MOLECULAR ECOLOGY

**Supplemental Information for:**

# .andscape attributes governing local transmission of an endemic zoonotic virus: rabies in domestic dogs.

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## Table of Contents:



**METHODS S1**

**454 pyrosequencing**

Whole genome sequences for five samples (see Table S1) were generated via 454 pyrosequencing protocols. DNA for three samples was prepared according to the depletion method detailed in the main methods and sent to the Animal & Plant Health Agency (APHA) sequencing facility for the preparation of sequencing libraries and 454 pyrosequencing. The other two samples were prepared according to a PCR amplicon approach as follows. TRIzol-extracted viral RNA was reverse transcribed to cDNA using the primer RABV_Tzdg.p1f (5’ ACGCTTAACAACAAAATCAGAG 3’) at a concentration of 2pmol/µl and Superscript III reverse transcriptase (Invitrogen) in a total volume of 20µl, as per manufacturer’s instructions. An in house set of 26 short, tagged, overlapping primer pairs spanning the entire RABV genome was used to obtain PCR products with 1µl of cDNA and

KOD hot start DNA polymerase kit as per the manufacturer's protocol (Novagen). The following cycling parameters were used: 1 hold at 95 °C for 2 mins, 35 cycles at 95 °C for 20 s, 50-60°C (dependent on the optimized temperature for each primer pair) for 20 s, 70 °C for 20 s and a final hold at 70 °C for 10 min. Products were pooled for each sample with libraries and sequencing completed by the APHA sequencing facility.

**Construction of resistance surfaces**

Landscape attributes were characterized as surface models by assigning cell values to represent the assumed facilitating or impeding impact of a predictor on RABV diffusion. Resistance surfaces for each attribute were formatted as follows:

i) Dog density

Dog density estimates were taken from a household census conducted in the Serengeti District in 2014-2015, which provided the GPS location and dog count for each household. The density point pattern was smoothed across the default raster grid using an isotropic Gaussian smoothing kernel with sigma=500 using the R package spatstat (1) with cell values expressing the estimated intensity values. As dog density is assumed to facilitate RABV diffusion, the reciprocal of these values was used as a resistance value in each cell. Serengeti National Park (SNP) areas were assigned a low resistance value, equivalent to 1 dog per $km^2$ to reflect the low dog density in this area. Cells outside the district (accounting for ~12% of all cells) were assigned random values from the Serengeti density data.

ii) Dog presence

Dog census data as described above was used to assign a presence or absence value to 100m grid cells based on the exact locations of dogs. Dog presence was assigned a low resistance value of 0.1 to represent conductive "corridors" of movement through normal landscape, whereas absence was the null IBD value of 1 to represent higher resistance to dog movement outside connected corridors.

iii) Elevation and slope

A digital elevation model covering the landscape was converted to raster format and elevation values used directly as resistance values. Slope values were calculated from the digital elevation model using the SDMTools package (2) in R. All slope values were increased by a value of 1 to ensure comparison to a null IBD surface was possible. The resolution of the digital elevation model was not consistent across the extent of the landscape as some areas have been mapped in more detail, which resulted in some finer grained areas in raster grids.

iv) Human to dog ratio (HDR)

Household census data was used to estimate the human to dog ratio per village, which was assigned directly as a resistance value in each cell.

v) Major roads and rivers

Shapefiles of major roads and rivers in the study area were converted to raster grids (one for roads, one for rivers) with the defined spatial extent and resolution. Cells containing a road feature were assigned a low resistance value of 0.001 to represent increased diffusion along roads relative to uniform landscape, all other cells were assigned a value of 1. River cells were assigned high resistance values of 1000 to reflect their influence as a barrier to diffusion.

vi) Average vaccination coverage

Mass dog vaccination campaigns have been undertaken in the Serengeti District since 2002, with varying annual coverage across villages. We used an average annual % vaccination coverage per village across the 11-year period from 2002 up to 2013 and assigned values to grid cells as resistance values [range: 6.43-100]. Rabies appears to have been locally eliminated in the SNP and there is a requirement for all dogs to be vaccinated within the park boundaries, therefore SNP cells were assigned the highest resistance value of 100. Cells outside the district and SNP were assigned the minimum observed average vaccination coverage of 6.43% as there is no formal vaccination initiative in these areas and therefore coverage is assumed to be low.

vi) Susceptible dog density

The dog density estimates were depleted according to the averaged vaccination coverage described above to produce a resistance surface representative of the susceptible host population density.

vii) Number of vaccination campaigns

The number of vaccination campaigns conducted across the sampled time period 2004-2013 was summed for each village and assigned to each grid cell. Note some villages experienced return visits when turnout was less than expected, these were counted as separate campaigns if a coverage of at least 10% was achieved.

**Determining an optimum location state partitioning scheme**

Rabies cases projected in MDS attribute-defined space were partitioned according to varying levels of spatial aggregation using a *k*-means algorithm. The following methods were used to obtain an optimum range of *k*-values to determine a partitioning scheme:

i) Elbow method: the point of maximum curvature in a plot of number of clusters versus within-group sum of squares;

ii) Partitioning around medoids: using the optimum average silhouette to estimate the number of clusters, R package: fpc (3)

iii) Model-based clustering: chooses the optimal model and number of clusters according to Bayesian Information Criterion for expectation-maximisation, R package:mclust (4)

iv) Affinity propagation: a clustering algorithm that takes a pairwise similarity matrix and simultaneously considers all data points as potential cluster centres. The algorithm finds an optimum set of clusters that maximises the total similarity between data points and their cluster centres by an iterative process (5), R package: apcluster (6);

v) Gap statistic: a statistical procedure to formalise the "elbow" method by comparing the change in within-cluster dispersion to a reference null distribution (7), R package: cluster (8);

vi) R package NbClust: provides 30 indices to determine the number of clusters (9).

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MOLECULAR ECOLOGY

**S1 Table. Model selection results of the continuous phylogeography diffusion model for Tanzania rabies virus dataset.** Shown are marginal likelihood estimates using path sampling and stepping stone sampling in BEAST, with the best model in bold.

| Diffusion model | Path Sampling | Stepping Stone |
|---|---|---|
| Homogeneous | -26674.93 | -26679.87 |
| **Gamma** | **-26661.45** | **-26666.37** |
| Lognormal | -26683.68 | -26688.12 |

MOLECULAR ECOLOGY

**S2 Table. Pearson's correlation coefficients between paired resistance distance matrices for landscape attributes used to parameterize GLM diffusion models estimating the rabies virus movement in the Serengeti District.** Pairwise resistance distance matrices were constructed for *k*=5 to 15 centroids. Correlations greater than 0.9 are highlighted in large bold text.

