

## Supplementary Tables and Figures

**Supplementary Table S1.** Avian sampling. Complete list of fecal samples from wild bird species collected in both southern and northern Ukraine from December 2016 – December 2017. Sampling in the autumn (August-October) and winter (November-February) seasons were focused on collecting migrating birds, while spring season was focused on spring migration (March-May) and sampling prior to and after nesting period (June-July).

Bird Species		Seasons			Total
Common Name	Scientific Name	Winter	Spring	Autumn	
<b>ANSERIFORMES</b>					
White-fronted Goose	<i>Anser albifrons</i>	417	257	359	1033
Red-breasted Goose	<i>Rufibrenta ruficollis</i>	-	-	23	23
Garganey	<i>Anas querquedula</i>	25	18		43
Mallard	<i>Anas platyrhynchos</i>	253	415	432	1100
Shelduck	<i>Tadorna tadorna</i>	208	82	139	429
Ruddy Shelduck	<i>Tadorna ferruginea</i>	35	25	43	103
Mute Swan	<i>Cygnus olor</i>	11	23	15	49
Whooper Swan	<i>Cygnus cygnus</i>	125	-	145	270
Greylag Goose	<i>Anser anser</i>	32	340	14	386
Wigeon	<i>Anas penelope</i>	5	-	10	15
Shoveler	<i>Anas clypeata</i>	22	2	-	24
Teal	<i>Anas crecca</i>	10	-	51	61
Wild duck	<i>Anas spp.</i>	38	-	-	38
Pintail	<i>Anas acuta</i>	6	-	-	6
<b>CHARADRIIFORMES</b>					
Yellow-legged Gull	<i>Larus cachinnans</i>	23	48	62	133
Black-headed Gull	<i>Larus ridibundus</i>	8	236	18	262
Slender-billed Gull	<i>Larus genei</i>	20	16	-	36
Ruff	<i>Phylomachus pugnax</i>	101	1	-	102
Mediterranean Gull	<i>Larus melanocephalus</i>	20	169	-	189
Common Gull	<i>Larus canus</i>	10	-	8	18
Great Black-headed Gull	<i>Larus ichthyæetus</i>	-	5	35	40
Dunlin	<i>Calidris alpina</i>	-	-	10	10
Snipe	<i>Gallinago gallinago</i>	-	-	15	15
Little Gull	<i>Larus minutus</i>	-	5	-	5
Little Tern	<i>Sterna albifrons</i>	-	5	-	5
White-winged Black Tern	<i>Chlidonias leucopterus</i>	-	20	-	20
Caspian Tern	<i>Hydroprogne caspia</i>	7	-	-	7
Avocet	<i>Recurvirostra avosetta</i>	5	-	-	5
Gulls spp.		4	10	-	14

<b>PODICIPEDIFORMES</b>						
Great Crested Grebe	<i>Podiceps cristatus</i>	-	-	1	1	
<b>GRUIFORMES</b>						
Demoiselle Crane	<i>Anthropoides virgo</i>	-	12	-	12	
Crane	<i>Grus grus</i>	16	17	-	33	
Coot	<i>Fulica atra</i>	9	-	-	9	
<b>CICONIIFORMES</b>						
Great White Egret	<i>Egretta alba</i>	-	15	-	15	
Little Egret	<i>Egretta garzetta</i>	-	5	-	5	
Grey Heron	<i>Ardea cinerea</i>	-	29	-	29	
Spoonbill	<i>Platalea leucorodia</i>	-	7	-	7	
<b>PELECANIFORMES</b>						
Dalmatian Pelican	<i>Pelecanus crispus</i>	-	13	2	15	
Cormorant	<i>Phalacrocorax carbo</i>	-	64	67	131	
White Pelican	<i>Pelecanus onocrotalus</i>	15	26	-	41	
Pygmy Cormorant	<i>Phalacrocorax pygmaeus</i>	5	-	-	5	
<b>FALCONIFORMES</b>						
Marsh Harrier	<i>Circus aeruginosus</i>	-	1	-	1	
<b>OTHER</b>						
Environmental (Fresh bird feces)	<i>Species was not identified</i>	-	45	-	45	
<b>Total</b>		<b>1430</b>	<b>1911</b>	<b>1449</b>	<b>4790</b>	

