Suplementary Table 1. Raw data matrix of species, morphological data and carrier frequecny used in the PGLM analysis.

	Species	File length (mm)	Vibrating area (mm^2)	Frequency (kHz)		Ln file	Ln Vibrating Area	Ln Frequency
1	Acantheremus nov sp TAMUIC IGC 003586	1.43	2.80	24.00		0.36	1.02961942	3.17805383
2	Acanthodis curvidens TAMUIC IGC 003904	2.60	8.37	22.00		0.96	2.12465388	3.09104245
3	Aglaothorax ovatus TAMUIC IGC 003313	5.10	6.90	14.30		1.63	1.93152141	2.66025954
4	Anabrus simplex OR034	4.20	5.70	13.55		1.44	1.74046617	2.60638655
5	Artiotonus artius TAMUIC IGC 003898	1.75	1.58	40.70		0.56	0.45742485	3.70622809
6	Artiotonus tinae TAMUIC IGC 003895	1.70	1.24	35.40		0.53	0.21511138	3.56671182
7	Axylus philippinus TAMUIC IGC 003577	1.56	1.15	34.70		0.44	0.13976194	3.54673969
8	Bucrates capitatus TAMUIC IGC 003887	3.20	12.20	9.50		1.16	2.50143595	2.2512918
9	Burned toast Anchicaya nov gen sp TAMUIC IGC 003608	1.43	1.41	25.40		0.36	0.3435897	3.23474917
10	Championica pilata TAMUIC IGC 003643	1.97	2.38	22.70		0.68	0.86710049	3.12236492
11	Chibchella nigrospecula TAMUIC IGC 003686	3.04	10.34	9.42		1.11	2.33601987	2.24283509
12	Chondroderella borneensis TAMUIC IGC 002897	2.60	6.51	11.60		0.96	1.87333946	2.4510051
13	Clonia sp TAMUIC IGC 002990	2.46	2.88	18.00		0.9	1.05779029	2.89037176
14	Cocconotus sp TAMUIC IGC 002838	1.58	2.33	31.10		0.46	0.84586827	3.43720782
15	Conocephalus cf versicolor TAMUIC IGC 003607	1.25	0.97	36.00		0.22	-0.0304592	3.58351894
16	Copiphora brevirostris TAMUIC IGC 003906	3.20	4.46	15.60		1.16	1.49514877	2.74727091
17	Copiphora gorgonensis TAMUIC IGC 003616	1.98	2.49	22.60		0.68	0.91228271	3.11794991
18	Copiphora gracilis TAMUIC IGC 003595	2.00	3.65	20.60		0.69	1.29472717	3.02529108
19	Copiphora vigorosa TAMUIC IGC 003901	3.12	6.00	10.19		1.14	1.79175947	2.32140685
20	Cyphoderris buckelli F2255	2.85	3.30	13.30		1.05	1.19392247	2.58776404
21	Cyphoderris monstrosa INSnfrTBQRAAPEI 16	3.14	9.76	13.00		1.14	2.2782924	2.56494936
22	Cyphoderris strepitans F2289	3.30	9.07	12.70		1.19	2.20497226	2.54160199
23	Dioncomena jagoi TAMUIC IGC 003644	1.31	1.60	53.00		0.27	0.47000363	3.97029191
24	Docidocercus gausodontus TAMUIC IGC 003610	2.10	3.00	22.50		0.74	1.09861229	3.11351531
25	Docidocercus gigliotisi TAMUIC IGC 003596	2.41	2.73	26.80		0.88	1.00430161	3.28840189
26	Docidocercus sagittatus TAMUIC IGC 003652	2.00	2.90	30.00		0.69	1.06471074	3.40119738
27	Ephippiger ephippiger TAMUIC IGC 003998	4.30	5.93	20.00		1.46	1.78002421	2.99573227
28	Erioloides consobrinus TAMUIC IGC 002802	1.90	2.90	22.90		0.64	1.06471074	3.13113691
29	Eriolus sp 2 TAMUIC IGC 003609	1.74	1.35	30.30		0.55	0.30010459	3.41114771
30	Eschatoceras punctifrons OR550	0.74	0.54	64.00		-0.3	-0.6161861	4.15888308
31	Euanisous teuthroides TAMUIC IGC 003583	0.73	0.45	30.30		-0.31	-0.7985077	3.41114771
