

**Part 1:** **TITLE, AUTHORS, APPROVALS, etc**

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| **Code assigned:** | **2020.014D** |  |
| **Short title:** Create nine new species in the genus *Gyrovirus* (*Anelloviridae*) | | |
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**Author(s) and email address(es)**

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**List the ICTV Study Group(s) that have seen this proposal**

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| *Anelloviridae* SG |

**ICTV study group comments and response of proposer**

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**Authority to use the name of a living person**

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| **Taxon name** | **Person from whom the name is derived** | **Permission attached (Y/N)** |
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**Submission dates**

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| Date first submitted to SC Chair | August 4, 2020 |
| Date of this revision (if different to above) | August 21, 2020 |

**ICTV-EC comments and response of the proposer**

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**Part 3:** **TAXONOMIC PROPOSAL**

**Name of accompanying Excel module**

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| 2020.014D.R.Gyrovirus\_9nsp.xlsx |

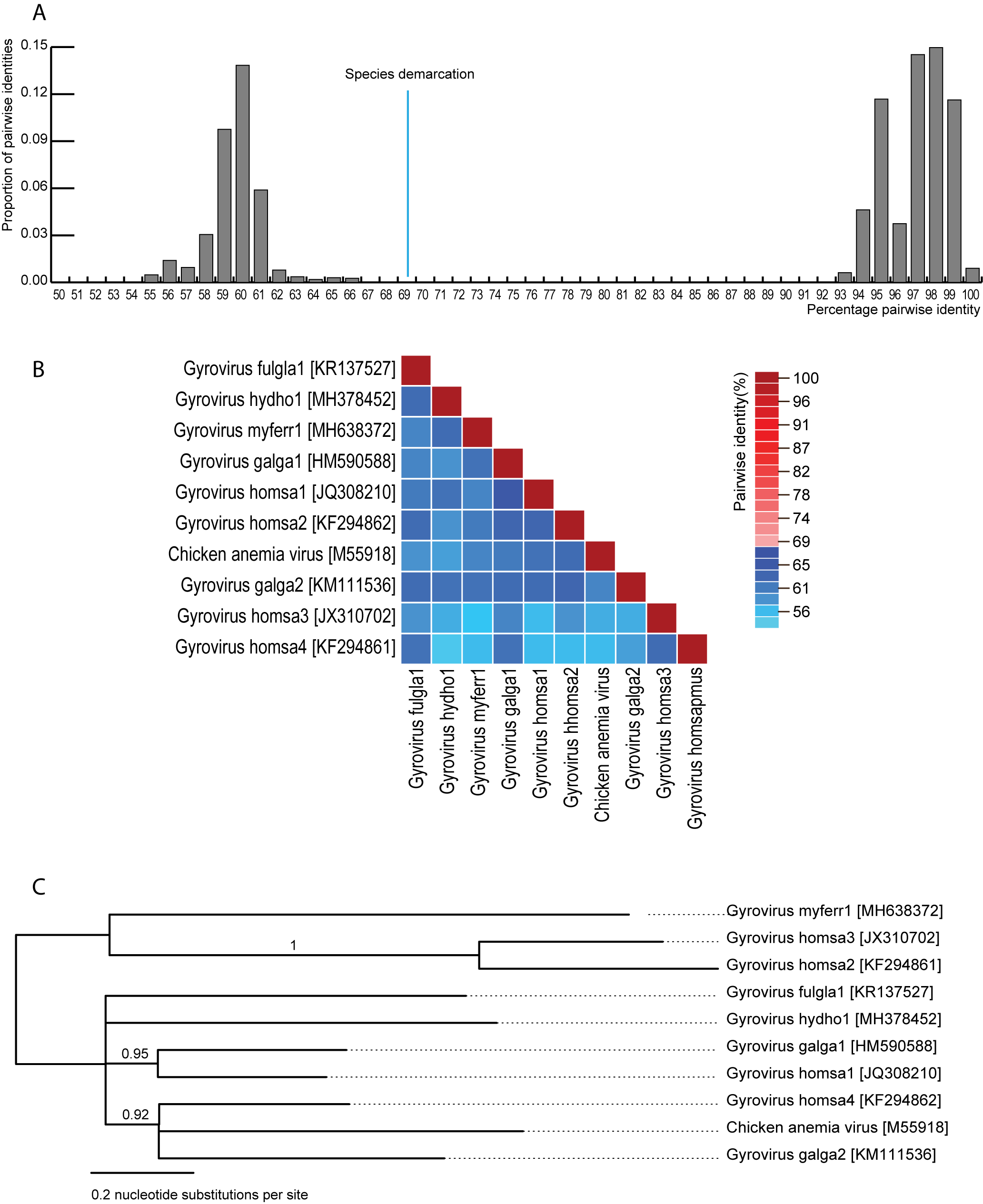
**Abstract**

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| The genus *Gyrovirus* was assigned to the family *Anelloviridae* in 2018. The genus *Gyrovirus* has one assigned species, *Chicken anemia virus.* Over that last decade many diverse viruses that are related to chicken anemia virus have been identified but are not classified. Here we propose a frame work for classifying viruses into species in the genus *Gyrovirus*. |

**Text of proposal**

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**Supporting evidence**

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**Figure 1: A.** Distribution of pairwise identities of the VP1 nucleotide sequences of gyrovirus genomes available in GenBank (n=229). **B**. Pairwise identity matrix of representative sequences from each species inferred using SDT v1.2 [3]. **C**. Maximum likelihood phylogenetic tree of the aligned VP1 sequences of representative gyroviruses inferred using PHYML [1] with GTR+G model (determined using jModelTest) [4] and aLRT branch support. The tree is midpoint rooted.

