

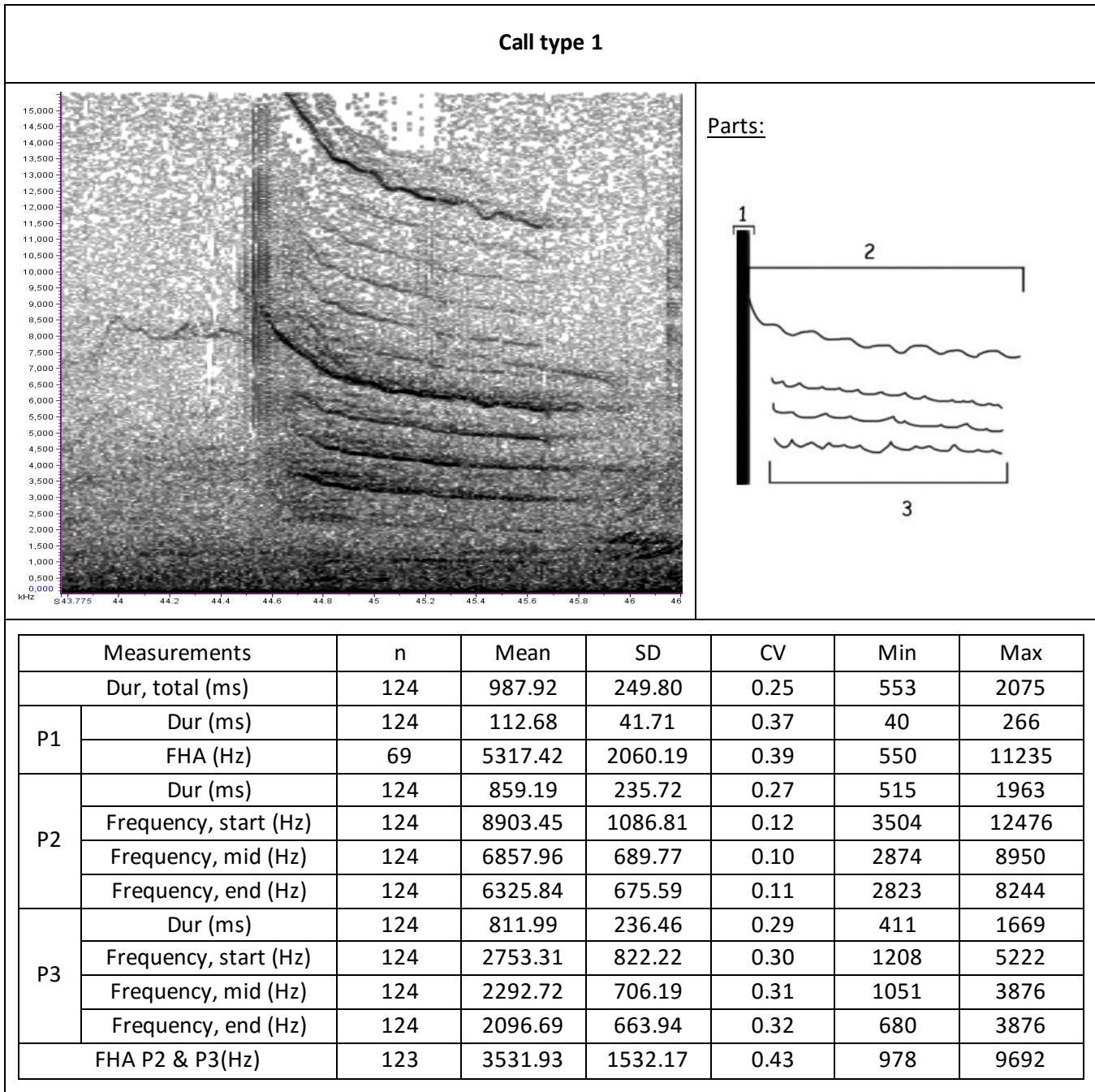
Call Catalogue for Antarctic Ecotype C Killer Whales



Compiled by Elena Schall

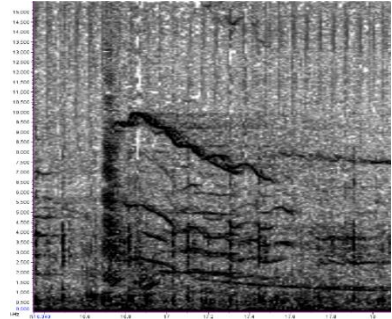
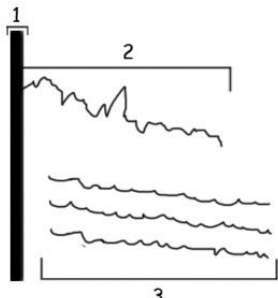
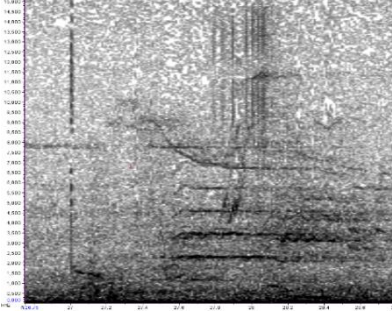
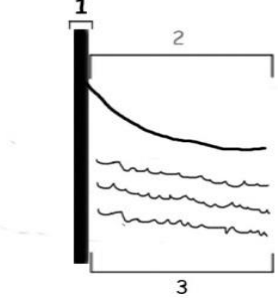
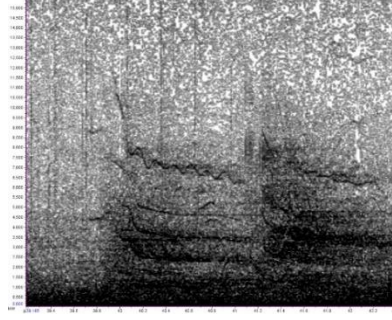
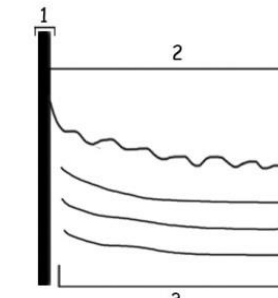
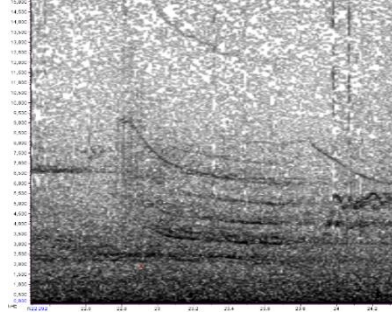
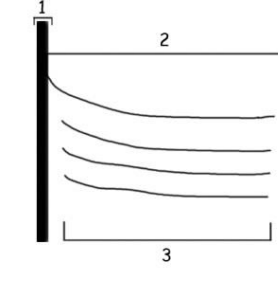
2016

Very frequent call types (occurred more than 100 times)

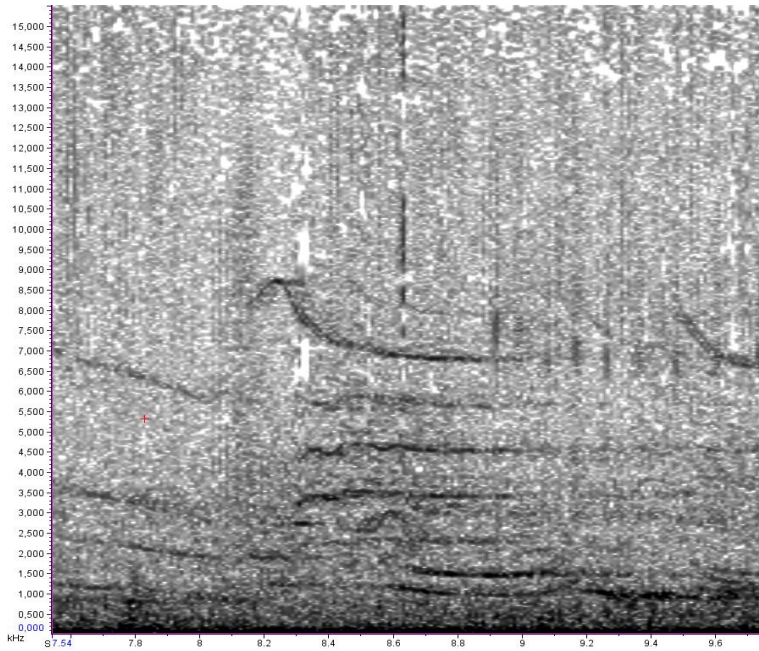


This call type consists of three segments. The first part (P1) can be described as a relatively short broadband pulse, followed by a combination of a biphonal low and high frequency component (LFC & HFC). The HFC (P2) starts during the same time as part 1 and decreases over time in frequency. The LFC (P3) typically starts a little bit later than the HFC. This part also decreases slightly in frequency with time. At least five different variants exist of this call type. These variants differ in the extent of frequency modulation of both the HFC and the LFC.

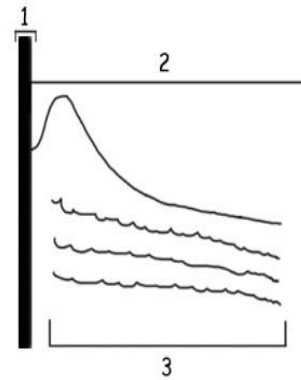
The first variant features a constant and moderate frequency modulation in both the HFC and LFC, is the most abundant variant and is shown above. The second variant features a strong and irregular frequency modulation in its HFC, the third variant features no frequency modulation in its HFC, the fourth variant features no frequency modulation in its LFC and the fifth variant features no frequency modulation in both its HFC and LFC (see below). The LFC of all variants shows visible harmonics between 2 and 7 kHz (sometimes up to 15 kHz).

Variant	Example	Parts
2		
3		
4		
5		

Call type 2



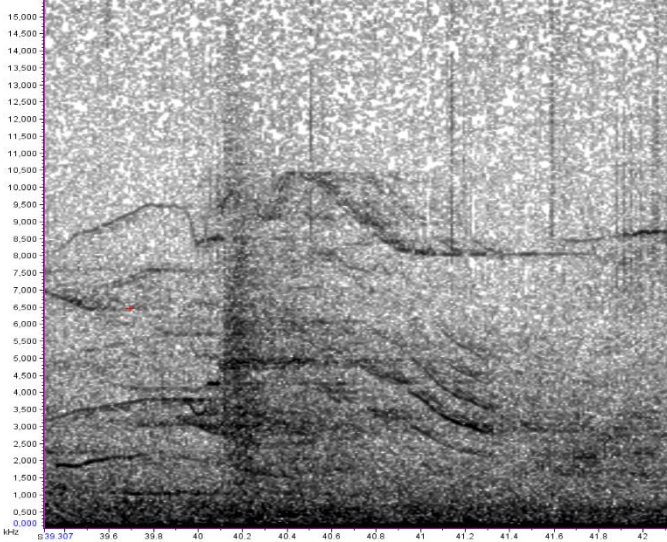
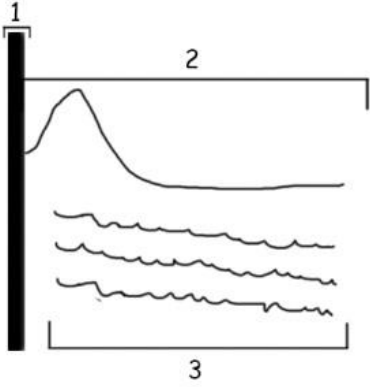
Parts:



Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		51	940.07	198.01	0.21	497	1652
P1	Dur (ms)	51	121.85	35.49	0.29	43	251
	FHA (Hz)	41	2896.83	2744.28	0.95	378	15363
P2	Dur (ms)	51	786.88	200.00	0.25	335	1519
	Frequency, start (Hz)	51	9108.79	443.01	0.05	7949	10034
	Frequency, peak (Hz)	51	9642.75	587.16	0.06	6950	10444
	Frequency, end (Hz)	51	7088.87	327.10	0.05	6353	8412
P3	Dur (ms)	51	694.04	171.46	0.25	338	1135
	Frequency, start (Hz)	51	3345.26	1000.01	0.30	1782	5092
	Frequency, mid (Hz)	51	2714.04	706.10	0.26	1638	4160
	Frequency, end (Hz)	51	2392.16	628.14	0.26	1354	3807
FHA P2 & P3(Hz)		51	3545.85	1376.02	0.39	853	8639

Similar to call type 1, call type 2 also consists of three parts. P1, the short and broadband pulse and P3, the LFC are similar to those of call type 1. The LFC most of the time features a constant and moderate extent of frequency modulation. P2, the HFC shows virtually no frequency modulation and exists in two variants. The first variant increases initially in frequency to decrease thereafter continuously till the end of the tone (see above).