**Supplementary Table S2.** Overview of the infection rate of APMV-1 in wild birds by RT-PCR.

Species	Infection Rate (%)
Whooper Swan	0.37
Mallard	0.36
Mediterranean Gull	0.52
Shelduck	0.46
White-fronted Goose	0.09
White pelican	2.43
Snipe	0.07

**Supplementary Table S3.** The isolation rate of APMV (avulavirus) in wild birds by virus isolation *in ovo*.

Species	Isolation Rate (%) APMV
Greylag Goose	0.26
Mallard	0.54
Shelduck	0.46
Ruddy shelduck	1.94

**Supplementary Table S4.** Overview of samples tested by HI assay from wild birds in 2017. AIV, avian influenza virus with provisional HA serological subtype noted, APMV avian paramyxovirus (avulavirus) with provisional type noted; Unidentified, samples that were HI positive (hemagglutinating) but not identifiable by serological panel available.

No.	Strain Name	Serological Identification
1	Shelduck/Baz Odesa/13-16-28-10/17	AIV H2/H5/H7
2	Mallard/Er Odesa/41-50-8-08/17	AIV H3
3	Mallard/Dr3 Kherson /1-5/6-08/17	AIV H3
4	Ruddy shelduck/Pop Kherson/1-5-23-01/17	AIV H3
5	Ruddy shelduck/Pop Kherson/6-10-23-01/17	AIV H3
6	Ruddy shelduck/Pop Kherson/11-15-23-01/17	AIV H3
7	Shelduck/Zh. Yar Odesa/1-5-27-10/17	AIV H3/H7
8	Environmental/ND Kherson/31-35-7-08/17	AIV H4
9	Mallard/Ol2 Kherson/33-36/5-09/17	AIV H4
10	Mallard/Dr3 Kherson /6-10-6-08/17	AIV H4
11	Mallard/Zh. Yar Odesa/1-5/10-08/17	AIV H4
12	Mallard/Syv Kherson/1-4/4-09/17	AIV H5
13	Mallard/Chon Kherson/13-16/3-09/17	AIV H5
14	Mallard/Hor Kherson/16-20/29-11/17	AIV H7/H9
15	Shelduck/Pop Kherson/21-25/23-01/17	AIV H10
16	Whooper Swan/Des Odesa/1-5/30-01/17	AIV H11
17	Whooper Swan/Des Odesa /6-10/30-01/17	AIV H11
18	Black-headed Gull / Dr3 Kherson /1-3/6-08/17	AIV H11/H13
19	Greylag Goose /Myt Kherson/1-4/4-09/17	APMV-1
20	Mallard/Myt Kherson/1-4/4-09/17	APMV-1
21	Shelduck/Ser Kherson/11-15/6-08/17	APMV-1
22	Mallard/Kat Odesa/1-5/1-12/17	APMV-1
23	Mallard/Kat Odesa/6-10/1-12/17	APMV-1
24	Shelduck/Chur Kherson/1-5/2-11/17	APMV-1
25	Ruddy shelduck/Hr Kherson/11-15/27-01/17	APMV-1/APMV-7
26	Mallard/Hor Kherson/56-60/29-11/17	APMV-4
27	Mallard/Druzh Kherson/1-3/5-09/17	APMV-4
28	Environmental/ND Kherson /41-45/7-08/17	APMV-6
29	Mallard/ND Kherson /11-15/4-09/17	APMV-6
30	Mallard/Chon Kherson/41-45/1-11/17	AIV H1
31	Ruddy shelduck/ ND Kherson /1-5/5-08/17	Unidentified
32	Mallard/Prym T Odesa/35-39/26-09/17	Unidentified
33	White fronted goose/Vas Kherson/2,4,5/29-11/17	Unidentified
34	Environmental/ND Kherson /26-30/7-08/17	Unidentified
35	Shelduck/Ser Kherson/16-20/6-08/17	Unidentified
36	Mallard/Dr2 Kherson /16-20/6-08/17	Unidentified
37	Mallard/Ras Odesa/36-40/11-08/17	Unidentified
38	Mallard/Ras Odesa/16-20/11-08/17	Unidentified
39	Mallard/PK Kherson/1-5/7-08/17	Unidentified
40	Mallard/Vas Kherson/1-5/24-01/17	Unidentified

**Supplementary Table S7.** Overview of 2017 APMV-1 and APMV-6 positive samples sequenced using MinION. APMV was amplified using a RT PCR with four pools of tiling primers. Amplicons were sequenced with an LSK109 nanopore sequencing kit. Sequences were aligned to a reference database to identify a closest match for further analysis with Minimap2. Consensus sequences were generated using Medaka. Sequences were realigned to the reference and the percent identity was calculated with Geneious.

