

# **Supplementary Information for**

## **Patterns of coevolutionary adaptations across time and space in mouse gammaretroviruses and three restrictive host factors**

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**Datafile S1.** Additional sequences (Provided as a separate text file)

### **Supplementary Figures**

**Figure S1. Phylogeny of E-MLV *env* sequences.** Full-length envelope gene sequences of the indicated E-MLVs were aligned and a maximum likelihood tree was generated using RaxML with 500 replicates. Bootstrap values are shown at each node. The tree was midrooted.

**Figure S2. Phylogeny of *Cat1/Slc7a1* in rodents.** *Cat1/Slc7a1* coding sequence of the indicated rodent species were aligned and a maximum likelihood tree was generated using RaxML with 500 replicates. Bootstrap values are shown at each node. The tree was rooted at Rabbit *Slc7a1* sequence.

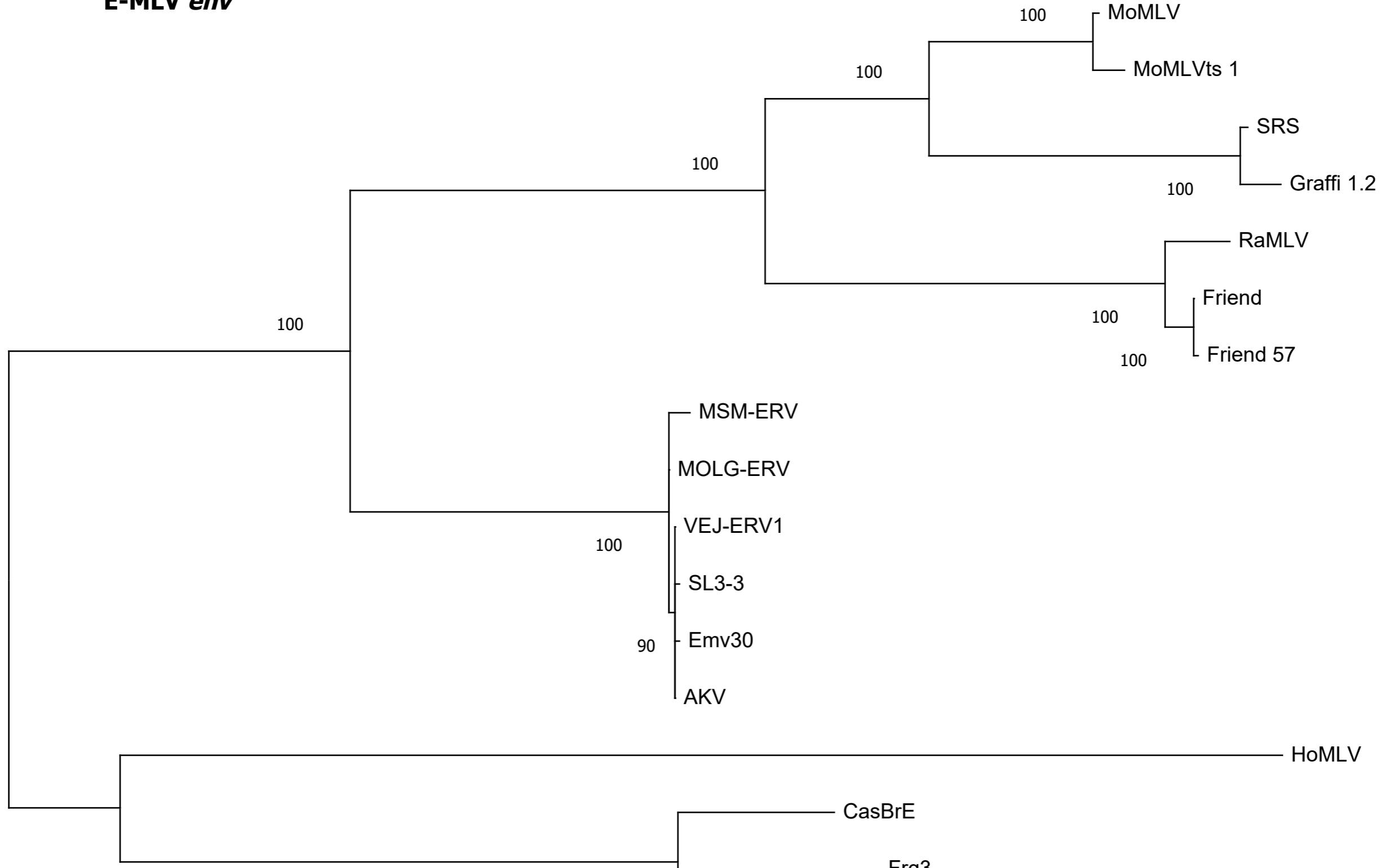
**Figure S3. Phylogeny of X/P-MLV *env* RBD sequences.** Sequences corresponding to the RBD of the *env* gene of the indicated X/P-MLVs were aligned and a maximum

likelihood tree was generated using RaxML with 500 replicates. Bootstrap values are shown at each node. The tree was midrooted.

**Figure S4. Phylogeny of X/P-MLV *env* sequences.** Envelope gene sequence of the indicated X/P-MLVs were aligned and a maximum likelihood tree was generated using RaxML with 500 replicates. Bootstrap values are shown at each node. The tree was midrooted.