| Pairwise attribute combinations | k5 | k6 | k7 | k8 | k9 | k10 | k11 | k12 | k13 | k14 | k15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Campaigns,Dog density | 0.55 | 0.85 | 0.58 | 0.45 | 0.56 | 0.51 | 0.70 | 0.54 | 0.35 | 0.30 | 0.39 |
| Campaigns,Dog presence | 0.58 | 0.65 | 0.66 | 0.13 | 0.30 | 0.12 | 0.08 | 0.57 | 0.26 | 0.34 | 0.41 |
| Campaigns,Elevation | 0.53 | 0.50 | 0.67 | 0.21 | 0.36 | -0.21 | -0.12 | 0.58 | -0.11 | 0.44 | 0.23 |
| Campaigns,HDR | 0.48 | 0.42 | -0.05 | 0.63 | 0.70 | -0.53 | -0.05 | 0.62 | -0.32 | 0.17 | 0.74 |
| Campaigns,Rivers | -0.29 | 0.10 | 0.02 | -0.13 | 0.07 | -0.22 | -0.27 | 0.15 | 0.12 | 0.30 | 0.00 |
| Campaigns,Roads | 0.87 | 0.74 | 0.60 | 0.57 | 0.56 | 0.27 | 0.17 | 0.63 | 0.62 | 0.28 | 0.02 |
| Campaigns,Slope | -0.01 | 0.15 | -0.15 | -0.28 | -0.31 | -0.67 | -0.62 | -0.12 | -0.27 | -0.10 | -0.51 |
| Campaigns,Susceptibles | 0.52 | 0.84 | 0.66 | 0.53 | 0.67 | 0.46 | 0.68 | 0.69 | 0.48 | 0.39 | 0.41 |
| Campaigns,VaccCov | 0.57 | 0.70 | 0.88 | 0.72 | 0.77 | -0.51 | -0.07 | 0.72 | 0.73 | 0.85 | 0.47 |
| Dog density,Dog presence | 0.86 | **0.91** | 0.73 | 0.82 | 0.75 | -0.17 | 0.06 | 0.68 | 0.66 | 0.63 | 0.09 |
| Dog density,Elevation | 0.47 | 0.65 | 0.35 | 0.44 | 0.38 | 0.43 | 0.28 | 0.47 | -0.05 | 0.36 | 0.37 |
| Dog density,HDR | -0.01 | 0.14 | 0.10 | 0.03 | 0.17 | -0.32 | -0.03 | 0.01 | -0.08 | -0.04 | 0.28 |
| Dog density,Rivers | 0.14 | 0.34 | -0.22 | 0.41 | 0.39 | -0.10 | -0.18 | 0.27 | 0.04 | 0.21 | -0.02 |
| Dog density,Roads | 0.22 | 0.69 | 0.69 | 0.26 | 0.37 | 0.59 | -0.19 | 0.52 | 0.66 | 0.51 | 0.51 |
| Dog density,Slope | 0.78 | 0.61 | 0.22 | 0.54 | 0.21 | -0.67 | -0.47 | 0.05 | 0.35 | 0.21 | -0.54 |
| Dog density,Susceptibles | **0.97** | **0.99** | **0.98** | **0.98** | **0.98** | **0.96** | **0.98** | **0.96** | **0.96** | **0.97** | **0.98** |
| Dog density,VaccCov | 0.30 | 0.55 | 0.23 | 0.31 | 0.36 | -0.22 | 0.28 | 0.20 | 0.09 | 0.40 | 0.38 |
| Dog presence,Elevation | 0.85 | 0.86 | 0.77 | 0.80 | 0.83 | 0.11 | 0.15 | **0.90** | 0.00 | 0.86 | 0.14 |
| Dog presence,HDR | 0.19 | 0.20 | -0.10 | 0.03 | 0.20 | 0.04 | 0.11 | 0.38 | -0.17 | 0.03 | 0.51 |
| Dog presence,Rivers | 0.24 | 0.59 | -0.13 | 0.75 | 0.78 | 0.57 | 0.51 | 0.73 | 0.00 | 0.08 | 0.55 |
| Dog presence,Roads | 0.34 | 0.66 | 0.84 | 0.26 | 0.44 | -0.06 | 0.26 | 0.57 | 0.54 | 0.63 | 0.19 |
| Dog presence,Slope | 0.67 | 0.67 | 0.29 | 0.76 | 0.54 | 0.38 | 0.43 | 0.19 | 0.61 | 0.56 | 0.08 |
| Dog presence,Susceptibles | 0.88 | **0.93** | 0.74 | 0.82 | 0.73 | -0.16 | 0.06 | 0.70 | 0.64 | 0.66 | 0.12 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Dog presence,VaccCov | 0.45 | 0.53 | 0.51 | 0.06 | 0.11 | -0.16 | 0.12 | 0.36 | 0.22 | 0.33 | -0.12 |
| Elevation,HDR | 0.42 | 0.55 | -0.18 | 0.39 | 0.49 | 0.32 | -0.11 | 0.60 | 0.65 | 0.09 | 0.20 |
| Elevation,Rivers | 0.26 | 0.78 | 0.10 | 0.75 | 0.79 | 0.25 | 0.26 | 0.71 | 0.35 | 0.04 | 0.20 |
| Elevation,Roads | 0.52 | 0.52 | 0.46 | 0.49 | 0.57 | 0.41 | -0.06 | 0.54 | 0.03 | 0.49 | 0.45 |
| Elevation,Slope | 0.28 | 0.41 | 0.15 | 0.47 | 0.33 | 0.10 | 0.30 | 0.14 | 0.02 | 0.36 | -0.04 |
| Elevation,Susceptibles | 0.51 | 0.69 | 0.42 | 0.52 | 0.43 | 0.46 | 0.33 | 0.55 | -0.08 | 0.41 | 0.43 |
| Elevation,VaccCov | 0.49 | 0.55 | 0.74 | 0.09 | 0.17 | 0.37 | 0.31 | 0.48 | -0.15 | 0.39 | 0.52 |
| HDR,Rivers | 0.42 | 0.32 | -0.03 | 0.10 | 0.31 | 0.42 | 0.24 | 0.36 | 0.14 | 0.05 | 0.24 |
| HDR,Roads | 0.51 | 0.21 | 0.05 | 0.21 | 0.23 | -0.03 | -0.21 | 0.28 | -0.11 | -0.13 | -0.09 |
| HDR,Slope | -0.49 | -0.42 | 0.08 | -0.37 | -0.48 | 0.35 | 0.06 | -0.33 | -0.10 | 0.05 | -0.05 |
| HDR,Susceptibles | 0.14 | 0.21 | 0.10 | 0.15 | 0.32 | -0.16 | -0.02 | 0.21 | -0.12 | -0.07 | 0.27 |
| HDR,VaccCov | **0.91** | 0.75 | -0.13 | 0.73 | 0.79 | 0.90 | 0.15 | 0.80 | -0.30 | 0.10 | 0.24 |
| Rivers,Roads | -0.29 | 0.06 | -0.40 | 0.09 | 0.22 | -0.07 | 0.23 | 0.33 | -0.08 | 0.16 | 0.26 |
| Rivers,Slope | 0.16 | 0.51 | 0.35 | 0.52 | 0.35 | 0.51 | 0.60 | 0.25 | -0.04 | -0.09 | 0.50 |
| Rivers,Susceptibles | 0.28 | 0.34 | -0.28 | 0.42 | 0.39 | -0.01 | -0.14 | 0.28 | -0.06 | 0.33 | 0.04 |
| Rivers,VaccCov | 0.43 | 0.10 | -0.06 | -0.13 | 0.02 | 0.24 | -0.03 | 0.13 | 0.23 | 0.44 | 0.01 |
| Roads,Slope | -0.32 | 0.06 | 0.04 | -0.13 | 0.00 | -0.57 | -0.09 | -0.07 | -0.03 | 0.03 | -0.19 |
| Roads,Susceptibles | 0.14 | 0.70 | 0.75 | 0.33 | 0.45 | 0.63 | -0.11 | 0.63 | 0.72 | 0.60 | 0.58 |
| Roads,VaccCov | 0.40 | 0.54 | 0.43 | 0.02 | 0.06 | 0.10 | -0.23 | 0.19 | 0.36 | 0.06 | 0.15 |
| Slope,Susceptibles | 0.75 | 0.57 | 0.08 | 0.51 | 0.11 | -0.67 | -0.51 | -0.09 | 0.22 | 0.15 | -0.53 |
| Slope,VaccCov | -0.16 | -0.16 | -0.40 | -0.13 | -0.36 | 0.29 | -0.25 | -0.34 | -0.41 | -0.11 | -0.24 |
| Susceptibles,VaccCov | 0.48 | 0.64 | 0.36 | 0.35 | 0.44 | -0.08 | 0.32 | 0.37 | 0.24 | 0.49 | 0.45 |