32	Eubliastes aethiops TAMUIC IGC 003653	2.87	3.76	21.60		1.05	1.32441896	3.07269331
33	Eubliastes viridicorpus TAMUIC IGC 003907	3.60	9.17	23.40		1.28	2.21593729	3.15273602
34	Eumecopoda cyrtoscelis OR385	2.63	5.60	3.10		0.97	1.7227666	1.13140211
35	Graminofolium castneri TAMUIC IGC 003597	1.45	0.85	27.70		0.37	-0.1625189	3.32143241
36	Gryllus bimaculatus TAMUIC IGC 002933	5.60	28.60	4.80		1.72	3.35340672	1.56861592
37	Hemisaga sp OR483	3.00	1.97	7.40		1.1	0.67803354	2.00148
38	Hexacentrus unicolor TAMUIC IGC 002896	2.10	8.80	11.00		0.74	2.17475172	2.39789527
39	Idiarthron sp TAMUIC IGC 002825	2.00	3.61	23.90		0.69	1.28370777	3.17387846
40	Ischnomela gracilis TAMUIC IGC 002822	2.50	1.98	15.10		0.92	0.68309684	2.71469474
41	Ischnomela sp Gorgona TAMUIC IGC 003891	2.46	1.95	16.80		0.9	0.66782937	2.82137889
42	Kuzicus denticulatus TAMUIC IGC 003576	1.10	1.46	39.60		0.1	0.37843644	3.67882912
43	Leptophyes punctatissima OR044	1.25	1.40	41.00		0.22	0.33647224	3.71357207
44	Leurophyllum sp TAMUIC IGC 003657	1.60	4.50	23.00		0.47	1.5040774	3.13549422
45	Lipotactes maculatus TAMUIC IGC 002853	1.20	1.50	33.10		0.18	0.40546511	3.49953328
46	Lirometopum coronatum OR586	3.20	11.40	10.80		1.16	2.43361336	2.37954613
47	Macrochiton macromelos TAMUIC IGC 003902	2.84	6.65	13.80		1.04	1.89461685	2.62466859
48	Mecopoda cf elongata TAMUIC IGC 002926	4.88	20.95	7.00		1.59	3.04213865	1.94591015
49	Metrioptera brachyptera OR070	1.32	2.54	30.00		0.28	0.93216408	3.40119738
50	Microcentrum lobophylloides TAMUIC IGC 003620	3.73	3.37	11.70		1.32	1.21491274	2.45958884
51	Microcentrum rhombifolium OR033	4.70	11.70	9.80		1.55	2.45958884	2.28238239
52	Microtettigonia tachys TAMUIC IGC 003693	0.70	0.75	50.00		-0.36	-0.2876821	3.91202301
53	Mimetica incisa TAMUIC IGC 003900	3.00	5.22	17.00		1.1	1.6524974	2.83321334
54	Neduba convexa TAMUIC IGC 003314	3.50	7.83	13.90		1.25	2.05796251	2.63188884
55	Neobarrettia spinosa TAMUIC IGC 003909	4.75	9.09	10.00		1.56	2.20717491	2.30258509
56	Neoconocephalus sp TAMUIC IGC 003660	3.40	5.16	12.00		1.22	1.64093658	2.48490665
57	Neoscapteriscus vicinus TAMUIC IGC 003743	2.18	7.20	3.17		0.78	1.97408103	1.15373159
58	Orchelimum erythrocephalum TAMUIC IGC 003437	2.90	6.70	13.60		1.06	1.90210753	2.61006979
59	Orchelimum silvaticum TAMUIC IGC 003433	2.52	5.20	18.00		0.92	1.64865863	2.89037176
60	Orophus tessellatus TAMUIC IGC 003892	2.59	2.43	10.50		0.95	0.88789126	2.35137526
61	Panacanthus gibbosus TAMUIC IGC 003582	5.20	19.35	6.40		1.65	2.96269242	1.85629799
62	Panacanthus intensus TAMUIC IGC 003893	4.48	12.74	11.50		1.5	2.54474665	2.44234704
63	Panacanthus lacrimans TAMUIC IGC 003646	5.43	16.27	7.13		1.69	2.78932292	1.96431123
64	Panacanthus pallicornis TAMUIC IGC 003591	6.27	14.16	4.70		1.84	2.65042109	1.54756251
65	Paracyphoderris erebeus PAER1	3.10	4.80	14.00		1.13	1.56861592	2.63905733