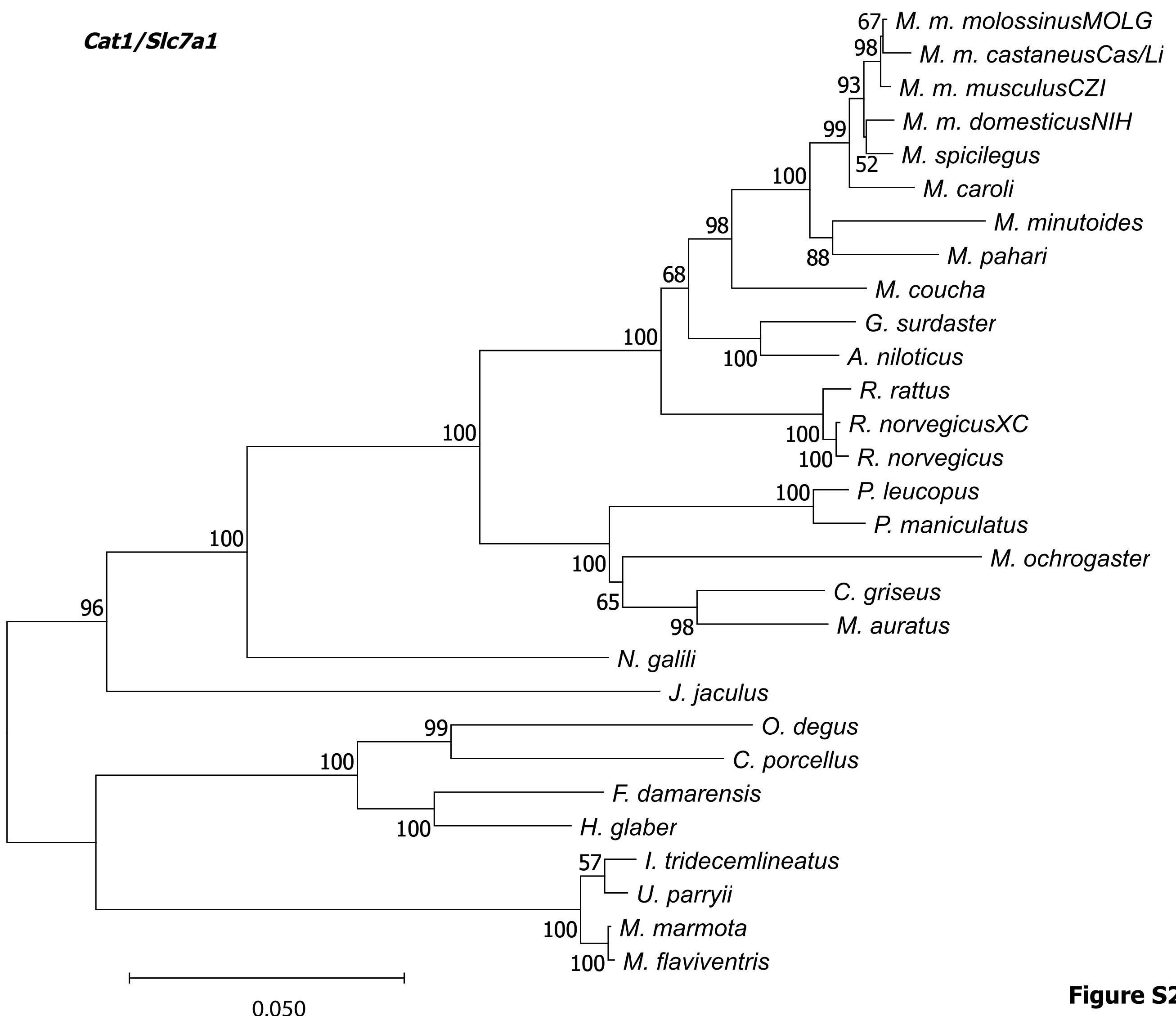
**Figure S5. Phylogeny of X/P and E-MLV capsid sequences.** Sequences corresponding to the capsid domain of the *gag* gene sequence of the indicated X/P and E-MLVs were aligned and a maximum likelihood tree was generated using RaxML