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

Code assigned:	*2017.012M*	(to be completed by ICTV officers)

Short title: Taxonomic expansion and reorganization of the order *Bunyavirales*

Modules attached
(Modules 1, 4 and either 2 or 3 are required.)

1 ☒ 2 ☒ 3 ☐ 4 ☒

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List the ICTV study group(s) that have seen this proposal:

A list of study groups and contacts is provided at http://www.ictvonline.org/subcommittees.asp . If in doubt, contact the appropriate subcommittee chair (there are six virus subcommittees: animal DNA and retroviruses, animal ssRNA-, animal ssRNA+, fungal and protist, plant, bacterial and archaeal)	**ICTV *Arenaviridae*, *Bunyaviridae*, *Emaravirus*, *Tenuivirus*, and *Tospovirus* Study Groups**

The ICTV *Arenaviridae*, *Bunyaviridae*, *Emaravirus*, *Tenuivirus*, and *Tospovirus* Study Groups and the additional authors of this TaxoProp have seen and discussed this proposal and agreed to its submission to the ICTV Executive Committee based on majority votes of support by individual Study Group members or the absence of (dissenting) votes.

ICTV Study Group comments (if any) and response of the proposer:

N/A

Date first submitted to ICTV: June 8, 2017
Date of this revision (if different to above):   August 11, 2017

ICTV-EC comments and response of the proposer:

EC49 decision:
      Uc: Add genome maps (or links); provide derivation of genus names; consider use of "-associated" in some species names.

Part 2: <u>**PROPOSED TAXONOMY**</u>

In 2016, the ICTV *Bunyaviridae*, *Emaravirus*, and *Tenuivirus* Study Groups have taken initial steps to taxonomically reorganize/reclassify bunyaviruses and bunya-like viruses using a global DEmARC analysis/Bayesian MCMC phylogeny (TaxoProp 2016.030a-vM "Create a new order, *Bunyavirales*, to accommodate nine families (eight new, one renamed) comprising thirteen genera)". This effort led to the official establishment of the order *Bunyavirales* by the ICTV/IUMS in March 2017 (Adams *et al*.).

Since the beginning of these efforts, numerous bunya-like viruses have been discovered in invertebrates (Li *et al*., Makhsous *et al*., Shi *et al*.). The majority of these viruses has not been isolated in tissue culture, nor is much information available about them other than complete, coding-complete, or fragmented genomic sequences. The ICTV recently decided that viruses are classifiable based on coding-complete/complete genomic sequences alone (Simmonds *et al*.).

Thus, we repeated the DEmARC/Bayesian MCMC analysis of 2016 with all those new viruses included for which complete or coding-complete alignable genome sequences have been deposited into GenBank (see accompanying Excel spreadsheet). Briefly, Bayesian phylogenetic analyses were inferred in BEAST 1.8.2 employing 20 independent MCMC runs with a chain length of 25,000,000 generations. Tree and log files of independent runs of BEAST were combined using LogCombiner 1.8.2, employing a Burn in period of 10%. The Markov chain Monte Carlo analyses were run until effective sample sizes above 200 were obtained. The consensus tree was built with TreeAnnotator 1.8.2 using the maximum clade credibility method and visualized in Figtree (http://tree.bio.ed.ac.uk/software/figtree/).

The results of this analysis are shown in Figures 1 and 2. They indicate that overall the taxonomic decisions of 2016 (establishment of the order and several new families, including emaraviruses and tenuiviruses) hold up. However, the resolution of the phylogeny increased significantly and several major taxonomic amendments are required:

- three monogeneric families (*Feraviridae*, *Jonviridae*, and *Tospoviridae*) need to be abandoned and their genera need to be moved into existing families
- three new families need to be established for highly divergent Chinese viruses
- the family *Arenaviridae* needs to be included in the order *Bunyavirales*
- 19 new genera need to be established

