

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

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| **Code assigned:** | **2021.005D** |  |
| **Short title:** Create two new species in the genus *Gammanudivirus* (*Lefavirales*: *Nudiviridae*) | | |
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**List the ICTV Study Group(s) that have seen this proposal**

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| ICTV *Baculoviridae* and *Nudiviridae* Study Group |

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

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| This proposal was evaluated by the *Baculoviridae* and *Nudiviridae* study group. A few textual corrections were made and we were asked to provide (provisional) GenBank Accession Numbers for these two proposed species, which we have now done. |

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

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| **Is any taxon name used here derived from that of a living person (Y/N)** | N |

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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 | May 15, 2021 |
| Date of this revision (if different to above) | May 28, 2021 |

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

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**Part 2:** **NON-TAXONOMIC PROPOSAL**

Not relevant

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

**Name of accompanying Excel module**

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| 2021.005D.R.Nudiviridae\_2nsp.xlsx |

**Abstract**

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| Our data indicate that *Crangon crangon* nudivirusfrom brown shrimp (Crangonidae: *Crangon crangon* (Linnaeus, 1758)) and *Carcinus maenas* nudivirus from European shore crabs (Portunidae: *Carcinus maenas* (Linnaeus, 1758)) belong to novel viral species within the genus *Gammanudivirus*, family *Nudiviridae*. Using the new latinized binominal method for the naming of virus species, we propose to name these two species *Gammanudivirus* c*racrangoni* and *Gammanudivirus camaenasi.* |

**Text of proposal**

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| |  | | --- | | Here we propose the naming and classification of *Gammanudivirus* c*racrangoni* and *Gammanudivirus camaenasi* as two novel viral species within the genus *Gammanudivirus*, family *Nudiviridae* [1]. Common names of the viruses will beCrangon crangon nudivirus (CcNV) and Carcinus maenas nudivirus (CmNV). These viruses were initially described as Crangon crangon bacilliform virus (CcBV) [2, 3] and Carcinus maenas bacilliform virus (CmBV) [3]. Using histological, ultrastructural and genomic data we show that these should now be classified within the family *Nudiviridae.*  Viral replication for both these viruses occurs in the nuclei of hepatopancreatic epithelial cells. Nuclei of infected cells are enlarged with marginalized chromatin. However, significant differences exist between the isolates placed in these newly proposed nudivirus species. They are also clearly different from isolates belonging to other nudivirus species. These differences refer to ultrastructural characteristics (Figure 1), genome size (Figure 2) and gene content as highlighted below:  **Crangon crangon nudivirus (CcNV)**  The distinct properties associated with CcNV are the following:   1. Infects the brown shrimp, *Crangon crangon* 2. Rod-shaped nucleocapsids are enclosed in an envelope with characteristic expansion of the envelope at one end, enveloped virions measuring 280 nm by 71.8 nm [2]. 3. Large, circular dsDNA genome of about 132 kb and 105 open reading frames 4. G+C content of the genome 29.5% 5. The three thymidine kinase (*tk*) genes present in all other sequenced nudivirus genomes so far, are absent in CcNV 6. CcNV has 5 copies of the gene encoding homologs of the baculovirus ODV-E66 protein   **Carcinus maenas nudivirus (CmNV)**  The distinct properties associated with CmNV are the following:   1. Infects the European shore crab, *Carcinus maenas* 2. Rod-shaped nucleocapsids are enclosed in an envelope with characteristic expansion of the envelope at one end, some nucleocapsids appear as slightly bent and u-shaped within the envelopes, enveloped virions measuring 340 nm by 75 nm 3. Large, circular dsDNA genome of about 113 kb and 98 open reading frames 4. G+C content of the genome 38.8%   Genome size, number of ORFs and presence of conserved genes show that the two crustacean dsDNA viruses highlighted here belong to the family *Nudiviridae*. The position of these viruses in phylogenetic trees (Figure 3) indicate that each of these viruses belong to separate clades, are separated from other viruses by branch lengths longer than those that separate viruses of other established species in family *Nudiviridae* andare rather distinct from other viruses in these clades. Hence these two nudiviruses should be placed into two distinct species as proposed.  The genome sequences have been deposited to GenBank with provisional Accession Numbers, for CcNV (MZ311577) and CmNV (MZ311578). | |

