding

GO:0050896	response to stimulus	0.00183771	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000003664	519161		1,06E+08	1,06E+08	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_1	1	16947	147231	ENSBTAG00000039257	NA		69695	71121	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_120	7	6604091	6718398	ENSBTAG00000047589	NA		6703832	6705051	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_375	21	975606	2085345	ENSBTAG00000013567	NA		1852998	1854799	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_127	7	15147652	15178739	ENSBTAG00000047799	787445		15151349	15153336	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_200	11	20031	118377	ENSBTAG00000038257	NA		25404	26705	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_272	15	43737	508576	ENSBTAG00000048221	NA		415571	416485	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_272	15	43737	508576	ENSBTAG00000040008	781264		362684	363613	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_272	15	43737	508576	ENSBTAG00000045558	1E+08		248025	248981	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_272	15	43737	508576	ENSBTAG00000046228	NA		182645	183853	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_272	15	43737	508576	ENSBTAG00000038319	509895		212769	213701	protein_coding

GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_290	15	79263122	79317375	ENSBTAG00000031030	781504		79267160	79268059	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_290	15	79263122	79317375	ENSBTAG00000031032	1,01E+08		79315293	79316222	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_290	15	79263122	79317375	ENSBTAG00000012549	614652		79276428	79277363	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_292	15	79744750	79974613	ENSBTAG00000015876	787522		79824624	79825547	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_292	15	79744750	79974613	ENSBTAG00000023511	788874		79921913	79922869	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_292	15	79744750	79974613	ENSBTAG00000005874	785930		79958958	79959914	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_292	15	79744750	79974613	ENSBTAG00000003056	NA		79864248	79865213	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_292	15	79744750	79974613	ENSBTAG00000005087	787446		79852685	79853677	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_292	15	79744750	79974613	ENSBTAG00000014594	787428		79873735	79874785	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_292	15	79744750	79974613	ENSBTAG00000046471	787385		79895419	79896363	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_292	15	79744750	79974613	ENSBTAG00000020746	787543		79811632	79812585	protein_coding

GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000007944	538864		79774520	79775464	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_292	15	79744750	79974613	ENSBTAG00000048141	NA		79933396	79935009	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035990	519317		80661499	80662446	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000045723	785914		80807806	80808747	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000039348	785680		80685809	80686821	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000040330	788130	OR5M11	81067188	81068141	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000046278	528502		80371554	80372495	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035989	506891		80737480	80738442	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000024423	785470		80602080	80603051	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000045709	514057		80389094	80390035	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNVR_293	15	80254337	81131105	ENSBTAG00000035029	NA		80856241	80857182	protein_coding

GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000035986	NA		80477852	80478754	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000035059	522150		80515014	80515961	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000038049	1,05E+08		80695336	80696395	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000039182	513633	OR5M3	81042867	81043799	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000045739	1E+08	OR5R1	80990805	80991764	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000046845	520399		80647002	80647943	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000038479	NA		80933345	80935697	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000037878	NA		80338056	80338526	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000014309	515598		80314082	80314987	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000039110	1E+08		80949244	80950203	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.00105487	CNV_293	15	80254337	81131105	ENSBTAG00000023542	782555		81105854	81107065	protein_coding

GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000046167	NA		80827951	80829405	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000035031	790274		80842358	80843299	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000022858	NA		80555499	80556455	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000023310	785406		80586288	80587247	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000016146	618091		81091987	81092922	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000046285	1E+08	OR8I2	80254691	80256208	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000046801	1E+08		80920112	80921056	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000046710	1E+08		80502821	80503741	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000047721	1E+08		80882784	80883710	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000001291	617362		80288368	80289306	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNV_293	15	80254337	81131105	ENSBTAG00000035988	785944		80420321	80421262	protein_coding

GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_293	15	80254337	81131105	ENSBTAG00000035985	513114		80484654	80485613	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_293	15	80254337	81131105	ENSBTAG00000046274	615824		80507650	80508576	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_296	16	24074	498301	ENSBTAG00000039944	787642		382697	383632	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_296	16	24074	498301	ENSBTAG00000035659	511893		297300	298235	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_296	16	24074	498301	ENSBTAG00000047603	NA		415781	416614	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_296	16	24074	498301	ENSBTAG00000015517	524282		353116	354883	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_466	29	27711080	27844168	ENSBTAG00000037623	787625		27770678	27771721	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_466	29	27711080	27844168	ENSBTAG00000035631	1,12E+08		27820502	27821434	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_466	29	27711080	27844168	ENSBTAG00000040250	510984		27786854	27787786	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_466	29	27711080	27844168	ENSBTAG00000046665	516940		27716012	27718456	protein_coding
GO:0050911	detection of chemical stimulus involved in sensory perception of smell	0.001054872	CNVR_80	4	1,06E+08	1,06E+08	ENSBTAG00000003664	519161		1,06E+08	1,06E+08	protein_coding

GO:0097638	L-arginine import across plasma membrane	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000015987	525820		61849212	61855551	protein_coding
GO:0097638	L-arginine import across plasma membrane	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000009364	514552		61714020	61719354	protein_coding
GO:0097638	L-arginine import across plasma membrane	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000002290	NA		61680432	61686814	protein_coding
GO:0097638	L-arginine import across plasma membrane	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000013345	NA		61832253	61835027	protein_coding
GO:1903352	L-ornithine transmembrane transport	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000015987	525820		61849212	61855551	protein_coding
GO:1903352	L-ornithine transmembrane transport	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000009364	514552		61714020	61719354	protein_coding
GO:1903352	L-ornithine transmembrane transport	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000002290	NA		61680432	61686814	protein_coding
GO:1903352	L-ornithine transmembrane transport	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000013345	NA		61832253	61835027	protein_coding
GO:1903401	L-lysine transmembrane transport	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000015987	525820		61849212	61855551	protein_coding
GO:1903401	L-lysine transmembrane transport	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000009364	514552		61714020	61719354	protein_coding
GO:1903401	L-lysine transmembrane transport	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000002290	NA		61680432	61686814	protein_coding

GO:1903401	L-lysine transmembrane transport	0.0036548	CNVR_343	18	61638038	61929947	ENSBTAG00000013345	NA		61832253	61835027	protein_coding

3 CONCLUSÃO

Variações estruturais do tipo CNV foram identificados ao longo de todo genoma em animais da raça Nelore corroborando com estudos prévios. Nossos resultados relatam regiões CNVs abrangendo genes que desempenham papéis fundamentais em um amplo espectro de processos moleculares e biológicos ligados a características de qualidade de carne e carcaça, incluindo diferenciação muscular, crescimento e desenvolvimento, regulação de processos celulares e metabolismo lipídico e energético. Além disso, prováveis genes com efeito pleiotrópico foram identificados estando diretamente relacionados à deposição muscular, conversão muscular à deposição de carne e gordura. Essas variações no número de cópias podem resultar em fenótipos diferentes entre a população de animais. Assim, podemos conhecer melhor a arquitetura genética de variações estruturais que possam afetar o fenótipo, a fim de incorporar nos programas de melhoramento genético animal novas ferramentas que possibilitam a seleção de animais com melhores características de carcaça e carne.