Sample Identifier	Species	Sample Location	Total # of Reads Sequenced	Closest Reference	Percent Identity	Consensus Sequence Length
APMV1 Mallard Myt_Kherson 1-4-4-09 2017	Mallard	Myt Kherson	92,095	KX352836 APMV1 Teal Russia 2010_08_28	98.4%	14,089
APMV1 Mallard AN_Kherson TM434778 2002	Mallard	Kherson	653,240	KX352836 APMV1 Teal Russia 2010_08_28	98.7%	15,168
APMV-6 Environmental ND Kherson 41-45 7-08 2017	Env.	Kherson	429,606	JX522537.1 APMV6 Mallard China 2011	98.6%	16,234
APMV-6 Mallard ND Kherson 11-15 4-09 2017	Mallard	Kherson	764,971	JN571486 APM6 Duck Belgium 2007	96.6%	16,235
APMV-1 Mallard Dr_Kherson 1-3 5-09 2017	Mallard	Druzh Kherson	121,493	KU601398 APMV1 Auk Russia 2015	98.7%	15,085
APMV-1 Grey_Goose Myt 1-4 4-09 2017	Grey goose	Myt Kherson	925,542	KU601398 APMV1 Auk Russia 2015	99.1%	15,093
APMV-1 Shelduck Chur_Kherson 1-5 2-11 2017	Shelduck	Chur Kherson	1,276,200	KU601398 APMV1 Auk Russia 2015	99.2%	15,090

**Supplementary Table S8.** Amino acid substitution table for APMV1/Mallard/Myt Kherson/1-4/4-09/17 compared to reference KX352836|APMV1|Teal|Russia|2010\_08\_28.

Nucleoprotein	Phosphoprotein	Matrix Protein	Fusion Protein	Hemagglutinin Protein	Large Polymerase Protein
Y230H	T210I	K226R	None	L211P	S3G
	S239N	G230R		RR 293G	V187I
	I248V			E495V	V207E
	A341V			C596Y	I661V
	M342I			K603E	S894F
					S952N
					R1071K
					N1564H
					S1753N
					weird
					weird
					weird
					T2095I
					L2139P
					weird
					weird
					D2053N
					weird

**Supplementary Table S9.** Amino acid substitution table for APMV-1/Mallard/AN Kherson/TM434778/2002 compared to reference KX352836|APMV1|Teal|Russia|2010\_08\_28.

Nucleoprotein	Phosphoprotein	Matrix Protein	Fusion Protein	Hemagglutinin Protein	Large Polymerase Protein
None	A78V	None	T203A	R63K	S3G
				C123S	S156C
				D285E	V187I
				R293G	O626P
				K567R	S894F
				I590V	E1031G
				K603E	P1734S
					Y2202C

**Supplementary Table S10.** Amino acid substitution table for APMV-6/Environmental/ND Kherson/41-45/7-08/17 compared to reference JX522537.1|APMV6|Mallard|China|2011.

Nucleoprotein	Hemagglutinin Protein	Phosphoprotein	Matrix Protein	Fusion Protein	Large Polymerase Protein	SH Protein
A79T	K57R	S64P	V342I	N20S	T51A	T49A
D419N	P64S	S68P		A76T	I121V	N89T
	S71G	N83D		S77G	A405T	
	V171A	H168Y		E148D	S637N	
	V212I				P650L/M	
	R356G				H725N	
	C438T				P939L	
	I446L/M				Q1097H	
	A481V				N1269K	
	F560S				Y1599C	
	T604A				V2031A	
					Q2099H	
					L2229F	

**Supplementary Table S11.** Amino acid substitution table for APMV-6/Mallard/ND Kherson/11-15/4-09/17 compared to reference JN571486|APM6|Duck|Belgium|2007.