with 500 replicates. Bootstrap values are shown at each node. The tree was midrooted.

### E-MLV env



0.050

**Figure S1**

***Cat1/Slc7a1*****Figure S2**

## X/P MLV<sub>env</sub> RBD

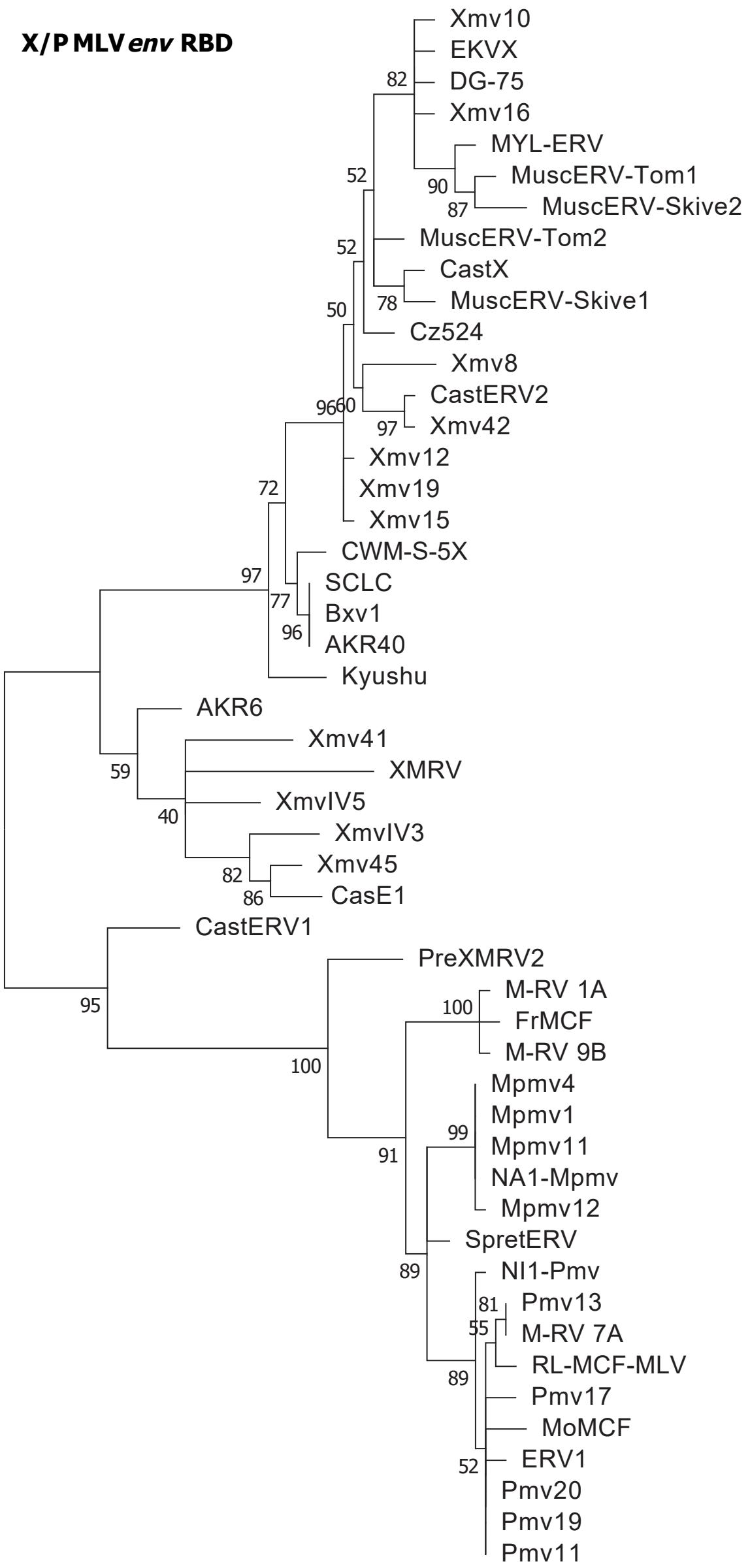
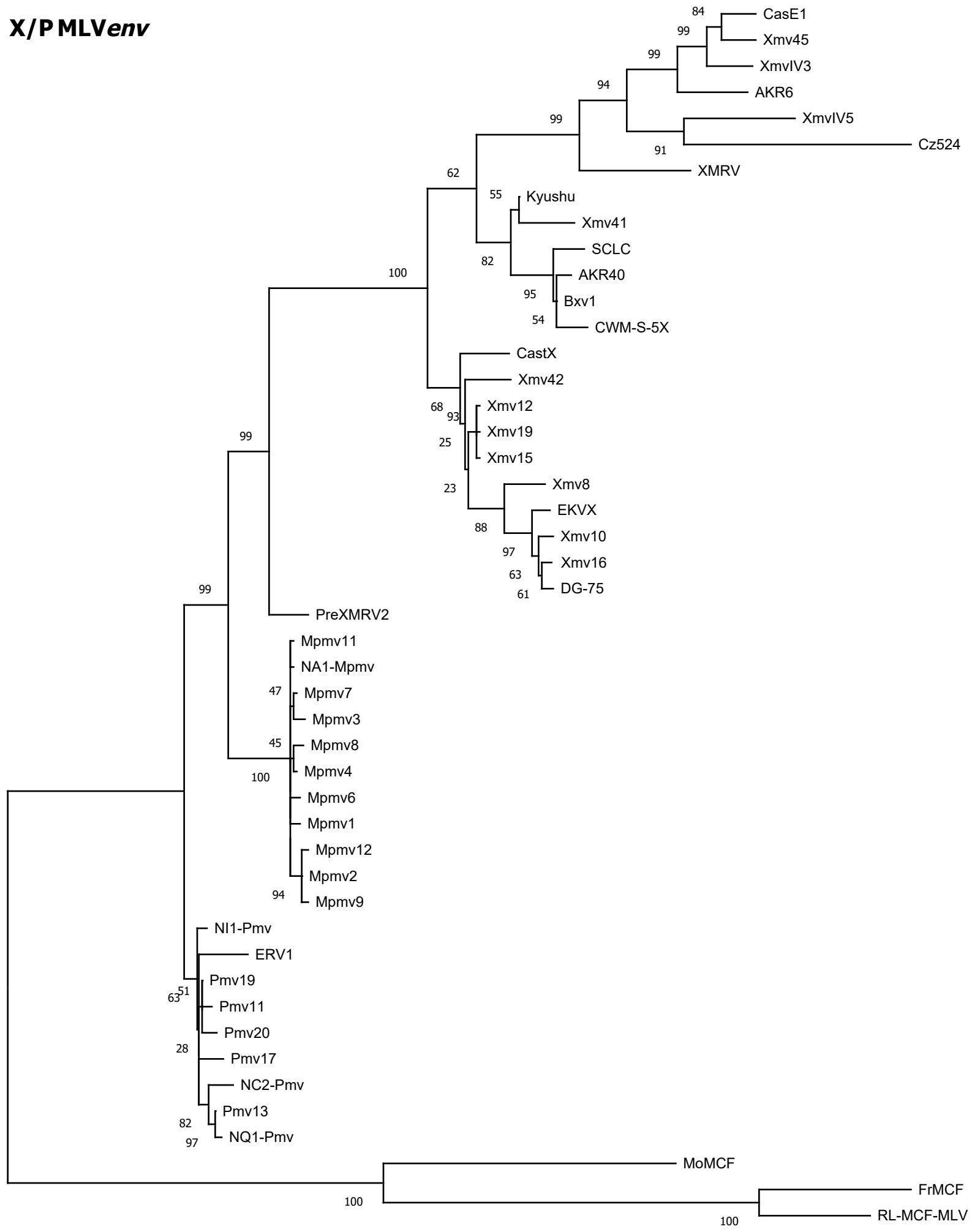