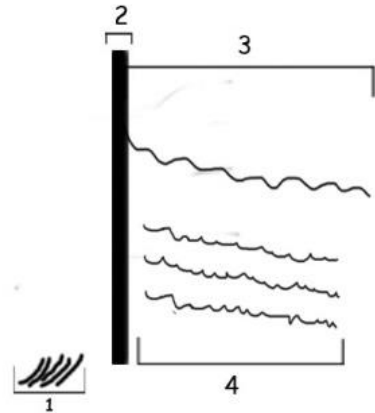
The HFC of the second variant does not decrease continuously after reaching the maximum frequency, but decreases until it reaches a plateau, where the tone has a constant frequency till the end of the call (see below). The LFC of both variants features harmonics between 2 and 7 kHz.

Variant	Example	Parts
2		

Call type 3



Parts:

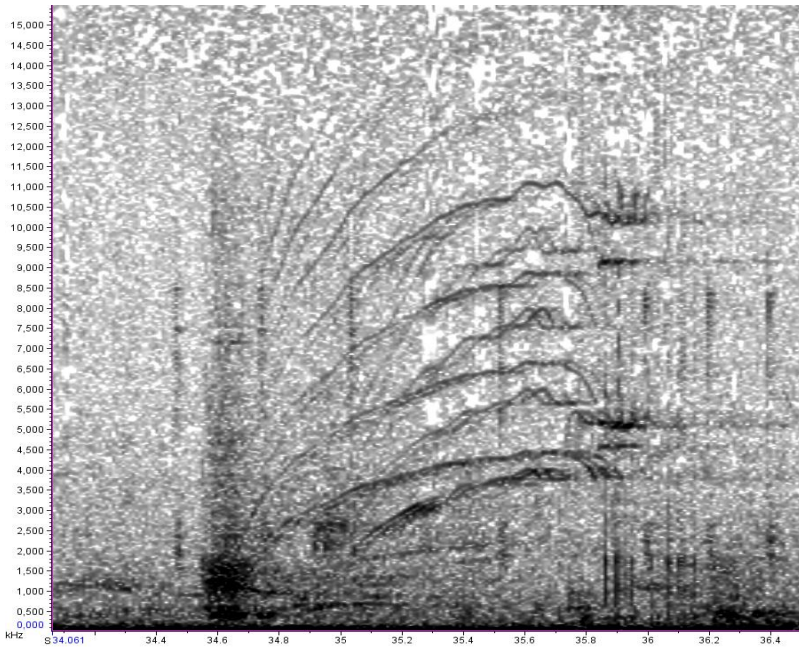


	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	9	1142.44	190.27	0.17	906	1493
P1	Dur (ms)	9	250.89	95.98	0.38	105	384
	FHA (Hz)	9	1079.11	261.85	0.24	603	1513
P2	Dur (ms)	9	84.56	24.67	0.29	58	129
	FHA (Hz)	6	6589.83	4205.21	0.64	1485	12187
P3	Dur (ms)	9	649.56	93.94	0.14	533	855
	Frequency, start (Hz)	9	8594.44	657.83	0.08	7334	9456
	Frequency, mid (Hz)	9	7183.00	496.28	0.07	6313	7832
	Frequency, end (Hz)	9	6929.89	579.23	0.08	6208	7911
P4	Dur (ms)	9	592.00	151.81	0.26	338	815
	Frequency, start (Hz)	9	2622.00	898.94	0.34	1388	4060
	Frequency, mid (Hz)	9	2255.22	824.48	0.37	1205	3326
	Frequency, end (Hz)	9	2112.56	831.65	0.39	1021	3248
	FHA P3 & P4 (Hz)	9	3501.00	1438.34	0.41	1695	6898

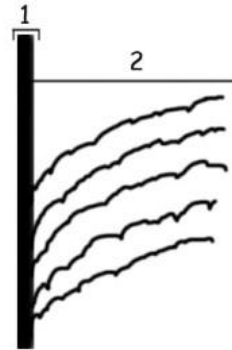
Call type 3 is a combination of two also separately existing call types. P1 of this call type is equal to call type 13 and P2 to P4 match with call type 1, but sometimes can also look in some features more like other call types (aberrant forms). Identification of this call type is based on the presence of P1 and P2 and the presence of a HFC and a LFC of variable shapes. P2 starts after a short temporal break and its acoustic parameters (e.g., duration and frequency) match those of P1 of call type 1. P4 always features many tightly spaced harmonics between 2 and 7 kHz.

Frequent call types (occurred between 20 and 99 times)

Call type 4



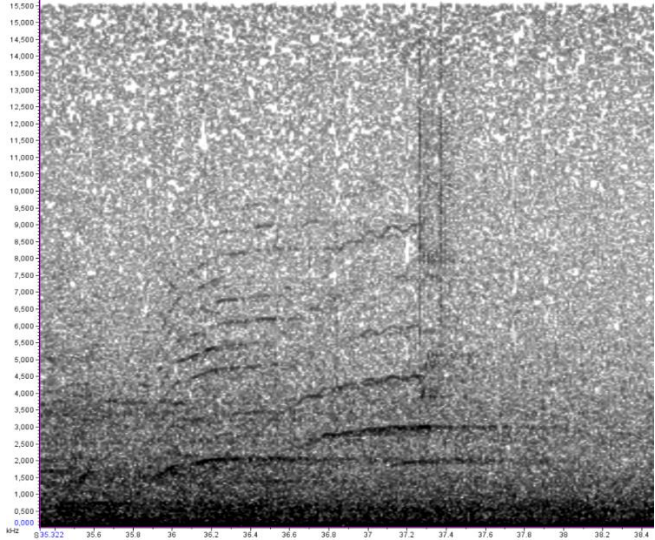
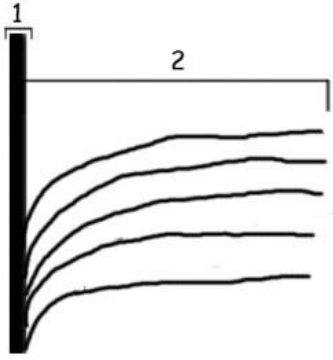
Parts:



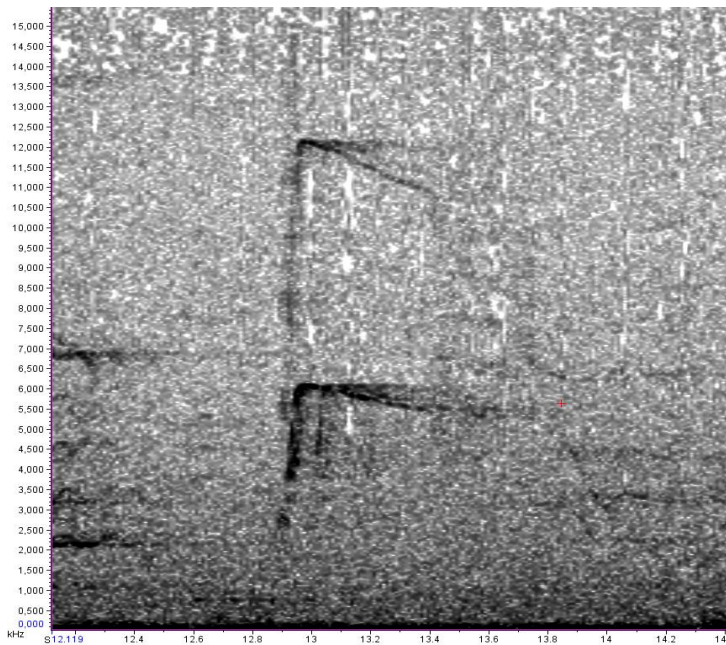
Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		12	1126.09	121.63	0.11	930	1228
P1	Dur (ms)	12	139.67	32.36	0.23	91	179
	FHA (Hz)	12	762.12	703.43	0.92	306	1868
P2	Dur (ms)	12	988.45	116.46	0.12	785	1115
	Frequency, start (Hz)	12	1350.35	812.20	0.60	1257	4217
	Frequency, mid (Hz)	12	2924.09	590.58	0.20	2593	3667
	Frequency, end (Hz)	12	3049.35	971.97	0.32	1571	4296
FHA (Hz)		12	2168.50	692.15	0.32	2069	3755

Call type 4 is a monophonic call type with just two components. P1 is the common short broadband pulse and P2 is a constant in frequency increasing contour. Two variants of P2 exist. The first variant has a constant and moderate frequency modulation pattern (see above).

P2 of the second variant is unmodulated (see below). P2 of both variants often is of relatively long duration and features many harmonics between 2 and 10 kHz.

Variant	Example	Parts
2	 <p>A spectrogram showing frequency in kHz on the y-axis (0.000 to 15.500) and time on the x-axis (35.322 to 38.4). A prominent vertical line is visible at approximately 37.2 kHz. Several horizontal lines are present between 2 and 10 kHz, indicating harmonics.</p>	 <p>A diagram illustrating the signal structure. A vertical line labeled '1' represents the initial pulse. A horizontal line labeled '2' represents the duration of the signal, which is followed by several curved lines representing the harmonics.</p>

Call type 5



Parts:



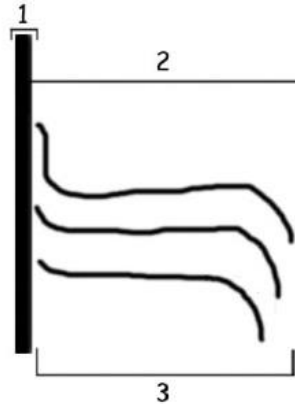
Measurements	n	Mean	SD	CV	Min	Max
Dur, total (ms)	10	504.10	85.51	0.17	346	605
Frequency, start (Hz)	10	4996.60	1304.73	0.26	2546	7765
Frequency, peak (Hz)	10	6181.60	671.36	0.11	5597	8017
Frequency, end (Hz)	10	5359.70	900.35	0.17	3983	7488
FHA (Hz)	10	6015.90	672.75	0.11	5436	7863

Call type 5 has a relatively simple contour consisting just of one part and therefore also belongs to the monophonic calls. This call is of relatively short duration and first increases steeply in frequency and then decreases gradually. The start frequency has the highest coefficient of variation, which can be explained by the strongly varying length of the increasing part of the call. Most of the time the first harmonic is visible around 12 kHz.

Call type 6



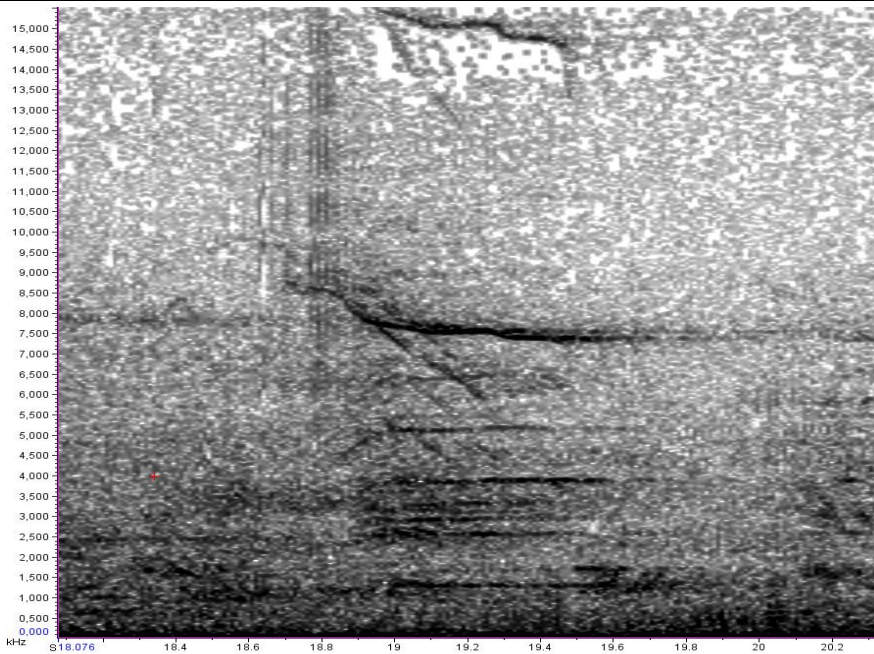
Parts:



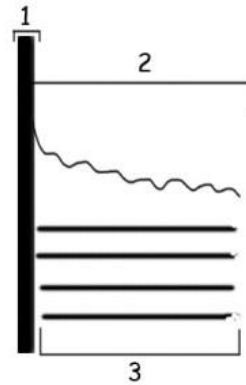
Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		10	902.50	158.89	0.18	622	1209
P1	Dur (ms)	10	98.50	54.63	0.55	42	197
	FHA (Hz)	5	7875.40	3803.20	0.48	4330	14036
P2	Dur (ms)	10	783.50	130.46	0.17	588	1034
	Frequency, start (Hz)	10	8300.90	1026.62	0.12	5658	9692
	Frequency, mid (Hz)	10	7221.70	956.00	0.13	4741	7858
	Frequency, end (Hz)	10	6084.80	1069.70	0.18	3876	7806
P3	Dur (ms)	10	724.50	128.67	0.18	533	938
	Frequency, start (Hz)	10	2978.00	888.40	0.30	1440	4636
	Frequency, mid (Hz)	10	2417.40	756.04	0.31	1152	3693
	Frequency, end (Hz)	10	2024.40	712.89	0.35	864	3195
FHA P2 & P3 (Hz)		10	3836.00	2191.85	0.57	1945	8220

Call type 6 is a biphonic call type. It is composed of three parts, of which just P1, the short and broadband pulse is the same as in most other call types. P2 decreases first sharply, then continues at constant frequency and finally decreases again. P3 shows a similar shape as P2, but is slightly delayed in onset and decreases less steeply in frequency in the beginning and the end compared to P2. The LFC is featured by harmonics between 2 and 9 kHz, which sometimes causes confusing identifying the actual HFC.