Nucleoprotein	Hemagglutinin Protein	Phosphoprotein	Matrix Protein	Fusion Protein	Large Polymerase Protein	SH Protein
G50S	V34I	T60I	I48V	L8P	R131Q	V20G
	I63V	S78I		R26G	N176S	I38V
	E106K	G82E		E98D	R207K	G39R
	N153S	S84L			E294G	N90D
	V205A	P94L			E322D	
	V226M	P108L/M			I456V	
	D293N	T117X			K502R	
	Q315H	N118H			L631F	
	L339F	T150A			T643K	
	K414R	A166T			P644S	
	G596M	T175A			T648A	
	Y603H	D196E			D726N	
		E206D			P937L	
		F246L			L1059Q	
		A348T			S1400I	
		I379T			N1814H	
		T380M			P2080S	
		N415S				

**Supplementary Table S12.** Amino acid substitution table for APMV-1/mallard/Dr Kherson/1-3/5-09/17 2017 compared to reference KU601398|APMV1|Auk|Russia|2015.

Nucleoprotein	Hemagglutinin Protein	Phosphoprotein	Matrix Protein	Fusion Protein	Large Polymerase Protein
Y489H	L211P	V78A	S48L	I335T	K263R
	I270M	S239N	K256R		I417V
	E495V	I248V	G230R		O626P
	C596Y	A341V			I661V
	A598T	M342I			S952N
					V1365M
					N1564H



**Supplementary Table S13.** Amino acid substitution table for APMV-1/Grey goose/Myt/1-4/4-09/17 compared to reference KU601398|APMV1|Auk|Russia|2015.

Nucleoprotein	Hemagglutinin Protein	Phosphoprotein	Matrix Protein	Fusion Protein	Large Polymerase Protein
Y489H	I270M	V78A	K226R	I335T	K263R
	E495K	T210I	G230R		I417V
	C596Y	S239N			O626P
	A598T	A341V			I661V
		M342I			S952N
					V1365M

**Supplementary Table S14.** Amino acid substitution table for APMV-1/shelduck/Chur/1-5/2-11/17 compared to reference KU601398|APMV1|Auk|Russia|2015.

Nucleoprotein	Hemagglutinin Protein	Phosphoprotein	Matrix Protein	Fusion Protein	Large Polymerase Protein
N463S	I270M	none	T74I	V19A	T253M
	A598T			I335T	I417V
					K1071R
					V1365M
					M2056T

Sample ID	Nucleoprotein	Phosphoprotein	Matrix protein	Fusion protein	Hemagglutinin-Neuraminidase protein	Large polymerase protein
APMV1/Mellard/Myt Kherson/1-4-4-09/2017	Not enough sequence data	991 – 2178	2394 – 3488	3648 – 5309	5516 - 7366	Not enough sequence data
APMV1/Mellard/AN Kherson/TM434778/2002	109 - 1578	1874 - 3061	3277 – 4371	4532 - 6193	6400 - 8250	8369 - 14983
APMV1/Mellard/Dr Kherson/1-3-5-09/2017	100 - 1569	1873 - 3060	3276 - 4370	4531 - 6192	6399 - 8249	8268 - 14983
APMV1/Grey Goose/Myt/1-4-4-09/2017	115 - 1584	1879 - 3066	3282 - 4376	4536 - 6197	6404 - 8254	8373 – 14987
APMV1/Shelduck/Chur/1-5-2-11/2017	113 - 1582	1878 - 3065	3281 - 4375	4535 - 6196	6403 - 8253	8372 - 14985

**Supplementary Figure S1.** Genome assembly of APMV-1 sequences isolated in this study. Reads were aligned to APMV-1 specific reference database to identify a closest reference using Minimap2 and a consensus sequence was generated using Medaka. Consensus sequence was re-aligned to the reference to generate genome annotations using Geneious v.11.0.3.

Sample ID	Nucleoprotein	Phosphoprotein	Matrix protein	Fusion protein	Small Hydrophobic Protein	Hemagglutinin – Neuraminidase Protein	Large polymerase protein
APMV6/Environment al/ND Kherson/41- 45-7-08/2017	130 - 1408	1685 - 2977	3233 - 4333	4596 - 6263	6539 - 6965	7117 - 8958	9273 - 15998
APMV6/Mallard/ND Kherson/11-15-4- 09/2017	128 - 1525	1687 - 2978	3234 - 4334	4597 - 6264	6541 - 6969	7121 - 8962	9277 - 16002

**Supplementary Figure S2.** Genome assembly of APMV-6 sequences isolated from this study. Reads were aligned to APMV-6 specific reference database to identify a closest reference using Minimap2 and a consensus sequence was generated using Medaka. Consensus sequence was re-aligned to the reference to generate genome annotations using Geneious v11.0.3.