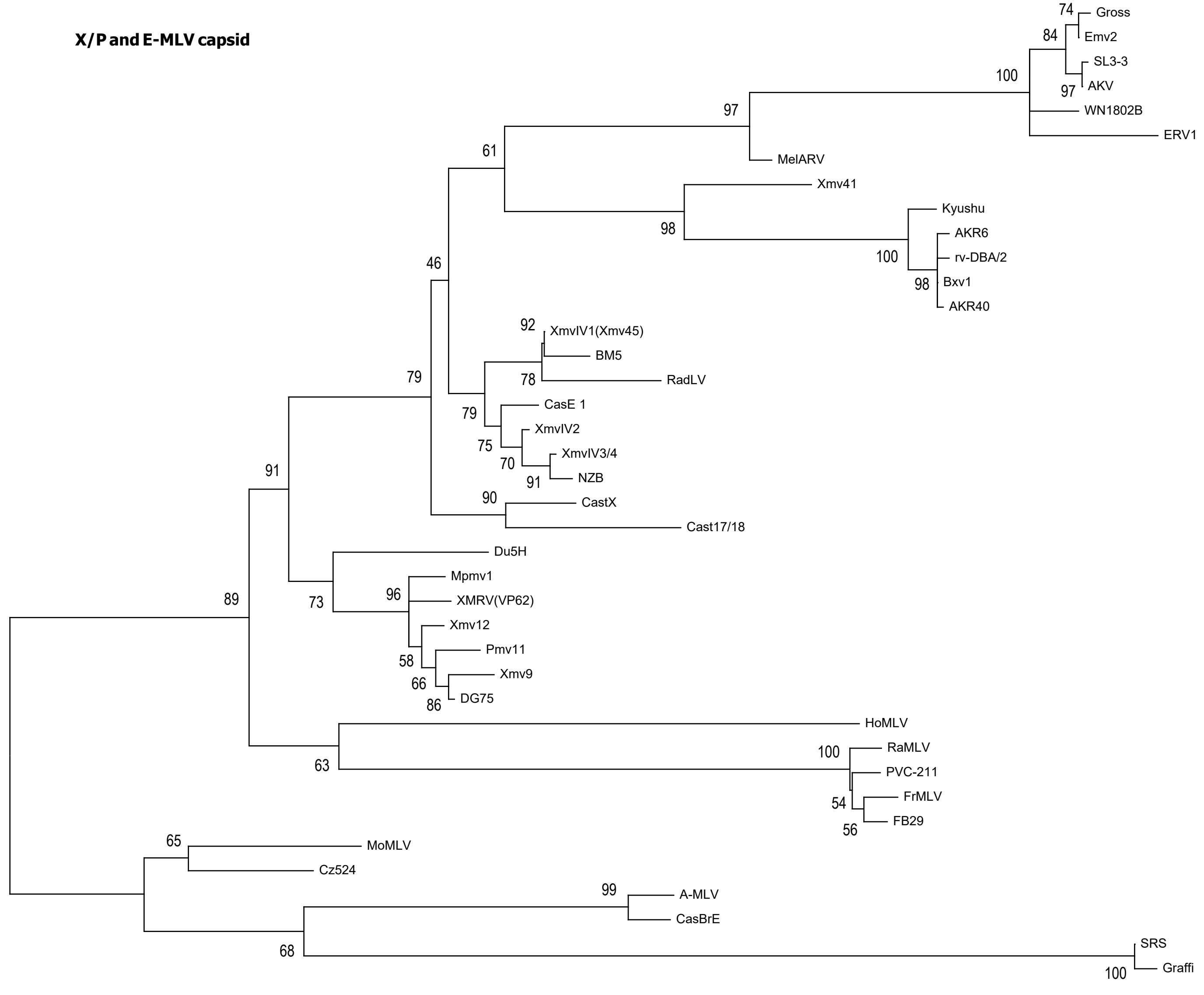
Figure S3

## X/PMLVenv



**Figure S4**

**X/P and E-MLV capsid**



**Figure S5**

## Supplementary Tables

**Table S1.** Sources of wild-caught and wild-derived mice and mouse DNAs.

| Mus musculus<br>subspecies <sup>1</sup> | Alternate<br>designation | Trapping location                      | DNA ID #          | Source                 | Used in <sup>2</sup> |           |
|-----------------------------------------|--------------------------|----------------------------------------|-------------------|------------------------|----------------------|-----------|
|                                         |                          |                                        |                   |                        | Figure 2             | Figure 6b |
| <i>bactrianus</i>                       | M.Bac-Iran               | Mashhad, Iran                          | MG-0417<br>(1510) | RIKEN                  | X                    | X         |
| <i>bactrianus</i>                       | M.Bac-Iran               | Mashhad, Iran                          | MG-5047<br>(1622) | RIKEN                  |                      | X         |
| <i>castaneus</i>                        | Bal                      | Bandar, Sumatra,<br>Indonesia          | MG-5121<br>(111)  | RIKEN                  | X                    | X         |
| <i>castaneus</i>                        | CASA/RkJ                 | Thailand                               |                   | Jackson                | X                    | X         |
| <i>castaneus</i>                        | CAST/17                  | Pathum Thani,<br>Thailand              |                   | Hartley                | X                    | X         |
| <i>castaneus</i>                        | CAST/N                   | Thonburi,<br>Thailand                  |                   | Potter                 | X                    |           |
| <i>castaneus</i>                        | CAST/EiJ                 | Thonburi,<br>Thailand                  |                   | Jackson                |                      | X         |
| <i>castaneus</i>                        | CAST/Rp                  | Thonburi,<br>Thailand                  |                   | Roswell<br>Park        |                      |           |
| <i>castaneus</i>                        | CAS/Li                   | Thonburi,<br>Thailand                  |                   | Potter                 |                      | X         |
| <i>castaneus</i>                        | CASP/1Nga                |                                        |                   | RIKEN                  | X                    | X         |
| <i>castaneus</i>                        | H14,H12                  | Katrain, India                         |                   | Halligan/<br>Keightley |                      | X         |
| <i>castaneus</i>                        | H24,H15,H26<br>,H27      | Mandi, India                           |                   | Halligan/<br>Keightley |                      | X         |
| <i>castaneus</i>                        | H30,H28,H34<br>,H36      | Kunihar, India                         |                   | Halligan/<br>Keightley |                      | X         |
| <i>castaneus</i>                        | HMI/Ms                   | Hemei, Taiwan                          |                   | RIKEN,Ab<br>e          | X                    |           |
| <i>castaneus</i>                        | Mal                      | Malaysia                               | MG-5060<br>(1635) | RIKEN                  | X                    | X         |
| <i>castaneus</i>                        | MY5/Mz                   |                                        |                   | RIKEN                  |                      |           |
| <i>castaneus</i>                        | Nin                      | Ningpo, China                          | MG-0795<br>(259)  | RIKEN                  | X                    | X         |
| <i>castaneus</i>                        | Qzn                      | Quezon City,<br>Philippines            | MG-0421<br>(1514) | RIKEN                  | X                    | X         |
| <i>castaneus</i>                        | M.mus-sp                 | Vladivostok,<br>Kirova 62,<br>U.S.S.R. | MG-3077<br>(195)  | RIKEN                  | X                    | X         |
| <i>domesticus</i>                       | ABUR                     | Abu Rawash,<br>Egypt                   |                   | Potter                 | X                    | X         |
| <i>domesticus</i>                       | BIBB                     | Sede Boger, Israel                     | MG-0377<br>(1474) | RIKEN                  | X                    |           |
| <i>domesticus</i>                       | BQC                      | Bouquet Canyon,<br>CA                  |                   | Potter                 |                      | X         |

|                                      |                               |                                    |                   |                    |   |   |
|--------------------------------------|-------------------------------|------------------------------------|-------------------|--------------------|---|---|
| <i>domesticus</i>                    | CALB/RkJ                      | California                         |                   | Jackson            |   |   |
| <i>domesticus</i>                    | CalWM (7)                     | Lake Casitas, CA                   |                   | Rasheed            |   |   |
| <i>domesticus</i>                    | CLA<br>(Centreville Lite)     | Centreville, MD                    |                   | Potter             |   |   |
| <i>domesticus</i>                    | DFC                           | Corse, France                      | MG-0385<br>(1481) | RIKEN              |   | X |
| <i>domesticus</i>                    | HAF (Havens Farm)             | Davidsonville, MD                  |                   | Potter             |   |   |
| <i>domesticus</i>                    | JJD<br>(J.J.Downs)            | Ridgely, MD                        |                   | Potter             |   |   |
| <i>domesticus</i>                    | LW,<br>LEWES/EiJ              | Lewes, DE                          |                   | Potter,<br>Jackson |   |   |
| <i>domesticus</i>                    | PERA/EiJ                      | Rimac Valley,<br>Peru              |                   | Jackson            |   |   |
| <i>domesticus</i>                    | PERC/EiJ                      | Rimac Valley,<br>Peru              |                   | Jackson            |   |   |
| <i>domesticus</i>                    | PGN2                          | Pegion region,<br>Canada           |                   | Abe                |   |   |
| <i>domesticus</i>                    | TIRANO,<br>poschiavinus       | Tirano, Italy                      |                   | Potter             | X | X |
| <i>domesticus</i>                    | ZALENDE,<br>poschiavinus      | Zalende,<br>Switzerland            |                   | Potter             | X | X |
| <i>domesticus</i>                    | PRAE,<br>praetextus<br>(PRAE) | Erfoud, Morocco                    |                   | Potter             | X |   |
| <i>domesticus</i>                    | SAF (Sanners Farm)            | Davidsonville, MD                  |                   | Potter             |   |   |
| <i>domesticus</i>                    | SC-1 cells                    | California                         |                   | Hartley            |   |   |
| <i>domesticus</i>                    | SF/CamEiJ                     | Marin County, CA                   |                   | Jackson            |   |   |
| <i>domesticus</i>                    | SK/Cam                        | Skokholm Is., U.K.                 | MG-0067<br>(1294) | RIKEN              | X | X |
| <i>domesticus</i>                    | WS (Watkins Star)             | Watkins Farm,<br>MD                |                   | Potter             |   |   |
| <i>domesticus</i>                    | WMP/PasDnJ                    | Monastir, Tunisia                  |                   | Jackson            | X |   |
| <i>M.m.gansuensis</i><br><i>spp.</i> | Htn                           | Hotan, China                       | MG-0762<br>(226)  | RIKEN              | X | X |
| <i>M.m.gansuensis</i><br><i>is</i>   | M.sub-Aks                     | Akus, China                        | MG-0608<br>(4)    | RIKEN              | X | X |
| <i>M.m.gansuensis</i><br><i>is</i>   | M.sub-Kes                     | Kashi, Chaina                      | MG-0686<br>(60)   | RIKEN              | X | X |
| <i>M.m.homourus</i>                  | M.sub-Jin                     | Jinan, China                       | MG-0784<br>(248)  | RIKEN              | X | X |
| <i>M.m.homourus</i>                  | M.sub-Zhe                     | Zheng Zhou,<br>China               | MG-0928<br>(647)  | RIKEN              | X | X |
| <i>Mus.leggada</i>                   | Leg-Per                       | Peradeniya, Sri Lanka              | MG-0273<br>(1382) | RIKEN              |   | X |
| <i>molossinus</i>                    | Aiz1                          | Aizuwakamatsu,<br>Fukushima, Japan | MG-0489<br>(1575) | RIKEN              | X | X |