REFERÊNCIAS

ALVES, D.; GOES, R. H. DE; MANCIO, A. maciez da carne bovina**. Ciência Animal Brasileira**, v. 6, n. 3, p. 135-149, 31 out. 2006.

BERTON, M. P. **Associação entre as variações no número de cópias no genoma de bovinos Nelore com características qualitativas e quantitativas da carne.** 2017. M499a. Tese (doutorado) – Universidade Estadual Paulista, Faculdade de Ciências Agrárias e Veterinárias, Jaboticabal, 2017.

BICKHART, D. M.; HOU, Y.; SCHROEDER, S. G. et al. Copy number variation of individual cattle genomes using next-generation sequencing. **Genome Res.** v.22, n.4, p.778–790, 2012. https://doi.org/10.1101/gr.133967.111

BICKHART, D. M.; LIU, G. E. The challenges and importance of structural variation detection in livestock. **Front. Genet.** v. 5, n. 37, 2014. https://doi.org/10.3389/fgene.2014.00037

BORGES, A. S.; ZAPATA, J. F. F.; GARRUTI, D. S.; RODRIGUES, M. C. P.; FREITAS, E. R.; PEREIRA, A. L. F. Medições instrumentais e sensoriais de dureza e suculência na carne caprina. **Ciênc. Tecnol. Aliment**., v. 4, 2006, p. 891-896. https://doi.org/10.1590/S0101-20612006000400028

BRAGAGNOLO, N. Aspectos comparativos entre carnes segundo a composição de ácidos graxos e teor de colesterol. In: CONFERÊNCIA INTERNACIONAL VIRTUAL SOBRE QUALIDADE DE CARNE SUÍNA, 2., 2001, Concórdia. **Anais...** Concórdia, 2001. p. 393-402.

CASSESE, A.; GUINDANI, M.; TADESSE, M. G.; FALCIANI, F.; VANNUCCI, M. A hierarchical Bayesian model for inference of copy number variants and their association to gene expression. **Annals of Applied Statistics**, v. 8, p.148-175, 2014. https://doi.org/10.1214/13-AOAS705

CHUNG, Y. J.; KIM, J. H. CNVRuler. Publicado:16/06/2011. Disponível em: http://www.ircgp.com/CNVRuler/CNVRuler_User_Manual.pdf Acesso: 10 de dezembro de 2017.

CLOP, A.; VIDAL, O.; AMILLS, M. Copy number variation in the genomes of domestic animals. **Animal Genetics**, v. 43,p. 503–17, 2012. https://doi.org/10.1111/j.1365-2052.2012.02317.x

COLELLA, S.; YAU, C.; TAYLOR, J. M.; MIRZA, G.; BUTLER, H.; CLOUSTON, P.; BASSETT, A.S.; SELLER, A.; HOLMES, C. C.; RAGOUSSIS, J. QuantiSNP: an Objective Bayes Hidden-Markov Model to detect and accurately map copy number variation using SNP genotyping data. **Nucleic Acids Research**, v. 35, n. 6, p. 2013- 2025, 2007. https://doi.org/10.1093/nar/gkm076

COUTINHO, C. C. **Curvas de crescimento de características de carcaça obtidas por ultrassonografia em bovinos Nelore selecionados para peso pós desmame**. 2014. Dissertação (Mestrado), Universidade Estadual Paulista, Faculdade de Ciências Agronômicas, Botucatu, São Paulo, 2014.

Dierssen, M.; Herault, Y.; Estivill, X. Aneuploidy: from a physiological mechanism of variance to Down Syndrome. **Physiological Reviews** 89(3): 887-920, 2007. https://doi.org/10.1152/physrev.00032.2007

FEIJÓ, G. L. D. (Coord.) Qualidade da carne bovina. In: CURSO CONHECENDO A CARNE QUE VOCÊ CONSOME, 1., 1999, Campo Grande. Campo Grande: Embrapa Gado de Corte, 1999.

HADLICH, J. C. **Metodologias de análises de maciez como parâmetros de qualidade de carne de bovinos de diferentes grupos genéticos e idades**. 2003. Dissertação (mestrado), Universidade estadual paulista – faculdade de medicina veterinária, Botucatu, São Paulo, 2003.

HASTINGS, P. J., LUPSKI, J. R., ROSENBERG, S. M., IRA, G. Mechanisms of change in gene copy number. **Nat Rev Genet** v.10, p.551–564, 2009. https://doi.org/10.1038/nrg2593

IBGE – Instituto Brasileiro de Geografia e Estatística. Agropecuária puxa o PIB de 2017. Publicado em: 04/12/2017. Disponível em: < http://www.agricultura.gov.br/noticias/agropecuaria-puxa-o-pib-de-2017> Acessado em: 23 de abril de 2019.

IBGE – Instituto Brasileiro de Geografia e Estatística. Em 2018, abate de bovinos e suínos continua em alta. Publicado em: 14/03/2019. Disponível em <https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/23989-em-2018-abate-de-bovinos-e-suinos-continua-em-alta> Acessado em: 23 de abril de 2019.

ILLUMINA. GenomeStudio 2.0 data analysis software. 2016. Disponível em: < https://www.illumina.com/content/dam/illumina-marketing/documents/products/datasheets/datasheet_genomestudio_software.pdf > Acessado em: 23 de abril de 2019.

INTERNATIONAL HAPMAP CONSORTIUM: A haplotype map of the human genome. **Nature.** v.437, p.1299-1320, 2005.
https://doi.org/10.1038/nature04226

JÚNIOR, G. A. F. **Seleção Genômica para características de carcaça em bovinos da raça Nelore**. 2015. Tese (doutorado) – Universidade Estadual Paulista, Faculdade de Ciências Agrárias e Veterinárias. Jaboticabal, São Paulo, 2015.

LEHNINGER, N.D. **Príncipios de bioqímica de Lehninger**. 6. ed. Porto Alegre: Artmed, 2014. 1298 p.

