

Supplementary Information

Supplementary Table S1. Cytochrome c oxidase subunit 1 (CO1) haplotypes of *Rhinolophus* species analysed in this study

Supplementary Table S2. Geographic records used to infer the ecological niche of bat viruses related to SARS-CoV.

Supplementary Figure S1. Model performance in geographic space on training data. Ecological niche of bat viruses related to SARS-CoV (SCoVrCs).

Supplementary Figure S2. Model performance in geographic space on training data. Ecological niches of bat viruses closely related to SARS-CoV-2 (SCoV2rCs) predicted using 4 points (data set A).

Supplementary Figure S3. Model performance in geographic space on training data. Ecological niches of bat viruses closely related to SARS-CoV-2 (SCoV2rCs) predicted using 21 points (data set B).

Table S1. Cytochrome c oxidase subunit 1 (COI) haplotypes of *Rhinolophus* species analysed in this study.

Species	GenBank accession numbers	Haplotypes	Country	Location	Code	Latitude	Longitude	References	EN datasets
<i>R. acuminatus</i>	MW712895, MW712896	Rac1	Cambodia	Krong Preah Vihear	C2	13.7641	104.8592	This study	20 points, 30 points
<i>R. acuminatus</i>	MW712894	Rac1	Cambodia	near Kok Lak, Rattanakiri	C4	14.0186	106.7484	This study	20 points, 30 points
<i>R. acuminatus</i>	MW712891-MW712893	Rac1	Cambodia	Virachey	C5	14.2032	107.0050	This study	20 points, 30 points
<i>R. acuminatus</i>	MW712897	Rac1	Cambodia	Mondolkiri	C6	12.1803	106.9819	This study	20 points, 30 points
<i>R. acuminatus</i>	MW712898- MW712900	Rac2	Cambodia	Mondolkiri	C6	12.1803	106.9819	This study	20 points, 30 points
<i>R. acuminatus</i>	HM541312, HM541313, HM541317, HM541318	Rac1	Laos	Dong Hua Sao	L10	14.8220	106.0600	[1]	20 points, 30 points
<i>R. acuminatus</i>	HM541319, HM541320, HM541321, HM541322, HM541323, HM541324, HM541314	Rac1	Laos	Dong Kanthung	L11	14.1750	105.5750	[1]	20 points, 30 points
<i>R. acuminatus</i>	HM541315	Rac6	Laos	Dong Hua Sao	L10	14.8220	106.0600	[1]	30 points
<i>R. acuminatus</i>	HM541310, HM541311	Rac3	Malaysia	Tabin	M5	5.0830	118.6670	[1]	
<i>R. acuminatus</i>	SRR13380249, SRR13380251	Rac1	Thailand	Khao Ang Rue Nai	T4	13.2067	101.7119	[2]	4 points, 20 points, 30 points
<i>R. acuminatus</i>	SRR13380250	Rac2	Thailand	Khao Ang Rue Nai	T4	13.2067	101.7119	[2]	4 points, 20 points, 30 points
