

S2 Table. Basic information of all sequenced baculovirus genomes in GenBank*.

Genus	Virus	Strain/isolate	Abbreviation	Accession no.	Length (bp)	Orfs	<i>bro</i> s	G+C (%)	Refere nce
<i>Alphabaculovirus</i> (Group I)	<i>Antheraea pernyi</i> NPV	Liaoning	AnpeNPV	NC_008035	126629	147	2	53.5	[1]
	<i>Antheraea pernyi</i> NPV	Liaoning	AnprNPV	LC194889	126593	150	2	53.3	NP
	<i>Antherea yammamai</i> NPV	Nagano	AnyaNPV	LC375537	126270	152	2	53.3	NP
	<i>Anticarsia gemmatalis</i> NPV	AgMNPV-2D	AgMNPV	NC_008520	132239	158	7	44.5	[2]
	<i>Autographa californica</i> MNPV	C6	AcMNPV	NC_001623	133894	156	1	40.7	[3]
	<i>Bombyx mandarina</i> NPV	T3	BomaNPV	NC_012672	126770	141	3	40.2	[4]
	<i>Bombyx mori</i> NPV	T3	BmNPV	NC_001962	128413	143	5	40.4	[5]
	<i>Catopsilia Pomona</i> NPV	416	CapoNPV	KU565883	128058	131	1	39.7	[6]
	<i>Choristoneura fumiferana</i> DEF MNPV	-	CfDEFMNPV	NC_005137	131160	149	4	45.8	[7]
	<i>Choristoneura fumiferana</i> MNPV	-	CfMNPV	NC_004778	129593	146	1	50.1	[8]
	<i>Choristoneura murinana</i> NPV	Darmstadt	ChmuNPV	NC_023177	124688	147	1	50	[9]
	<i>Choristoneura occidentalis</i> NPV	BC1	ChocNPV	NC_021925	128446	148	2	50.1	[10]
	<i>Choristoneura rosaceana</i> NPV	NB_1	ChroNPV	NC_021924	129052	149	2	48.6	[10]
	<i>Condylorrhiza vestigialis</i> MNPV	-	CoveMNPV	NC_026430	125767	138	9	42.9	[11]
	<i>Cyclophragma undans</i> NPV	Whiov	CyunNPV	KT957089	142900	147	10	45	NP
	<i>Dasychira pudibunda</i> NPV	ML1	DapuNPV	KP747440	136761	161	3	54.4	[12]
	<i>Dendrolimus kikuchii</i> NPV	YN	DekiNPV	JX193905	141454	147	9	47.8	NP
	<i>Epiphyas postvittana</i> NPV	-	EppoNPV	NC_003083	118584	136	1	40.7	[13]
	<i>Hyphantria cunea</i> NPV	-	HycuNPV	NC_007767	132959	148	5	45.5	[14]
	<i>Lonomia obliqua</i> MNPV	SP/2000	LoobNPV	KP763670	120023	134	1	35.7	NP
	<i>Maruca vitrata</i> MNPV	-	MaviMNPV	NC_008725	111953	126	0	38.6	[15]
	<i>Neophasia</i> sp. alphabaculovirus	11	NespNPV	MK293724	129018	144	6	44.6	NP
	<i>Orgyia pseudotsugata</i> MNPV	-	OpMNPV	NC_001875	131995	152	0	55	[16]
	<i>Oxyplax ochracea</i> NPV	435	OxocNPV	MF143631	113971	124	0	31.1	[17]
	<i>Philosamia cynthia ricini</i> NPV	GX-1	PhcyNPV	JX404026	125376	138	2	53.7	[18]
	<i>Plutella xylostella</i> MNPV	C6	PlxyMNPV	NC_008349	134417	152	2	40.7	[19]
	<i>Rachiplusia ou</i> MNPV	C6	RoMNPV	NC_004323	131526	149	0	39.1	[20]
	<i>Samia Cynthia</i> NPV	Nagano	SacyNPV	LC375538	126094	152	2	53.3	NP
	<i>Samia ricini</i> nucleopolyhedrovirus	Guangxi	SariNPV	LC375541	125921	149	2	53.5	NP
	<i>Spilosoma obliqua</i> NPV	IIPR	SpobNPV	KY550224	136141	135	6	45.4	NP
	<i>Thysanoplusia orichalcea</i> NPV	P2	ThorNPV	NC_019945	132978	145	2	39.5	[21]