**Table 2:** Details of the members of each species. New species are highlighted in red font.

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| **Species** | **Accession number** | **Host species** |
| *Chicken anemia virus* | AF285882 | *Gallus gallus* |
|  | AF311892 | *Gallus gallus* |
|  | AF311900 | *Gallus gallus* |
|  | AF390038 | *Gallus gallus* |
|  | AF390102 | *Gallus gallus* |
|  | AF395114 | *Gallus gallus* |
|  | AF475908 | *Gallus gallus* |
|  | AY040632 | *Gallus gallus* |
|  | AY839944 | *Gallus gallus* |
|  | AY843527 | *Gallus gallus* |
|  | AY846844 | *Gallus gallus* |
|  | AY999018 | *Gallus gallus* |
|  | DQ124934 | *Gallus gallus* |
|  | DQ124935 | *Gallus gallus* |
|  | DQ124936 | *Gallus gallus* |
|  | DQ141670 | *Gallus gallus* |
|  | DQ141671 | *Gallus gallus* |
|  | DQ141672 | *Gallus gallus* |
|  | DQ141673 | *Gallus gallus* |
|  | DQ217400 | *Gallus gallus* |
|  | DQ217401 | *Gallus gallus* |
|  | DQ991394 | *Gallus gallus* |
|  | EF176599 | *Gallus gallus* |
|  | FJ172347 | *Gallus gallus* |
|  | JF507715 | *Gallus gallus* |
|  | JQ690762 | *Homo sapiens* |
|  | JX260426 | *Gallus gallus* |
|  | JX964755 | *Gallus gallus* |
|  | KC414026 | *Gallus gallus* |
|  | KF224926 | *Gallus gallus* |
|  | KF224927 | *Gallus gallus* |
|  | KF224928 | *Gallus gallus* |
|  | KF224929 | *Gallus gallus* |
|  | KF224930 | *Gallus gallus* |
|  | KF224931 | *Gallus gallus* |
|  | KF224932 | *Gallus gallus* |
|  | KF224933 | *Gallus gallus* |
|  | KF224934 | *Gallus gallus* |
|  | KF224935 | *Gallus gallus* |
|  | KF224936 | *Gallus gallus* |
|  | KF224937 | *Gallus gallus* |
|  | KF224938 | *Gallus gallus* |
|  | KJ728814 | *Gallus gallus* |
|  | KJ728815 | *Gallus gallus* |
|  | KJ728816 | *Gallus gallus* |
|  | KJ728817 | *Gallus gallus* |
|  | KJ728818 | *Gallus gallus* |
|  | KJ728819 | *Gallus gallus* |
|  | KJ728820 | *Gallus gallus* |
|  | KJ728821 | *Gallus gallus* |
|  | KJ728822 | *Gallus gallus* |
|  | KJ728823 | *Gallus gallus* |
|  | KJ728824 | *Gallus gallus* |
|  | KJ728825 | *Gallus gallus* |
|  | KJ728826 | *Gallus gallus* |
|  | KJ728827 | *Gallus gallus* |
|  | KJ728828 | *Gallus gallus* |
|  | KJ728829 | *Gallus gallus* |
|  | KJ728830 | *Gallus gallus* |
|  | KJ872513 | *Gallus gallus* |
|  | KJ872514 | *Gallus gallus* |
|  | KU050677 | *Gallus gallus* |
|  | KU050678 | *Gallus gallus* |
|  | KU050679 | *Gallus gallus* |
|  | KU050680 | *Gallus gallus* |
|  | KU221054 | *Gallus gallus* |
|  | KU598851 | *Gallus gallus* |
|  | KU641013 | *Gallus gallus* |
|  | KU641014 | *Gallus gallus* |
|  | KU641015 | *Gallus gallus* |
|  | KU645506 | *Gallus gallus* |
|  | KU645507 | *Gallus gallus* |
|  | KU645508 | *Gallus gallus* |
|  | KU645509 | *Gallus gallus* |
|  | KU645510 | *Gallus gallus* |
|  | KU645511 | *Gallus gallus* |
|  | KU645512 | *Gallus gallus* |
|  | KU645513 | *Gallus gallus* |
|  | KU645514 | *Gallus gallus* |