|                   |                                                |                                  |                   |               |   |   |
|-------------------|------------------------------------------------|----------------------------------|-------------------|---------------|---|---|
| <i>molossinus</i> | Hkz                                            | Hakozaki,<br>Fukuoka, Japan      | MG-0461<br>(1551) | RIKEN         | X | X |
| <i>molossinus</i> | JF1                                            |                                  |                   | Jackson       |   |   |
| <i>molossinus</i> | Kgs                                            | Kagoshima,<br>Kagoshima, Japan   | MG-5013<br>(1593) | RIKEN         | X | X |
| <i>molossinus</i> | Kor                                            | Kohriyama,<br>Fukushima, Japan   | MG-0492<br>(1578) | RIKEN         | X | X |
| <i>molossinus</i> | Mol-<br>KOR1/Stm                               | Koriyama, Japan                  |                   | RIKEN         |   |   |
| <i>molossinus</i> | KOR5                                           | Koriyama,<br>Fukushima, Japan    |                   | RIKEN         | X |   |
| <i>molossinus</i> | KOR7                                           | Kouriyama,<br>Fukushima, Japan   |                   | RIKEN         |   |   |
| <i>molossinus</i> | MAE                                            | Maesawa, Iwate,<br>Japan         |                   | RIKEN         | X |   |
| <i>molossinus</i> | Mae2                                           | Maesawa, Iwate,<br>Japan         | MG-0494<br>(1580) | RIKEN         | X | X |
| <i>molossinus</i> | Mol/Li                                         | Kyushu, Japan                    |                   | Potter        |   |   |
| <i>molossinus</i> | MOLD/RkJ,<br>MOLF/EiJ,<br>MOLG/DnJ,<br>MOLC/Rk | Fukuoka, Kyushu,<br>Japan        |                   | Jackson       | X | X |
| <i>molossinus</i> | MOM                                            | Mizuho Aichi,<br>Japan           |                   | RIKEN         | X |   |
| <i>molossinus</i> | Mro                                            | Morioka, Iwate                   | MG-0271<br>(1380) | RIKEN         | X | X |
| <i>molossinus</i> | MSM                                            | Mishima,<br>Shizuoka, Japan      | MG-0082<br>(1297) | RIKEN,Ab<br>e | X | X |
| <i>molossinus</i> | MZH (MOM)                                      | Mizuho, Aichi,<br>Japan          | MG-0099<br>(1310) | RIKEN         | X | X |
| <i>molossinus</i> | Nig                                            | Niigata, Japan                   | MG-0202<br>(1324) | RIKEN         | X | X |
| <i>molossinus</i> | Ohm                                            | Oma, Aomori,<br>Japan            | MG-0282<br>(1389) | RIKEN         | X | X |
| <i>molossinus</i> | STM1,STM2                                      | Japan                            |                   | RIKEN         |   |   |
| <i>molossinus</i> | Tsm                                            | Tsushima,<br>Nagasaki, Japan     | MG-0441<br>(1532) | RIKEN         | X | X |
| <i>molossinus</i> |                                                | Ashiro, Iwate,<br>Japan          | MG-0257<br>(1370) | RIKEN         | X | X |
| <i>molossinus</i> |                                                | Higashiohmiya,<br>Saitama, Japan | MG-0210<br>(1332) | RIKEN         | X | X |
| <i>molossinus</i> |                                                | Kanazawa,<br>Ishikawa, Japan     | MG-0255<br>(1368) | RIKEN         | X | X |
| <i>molossinus</i> |                                                | Kyoto, Japan                     | MG-0422<br>(1515) | RIKEN         | X | X |
| <i>molossinus</i> |                                                | Mito, Ibaragi,<br>Japan          | MG-0235<br>(1357) | RIKEN         | X | X |
| <i>molossinus</i> |                                                | Nirayama,<br>Shizuoka, Japan     | MG-0219<br>(1341) | RIKEN         | X | X |

|                   |                   |                                    |                |               |   |   |
|-------------------|-------------------|------------------------------------|----------------|---------------|---|---|
| <i>molossinus</i> |                   | Ohmiya, Saitama, Japan             | MG-0335 (1436) | RIKEN         | X | X |
| <i>molossinus</i> |                   | Shizuoka, Shizuoka, Japan          | MG-0427 (1520) | RIKEN         | X | X |
| <i>molossinus</i> |                   | Takatsuki, Osaka, Japan            | MG-0240 (1362) | RIKEN         | X | X |
| <i>molossinus</i> |                   | Tanegashima, Kagoshima, Japan      | MG-0442 (1533) | RIKEN         | X | X |
| <i>musculus</i>   | Akt/TUA           | Aktyubinsk, Kazakhstan             |                | RIKEN         | X |   |
| <i>musculus</i>   | Ast/TUA (wagneri) | Astrakhan, Russia                  |                | RIKEN         | X |   |
| <i>musculus</i>   | BLG2              | Toshevo, Bulgaria                  |                | Abe           | X |   |
| <i>musculus</i>   | CZI, CZECH/Eij    | Morovia, Czech Republic            |                | Potter        | X | X |
| <i>musculus</i>   | CzII, CZECHII/Eij | Bratislava, Slovakia               |                | Potter        | X | X |
| <i>musculus</i>   | Gor/TUA           | Gorno-Altaisk, Russia              |                | RIKEN         | X | X |
| <i>musculus</i>   | Hul               | Hulin, China                       | MG-0920 (639)  | RIKEN         | X | X |
| <i>musculus</i>   | IRK/TUA           | Irkutsk, E. Siberia, Russia        |                | RIKEN         | X | X |
| <i>musculus</i>   | Jix               | Ji Xian, China                     | MG-0843 (562)  | RIKEN         | X | X |
| <i>musculus</i>   | KAZ/TUA           | Alma-Ata, Kazakhstan               |                | RIKEN         | X | X |
| <i>musculus</i>   | Krk1              | Krakow, Poland                     | MG-5235 (1766) | RIKEN         | X | X |
| <i>musculus</i>   | MBT/Pas           | Toshevo, Bulgaria                  |                | RIKEN         |   |   |
| <i>musculus</i>   | MYL               | Ljubljana Slovenia, Yugoslavia     | MG-0399 (1494) | RIKEN         | X | X |
| <i>musculus</i>   | NJL               | Northern Jutland, Denmark          |                | Abe, RIKE N   | X |   |
| <i>musculus</i>   | PWD/PhJ           | Kunratice, Czech Republic          |                | Jackson       | X | X |
| <i>musculus</i>   | PWK/PhJ           | Lhotka, Czech Republic             |                | Jackson       |   | X |
| <i>musculus</i>   | Skive             | Skive, Denmark                     |                | Potter        | X | X |
| <i>musculus</i>   | Tom/TUA           | Tomsk, Tuva, Siberia, USSR, Russia |                | RIKEN         | X | X |
| <i>musculus</i>   | Okh/TUA           | Okha, Russia                       |                | RIKEN         | X | X |
| <i>musculus</i>   | VEJ               | Vejrumbro, Denmark                 |                | Potter, Morse | X | X |
| <i>musculus</i>   |                   | Belgrade                           |                | Morse         |   | X |
| <i>musculus</i>   |                   | Brno                               |                | Morse         | X |   |
| <i>musculus</i>   |                   | Viborg                             |                | Morse         |   | X |