LUCHIARI FILHO, A. **Pecuária da carne bovina**. São Paulo: LinBife, 2000. 134p.

MATUKUMALLI, L.K.; LAWLEY, C. T.; SCHNABEL, R. D.; TAYLOR, J. F.; ALLAN, M. F.; HEATON, M. P.; et al. Development and characterization of a high density SNP genotyping assay for cattle. **PLoS ONE**. 2009.
https://doi.org/10.1371/journal.pone.0005350

NELSON, D. L.; COX, M. M. **Princípios de bioquímica de Lehninger**. Porto Alegre: Artmed, 2011. 6 ed. Porto Alegre, 2011.

PROENÇA, R. P. C. Alimentação e globalização: algumas reflexões. **Cienc. Cult.** v.62 no.4 São Paulo, 2010.

REDON, R.; ISHIKAWA, S.; FITCH, K.R.; FEUK, L.; PERRY, G. H.; ANDREWS, D.; et al. Global variation in copy number in the human genome. **Nature**, v.444, p.444-454, 2006.
https://doi.org/10.1038/nature05329

SAINZ, R. D.; ARAUJO, F. R. C. Tipificação de carcaças de bovinos e suínos. **I Congresso Brasileiro de Ciência e Tecnologia de Carne**, São Pedro, SP, 2011.

SCHIAVO, M.; LUNARDELLI, A.; OLIVEIRA, J. R. Influência da dieta na concentração sérica de triglicerídeos. **Jornal Brasileiro de Patologia e Medicina Laboratorial**, Rio de Janeiro, v. 39, n. 4, p. 283-288, 2003.
https://doi.org/10.1590/S1676-24442003000400004

SILVA, J. M., GIACHETTO P.F., SILVA L.O., CINTRA L.C., PAIVA S.R., YAMAGISHI M.Esil.B., CAETANO A.R. Genome-wide copy number variation (CNV) detection in Nelore cattle reveals highly frequent variants in genome regions harboring QTLs affecting production traits**. BMC Genomics** v.17, p.454-468, 2016.
https://doi.org/10.1186/s12864-016-2752-9

SILVA, V. H.; REGITANO, L. C. A.; GEISTLINGER, L.; PÉRTILLE, F.; GIACHETTO, P. F.; BRASSALOTI, R. A.; MOROSINI, N. S.; ZIMMER, R.; COUTINHO, L. L. Genome-Wide Detection of CNVs and Their Association with Meat Tenderness in Nelore Cattle. **PLoS ONE**, 2016.
https://doi.org/10.1371/journal.pone.0157711

SIMEONI, C. P.; FRUET, A. P. B.; MENEZES, M. F. C.; KIRINUS, J. K.; TEIXEIRA, C.; RITT, L. A. Fatores pós-abate que contribuem para a maciez da carne. **Revista Eletrônica em Gestão, Educação e Tecnologia Ambiental – REGET**, v. 18, 2014, p. 18-24.
https://doi.org/10.5902/2236117013019

STRACHAN, T.; READ, A. **Genética molecular humana**. 4ª ed. Porto Alegre: Artmed, 2013. 808p.

SUGUISAWA, L. **Ultrasonografia para predição das características e composição da carcaça de bovinos**. 2002. Dissertação (mestrado), Escola Superior de Agricultura Luiz de Queiroz, Piracicaba, São Paulo, 2002.

THE BOVINE GENOME SEQUENCING AND ANALYSIS CONSORTIUM. The Genome Sequence of Taurine Cattle: A window to ruminant biology and evolution. **Science** v.324, p.522–528, 2009.

TIZIOTO, P. C. **Identificação de regiões genômicas e genes candidatos associados com qualidade de carne e conteúdo de minerais no músculo em bovinos da raça Nelore.** 2014. 119f. Tese (doutorado) – Universidade Federal de São Carlos, 2014.

USDA Foreign Agricultural Service. **Brazil - Livestock and Products Annual, Annual Livestock 2018.** Disponível em < https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Livestock%20and%20Products%20Annual_Brasilia_Brazil_9-4-2018.pdf> Acesso em: 06 de maio de 2019.

USDA – United States Department of Agriculture Foreing Agricultural Service. **Livestock and Poultry: World Markets and Trade.** Disponível em < https://apps.fas.usda.gov/psdonline/circulars/livestock_poultry.pdf> Acesso em: 06 de maio de 2019.

WANG, K.; LI, M.; HADLEY, D.; et al. PennCNV: an integrated hidden Markov model designed for high-resolution copy number variation detection in whole-genome SNP genotyping data. **Genome Res.** v.17, p.1665–1674, 2007.
https://doi.org/10.1101/gr.6861907

ZIMIN, A.V.; DELCHER, A. L.; FLOREA, L.; KELLEY, D. R.; SCHATZ, M. C.; PUIU, D.; HANRAHAN, F.; PERTEA, G.; VAN TASSELL, C. P.; SONSTEGARD, T. S.; et al. A whole-genome assembly of the domestic cow, Bostaurus. **Genome Biol** v.1, p.42, 2009. https://doi.org/10.1186/gb-2009-10-4-r42

ANEXO

Submission Guidelines

PLOS Genetics publishes original research that clearly demonstrates novelty, importance to a particular field, biological significance, and conclusions that are justified by the study.

Our aim is to make the editorial process rigorous and consistent, and to offer the best possible support to our authors throughout this process. Authors are encouraged to decide how best to present their ideas, results, and conclusions, but all research should be presented in a form that is readable to those in the field, easily understood by scientists outside of the immediate discipline, and comprehensible to readers whose first language is not English. The writing style should therefore be concise and accessible. Care should be taken to define abbreviations clearly and to use correct genetic and systematic nomenclature.

We strongly encourage authors to seek input from their co-authors and colleagues with different expertise when preparing their manuscript for submission to ensure that the style of writing, clarity of meaning, and spelling, punctuation, and grammar are at a very high level. A variety of style and writing guides are available, including The Elements of Style (New York: bartleby.com, 1999) and the Manuscript Preparation recommendations of the International Committee of Medical Journal Editors (ICMJE). Editors and/or reviewers may also make suggestions for how to achieve optimal quality and clarity of presentation, as well as potential cuts or additions that could strengthen the manuscript.

Related information for authors

Submission system
Journal scope and publication criteria
Getting started guide
Guidelines for other article types
Guidelines for revisions
Publication fees

Style and Format

PLOS Genetics accepts initial submissions of manuscripts in a single PDF file which can include text and figures. If you are submitting a revised manuscript, upload separate files for your text, figures, and supporting information. The editor will then assess your submission.