|  | KU645515 | *Gallus gallus* |
|  | KU645516 | *Gallus gallus* |
|  | KU645517 | *Gallus gallus* |
|  | KU645518 | *Gallus gallus* |
|  | KU645519 | *Gallus gallus* |
|  | KU645520 | *Gallus gallus* |
|  | KU645521 | *Gallus gallus* |
|  | KU645522 | *Gallus gallus* |
|  | KU645523 | *Gallus gallus* |
|  | KU645524 | *Gallus gallus* |
|  | KU645525 | *Gallus gallus* |
|  | KU845734 | *Gallus gallus* |
|  | KU845735 | *Gallus gallus* |
|  | KX447633 | *Gallus gallus* |
|  | KX447634 | *Gallus gallus* |
|  | KX447635 | *Gallus gallus* |
|  | KX447636 | *Gallus gallus* |
|  | KX447637 | *Gallus gallus* |
|  | KX811526 | *Gallus gallus* |
|  | KY024579 | *Gallus gallus* |
|  | KY053900 | *Gallus gallus* |
|  | KY486136 | *Gallus gallus* |
|  | KY486137 | *Gallus gallus* |
|  | KY486138 | *Gallus gallus* |
|  | KY486139 | *Gallus gallus* |
|  | KY486140 | *Gallus gallus* |
|  | KY486141 | *Gallus gallus* |
|  | KY486142 | *Gallus gallus* |
|  | KY486143 | *Gallus gallus* |
|  | KY486144 | *Gallus gallus* |
|  | KY486145 | *Gallus gallus* |
|  | KY486146 | *Gallus gallus* |
|  | KY486147 | *Gallus gallus* |
|  | KY486148 | *Gallus gallus* |
|  | KY486149 | *Gallus gallus* |
|  | KY486150 | *Gallus gallus* |
|  | KY486151 | *Gallus gallus* |
|  | KY486152 | *Gallus gallus* |
|  | KY486153 | *Gallus gallus* |
|  | KY486154 | *Gallus gallus* |
|  | KY486155 | *Gallus gallus* |
|  | MF614011 | *Gallus gallus* |
|  | MG827098 | *Gallus gallus* |
|  | MG827099 | *Gallus gallus* |
|  | MG827100 | *Gallus gallus* |
|  | MG846491 | *Gallus gallus* |
|  | MH001553 | *Gallus gallus* |
|  | MH001554 | *Gallus gallus* |
|  | MH001555 | *Gallus gallus* |
|  | MH001556 | *Gallus gallus* |
|  | MH001557 | *Gallus gallus* |
|  | MH001558 | *Gallus gallus* |
|  | MH001559 | *Gallus gallus* |
|  | MH001560 | *Gallus gallus* |
|  | MH001561 | *Gallus gallus* |
|  | MH001562 | *Gallus gallus* |
|  | MH001563 | *Gallus gallus* |
|  | MH001564 | *Gallus gallus* |
|  | MH001565 | *Gallus gallus* |
|  | MH001566 | *Gallus gallus* |
|  | MH001567 | *Gallus gallus* |
|  | MH001568 | *Gallus gallus* |
|  | MH001569 | *Gallus gallus* |
|  | MH001570 | *Gallus gallus* |
|  | MH186137 | *Gallus gallus* |
|  | MH186138 | *Gallus gallus* |
|  | MH186139 | *Gallus gallus* |
|  | MH186140 | *Gallus gallus* |
|  | MH186141 | *Gallus gallus* |
|  | MH186142 | *Gallus gallus* |
|  | MH536104 | *Gallus gallus* |
|  | MH536105 | *Gallus gallus* |
|  | MH536106 | *Gallus gallus* |
|  | MK089240 | *Felis catus* |
|  | MK089241 | *Felis catus* |
|  | MK089242 | *Felis catus* |
|  | MK089243 | *Felis catus* |
|  | MK358456 | *Gallus gallus* |
|  | MK360817 | *Gallus gallus* |
|  | MK376315 | *Gallus gallus* |
|  | MK376316 | *Gallus gallus* |
|  | MK386570 | *Gallus gallus* |
|  | MK423866 | *Gallus gallus* |
|  | MK423867 | *Gallus gallus* |
|  | MK423868 | *Gallus gallus* |