Alphabaculovirus (Group II and other alphabaculovirus)	Adoxophyes honmai NPV	ADN001	AdhoNPV	NC_004690	113220	125	4	35.6	[22]
	Adoxophyes orana NPV	English	AdorNPV	NC_011423	111724	121	3	35	[23]
	Agrotis ipsilon MNPV	Illinois	AgipMNPV	NC_011345	155122	163	5	48.6	[24]
	Agrotis segetum NPV	A	AgseNPV-A	NC_007921	147544	153	4	45.7	[25]
	Agrotis segetum NPV B	B	AgseNPV-B	NC_025960	148981	150	2	45.7	[26]
	Apocheima cinerarium NPV	-	ApciNPV	NC_018504	123876	118	1	45	NP
	Buzura suppressaria NPV	Hubei	BusuNPV	NC_023442	120420	127	3	36.8	[27]
	Chrysodeixis chalcites NPV	-	ChchNPV	NC_007151	149622	151	4	39	[28]
	Chrysodeixis includens NPV	IA	ChinNPV	KU669289	140808	142	3	39.2	[29]
	Clanis bilineata NPV	DZ1	ClbiNPV	NC_008293	135454	129	3	37.7	[30]
	Cryptophlebia peltastica NPV	SA	CrpeNPV	MH394321	115728	126	3	37.2	[31]
	Ectropis obliqua NPV	A1	EcobNPV	NC_008586	131204	126	2	37.6	[32]
	Artaxa digramma NPV	424	ArdiNPV	MN233792	161734	149	10	39.1	This paper
	Euproctis pseudoconsersa NPV	Hangzhou	EupsNPV	NC_012639	141291	139	2	40.3	[33]
	Helicoverpa armigeraSNPV AC53	AC53	HaSNPV-AC 53	NC_024688	130442	138	3	39.1	[34]
	Helicoverpa armigera MNPV	B	HearMNPV	NC_011615	154196	162	6	40.1	[35]
	Helicoverpa armigera NPV	C1	HearNPV	NC_003094	130759	137	3	38.9	[36]
	Helicoverpa armigera NPV G4	G4	HearNPV-G4	NC_002654	131405	135	3	39	[37]
	Helicoverpa armigera NPV NNg1	NNg1	HearNPV-NN g1	NC_011354	132425	143	4	39.2	[38]
	Helicoverpa assulta nucleopolyhedrovirus	HasNPV-DJ00 31	HeasNPV	MG569706	129801	128	2	38.8	NP
	Helicoverpa zea SNPV	-	HzSNPV	NC_003349	130869	139	3	39.1	[39]
	Hemileuca sp. NPV	-	HespNPV	NC_021923	140633	137	2	38.1	[40]
	Hyposidra talaca NPV	HytaNPVIndia 001	HytaNPV	MH261376	139089	141	4	39.6	[41]
	Lambdina fiscellaria NPV	GR15	LafiNPV	NC_026922	157977	137	0	43.7	[42]
	Leucania separata NPV	AH1	LeseNPV	NC_008348	168041	169	10	48.6	[43]
	Lymantria dispar MNPV	-	LdMNPV	NC_001973	161046	164	16	57.5	[44]
	Lymantria xyliina MNPV	LyxyMNPV-5	LyxyMNPV	NC_013953	156344	157	14	53.5	[45]
	Malacosoma Neustria NPV	ManeNPV-T2	ManeNPV	NC_040606	130202	131	2	38.2	[46]
	Mamestra brassicae MNPV	K1	MabrMNPV	NC_023681	152710	159	6	39.9	[47]
	Mamestra configurata NPV-A	A	MacoNPV-A	NC_003529	155060	169	8	41.7	[48]
	Mamestra configurata NPV-B	B	MacoNPV-B	NC_004117	158482	168	7	40	[49]
	Mythimna unipuncta NPV	#7	MyunNPV	MF375894	148482	159	7	48.58	[50]

	Orgyia leucostigma NPV	CFS-77	OrleNPV	NC_010276	156179	135	5	39.9	[51]
	Operophtera brumata nucleopolyhedrovirus	OpbuNPV-M A	OpbuNPV	NC_040621	119054	130	2	39.8	[52]
	Peridroma NPV	GR_167	PespNPV	NC_024625	151109	139	6	53.2	[53]
	Perigonia lusca single NPV	-	PeluSNPV	NC_027923	132831	145	1	40	[54]
	Pseudoplusia includens SNPV	IE	PsinSNPV	NC_026268	139132	141	2	39.3	[55]
	Spodoptera exigua MNPV	-	SeMNPV	NC_002169	135611	139	0	43.8	[56]
	Spodoptera frugiperda MNPV virus	3AP2	SfMNPV	NC_009011	131331	143	1	40.2	[57]
	Spodoptera eridania NPV	251	SperNPV	MH320559	149090	146	2	45	NP
	Spodoptera exempta NPV	244.1	SpexNPV	MH717816	129528	139	3	41.2	NP
	Spodoptera littoralis MNPV	AN1956	SpliNPV	JX454574	137998	132	1	44.7	[58]
	Spodoptera litura NPV	G2	SpltNPV	NC_003102	139342	141	2	42.8	[59]
	Spodoptera litura NPV II	II	SpltNPV-II	NC_011616	148634	147	2	45	NP
	Sucra jujuba NPV	473	SujuNPV	KJ676450	135952	131	4	38.7	[60]
	Trichoplusia ni SNPV	-	TnSNPV	NC_007383	134394	145	2	39	[61]
	Urbanus proteus NPV	Southern Brazil	UrprNPV	NC_029997	105555	119	7	34.7	NP
Betabaculovirus	Adoxophyes orana GV	-	AdorGV	NC_005038	99657	119	0	34.5	[62]
	Agrotis segetum GV	China: Urumuqi, Xinjiang	AgseGV	NC_005839	131680	132	0	37.3	NP
	Choristoneura occidentalis GV	-	ChocGV	NC_008168	104710	116	0	32.7	[63]
	Clostera anachoreta GV	ClanGV-HBH N	ClanGV	NC_015398	101487	123	0	44.4	[64]
	Clostera anastomosis GV	HENAN	ClasGV-A	NC_022646	101818	122	0	46.7	[65]
	Clostera anastomosis GV-B	ClasGV-B	ClasGV-B	KR091910	107439	123	0	37.8	[66]
	Cnaphalocrocis medinalis GV	-	CnmeGV	KP658210	112060	101	2	35.2	[67]
	Cydia pomonella GV	Mexican 1	CpGV	NC_002816	123500	143	1	45.3	[68]
	Cryptophlebia leucotreta GV	CV3	CrleGV	NC_005068	110907	128	0	32.4	[69]
	Diatraea saccharalis GV	Parana-2009	DisaGV	NC_028491	98392	125	0	35	[70]
	Epinotia aporema GV	-	EpapGV	NC_018875	119082	132	0	41.5	[71]
	Erinnyis ello GV	S86	ErelGV	NC_025257	102759	130	0	38.7	[72]
	Helicoverpa armigera GV	-	HearGV	NC_010240	169794	179	10	40.8	[73]
	Hyphantria cunea GV	Hc1	HycuGV	MH923363	114825	132	2	39.3	NP
	Mocis latipes GV	Southern Brazil	MolaGV	KR011718	134272	145	2	38.1	NP
	Mythimna unipuncta GV	MyunGV#8	MyunGV	NC_033780	144673	153	5	49.9	[74]
	Phthorimaea operculella GV	-	PhopGV	NC_004062	119217	130	1	35.7	[75]