<i>R. acuminatus</i>	SRR13380247	Rac4	Thailand	Khao Ang Rue Nai	T4	13.2067	101.7119	[2]	4 points, 20 points, 30 points
<i>R. acuminatus</i>	SRR13380248	Rac5	Thailand	Khao Ang Rue Nai	T4	13.2067	101.7119	[2]	4 points, 20 points, 30 points
<i>R. acuminatus</i>	HM541316	Rac1	Vietnam	Yok Don NP	V13	12.8670	107.7000	[1]	20 points, 30 points
<i>R. acuminatus</i>	HM914924, HM914925	Rac1	Vietnam	Bu Gia Map	V14	12.1940	107.2060	[2]	
<i>R. acuminatus</i>	HM541325, HM914901, HM914902, HM914913, HM914914	Rac1	Vietnam	Cat Tien	V17	11.4170	107.4330	[1]	20 points, 30 points
<i>R. affinis</i>	MW712901- MW712909	Ra1	Cambodia	Preah Vihear Temple	C1	14.3594	104.7859	This study	
<i>R. affinis</i>	MW712910- MW712912	Ra1	Cambodia	Virachey	C5	14.2032	107.0050	This study	
<i>R. affinis</i>	MW712913, MW712914	Ra2	Cambodia	Virachey	C5	14.2032	107.0050	This study	
<i>R. affinis</i>	MW712915- MW712921	Ra3	Cambodia	Virachey	C5	14.2032	107.0050	This study	30 points
<i>R. affinis</i>	MW712922	Ra4	Cambodia	Virachey	C5	14.2032	107.0050	This study	
<i>R. affinis</i>	HM541383, HM541387	Ra3	China	Guangxi, Jing Xin County Provincial Nature Reserve	Ch4	23.1170	105.9670	[1]	30 points
<i>R. affinis</i>	HM541347, HM541348, HM541353	Ra3	China	Guangxi, Shiwandashan National Reserve	Ch5	21.8460	107.8890	[1]	30 points
<i>R. affinis</i>	SRR11085797	Ra5	China	Mojiang	Ch1	23.4319	101.6924	[3]	4 points, 20 points, 30 points
<i>R. affinis</i>	HM541342, HM541343-6, HM541377-82, HM541384-6, HM541388-90, HM541392-4	Ra6	China	Guangxi, Jing Xin County Provincial Nature Reserve	Ch4	23.1170	105.9670	[1]	
<i>R. affinis</i>	HM541349, HM541350-2, HM541354-9, HM541368-76	Ra6	China	Guangxi, Shiwandashan National Reserve	Ch5	21.8460	107.8890	[1]	
<i>R. affinis</i>	HM541391	Ra7	China	Guangxi, Jing Xin County Provincial Nature Reserve	Ch4	23.1170	105.9670	[1]	
<i>R. affinis</i>	JF444035	Ra8	China	Shuhuangshan Reserve	Ch6	26.4167	111.0330	unpublished	
<i>R. affinis</i>	KP192694	Ra16	Indonesia	Sumatra	I1	-4.5597	105.4068	[4]	
<i>R. affinis</i>	KP192693	Ra17	Indonesia	Sumatra	I1	-4.5597	105.4068	[4]	
<i>R. affinis</i>	HM541335	Ra1	Laos	Dong Hua Sao	L10	14.8220	106.0600	[1]	
<i>R. affinis</i>	HM541336, HM541341	Ra10	Laos	Xiangkhoang, Nam Et NBCA	L2	20.0730	103.4330	[1]	
<i>R. affinis</i>	HM541339, HM541340	Ra3	Laos	LouangNamtha	L1	20.7360	101.1670	[1]	30 points