Call type 7



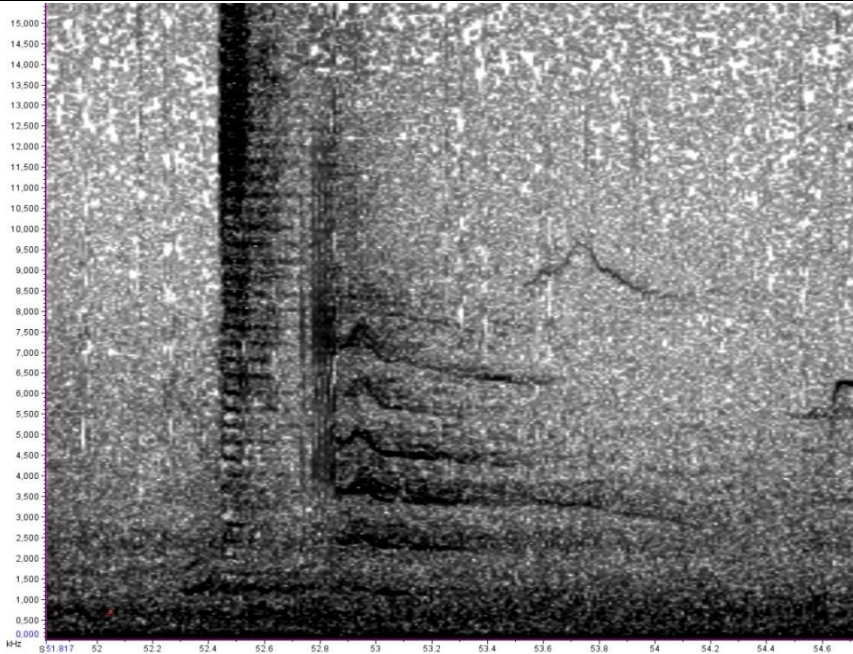
Parts:



Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		10	747.30	163.85	0.22	578	1034
P1	Dur (ms)	10	88.10	17.85	0.20	64	117
	FHA (Hz)	6	5612.50	2607.26	0.46	2759	8996
P2	Dur (ms)	10	671.60	158.64	0.24	509	974
	Frequency, start (Hz)	10	8502.60	850.44	0.10	7675	10740
	Frequency, mid (Hz)	10	7234.80	526.71	0.07	6601	8408
	Frequency, end (Hz)	10	6954.50	357.98	0.05	6522	7622
P3	Dur (ms)	10	554.00	169.37	0.31	372	936
	Frequency, start (Hz)	10	2689.80	639.78	0.24	1362	3641
	Frequency, mid (Hz)	10	2469.10	605.10	0.25	1205	3274
	Frequency, end (Hz)	10	2399.10	576.00	0.24	1205	3274
FHA P2 & P3 (Hz)		10	4233.50	1506.87	0.36	2625	7042

Call type 7 is also a biphonic call type with three parts, starting with P1, the short and broadband pulse. P2 is a downswEEPING tone with a moderate and constant frequency modulation pattern. P3 by contrast is characterized by a relatively constant frequency contour without frequency modulation and harmonics concentrated between 2 and 7 kHz. The duration of the whole call is shorter than other call types with similar structure (e.g. call 1 or 2).

Call type 8



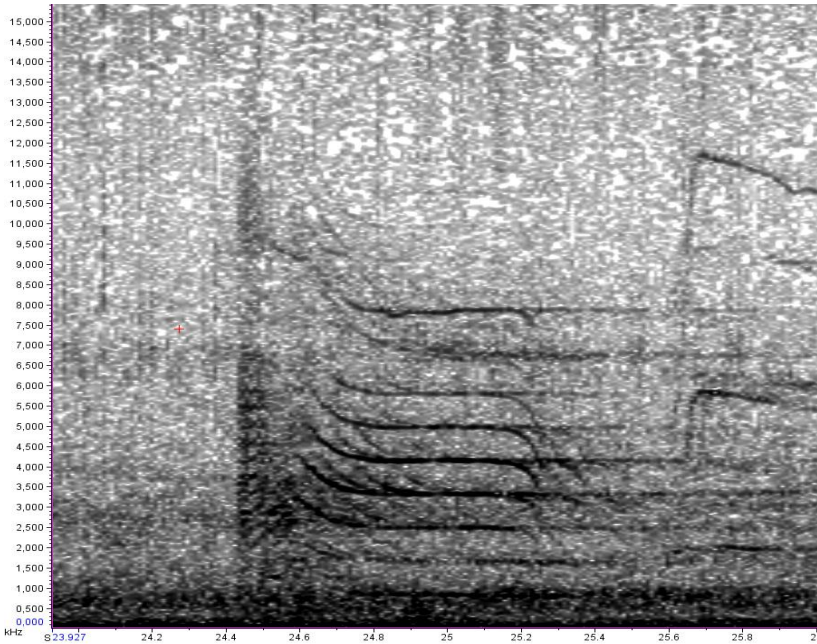
Parts:



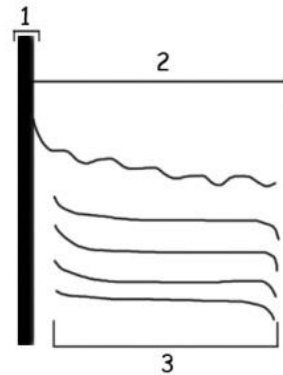
	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	10	852.90	246.14	0.29	477	1276
P1	Dur (ms)	10	87.90	34.05	0.39	42	141
	FHA (Hz)	8	3353.13	2361.73	0.70	555	8048
P2	Dur (ms)	10	738.60	225.36	0.31	441	1109
	Frequency, start (Hz)	10	3203.20	718.96	0.22	2331	4479
	Frequency, peak (Hz)	10	3339.50	748.37	0.22	2462	4610
	Frequency, end (Hz)	10	2475.00	817.62	0.33	1519	4086
	FHA (Hz)	10	3468.00	902.23	0.26	2242	5432

Call type 8 is a monophonic call type. The two call parts occur subsequently without any visible gaps. P1 is the short broadband pulse and P2 is a tonal signature with little/no patterns of frequency modulation. It first increases to a peak frequency and thereafter decreases to a contour of relative constant frequency which lasts more than 2/3 of the overall call duration.

Call type 9



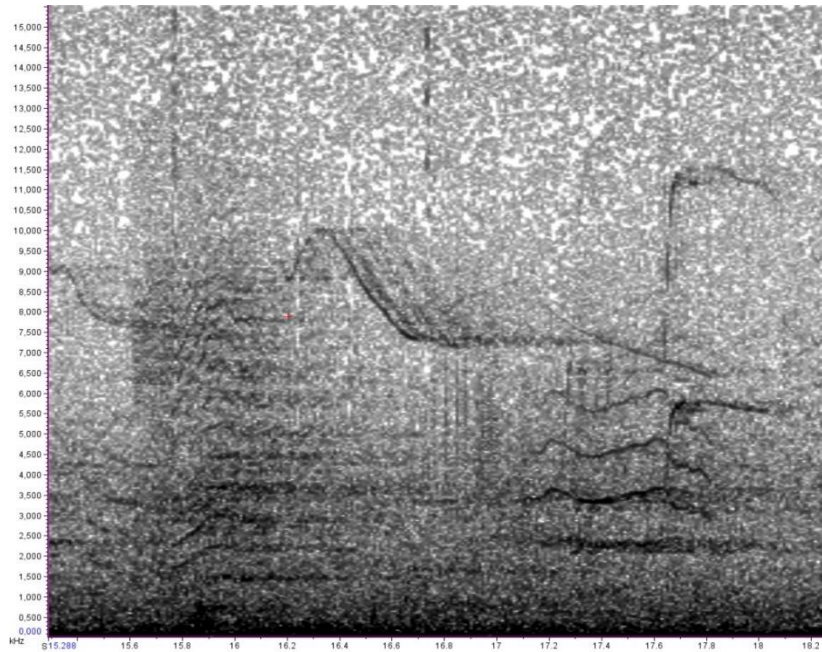
Parts:



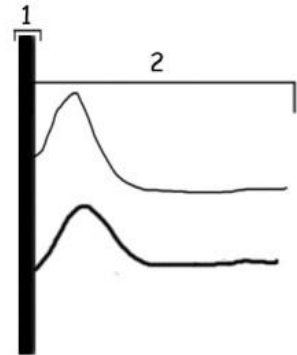
	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	11	788.00	120.01	0.15	623	1023
P1	Dur (ms)	11	93.09	42.69	0.46	50	202
	FHA (Hz)	6	6909.17	2391.47	0.35	2804	9769
P2	Dur (ms)	11	698.27	82.28	0.12	594	861
	Frequency, start (Hz)	11	8743.64	749.58	0.09	6857	9807
	Frequency, mid (Hz)	11	7606.91	174.83	0.02	7311	7866
	Frequency, end (Hz)	11	7150.73	300.38	0.04	6555	7513
P3	Dur (ms)	11	636.73	104.44	0.16	465	774
	Frequency, start (Hz)	11	3575.18	1023.90	0.29	1235	4412
	Frequency, mid (Hz)	11	3213.09	1058.63	0.33	1235	3958
	Frequency, end (Hz)	11	2706.45	958.53	0.35	756	3378
	FHA P2 & P3 (Hz)	11	4690.91	1884.29	0.40	2615	7689

Call type 9 is a combination of parts from call type 1 and 6. P1 is the common broadband pulse, P2 is a HFC, which decreases in frequency and features a constant and moderate frequency modulation pattern. P3 is a LFC similar to the LFC of call type 6 (a decreasing tone, followed by a constant tone and a final decline). P3 also features dense harmonics between 2 and 7 kHz. The fundamental frequency of P3 lies on average slightly higher than the fundamental frequency of call type 6. The total duration of this call type is slightly shorter compared to call types with similar segments.