66	Paragraecia temasek TAMUIC IGC 003639	1.50	2.80	12.60		0.41	1.02961942	2.53369681
67	Paranelytra bruneri TAMUIC IGC 003663	1.03	0.94	40.90		0.03	-0.0618754	3.71113006
68	Pediodectes sp TAMUIC IGC 003008	2.60	1.30	18.00		0.96	0.26236426	2.89037176
69	Phaneroptera brevis TAMUIC IGC 002909	1.70	1.50	21.90		0.53	0.40546511	3.08648664
70	Phaneroptera nana TAMUIC IGC 003628	1.50	3.20	19.80		0.41	1.16315081	2.98568194
71	Phlugis glabra TAMUIC IGC 003669	0.46	0.56	49.50		-0.78	-0.5798185	3.90197267
72	Pholidoptera griseoptera TAMUIC IGC 002983	3.80	3.70	21.00		1.34	1.30833282	3.04452244
73	Phyllomimus inversus TAMUIC IGC 002854	4.40	9.90	10.00		1.48	2.29253476	2.30258509
74	Phymonotus jacintotopos TAMUIC IGC 003321	2.73	1.07	16.90		1	0.06765865	2.82731362
75	Pristonotus latistylus TAMUIC IGC 002841	5.10	20.22	10.00		1.63	3.00667221	2.30258509
76	Psyrana tigrina TAMUIC IGC 003638	2.20	1.10	35.50		0.79	0.09531018	3.5695327
77	Ragoniella sp 2 TAMUIC IGC 003604	2.10	4.99	15.80		0.74	1.60743591	2.76000994
78	Roeseliana roeselii OR046	1.56	3.70	21.00		0.44	1.30833282	3.04452244
79	Salomona maculifrons TAMUIC IGC 003573	2.27	2.33	30.50		0.82	0.84586827	3.41772668
80	Satizabalus sodalis TAMUIC IGC 003666	3.02	6.20	16.30		1.11	1.82454929	2.79116511
81	Scambophyllum sanguinolentum TAMUIC IGC 003584	1.50	2.23	23.70		0.41	0.80200159	3.16547505
82	Scopiorinus fragilis TAMUIC IGC 003647	2.26	21.21	25.60		0.82	3.05447277	3.24259235
83	Speculophlugis hishquten TAMUIC IGC 003894	0.51	0.29	50.00		-0.67	-1.2378744	3.91202301
84	Sphyrometopa femorata TAMUIC IGC 003623	3.28	4.58	11.00		1.19	1.521699	2.39789527
85	Stetharasa exarmata TAMUIC IGC 003658	2.90	4.12	22.85		1.06	1.41585316	3.12895112
86	Supersonus aequoreus TAMUIC IGC 003631	0.60	0.23	150.00		-0.51	-1.469676	5.01063529
87	Supersonus piercei TAMUIC IGC 003897	0.70	0.32	129.00		-0.36	-1.1394343	4.8598124
88	Teleutias cf fasciatus TAMUIC IGC 003602	1.20	2.14	24.10		0.18	0.76080583	3.18221184
89	Teleutias sp OR391 (cf castaneous)	1.40	1.52	42.10		0.34	0.41871033	3.74004774
90	Tettigonia catans OR075	2.50	5.90	8.00		0.92	1.77495235	2.07944154
91	Tettigonia viridissima OR040	2.40	4.00	12.03		0.88	1.38629436	2.48740353
92	Trichotettix nov sp TAMUIC IGC 003672	1.47	1.40	20.00		0.39	0.33647224	2.99573227
93	Trichotettix pilosula TAMUIC IGC 003589	1.71	1.39	16.90		0.54	0.32930375	2.82731362
94	Triencentrus cf magdalenae TAMUIC IGC 003605	2.79	3.80	21.00		1.03	1.33500107	3.04452244
95	Typophyllum spuriocolus OR196	5.50	17.30	7.00		1.7	2.8507065	1.94591015

Supplementary Table 4. Training dataset for Gaussian Process Regression model. Predictor variables include stridulatory file length (mm), total tooth number, dominant frequency (kHz), and syllable duration (ms). Syllable rate (syllables s^{-1}) was calculated at 20 °C using published temperature dependent relationships.