These results are also in line with analyses published by others (Gutteres *et al*., Li *et al*., Shi *et al*.) and are confirmed by a global RNA virus RdRp analysis (co-submitted proposal to establish a phylum for negative-sense RNA viruses).
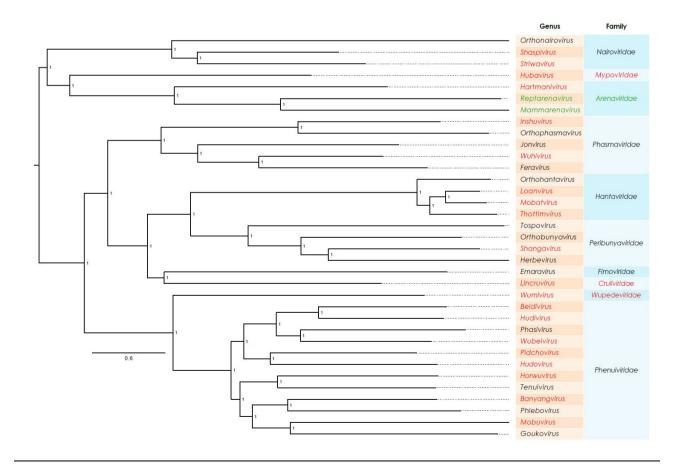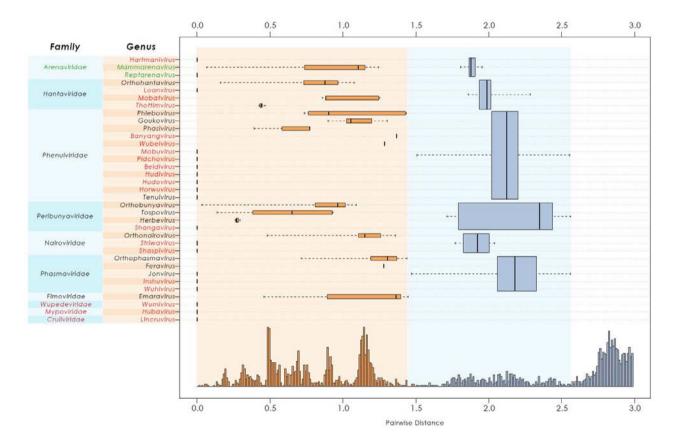
Figure 1. The figure shows a Bayesian MCMC tree estimated using a Bayesian Markov Chain Monte Carlo method implemented in BEAST, using the WAG amino acid model of amino acid substitutions. Maximum clade credibility trees were determined using TreeAnnotator with a burn-in of 10% of the sampled trees. The Markov chain Monte Carlo analyses were run until effective sample sizes above 200 were obtained. The dataset used consists of full length products of coding regions of the S, M, and L segments (nucleocapsid protein, glycoprotein precursor, and RNA-dependent RNA polymerase, respectively) or in the case of arenavirus S and L segments and concatenated in one multiple alignment. The dashed boxes show the proposed family delineation as calculated with DEmARC version 1.0. The DEmARC method is an approach for partitioning the genetic diversity of a virus family /genus within a hierarchically organized framework. The developed approach can provide quantitative support for both the delineated classification levels and the inferred taxa by objectively devising the number and values of thresholds on family genetic divergence at each level in a rational and family/genus-wide manner. Genetic divergence is quantified by pairwise evolutionary distances (PEDs) estimated by maximum likelihood inference on a multiple alignment of proteins. Numbers over each main node represents the Bayesian Posterior probabilities. The number below the bar (0.6) corresponds to the amino acid distance between sequences.

Figure 2: Intra-order genetic divergence in three-level hierarchical clustering of bunyaviruses by DEmARC (version 1.0). Levels are defined by the three strongest PED thresholds. The number of viruses in the identified clusters are shown in brackets. All identified clusters correspond to monophyletic groups. Box-and-whisker graphs were used to plot distributions of distances between viruses from the same genus (orange), and between viruses from different species but the same genus (blue), and between viruses from different genera but the same family (blue). The boxes span from the first to the third quartile and include the median (bold line), and the whiskers (dashed lines) extend to the extreme values. The corresponding part of the PED distribution is shown below.