File format

Manuscript files can be in the following formats: DOC, DOCX, RTF or PDF. Microsoft Word documents should not be locked or protected.
LaTeX manuscripts must be submitted as PDFs. Read the LaTeX guidelines.

Length

Manuscripts can be any length. There are no restrictions on word count, number of figures, or amount of supporting information. We encourage you to present and discuss your findings concisely.

Font
Use a standard font size and any standard font, except for the font named "Symbol". To add symbols to the manuscript, use the Insert → Symbol function in your word processor or paste in the appropriate Unicode character.

Headings
Limit manuscript sections and sub-sections to 3 heading levels. Make sure heading levels are clearly indicated in the manuscript text.
Layout and spacing
Manuscript text should be double-spaced.
Do not format text in multiple columns.

Page and line numbers
Include page numbers and line numbers in the manuscript file. Use continuous line numbers (do not restart the numbering on each page).
Footnotes
Footnotes are not permitted. If your manuscript contains footnotes, move the information into the main text or the reference list, depending on the content.
Language
Manuscripts must be submitted in English.

You may submit translations of the manuscript or abstract as supporting information. Read the supporting information guidelines.

Abbreviations
Define abbreviations upon first appearance in the text.
Do not use non-standard abbreviations unless they appear at least three times in the text.
Keep abbreviations to a minimum.

Reference style
PLOS uses "Vancouver" style, as outlined in the ICMJE sample references.
See reference formatting examples and additional instructions below.

Equations
We recommend using MathType for display and inline equations, as it will provide the most reliable outcome. If this is not possible, Equation Editor or Microsoft's Insert→Equation function is acceptable.

Avoid using MathType, Equation Editor, or the Insert→Equation function to insert single variables (e.g., "$a^2 + b^2 = c^2$"), Greek or other symbols (e.g., β, Δ, or ′ [prime]), or mathematical operators (e.g., x, ≥, or ±) in running text. Wherever possible, insert single symbols as normal text with the correct Unicode (hex) values.

Do not use MathType, Equation Editor, or the Insert→Equation function for only a portion of an equation. Rather, ensure that the entire equation is included. Equations should not contain a

mix of different equation tools. Avoid “hybrid” inline or display equations, in which part is text and part is MathType, or part is MathType and part is Equation Editor.

Nomenclature

Use correct and established nomenclature wherever possible.

Units of measurementUse SI units. If you do not use these exclusively, provide the SI value in parentheses after each value. Read more about SI units.

Drugs Provide the Recommended International Non-Proprietary Name (rINN).

Species namesWrite in italics (e.g., Homo sapiens). Write out in full the genus and species, both in the title of the manuscript and at the first mention of an organism in a paper. After first mention, the first letter of the genus name followed by the full species name may be used (e.g., H. sapiens).

Genes, mutations, genotypes, and alleles Write in italics. Use the recommended name by consulting the appropriate genetic nomenclature database (e.g., HUGO for human genes). It is sometimes advisable to indicate the synonyms for the gene the first time it appears in the text. Gene prefixes such as those used for oncogenes or cellular localization should be shown in roman typeface (e.g., v-fes, c-MYC).

Allergens

The systematic allergen nomenclature of the World Health Organization/International Union of Immunological Societies (WHO/IUIS) Allergen Nomenclature Sub-committee should be used for manuscripts that include the description or use of allergenic proteins. For manuscripts describing new allergens, the systematic name of the allergen should be approved by the WHO/IUIS Allergen Nomenclature Sub-Committee prior to manuscript publication. Examples of the systematic allergen nomenclature can be found at the WHO/IUIS Allergen Nomenclature site.

Copyediting manuscripts

Prior to submission, authors who believe their manuscripts would benefit from in-depth professional copyediting are encouraged to use language-editing and copyediting services. Obtaining this service is the responsibility of the author and should be done before initial submission. These services can be found on the web using search terms like “scientific editing service” or “manuscript editing service”.

Note that if your manuscript is accepted, PLOS will not perform a detailed copyediting step. Therefore, please carefully review your manuscript, paying special attention to spelling, punctuation, and grammar, as well as scientific content.

Manuscript Organization

Most manuscripts should be organized as follows. Instructions for each element appear below.

Title
Authors
Affiliations
Abstract
Author Summary
Introduction
Results
Discussion
Materials and Methods (also called Methods or Models)

Acknowledgments
References
Supporting information captions
Uniformity in format facilitates the experience of readers and users of the journal. To provide flexibility, however, authors are also able to include the Materials and Methods section before the Results section or before the Discussion section. Please clarify the reasons for including your Materials and Methods section before the Results or Discussion sections in your cover letter when submitting your manuscript files.

Please also note that the Results and Discussion can be combined into one Results/Discussion section.

Other elements
When submitting your initial manuscript, embed figure captions within the manuscript text after their first mention, or group figure captions together at the end of the manuscript. Upon editorial acceptance, upload figures separately to the manuscript. After the first paragraph citing the figure, insert figure captions in reading order. Read more information about our figure requirements.
Tables are inserted immediately after the first paragraph in which they are cited.
Supporting information files are uploaded separately.
Please refer to our downloadable sample files to ensure that your submission meets our formatting requirements:

Download sample title, author list, and affiliations page (PDF)
Download sample manuscript body (PDF)
Viewing Figures and Supporting Information in the compiled submission PDF
The compiled submission PDF includes low-resolution preview images of the figures after the reference list. The function of these previews is to allow you to download the entire submission as quickly as possible. Click the link at the top of each preview page to download a high-resolution version of each figure. Links to download Supporting Information files are also available after the reference list.

Parts of a Submission

Title
Include a full title and a short title for the manuscript.
Title Length Guidelines Examples
Full title 200 characters - Specific, descriptive, concise, and comprehensible to readers outside the field
Impact of cigarette smoke exposure on innate immunity: A Caenorhabditis elegans model
Solar drinking water disinfection (SODIS) to reduce childhood diarrhoea in rural Bolivia: A cluster-randomized, controlled trial
Short title 70 characters - State the topic of the study
Cigarette smoke exposure and innate immunity

SODIS and childhood diarrhoea
Titles should be written in sentence case (only the first word of the text, proper nouns, and genus names are capitalized). Avoid specialist abbreviations if possible. For clinical trials, systematic reviews, or meta-analyses, the subtitle should include the study design.

