TAXONOMY OF THE ORDER *MONONEGAVIRALES*: UPDATE 2016

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ABSTRACT

In 2016, the order *Mononegavirales* was emended through the addition of two new families (*Mymonaviridae* and *Sunviridae*), the elevation of the paramyxoviral subfamily *Pneumovirinae* to family status (*Pneumoviridae*), the addition of five free-floating genera (*Anphevirus*, *Arlivirus*, *Chengtivirus*, *Crustavirus*, and *Wastrivirus*), and several other changes at the genus and species levels. This article presents the updated taxonomy of the order *Mononegavirales* as now accepted by the International Committee on Taxonomy of Viruses (ICTV).

INTRODUCTION

The viral order *Mononegavirales* was established in 1991 to accommodate related viruses with nonsegmented, linear, single-stranded negative-sense RNA genomes. These viruses were initially assigned to three mononegaviral families: *Filoviridae*, *Paramyxoviridae*, and *Rhabdoviridae* [20, 21]. In subsequent years, these families continued to grow through the inclusion of numerous novel species and genera, and the order was therefore emended in 1995 [4], 1997 [23], 2000 [24], 2005 [25], and 2011 [8]. The families *Bornaviridae* and *Nyamiviridae* joined the other three mononegaviral families in 1996 [22] and 2014 [1, 11], respectively. In 2015, the Study Groups of the International Committee on Taxonomy of Viruses (ICTV) responsible for the taxonomy of the order and its five families embarked on a joint effort to assign unclassified mononegaviruses to existing or novel taxa and to streamline order nomenclature. Here we present a brief overview of the first round of these efforts, which by now is accepted by the ICTV Executive Committee and, thereby, is official taxonomy.

TAXONOMIC CHANGES AT THE ORDER LEVEL

In recent years, several mononegaviruses have been described that are only distantly related to the members of the families *Bornaviridae*, *Filoviridae*, *Nyamiviridae*, *Paramyxoviridae*, and *Rhabdoviridae*. These viruses include Sclerotinia sclerotiorum negative-stranded RNA virus 1 (SsNSRV-1) found in an ascomycete in China [16]; Sunshine Coast virus (SunCV; previously called Sunshine virus) isolated from Australian carpet pythons [10]; and Líshí spider virus 2 (LsSV-2), Sānxiá water strider virus 4 (SxWSV-4), Tǎchéng tick virus 6 (TcTV-6), Wēnzhōu crab virus 1 (WzCV-1), and Xīnchéng mosquito virus (XcMV) detected in Chinese arthropods [15]. To accommodate these viruses in the order and to appropriately reflect their phylogenetic relationships to other mononegaviral taxa, two new families and four free-floating genera were established: *Mymonaviridae* (accommodating SsNSRV-1), *Sunviridae* (SunCV), *Anphevirus* (XcMV), *Arlivirus* (LsSV-2), *Chengtivirus* (TcTV-6), *Crustavirus* (WzCV-1), and *Wastrivirus* (SxWSV-4). In addition, the paramyxoviral subfamily *Pneumovirinae* was elevated to family status (*Pneumoviridae*) because the members of this taxon are as closely related to filoviruses as to the members of the paramyxoviral subfamily *Paramxyovirinae* (now dissolved) (Table 1).

TAXONOMIC CHANGES AT THE FAMILY LEVEL

The monogeneric family *Bornaviridae* was reorganized in 2015 by establishing five distinct species in the genus *Bornavirus* [2, 12] following a non-Latinized binomial species name format [29]. These efforts were continued in 2016 by expanding the genus by an additional two species (*Elapid 1 bornavirus* for Loveridge's garter snake virus 1 [27] and *Psittaciform 2 bornavirus* for parrot bornavirus 5 [9, 18]) (Table 1).