Call type 10



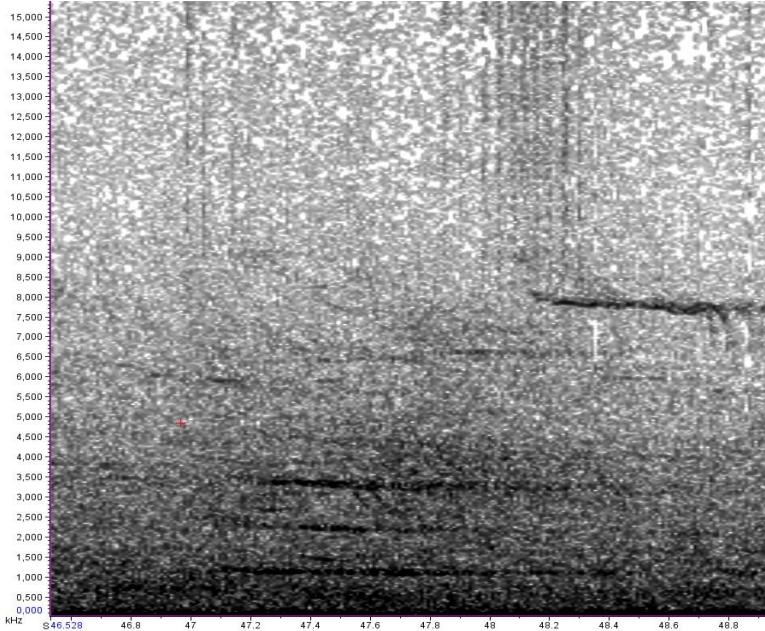
Parts:



Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		10	781.60	324.94	0.42	539	1686
P1	Dur (ms)	10	151.20	149.15	0.99	72	570
	FHA (Hz)	6	3798.67	3002.09	0.79	1092	8278
P2	Dur (ms)	10	636.60	193.47	0.30	433	1155
	Frequency, start (Hz)	10	9058.00	468.26	0.05	8435	9980
	Frequency, peak (Hz)	10	9833.40	285.58	0.03	9247	10163
	Frequency, end (Hz)	10	7421.00	596.80	0.08	6732	8278
	FHA (Hz)	10	7549.80	1269.11	0.17	4570	9361

Call type 10 is a monophonic call type containing the common short and broadband pulse as P1 and the HFC of call type 2 as P2. In most calls of this type, only the fundamental frequency is visible as P2 (as in the HFC from call type 2). In some cases however this fundamental frequency is lower in frequency with one or more harmonics visible. The whole call type itself is shorter than call type 2 whereas the pulse is longer.

Call type 11



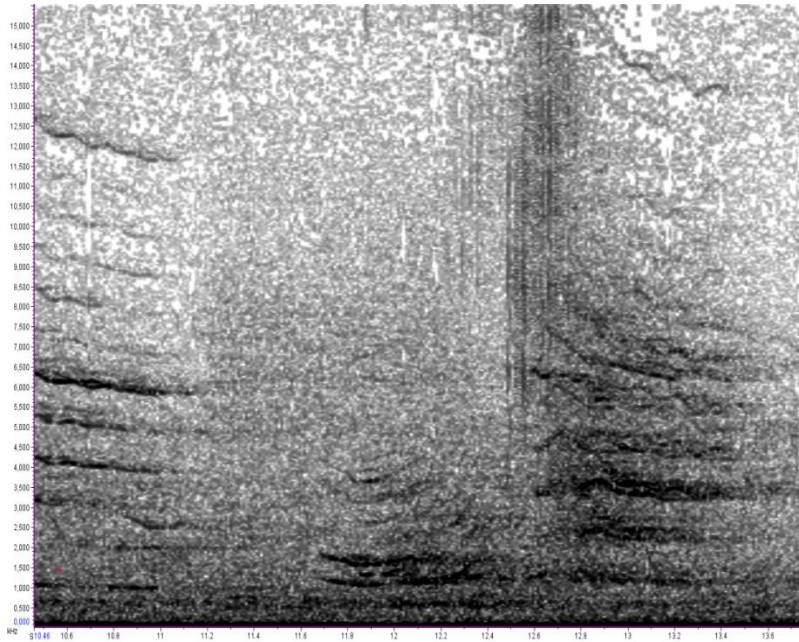
Parts:



Measurements	n	Mean	SD	CV	Min	Max
Dur (ms)	21	1254.48	394.25	0.31	566	2113
Frequency, start (Hz)	21	1375.33	394.44	0.29	891	2673
Frequency, mid (Hz)	21	1310.86	389.39	0.30	891	2441
Frequency, end (Hz)	21	1269.33	402.92	0.32	802	2370
FHA (Hz)	21	1529.76	716.46	0.47	859	3376

Call type 11 is a simple monophonic call consisting of only one part. This call type is relatively long and shows a constant and moderate pattern of frequency modulation. However this regular pattern of frequency modulation in some calls is nearly not visible.

Call type 12



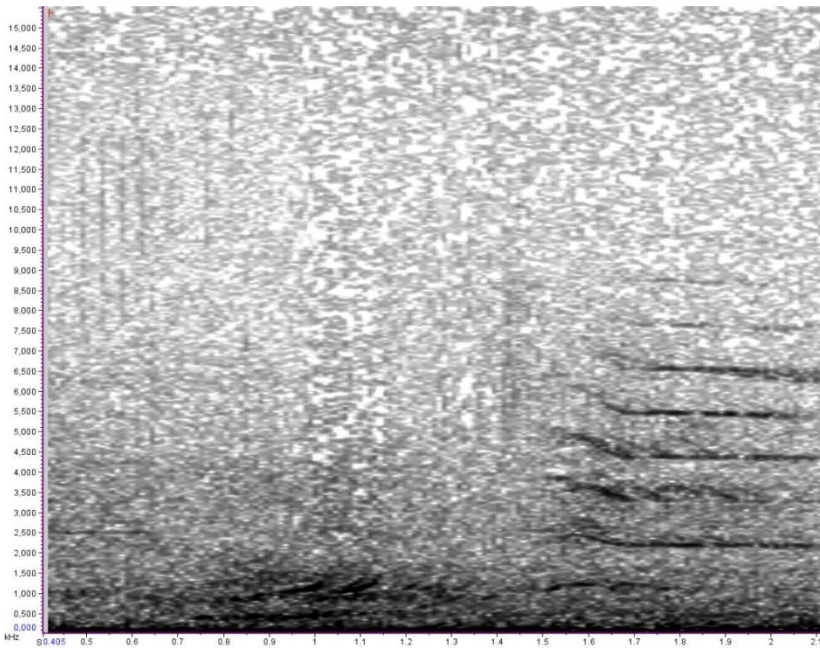
Parts:



Measurements	n	Mean	SD	CV	Min	Max
Dur, total (ms)	10	578.70	212.34	0.37	299	958
Frequency, start (Hz)	10	1129.00	326.13	0.29	453	1689
Frequency, mid (Hz)	10	990.10	284.00	0.29	353	1307
Frequency, end (Hz)	10	1240.10	414.56	0.33	302	1764
FHA (Hz)	10	1329.30	468.44	0.35	362	2064

Call Type 12 is one of the few call types at really low frequencies. It is a monophonic call type with just one part. This part is a concave tone, which first decreases in frequency and then increases again. Additionally it is characterized by its short duration and tightly spaced harmonics below 2.5 kHz.

Call type 13



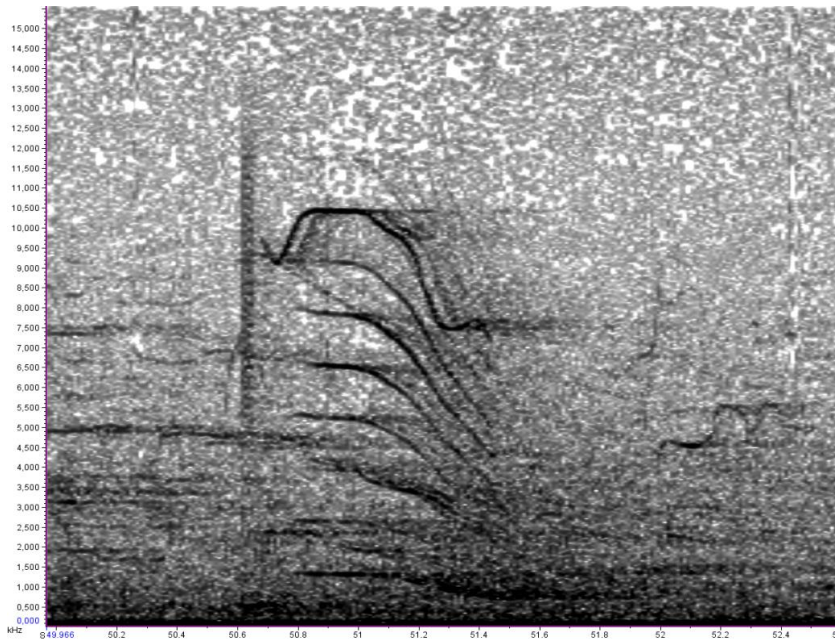
Parts:



Measurements	n	Mean	SD	CV	Min	Max
Dur, total (ms)	8	211.88	74.33	0.35	122	335
Frequency, start (Hz)	8	1203.38	294.57	0.24	882	1840
Frequency, mid (Hz)	8	1244.50	331.60	0.27	958	1991
Frequency, end (Hz)	8	1632.13	384.58	0.24	1134	2294
FHA (Hz)	8	1246.25	360.16	0.29	929	2064

Call type 13 is also a monophonic call type at really low frequencies. It also consists of one part. Calls are typically short in duration. The frequency contour increases continuously. However this call type here is defined to be composed of just one part, it actually features a varying number of fundamental frequencies subsequently following each other. Because the differentiation of single contours (sometimes maybe also including harmonics) was difficult due to noise limitations in the lower frequency band, the call type was just defined by its overall presence.

Call type 14



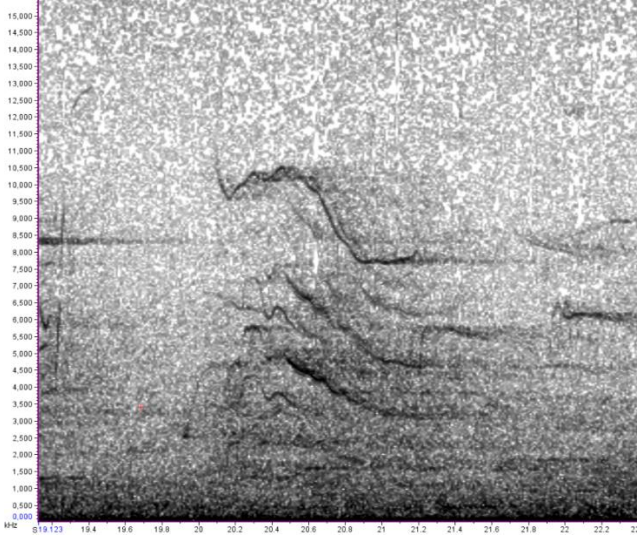
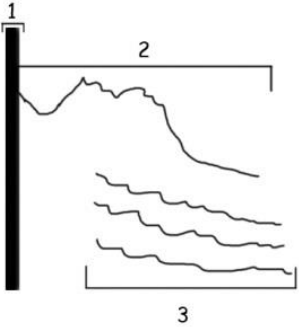
Parts:



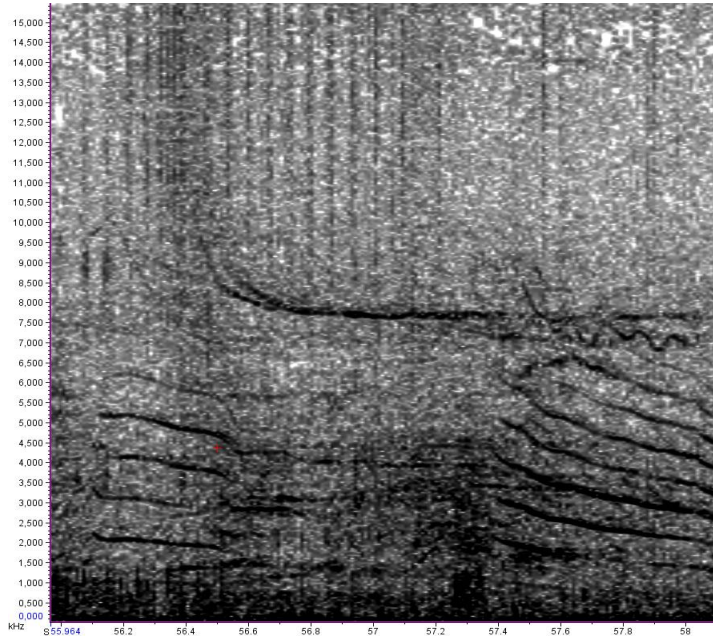
Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		11	1210.05	515.61	0.43	486	2759
P1	Dur (ms)	11	105.90	40.26	0.38	43	193
	FHA (Hz)	4	2775.67	199.76	0.07	189	535
P2	Dur (ms)	11	1075.50	523.19	0.49	486	2679
	Frequency, start (Hz)	11	9593.05	563.06	0.06	8597	10302
	Frequency, peak (Hz)	11	10176.89	742.72	0.07	8093	11282
	Frequency, end (Hz)	11	6950.74	897.64	0.13	5329	8056
P3	Dur (ms)	11	882.57	378.02	0.43	400	1932
	Frequency, start (Hz)	11	3092.02	1313.68	0.42	1613	5168
	Frequency, mid (Hz)	11	2506.20	1203.61	0.48	1386	4790
	Frequency, end (Hz)	11	1830.02	696.87	0.38	1210	3101
FHA P2 & P3 (Hz)		11	4892.65	2701.37	0.55	1481	10321

Call type 14 is a biphonic call type consisting of three parts. P1 is the common short and broadband pulse. P2 is a HFC, which first decreases and then increases to a peak frequency, from where the tone decreases with an irregular slope (sometimes also short frequency increases are integrated). The duration of P2 is relatively variable, which is also reflected in the highest coefficient of variation for this parameter. P3 of this call type starts a little bit later than the LFC in other call types and at higher frequencies. P3 is characterized by a constant frequency tone which then decreases sharply or an overall continuously decreasing tone. The LFC features harmonics between 2 and 9 kHz. Call type 14 exists in two different variants. The first variant features no pattern of frequency modulation in its HFC and LFC (see above).