Name of accompanying spreadsheet: 2017.012M.N.v1.Bunyavirales_rev

Please display the taxonomic changes you are proposing on the accompanying spreadsheet module 2017_TP_Template_Excel_module. Submit both this and the spreadsheet to the appropriate ICTV Subcommittee Chair.

Part 4: <u>APPENDIX</u>: supporting material

For genome maps of most viruses proposed to be classified here see Li *et al.* (https://elifesciences.org/articles/05378**) and Shi *et al*.**

Etymology of proposed genus and family names:

- *Banyangvirus*: *Banyang*: sigil of <u>B</u>h<u>an</u>ja virus and Huai<u>yang</u>shan virus; *virus*: suffix for a genus
- *Beidivirus*: *Beidi*: sigil of Hú<u>bě</u>i <u>di</u>ptera virus 3; *virus*: suffix for a genus
- *Cruliviridae*: *Cruli*: sigil of <u>Cru</u>stacean <u>li</u>ncruvirus; *viridae*: suffix for a family
- *Horwuvirus*: *Horwu*: sigil of <u>Wǔ</u>hàn <u>hor</u>sefly virus; *virus*: suffix for a genus
- *Hubavirus*: *Huba*: sigil of <u>Hú</u>bě<u>i</u> myriapod<u>a</u> virus 5; *virus*: suffix for a genus
- *Hudivirus*: *Hudi*: sigil of <u>Hú</u>bě<u>i</u> <u>di</u>ptera virus 4; *virus*: suffix for a genus
- *Hudovirus*: *Hudo*: sigil of <u>Hú</u>bě<u>i</u> lep<u>ido</u>ptera virus 1; *virus*: suffix for a genus
- *Inshuvirus*: *Inshu*: sigil of <u>Shu</u>āngào <u>in</u>sect virus 2; *virus*: suffix for a genus
- *Lincruvirus*: *Lincru*: sigil of *Wēn<u>lǐ</u>ng <u>cru</u>stacean virus 9*; *virus*: suffix for a genus
- *Loanvirus*: *Loan*: sigil of <u>Ló</u>ngqu<u>án</u>; *virus*: suffix for a genus
- *Mobatvirus*: *Mobat*: sigil of <u>mo</u>le and <u>bat</u>; *virus*: suffix for a genus
- *Mobuvirus*: *Mobu*: sigil of <u>Mo</u>thra virus and <u>bu</u>nyavirus; *virus*: suffix for a genus
- *Mypoviridae*: *Mypo*: sigil of Húbě<u>i</u> <u>my</u>riap<u>o</u>da virus 5; *viridae*: suffix for a family
- *Pidchovirus*: *Pidcho*: derived from Pidgey virus; *virus*: suffix for a genus
- *Shangavirus*: *Shanga*: sigil of <u>Shu</u>āngào insect virus 1; *virus*: suffix for a genus
- *Shaspivirus*: *Shaspi*: sigil of <u>Shā</u>yáng <u>spi</u>der virus 1; *virus*: suffix for a genus
- *Striwavirus*: *Striwa*: sigil of Sānxiá <u>wa</u>ter <u>stri</u>der virus 1; *virus*: suffix for a genus
- *Thottimvirus*: *Thottim*: derived from Thottopalayam; *virus*: suffix for a genus
- *Wubeivirus*: *Wubei*: sigil of <u>Wǔ</u>hàn fly virus 1 and Hú<u>bě</u>i diptera virus 5; *virus*: suffix for a genus
- *Wuhivirus*: *Wuhi*: sigil of <u>Wǔ</u>hàn <u>i</u>nsect virus 2; *virus*: suffix for a genus
- *Wumivirus*: *Wumi*: sigil of <u>Wǔ</u>hàn <u>mi</u>llipede virus 2; *virus*: suffix for a genus
- *Wupedeviridae*: *Wupede*: sigil of <u>Wǔ</u>hàn milli<u>pede</u> virus 2; *viridae*: suffix for a family

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CURRENT TAXONOMY / PROPOSED TAXONOMY