The monogeneric family *Nyamiviridae* was expanded to include a second genus (*Socyvirus*) for the until-then free-floating nyamivirus species *Soybean cyst nematode virus*. This species name

was changed to *Soybean cyst nematode socyvirus* to adhere to the non-Latinized binomial species name format [29] (Table 1).

The family *Paramyxoviridae* was emended by expanding the genus *Avulavirus* by three species (*Avian paramyxovirus 10-12* for avian paramyxoviruses 10-12, respectively [5, 19, 28]), the genus *Henipavirus* by three species (*Cedar henipavirus* for Cedar virus [17], *Ghanaian bat henipavirus* for Kumasi virus [GH-M74a] [7], and *Mojiang henipavirus* for Mòjiāng virus [31]), the genus *Morbillivirus* by one species (*Feline morbillivirus* for feline morbillivirus [30]) and the genus *Respirovirus* by one species (*Porcine parainfluenza virus 1* for porcine parainfluenza virus 1 [14]). The species *Simian Virus 10* was dissolved on the evidence that simian virus 10 is an isolate of human parainfluenzavirus 3 rather than a distinct virus [13]. The genus *Pneumovirus*, now included in the new family *Pneumoviridae*, was renamed *Orthopneumovirus* to avoid confusion between family and genus members (Table 1).

The family *Rhabdoviridae* was expanded by two genera: *Dichorhavirus* (new; [6]) and *Varicosavirus* (previously free-floating outside of the order) to accommodate bisegmented plant viruses (coffee ringspot virus and orchid fleck virus; lettuce big-vein associated virus). The species *Alfalfa dwarf cytorhabdovirus* (for alfalfa dwarf virus [3]) was added to the genus *Cytorhabdovirus*. Finally, the non-Latinized binomial species name format [29] was applied throughout the family (Table 1).

A summary of the current, ICTV-accepted taxonomy of the order *Mononegavirales* is presented in Table 1.

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Table 1. Taxonomy of the order *Mononegavirales* as of 2016. Listed are all mononegaviruses that have been classified into species. Asterisks denote type species.

Genus	Species	Virus (Abbreviation)
Family *Bornaviridae*		
Bornavirus	*Elapid 1 bornavirus*	Loveridge's garter snake virus 1 (LGSV-1)
	*Mammalian 1 bornavirus**	Borna disease virus 1 (BoDV-1)
		Borna disease virus 2 (BoDV-2)
	Passeriform 1 bornavirus	canary bornavirus 1 (CnBV-1)
		canary bornavirus 2 (CnBV-2)
		canary bornavirus 3 (CnBV-3)
	Passeriform 2 bornavirus	estrildid finch bornavirus 1 (EsBV-1)
	Psittaciform 1 bornavirus	parrot bornavirus 1 (PaBV-1)
		parrot bornavirus 2 (PaBV-2)
		parrot bornavirus 3 (PaBV-3)
		parrot bornavirus 4 (PaBV-4)
		parrot bornavirus 7 (PaBV-7)

	Psittaciform 2 bornavirus	parrot bornavirus 5 (PaBV-5)
	Waterbird 1 bornavirus	aquatic bird bornavirus 1 (ABBV-1)
		aquatic bird bornavirus 2 (ABBV-2)
Family *Filoviridae*		
Cuevavirus	*Lloviu cuevavirus**	Lloviu virus (LLOV)
Ebolavirus	*Bundibugyo ebolavirus*	Bundibugyo virus (BDBV)
	Reston ebolavirus	Reston virus (RESTV)
	Sudan ebolavirus	Sudan virus (SUDV)
	Taï Forest ebolavirus	Taï Forest virus (TAFV)
	*Zaire ebolavirus**	Ebola virus (EBOV)
Marburgvirus	*Marburg marburgvirus**	Marburg virus (MARV)
		Ravn virus (RAVV)
Family *Mymonaviridae*		
Sclerotimonavirus	*Sclerotinia sclerotimonavirus**	Sclerotinia sclerotiorum negative-stranded RNA virus 1 (SsNSRV-1)