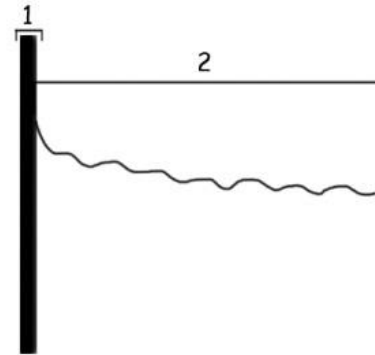
The second variant shows a constant and moderate pattern of frequency modulation in both its HFC and LFC (see below). This variant in most cases exhibits the short and broadband pulse as P1, but in some cases this starting pulse appears to be absent (see below). If P1 is absent the characteristic shapes of P2 and P3 are nevertheless present and then determining for call type recognition.

Variant	Example	Parts
2		

Call type 15



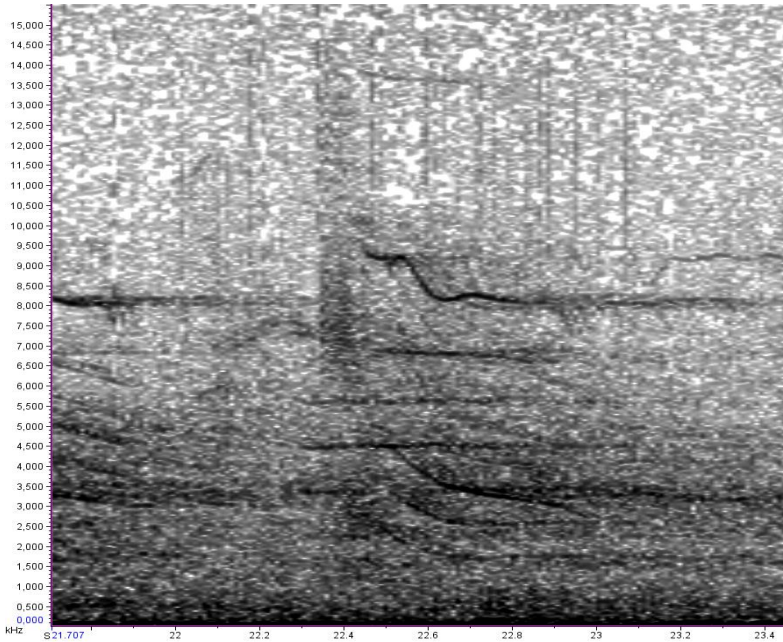
Parts:



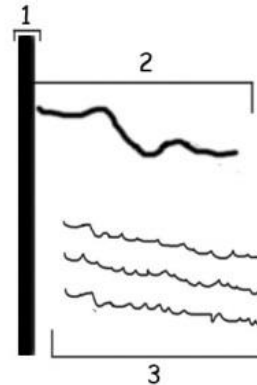
	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	7	1220.43	227.99	0.19	835	1540
P1	Dur (ms)	7	115.29	83.64	0.73	58	300
	FHA (Hz)	3	13186.67	2191.86	0.17	10855	15205
P2	Dur (ms)	7	1120.71	226.85	0.20	755	1485
	Frequency, start (Hz)	7	9115.71	1259.23	0.14	7780	10792
	Frequency, mid (Hz)	7	7410.29	402.16	0.05	6653	7884
	Frequency, end (Hz)	7	7263.14	490.16	0.07	6260	7780
	FHA (Hz)	7	7360.57	304.77	0.04	6735	7693

Call type 15 is a monophonic call type. It is composed of two parts: a short and broadband pulse (P1) and a HFC (P2). The HFC is a constantly downswEEPing tone with a moderate pattern of frequency modulation. The total duration of this call type is comparably long. The FHA of P1 is on average higher than this of the short and broadband pulse in other call types.

Call type 16



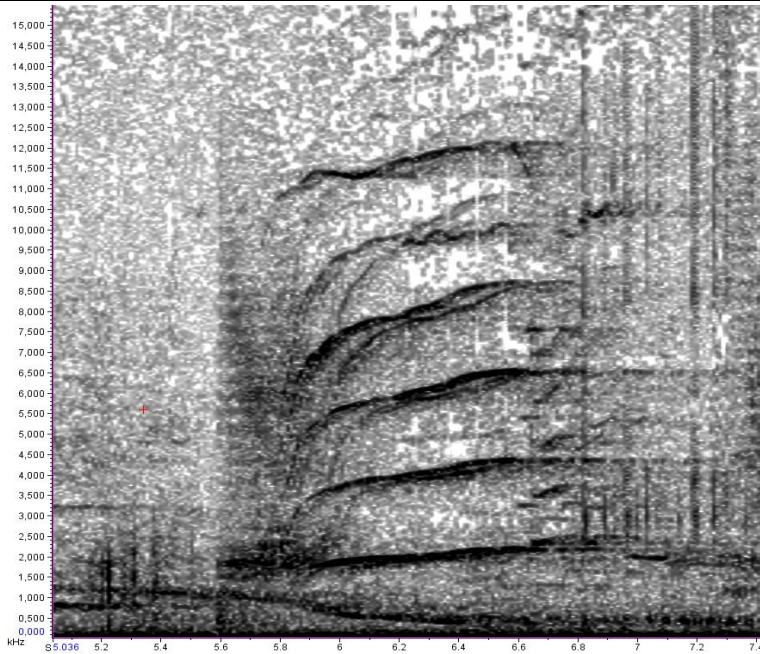
Parts:



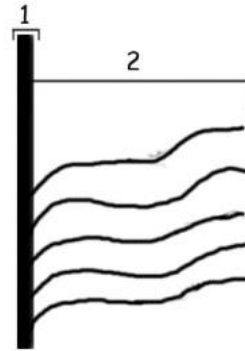
Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		6	724.83	211.72	0.29	388	990
P1	Dur (ms)	6	84.17	24.47	0.29	60	127
	FHA (Hz)	5	5817.40	4283.65	0.74	2519	13184
P2	Dur (ms)	6	622.83	218.43	0.35	332	908
	Frequency, start (Hz)	6	9106.83	416.94	0.05	8435	9561
	Frequency, mid (Hz)	6	7465.33	469.25	0.06	6679	8068
	Frequency, end (Hz)	6	6701.33	799.26	0.12	5920	8068
P3	Dur (ms)	6	554.50	154.19	0.28	292	755
	Frequency, start (Hz)	6	2462.00	584.45	0.24	1624	3274
	Frequency, mid (Hz)	6	1889.83	506.76	0.27	1283	2488
	Frequency, end (Hz)	6	1614.83	419.28	0.26	916	1990
FHA P2 & P3 (Hz)		6	3523.83	1868.79	0.53	2050	7205

Call type 16 is a biphonic call type composed of three parts. P1 is the common short and broadband pulse. P3 is a LFC similar to LFCs of various other call types (i.e. 1 & 2). The fundamental frequency of P3 decreases towards the end of the call, has a constant and moderate pattern of frequency modulation and harmonics between 2 and 9 kHz. Call parts P1 and P3 are similar in parameter values to respective segments occurring in other call types. P2 of this call type has a distinct signature shape, first increasing slowly, then decreasing sharply in frequency, slightly increasing again to finally decrease to the end frequency. This typical signature shape was exhibited by all calls that were assigned to call type 16. This call type is further characterized by a relative short duration.

Call type 17



Parts:

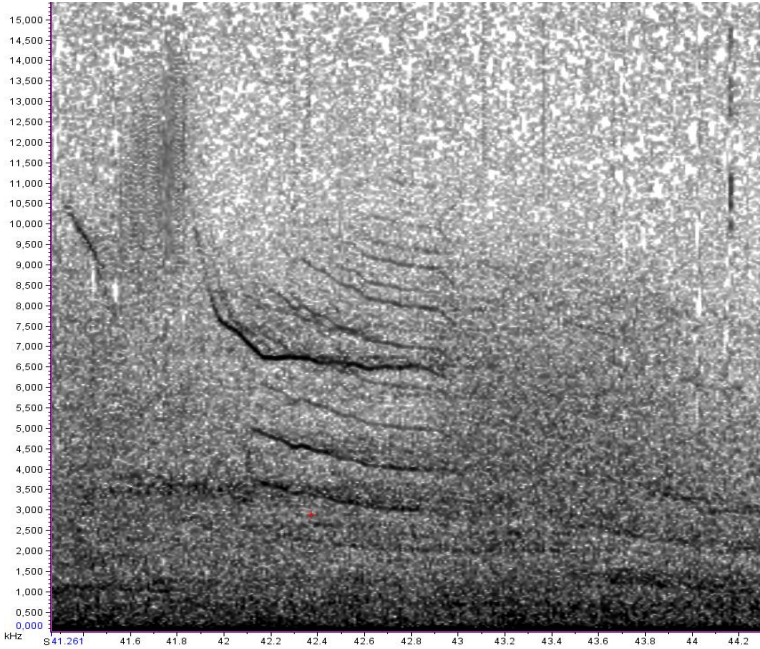


Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		5	1067.40	156.19	0.15	868	1293
P1	Dur (ms)	5	176.40	60.67	0.34	119	270
	FHA (Hz)	4	2588.00	1046.98	0.40	1686	3971
P2	Dur (ms)	5	865.60	117.60	0.14	720	1008
	Frequency, start (Hz)	5	1935.80	594.87	0.31	1285	2697
	Frequency, mid (Hz)	5	3005.00	847.83	0.28	2042	4059
	Frequency, end (Hz)	5	3306.80	926.33	0.28	2143	4336
	FHA (Hz)	5	3264.60	1504.11	0.46	1875	5641

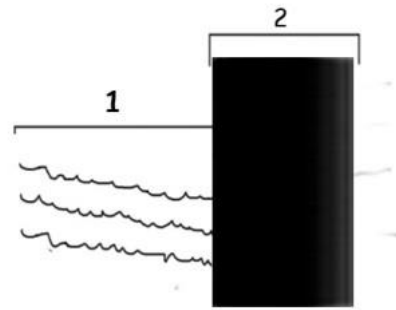
Call type 17 is a monophonic call type composed of two parts. P1 is the short and broadband pulse. P2 is a LFC first increasing in frequency, then levelling to a constant frequency and then increasing again till the end.