Order	Family	Subfamily	Genus	Species	Type Sp?	Exemplar Acc	Order	Family	Subfamily	Genus	Species	Type Sp?	Exemplar Acc	Exemplar virus name	Exemplar isolate	complete genome?	Abbrev	Proposed change	code	M
Unassigned	Arenaviridae						Bunyavirales	Arenaviridae										assign family to an order	2017.012M	M
							Bunyavirales	Cruliviridae										new family	2017.012M	M
							Bunyavirales	Cruliviridae		Lincruvirus								new genus	2017.012M	M
							Bunyavirales	Cruliviridae		Lincruvirus	Crustacean lincruvirus	1	L: KX884856	Wēnlíng crustacean vir	WLIQ10091	CCG	WlCV-9	new (type) species	2017.012M	M
							Bunyavirales	Hantaviridae		Loanvirus								new genus	2017.012M	M
Bunyavirales	Hantaviridae		Orthohantavirus	Longquan orthohantavirus	0	M:JX465402,S	Bunyavirales	Hantaviridae		Loanvirus	Longquan loanvirus	1	M:JX465402	Lóngquán virus	Longquan-	PG	LQUV	move species to be type species	2017.012M	M
							Bunyavirales	Hantaviridae		Mobatvirus								new genus	2017.012M	M
Bunyavirales	Hantaviridae		Orthohantavirus	Laibin orthohantavirus	0	L:KM102249,M	Bunyavirales	Hantaviridae		Mobatvirus	Laibin mobatvirus	0	L:KM102249	Láibīn virus	BT20	CG	LAIV	move species	2017.012M	M
Bunyavirales	Hantaviridae		Orthohantavirus	Nova orthohantavirus	0	L:KR072623,M	Bunyavirales	Hantaviridae		Mobatvirus	Nova mobatvirus	1	L:KR072623	Nova virus	3483 (Te34)	CG	NVAV	move species to be type species	2017.012M	M
Bunyavirales	Hantaviridae		Orthohantavirus	Quezon orthohantavirus	0	L:KU950715,M	Bunyavirales	Hantaviridae		Mobatvirus	Quezon mobatvirus	0	L:KU950715	Quezon virus	MT1720/16	CG	QZNV	move species	2017.012M	M
							Bunyavirales	Hantaviridae		Thottimvirus								new genus	2017.012M	M
Bunyavirales	Hantaviridae		Orthohantavirus	Imjin orthohantavirus	0	L:KJ420567,M	Bunyavirales	Hantaviridae		Thottimvirus	Imjin thottimvirus	0	L:KJ420567,	Imjin virus	Cixi-Cl-23	CG	MJNV	move species	2017.012M	M
Bunyavirales	Hantaviridae		Orthohantavirus	Thottapalayam orthohant	0	L: DQ825770,	Bunyavirales	Hantaviridae		Thottimvirus	Thottapalayam thottimvirus	1	L: DQ82577	Thottapalayam virus	VRC 66412	CG	TPMV	move species to be type species	2017.012M	M
							Bunyavirales	Mypoviridae										new family	2017.012M	M
							Bunyavirales	Mypoviridae		Hubavirus								new genus	2017.012M	M
							Bunyavirales	Mypoviridae		Hubavirus	Myriapod hubavirus	1	L: KX884759	Húběi myriapoda virus	GCM10499	CCG	HbMV-5	new (type) species	2017.012M	M
							Bunyavirales	Nairoviridae		Shaspivirus								new genus	2017.012M	M
							Bunyavirales	Nairoviridae		Shaspivirus	Spider shaspivirus	1	L: KM81767	Shāyáng spider virus 1	SYZZ-4	CCG	SySV-1	new (type) species	2017.012M	M
							Bunyavirales	Nairoviridae		Striwavirus								new genus	2017.012M	M
							Bunyavirales	Nairoviridae		Striwavirus	Strider striwavirus	1	L: KM81767	Sānxiá water strider vi	SXSSP08	CCG	SxWSV-1	new (type) species	2017.012M	M
							Bunyavirales	Peribunyaviridae		Shangavirus								new genus	2017.012M	M