Family *Nyamiviridae*		
Nyavirus	*Midway nyavirus*	Midway virus (MIDWV)
	*Nyamanini nyavirus**	Nyamanini virus (NYMV)
	Sierra Nevada nyavirus	Sierra Nevada virus (SNVV)
Socyvirus	*Soybean cyst nematode socyvirus**	soybean cyst nematode virus 1 (SbCNV-1)
Family *Paramyxoviridae*		
Aquaparamyxovirus	*Atlantic salmon paramyxovirus**	Atlantic salmon paramyxovirus (AsaPV)
Avulavirus	*Avian paramyxovirus 2*	avian paramyxovirus 2 (APMV-2)
	Avian paramyxovirus 3	avian paramyxovirus 3 (APMV-3)
	Avian paramyxovirus 4	avian paramyxovirus 4 (APMV-4)
	Avian paramyxovirus 5	avian paramyxovirus 5 (APMV-5)
	Avian paramyxovirus 6	avian paramyxovirus 6 (APMV-6)
	Avian paramyxovirus 7	avian paramyxovirus 7 (APMV-7)
	Avian paramyxovirus 8	avian paramyxovirus 8 (APMV-8)
	Avian paramyxovirus 9	avian paramyxovirus 9 (APMV-9)

	Avian paramyxovirus 10	avian paramyxovirus 10 (APMV-10)
	Avian paramyxovirus 11	avian paramyxovirus 11 (APMV-11)
	Avian paramyxovirus 12	avian paramyxovirus 12 (APMV-12)
	*Newcastle disease virus**	avian paramyxovirus 1 (APMV-1)[1]
Ferlavirus	*Fer-de-Lance paramyxovirus**	Fer-de-Lance virus (FDLV)[2]
Henipavirus	*Cedar henipavirus*	Cedar virus (CedV)
	Ghanaian bat henipavirus	Kumasi virus (KV)[3]
	*Hendra virus**	Hendra virus (HeV)
	Mojiang henipavirus	Mòjiāng virus (MojV)
	Nipah virus	Nipah virus (NiV)
Morbillivirus	*Canine distemper virus*	canine distemper virus (CDV)
	Cetacean morbillivirus	cetacean morbillivirus (CeMV)
	Feline morbillivirus	feline morbillivirus (FeMV)[4]
	*Measles virus**	measles virus (MeV)
	Peste-des-petits-ruminants virus	peste-des-petits-ruminants virus (PPRV)

	Phocine distemper virus	phocine distemper virus (PDV)
	Rinderpest virus	rinderpest virus (RPV)
Respirovirus	*Bovine parainfluenza virus 3*	bovine parainfluenza virus 3 (BPIV-3)
	Human parainfluenza virus 1	human parainfluenza virus 1 (HPIV-1)
	Human parainfluenza virus 3	human parainfluenza virus 3 (HPIV-3)[5]
	Porcine parainfluenza virus 1	porcine parainfluenza virus 1 (PPIV-1)
	*Sendai virus**	Sendai virus (SeV)[6]
Rubulavirus	*Human parainfluenza virus 2*	human parainfluenza virus 2 (HPIV-2)
	Human parainfluenza virus 4	human parainfluenza virus 4a (HPIV-4a)
		human parainfluenza virus 4b (HPIV-4b)
	Mapuera virus	Mapuera virus (MapV)
	*Mumps virus**	mumps virus (MuV)
		bat mumps virus (BMV)[7]
	Parainfluenza virus 5	parainfluenza virus 5 (PIV-5)[8]
	Porcine rubulavirus	La Piedad Michoacán Mexico virus