	Plutella xylostella GV	K1	PlxyGV	NC_002593	100999	120	0	40.7	[76]
	Plodia interpunctella GV	Cambridge	PlinGV	NC_032255	112536	123	0	44.1	NP
	Pieris rapae GV	Wuhan	PrGV	NC_013797	108592	120	0	33.2	[77]
	Pseudaletia unipuncta GV	Hawaiiin	PsunGV	NC_013772	176677	183	11	39.8	NP
	Spodoptera frugiperda GV	VG008	SpfrGV	NC_026511	140913	146	7	46.2	[78]
	Spodoptera litura GV	SIGV-K1	SpliGV	NC_009503	124121	136	6	38.8	[79]
	Trichoplusia ni GV	LBIV-12	TmiGV	KU752557	175360	172	11	39.7	NP
	Xestia c-nigrum GV	-	XcGV	NC_002331	178733	181	7	40.7	[80]
<i>Gammabaculovirus</i>	Neodiprion abietis NPV	-	NeabNPV	NC_008252	84264	93	0	33.4	[81]
	Neodiprion lecontei NPV	-	NeleNPV	NC_005906	81755	89	0	33.3	[82]
	Neodiprion sertifer NPV	-	NeseNPV	NC_005905	86462	90	0	33.8	[83]
<i>Deltabaculovirus</i>	Culex nigripalpus NPV	Florida1997	CuniNPV	NC_003084	108252	109	5	50.9	[84]

*Updated by Aug 21th, 2019. NP: Unpublished.

Reference

1. Nie, Z.M.; Zhang, Z.F.; Wang, D.; He, P.A.; Jiang, C.Y.; Song, L.; Chen, F.; Xu, J.; Yang, L.; Yu, L.L., et al. Complete sequence and organization of *Antheraea pernyi* nucleopolyhedrovirus, a dr-rich baculovirus. *BMC Genomics* **2007**, *8*, 248-252, doi:10.1186/1471-2164-8-248.
2. Oliveira, J.V.d.C.; Wolff, J.L.C.; Garcia-Maruniak, A.; Ribeiro, B.M.; de Castro, M.E.B.; de Souza, M.L.; Moscardi, F.; Maruniak, J.E.; Zanotto, P.M.d.A. Genome of the most widely used viral biopesticide: *Anticarsia gemmatalis* multiple nucleopolyhedrovirus. *J. Gen. Virol.* **2006**, *87*, 3233-3250, doi:10.1099/vir.0.82161-0.
3. Ayres MD, H.S., Kuzio J, Lopez-Ferber M, Possee RD. The complete DNA sequence of *Autographa californica* nuclear polyhedrosis virus. *Virology* **1994**, *202*, 586-605.
4. Xu, Y.P.; Ye, Z.P.; Niu, C.Y.; Bao, Y.Y.; Wang, W.B.; Shen, W.D.; Zhang, C.X. Comparative analysis of the genomes of *Bombyx mandarina* and *Bombyx mori* nucleopolyhedroviruses. *J. Microbiol.* **2010**, *48*, 102-110, doi:10.1007/s12275-009-0197-4.
5. Gomi S, M.K., Maeda S. Sequence analysis of the genome of *Bombyx mori* nucleopolyhedrovirus. *J. Gen. Virol.* **1999**, *80*, 1323-1337.
6. Wang, J.; Zhu, Z.; Zhang, L.; Hou, D.; Wang, M.; Arif, B.; Kou, Z.; Wang, H.; Deng, F.; Hu, Z. Genome sequencing and analysis of *Catopsilia pomona* nucleopolyhedrovirus: A distinct Species in Group I Alphabaculovirus. *PLoS One* **2016**, *11*, e0155134, doi:10.1371/journal.pone.0155134.
7. Lauzon, H.A.; Jamieson, P.B.; Krell, P.J.; Arif, B.M. Gene organization and sequencing of the *Choristoneura fumiferana* defective nucleopolyhedrovirus genome. *J. Gen. Virol.* **2005**, *86*, 945-961, doi:10.1099/vir.0.80489-0.
8. de Jong, J.G.; Lauzon, H.A.; Dominy, C.; Poloumienko, A.; Carstens, E.B.; Arif, B.M.; Krell, P.J. Analysis of the *Choristoneura fumiferana* nucleopolyhedrovirus genome. *J. Gen. Virol.* **2005**, *86*, 929-943, doi:10.1099/vir.0.80490-0.
9. Rohrmann, G.F.; Erlandson, M.A.; Theilmann, D.A. Genome Sequence of an Alphabaculovirus Isolated from *Choristoneura murinana*. *Genome Announc* **2014**, *2*, e01135-01113, doi:10.1128/genomeA.01135-13.
10. Thumbi, D.K.; Beliveau, C.; Cusson, M.; Lapointe, R.; Lucarotti, C.J. Comparative genome sequence analysis of *Choristoneura occidentalis* Freeman and *C. rosaceana* Harris (Lepidoptera: Tortricidae) alphabaculoviruses. *PLoS One* **2013**, *8*, e68968,