**S3 Table. Epidemiological information and whole genome sequencing (WGS) details for 152 rabies virus samples collected from the Serengeti District, Tanzania, between 2004 and 2013.**

| Sample ID | Date of sample collection | Easting | Northing | Host | WGS protocol | Total quality trimmed reads | Viral reads mapped | Proportion viral reads | Average depth | GenBank Accession | Details/Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RV2483 | 28/09/08 | 701590 | 9794710 | Goat | MiSeq | 397221 | 2045 | 0.51 | 22.05 | KY210220 | This paper |
| RV2485 | 28/09/08 | 701590 | 9794710 | Goat | MiSeq | 300966 | 907 | 0.30 | 8.12 | KY210221 | This paper |
| RV2489 | 17/01/09 | 699900 | 9794413 | Domestic dog | MiSeq | 2665913 | 3359 | 0.13 | 16.43 | KY210222 | This paper |
| RV2490 | 07/08/08 | 702122 | 9796402 | Domestic dog | MiSeq | 1013605 | 8526 | 0.84 | 79.09 | KR534217 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2491 | 02/08/08 | 696748 | 9794246 | Domestic dog | MiSeq | 1421454 | 10733 | 0.76 | 101.98 | KR534218 | Original GenBank submission (Brunker |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | *et al* ,2015) updated to WGS for this paper |
| RV24 92 | 03/11/07 | 685 837 | 9799 418 | Dom estic dog | MiSeq | 1642925 | 12895 | 0.78 | 100.93 | KR53 4219 | Original GenBank submissio n (Brunker *et al* ,2015) updated to WGS for this paper |
| RV24 93 | 31/07/08 | 700 689 | 9793 979 | Dom estic dog | MiSeq | 1304543 | 4780 | 0.37 | 44.57 | KR53 4220 | Original GenBank submissio n (Brunker *et al* ,2015) updated to WGS for this paper |
| RV24 95 | 12/07/08 | 696 385 | 9802 796 | Dom estic dog | MiSeq | 1946750 | 14768 | 0.76 | 129.48 | KR90 6734 | Brunker *et al* ,2015 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| RV2497 | 22/06/07 | 678577 | 9807715 | Domestic dog | MiSeq/NextSeq | 15591341 | 6031 | 0.04 | 63.98 | KY210223 | This paper |
| RV2500 | 23/11/08 | 698019 | 9804712 | Domestic dog | MiSeq | 557886 | 1536 | 0.28 | 15.86 | KR906737 | Brunker *et al* ,2015 |
| RV2501 | 14/02/04 | 679372 | 9810508 | Domestic dog | MiSeq | 1030023 | 11539 | 1.12 | 108.23 | KR906738 | Brunker *et al* ,2015 |
| RV2503 | 15/02/09 | 686729 | 9761151 | Wild cat | MiSeq | 1325075 | 2774 | 0.21 | 28.64 | KR906740 | Brunker *et al* ,2015 |
| RV2767 | 12/09/09 | 665178 | 9777064 | Domestic dog | MiSeq | 1039525 | 23560 | 2.27 | 249.79 | KR906742 | Brunker *et al* ,2015 |
| RV2786 | 20/06/10 | 670876 | 9811501 | Domestic dog | MiSeq/NextSeq | 15706254 | 10705 | 0.07 | 109.00 | KY210224 | This paper |
| RV2788 | 05/08/10 | 668396 | 9794012 | Domestic dog | MiSeq | 1952400 | 16416 | 0.84 | 181.53 | KR534228 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2789 | 22/10/10 | 686741 | 9795339 | Domestic | MiSeq | 825552 | 1753 | 0.21 | 16.94 | KR534229 | Original GenBank |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | dog | | | | | | | submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2790 | 01/11/10 | 678362 | 9807838 | Domestic dog | MiSeq | 190118 | 2054 | 1.08 | 20.87 | KR534230 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2791 | 08/11/10 | 681329 | 9802616 | Domestic dog | MiSeq/NextSeq | 15068608 | 20740 | 0.14 | 237.54 | KR534231 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| RV27 92 | 07/01/11 | 670 624 | 9824 613 | Jackal | MiSeq/NextSeq | 13995380 | 19366 | 0.14 | 215.26 | KR53 4232 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV27 93 | 02/01/11 | 657 176 | 9822 908 | Cow | MiSeq | 149085 | 3900 | 2.62 | 38.81 | KR90 6755 | Brunker *et al* ,2015 |
| RV27 94 | 12/01/11 | 679 391 | 9807 221 | Domestic dog | MiSeq | 514797 | 2064 | 0.40 | 19.28 | KR53 4233 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV27 95 | 16/01/11 | 682 879 | 9801 080 | Cow | MiSeq | 369231 | 12824 | 3.47 | 134.33 | KR53 4234 | Original GenBank submission (Brunker *et al* |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | ,2015) updated to WGS for this paper |
| RV2796 | 19/01/11 | 671651 | 9801501 | Cow | MiSeq | 1033943 | 56028 | 5.42 | 508.13 | KR534235 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2797 | 30/01/11 | 663782 | 9800181 | Cow | MiSeq | 1278027 | 25740 | 2.01 | 229.21 | KR534236 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2798 | 31/01/11 | 663782 | 9800181 | Cow | MiSeq | 1287235 | 69613 | 5.41 | 604.45 | KR534237 | Original GenBank submission |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2799 | 29/01/11 | 680129 | 9805797 | Domestic dog | MiSeq | 1347238 | 4352 | 0.32 | 41.33 | KR906756 | Brunker *et al* ,2015 |
| RV2800 | 17/02/11 | 666237 | 9778079 | Domestic dog | MiSeq | 142582 | 2917 | 2.05 | 33.48 | KR534238 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2858 | 21/02/11 | 646139 | 9824316 | Goat | MiSeq | 1503125 | 120336 | 8.01 | 935.41 | KY210225 | This paper |
| RV2859 | 01/03/11 | 650148 | 9819597 | Domestic dog | MiSeq | 283796 | 8437 | 2.97 | 88.54 | KY210226 | This paper |
| RV2861 | 11/05/11 | 691423 | 9791388 | Domestic dog | MiSeq | 1359627 | 164027 | 12.06 | 1259.37 | KR906767 | Brunker *et al* ,2015 |
| RV2862 | 11/05/11 | 674259 | 9805687 | Domestic | MiSeq | 1177250 | 2121 | 0.18 | 21.18 | KR906768 | Brunker *et al* |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | dog | | | | | | | ,2015 |
| RV2863 | 19/04/11 | 672066 | 9805512 | Domestic dog | MiSeq | 448320 | 24262 | 5.41 | 194.02 | KY210227 | This paper |
| RV2866 | 15/04/11 | 678461 | 9808213 | Goat | MiSeq/NextSeq | 17707815 | 1007 | 0.01 | 9.98 | KY210228 | This paper |
| RV2867 | 22/05/11 | 677206 | 9802038 | Domestic dog | 454 pyrosequencing: depletion | 2965005 | 2967 | 0.10 | 18.65 | KY210229 | This paper |
| RV2868 | 06/06/11 | 678588 | 9807873 | Cow | MiSeq | 703095 | 27276 | 3.88 | 272.91 | KY210230 | This paper |
| RV2870 | 01/06/11 | 697216 | 9792726 | Domestic dog | MiSeq | 529286 | 19381 | 3.66 | 154.52 | KY210231 | This paper |
| RV2871 | 17/06/11 | 701315 | 9794641 | Domestic dog | 454 pyrosequencing: amplicon | 46796 | 8850 | 18.91 | 25.34 | KR906769 | Brunker *et al* ,2015 |
| RV2873 | 20/06/11 | 687042 | 9796792 | Domestic dog | MiSeq | 2235772 | 35378 | 1.58 | 359.16 | KY210232 | This paper |
| RV2875 | 29/06/11 | 680196 | 9811835 | Domestic dog | MiSeq | 407187 | 9927 | 2.44 | 99.27 | KR906770 | |
| RV2877 | 30/06/11 | 679837 | 9808655 | Goat | MiSeq | 4169008 | 168447 | 4.04 | 1494.91 | KY210233 | This paper |
| RV2878 | 03/07/11 | 689579 | 9796947 | Domestic dog | MiSeq | 146105 | 1933 | 1.32 | 21.85 | KY210234 | This paper |
| RV2879 | 10/06/11 | 698379 | 9806085 | Domestic dog | MiSeq | 696671 | 6806 | 0.98 | 68.17 | KY210235 | This paper |