		(LPMV)[9]
	Simian virus 41	simian virus 41 (SV-41)
Family *Pneumoviridae*		
Metapneumovirus	*Avian metapneumovirus**	avian metapneumovirus (AMPV)[10]
	Human metapneumovirus	human metapneumovirus (HMPV)
Orthopneumovirus	*Bovine respiratory syncytial virus*	bovine respiratory syncytial virus (BRSV)
	*Human respiratory syncytial virus**	human respiratory syncytial virus A2 (HRSV-A2)
		human respiratory syncytial virus B1 (HRSV-B1)
		human respiratory syncytial virus S2 (HRSV-S2)
	Murine pneumonia virus	murine pneumonia virus (MPV)
Family *Rhabdoviridae*		
Cytorhabdovirus	*Alfalfa dwarf cytorhabdovirus*	alfalfa dwarf virus (ADV)
	Barley yellow striate mosaic	barley yellow striate mosaic virus

	cytorhabdovirus	(BYSMV)
	Broccoli necrotic yellows cytorhabdovirus	broccoli necrotic yellows virus (BNYV)
	Festuca leaf streak cytorhabdovirus	festuca leaf streak virus (FLSV)
	*Lettuce necrotic yellows cytorhabdovirus**	lettuce necrotic yellows virus (LNYV)
	Lettuce yellow mottle cytorhabdovirus	lettuce yellow mottle virus (LYMoV)
	Northern cereal mosaic cytorhabdovirus	northern cereal mosaic virus (NCMV)
	Sonchus cytorhabdovirus 1	sonchus virus (SonV)
	Strawberry crinkle cytorhabdovirus	strawberry crinkle virus (SCV)
	Wheat American striate mosaic cytorhabdovirus	wheat American striate mosaic virus (WASMV)
Dichorhavirus	*Coffee ringspot dichorhavirus*	coffee ringspot virus (CoRSV)
	*Orchid fleck dichorhavirus**	orchid fleck virus (OFV)[11]
Ephemerovirus	*Adelaide River ephemerovirus*	Adelaide River virus (ARV)
	Berrimah ephemerovirus	Berrimah virus (BRMV)
	*Bovine fever ephemerovirus**	bovine ephemeral fever virus (BEFV)[12]

	Kotonkan ephemerovirus	kotonkan virus (KOTV)
	Obodhiang ephemerovirus	Obodhiang virus (OBOV)
Lyssavirus	*Aravan lyssavirus*	Aravan virus (ARAV)
	Australian bat lyssavirus	Australian bat lyssavirus (ABLV)
	Bokeloh bat lyssavirus	Bokeloh bat lyssavirus (BBLV)
	Duvenhage lyssavirus	Duvenhage virus (DUVV)
	European bat 1 lyssavirus	European bat lyssavirus 1 (EBLV-1)
	European bat 2 lyssavirus	European bat lyssavirus 2 (EBLV-2)
	Ikoma lyssavirus	Ikoma lyssavirus (IKOV)
	Irkut lyssavirus	Irkut virus (IRKV)
	Khujand lyssavirus	Khujand virus (KHUV)
	Lagos bat lyssavirus	Lagos bat virus (LBV)
	Mokola lyssavirus	Mokola virus (MOKV)
	*Rabies lyssavirus**	rabies virus (RABV)
	Shimoni bat lyssavirus	Shimoni bat virus (SHIBV)

	West Caucasian bat lyssavirus	West Caucasian bat virus (WCBV)
Novirhabdovirus	*Hirame novirhabdovirus*	Hirame rhabdovirus (HIRV)
	*Oncorhynchus 1 novirhabdovirus**	infectious hematopoietic necrosis virus (IHNV)
	Oncorhynchus 2 novirhabdovirus	viral hemorrhagic septicemia virus (VHSV)[13]
	Snakehead novirhabdovirus	snakehead rhabdovirus (SHRV)
Nucleorhabdovirus	*Datura yellow vein nucleorhabdovirus*	datura yellow vein virus (DYVV)
	Eggplant mottled dwarf nucleorhabdovirus	eggplant mottled dwarf virus (EMDV)
	Maize fine streak nucleorhabdovirus	maize fine streak virus (MSFV)
	Maize Iranian mosaic nucleorhabdovirus	maize Iranian mosaic virus (MIMV)
	Maize mosaic nucleorhabdovirus	maize mosaic virus (MMV)
	*Potato yellow dwarf nucleorhabdovirus**	potato yellow dwarf virus (PYDV)
	Rice yellow stunt nucleorhabdovirus	rice yellow stunt virus (RYSV)
		rice transitory yellowing virus (RTYV)