Author list
Authorship requirements

All authors must meet the criteria for authorship as outlined in the authorship policy. Those who contributed to the work but do not meet the criteria for authorship can be mentioned in the Acknowledgments. Read more about Acknowledgments.

The corresponding author must provide an ORCID iD at the time of submission by entering it in the user profile in the submission system. Read more about ORCID.
Author names and affiliations
Enter author names on the title page of the manuscript and in the online submission system.

On the title page, write author names in the following order:
First name (or initials, if used)
Middle name (or initials, if used)
Last name (surname, family name)
Each author on the list must have an affiliation. The affiliation includes department, university, or organizational affiliation and its location, including city, state/province (if applicable), and country. Authors have the option to include a current address in addition to the address of their affiliation at the time of the study. The current address should be listed in the byline and clearly labeled "current address." At a minimum, the address must include the author's current institution, city, and country.

If an author has multiple affiliations, enter all affiliations on the title page only. In the submission system, enter only the preferred or primary affiliation. Author affiliations will be listed in the typeset PDF article in the same order that authors are listed in the submission.

Author names will be published exactly as they appear in the manuscript file. Please double-check the information carefully to make sure it is correct.
Corresponding author
The submitting author is automatically designated as the corresponding author in the submission system. The corresponding author is the primary contact for the journal office and the only author able to view or change the manuscript while it is under editorial consideration.

The corresponding author role may be transferred to another coauthor. However, note that transferring the corresponding author role also transfers access to the manuscript. (To designate a new corresponding author while the manuscript is still under consideration, watch the video tutorial below.)

Only one corresponding author can be designated in the submission system, but this does not restrict the number of corresponding authors that may be listed on the article in the event of publication. Whoever is designated as a corresponding author on the title page of the manuscript file will be listed as such upon publication. Include an email address for each corresponding author listed on the title page of the manuscript.

How to select a new corresponding author in Editorial Manager

Consortia and group authorship

If a manuscript is submitted on behalf of a consortium or group, include its name in the manuscript byline. Do not add it to the author list in the submission system. You may include the full list of members in the Acknowledgments or in a supporting information file.
PubMed only indexes individual consortium or group author members listed in the article byline. If included, these individuals must qualify for authorship according to our criteria.

Read the group authorship policy.
Author contributions
Provide at minimum one contribution for each author in the submission system. Use the CRediT taxonomy to describe each contribution. Read the policy and the full list of roles.
Contributions will be published with the final article, and they should accurately reflect contributions to the work. The submitting author is responsible for completing this information at submission, and we expect that all authors will have reviewed, discussed, and agreed to their individual contributions ahead of this time.

Cover letter
Upload a cover letter as a separate file in the online system.
The cover letter should address the following questions:
Why is this manuscript suitable for publication in PLOS Genetics?
Why will your study inspire the other members of your field, and how will it drive research forward?
You may recommend a suitable Associate Editor to handle your submission; however, the editors reserve the right to contact an alternative—either from the board or a guest editor.
The cover letter will be available to the editors and to any external peer reviewers, so please send anything confidential directly to the journal office.

Title page
The title, authors, and affiliations should all be included on a title page as the first page of the manuscript file.
Download our sample title, author list, and affiliations page (PDF)

Abstract
The Abstract comes after the title page in the manuscript file. The abstract text is also entered in a separate field in the submission system.
The Abstract of the paper should be succinct; it must not exceed 300 words. Authors should mention the techniques used without going into methodological detail and should summarize the most important results.
While the Abstract is conceptually divided into three sections (Background, Methodology/Principal Findings, and Conclusions/Significance), do not apply these distinct headings to the Abstract within the article file.
Do not include any citations. Avoid specialist abbreviations.

Author Summary
We ask that all authors of research articles include a 150–200 word non-technical summary of the work as part of the manuscript to immediately follow the abstract. This text is subject to editorial change, should be written in the first-person voice, and should be distinct from the scientific abstract.
Aim to highlight where your work fits within a broader context; present the significance or possible implications of your work simply and objectively; and avoid the use of acronyms and

complex terminology wherever possible. The goal is to make your findings accessible to a wide audience that includes both scientists and non-scientists.
Authors may benefit from consulting with a science writer or press officer to ensure they effectively communicate their findings to a general audience.

Example Author Summaries

Complex Seizure Disorder Caused by Brunol4 Deficiency in Mice
Genome-Wide Association Scan Shows Genetic Variants in the FTO Gene Are Associated with Obesity-Related Traits
A Mutation in the Myostatin Gene Increases Muscle Mass and Enhances Racing Performance in Heterozygote Dogs
Introduction
The Introduction should put the focus of the manuscript into a broader context. As you compose the Introduction, think of readers who are not experts in this field. Include a brief review of the key literature. If there are relevant controversies or disagreements in the field, they should be mentioned so that a non-expert reader can delve into these issues further. The Introduction should conclude with a brief statement of the overall aim of the experiments and a comment about whether that aim was achieved.

Results
The Results section should provide details of all of the experiments that are required to support the conclusions of the paper. There is no specific word limit for this section, but details of experiments that are peripheral to the main thrust of the article and that detract from the focus of the article should not be included. The section may be divided into subsections, each with a concise subheading. The section should be written in the past tense.
PLOS journals require authors to make all data underlying the findings described in their manuscript fully available without restriction, with rare exception. When submitting a manuscript online, authors must provide a Data Availability Statement describing compliance with PLOS's policy.
Large data sets, including raw data, may be deposited in an appropriate public repository. See our list of recommended repositories.
For smaller data sets and certain data types, authors may provide their data within supporting information files accompanying the manuscript. Authors should take care to maximize the accessibility and reusability of the data by selecting a file format from which data can be efficiently extracted (for example, spreadsheets or flat files should be provided rather than PDFs when providing tabulated data).
For more information on how best to provide data, read our policy on data availability. PLOS does not accept references to “data not shown.”

Discussion
The Discussion should spell out the major conclusions of the work along with some explanation or speculation on the significance of these conclusions. How do the conclusions affect the existing assumptions and models in the field? How can future research build on these observations? What are the key experiments that must be done?
The Discussion should be concise and tightly argued.
The Results and Discussion may be combined into one section, if desired.