Bunyavirales	Peribunyaviridae		Herbevirus	Shuangao insect herbevi	0	L:KM817679,M	Bunyavirales	Peribunyaviridae		Shangavirus	Insect shangavirus	1	L:KM81767	Shuāngáo insect virus	QSA02	CCG	SgIV-1	rename and move species to be	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus				Bunyavirales	Peribunyaviridae		Tospovirus								rename and move genus (and all	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Groundnut bud necrosis o	0	L: AF025538,	Bunyavirales	Peribunyaviridae		Tospovirus	Groundnut bud necrosis tosp	0	L: AF025538	groundnut bud necrosis virus			GBNV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Groundnut ringspot ortho	0	L: KT972590,	Bunyavirales	Peribunyaviridae		Tospovirus	Groundnut ringspot tospov	0	L: KT972590	groundnut ringspot vir	GRSV-AR	CCG	GRSV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Groundnut yellow spot or	0	S: HQ402596	Bunyavirales	Peribunyaviridae		Tospovirus	Groundnut yellow spot tosp	0	S: HQ40259	groundnut yellow spot virus		PG	GYSV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Impatiens necrotic spot o	0	L: X93218, M:	Bunyavirales	Peribunyaviridae		Tospovirus	Impatiens necrotic spot tosp	0	L: X93218,	impatiens necrotic spot virus		CG	INSV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Iris yellow spot orthotosp	0	L: FJ623474,	Bunyavirales	Peribunyaviridae		Tospovirus	Iris yellow spot tospovirus	0	L: FJ623474	iris yellow spot virus			IYSV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Polygonum ringspot ortho	0	L: KJ541746,	Bunyavirales	Peribunyaviridae		Tospovirus	Polygonum ringspot tospov	0	L: KJ541746	polygonum ringspot virus			PolRSV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Tomato chlorotic spot ort	0	L: HQ700667	Bunyavirales	Peribunyaviridae		Tospovirus	Tomato chlorotic spot tosp	0	L: HQ70066	tomato cholorotic spot virus			TCSV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Tomato spotted wilt orth	1	L: D10066, S:	Bunyavirales	Peribunyaviridae		Tospovirus	Tomato spotted wilt tospov	1	L: D10066,	tomato spotted wilt virus			TSWV	rename species	2017.012M	M
Bunyavirales	Bunyaviridae	Tospovirinae	Orthotospovirus	necros	0	L:	Bunyavirales	Peribunyaviridae		Tospovirus	Watermelon bud necrosis to	0	L: GU73540	watermelon bud necrosis virus			WBNV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Watermelon silver mottle	0	L: AF133128,	Bunyavirales	Peribunyaviridae		Tospovirus	Watermelon silver mottle to	0	L: AF133128	watermelon silver mottle virus			WSMoV	rename species	2017.012M	M
Bunyavirales	Tospoviridae		Orthotospovirus	Zucchini lethal chlorosis o	0	L:KU641378,	Bunyavirales	Peribunyaviridae		Tospovirus	Zucchini lethal chlorosis tosp	0	L:KU641378	zucchini lethal chloros	ZLCV-SP	CG	ZLC	rename species	2017.012M	M
Bunyavirales	Feraviridae		Orthoferavirus				Bunyavirales	Phasmaviridae		Feravirus								rename and move genus (and all	2017.012M	M
Bunyavirales	Feraviridae		Orthoferavirus	Ferak orthoferavirus	1	L:KP710246,M	Bunyavirales	Phasmaviridae		Feravirus	Ferak feravirus	1	L:KP710246	ferak virus	CS1- Cl-200	CG	FERV	rename species	2017.012M	M
							Bunyavirales	Phasmaviridae		Inshuvirus								new genus	2017.012M	M
Bunyavirales	Phasmaviridae		Orthophasmavirus	Shuangao insect orthoph	0	L:KM817680,	Bunyavirales	Phasmaviridae		Inshuvirus	Insect inshuvirus	1	L:KM81768	Shuāngáo insect virus	QSA03	CCG	SgIV-2	move species to be type species	2017.012M	M