	Sonchus yellow net nucleorhabdovirus	sonchus yellow net virus (SYNV)
	Sowthistle yellow vein nucleorhabdovirus	sowthistle yellow vein virus (SYVV)
	Taro vein chlorosis nucleorhabdovirus	taro vein chlorosis virus (TaVCV)
Perhabdovirus	*Anguillid perhabdovirus*	eel virus European X (EVEX)
	*Perch perhabdovirus**	perch rhabdovirus (PRV)
	Sea trout perhabdovirus	lake trout rhabdovirus (LTRV)
Sigmavirus	*Drosophila affinis sigmavirus*	Drosophila affinis sigmavirus (DAffSV)
	Drosophila ananassae sigmavirus	Drosophila ananassae sigmavirus (DAnaSV)
	Drosophila immigrans sigmavirus	Drosophila immigrans sigmavirus (DImmSV)
	*Drosophila melanogaster sigmavirus**	Drosophila melanogaster sigmavirus (DMelSV)
	Drosophila obscura sigmavirus	Drosophila obscura sigmavirus (DObsSV)
	Drosophila tristis sigmavirus	Drosophila tristis sigmavirus (DTriSV
	Muscina stabulans sigmavirus	Muscina stabulans sigmavirus (MStaSV)

Sprivivirus	*Carp sprivivirus**	spring viremia of carp virus (SVCV)
	Pike fry sprivivirus	grass carp rhabdovirus (GrCRV)
		pike fry rhabdovirus (PFRV)
		Tench rhabdovirus (TenRV)
Tibrovirus	*Coastal Plains tibrovirus*	Coastal Plains virus (CPV)
	*Tibrogargan tibrovirus**	Bivens Arm virus (BAV)
		Tibrogargan virus (TIBV)
Tupavirus	*Durham tupavirus**	Durham virus (DURV)
	Tupaia tupavirus	tupaia virus (TUPV)
Varicosavirus	*Lettuce big-vein associated varicosavirus**	lettuce big-vein associated virus (LBVaV)[14]
Vesiculovirus	*Alagoas vesiculovirus*	vesicular stomatitis Alagoas virus (VSAV)
	Carajas vesiculovirus	Carajás virus (CJSV)
	Chandipura vesiculovirus	Chandipura virus (CHPV)
	Cocal vesiculovirus	Cocal virus (COCV)

	*Indiana vesiculovirus**	vesicular stomatitis Indiana virus (VSIV)
	Isfahan vesiculovirus	Isfahan virus (ISFV)
	Maraba vesiculovirus	Maraba virus (MARAV)
	New Jersey vesiculovirus	vesicular stomatitis New Jersey virus (VSNJV)
	Piry vesiculovirus	Piry virus (OIRYV)
Unassigned	*Flanders virus*	Flanders virus (FLAV)
	Ngaingan virus	Ngaingan virus (NGAV)
	Wongabel virus	Wongabel virus (WONV)
Family *Sunviridae*		
Sunshinevirus	*Reptile sunshinevirus 1**	Sunshine Coast virus (SunCV)
Unassigned		
Anphevirus	*Xinchng anphevirus**	Xīnchéng mosquito virus (XcMV)
Arlivirus	*Lishi arlivirus**	Líshí spider virus 2 (LsSV-2)
Chengtivirus	*Tacheng chengtivirus**	Tăchéng tick virus 6 (TcTV-6)