doi:10.1371/journal.pone.0068968.

11. Castro, M.E.; Ribeiro, Z.M.; Santos, A.C.; Souza, M.L.; Machado, E.B.; Sousa, N.J.; Moscardi, F. Identification of a new nucleopolyhedrovirus from naturally-infected *Condylorrhiza vestigialis* (Guenée) (Lepidoptera: Crambidae) larvae on poplar plantations in South Brazil. *J. Invertebr. Pathol.* **2009**, *102*, 149-154, doi:10.1016/j.jip.2009.07.011.
12. Krejmer, M.; Skrzecz, I.; Wasag, B.; Szewczyk, B.; Rabalski, L. The genome of *Dasychira pudibunda* nucleopolyhedrovirus (DapuNPV) reveals novel genetic connection between baculoviruses infecting moths of the *Lymantriidae* family. *BMC Genomics* **2015**, *16*, 759-772, doi:10.1186/s12864-015-1963-9.
13. Hyink O, D.R., Olsen MJ, Caradoc-Davies KMB, Drake K, Herniou EA, et al. . Whole genome analysis of the *Epiphyas postvittana* nucleopolyhedrovirus. *J. Gen. Virol.* **2002**, *83*, 957-971, doi:10.1099/0022-1317-83-4-957.
14. Ikeda, M.; Shikata, M.; Shirata, N.; Chaeychomsri, S.; Kobayashi, M. Gene organization and complete sequence of the *Hyphantria cunea* nucleopolyhedrovirus genome. *J. Gen. Virol.* **2006**, *87*, 2549-2562, doi:10.1099/vir.0.81930-0.
15. Chen, Y.R.; Wu, C.Y.; Lee, S.T.; Wu, Y.J.; Lo, C.F.; Tsai, M.F.; Wang, C.H. Genomic and host range studies of *Maruca vitrata* nucleopolyhedrovirus. *J. Gen. Virol.* **2008**, *89*, 2315-2330, doi:10.1099/vir.0.2008/001412-0.
16. Ahrens CH, R.R., Funk CJ, Evans JT, Harwood SH, Rohrmann GF. The sequence of the *Orgyia pseudotsugata* multinucleocapsid nuclear polyhedrosis virus genome. *Virology* **1997**, *229*, 381-399.
17. Wang, J.; Hou, D.; Wang, Q.; Kuang, W.; Zhang, L.; Li, J.; Shen, S.; Deng, F.; Wang, H.; Hu, Z., et al. Genome analysis of a novel Group I alphabaculovirus obtained from *Oxyplax ochracea*. *PLoS One* **2018**, *13*, e0192279, doi:10.1371/journal.pone.0192279.
18. Qian H, Z.Y., Wu Y, Sun P, Zhu S, et al. Analysis of the genomic sequence of *Philosamia cynthia* nucleopolyhedrin virus and comparison with *Antheraea pernyi* nucleopolyhedrin virus. *BMC Genomics* **2013**, *14*, 115-121.
19. Harrison, R.L.; Lynn, D.E. Genomic sequence analysis of a nucleopolyhedrovirus isolated from the diamondback moth, *Plutella xylostella*. *Virus Genes* **2007**, *35*, 857-873, doi:10.1007/s11262-007-0136-6.
20. Harrison, R.L.; Bonning, B.C. Comparative analysis of the genomes of *Rachiplusia ou* and *Autographa californica* multiple nucleopolyhedroviruses. *J. Gen. Virol.* **2003**, *84*, 1827-1842,

doi:10.1099/vir.0.19146-0.