<i>R. affinis</i>	HM541334	Ra3	Laos	Dong Hua Sao	L10	14.8220	106.0600	[1]	30 points
<i>R. affinis</i>	HM541366, HM541367	Ra3	Laos	TakLeuk	L5	18.3830	103.0670	[1]	30 points
<i>R. affinis</i>	HM541333	Ra3	Laos	Attapeu	L9	14.9500	107.1330	[1]	30 points
<i>R. affinis</i>	HM541365	Ra9	Laos	TakLeuk	L5	18.3830	103.0670	[1]	
<i>R. affinis</i>	HM541337, HM541338	Ra11	Malaysia	Cameron Highlands	M1	4.4600	101.3800	[1]	
<i>R. affinis</i>	HM541330	Ra11	Malaysia	Kuala Lompat	M2	3.7170	102.1670	[1]	
<i>R. affinis</i>	HM541331, HM541332	Ra11	Malaysia	Pasoh Forest	M3	2.9670	102.3000	[1]	
<i>R. affinis</i>	HM541411, HM541412, HM541413, HM541407-10	Ra11	Malaysia	Endau Rompin	M4	2.5330	103.4000	[1]	
<i>R. affinis</i>	HM541414	Ra12	Malaysia	Endau Rompin	M4	2.5330	103.4000	[1]	
<i>R. affinis</i>	MK410386	Ra13	Myanmar	Chin	B1	22.8065	93.6998	[5]	
<i>R. affinis</i>	HM541326	Ra14	Myanmar	Nyaungshwe	B5	20.6630	96.9670	[1]	
<i>R. affinis</i>	KP192682	Ra15	Myanmar	Kadan	B6	12.4739	98.4032	[4]	
<i>R. affinis</i>	KY034102, KY034135	Ra1	Thailand	Loei	T2	17.5050	100.9380	unpublished	
<i>R. affinis</i>	KP192677, KP192678	Ra11	Thailand	Khuan Kalong	T5	7.0129	100.0210	[4]	
<i>R. affinis</i>	KY034109	Ra11	Thailand	Songkla	T6	6.9940	100.1490	unpublished	
<i>R. affinis</i>	KP192673, KP192675, KP192676	Ra11	Thailand	Hala Bala	T7	5.7983	101.8250	[4]	
<i>R. affinis</i>	KY034138	Ra18	Thailand	Loei	T2	17.5050	100.9380	unpublished	
<i>R. affinis</i>	KP192689, KP192690, KP192691	Ra19	Thailand	Adang	T6	6.5146	99.3173	[4]	
<i>R. affinis</i>	KY034134	Ra20	Thailand	Songkla	T6	6.9940	100.1490	unpublished	
<i>R. affinis</i>	KP192687, KP192688	Ra21	Thailand	Chieng Mai	T1	19.5093	98.8326	[4]	
<i>R. affinis</i>	KP192679, KP192680, KP192681	Ra22	Thailand	KhuanKalong	T5	7.0129	100.0210	[4]	
<i>R. affinis</i>	KP192692, KY034116, KY034119	Ra22	Thailand	Adang	T6	6.5146	99.3173	[4]	
<i>R. affinis</i>	KP192674	Ra23	Thailand	Hala Bala	T7	5.7983	101.8250	[4]	
<i>R. affinis</i>	HM541360	Ra1	Vietnam	Ngoc Linh, Quang Nam	V11	15.2088	107.7395	[1]	
<i>R. affinis</i>	HM541363	Ra1	Vietnam	Cat Tien	V17	11.4170	107.4330	[1]	
<i>R. affinis</i>	MW712923	Ra1	Vietnam	Huong Hoa	V9	16.9370	106.5810	This study	
<i>R. affinis</i>	MW712924, MW712925, HM541399, HQ580330	Ra24	Vietnam	Tram Ton, Sapa	V1	22.3278	103.7792	This study, [1], unpublished	
<i>R. affinis</i>	MW712926	Ra25	Vietnam	Hanoi, Ba Vi National park	V4	21.0830	105.3730	This study	
<i>R. affinis</i>	MW712927-MW712929	Ra26	Vietnam	Hanoi, Ba Vi National park	V4	21.0830	105.3730	This study	
<i>R. affinis</i>	MW712930, HM541402	Ra27	Vietnam	Ngoc Linh, Kon Tum	V11	15.2088	107.7395	This study, [1]	
<i>R. affinis</i>	MW712931	Ra28	Vietnam	Ngoc Linh, Kon Tum	V11	15.2088	107.7395	This study	
<i>R. affinis</i>	MW712932	Ra29	Vietnam	Kon Tum, Chu Mom Ray	V12	14.4250	107.7860	This study	
<i>R. affinis</i>	MW712933	Ra3	Vietnam	Dakrong	V10	16.6000	106.8667	This study	30 points
<i>R. affinis</i>	KP192684	Ra3	Vietnam	Vinh Phuc, Tam Dao National Park	V2	21.5075	105.6082	[6]	30 points
<i>R. affinis</i>	MW712934- MW712936	Ra3	Vietnam	Hanoi, Ba Vi National park	V4	21.0830	105.3730	This study	30 points
<i>R. affinis</i>	MW712937	Ra3	Vietnam	Thanh Hoa, Ba Thuoc	V5	20.4600	105.2520	This study	30 points
<i>R. affinis</i>	MW712938	Ra3	Vietnam	Thanh Hoa, Pu Luong Nature Reserve	V6	20.3050	105.0120	This study	30 points
<i>R. affinis</i>	MW712939-MW712942	Ra3	Vietnam	Vu Quang	V8	18.3200	105.4360	This study	30 points