Materials and Methods

The Materials and Methods should provide enough detail for reproduction of the findings. Submit detailed protocols for newer or less established methods. Well-established protocols may simply be referenced.
Details of algorithms and protocol documents for clinical trials, observational studies, and other non-laboratory investigations may be uploaded as supporting information. These are not included in the typeset manuscript, but are downloadable and fully searchable from the HTML version of the article. Read the supporting information guidelines for formatting instructions.
We recommend and encourage you to deposit laboratory protocols in protocols.io, where protocols can be assigned their own persistent digital object identifiers (DOIs).
To include a link to a protocol in your article:
Describe your step-by-step protocol on protocols.io
Select Get DOI to issue your protocol a persistent digital object identifier (DOI)
Include the DOI link in the Methods section of your manuscript using the following format provided by protocols.io: http://dx.doi.org/10.17504/protocols.io.[PROTOCOL DOI]
At this stage, your protocol is only visible to those with the link. This allows editors and reviewers to consult your protocol when evaluating the manuscript. You can make your protocols public at any time by selecting Publish on the protocols.io site. Any referenced protocol(s) will automatically be made public when your article is published.
Consult our reporting guidelines, and include an ethics statement in the Materials and Methods section when reporting results from human subjects research and animal research.

Acknowledgments
Those who contributed to the work but do not meet our authorship criteria should be listed in the Acknowledgments with a description of the contribution.
Authors are responsible for ensuring that anyone named in the Acknowledgments agrees to be named.
PLOS journals publicly acknowledge the indispensible efforts of our editors and reviewers on an annual basis. To ensure equitable recognition and avoid any appearance of partiality, do not include editors or peer reviewers—named or unnamed—in the Acknowledgments.
Do not include funding sources in the Acknowledgments or anywhere else in the manuscript file. Funding information should only be entered in the financial disclosure section of the submission system.

References
Any and all available works can be cited in the reference list. Acceptable sources include:
Published or accepted manuscripts
Manuscripts on preprint servers, providing the manuscript has a citable DOI or arXiv URL.
Do not cite the following sources in the reference list:
Unavailable and unpublished work, including manuscripts that have been submitted but not yet accepted (e.g., “unpublished work,” “data not shown”). Instead, include those data as supplementary material or deposit the data in a publicly available database.
Personal communications (these should be supported by a letter from the relevant authors but not included in the reference list)
References are listed at the end of the manuscript and numbered in the order that they appear in the text. In the text, cite the reference number in square brackets (e.g., “We used the techniques developed by our colleagues [19] to analyze the data”). PLOS uses the numbered citation (citation-sequence) method and first six authors, et al.

Do not include citations in abstracts.

Make sure the parts of the manuscript are in the correct order before ordering the citations.

Formatting references

Because all references will be linked electronically as much as possible to the papers they cite, proper formatting of the references is crucial.

PLOS uses the reference style outlined by the International Committee of Medical Journal Editors (ICMJE), also referred to as the "Vancouver" style. Example formats are listed below. Additional examples are in the ICMJE sample references.

A reference management tool, EndNote, offers a current style file that can assist you with the formatting of your references. If you have problems with any reference management program, please contact the source company's technical support.

Journal name abbreviations should be those found in the National Center for Biotechnology Information (NCBI) databases.

SourceFormat

Published articles

Hou WR, Hou YL, Wu GF, Song Y, Su XL, Sun B, et al. cDNA, genomic sequence cloning and overexpression of ribosomal protein gene L9 (rpL9) of the giant panda (Ailuropoda melanoleuca). Genet Mol Res. 2011;10: 1576-1588.

Devaraju P, Gulati R, Antony PT, Mithun CB, Negi VS. Susceptibility to SLE in South Indian Tamils may be influenced by genetic selection pressure on TLR2 and TLR9 genes. Mol Immunol. 2014 Nov 22. pii: S0161-5890(14)00313-7. doi: 10.1016/j.molimm.2014.11.005.

Note: A DOI number for the full-text article is acceptable as an alternative to or in addition to traditional volume and page numbers. When providing a DOI, adhere to the format in the example above with both the label and full DOI included at the end of the reference (doi: 10.1016/j.molimm.2014.11.005). Do not provide a shortened DOI or the URL.

Accepted, unpublished articles Same as published articles, but substitute "Forthcoming" for page numbers or DOI.

Online articles

Huynen MMTE, Martens P, Hilderlink HBM. The health impacts of globalisation: a conceptual framework. Global Health. 2005;1: 14. Available from: http://www.globalizationandhealth.com/content/1/1/14

Books

Bates B. Bargaining for life: A social history of tuberculosis. 1st ed. Philadelphia: University of Pennsylvania Press; 1992.

Book chapters Hansen B. New York City epidemics and history for the public. In: Harden VA, Risse GB, editors. AIDS and the historian. Bethesda: National Institutes of Health; 1991. pp. 21-28.

Deposited articles (preprints, e-prints, or arXiv) Krick T, Shub DA, Verstraete N, Ferreiro DU, Alonso LG, Shub M, et al. Amino acid metabolism conflicts with protein diversity; 1991. Preprint. Available from: arXiv:1403.3301v1. Cited 17 March 2014.

Published media (print or online newspapers and magazine articles) Fountain H. For Already Vulnerable Penguins, Study Finds Climate Change Is Another Danger. The New York Times. 29 Jan 2014. Available from:

http://www.nytimes.com/2014/01/30/science/earth/climate-change-taking-toll-on-penguins-study-finds.html Cited 17 March 2014.
New media (blogs, web sites, or other written works) Allen L. Announcing PLOS Blogs. 2010 Sep 1 [cited 17 March 2014]. In: PLOS Blogs [Internet]. San Francisco: PLOS 2006 - . [about 2 screens]. Available from: http://blogs.plos.org/plos/2010/09/announcing-plos-blogs/.
Masters' theses or doctoral dissertations Wells A. Exploring the development of the independent, electronic, scholarly journal. M.Sc. Thesis, The University of Sheffield. 1999. Available from: http://cumincad.scix.net/cgi-bin/works/Show?2e09
Databases and repositories (Figshare, arXiv) Roberts SB. QPX Genome Browser Feature Tracks; 2013 [cited 2013 Oct 5]. Database: figshare [Internet]. Available from: http://figshare.com/articles/QPX_Genome_Browser_Feature_Tracks/701214
Multimedia (videos, movies, or TV shows) Hitchcock A, producer and director. Rear Window [Film]; 1954. Los Angeles: MGM.

Supporting Information
Authors can submit essential supporting files and multimedia files along with their manuscripts. All supporting information will be subject to peer review. All file types can be submitted, but files must be smaller than 10 MB in size.
Authors may use almost any description as the item name for a supporting information file as long as it contains an "S" and number. For example, "S1 Appendix" and "S2 Appendix," "S1 Table" and "S2 Table," and so forth.
Supporting information files are published exactly as provided, and are not copyedited.