21. Wang, Y.S.; Huang, G.H.; Cheng, X.H.; Wang, X.; Garretson, T.A.; Dai, L.Y.; Zhang, C.X.; Cheng, X.W. Genome of *Thysanoplusia orichalcea* multiple nucleopolyhedrovirus lacks the superoxide dismutase gene. *J. Virol.* **2012**, *86*, 11948-11949, doi:10.1128/JVI.02119-12.
22. Nakai, M. Genome sequence and organization of a nucleopolyhedrovirus isolated from the smaller tea tortrix, *Adoxophyes honmai*. *Virology* **2003**, 10.1016/s0042-6822(03)00599-3, 171-183, doi:10.1016/s0042-6822(03)00599-3.
23. Hilton, S.; Winstanley, D. Genomic sequence and biological characterization of a nucleopolyhedrovirus isolated from the summer fruit tortrix, *Adoxophyes orana*. *J. Gen. Virol.* **2008**, *89*, 2898-2908, doi:10.1099/vir.0.2008/002881-0.
24. Harrison, R.L. Genomic sequence analysis of the Illinois strain of the *Agrotis ipsilon* multiple nucleopolyhedrovirus. *Virus Genes* **2009**, *38*, 155-170, doi:10.1007/s11262-008-0297-y.
25. Jakubowska, A.K.; Peters, S.A.; Ziemnicka, J.; Vlak, J.M.; van Oers, M.M. Genome sequence of an enhancin gene-rich nucleopolyhedrovirus (NPV) from *Agrotis segetum*: collinearity with *Spodoptera exigua* multiple NPV. *J. Gen. Virol.* **2006**, *87*, 537-551, doi:10.1099/vir.0.81461-0.
26. Wennmann, J.T.; Gueli Alletti, G.; Jehle, J.A. The genome sequence of *Agrotis segetum* nucleopolyhedrovirus B (AgseNPV-B) reveals a new baculovirus species within the *Agrotis* baculovirus complex. *Virus Genes* **2015**, *50*, 260-276, doi:10.1007/s11262-014-1148-7.
27. Zhu, Z.; Yin, F.; Liu, X.; Hou, D.; Wang, J.; Zhang, L.; Arif, B.; Wang, H.; Deng, F.; Hu, Z. Genome sequence and analysis of *Buzura suppressaria* nucleopolyhedrovirus: a group II Alphabaculovirus. *PLoS One* **2014**, *9*, e86450, doi:10.1371/journal.pone.0086450.
28. van Oers, M.M.; Abma-Henkens, M.H.; Herniou, E.A.; de Groot, J.C.; Peters, S.; Vlak, J.M. Genome sequence of *Chrysodeixis chalcites* nucleopolyhedrovirus, a baculovirus with two DNA photolyase genes. *J. Gen. Virol.* **2005**, *86*, 2069-2080, doi:10.1099/vir.0.80964-0.
29. Craveiro, S.R.; Santos, L.A.; Togawa, R.C.; Inglis, P.W.; Grynberg, P.; Ribeiro, Z.M.; Ribeiro, B.M.; Castro, M.E. Complete genome sequences of six *Chrysodeixis includens* nucleopolyhedrovirus isolates from Brazil and Guatemala. *Genome Announc* **2016**, *4*, e01192-01116, doi:10.1128/genomeA.01192-16.
30. Zhu, S.Y.; Yi, J.P.; Shen, W.D.; Wang, L.Q.; He, H.G.; Wang, Y.; Li, B.; Wang, W.B. Genomic sequence, organization and characteristics of a new nucleopolyhedrovirus isolated from *Clanis bilineata* larva. *BMC Genomics* **2009**, *10*, 91-100, doi:10.1186/1471-2164-10-91.

31. Marsberg, T.; Jukes, M.D.; Krejmer-Rabalska, M.; Rabalski, L.; Knox, C.M.; Moore, S.D.; Hill, M.P.; Szewczyk, B. Morphological, genetic and biological characterisation of a novel alphabaculovirus isolated from *Cryptophlebia peltastica* (Lepidoptera: Tortricidae). *J. Invertebr. Pathol.* **2018**, *157*, 90-99, doi:10.1016/j.jip.2018.08.006.
32. Ma, X.-C.; Shang, J.-Y.; Yang, Z.-N.; Bao, Y.-Y.; Xiao, Q.; Zhang, C.-X. Genome sequence and organization of a nucleopolyhedrovirus that infects the tea looper caterpillar, *Ectropis obliqua*. *Virology* **2007**, *360*, 235-246, doi:10.1016/j.virol.2006.10.024.
33. Tang, X.-D.; Xiao, Q.; Ma, X.-C.; Zhu, Z.-R.; Zhang, C.-X. Morphology and genome of *Euproctis pseudoconspersa* nucleopolyhedrovirus. *Virus Genes* **2009**, *38*, 495-506, doi:10.1007/s11262-009-0355-0.
34. Nouné, C.; Hauxwell, C. Complete Genome Sequences of *Helicoverpa armigera* single nucleopolyhedrovirus Strains AC53 and H25EA1 from Australia. *Genome Announc* **2015**, *3*, e01083-01015, doi:10.1128/genomeA.01083-15.
35. Tang P, Z.H., Li Y, Han B, Wang G, Qin Q, et al. Genomic sequencing and analyses of HearMNPV--a new Multinucleocapsid nucleopolyhedrovirus isolated from *Helicoverpa armigera*. *Virology journal* **2012**, *9*, doi:10.1186/1743-422X-9-168.
36. Chen X, W.I., Tarchini R, Sun X, Sandbrink H, et al. The sequence of the *Helicoverpa armigera* single nucleocapsid nucleopolyhedrovirus genome. *J. Gen. Virol.* **2001**, *82*, 241-257.
37. Zhang, C.X.; Ma, X.C.; Guo, Z.J. Comparison of the complete genome sequence between C1 and G4 isolates of the *Helicoverpa armigera* single nucleocapsid nucleopolyhedrovirus. *Virology* **2005**, *333*, 190-199, doi:10.1016/j.virol.2004.12.028.
38. Ogembo JG, C.B., Shikata M, Chaeychomsri S, Kobayashi M, et al. Comparative genomic sequence analysis of novel *Helicoverpa armigera* nucleopolyhedrovirus (NPV) isolated from Kenya and three other previously sequenced *Helicoverpa* spp. NPVs. *Virus Genes* **2009**, *39*, 261-272, doi:10.1007/s11262-009-0389-3).
39. Chen X, Z.W., Wong J, Chun G, Lu A, et al. Comparative analysis of the complete genome sequences of *Helicoverpa zea* and *Helicoverpa armigera* single-nucleocapsid nucleopolyhedroviruses. *J. Gen. Virol.* **2002**, *83*, 673-684.
40. Rohrmann, G.F.; Erlandson, M.A.; Theilmann, D.A. The genome of a baculovirus isolated from *Hemileuca* sp. encodes a serpin ortholog. *Virus Genes* **2013**, *47*, 357-364, doi:10.1007/s11262-013-0951-x.
41. Nguyen, T.T.; Suryamohan, K.; Kuriakose, B.; Janakiraman, V.; Reichelt, M.; Chaudhuri, S.;