Less frequent call types (occurred between 5 and 20 times)

Call type 18



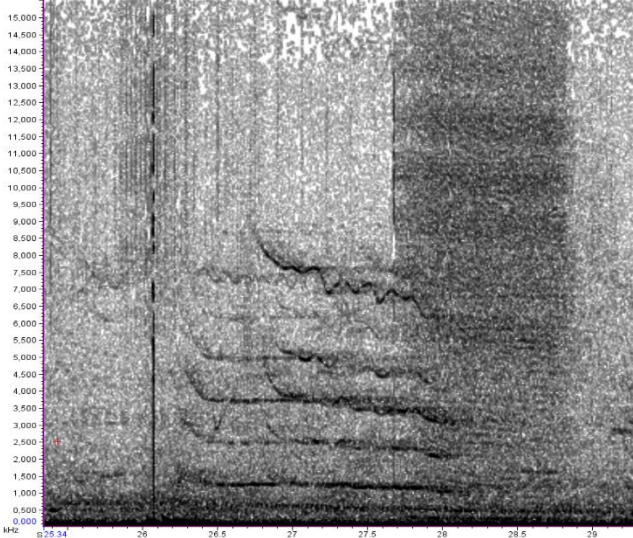
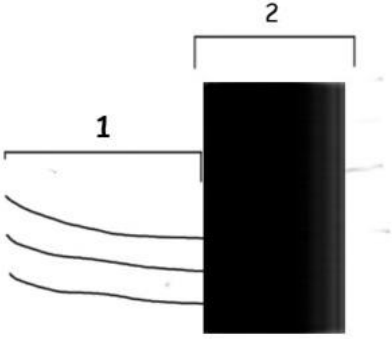
Parts:



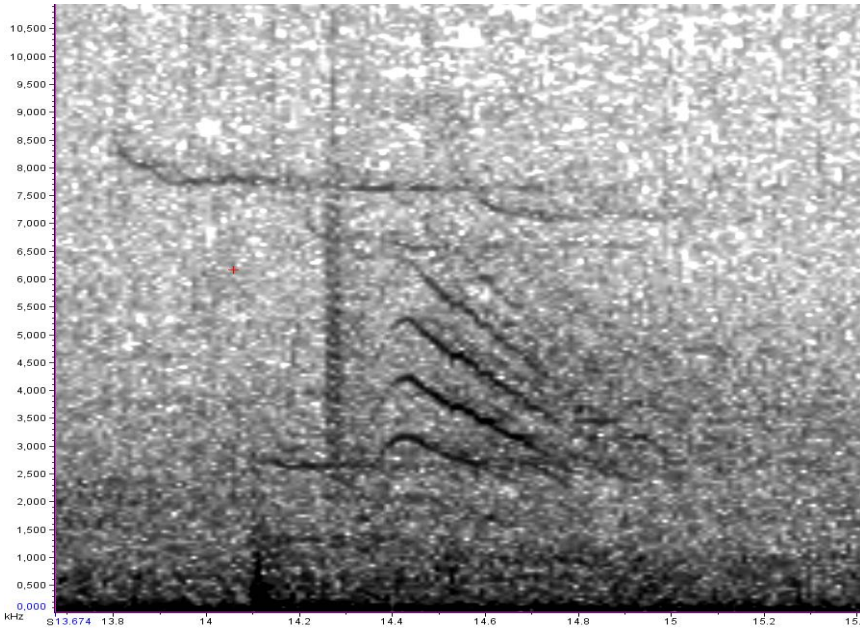
	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	8	2059.65	221.36	0.11	1121	2607
P1	Dur (ms)	8	1020.86	181.84	0.18	356	1440
	Frequency, start (Hz)	8	2374.86	1261.42	0.53	864	4793
	Frequency, mid (Hz)	8	2032.00	1251.21	0.62	1021	4946
	Frequency, end (Hz)	8	1778.29	832.08	0.47	995	3431
	FHA (Hz)	8	2267.72	1577.30	0.70	1121	5911
P2	Dur (ms)	8	1029.15	133.88	0.13	765	1177
	FHA (Hz)	5	6593.63	1556.12	0.24	1303	10179

Call type 18 is a monophonic call type consisting of two parts. It typically starts with the LFC (P1) which is followed by a longer duration broadband burst pulse (P2). The frequency contour of P1 is characterized by a constant decrease in frequency and various harmonics between 2 and 10 kHz. The call type exists in two variants. The first variant distinguishes itself by a constant and moderate pattern of frequency modulation (see above).

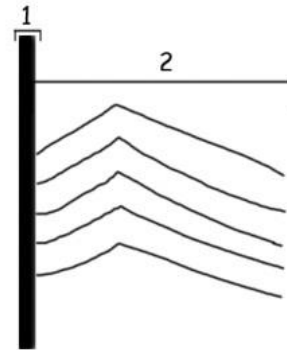
The second variant by contrast features no frequency modulation in P1 (see below). In some cases P1 just decreases over a short duration and continuous then with a constant frequency (see below).

Variant	Example	Parts
2		

Call type 19



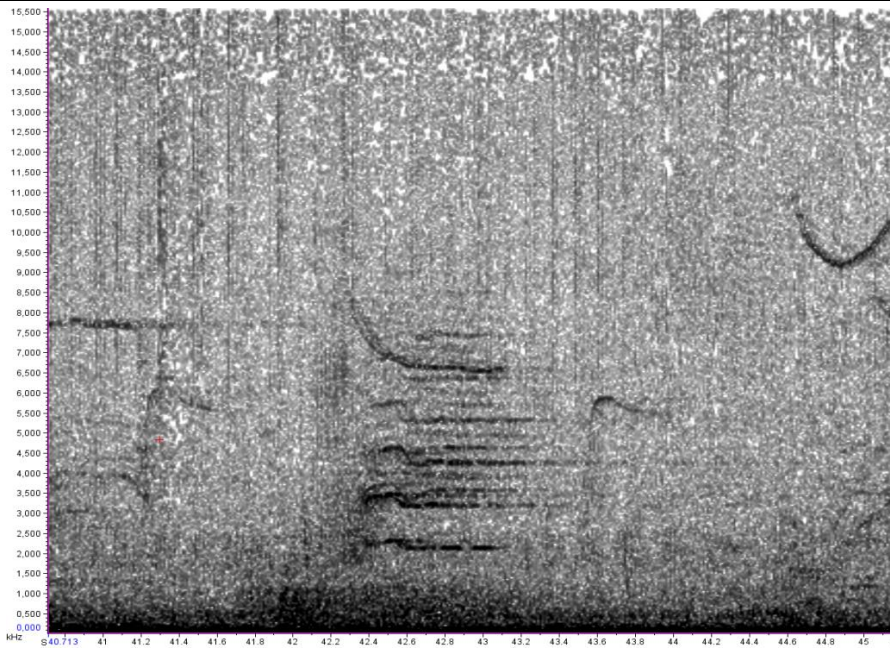
Parts:



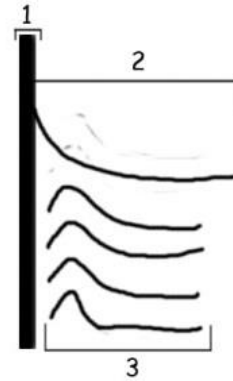
	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	6	622.83	108.70	0.17	511	810
P1	Dur (ms)	6	93.50	53.07	0.57	36	180
	FHA (Hz)	4	4471.00	1863.38	0.42	3183	7232
P2	Dur (ms)	6	468.17	133.18	0.28	270	652
	Frequency, start (Hz)	6	2819.00	1137.14	0.40	1109	4538
	Frequency, peak (Hz)	6	3311.00	1526.25	0.46	1336	5572
	Frequency, end (Hz)	6	2352.83	1292.76	0.55	680	4538
	FHA (Hz)	6	3117.00	1438.83	0.46	1134	4727

Call type 19 is a monophonic call type composed of two parts. P1 is the short and broadband pulse. P2 increases sharply in frequency up to a climax and decreases thereafter also sharply. The overall duration of the call is relatively short compared to other call types. Many parameters for this call type show a relatively high coefficient of variation, indicating the high variability within this call type.

Call type 20



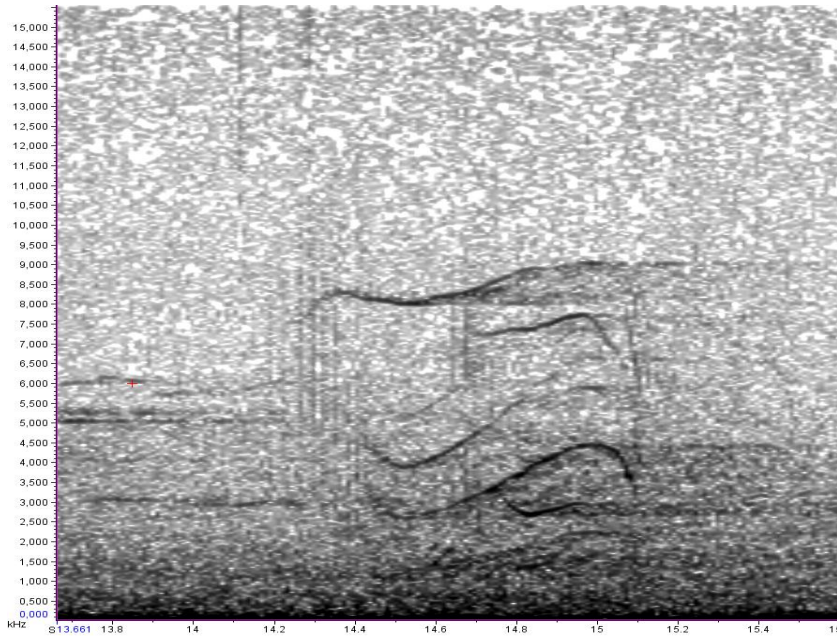
Parts:



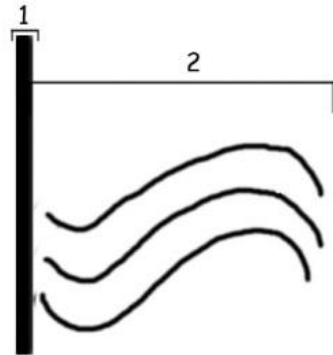
Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		8	878.50	224.97	0.26	544	1109
P1	Dur (ms)	8	109.75	21.97	0.20	86	140
	FHA (Hz)	6	3747.33	4642.49	1.24	551	12905
P2	Dur (ms)	8	734.13	211.77	0.29	403	976
	Frequency, start (Hz)	8	9107.63	968.55	0.11	7513	10690
	Frequency, mid (Hz)	8	6592.75	247.41	0.04	6303	7034
	Frequency, end (Hz)	8	6223.88	350.73	0.06	5723	6630
P3	Dur (ms)	8	730.38	234.60	0.32	392	1030
	Frequency, start (Hz)	8	2804.38	596.62	0.21	2143	3479
	Frequency, peak (Hz)	8	2946.25	542.50	0.18	2344	3580
	Frequency, end (Hz)	8	2451.38	546.48	0.22	1890	3277
FHA P2 & P3 (Hz)		8	2997.50	768.61	0.26	1118	3372

Call type 20 is a biphonic call type composed of three parts, starting with the short and broadband pulse as P1. P2 is a HFC constantly decreasing in frequency and without frequency modulations. P3 is a LFC similar to that from call type 8. Its fundamental frequency increases to a peak frequency and then decreases again to a constant frequency. P3 is also characterized by the presence of harmonics between 2 and 7 kHz.

Call type 21



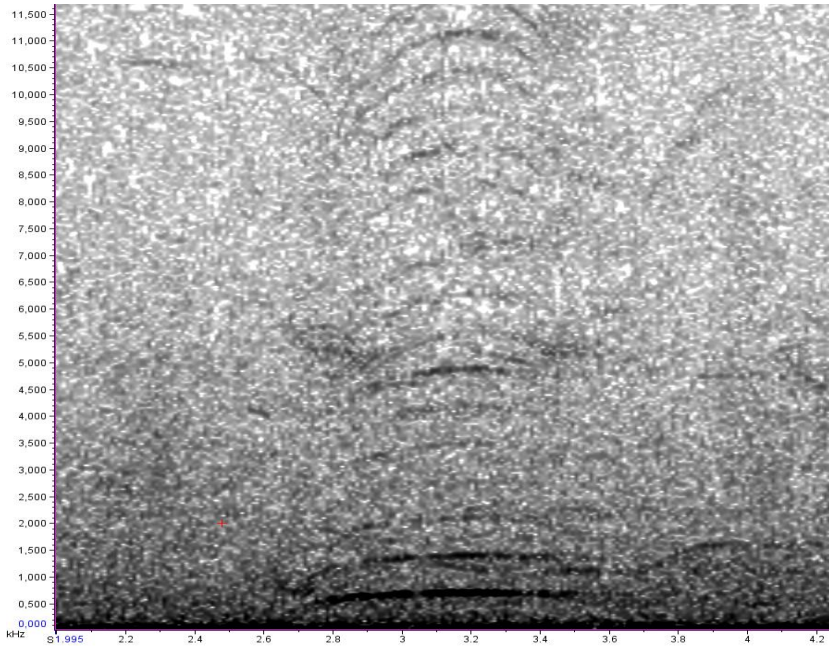
Parts:



Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		4	740.00	121.89	0.16	594	853
P1	Dur (ms)	4	119.00	28.98	0.24	97	161
	FHA (Hz)	2	7363.00	6144.76	0.83	3018	11708
P2	Dur (ms)	4	635.00	135.61	0.21	475	777
	Frequency, start (Hz)	4	2200.00	766.57	0.35	1466	2986
	Frequency, peak (Hz)	4	3562.00	1049.87	0.29	2069	4531
	Frequency, end (Hz)	4	2809.00	789.65	0.28	1807	3719
	FHA (Hz)	4	2799.50	1214.31	0.43	1638	3937

Call type 21 is a monophonic call type, starting with the short and broadband pulse (P1). P2 is a LFC and is characterized by its typical wave-shaped form. First it decreases to a minimum in frequency, then increases again faintly to a peak frequency and finally decreases to the end frequency.