Supporting information captions
List supporting information captions at the end of the manuscript file. Do not submit captions in a separate file.
The file number and name are required in a caption, and we highly recommend including a one-line title as well. You may also include a legend in your caption, but it is not required.

Example caption
S1 Text. Title is strongly recommended. Legend is optional.
In-text citations
We recommend that you cite supporting information in the manuscript text, but this is not a requirement. If you cite supporting information in the text, citations do not need to be in numerical order.
Read the supporting information guidelines for more details about submitting supporting information and multimedia files.

Figures and Tables

Figure files
You can include figures in the main manuscript file at initial submission. If the manuscript reaches the revise stage, prepare and submit each figure as an individual file.
Cite figures in ascending numeric order at first appearance in the manuscript file.
For detailed instructions, read the guidelines for figures.
Figure Captions
If you are submitting a new or revised manuscript, embed figure captions within the manuscript text after their first mention, or group together at the end of the manuscript.

After editorial acceptance, insert captions in read order in the manuscript text, immediately following the paragraph where the figure is first cited. Don't include captions as part of the figure files themselves or submit them in a separate document.

At a minimum, include the following in your figure captions:

A figure label with Arabic numerals, and "Figure" abbreviated to "Fig" (e.g. Fig 1, Fig 2, Fig 3, etc). Match the label of your figure with the name of the file uploaded at submission (e.g. a figure citation of "Fig 1" must refer to a figure file named "Fig1.tif").
A concise, descriptive title
The caption may also include a legend as needed.

For detailed instructions, read the guidelines for figures.
Data presentation in graphs
To better illustrate your results and to improve the reader's understanding and interpretation of your data, we discourage the use of bar graphs and line plots for continuous data, particularly for studies with small sample sizes (n≤9 independent observations per group).
See this Perspective for more information about our position on data presentation in graphs:
Weissgerber TL, Milic NM, Winham SJ, Garovic VD (2015) Beyond Bar and Line Graphs: Time for a New Data Presentation Paradigm. PLoS Biol 13(4): e1002128. doi:10.1371/journal.pbio.1002128
We recommend that continuous data is presented in such a way that the reader can evaluate the distribution of the individual data points. Scatterplots, boxplots, and histograms are more informative than bar or line charts.
If there is a particular reason that bar or line graphs are preferred, these must include inferential error bars:
SD - standard deviation of the population, or CI - confidence intervals.
Paired or non-independent data should be presented to include information about whether changes are consistent across individuals.
Figures presenting small sample size data (n≤9 independent observations per group) should show the full distribution of the data, as opposed to summary statistics.
All numerical values used to generate graphs must be provided as per the PLOS Data Availability policy.

For more information about our Data Availability policy, see this Editorial:
Bloom T, Ganley E, Winker M (2014) Data Access for the Open Access Literature: PLOS's Data Policy. PLoS Biol 12(2): e1001797. https://doi.org/10.1371/journal.pbio.1001797

For PLOS Genetics-specific guidance, read:
Barsh GS, Cooper GM, Copenhaver GP, Gibson G, McCarthy MI, Tang H, et al. (2015) PLOS Genetics Data Sharing Policy: In Pursuit of Functional Utility. PLoS Genet 11(12): e1005716. https://doi.org/10.1371/journal.pgen.1005716
Tables
Cite tables in ascending numeric order upon first appearance in the manuscript file.

Place each table in your manuscript file directly after the paragraph in which it is first cited (read order). Do not submit your tables in separate files.

Tables require a label (e.g., "Table 1") and brief descriptive title to be placed above the table. Place legends, footnotes, and other text below the table.

Read the guidelines for tables.

Data reporting

All data and related metadata underlying the findings reported in a submitted manuscript should be deposited in an appropriate public repository, unless already provided as part of the submitted article.

Read our policy on data availability.

Repositories may be either subject-specific (where these exist) and accept specific types of structured data, or generalist repositories that accept multiple data types. We recommend that authors select repositories appropriate to their field. Repositories may be subject-specific (e.g., GenBank for sequences and PDB for structures), general, or institutional, as long as DOIs or accession numbers are provided and the data are at least as open as CC BY. Authors are encouraged to select repositories that meet accepted criteria as trustworthy digital repositories, such as criteria of the Centre for Research Libraries or Data Seal of Approval. Large, international databases are more likely to persist than small, local ones.

See our list of recommended repositories.

To support data sharing and author compliance of the PLOS data policy, we have integrated our submission process with a select set of data repositories. The list is neither representative nor exhaustive of the suitable repositories available to authors. Current repository integration partners include Dryad and FlowRepository. Please contact data@plos.org to make recommendations for further partnerships.

Instructions for PLOS submissions with data deposited in an integration partner repository:

Deposit data in the integrated repository of choice.

Once deposition is final and complete, the repository will provide you with a dataset DOI (provisional) and private URL for reviewers to gain access to the data.

Enter the given data DOI into the full Data Availability Statement, which is requested in the Additional Information section of the PLOS submission form. Then provide the URL passcode in the Attach Files section.

If you have any questions, please email us.

Accession numbers

All appropriate data sets, images, and information should be deposited in an appropriate public repository. See our list of recommended repositories.

Accession numbers (and version numbers, if appropriate) should be provided in the Data Availability Statement. Accession numbers or a citation to the DOI should also be provided when the data set is mentioned within the manuscript.

In some cases authors may not be able to obtain accession numbers of DOIs until the manuscript is accepted; in these cases, the authors must provide these numbers at acceptance. In all other cases, these numbers must be provided at submission.

Identifiers

As much as possible, please provide accession numbers or identifiers for all entities such as genes, proteins, mutants, diseases, etc., for which there is an entry in a public database, for example:

Ensembl

Entrez Gene
FlyBase
InterPro
Mouse Genome Database (MGD)
Online Mendelian Inheritance in Man (OMIM)
PubChem
Identifiers should be provided in parentheses after the entity on first use.

Research Resource Identifiers
Research Resource Identifiers are unique Resource Identifiers (RRIDs) for citing resources used in the research. We encourage authors to use RRIDs within the text of their papers to identify their model organisms, antibodies, or tools.
PLOS is a part of the Research Resource Identification Initiative (#RII), a cross-publisher effort to enable effective tracking of the utilization of particular research resources across all biomedical literature and promote reproducibility in science. RRIDs are found via the RRID portal.
If an RRID does not exist, you may create a new one as needed through the RRID Portal. The Research Resource Citation guidelines provide instructions on how to cite the resource in the manuscript.