|                                          |           |                                          |                   |       |   |   |
|------------------------------------------|-----------|------------------------------------------|-------------------|-------|---|---|
| <i>tantillus</i>                         | Las       | Lasa, China                              | MG-0723<br>(90)   | RIKEN | X | X |
| <i>musculus spp.</i><br><i>M.wag-Ton</i> | m.wag-Ton | Tongliac, China                          | MG-0856<br>(575)  | RIKEN | X | X |
| <i>musculus</i><br><i>(wagneri)</i>      | KNB/TUA   | Balkhash Lake,<br>Kazakhstan             |                   | RIKEN | X | X |
| <i>spp.</i>                              | Bjn2      | Beijing, China                           | MG-5066<br>(2009) | RIKEN | X | X |
| <i>spp.</i>                              | Dal       | Dali, China                              | MG-0788<br>(252)  | RIKEN | X | X |
| <i>spp.</i>                              | Gui       | Guilin China                             | MG-0501<br>(1876) | RIKEN | X |   |
| <i>spp.</i>                              | Gui       | Guilin, China                            | MG-0502<br>(1877) | RIKEN |   | X |
| <i>spp.</i>                              | Ias3      | Suweon, Korea                            | MG-5018<br>(1598) | RIKEN | X | X |
| <i>spp.</i>                              | Jia       | Jiangyin, China                          | MG-2100<br>(842)  | RIKEN | X | X |
| <i>spp.</i>                              | Jin       | Jinan, China                             | MG-0790           | RIKEN |   | X |
| <i>spp.</i>                              | Kjr       | Kojuri, Korea                            | MG-0060<br>(1290) | RIKEN | X | X |
| <i>spp.</i>                              | Kun       | Kunming, China                           | MG-0529           | RIKEN | X | X |
| <i>spp.</i>                              | Lai       | Laiyang, China                           | MG-2022<br>(764)  | RIKEN | X | X |
| <i>spp.</i>                              | Las       | Lasa, China                              | MG-0721           | RIKEN | X | X |
| <i>spp.</i>                              | Lzh       | Lanzhou, China                           | MG-0507           | RIKEN | X | X |
| <i>spp.</i>                              | Moh       | Mohe, China                              | MG-0670           | RIKEN | X | X |
| <i>spp.</i>                              | Qiq       | Qiqihare, China                          | MG-0993<br>(735)  | RIKEN | X | X |
| <i>spp.</i>                              | Qiq       | Qiqihare, China                          | MG-0992<br>(734)  | RIKEN | X | X |
| <i>spp.</i>                              | Tac       | Tacheng ,China                           | MG-0611<br>(9)    | RIKEN | X | X |
| <i>spp.</i>                              | Tum       | Tumen, China                             | MG-0980<br>(722)  | RIKEN | X | X |
| <i>spp.</i>                              | Wuh       | Wuhan, China                             | MG-0908<br>(627)  | RIKEN | X | X |
| <i>spp.</i>                              | Wuh       | Wuhan, China                             | MG-0950<br>(669)  | RIKEN | X | X |
| <i>spp.</i>                              | Yaz       | Yangzhou, China                          | MG-0715           | RIKEN | X | X |
| <i>spp.</i>                              | Zhj       | Zhenjiang, China                         | MG-0713<br>(80)   | RIKEN | X | X |
| <i>spp.</i>                              | Zhj       | Zhenjiang, China                         | MG-0714<br>(81)   | RIKEN | X | X |
| <i>spp.</i>                              |           | Amur region,<br>Blagovetsensk,<br>Russia | MG-3064<br>(182)  | RIKEN | X | X |
| <i>spp.</i>                              |           | Birakan<br>Settlement,                   | MG-3027<br>(145)  | RIKEN | X | X |

|             |  |                                                              |                   |       |   |   |
|-------------|--|--------------------------------------------------------------|-------------------|-------|---|---|
|             |  | Khabarovski<br>region, Western<br>Birobidzan city,<br>Russia |                   |       |   |   |
| <i>spp.</i> |  | Donetsk, Russia                                              | MG-3065<br>(183)  | RIKEN | X | X |
| <i>spp.</i> |  | Magadan, Russia                                              | MG-3063<br>(181)  | RIKEN | X | X |
| <i>spp.</i> |  | Moscow region,<br>Chevnogolvka,<br>Russia                    | MG-3056           | RIKEN | X | X |
| <i>spp.</i> |  | Moscow region,<br>Russia                                     | MG-3058<br>(176)  | RIKEN | X | X |
| <i>spp.</i> |  | North Caucasus,<br>Grozny City,<br>Russia                    | MG-3010<br>(128)  | RIKEN | X | X |
| <i>spp.</i> |  | Novii settlement,<br>Russia                                  | MG-3012<br>(130)  | RIKEN | X | X |
| <i>spp.</i> |  | Novosibirsk,<br>Russia                                       | MG-3054<br>(172)  | RIKEN | X | X |
| <i>spp.</i> |  | Pusan, Korea                                                 | MG-0444<br>(1535) | RIKEN | X | X |
| <i>spp.</i> |  | Pusan, Korea                                                 | MG-0445<br>(1536) | RIKEN | X | X |
| <i>spp.</i> |  | set. Innokentevka,<br>Russia                                 | MG-3073<br>(191)  | RIKEN | X | X |
| <i>spp.</i> |  | Teli settlement,<br>Russia                                   | MG-3004<br>(122)  | RIKEN | X | X |
| <i>spp.</i> |  | Vladivostok,<br>Kirova 62, Russia                            | MG-3034<br>(152)  | RIKEN | X | X |
| <i>spp.</i> |  | Vladivostok,<br>Russia                                       | MG-3025<br>(143)  | RIKEN | X | X |
| <i>spp.</i> |  | Yu-Sahalinsk,<br>Russia                                      | MG-3047<br>(165)  | RIKEN | X | X |

<sup>1</sup>spp., species undetermined

<sup>2</sup>unchecked boxes include mice from the Americas or trapped in duplicate locations or poorly defined sites

