

**Supplementary Table S1.** Coronavirus species considered in this study. The RefSeq accession numbers, genera, subgenera and species names of the 38 coronaviruses are listed in the table.

RefSeq	Genus	Subgenus	Species
NC_022103.1	Alphacoronavirus	Colacovirus	Bat coronavirus CDPHE15
NC_018871.1	Alphacoronavirus	Decacovirus	Bat coronavirus HKU10
NC_028814.1	Alphacoronavirus	Decacovirus	Rhinolophus ferrumequinum alphacoronavirus HuB-2013
NC_002645.1	Alphacoronavirus	Duvinacovirus	Human coronavirus 229E
NC_032730.1	Alphacoronavirus	Luchacovirus	Lucheng Rn rat coronavirus
NC_023760.1	Alphacoronavirus	Minacovirus	Mink coronavirus 1
NC_010437.1	Alphacoronavirus	Minunacovirus	Miniopterus bat coronavirus 1
NC_010438.1	Alphacoronavirus	Minunacovirus	Miniopterus bat coronavirus HKU8
NC_028811.1	Alphacoronavirus	Myotacovirus	Myotis ricketti alphacoronavirus Sax-2011
NC_028833.1	Alphacoronavirus	Nyctacovirus	Nyctalus velutinus alphacoronavirus SC-2013
NC_003436.1	Alphacoronavirus	Pedacovirus	Porcine epidemic diarrhea virus
NC_009657.1	Alphacoronavirus	Pedacovirus	Scotophilus bat coronavirus 512
NC_009988.1	Alphacoronavirus	Rhinacovirus	Rhinolophus bat coronavirus HKU2
NC_005831.2	Alphacoronavirus	Setracovirus	Human coronavirus NL63
NC_032107.1	Alphacoronavirus	Setracovirus	NL63-related bat coronavirus strain BtKYNL63-9b
NC_038861.1	Alphacoronavirus	Tegacovirus	Alphacoronavirus 1
NC_006213.1	Betacoronavirus	Embecovirus	Betacoronavirus 1
NC_026011.1	Betacoronavirus	Embecovirus	China Rattus coronavirus HKU24
NC_006577.2	Betacoronavirus	Embecovirus	Human coronavirus HKU1
NC_012936.1	Betacoronavirus	Embecovirus	Murine coronavirus
NC_025217.1	Betacoronavirus	Hibecovirus	Bat Hp-betacoronavirus Zhejiang2013
NC_039207.1	Betacoronavirus	Merbecovirus	Hedgehog coronavirus 1
NC_038294.1	Betacoronavirus	Merbecovirus	Middle East respiratory syndrome-related coronavirus
NC_009020.1	Betacoronavirus	Merbecovirus	Pipistrellus bat coronavirus HKU5
NC_009019.1	Betacoronavirus	Merbecovirus	Tylonycteris bat coronavirus HKU4
NC_030886.1	Betacoronavirus	Nobecovirus	Rousettus bat coronavirus GCCDC1
NC_009021.1	Betacoronavirus	Nobecovirus	Rousettus bat coronavirus HKU9
NC_004718.3	Betacoronavirus	Sarbecovirus	Severe acute respiratory syndrome-related coronavirus
NC_045512.2	Betacoronavirus	Sarbecovirus	Severe acute respiratory syndrome coronavirus 2
NC_016995.1	Deltacoronavirus	Andecovirus	Wigeon coronavirus HKU20
NC_011547.1	Deltacoronavirus	Buldecovirus	Bulbul coronavirus HKU11
NC_016996.1	Deltacoronavirus	Buldecovirus	Common moorhen coronavirus HKU21
NC_039208.1	Deltacoronavirus	Buldecovirus	Coronavirus HKU15
NC_011550.1	Deltacoronavirus	Buldecovirus	Munia coronavirus HKU13
NC_016991.1	Deltacoronavirus	Buldecovirus	White-eye coronavirus HKU16
NC_016994.1	Deltacoronavirus	Herdecovirus	Night heron coronavirus HKU19
NC_010646.1	Gammacoronavirus	Cegacovirus	Beluga whale coronavirus SW1
NC_001451.1	Gammacoronavirus	Igacovirus	Avian coronavirus