Species	Family	File length [mm]	Number of teeth	f_c [kHz]	Syllable duration [ms]	Syllable rate (s-1) at 20°C
Cyphoderris strepitans	Prophalangopsidae	3.1	88	12.7	4.1	43.32
Cyphoderris monstrosa	Prophalangopsidae	3.49	110	13	6.6	60.83
Cyphoderris buckelli	Prophalangopsidae	2.25	72	13.3	3.6	53.42
Cyrtoxopha gundlachi	Trigonidiinae	1.34	192	5.9	32	12.75
Cyrtoxopha columbiana	Trigonidiinae	1.29	150	6.6	17	27.76
Cyrtoxopha nola	Trigonidiinae	1.04	120	6.4	15.5	40.88
Cyrtoxopha confusa	Trigonidiinae	0.85	88	7.5	9.5	68.47
Neoconocephalus bivocatus	Tettigoniidae	2.5	83.6	9	3.5	59.69
Neoconocephalus triops	Tettigoniidae	2.1	75.8	11	10	91.93
Amblycorypha alexanderi	Tettigoniidae	2.19	97.7	13.6	113	2.48
Amblycorypha rotundifolia	Tettigoniidae	1.91	93	10	16	18.13
Amblycorypha bartrami	Tettigoniidae	1.99	92.94	9.76	40	7.78
Neoxabea bipunctata	Gryllidae	0.94	21.5	3.4	8	82.88
Anurogryllus arboreus	Gryllidae	2.4	72	5.6	7	63.57
Oecanthus celerinictus	Gryllidae	1.07	41.1	3.9	13	46.66
Oecanthus quadripunctatus	Gryllidae	1.47	56.7	4.2	16	32.26
Oecanthus exclamationis	Gryllidae	0.97	20.5	2.6	8	62.6
Oecanthus niveus	Gryllidae	1	26	3	13.5	54.48
Oecanthus fultoni	Gryllidae	1.79	41.3	2.9	16.2	40.58
Oecanthus latipennis	Gryllidae	1.48	42.1	2.9	19	41.36
Orocharis saltator	Gryllidae	2.08	77	5.1	15	44.22
Orocharis luteolira	Gryllidae	1.97	75	5.1	12	55.21
Orocharis tricornis	Gryllidae	2.16	120	6.1	19.5	33.24
Orocharis nigrifrons	Gryllidae	1.96	135	4.8	21	34.25
Orocharis diplastes	Gryllidae	1.95	104	5.7	25	11.54

Supplementary Table 3. Supplementary training set used to train the model.