- Guillory, J.; Divakaran, N.; Rabins, P.E.; Goel, R., et al. Comprehensive analysis of single molecule sequencing-derived complete genome and whole transcriptome of *Hyposidra talaca* nuclear polyhedrosis virus. *Sci. Rep.* **2018**, *8*, 8924-8935, doi:10.1038/s41598-018-27084-y.
42. Rohrmann, G.F.; Erlandson, M.A.; Theilmann, D.A. Genome Sequence of an Alphabaculovirus Isolated from the Oak Looper, *Lambdina fiscellaria*, Contains a Putative 2-Kilobase-Pair Transposable Element Encoding a Transposase and a FLYWCH Domain-Containing Protein. *Genome Announc* **2015**, *3*, e00186-00115, doi:10.1128/genomeA.00186-15.
 43. Xiao, H.; Qi, Y. Genome sequence of *Leucania seperata* nucleopolyhedrovirus. *Virus Genes* **2007**, *35*, 845-856, doi:10.1007/s11262-007-0106-z.
 44. Kuzio J, P.M., Harwood SH, Funk CJ, Evans JT, et al. Sequence and analysis of the genome of a baculovirus pathogenic for *Lymantria dispar*. *Virology* **1999**, *253*, 17-34.
 45. Nai, Y.S.; Wu, C.Y.; Wang, T.C.; Chen, Y.R.; Lau, W.H.; Lo, C.F.; Tsai, M.F.; Wang, C.H. Genomic sequencing and analyses of *Lymantria xylin*a multiple nucleopolyhedrovirus. *BMC Genomics* **2010**, *11*, 116-130, doi:10.1186/1471-2164-11-116.
 46. Gencer, D.; Nalcacioglu, R.; Demirbag, Z.; Demir, I. Complete genome sequence analysis of the *Malacosoma neustria* nucleopolyhedrovirus from Turkey. *Virus Genes* **2018**, *54*, 706-718, doi:10.1007/s11262-018-1595-7.
 47. Choi, J.B.; Heo, W.I.; Shin, T.Y.; Bae, S.M.; Kim, W.J.; Kim, J.I.; Kwon, M.; Choi, J.Y.; Je, Y.H.; Jin, B.R., et al. Complete genomic sequences and comparative analysis of *Mamestra brassicae* nucleopolyhedrovirus isolated in Korea. *Virus Genes* **2013**, *47*, 133-151, doi:10.1007/s11262-013-0922-2.
 48. Li, Q.; Donly, C.; Li, L.; Willis, L.G.; Theilmann, D.A.; Erlandson, M. Sequence and organization of the *Mamestra configurata* nucleopolyhedrovirus genome. *Virology* **2002**, *294*, 106-121, doi:10.1006/viro.2001.1313.
 49. Li, L.; Li, Q.; Willis, L.G.; Erlandson, M.; Theilmann, D.A.; Donly, C. Complete comparative genomic analysis of two field isolates of *Mamestra configurata* nucleopolyhedrovirus-A. *J. Gen. Virol.* **2005**, *86*, 91-105, doi:10.1099/vir.0.80488-0.
 50. Harrison, R.L.; Mowery, J.D.; Rowley, D.L.; Bauchan, G.R.; Theilmann, D.A.; Rohrmann, G.F.; Erlandson, M.A. The complete genome sequence of a third distinct baculovirus isolated from the true armyworm, *Mythimna unipuncta*, contains two copies of the *lef-7* gene. *Virus Genes* **2017**, *54*, 297-310, doi:10.1007/s11262-017-1525-0.