**Supporting evidence**

**A close-up of some graffiti

Description automatically generated with low confidence**

**Figure 1.** A) Crangon crangon nudivirus (CcNV)-infected nuclei within hepatopancreas tubules. Infected nuclei (arrows) are enlarged with marginalized chromatin and contain an eosinophilic inclusion body. H&E stain. Scale bar = 50 µm. B) CcNV virions within an infected nucleus. Virions contain a rod shaped, electron dense nucleocapsid surrounded by a trilaminar envelope (inset, scale bar = 100 nm). Virions have been observed in cross section (black arrow) and longitudinal section (white arrow) within the nucleus. TEM. Scale bar = 1 µm. C) Carcinus maenas nudivirus (CmNV)-infected nuclei within hepatopancreas tubules. Infected nuclei (arrows) are enlarged with marginalized chromatin and contain an eosinophilic inclusion body. H&E stain. Scale bar = 50 µm. D) CmNV virions within an infected nucleus. Virions contain a rod shaped, electron dense nucleocapsid surrounded by a trilaminar envelope. Virions have been observed in cross section (black arrow) and longitudinal section (white arrow) within the nucleus. Some of the nucleocapsids appear curved (inset, scale bar = 100 nm) or u shaped (line arrow) within the envelope. TEM. Scale bar = 2 µm.

**Diagram, schematic

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B

A

**Figure 2.** Circular genomic maps of (A) Crangon crangon nudivirus (CcNV) and (B) Carcinus maenas nudivirus (CmNV) dsDNA. The outermost to innermost tracks represent: 1) predicted protein-coding genes and their orientation, 2) predicted protein-coding genes on the forward strand, 3) protein-coding genes on the reverse strand, 4) tandem repeat regions, 5) GC content and 6) GC skew, 7) genome coordinates.

***See next page for Figure 3***

**Chart, diagram, box and whisker chart

Description automatically generated**

*Alphanudivirus*

*Betanudivirus*

*Deltanudivirus*

*Gammanudivirus\**

**Figure 3.** Maximum likelihood phylogeny of concatenated sequence of 28 core genes (total alignment length 78,660 amino acids) of 15 nudiviruses, new viruses proposed here are underlined in red. Node labels indicate bootstrap support expressed as a percentage. CcNV = Crangon crangon nudivirus (MZ311577), CmNV = Carcinus maenas nudivirus (MZ311578), DhNV = Dikerogammarus haemobaphes nudivirus (MT488302.1), DiNV = Drosophila innubila nudivirus (NC\_040699.1), ENV = Esparto virus (NC\_040536.1), GbNV = Gryllus bimaculatus nudivirus (NC\_009240.1), HgNV = Homarus gammarus nudivirus (MK439999.1), HzNV-1 = Heliothis zea nudivirus 1 (AF451898.1), HzNV-2 = Heliothis zea nudivirus 2 (NC\_004156.2), KNV = Kallithea virus (NC\_033829.1), MNV = Mauternbach virus (MG969167), OrNV = Oryctes rhinoceros nudivirus (NC\_011588.1), PmNV = Penaeus monodon nudivirus (KJ184318), TNV = Tomelloso virus (NC\_040789.1), ToNV = Tipula oleracea nudivirus (NC\_026242.1).

\* DhNV is not yet classified belonging to a distinct species, but it seems to belong to the genus *Gammanudivirus.*

**References**

1. Bateman KS, Kerr R, Stentiford GD, Bean T, Hooper C, Van Eynde B, Bojko J, Christiaens O, Taning CNT, Smagghe G, van Oers MM, van Aerle R (In Prep) Identification and full characterisation of two novel crustacean infecting members of the family *Nudiviridae* provides support for two subfamilies. Viruses (*in preparation*)

2. Stentiford GD, Bateman K, Feist SW (2004) Pathology and ultrastructure of an intranuclear bacilliform virus (IBV) infecting brown shrimp *Crangon crangon* (Decapoda: Crangonidae). Diseases of Aquatic Organisms 58:89-97 PMID: 15109130 DOI: 10.3354/dao058089

3. Stentiford GD, Feist SW (2005) A histopathological survey of shore crab (Carcinus maenas) and brown shrimp (Crangon crangon) from six estuaries in the United Kingdom. Journal of Invertebrate Pathology 88:136-146. PMID: 15766930 DOI: 10.1016/j.jip.2005.01.006