**Table S2.** Primer sequences used for PCR.

| Primer         | Primer sequence from 5'     | Reference sequence<br>(Accession #) | Position in<br>Reference |
|----------------|-----------------------------|-------------------------------------|--------------------------|
| <b>MLV env</b> |                             |                                     |                          |
| AKEnvF1        | TAGAACCTCGCTGGAAGG          | AKV MLV (J01998)                    | 5653-5670                |
| AKenvF2        | CTGATTCTCGGAGGGGTCAACC      | AKV MLV (J01998)                    | 5852-5873                |
| AKenvF1        | CACGCCCCGATAAAACCATC        | AKV MLV (J01998)                    | 5762-5782                |
| AKenvR1        | GCCAGAGTTAGTGAGACGG         | AKV MLV (J01998)                    | 6981-6998                |
| AkvER4         | GCCTGGAGTTGTTGGAAGT         | AKV MLV (J01998)                    | 7295-7314                |
| AKVspF         | CCCCGATAAAACCATCAT          | AKV MLV (J01998)                    | 5766-5784                |
| AKSU7100R      | CACAGTAATCGGTGGTGAGG        | AKV MLV (J01998)                    | 7087-7106                |
| Emv7480R       | CCGTACCAATCCTGTGTG          | AKV MLV (J01998)                    | 7489-7504                |
| XE6040F        | GAACCTCGCTGGAAAGGAC         | AKR40 (MH450109)                    | 5654-5672                |
| XP7400R        | GATGGGTTTGGGAAGTGTCC        | AKR6 (MH450110)                     | 6865-6886                |
| Hog3F          | CCTGACATTGGCGGAAG           | HoMuLV (KU324805)                   | 1844-1861                |
| Hopol1R        | GAAACCAGCCGTTCCAAG          | HoMuLV (KU324805)                   | 3523-3541                |
| HoEnv1F        | GGCATTGGGTAAAGGCAGTCC       | HoMuLV (KU324805)                   | 5868-5887                |
| HoEnv3R        | CAGTCGGTTAGAATACAGGGT<br>CC | HoMuLV (KU324805)                   | 7654-7677                |
| Xenv150F       | CTAATGACAGGACAAACAGC        | AKR40 (MH450109)                    | 5932-5951                |
| Xenv400R       | CATCCCCATTGCCTCTGTAG        | AKR40 (MH450109)                    | 6165-6185                |
| FrgR1          | GCTTCCAGACCTCTCGTTGTAC      | Frg3 (AB050721)                     | 53-74                    |
| FrgF3          | CTCGTGACAGGAGGGTTAGC        | Fv4 (M33884)                        | 160-179                  |
| Fv4EF2, ER2    | CAACTGCCCTAGTCGCCAC         | Fv4 (M33884)                        | 1595-1614                |
| Fv4-3'R2       | CCATCACCCACAAGGTAG          | C57BL/6 Chr 12 (NC_000078)          | 80844616-80844634        |
| Fv4-5'F1       | CCTTCTGGCATTCCGTAG          | C57BL/6 Chr 12 (NC_000078)          | 80843155-80843174        |
| <b>Capsid</b>  |                             |                                     |                          |
| AKp30F2        | GGCTTCCCCTCCGTTGG           | AKV MLV (J01998)                    | 1274-1293                |
| XE1400F        | GTCCTCATCACCCACCAAG         | DG-75 MLV (AF221065)                | 1395-1412                |
| Emv1840R       | CGACCAATGTCTGGAGCG          | AKV MLV (J01998)                    | 1838-1855                |
| XMLvp10R       | CTCCCCCTGTCTATCCTGTCT<br>TG | AKV MLV (J01998)                    | 2088-2112                |
| <b>Fv1</b>     |                             |                                     |                          |
| FvF1-F         | AGCCGAGTTCTAGGGAAACAA       | Fv1b (X97719)                       | 2136-2156                |
| MHRF           | TTTAAGGGTGTGGATAATGG<br>T   | Fv1b (X97719)                       | 3003-3024                |
| GT17aR         | CATCTATACTATCTTGGTGAG       | Fv1b (X97719)                       | 4831-4851                |
| <b>CAT1</b>    |                             |                                     |                          |
| CATF1          | CTGGTAAGTGGCTGACCATC        | C57BL/6 Chr 5 (NC_000070)           | 148282801-<br>148282821  |
| CATF2          | GCTGTCCTCTCTCAGAGC          | C57BL/6 Chr 5 (NC_000070)           | 148279738-<br>148279757  |

|       |                                   |                           |                     |
|-------|-----------------------------------|---------------------------|---------------------|
| CATR1 | CCTATGAACGGTATCACCCAG             | C57BL/6 Chr 5 (NC_000070) | 148282518-148282538 |
| CATR2 | CCTGTGCCAAGAGGAAAAGG              | C57BL/6 Chr 5 (NC_000070) | 148279471-148279490 |
| CATR3 | CCACTGGGCTAAAACACAACG             | C57BL/6 Chr 5 (NC_000070) | 148278665-148278685 |
| CATR4 | CACAGCGCAGGAAGATTG                | C57BL/6 Chr 5 (NC_000070) | 148277253-148277271 |
| MCATF | GC GGAT CCTA ATGGGCTGCAA<br>AAACC | (NM_007513)               | 280-296             |
| MCATR | CGGGATCCGT CATT GCACTGG<br>TCC    | (NM_007513)               | 2134-51             |

**Table S3.** Accession numbers for MLV XRVs and ERVs and for *Cat1* and *Fv1* gene sequences.

| <b>E-XRVs</b> | <b>Accession Number</b> |
|---------------|-------------------------|
| AKV           | J01998                  |
| BM5           | AY252102                |
| CasBrE        | X57540                  |
| CAST17/18     | KU324807                |
| FB29          | NC_001362               |
| FrMLV         | X02794                  |
| FrMLV57       | LC229035                |
| Graffi-1.2    | AB187566                |
| Gross         | AY294332                |
| HoMLV         | KU324805                |
| MeIARV        | DQ366148                |
| MoMLV         | AF033811                |
| MoMLV-ts1     | AF462057                |
| PVC-211       | M93134                  |
| RaMLV         | U94692                  |
| RadLV         | K03363                  |
| SL3-3         | AF169256                |
| SRS           | AF019230                |
| WN1802B       | K01204                  |
| <b>P-XRVs</b> |                         |
| FRMCF         | X01679                  |
| MoMCF         | J02254                  |
| RL-MCF-MLV    | AF288942                |
| <b>X-XRVs</b> |                         |
| AKR6          | MH450110                |
| AKR40         | MH450109                |
| CASTX         | KU324803                |
| CWM-S-5X      | MH450113                |
| DG-75         | AF221065                |
| Du5H          | X14576                  |
| EKVN          | JF908817                |
| Kyushu        | MH450114                |
| NZB           | EU334447                |
| rv-DBA/2      | L37059                  |
| SCLC          | MH450112                |
| XMRV          | DQ399707                |