MOLECULAR ECOLOGY

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|---|---|---|---|---|---|---|---|---|---|---|---|
| RV2880 | 02/07/11 | 678588 | 9807873 | Cow | MiSeq | 795216 | 8731 | 1.10 | 92.11 | KY210236 | This paper |
| RV2881 | 07/07/11 | 698357 | 9806963 | Cow | MiSeq | 1101481 | 12573 | 1.14 | 117.68 | KY210237 | This paper |
| RV2882 | 23/07/11 | 676741 | 9807751 | Domestic dog | 454 pyrosequencing: depletion | 2896363 | 35151 | 1.21 | 88.58 | KY210238 | This paper |
| RV2883 | 23/07/11 | 686525 | 9797308 | Domestic dog | MiSeq/NextSeq | 20693938 | 21557 | 0.10 | 221.41 | KY210239 | This paper |
| RV2884 | 21/07/11 | 675366 | 9806739 | Cow | MiSeq | 1107607 | 9926 | 0.90 | 102.65 | KY210240 | This paper |
| RV2885 | 24/07/11 | 694855 | 9798730 | Goat | MiSeq | 969814 | 3303 | 0.34 | 33.06 | KY210241 | This paper |
| RV2886 | 21/07/11 | 701234 | 9794942 | Goat | 454 pyrosequencing: amplicon | 48056 | 16226 | 33.76 | 64.02 | KY210242 | This paper |
| RV2887 | 25/07/11 | 695864 | 9798032 | Domestic dog | MiSeq | 1044324 | 2444 | 0.23 | 24.46 | KY210243 | This paper |
| RV2888 | 29/07/11 | 700262 | 9793490 | Domestic dog | MiSeq | 1517717 | 19413 | 1.28 | 189.29 | KY210244 | This paper |
| RV2889 | 03/08/11 | 693407 | 9791698 | Domestic dog | MiSeq | 1395952 | 5503 | 0.39 | 50.33 | KR534244 | Original GenBank submission (Brunker *et al* ,2015) updated |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | to WGS for this paper |
| RV2890 | 03/08/11 | 651666 | 9819798 | Cow | MiSeq | 1725539 | 16406 | 0.95 | 155.06 | KR534245 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2891 | 10/08/11 | 680536 | 9813026 | Civet | MiSeq | 1290933 | 54121 | 4.19 | 414.53 | KR534246 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2892 | 12/08/11 | 676741 | 9807751 | Domestic dog | 454 pyrosequencing: depletion | 2796394 | 50188 | 1.79 | 91.09 | KR534247 | Original GenBank submission (Brunker *et al* |