Crustavirus	*Wenzhou crustavirus**	Wēnzhōu crab virus 1 (WzCV-1)
Wastrivirus	*Sanxia wastrivirus**	Sānxiá water strider virus 4 (SxWSV-4)

[1]Includes: Newcastle disease virus (NDV) and pigeon paramyxovirus; [2]synonym: anaconda paramyxovirus; [3]synonym: GH-M74a virus; [4]abbreviation as recently introduced in [26]; [5]historically, an isolate from a samango monkey (Cercopithecus mitis) in 1963 was long classified as a distinct species called simian agent 10 (SA-10), but was shown later to be HPIV-3. SA-10 was sometimes called SV-10; [6]synonym: murine parainfluenza virus 1; [7]synonym: bat paramyxovirus; [8]synonym: simian virus 5; [9]synonym: porcine rubulavirus; [10]synonyms: avian pneumovirus, turkey rhinotracheitis virus; [11]synonyms: citrus leprosis virus nuclear type, citrus necrotic spot virus; [12]synonym Tzipori virus; [13]synonyms: Egtved virus, Paralichthys olivaceus rhabdovirus; [14]synonym: tobacco stunt virus.

COMPLIANCE WITH ETHICAL STANDARDS

The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the US Department of the Army, the US Department of Defense, the US Department of Health and Human Services, the Department of Homeland Security (DHS) Science and Technology Directorate (S&T) or of the institutions and companies affiliated with the authors. In no event shall any of these entities have any responsibility or liability for any use, misuse, inability to use, or reliance upon the information contained herein. The US departments do not endorse any products or commercial services mentioned in this publication.

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Conflict of Interest

The authors have no conflicts of interest.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

REFERENCES

1. Adams MJ, Lefkowitz EJ, King AM, Carstens EB (2014) Ratification vote on taxonomic proposals to the International Committee on Taxonomy of Viruses (2014). Arch Virol 159:2831-2841
2. Adams MJ, Lefkowitz EJ, King AM, Bamford DH, Breitbart M, Davison AJ, Ghabrial SA, Gorbalenya AE, Knowles NJ, Krell P, Lavigne R, Prangishvili D, Sanfacon H, Siddell SG, Simmonds P, Carstens EB (2015) Ratification vote on taxonomic proposals to the International Committee on Taxonomy of Viruses (2015). Arch Virol 160:1837-1850
3. Bejerman N, Giolitti F, de Breuil S, Trucco V, Nome C, Lenardon S, Dietzgen RG (2015) Complete genome sequence and integrated protein localization and interaction map for alfalfa dwarf virus, which combines properties of both cytoplasmic and nuclear plant rhabdoviruses. Virology 483:275-283
4. Bishop DHL, Pringle CR (1995) Order *Mononegavirales*. In: Murphy FA, Fauquet CM, Bishop DHL, Ghabrial SA, Jarvis AW, Martelli GP, Mayo MA, Summers MD (eds) Virus Taxonomy—Sixth Report of the International Committee on Taxonomy of Viruses/Archives of Virology Supplement 10. Springer-Verlag, Vienna, Austria, pp 265-267

5. Briand FX, Henry A, Massin P, Jestin V (2012) Complete genome sequence of a novel avian paramyxovirus. J Virol 86:7710

6. Dietzgen RG, Kuhn JH, Clawson AN, Freitas-Astúa J, Goodin MM, Kitajima EW, Kondo H, Wetzel T, Whitfield AE (2014) *Dichorhavirus*: a proposed new genus for *Brevipalpus* mite-transmitted, nuclear, bacilliform, bipartite, negative-strand RNA plant viruses. Arch Virol 159:607-619