51. Thumbi, D.K.; Eveleigh, R.J.; Lucarotti, C.J.; Lapointe, R.; Graham, R.I.; Pavlik, L.; Lauzon, H.A.; Arif, B.M. Complete sequence, analysis and organization of the *Orgyia leucostigma* nucleopolyhedrovirus genome. *Viruses* **2011**, *3*, 2301-2327, doi:10.3390/v3112301.
52. Harrison RL; Rowley DL; Mowery JD; Bauchan GR; Burand JP. The Operophtera brumata Nucleopolyhedrovirus (OpbuNPV) Represents an Early, Divergent Lineage within Genus Alphabaculovirus. *Viruses* **2017**, *9*(10):307, doi:10.3390/v9100307
53. Rohrmann, G.F.; Erlandson, M.A.; Theilmann, D.A. A Distinct Group II Alphabaculovirus Isolated from a *Peridroma* Species. *Genome Announc* **2015**, *3*, e00185-00115, doi:10.1128/genomeA.00185-15.
54. Ardisson-Araujo, D.M.; Lima, R.N.; Melo, F.L.; Clem, R.J.; Huang, N.; Bao, S.N.; Sosa-Gomez, D.R.; Ribeiro, B.M. Genome sequence of *Perigonia lusca* single nucleopolyhedrovirus: insights into the evolution of a nucleotide metabolism enzyme in the family baculoviridae. *Sci. Rep.* **2016**, *6*, 24612-24626, doi:10.1038/srep24612.
55. Craveiro, S.R.; Inglis, P.W.; Togawa, R.C.; Grynberg, P.; Melo, F.L.; Ribeiro, Z.M.; Ribeiro, B.M.; Bao, S.N.; Castro, M.E. The genome sequence of *Pseudoplusia includens* single nucleopolyhedrovirus and an analysis of p26 gene evolution in the baculoviruses. *BMC Genomics* **2015**, *16*, 127, doi:10.1186/s12864-015-1323-9.
56. WF II, v.S.E., Heldens JG, Broer R, Zuidema D, et al. Sequence and organization of the *Spodoptera exigua* multicapsid nucleopolyhedrovirus genome. *J. Gen. Virol.* **1999**, *80*, 3289-3304.
57. Harrison, R.L.; Puttler, B.; Popham, H.J. Genomic sequence analysis of a fast-killing isolate of *Spodoptera frugiperda* multiple nucleopolyhedrovirus. *J. Gen. Virol.* **2008**, *89*, 775-790, doi:10.1099/vir.0.83566-0.
58. Jonathan E. B., El-Sayed A. E., Robert L. Harrison, Daniel L. Rowley, Michael E. S., Dawn E. Gundersen-Rindal, Holly J.R. Popham. Determination and analysis of the genome sequence of *Spodoptera littoralis* multiple nucleopolyhedrovirus. *Virus. Research.* **2013**, *171*,1, 194-208.
59. Pang, Y.; Yu, J.; Wang, L.; Hu, X.; Bao, W.; Li, G.; Chen, C.; Han, H.; Hu, S.; Yang, H. Sequence analysis of the *Spodoptera litura* multicapsid nucleopolyhedrovirus genome. *Virology* **2001**, *287*, 391-404, doi:10.1006/viro.2001.1056.
60. Liu, X.; Yin, F.; Zhu, Z.; Hou, D.; Wang, J.; Zhang, L.; Wang, M.; Wang, H.; Hu, Z.; Deng, F. Genomic sequencing and analysis of *Sucra jujuba* nucleopolyhedrovirus. *PLoS One* **2014**, *9*,

e110023, doi:10.1371/journal.pone.0110023.

61. Willis, L.G.; Seipp, R.; Stewart, T.M.; Erlandson, M.A.; Theilmann, D.A. Sequence analysis of the complete genome of Trichoplusia ni single nucleopolyhedrovirus and the identification of a baculoviral photolyase gene. *Virology* **2005**, *338*, 209-226, doi:10.1016/j.virol.2005.04.041.
62. Wormleaton, S.; Kuzio, J.; Winstanley, D. The complete sequence of the Adoxophyes orana granulovirus genome. *Virology* **2003**, *311*, 350-365, doi:10.1016/s0042-6822(03)00149-1.
63. Escasa, S.R.; M., L.H.A.; Mathur, A.C.; Krell, P.J.; Arif, B. Sequence analysis of the Choristoneura occidentalis granulovirus genome. *J. Gen. Virol.* **2006**, *87*, 1917-1933, doi:10.1099/vir.0.81792-0.
64. Liang, Z.; Zhang, X.; Yin, X.; Cao, S.; Xu, F. Genomic sequencing and analysis of Clostera anachoreta granulovirus. *Arch. Virol.* **2011**, *156*, 1185-1198, doi:10.1007/s00705-011-0977-0.
65. Liang, Z.; Zhang, X.; Yin, X.; Song, X.; Shao, X.; Wang, L.. Comparative analysis of the genomes of Clostera anastomosis (L.) granulovirus and Clostera anachoreta granulovirus. *Archives of Virology* **2013**, *158*, 2109-2114, doi:10.1007/s00705-013-1710-y.
66. Yin, F.; Zhu, Z.; Liu, X.; Hou, D.; Wang, J.; Zhang, L.; Wang, M.; Kou, Z.; Wang, H.; Deng, F., et al. The Complete Genome of a new betabaculovirus from Clostera anastomosis. *PLoS One* **2015**, *10*, e0132792, doi:10.1371/journal.pone.0132792.
67. Han, G.; Xu, J.; Liu, Q.; Li, C.; Xu, H.; Lu, Z. Genome of Cnaphalocrocis medinalis Granulovirus, the first Crambidae-Infecting betabaculovirus isolated from Rice Leafroller to sequenced. *PLoS One* **2016**, *11*, e0147882, doi:10.1371/journal.pone.0147882.
68. Luque T, F.R., Crook N, O'Reilly DR, Winstanley D. The complete sequence of the Cydia pomonella granulovirus genome. *J. Gen. Virol.* **2001**, *82*, 2531-2547.
69. Lange, M.; Jehle, J.A. The genome of the Cryptophlebia leucotreta granulovirus. *Virology* **2003**, *317*, 220-236, doi:10.1016/s0042-6822(03)00515-4.
70. Ardisson-Araujo, D.M.; Melo, F.L.; Clem, R.J.; Wolff, J.L.; Ribeiro, B.M. A Betabaculovirus-Encoded gp64 Homolog Codes for a Functional Envelope Fusion Protein. *J. Virol.* **2016**, *90*, 1668-1672, doi:10.1128/JVI.02491-15.
71. Ferrelli ML, S.R., Biedma ME, Berretta MF, Haase S, et al. Genome of Epinotia aporema granulovirus (EpapGV), a polyorganotropic fast killing betabaculovirus with a novel