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<i>R. affinis</i>	MW712943-MW712945	Ra3	Vietnam	Huong Hoa	V9	16.9370	106.5810	This study	30 points
<i>R. affinis</i>	HM541398, HQ580331	Ra30	Vietnam	Sapa, Hoang Lien NP	V1	22.3278	103.7792	[1], unpublished	
<i>R. affinis</i>	HM541364	Ra31	Vietnam	Lao Cai, Ta Phinh	V1	22.3278	103.7792	[1]	30 points
<i>R. affinis</i>	KP192683	Ra32	Vietnam	Vinh Phuc, Tam Dao National Park	V2	21.5075	105.6082	[4]	
<i>R. affinis</i>	MW712946, HM541395, HM541401	Ra33	Vietnam	Ngoc Linh, Quang Nam	V11	15.2088	107.7395	[1]	30 points
<i>R. affinis</i>	GU684791, GU684792-4, GU684798, GU684801, HM541327	Ra34	Vietnam	Bi Doup-Nui Ba	V15	12.1790	108.6790	[1], unpublished	
<i>R. affinis</i>	HM541396	Ra35	Vietnam	Xuan Truong	V16	11.8670	108.5500	[1]	30 points
<i>R. affinis</i>	HM541361	Ra36	Vietnam	Cat Tien	V17	11.4170	107.4330	[1]	
<i>R. affinis</i>	HM541362	Ra37	Vietnam	Cat Tien	V17	11.4170	107.4330	[1]	
<i>R. affinis</i>	HM541328	Ra38	Vietnam	Vu Quang	V8	18.3200	105.4360	[1]	
<i>R. affinis</i>	HM541329	Ra39	Vietnam	Vu Quang	V8	18.3200	105.4360	[1]	
<i>R. affinis</i>	KP192685, KP192686	Ra6	Vietnam	Vinh Phuc, Tam Dao National Park	V2	21.5075	105.6082	[4]	
<i>R. affinis</i>	MW712947	Ra6	Vietnam	Phu Tho, Xuan Son	V3	21.1386	104.9399	This study	
<i>R. affinis</i>	MW712948-MW712957	Ra6	Vietnam	Hanoi, Ba Vi National park	V4	21.0830	105.3730	This study	
<i>R. malayanus</i>	MW712958	Rm1	Cambodia	Preah Vihear Temple	C1	14.3594	104.7859	This study	20 points, 30 points
<i>R. malayanus</i>	MW712959	Rm2	Cambodia	Krong Preah Vihear	C2	13.7641	104.8592	This study	
<i>R. malayanus</i>	MW712960	Rm3	Cambodia	Kampot	C8	10.5597	104.2822	This study	4 points, 20 points, 30 points
<i>R. malayanus</i>	MK900704, MK900705	Rm4	China	Yunnan	Ch2	21.8896	101.2979	[7]	
<i>R. malayanus</i>	SRR12432009	Rm4	China	Mengla County	Ch3	21.9189	101.2716	[8]	30 points
<i>R. malayanus</i>	MK900706	Rm5	China	Yunnan	Ch2	21.8896	101.2979	[7]	
<i>R. malayanus</i>	HM541621	Rm10	Laos	Hin Nam No	L8	17.5670	105.8330	[1]	30 points
<i>R. malayanus</i>	HM541622	Rm11	Laos	Hin Nam No	L8	17.5670	105.8330	[1]	
<i>R. malayanus</i>	HM541610	Rm12	Laos	Dong Hua Sao	L10	14.8220	106.0600	[1]	30 points
<i>R. malayanus</i>	HM541606, HM541607, HM541608, HM541609	Rm2	Laos	Attapeu	L9	14.9500	107.1330	[1]	
<i>R. malayanus</i>	HM541613	Rm4	Laos	LouangNamtha	L1	20.7360	101.1670	[1]	20 points, 30 points
<i>R. malayanus</i>	MW712961	Rm4	Laos	Nam Khan	L3	19.6823	102.3377	This study	
<i>R. malayanus</i>	HM541614, HM541615, HM541616	Rm6	Laos	TakLeuk	L5	18.3830	103.0670	[1]	30 points
<i>R. malayanus</i>	HM541619	Rm7	Laos	TakLeuk	L5	18.3830	103.0670	[1]	
<i>R. malayanus</i>	HM541620	Rm8	Laos	TakLeuk	L5	18.3830	103.0670	[1]	30 points
<i>R. malayanus</i>	HM541618	Rm9	Laos	Ban Pomkhoun-Phonsong	L7	17.6330	104.9500	[1]	
<i>R. malayanus</i>	HM541624, HM541617, HM541623	Rm9	Laos	Hin Nam No	L8	17.5670	105.8330	[1]	30 points
<i>R. malayanus</i>	KX099327, KX099330	Rm13	Myanmar	NA	B2	22.0476	95.9993	[9]	
<i>R. malayanus</i>	HM541612	Rm13	Myanmar	NA	B3	22.1000	96.6200	[1]	30 points
<i>R. malayanus</i>	KX099328, KX099329	Rm14	Myanmar	NA	B2	22.0476	95.9993	[9]	
<i>R. malayanus</i>	KX099331	Rm15	Myanmar	NA	B2	22.0476	95.9993	[9]	30 points
<i>R. malayanus</i>	KX099332	Rm16	Myanmar	NA	B2	22.0476	95.9993	[9]	
<i>R. malayanus</i>	HM541611	Rm17	Myanmar	NA	B4	22.4690	96.9930	[1]	30 points
<i>R. malayanus</i>	MW712962	Rm19	Thailand	Kanchanaburi	T3	14.4500	98.8500	This study	
<i>R. malayanus</i>	MW712966-MW712971	Rm1	Vietnam	Dakrong	V10	16.6000	106.8667	This study	30 points
<i>R. malayanus</i>	MW712963	Rm1	Vietnam	Ngoc Lac	V7	20.0944	105.3797	This study	
<i>R. malayanus</i>	MW712964	Rm1	Vietnam	Huong Hoa	V9	16.9370	106.5810	This study	