Bunyavirales	Jonviridae		Orthojonvirus				Bunyavirales	Phasmaviridae		Jonvirus								rename and move genus	2017.012M	M
Bunyavirales	Jonviridae		Orthojonvirus	Jonchet orthojonvirus	1	L:KP710232,1	Bunyavirales	Phasmaviridae		Jonvirus	Jonchet jonvirus	1	L:KP710232	jonchet virus	B81-Cl-2004	CG	JONV	rename species	2017.012M	M
							Bunyavirales	Phasmaviridae		Wuhivirus								new genus	2017.012M	M
							Bunyavirales	Phasmaviridae		Wuhivirus	Insect wuhivirus	1	L: KM81769	Wǔhàn insect virus 2	WHDL02	CCG	WhIV-2	new (type) species	2017.012M	M
							Bunyavirales	Phenuiviridae		Banyangvirus								new genus	2017.012M	M
Bunyavirales	Phenuiviridae		Phlebovirus	SFTS phlebovirus	0	L: KT254588,	Bunyavirales	Phenuiviridae		Banyangvirus	Huaiyangshan banyangvirus	1	L: KT254588	severe fever with thro	HNXH	CG	SFTSV	move species to be type species	2017.012M	M
							Bunyavirales	Phenuiviridae		Beidivirus								new genus	2017.012M	M
							Bunyavirales	Phenuiviridae		Beidivirus	Dipteran beidivirus	1	L: KX884790	Húběi diptera virus 3	SCM17647	CCG	HbDV-3	new (type) species	2017.012M	M
							Bunyavirales	Phenuiviridae		Horwuvirus								new genus	2017.012M	M
							Bunyavirales	Phenuiviridae		Horwuvirus	Horsefly horwuvirus	1	L: KM81769	Wǔhàn horsefly virus	JJ2-1	CCG	WhHV	new (type) species	2017.012M	M
							Bunyavirales	Phenuiviridae		Hudivirus								new genus	2017.012M	M
							Bunyavirales	Phenuiviridae		Hudivirus	Dipteran hudivirus	1	L: KX884805	Húběi diptera virus 4	SCM94992	CCG	HbDV-4	new (type) species	2017.012M	M
							Bunyavirales	Phenuiviridae		Hudovirus								new genus	2017.012M	M
							Bunyavirales	Phenuiviridae		Hudovirus	Lepidopteran hudovirus	1	L: KX884771	Húběi lepidoptera viru	LCM141331	CCG	HbLV-1	new (type) species	2017.012M	M
							Bunyavirales	Phenuiviridae		Mobuvirus								new genus	2017.012M	M
							Bunyavirales	Phenuiviridae		Mobuvirus	Mothra mobuvirus	1	L: KX272883	Mothra virus	JG1	CCG	MTHV	new (type) species	2017.012M	M
							Bunyavirales	Phenuiviridae		Pidchovirus								new genus	2017.012M	M
							Bunyavirales	Phenuiviridae		Pidchovirus	Pidgey pidchovirus	1	L: KX852391	Pidgey virus	M6	CCG	PGVV	new (type) species	2017.012M	M
							Bunyavirales	Phenuiviridae		Wubeivirus								new genus	2017.012M	M
							Bunyavirales	Phenuiviridae		Wubeivirus	Dipteran wubeivirus	1	L: KX884795	Húběi diptera virus 5	SCM245062	CCG	HbDV-5	new (type) species	2017.012M	M
							Bunyavirales	Phenuiviridae		Wubeivirus	Fly wubeivirus	0	L: KM81768	Wǔhàn fly virus 1	SYY1-9	CCG	WhFV-1	new species	2017.012M	M
							Bunyavirales	Wupedeviridae										new family	2017.012M	M
							Bunyavirales	Wupedeviridae		Wumivirus								new genus	2017.012M	M
							Bunyavirales	Wupedeviridae		Wumivirus	Millipede wumivirus	1	L: KM81769	Wǔhàn millipede virus	WHWG03	CCG	WhMV-2	new (type) species	2017.012M	M
Bunyavirales	Tospoviridae																	abolish (empty) family	2017.012M	M
Bunyavirales	Feraviridae																	abolish (empty) family	2017.012M	M
Bunyavirales	Jonviridae																	abolish (empty) family	2017.012M	M