|  | MK423869 | *Gallus gallus* |
|  | MK423870 | *Gallus gallus* |
|  | MK423871 | *Gallus gallus* |
|  | MK423872 | *Gallus gallus* |
|  | MK423873 | *Gallus gallus* |
|  | MK423874 | *Gallus gallus* |
|  | MK484614 | *Gallus gallus* |
|  | MK484615 | *Gallus gallus* |
|  | MK484616 | *Gallus gallus* |
|  | MK770259 | *Gallus gallus* |
|  | MK887164 | *Gallus gallus* |
|  | MK887165 | *Gallus gallus* |
|  | MK887166 | *Gallus gallus* |
|  | MK887167 | *Gallus gallus* |
|  | MK887168 | *Gallus gallus* |
|  | MK887169 | *Gallus gallus* |
|  | MK887170 | *Gallus gallus* |
|  | MK887171 | *Gallus gallus* |
|  | MN103402 | *Gallus gallus* |
|  | MN103403 | *Gallus gallus* |
|  | MN103404 | *Gallus gallus* |
|  | MN103405 | *Gallus gallus* |
|  | MN103406 | *Gallus gallus* |
|  | MN299309 | *Gallus gallus* |
|  | MN299310 | *Gallus gallus* |
|  | MN299311 | *Gallus gallus* |
|  | MN299312 | *Gallus gallus* |
|  | MN299313 | *Gallus gallus* |
|  | MN299315 | *Gallus gallus* |
|  | MN299316 | *Gallus gallus* |
| **Gyrovirus homsa1** | **JQ308210** | ***Homo sapiens*** |
|  | KM348009 | *Mustela putorius furo* |
|  | MG366592 | *Gallus gallus* |
|  | MK089247 | *Felis catus* |
|  | MK089248 | *Felis catus* |
|  | MK089249 | *Felis catus* |
| **Gyrovirus galga1** | **HM590588** | ***Gallus gallus*** |
|  | FR823283 | *Homo sapiens* |
|  | JQ690763 | *Homo sapiens* |
|  | KJ452213 | *Mustela putorius furo* |
|  | KJ452214 | *Mustela putorius furo* |
|  | KU168250 | *Gallus gallus* |
|  | KX708506 | *Gallus gallus* |
|  | KX708507 | *Gallus gallus* |
|  | KX708508 | *Gallus gallus* |
|  | KX708509 | *Gallus gallus* |
|  | KX708510 | *Gallus gallus* |
|  | KX708511 | *Gallus gallus* |
|  | KX708512 | *Gallus gallus* |
|  | KX708513 | *Gallus gallus* |
|  | KX708514 | *Gallus gallus* |
|  | KX708515 | *Gallus gallus* |
|  | KX708516 | *Gallus gallus* |
|  | KX708517 | *Gallus gallus* |
|  | KX708518 | *Gallus gallus* |
|  | KX708519 | *Gallus gallus* |
|  | KX708520 | *Gallus gallus* |
|  | KX708521 | *Gallus gallus* |
|  | KX708522 | *Gallus gallus* |
|  | KY039279 | *Gallus gallus* |
|  | MG846492 | *Gallus gallus* |
|  | MK089244 | *Felis catus* |
|  | MK089245 | *Gallus gallus* |
|  | MK089246 | *Felis catus* |
|  | MK840982 | *Elaphe carinata* |
| **Gyrovirus homsa2** | **KF294862** | ***Homo sapiens*** |
|  | MK089250 | *Felis catus* |
|  | MK089251 | *Felis catus* |
| **Gyrovirus homsa3** | **JX310702** | ***Homo sapiens*** |
|  | KJ452215 | *Mustela putorius furo* |
|  | KY024580 | *Gallus gallus* |
|  | MG846493 | *Gallus gallus* |
| **Gyrovirus homsa4** | **KF294861** | ***Homo sapiens*** |
| **Gyrovirus fulgla1** | **KR137527** | ***Fulmarus glacialis*** |
| **Gyrovirus galga2** | **KM111536** | ***Gallus gallus*** |
| **Gyrovirus hydho1** | **MH378452** | ***Hydrobates homochroa*** |
| **Gyrovirus myferr1** | **MH638372** | ***Myrmoderus ferrugineus*** |