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| | | | | | | | | | | | ,2015) updated to WGS for this paper |
| RV2893 | 01/08/11 | 651666 | 9819798 | Cow | MiSeq | 1637158 | 31071 | 1.90 | 278.08 | KR534248 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2894 | 15/08/11 | 653024 | 9822353 | Domestic dog | MiSeq | 2125096 | 188049 | 8.85 | 1469.55 | KR906771 | Brunker *et al* ,2015 |
| RV2895 | 18/08/11 | 678334 | 9797356 | Domestic dog | MiSeq | 2273420 | 19720 | 0.87 | 210.02 | KR534249 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV28 | 19/08/11 | 681 | 9798 | Dom | MiSeq | 1104977 | 7214 | 0.65 | 68.67 | KR90 | Brunker |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 96 | | 869 | 035 | estic dog | | | | | | 6772 | *et al* ,2015 |
| RV2897 | 02/09/11 | 678907 | 9808303 | Domestic dog | MiSeq | 984501 | 9581 | 0.97 | 92.68 | KR534250 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2898 | 18/09/11 | 658269 | 9804143 | Domestic dog | MiSeq/NextSeq | 19197193 | 20664 | 0.11 | 206.05 | KR534251 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2899 | 23/09/11 | 658245 | 9804462 | Domestic dog | MiSeq | 897751 | 8818 | 0.98 | 85.53 | KR534252 | Original GenBank submission (Brunker *et al* ,2015) |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | updated to WGS for this paper |
| RV2900 | 27/09/11 | 656396 | 9803751 | Domestic dog | MiSeq | 1326869 | 8924 | 0.67 | 84.32 | KR906773 | Brunker *et al* ,2015 |
| RV2901 | 22/09/11 | 653179 | 9802910 | Domestic dog | MiSeq | 522728 | 10710 | 2.05 | 106.87 | KR906774 | Brunker *et al* ,2015 |
| RV2902 | 24/09/11 | 684532 | 9790009 | Domestic dog | MiSeq | 1204863 | 5234 | 0.43 | 43.68 | KR906775 | Brunker *et al* ,2015 |
| RV2903 | 05/10/11 | 657232 | 9804521 | Domestic dog | MiSeq | 1219764 | 6605 | 0.54 | 62.45 | KR534253 | Original GenBank submission (Brunker *et al* ,2015) updated to WGS for this paper |
| RV2906 | 08/09/11 | 681338 | 9808012 | Cat | MiSeq | 1283722 | 19254 | 1.50 | 170.85 | KR534254 | Original GenBank submission (Brunker *et al* ,2015) |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | updated to WGS for this paper |
| RV2907 | 16/10/11 | 700560 | 9803728 | Cow | MiSeq | 1353429 | 7867 | 0.58 | 71.47 | KR906776 | Brunker *et al* ,2015 |
| RV2909 | 12/11/11 | 663440 | 9804477 | Cow | MiSeq | 893349 | 20317 | 2.27 | 194.08 | KR534256 | Brunker *et al* ,2015 |
| RV3047 | 10/08/12 | 655560 | 9809040 | Domestic dog | NextSeq | 14822146 | 193963 | 1.31 | 1634.14 | KY210245 | This paper |
| RV3048 | 17/09/12 | 690718 | 9803251 | Sheep | NextSeq | 13774437 | 92882 | 0.67 | 865.92 | KY210246 | This paper |
| RV3049 | 04/10/12 | 689087 | 9797146 | Domestic dog | NextSeq | 14925758 | 68578 | 0.46 | 634.13 | KY210247 | This paper |
| RV3050 | 02/09/12 | 671593 | 9804068 | Domestic dog | NextSeq | 12716032 | 689856 | 5.43 | 5022.73 | KY210248 | This paper |
| RV3051 | 12/10/12 | 684769 | 9779316 | Domestic dog | NextSeq | 13274035 | 33398 | 0.25 | 308.65 | KY210249 | This paper |
| RV3052 | 13/11/12 | 643810 | 9813739 | Domestic dog | NextSeq | 10917330 | 110185 | 1.01 | 1077.20 | KY210250 | This paper |
| RV3053 | 10/11/12 | 646262 | 9815621 | Domestic dog | NextSeq | 11787802 | 61379 | 0.52 | 600.13 | KY210251 | This paper |
| RV30 | 08/12/12 | 655 | 9810 | Dom | NextSeq | 13502719 | 629341 | 4.66 | 4329.86 | KY21 | This paper |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 57 | | 999 | 468 | estic dog | | | | | | 0252 | |
| RV30 58 | 18/01/13 | 648 713 | 9819 325 | Dom estic dog | NextSeq | 11873546 | 143723 | 1.21 | 1031.42 | KY21 0253 | This paper |
| RV30 59 | 11/01/13 | 654 132 | 9825 734 | Dom estic dog | NextSeq | 12420277 | 786476 | 6.33 | 4587.68 | KY21 0254 | This paper |
| RV30 60 | 04/01/13 | 654 509 | 9823 226 | Dom estic dog | NextSeq | 12150398 | 316716 | 2.61 | 2450.02 | KY21 0255 | This paper |
| RV30 61 | 08/01/13 | 651 604 | 9821 249 | Dom estic dog | NextSeq | 12380235 | 386682 | 3.12 | 2883.85 | KY21 0256 | This paper |
| RV30 63 | 08/01/13 | 691 639 | 9810 370 | Dom estic dog | NextSeq | 11500684 | 37364 | 0.32 | 365.20 | KY21 0257 | This paper |
| RV30 64 | 02/01/13 | 687 567 | 9796 857 | Dom estic dog | NextSeq | 11829231 | 48612 | 0.41 | 469.26 | KY21 0258 | This paper |
| RV30 66 | 23/02/13 | 652 145 | 9807 506 | Cat | NextSeq | 10441152 | 159856 | 1.53 | 1487.65 | KY21 0259 | This paper |
| RV30 67 | 25/02/13 | 653 061 | 9777 091 | Dom estic dog | NextSeq | 15872978 | 3697 | 0.02 | 35.46 | KY21 0260 | This paper |
| RV30 68 | 11/04/13 | 696 403 | 9791 890 | Goat | NextSeq | 11386195 | 304247 | 2.67 | 2459.48 | KY21 0261 | This paper |
| RV30 70 | 27/02/13 | 673 866 | 9807 701 | Goat | NextSeq | 10573869 | 50029 | 0.47 | 504.04 | KY21 0262 | This paper |
| RV30 71 | 13/04/13 | 680 151 | 9814 868 | Dom estic | NextSeq | 13361066 | 1493699 | 11.18 | 7981.02 | KY21 0263 | This paper |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | dog | | | | | | | |
| RV3072 | 10/04/13 | 672356 | 9817934 | Domestic dog | NextSeq | 10909432 | 1088443 | 9.98 | 6940.73 | KY210264 | This paper |
| RV3073 | 18/02/13 | 697846 | 9808299 | Domestic dog | NextSeq | 9431525 | 84544 | 0.90 | 816.23 | KY210265 | This paper |
| RV3074 | 01/02/13 | 658498 | 9825235 | Domestic dog | NextSeq | 13487972 | 780515 | 5.79 | 5369.35 | KY210266 | This paper |
| RV3075 | 31/01/13 | 658498 | 9825235 | Domestic dog | NextSeq | 12309563 | 85376 | 0.69 | 834.07 | KY210267 | This paper |
| RV3078 | 26/05/13 | 684594 | 9779133 | Cow | NextSeq | 13267270 | 324339 | 2.44 | 2550.76 | KY210268 | This paper |
| RV3079 | 18/07/13 | 700214 | 9793780 | Domestic dog | NextSeq | 13140710 | 10369 | 0.08 | 103.78 | KY210269 | This paper |
| RV3080 | 17/07/13 | 700300 | 9793350 | Domestic dog | NextSeq | 12398079 | 71735 | 0.58 | 581.75 | KY210270 | This paper |
| RV3082 | 03/09/13 | 670878 | 9795201 | Domestic dog | NextSeq | 13023573 | 46367 | 0.36 | 485.26 | KY210271 | This paper |
| RV3084 | 22/08/13 | 697865 | 9803607 | Domestic dog | NextSeq | 9206525 | 18253 | 0.20 | 179.18 | KY210272 | This paper |
| RV3085 | 06/09/13 | 683848 | 9810611 | Domestic dog | NextSeq | 11789633 | 64210 | 0.54 | 590.80 | KY210273 | This paper |