Small and macromolecule crystal data
Manuscripts reporting new and unpublished three-dimensional structures must include sufficient supporting data and detailed descriptions of the methodologies used to allow the reproduction and validation of the structures. All novel structures must have been deposited in a community endorsed database prior to submission (please see our list of recommended repositories).

Small molecule single crystal data
Authors reporting X-Ray crystallographic structures of small organic, metal-organic, and inorganic molecules must deposit their data with the Cambridge Crystallographic Data Centre (CCDC), the Inorganic Crystal Structure Database (ICSD), or similar community databases providing a recognized validation functionality. Authors are also required to include the relevant structure reference numbers within the main text (e.g. the CCDC ID number), as well as the crystallographic information files (.cif format) as Supplementary Information, along with the checkCIF validation reports that can be obtained via the International Union of Crystallography (IUCr).

Macromolecular structures
Authors reporting novel macromolecular structures must have deposited their data prior to submission with the Worldwide Protein Data Bank (wwPDB), the Biological Magnetic Resonance Data Bank (BMRB), the Electron Microscopy Data Bank (EMDB), or other community databases providing a recognized validation functionality. Authors must include the structure reference numbers within the main text and submit as Supplementary Information the official validation reports from these databases.

Striking image
You can upload a visually striking image alongside your submission, which we may use to showcase your article through PLOS' online channels. The Editors-in-Chief choose the monthly issue image from the striking images submitted with articles scheduled for publication.

Submission Criteria
Choose an image that represents the article in a striking and eye-catching way.
It can be derived from a figure or supporting information file from the paper, and it may be a cropped portion of an image or the entire image.
Alternatively, you can create or source an image, as long as it adheres to our CC BY license.
High resolution: between 300-600 dpi
Single panel
Ideally avoid added details like text, scale bars, and arrows.
How to Submit
Submit your striking image to the submission system using the file type “Striking Image”.
Upload a separate file with corresponding caption.
If no striking image is uploaded, a member of the journal team will choose an appropriate image, which may be a figure from the submission or a separately sourced CC BY image.

Striking images should not contain potentially identifying images of people. Read our policy on identifying information.
The PLOS licenses and copyright policy also applies to striking images.
Additional Information Requested at Submission
Financial Disclosure Statement
This information should describe sources of funding that have supported the work. If your manuscript is published, your statement will appear in the Funding section of the article.
Include your statement in the Financial Disclosure section of the submission form.

The statement should include:
Specific grant numbers
Initials of authors who received each award
URLs to sponsors’ websites
Also state whether any sponsors or funders (other than the named authors) played any role in:
Study design
Data collection and analysis
Decision to publish
Preparation of the manuscript
If they had no role in the research, include this sentence: “The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.”

If the study was unfunded, include this sentence as the Financial Disclosure statement: “The author(s) received no specific funding for this work."

Read our policy on disclosure of funding sources.
Competing Interests
The corresponding author is asked at submission to declare, on behalf of all authors, whether there are any financial, personal, or professional interests that could be construed to have influenced the work.

Any relevant competing interests of authors must be available to editors and reviewers during the review process and will be stated in published articles.

Read our policy on competing interests.
Related manuscripts

When submitting a manuscript, all authors are asked to indicate that they do not have a related or duplicate manuscript under consideration (or accepted) for publication elsewhere. If related work has been or will be submitted elsewhere or is in press elsewhere, then a copy must be uploaded with the article submitted to PLOS. Reviewers will be asked to comment on the overlap between related submissions.

Read our policies on related manuscripts.
Preprints
PLOS encourages authors to post preprints as a way to accelerate the dissemination of research and supports authors who wish to share their work early and receive feedback before formal peer review. Deposition of manuscripts with preprint servers does not impact consideration of the manuscript at any PLOS journal.
Authors posting on bioRxiv may concurrently submit directly to PLOS journals through bioRxiv's direct transfer to journal service.
Authors submitting manuscripts in the life sciences to PLOS Genetics may opt-in to post their work on bioRxiv during the PLOS Genetics initial submission process.

Read more about preprints.

Learn how to post a preprint to bioRxiv during PLOS Genetics initial submission.
Reviewer and editor suggestions
We ask authors to suggest suitable editors and at least four potential reviewers when submitting their manuscript. Bear in mind any potential competing interests when making these suggestions. It is not appropriate to suggest recent collaborators or other researchers at your institution. See our policy on competing interests for more information.

Opposed reviewers
Authors may choose to request that an individual is excluded from the review process and not involved in their manuscript. When making these suggestions, please provide specific reasons why each person should not review your submission in each "Reason" box. The editorial team will respect these requests so long as this does not interfere with the objective and thorough assessment of the submission.

Selecting a Section
Authors are required to select a section upon submission to PLOS Genetics. This information is used to assign the relevant Senior Editor who can best evaluate each manuscript. Choose one of the following sections that most closely applies (listed topics are not exhaustive). Select 'General' if the other sections do not apply.

Cancer genetics
Genomic and/or epigenomic analyses in humans or model organisms that provide insight into cancer pathogenesis and/or approaches to therapy
Identification of heritable cancer-susceptibility genes and variants
Genome stability/DNA damage analyses relevant to understanding mechanisms of tumorigenesis
Cellular/molecular studies that expand understanding of cancer-related signaling pathways
Epigenetics
Epigenetic studies of gene and genome regulation
Chromatin and chromosome biology
Epigenetic mechanisms relevant to normal biology, development, or disease

Evolution
Studies of molecular or experimental evolution in any organism or system
Theoretical and/or computational approaches that represent a broad advance in understanding evolutionary dynamics and/or mechanisms
Genetic and/or genomic whole organism studies that provide insight into adaptation or speciation

Natural variation
Studies of humans, model, or non-model organisms that provide insight into genotype-phenotype relationships at a molecular, organismal, and/or population level
Comparative genomics associated with functional validation and/or elucidation of clear genotype-phenotype relationships
Experimental studies of genetic pathophysiology for Mendelian or complex disorders
Genetic variation in natural populations of any organism (of any animal)
Statistical, computational or bioinformatic methods that have broad application and lead to novel insights in the areas listed above

Prokaryotic genetics
Genetic approaches that provide insights of broad significance into the biology of bacteria, archaea, or phages
Phenotypic and molecular variation including gene expression, motility, cell cycle regulation, chromosome structure and function, metabolism, biofilm formation
Microbial interactions and microbiomes

General
Authors may choose the General section if the other sections do not apply. The Editors-in-Chief act as Senior Editors for this section.

Other Article Types
If you are submitting content other than a research article, read the guidelines for other article types.