Species	Family	File length [mm]	Number of teeth	f_c [kHz]	Syllable duration [ms]	Syllable rate (s-1) at 20°C
Cyphoderris strepitans	Prophalangopsidae	3.1	88	12.7	4.1	43.32
Cyphoderris monstrosa	Prophalangopsidae	3.49	110	13	6.6	60.83
Cyphoderris buckelli	Prophalangopsidae	2.25	72	13.3	3.6	53.42
Cyrtoxopha gundlachi	Trigonidiinae	1.34	192	5.9	32	12.75
Cyrtoxopha columbiana	Trigonidiinae	1.29	150	6.6	17	27.76
Cyrtoxopha nola	Trigonidiinae	1.04	120	6.4	15.5	40.88
Cyrtoxopha confusa	Trigonidiinae	0.85	88	7.5	9.5	68.47
Neoconocephalus bivocatus	Tettigoniidae	2.5	83.6	9	3.5	59.69
Neoconocephalus triops	Tettigoniidae	2.1	75.8	11	10	91.93
Amblycorypha alexanderi	Tettigoniidae	2.19	97.7	13.6	113	2.48
Amblycorypha rotundifolia	Tettigoniidae	1.91	93	10	16	18.13
Amblycorypha bartrami	Tettigoniidae	1.99	92.94	9.76	40	7.78
Neoxabea bipunctata	Gryllidae	0.94	21.5	3.4	8	82.88
Anurogryllus arboreus	Gryllidae	2.4	72	5.6	7	63.57
Oecanthus celerinictus	Gryllidae	1.07	41.1	3.9	13	46.66
Oecanthus quadripunctatus	Gryllidae	1.47	56.7	4.2	16	32.26
Oecanthus exclamationis	Gryllidae	0.97	20.5	2.6	8	62.6
Oecanthus niveus	Gryllidae	1	26	3	13.5	54.48
Oecanthus fultoni	Gryllidae	1.79	41.3	2.9	16.2	40.58
Oecanthus latipennis	Gryllidae	1.48	42.1	2.9	19	41.36
Orocharis saltator	Gryllidae	2.08	77	5.1	15	44.22
Orocharis luteolira	Gryllidae	1.97	75	5.1	12	55.21
Orocharis tricornis	Gryllidae	2.16	120	6.1	19.5	33.24
Orocharis nigrifrons	Gryllidae	1.96	135	4.8	21	34.25
Orocharis diplastes	Gryllidae	1.95	104	5.7	25	11.54

Supplementary Table 4. Training dataset for Gaussian Process Regression model. Predictor variables include stridulatory file length (mm), total tooth number, dominant frequency (kHz), and syllable duration (ms). Syllable rate (syllables s^{-1}) was calculated at 20 °C using published temperature dependent relationships.

Species	Family	File length [mm]	Number of teeth	f_c [kHz]	Syllable duration [ms]	Syllable rate (s-1) at 20°C
Cyphoderris strepitans	Prophalangopsidae	3.1	88	12.7	4.1	43.32
Cyphoderris monstrosa	Prophalangopsidae	3.49	110	13	6.6	60.83
Cyphoderris buckelli	Prophalangopsidae	2.25	72	13.3	3.6	53.42
Cyrtoxopha gundlachi	Trigonidiinae	1.34	192	5.9	32	12.75
Cyrtoxopha columbiana	Trigonidiinae	1.29	150	6.6	17	27.76
Cyrtoxopha nola	Trigonidiinae	1.04	120	6.4	15.5	40.88
Cyrtoxopha confusa	Trigonidiinae	0.85	88	7.5	9.5	68.47
Neoconocephalus bivocatus	Tettigoniidae	2.5	83.6	9	3.5	59.69
Neoconocephalus triops	Tettigoniidae	2.1	75.8	11	10	91.93
Amblycorypha alexanderi	Tettigoniidae	2.19	97.7	13.6	113	2.48
Amblycorypha rotundifolia	Tettigoniidae	1.91	93	10	16	18.13
Amblycorypha bartrami	Tettigoniidae	1.99	92.94	9.76	40	7.78
Neoxabea bipunctata	Gryllidae	0.94	21.5	3.4	8	82.88
Anurogryllus arboreus	Gryllidae	2.4	72	5.6	7	63.57
Oecanthus celerinictus	Gryllidae	1.07	41.1	3.9	13	46.66
Oecanthus quadripunctatus	Gryllidae	1.47	56.7	4.2	16	32.26
Oecanthus exclamationis	Gryllidae	0.97	20.5	2.6	8	62.6
Oecanthus niveus	Gryllidae	1	26	3	13.5	54.48
Oecanthus fultoni	Gryllidae	1.79	41.3	2.9	16.2	40.58
Oecanthus latipennis	Gryllidae	1.48	42.1	2.9	19	41.36
Orocharis saltator	Gryllidae	2.08	77	5.1	15	44.22
Orocharis luteolira	Gryllidae	1.97	75	5.1	12	55.21
Orocharis tricornis	Gryllidae	2.16	120	6.1	19.5	33.24
Orocharis nigrifrons	Gryllidae	1.96	135	4.8	21	34.25
Orocharis diplastes	Gryllidae	1.95	104	5.7	25	11.54