Call type 22



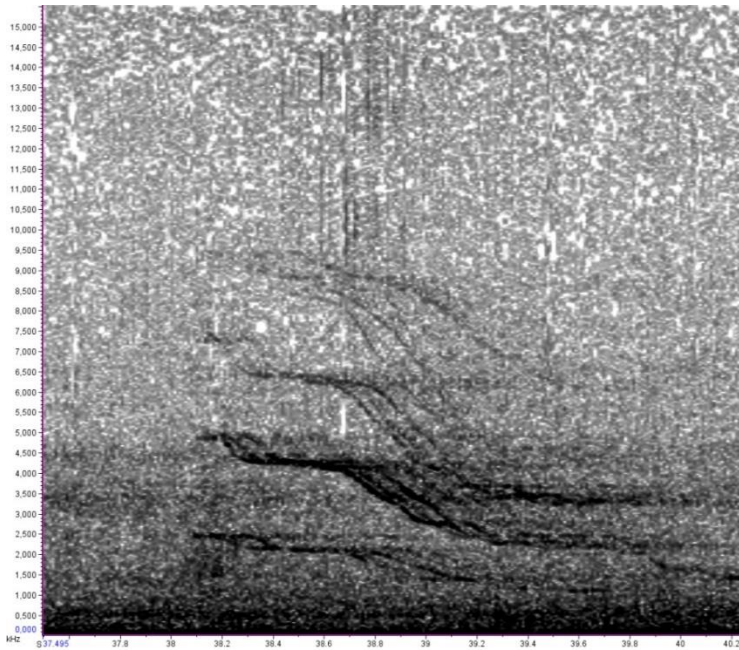
Parts:



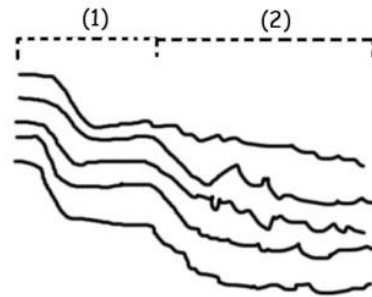
Measurements	n	Mean	SD	CV	Min	Max
Dur, total (ms)	7	666.71	265.38	0.40	277	990
Frequency, start (Hz)	7	831.43	368.58	0.44	327	1260
Frequency, mid (Hz)	7	892.00	414.23	0.46	353	1497
Frequency, end (Hz)	7	835.00	452.30	0.54	277	1411
FHA (Hz)	7	861.29	402.91	0.47	378	1497

Call type 22 is a call type at really low frequencies and is composed of only one part. Its contour faintly increases in frequency until it reaches a constant tone. Harmonics are visible between 1 and 7 kHz.

Call type 23



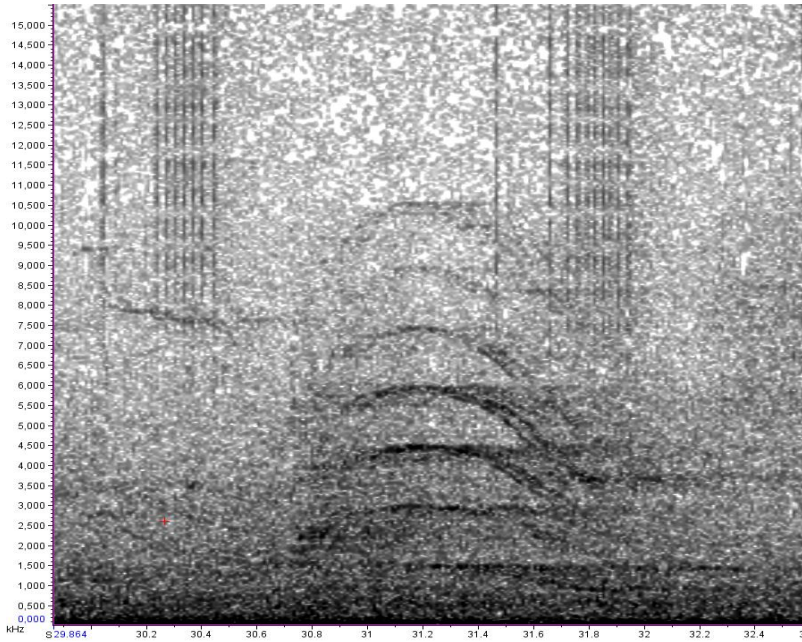
Parts:



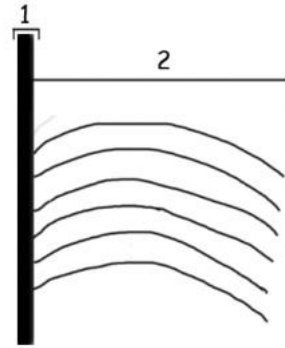
Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		4	1430.50	317.86	0.22	958	1642
P1	Dur (ms)	4	641.00	188.84	0.29	407	857
	Frequency, start (Hz)	4	2552.00	259.10	0.10	2243	2823
	Frequency, mid (Hz)	4	2445.00	300.34	0.12	2168	2823
	Frequency, end (Hz)	4	2401.00	273.59	0.11	2092	2748
	FHA (Hz)	4	3651.25	1609.78	0.44	2253	5625
P2	Dur (ms)	4	797.75	417.42	0.52	252	1181
	Frequency, start (Hz)	4	2401.00	258.55	0.11	2117	2723
	Frequency, mid (Hz)	4	1354.75	240.19	0.18	1109	1638
	Frequency, end (Hz)	4	982.75	360.50	0.37	479	1336
	FHA (Hz)	4	2812.50	794.80	0.28	1686	3372

Call type 23 is a monophonic call type composed of two parts, which are not separated by a break and therefore not really single segments (indicated by dotted line and number of parts in brackets). This call type is characterized by its long duration. P1 is z-shaped and starts with a constant frequency, decreases then sharply and then levels to a relatively constant frequency again. P2 decreases faintly in frequency and has a relatively regular pattern of frequency modulation. Harmonics are visible between 1 and 9 kHz.

Call type 24



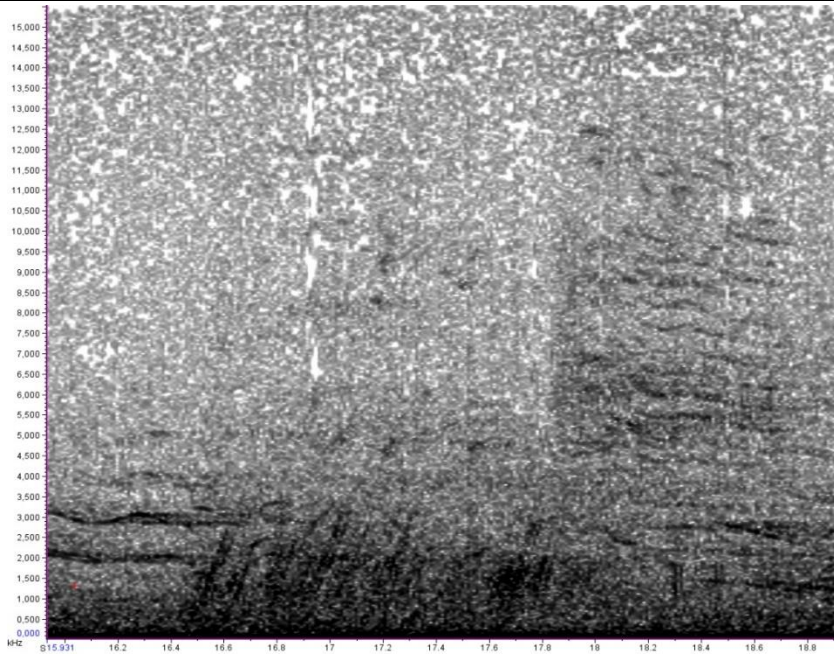
Parts:



	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	3	1282.00	180.39	0.14	1127	1480
P1	Dur (ms)	3	115.00	12.12	0.11	101	122
	FHA (Hz)	2	1938.00	356.38	0.18	1686	2190
P2	Dur (ms)	3	1055.00	232.49	0.22	857	1311
	Frequency, start (Hz)	3	2109.00	773.28	0.37	1260	2773
	Frequency, peak (Hz)	3	2352.33	846.23	0.36	1411	3050
	Frequency, end (Hz)	3	1403.00	343.55	0.24	1134	1790
	FHA (Hz)	3	3193.00	1567.79	0.49	1402	4317

Call type 24 is a monophonic call type composed of two parts. It starts with the short and broadband pulse (P1). P2 is of convex shape and first increases faintly to a peak frequency and then decreases again down to the end frequency. P2 is defined as a LFC and has harmonics between 2 and 10 kHz.

Call type 25



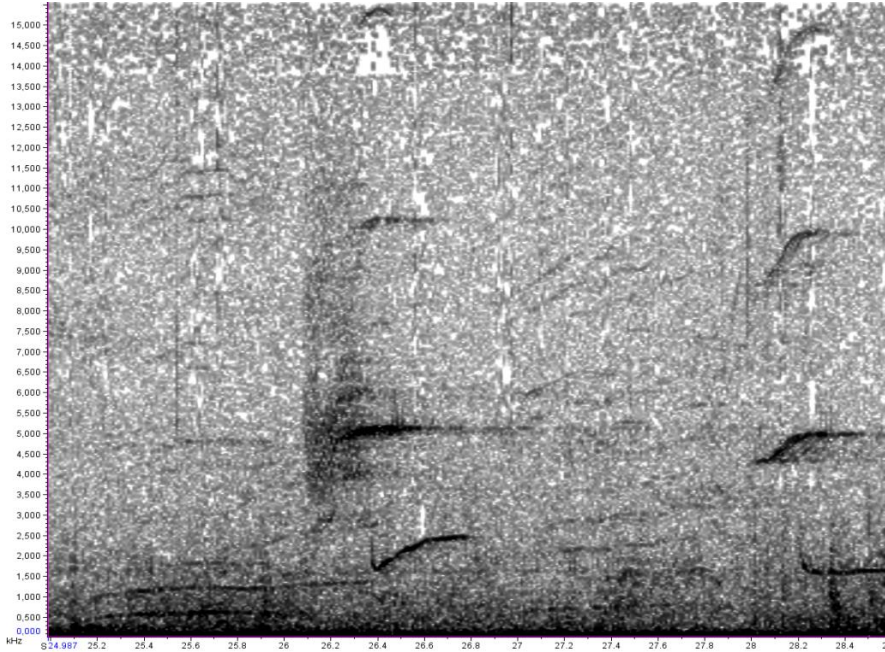
Parts:



Measurements	n	Mean	SD	CV	Min	Max
Dur, total (ms)	5	410.40	256.12	0.62	195	849
FHA (Hz)	5	1614.80	944.50	0.58	785	3161
Frequency, low (Hz)	5	759.20	333.70	0.44	366	1100
Frequency, high (Hz)	5	4316.40	1328.63	0.31	2933	6260

Call type 25 is again a call type at really low frequencies. The call is composed of a sequence of upsweeps. These 'call parts' are difficult to differentiate due to noise conditions in the lower frequency band, are very closely spaced and occur in varying numbers. Out of that reasons just their overall presence is used to distinguish this call type. The coefficient of variation is highest for the total duration, because this is dependent on the number of segments present in each call.