**References**

1. Guindon S, Dufayard JF, Lefort V, Anisimova M, Hordijk W, Gascuel O (2010) New algorithms and methods to estimate maximum-likelihood phylogenies: assessing the performance of PhyML 3.0. Syst Biol 59:307-321. PMID: 20525638 DOI: 10.1093/sysbio/syq010

2. Kato A, Fujino M, Nakamura T, Ishihama A, Otaki Y (1995) Gene organization of chicken anemia virus. Virology 209:480-488. PMID: 7778281 DOI: 10.1006/viro.1995.1280

3. Muhire BM, Varsani A, Martin DP (2014) SDT: a virus classification tool based on pairwise sequence alignment and identity calculation. PLoS One 9:e108277. PMID: 25259891 DOI: 10.1371/journal.pone.0108277

4. Posada D (2008) jModelTest: phylogenetic model averaging. Mol Biol Evol 25:1253-1256. PMID: 18397919 DOI: 10.1093/molbev/msn083

5. Rosario K, Breitbart M, Harrach B, Segales J, Delwart E, Biagini P, Varsani A (2017) Revisiting the taxonomy of the family Circoviridae: establishment of the genus Cyclovirus and removal of the genus Gyrovirus. Arch Virol 162:1447-1463. PMID: 28155197 DOI: 10.1007/s00705-017-3247-y

6. Todd D, Creelan JL, Mackie DP, Rixon F, McNulty MS (1990) Purification and biochemical characterization of chicken anaemia agent. J Gen Virol 4:819-823. PMID: 2109040 DOI: 10.1099/0022-1317-71-4-819