- thymidylate kinase gene. *BMC Genomics* **2012**, 13, 548-562.
72. Ardisson-Araújo DMP, d.M.F., Andrade MdS, Sihler W, Báo SN, Ribeiro BM, et al. Genome sequence of *Erinnyis ello* granulovirus (ErelGV), a natural cassava hornworm pesticide and the first sequenced sphingid-infecting betabaculovirus. *BMC Genomics* **2014**, 15, 856, doi:10.1186/1471-2164-15-856.
 73. Harrison, R.L.; Popham, H.J. Genomic sequence analysis of a granulovirus isolated from the Old World bollworm, *Helicoverpa armigera*. *Virus Genes* **2008**, 36, 565-581, doi:10.1007/s11262-008-0218-0.
 74. Harrison, R.L.; Rowley, D.L.; Mowery, J.; Bauchan, G.R.; Theilmann, D.A.; Rohrmann, G.F.; Erlandson, M.A. The complete genome sequence of a second distinct betabaculovirus from the True Armyworm, *Mythimna unipuncta*. *PLoS One* **2017**, 12, e0170510, doi:10.1371/journal.pone.0170510.
 75. Taha A; Nour-El-Din A.; Croizier L; Ferber ML; Croizier G. Comparative analysis of the granulin regions of the *Phthorimaea operculella* and *Spodoptera littoralis* granuloviruses. *Virus Genes*. **2000**, 10;21(3):147-55.
 76. Hashimoto, Y.; Hayakawa, T.; Ueno, Y.; Fujita, T.; Sano, Y.; Matsumoto, T. Sequence analysis of the *Plutella xylostella* granulovirus genome. *Virology* **2000**, 275, 358-372, doi:10.1006/viro.2000.0530.
 77. Zhang, B.Q.; Cheng, R.L.; Wang, X.F.; Zhang, C.X. The Genome of *Pieris rapae* Granulovirus. *J. Virol.* **2012**, 86, 9544, doi:10.1128/JVI.01431-12.
 78. Cuartas, P.E.; Barrera, G.P.; Belaich, M.N.; Barreto, E.; Ghiringhelli, P.D.; Villamizar, L.F. The complete sequence of the first *Spodoptera frugiperda* Betabaculovirus genome: a natural multiple recombinant virus. *Viruses* **2015**, 7, 394-421, doi:10.3390/v7010394.
 79. Wang, Y.; Choi, J.Y.; Roh, J.Y.; Liu, Q.; Tao, X.Y.; Park, J.B.; Kim, J.S.; Je, Y.H. Genomic sequence analysis of granulovirus isolated from the tobacco cutworm, *Spodoptera litura*. *PLoS One* **2011**, 6, e28163, doi:10.1371/journal.pone.0028163.
 80. Hayakawa T, K.R., Okano K, Seong SI, Goto C, et al. Sequence analysis of the *Xestia c-nigrum* granulovirus genome. *Virology* **1999**, 262, 277-297.
 81. Duffy, S.P.; Young, A.M.; Morin, B.; Lucarotti, C.J.; Koop, B.F.; Levin, D.B. Sequence analysis and organization of the *Neodiprion abietis* nucleopolyhedrovirus genome. *J. Virol.* **2006**, 80, 6952-6963, doi:10.1128/JVI.00187-06.

82. Lauzon, H.A.; Lucarotti, C.J.; Krell, P.J.; Feng, Q.; Retnakaran, A.; Arif, B.M. Sequence and organization of the Neodiprion lecontei nucleopolyhedrovirus genome. *J. Virol.* **2004**, *78*, 7023-7035, doi:10.1128/JVI.78.13.7023-7035.2004.
83. Garcia-Maruniak, A.; Maruniak, J.E.; Zanutto, P.M.; Doumbouya, A.E.; Liu, J.C.; Merritt, T.M.; Lanoie, J.S. Sequence analysis of the genome of the Neodiprion sertifer nucleopolyhedrovirus. *J. Virol.* **2004**, *78*, 7036-7051, doi:10.1128/JVI.78.13.7036-7051.2004.
84. Afonso, C.L.; Tulman, E.R.; Lu, Z.; Balinsky, C.A.; Moser, B.A.; Becnel, J.J.; Rock, D.L.; Kutish, G.F. Genome sequence of a baculovirus pathogenic for Culex nigripalpus. *J. Virol.* **2001**, *75*, 11157-11165.