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<i>R. malayanus</i>	MW712965	Rm2	Vietnam	Dakrong	V10	16.6000	106.8667	This study	
<i>R. malayanus</i>	HM541604	Rm20	Vietnam	Phu Quoc	V18	10.2000	104.0000	[1]	
<i>R. shameli</i>	MW712972-MW712981	Rsh1	Cambodia	Preah Vihear Temple	C1	14.3594	104.7859	This study	20 points, 30 points
<i>R. shameli</i>	MW712982, MW712983	Rsh1	Cambodia	Krong Preah Vihear	C2	13.7641	104.8592	This study	20 points, 30 points
<i>R. shameli</i>	MW712984-MW713001	Rsh1	Cambodia	SroLav	C3	13.7914	105.6022	This study	4 points, 20 points, 30 points
<i>R. shameli</i>	MW713002-MW713030	Rsh1	Cambodia	Virachey	C5	14.2032	107.0050	This study	20 points, 30 points
<i>R. shameli</i>	MW713031	Rsh2	Cambodia	Preah Vihear Temple	C1	14.3594	104.7859	This study	30 points
<i>R. shameli</i>	MW713032	Rsh3	Cambodia	Krong Preah Vihear	C2	13.7641	104.8592	This study	30 points
<i>R. shameli</i>	HM541778	Rsh4	Cambodia	KaohKong	C7	11.6390	103.5740	[1]	
<i>R. shameli</i>	MW713033, MW713034	Rsh5	Cambodia	Kampot	C8	10.5597	104.2822	This study	
<i>R. shameli</i>	HM541782, HM541783, HM541784, HM541793	Rsh1	Laos	Dong Hua Sao	L10	14.8220	106.0600	[1]	20 points, 30 points
<i>R. shameli</i>	HM541785	Rsh1	Laos	Nam Kading	L4	18.8420	104.5830	[1]	20 points, 30 points
<i>R. shameli</i>	HM541786	Rsh1	Laos	Vientiane	L6	18.0830	102.6670	[1]	20 points, 30 points
<i>R. shameli</i>	HM541780, HM541781, HM541792, JF444101	Rsh1	Laos	near Hin Nam No	L8	17.5670	105.8330	[1], unpublished	20 points, 30 points
<i>R. shameli</i>	HM541788, HM541789, HM541790, HM541791	Rsh1	Laos	Attapeu	L9	14.9500	107.1330	[1]	20 points, 30 points
<i>R. shameli</i>	HM541787, HM541794	Rsh6	Laos	Dong Kanthung	L11	14.1750	105.5750	[1]	30 points
<i>R. shameli</i>	HM541779	Rsh7	Laos	near Hin Nam No	L8	17.5670	105.8330	[1]	30 points
<i>R. shameli</i>	HM541777	Rsh5	Vietnam	PhuQuoc	V18	10.2000	104.0000	[1]	