7. Drexler JF, Corman VM, Müller MA, Maganga GD, Vallo P, Binger T, Gloza-Rausch F, Cottontail VM, Rasche A, Yordanov S, Seebens A, Knörnschild M, Oppong S, Adu Sarkodie Y, Pongombo C, Lukashev AN, Schmidt-Chanasit J, Stöcker A, Borges Carneiro AJ, Erbar S, Maisner A, Fronhoffs F, Buettner R, Kalko EKV, Kruppa T, Franke CR, Kallies R, Yandoko ERN, Herrler G, Reusken C, Hassanin A, Krüger DH, Matthee S, Ulrich RG, Leroy EM, Drosten C (2012) Bats host major mammalian paramyxoviruses. Nat Commun 3:796

8. Easton AJ, Pringle CR (2011) Order *Mononegavirales*. In: King AMQ, Adams MJ, Carstens EB, Lefkowitz EJ (eds) Virus Taxonomy—Ninth Report of the International Committee on Taxonomy of Viruses. Elsevier/Academic Press, London, United Kingdom, pp 653-657

9. Guo J, Tizard I (2015) The genome sequence of parrot bornavirus 5. Virus Genes 51:430-433

10. Hyndman TH, Marschang RE, Wellehan JF, Jr., Nicholls PK (2012) Isolation and molecular identification of Sunshine virus, a novel paramyxovirus found in Australian snakes. Infect Genet Evol 12:1436-1446

11. Kuhn JH, Bekal S, Caì Y, Clawson AN, Domier LL, Herrel M, Jahrling PB, Kondo H, Lambert KN, Mihindukulasuriya KA, Nowotny N, Radoshitzky SR, Schneider U, Staeheli P, Suzuki N, Tesh RB, Wang D, Wang L-F, Dietzgen RG (2013) *Nyamiviridae*: proposal for a new family in the order *Mononegavirales*. Arch Virol 158:2209–2226

12. Kuhn JH, Dürrwald R, Bào Y, Briese T, Carbone K, Clawson AN, deRisi JL, Garten W, Jahrling PB, Kolodziejek J, Rubbenstroth D, Schwemmle M, Stenglein M, Tomonaga K, Weissenböck H, Nowotny N (2015) Taxonomic reorganization of the family *Bornaviridae*. Arch Virol 160:621-632

13. Kumar S, Collins PL, Samal SK (2010) Identification of simian agent 10 as human parainfluenza virus type 3 suggests transmission of a human virus to an African monkey. J Virol 84:13068-13070

14. Lau SK, Woo PC, Wu Y, Wong AY, Wong BH, Lau CC, Fan RY, Cai JP, Tsoi HW, Chan KH, Yuen KY (2013) Identification and characterization of a novel paramyxovirus, porcine parainfluenza virus 1, from deceased pigs. J Gen Virol 94:2184-2190

15. Li CX, Shi M, Tian JH, Lin XD, Kang YJ, Chen LJ, Qin XC, Xu J, Holmes EC, Zhang YZ (2015) Unprecedented genomic diversity of RNA viruses in arthropods reveals the ancestry of negative-sense RNA viruses. Elife 4:e05378

16. Liu L, Xie J, Cheng J, Fu Y, Li G, Yi X, Jiang D (2014) Fungal negative-stranded RNA virus that is related to bornaviruses and nyaviruses. Proc Natl Acad Sci U S A 111:12205-12210

17. Marsh GA, de Jong C, Barr JA, Tachedjian M, Smith C, Middleton D, Yu M, Todd S, Foord AJ, Haring V, Payne J, Robinson R, Broz I, Crameri G, Field HE, Wang LF (2012) Cedar virus: a novel henipavirus isolated from Australian bats. PLoS Pathog 8:e1002836

18. Marton S, Bányai K, Gál J, Ihász K, Kugler R, Lengyel G, Jakab F, Bakonyi T, Farkas SL (2015) Coding-complete sequencing classifies parrot bornavirus 5 into a novel virus species. Arch Virol 160:2763-2768

19. Miller PJ, Afonso CL, Spackman E, Scott MA, Pedersen JC, Senne DA, Brown JD, Fuller CM, Uhart MM, Karesh WB, Brown IH, Alexander DJ, Swayne DE (2010) Evidence for a new avian paramyxovirus serotype 10 detected in rockhopper penguins from the Falkland Islands. J Virol 84:11496-11504