MOLECULAR ECOLOGY

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|---|---|---|---|---|---|---|---|---|---|---|---|
| RV3086 | 06/09/13 | 697902 | 9792902 | Cow | NextSeq | 13831121 | 298860 | 2.16 | 2439.13 | KY210274 | This paper |
| RV3087 | 06/09/13 | 699819 | 9795099 | Cow | NextSeq | 17902151 | 12527 | 0.07 | 126.18 | KY210275 | This paper |
| RV3088 | 25/04/13 | 691229 | 9812934 | Cow | NextSeq | 18221434 | 358845 | 1.97 | 2936.54 | KY210276 | This paper |
| RV3090 | 25/11/11 | 696825 | 9790124 | Cow | MiSeq | 129980 | 10825 | 8.33 | 104.41 | KY210277 | This paper |
| RV3091 | 05/12/11 | 696698 | 9792023 | Domestic dog | MiSeq/NextSeq | 18376860 | 50860 | 0.28 | 496.86 | KR906777 | Brunker *et al* ,2015 |
| RV3092 | 16/12/11 | 680305 | 9798935 | Domestic dog | MiSeq | 1045220 | 2104 | 0.20 | 18.69 | KY210278 | This paper |
| RV3093 | 22/12/11 | 681720 | 9798404 | Domestic dog | MiSeq | 495576 | 4371 | 0.88 | 42.70 | KR906778 | Brunker *et al* ,2015 |
| RV3094 | 21/12/11 | 699127 | 9791922 | Domestic dog | MiSeq | 1100604 | 3942 | 0.36 | 35.79 | KY210279 | This paper |
| RV3096 | 30/01/12 | 658200 | 9804251 | Domestic dog | MiSeq | 758254 | 2900 | 0.38 | 24.44 | KY210280 | This paper |
| RV3097 | 19/01/12 | 658323 | 9804533 | Domestic dog | MiSeq | 384498 | 12069 | 3.14 | 113.75 | KY210281 | This paper |
| RV3098 | 26/01/12 | 658761 | 9804127 | Domestic dog | MiSeq | 277003 | 7448 | 2.69 | 73.18 | KY210282 | This paper |
| RV3099 | 19/01/12 | 696747 | 9790182 | Cow | MiSeq | 1440888 | 30135 | 2.09 | 233.29 | KY210283 | This paper |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| RV3100 | 19/02/12 | 698140 | 9804256 | Domestic dog | MiSeq | 668576 | 2648 | 0.40 | 24.11 | KR906779 | Brunker *et al* ,2015 |
| RV3101 | 06/03/12 | 695255 | 9803449 | Jackal | MiSeq | 416501 | 10348 | 2.48 | 86.78 | KY210284 | Brunker *et al* ,2015 |
| RV3102 | 08/03/12 | 700597 | 9803335 | Goat | MiSeq | 291477 | 13309 | 4.57 | 123.32 | KY210285 | Brunker *et al* ,2015 |
| RV3103 | 10/12/11 | 653049 | 9821771 | Domestic dog | MiSeq/NextSeq | 17549986 | 11210 | 0.06 | 109.93 | KY210286 | Brunker *et al* ,2015 |
| RV3104 | 22/12/11 | 648913 | 9823033 | sheep | MiSeq | 1145840 | 11000 | 0.96 | 95.11 | KR906780 | Brunker *et al* ,2015 |
| RV3105 | 22/03/12 | 661920 | 9803801 | Domestic dog | MiSeq | 1009153 | 1365 | 0.14 | 13.11 | KY210287 | This paper |
| RV3107 | 09/04/12 | 656704 | 9803322 | Domestic dog | MiSeq | 959083 | 31920 | 3.33 | 292.64 | KR906781 | Brunker *et al* ,2015 |
| RV3109 | 12/04/12 | 656691 | 9803564 | Domestic dog | MiSeq | 409667 | 24684 | 6.03 | 259.04 | KY210288 | This paper |
| RV3110 | 30/04/12 | 686063 | 9798923 | Domestic dog | MiSeq | 346269 | 6180 | 1.78 | 65.54 | KY210289 | This paper |
| RV3111 | 29/04/12 | 650984 | 9807685 | Domestic dog | MiSeq | 897329 | 2674 | 0.30 | 26.85 | KR906782 | |
| RV31 | 06/05/12 | 685 | 9792 | Dom | MiSeq/NextSeq | 18115513 | 68797 | 0.38 | 761.18 | KY21 | This paper |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | | 149 | 574 | estic dog | | | | | | 0290 | |
| RV3114 | 06/05/12 | 685205 | 9792549 | Jackal | MiSeq | 854689 | 16344 | 1.91 | 159.71 | KY210291 | This paper |
| RV3115 | 11/05/12 | 680871 | 9782055 | Domestic dog | MiSeq | 800250 | 3034 | 0.38 | 29.22 | KY210292 | This paper |
| RV3117 | 12/05/12 | 669765 | 9795977 | Domestic dog | MiSeq | 2331749 | 6102 | 0.26 | 57.60 | KR906783 | Brunker *et al* ,2015 |
| RV3119 | 17/05/12 | 680871 | 9782055 | Domestic dog | MiSeq/NextSeq | 15519701 | 7634 | 0.05 | 81.87 | KY210293 | This paper |
| RV3121 | 28/05/12 | 655915 | 9809872 | Domestic dog | MiSeq | 1321266 | 14930 | 1.13 | 132.03 | KY210294 | This paper |
| RV3122 | 14/05/12 | 662827 | 9818718 | Domestic dog | MiSeq | 1328914 | 5972 | 0.45 | 56.12 | KY210295 | This paper |
| RV3123 | 26/04/12 | 647442 | 9799177 | Domestic dog | MiSeq | 1530487 | 7221 | 0.47 | 65.08 | KR906792 | Brunker *et al* ,2015 |
| RV3124 | 07/05/12 | 657028 | 9804565 | Domestic dog | MiSeq | 903958 | 9073 | 1.00 | 86.74 | KY210296 | This paper |
| RV3125 | 06/06/12 | 658003 | 9809433 | Goat | MiSeq/NextSeq | 16181484 | 10504 | 0.06 | 105.89 | KR906784 | Brunker *et al* ,2015 |
| RV3127 | 11/06/12 | 681576 | 9797817 | Domestic dog | MiSeq | 461052 | 20729 | 4.50 | 204.27 | KR906785 | Brunker *et al* ,2015 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| RV3128 | 16/06/12 | 674458 | 9797076 | Donkey | MiSeq | 2044844 | 9514 | 0.47 | 88.78 | KR906786 | Brunker *et al* ,2015 |
| RV3129 | 25/06/12 | 662827 | 9819718 | Sheep | MiSeq | 871812 | 41446 | 4.75 | 408.32 | KY210297 | This paper |
| RV3130 | 28/06/12 | 662827 | 9818718 | Goat | MiSeq | 155506 | 10100 | 6.49 | 103.35 | KY210298 | This paper |
| RV3131 | 07/07/12 | 685498 | 9797037 | Domestic dog | MiSeq | 1518274 | 12181 | 0.80 | 113.24 | KR906787 | Brunker *et al* ,2015 |
| RV3132 | 02/04/12 | 656028 | 9801566 | Domestic dog | MiSeq | 489623 | 1478 | 0.30 | 13.93 | KR906788 | Brunker *et al* ,2015 |
| RV3133 | 04/07/12 | 700856 | 9800221 | Domestic dog | MiSeq/NextSeq | 14589139 | 11715 | 0.08 | 118.01 | KR906789 | Brunker *et al* ,2015 |
| RV3134 | 19/07/12 | 689067 | 9791597 | Domestic dog | MiSeq | 1280905 | 3509 | 0.27 | 34.25 | KY210299 | This paper |
| RV3135 | 19/07/12 | 695591 | 9788282 | Domestic dog | MiSeq | 1327972 | 10241 | 0.77 | 95.70 | KY210300 | This paper |
| RV3136 | 16/07/12 | 678119 | 9799572 | Cow | MiSeq | 993550 | 15864 | 1.60 | 153.90 | KY210301 | This paper |
| RV3137 | 21/07/12 | 682623 | 9783025 | Goat | MiSeq | 673235 | 14221 | 2.11 | 140.50 | KY210302 | This paper |
| RV3138 | 16/07/12 | 677206 | 9805047 | Domestic dog | MiSeq | 1634873 | 13081 | 0.80 | 126.10 | KY210303 | This paper |
| RV3139 | 07/07/12 | 685498 | 9797937 | Domestic | MiSeq | 1500822 | 7764 | 0.52 | 74.40 | KY210304 | This paper |