| <b>Other XRVs</b>                 |                |
|-----------------------------------|----------------|
| A-MLV                             | AF411814       |
| CasE#1                            | KU324804       |
| Cz524                             | KU324804       |
| <b>ERVs</b>                       |                |
| Cast/EiJ-ERV1                     | KU324812       |
| Cast/EiJ-ERV3                     | KU324817       |
| Cast/NcR-ERV                      | KU324819       |
| CalWM1                            | KU324810       |
| CalWM2                            | KU324813       |
| <i>Emv30</i>                      | KJ668269       |
| ERV1                              | AF136489       |
| <i>Frg3</i>                       | ABO50721       |
| <i>Frg1</i>                       | AB050720       |
| <i>Fv4</i>                        | M33884         |
| M-RV 1A                           | AY714500       |
| M-RV 7A                           | AY714504       |
| M-RV 9B                           | AY714510       |
| NA1-Mpmv                          | AY219536       |
| NC2-Pmv                           | AY219545       |
| NI1-Pmv                           | AY219557       |
| NQ1-Pmv                           | AY219567       |
| PreXMRV2                          | FR871850       |
| <b>Fv1</b>                        |                |
| CAST/EiJ                          | FJ603568       |
| Mol/Li                            | FJ603569       |
| SKIVE                             | FJ603570       |
| CZECHI/EiJ                        | FJ603571       |
| LEWES                             | FJ603572       |
| CalWM                             | FJ603573       |
| PRAE                              | FJ603574       |
| <b><i>Slc7a1/CAT1</i></b>         |                |
| <i>Arvicathis niloticus</i>       | XM_034489669.1 |
| <i>Cavia porcellus</i>            | XM_003477412.4 |
| <i>Cricetulus griseus</i>         | XM_007652065.4 |
| <i>Fukomys damarensis</i>         | XM_010623858.3 |
| <i>Grammomys surdaster</i>        | XM_028779808.1 |
| <i>Heterocephalus glaber</i>      | XM_004854790.2 |
| <i>Ictidomys tridecemlineatus</i> | XM_040281633.1 |
| <i>Jaculus jaculus</i>            | XM_004659984.1 |
| <i>Marmota flaviventris</i>       | XM_027928856.1 |

|                               |                |
|-------------------------------|----------------|
| <i>Marmota marmota</i>        | XM_015484182.1 |
| <i>Mastomys coucha</i>        | XM_031338779.1 |
| <i>Mesocricetus auratus</i>   | NM_001310565.1 |
| <i>Microtus ochrogaster</i>   | XM_005344718.3 |
| <i>Mus caroli</i>             | XM_021162329.2 |
| <i>M.m.castaneus</i> (Cas/Li) | JN226410       |
| <i>M.m.musculus</i> (Czechl)  | JN226407       |
| <i>M.m.molossinus</i> (MOLG)  | JN226408       |
| <i>Mus pahari</i>             | XM_021186649.2 |
| <i>Mus spicilegus</i>         | JN226409.1     |
| <i>Nannospalax galili</i>     | XM_029559651.1 |
| NIH3T3                        | M26687         |
| <i>Peromyscus leucopus</i>    | XM_028878053.2 |
| <i>Peromyscus maniculatus</i> | XM_006979618.2 |
| <i>Rattus norvegicus</i>      | NM_013111.3    |
| Rattus norvegicusXC           | AB066224       |
| <i>Rattus rattus</i>          | XM_032886507.1 |
| <i>Octodon degus</i>          | XM_004631056.3 |
| <i>Urocitellus parryii</i>    | XM_026388381.1 |

**Table S4.** Residues under positive selection as identified by separate programs

| Gene                                     | Program | Residues under Positive Selection                                                                                                                                     | Reference |
|------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <i>Cat1</i> (All Rodents)                | MEME    | 159V, 226C, 229N, 233V, 237E, 323Q, 365F, 529V, 591T, 598I                                                                                                            | Mouse     |
|                                          | FEL     | 529V, 591T                                                                                                                                                            |           |
|                                          | FUBAR   | None                                                                                                                                                                  |           |
|                                          | SLAC    | None                                                                                                                                                                  |           |
|                                          | PAML    | 233V                                                                                                                                                                  |           |
| <i>Cat1</i> (Mice and Hamsters)          | MEME    | 7L, 365F, 598I                                                                                                                                                        | Mouse     |
|                                          | FEL     | 373N                                                                                                                                                                  |           |
|                                          | FUBAR   | 373N                                                                                                                                                                  |           |
|                                          | SLAC    | None                                                                                                                                                                  |           |
|                                          | PAML    | 599W, 610Q                                                                                                                                                            |           |
| E-MLV<br>RBDenv<br>(without FMR viruses) | MEME    | 97P, 144A, 169S, 262S                                                                                                                                                 | AKV       |
|                                          | FEL     | 97P, 169S                                                                                                                                                             |           |
|                                          | FUBAR   | None                                                                                                                                                                  |           |
|                                          | SLAC    | None                                                                                                                                                                  |           |
|                                          | PAML    | 92R, 97P, 106G, 108S, 111T, 112P, 203D, 213E, 228Q, 237W                                                                                                              |           |
| E-MLV env<br>(without FMR viruses)       | MEME    | 21I, 31P, 33T, 35G, 144A, 206T, 293N, 299T, 385L, 400T                                                                                                                | AKV       |
|                                          | FEL     | 10F, 33T, 35G, 293N, 400T                                                                                                                                             |           |
|                                          | FUBAR   | 27G, 35G                                                                                                                                                              |           |
|                                          | SLAC    | None                                                                                                                                                                  |           |
|                                          | PAML    | 27G, 34L, 237W, 305E, 385L                                                                                                                                            |           |
| X/P MLV env                              | MEME    | 9P, 31A, 72K, 91D, 94D, 98S, 101G, 107L, 119P, 157G, 161R, 175S, 217T, 228Q, 267T, 294E, 353E, 439K, 476A, 489T, 500A, 502E, 518G, 574G, 575L, 586I, 638P, 639E, 640E | AKR6      |
|                                          | FEL     | 9P, 91D, 120T, 161R, 175S, 217T, 267T, 294E                                                                                                                           |           |
|                                          | FUBAR   | 91D, 161R, 175S, 217T, 267T, 294E                                                                                                                                     |           |
|                                          | SLAC    | 217T                                                                                                                                                                  |           |
|                                          | PAML    | 91D, 175S, 217T                                                                                                                                                       |           |
| X/P MLV<br>RBDenv                        | MEME    | 72K, 87D, 88P, 91D, 92I, 107L, 153S, 161R, 217T                                                                                                                       | AKR6      |
|                                          | FEL     | 91D, 101G, 217T                                                                                                                                                       |           |
|                                          | FUBAR   | 87D, 91D, 92I, 161R, 175S, 217T                                                                                                                                       |           |
|                                          | SLAC    | 92I, 217T                                                                                                                                                             |           |
|                                          | PAML    | 84H, 87D, 88P, 91D, 92I, 107L, 161R, 217T                                                                                                                             |           |
| Capsid                                   | MEME    | 4L, 10L, 12Y, 35G, 109Q, 110R, 172P, 189D, 243E                                                                                                                       | AKV       |
|                                          | FEL     | 4L, 110R                                                                                                                                                              |           |
|                                          | FUBAR   | 4L, 110R                                                                                                                                                              |           |
|                                          | SLAC    | 110R                                                                                                                                                                  |           |
|                                          | PAML    | 109Q                                                                                                                                                                  |           |