20. Pringle CR (1991) Order *Mononegavirales*. In: Francki RIB, Fauquet CM, Knudson DL, Brown F (eds) Classification and Nomenclature of Viruses—Fifth Report of the International Committee on Taxonomy of Viruses/Archives of Virology Supplementum 2. Springer-Verlag, Vienna, Austria, pp 239-241

21. Pringle CR, Alexander DJ, Billeter MA, Collins PL, Kingsbury DW, Lipkind MA, Nagai Y, Orvell C, Rima B, Rott R, ter Meulen V (1991) The order *Mononegavirales*. Arch Virol 117:137-140

22. Pringle CR (1996) Virus taxonomy 1996—a bulletin from the Xth International Congress of Virology in Jerusalem. Arch Virol 141:2251-2256

23. Pringle CR (1997) The order *Mononegavirales*—current status. Arch Virol 142:2321-2326

24. Pringle CR (2000) Order *Mononegavirales*. In: van Regenmortel MHV, Fauquet CM, Bishop DHL, Carstens EB, Estes MK, Lemon SM, Maniloff J, Mayo MA, McGeoch DJ, Pringle CR, Wickner RB (eds) Virus Taxonomy—Seventh Report of the International Committee on Taxonomy of Viruses. Academic Press, San Diego, California, USA, pp 525-530

25. Pringle CR (2005) Order *Mononegavirales*. In: Fauquet CM, Mayo MA, Maniloff J, Desselberger U, Ball LA (eds) Virus Taxonomy—Eighth Report of the International Committee on Taxonomy of Viruses. Elsevier/Academic Press, San Diego, California, USA, pp 609-614

26. Sharp CR, Nambulli S, Acciardo AS, Rennick LJ, Drexler JF, Rima BK, Williams T, Duprex WP (2016) Chronic infection of domestic cats with feline morbillivirus, United States. Emerg Infect Dis 22:760-762

27. Stenglein MD, Leavitt EB, Abramovitch MA, McGuire JA, DeRisi JL (2014) Genome sequence of a bornavirus recovered from an African garter snake (*Elapsoidea loveridgei*). Genome Announc 2:e00779-00714

28. Terregino C, Aldous EW, Heidari A, Fuller CM, De Nardi R, Manvell RJ, Beato MS, Shell WM, Monne I, Brown IH, Alexander DJ, Capua I (2013) Antigenic and genetic analyses of isolate APMV/wigeon/Italy/3920-1/2005 indicate that it represents a new avian paramyxovirus (APMV-12). Arch Virol 158:2233-2243

29. Van Regenmortel MH, Burke DS, Calisher CH, Dietzgen RG, Fauquet CM, Ghabrial SA, Jahrling PB, Johnson KM, Holbrook MR, Horzinek MC, Keil GM, Kuhn JH, Mahy BW, Martelli GP, Pringle C, Rybicki EP, Skern T, Tesh RB, Wahl-Jensen V, Walker PJ, Weaver SC (2010) A proposal to change existing virus species names to non-Latinized binomials. Arch Virol 155:1909-1919

30. Woo PC, Lau SK, Wong BH, Fan RY, Wong AY, Zhang AJ, Wu Y, Choi GK, Li KS, Hui J, Wang M, Zheng BJ, Chan KH, Yuen KY (2012) Feline morbillivirus, a previously undescribed paramyxovirus associated with tubulointerstitial nephritis in domestic cats. Proc Natl Acad Sci U S A 109:5435-5440

31. Wu Z, Yang L, Yang F, Ren X, Jiang J, Dong J, Sun L, Zhu Y, Zhou H, Jin Q (2014) Novel henipa-like virus, Mojiang paramyxovirus, in rats, China, 2012. Emerg Infect Dis 20:1064-1066