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Table S2. Geographic records used to infer the ecological niche of bat viruses related to SARS-CoV.

Country	locality	Latitude	Longitude	References
China	Guangdong	22.65334	113.05734	[1,2]
China	Guangxi, Nanning	22.81700	108.36653	[1,3]
China	Guizhou, Anlong	25.09900	105.44269	[4]
China	Hebei	38.71913	114.80067	[1,2]
China	Henan, Jiyuan	35.06725	112.60192	[1,4]
China	Hong Kong	22.37425	114.08477	[5]
China	Hong Kong	22.42819	114.06778	[5]
China	Hubei, Yichang	30.69197	111.28647	[3]
China	Jilin, Tonghua county	41.67981	125.75925	[1,6]
China	Shaanxi	33.99589	107.48343	[1,2]
China	Shanxi	37.27425	111.24516	[1,2]
China	Yunnan, Baoshan	25.11206	99.16175	[7]
China	Yunnan, Kunming	24.88008	102.83289	[7-9]
China	Yunnan, Lufeng	25.15011	102.07903	[10]
China	Yunnan, Mangshi	24.43369	98.58808	[11]
China	Yunnan, Menglian	22.32911	99.58417	[6]
China	Zhejiang, Longquan	28.07464	119.14147	[4]
China	Zhejiang, Daishan	30.26671	122.22394	[1,12]
Korea	Jeongbuk	35.42772	127.13625	[13,14]

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Supplementary Figure S1. Model performance in geographic space on training data. Ecological niche of bat viruses related to SARS-CoV (SCoVrCs).