MOLECULAR ECOLOGY

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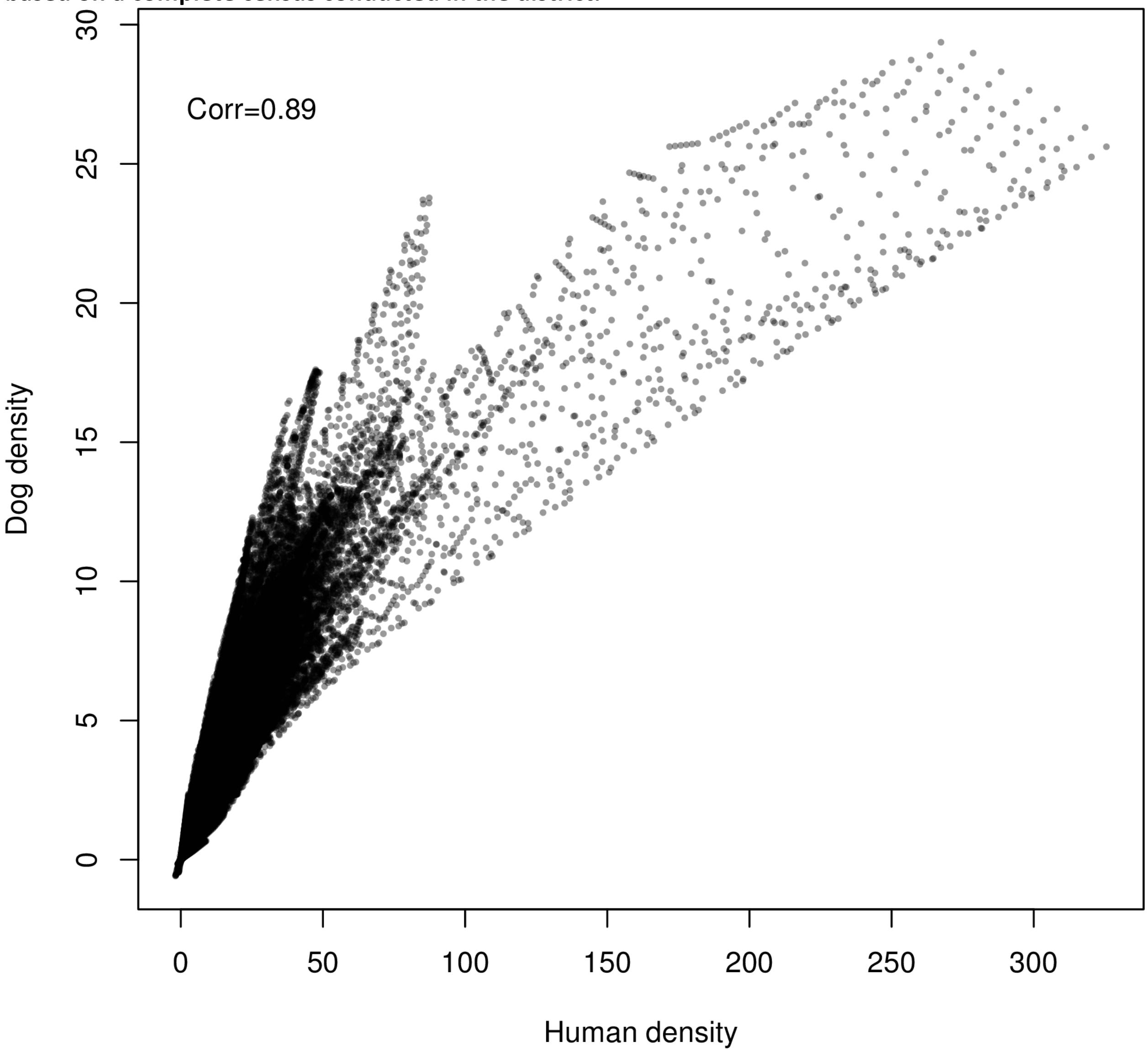
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | dog | | | | | | | | |
| RV3140 | 27/07/12 | 656945 | 9804374 | Domestic dog | MiSeq | 1907863 | 99500 | 5.22 | 737.59 | KR906790 | Brunker *et al* ,2015 |
| RV3145 | 08/08/12 | 658701 | 9825071 | Hyena | MiSeq/NextSeq | 15216797 | 10232 | 0.07 | 110.25 | KY210305 | This paper |
| RV3146 | 26/05/12 | 697865 | 9803637 | Civet | MiSeq/NextSeq | 16819682 | 13702 | 0.08 | 135.45 | KY210306 | This paper |
| RV3149 | 23/01/12 | 657742 | 9809576 | Domestic dog | MiSeq | 365335 | 802 | 0.22 | 6.23 | KR906791 | This paper |
| RV3150 | 24/03/12 | 682197 | 9791269 | Domestic dog | MiSeq | 1194163 | 43373 | 3.63 | 407.75 | KY210307 | This paper |
| RV3151 | 07/01/12 | 648913 | 9823033 | Cow | MiSeq | 105666 | 6227 | 5.89 | 60.67 | KY210308 | This paper |
| RV3152 | 31/05/12 | 695002 | 9803207 | NA | MiSeq/NextSeq | 14910632 | 4003 | 0.03 | 42.77 | KY210309 | This paper |
| RV3153 | 23/01/12 | 694625 | 9806377 | Goat | NextSeq | 12054558 | 62937 | 0.52 | 637.73 | KY210310 | This paper |
| RV3154 | 29/04/12 | 658670 | 9802617 | Domestic dog | NextSeq | 14618752 | 401835 | 2.75 | 3228.77 | KY210311 | This paper |