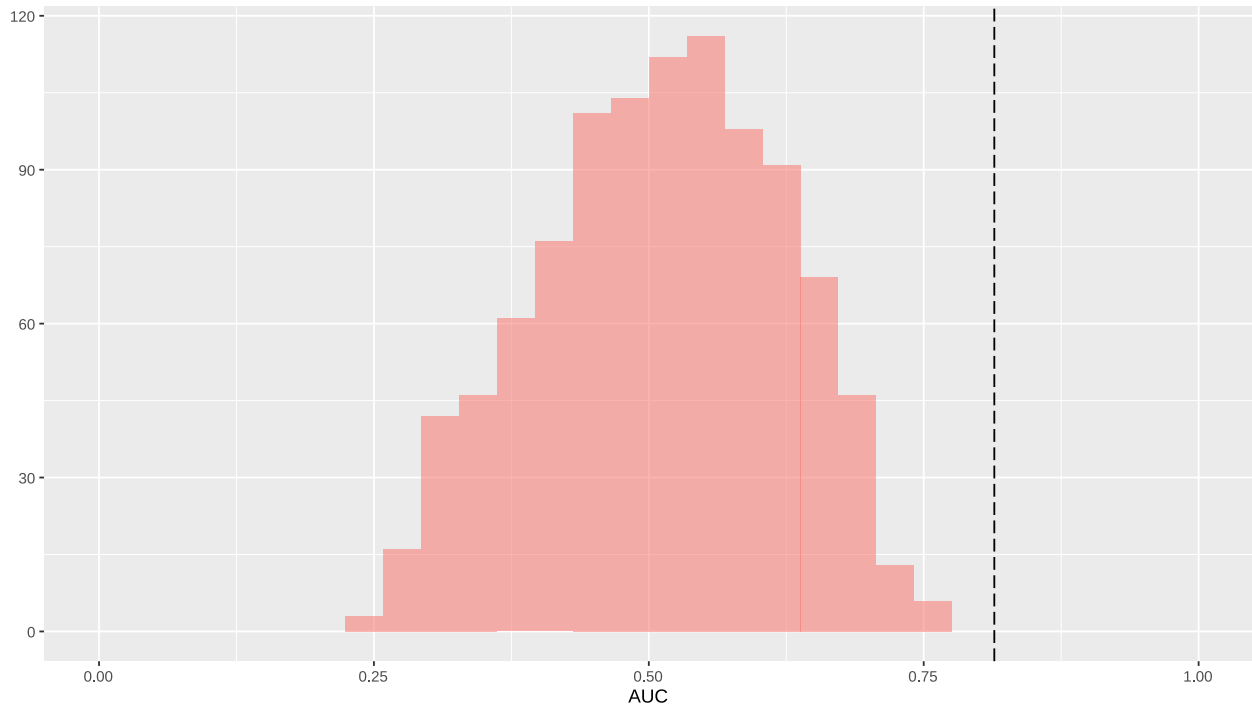


Figure S1 - 1 / 1

Supplementary Figure S2. Model performance in geographic space on training data. Ecological niches of bat viruses closely related to SARS-CoV-2 (SCoV2rCs) predicted using 4 points (data set A).

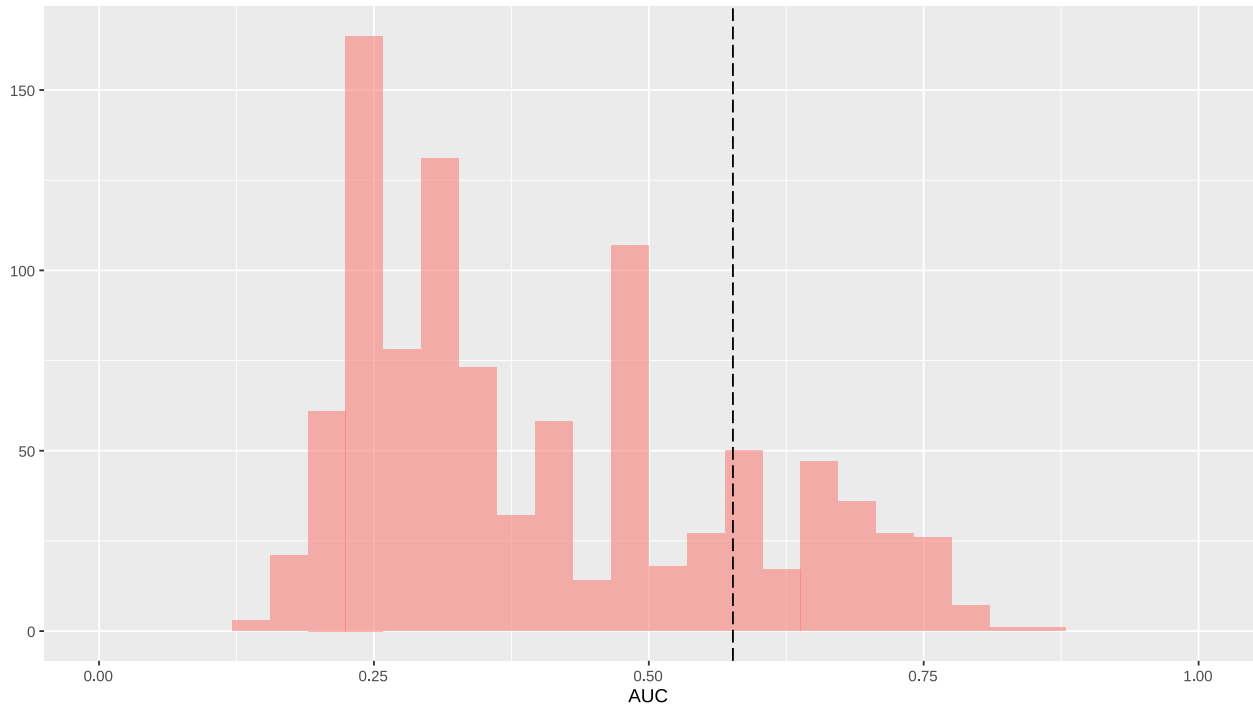


Figure S2 - 1 / 1

Supplementary Figure S3. Model performance in geographic space on training data. Ecological niches of bat viruses closely related to SARS-CoV-2 (SCoV2rCs) predicted using 21 points (data set B).