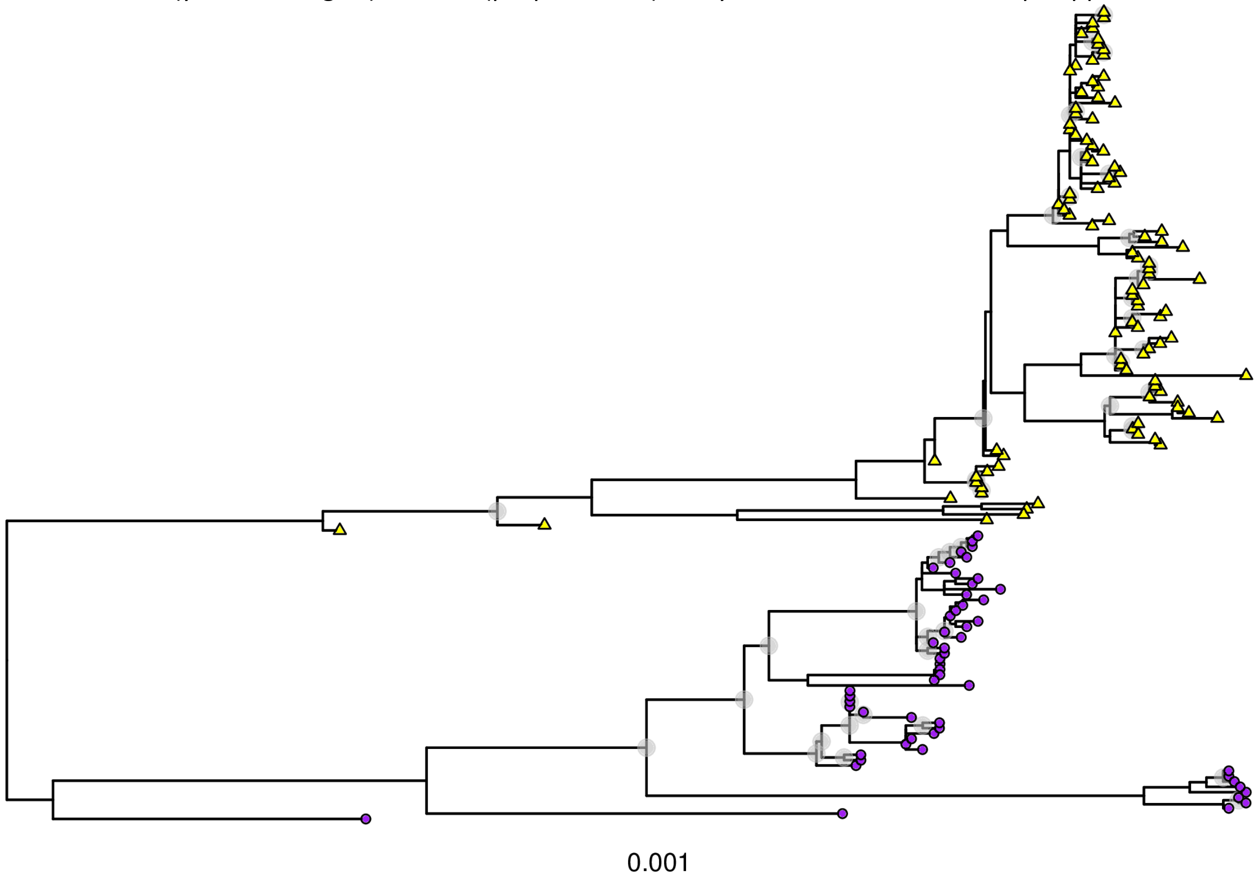
MOLECULAR ECOLOGY

**S1 Fig. Pearson's correlation between human and dog population density in the Serengeti District based on a complete census conducted in the district.**



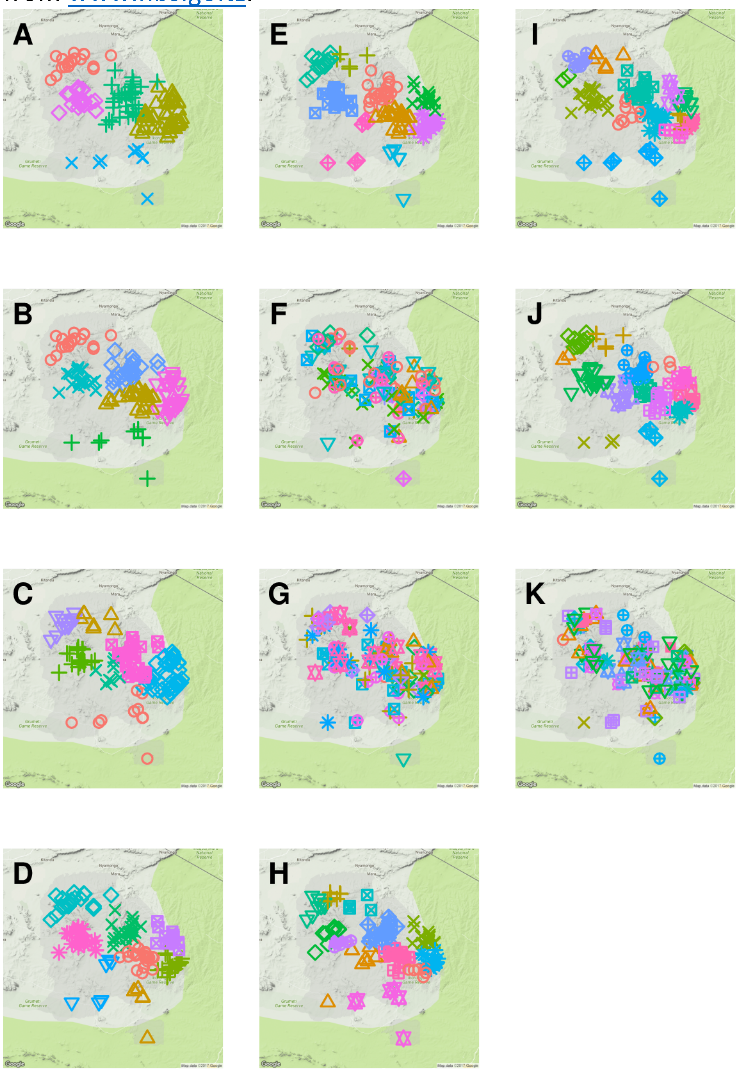
MOLECULAR ECOLOGY

**S2 Fig. Maximum likelihood phylogeny of 152 rabies cases collected from the Serengeti District, Tanzania 2004-2013.** The phylogeny is scaled in substitutions per site and two major lineages are coloured, Tz1 (yellow triangles) and Tz3 (purple circles). Grey circles indicate bootstrap support ≥80%.



MOLECULAR ECOLOGY

**S3 Fig. Spatial clusters of 152 rabies cases in the Serengeti District according to k-means partitioning using a Euclidean distance matrix.** (A-K) Each cluster is designated by a unique colour/symbol combination for a number of clusters (*k*) ranging from *k*=5 to *k*=15. Map created using R packages ggmap (Kahle & Wickham, 2013) and maptools (Lewin-Koh et al., 2012) with administrative boundaries from www.nbs.go.tz.



MOLECULAR ECOLOGY

**S4 Fig. Centroids of spatial clusters assigned according to according to k-means partitioning using a Euclidean distance matrix for 152 rabies cases in the Serengeti District.** (A-K) Centroid positions for a number of clusters (*k*) ranging from *k*=5 to *k*=15. Map created using R package maptools and administrative boundaries from www.nbs.go.tz.