Call type 26



Parts:



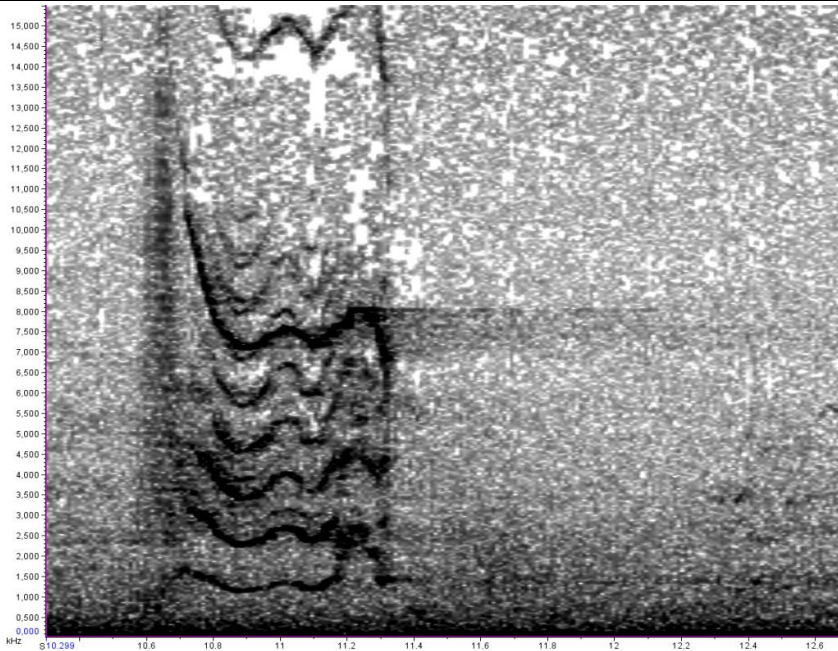
Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		2	466.00	190.92	0.41	331	601
P1	Dur (ms)	2	54.00	35.36	0.65	29	79
	FHA (Hz)	2	4483.00	545.89	0.12	4097	4869
P2	Dur (ms)	2	390.50	119.50	0.31	306	475
	Frequency, start (Hz)	2	4588.50	106.77	0.02	4513	4664
	Frequency, mid (Hz)	2	5332.00	339.41	0.06	5092	5572
	Frequency, end (Hz)	2	5357.50	338.70	0.06	5118	5597
FHA (Hz)		2	5341.50	400.93	0.08	5058	5625

Call type 26 is a monophonic call consisting of two parts. P1 is again the short and broadband pulse. P2 has a short duration and a faintly increasing frequency contour. In most cases P2 exhibits up to two harmonics between 10 and 15 kHz.

Additionally observed calls

- No official call types -

Call type 27



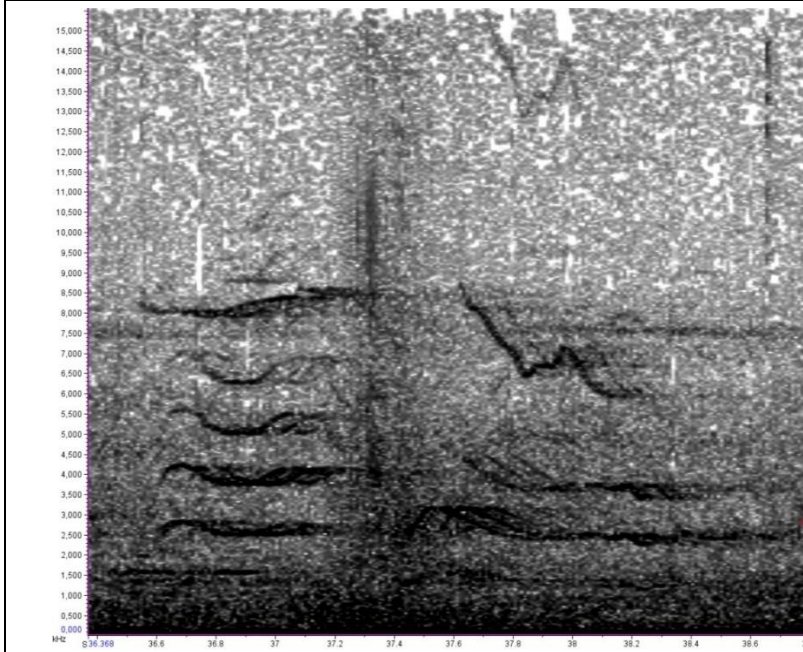
Parts:



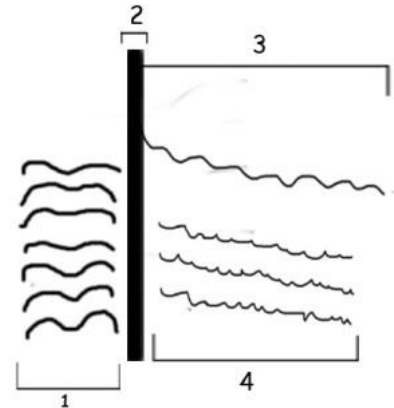
Measurements		n	Mean	SD	CV	Min	Max
Dur, total (ms)		4	607.75	147.66	0.24	487	815
P1	Dur (ms)	4	141.00	104.86	0.74	80	298
	FHA (Hz)	4	7878.00	4500.03	0.57	1140	10319
P2	Dur (ms)	4	469.50	50.79	0.11	419	519
	Frequency, start (Hz)	4	8775.25	3790.12	0.43	3091	10766
	Frequency, mid (Hz)	4	6483.00	2056.15	0.32	3431	7806
	Frequency, end (Hz)	4	5566.25	1540.64	0.28	3405	7046
P3	Dur (ms)	4	473.50	114.01	0.24	373	629
	Frequency, start (Hz)	4	1794.75	137.71	0.08	1684	1994
	Frequency, mid (Hz)	4	1528.75	572.95	0.37	1019	2349
	Frequency, end (Hz)	4	1550.75	401.42	0.26	1196	2127
FHA P2 & P3 (Hz)		4	2311.00	952.07	0.41	1360	3401

Call type 27 is a biphonic call type. This call type starts with the short and broadband pulse as P1. In some cases the independent HFC P2 is difficult to distinguish from the harmonics of the LFC (P3). It can therefore not be excluded that this call type also occurs in a monophonic variant. The shape of the P2 signature is often w-shaped and sometimes followed by a sharp decrease in frequency. P3 starts always a little bit later than P2, but often has the same w-shaped form as the HFC.

Call 28

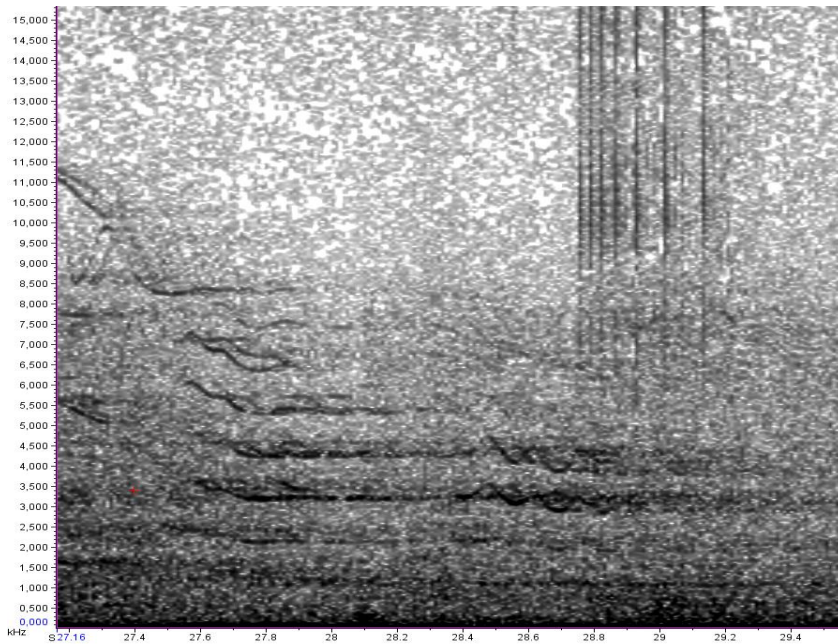


Parts:

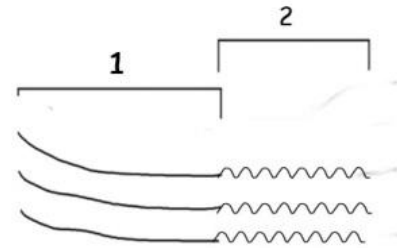


Call 28 is a highly variable biphonic call composed of four parts. The first part is a LFC, which is m-shaped. P2 is the short and broadband pulse. P3 and P4 resembled the HFC and LFC from call type 1. Sometimes call parts 3 and 4 can have different shapes. The determination of this call is based on the number of parts (4), the shape of the LFC (P1) and the combination of a LFC and a HFC as P3 and P4. Due to the high variability and the relatively small number calls for this call, no measurements were performed.

Call 29



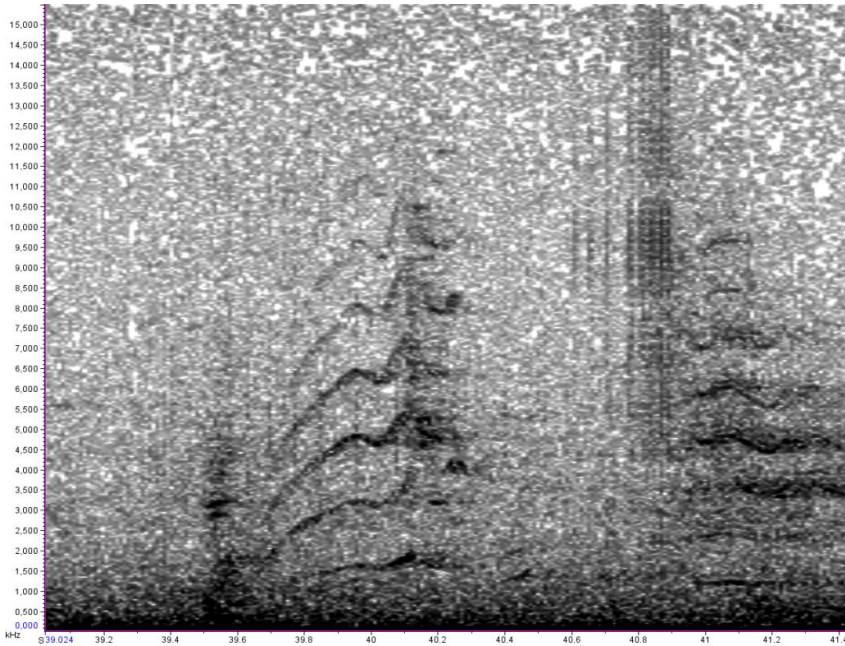
Parts:



	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	2	1388	53.74	0.04	1350	1426
P1	Dur (ms)	2	817.5	36.06	0.04	792	843
	Frequency, start (Hz)	2	3302.5	249.61	0.08	3126	3479
	Frequency, mid (Hz)	2	3037.5	195.87	0.06	2899	3176
	Frequency, end (Hz)	2	3214	124.45	0.04	3126	3302
	FHA (Hz)	2	3111.5	144.96	0.05	3009	3214
P2	Dur (ms)	2	605	19.80	0.03	591	619
	Frequency, start (Hz)	2	3214	124.45	0.04	3126	3302
	Frequency, mid (Hz)	2	2483	588.31	0.24	2067	2899
	Frequency, end (Hz)	2	2710	480.83	0.18	2370	3050
	FHA (Hz)	2	3135.5	67.18	0.02	3088	3183

Call 29 is a monophonic call composed of two LFCs. P1 is a continuously decreasing tone without frequency modulations and P2 is similar to the signature of call type 11. The whole call type has a relatively long duration compared to other call types. P2 typically starts immediately after the end of P1.

Call 30



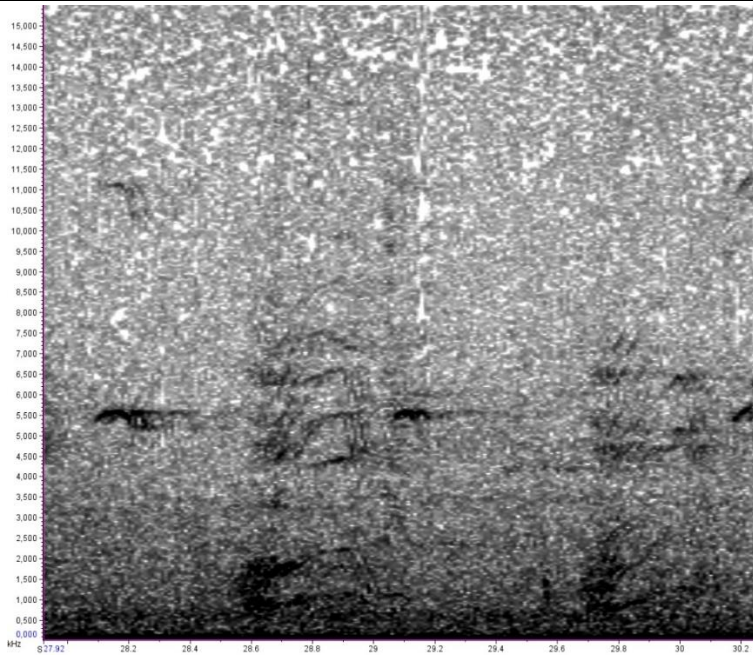
Parts:



Measurements		n	Value	SD	CV	Min	Max
Dur, total (ms)		1	739	—	—	—	—
P1	Dur (ms)	1	83	—	—	—	—
	FHA (Hz)	1	3190	—	—	—	—
P2	Dur (ms)	1	634	—	—	—	—
	Frequency, start (Hz)	1	681	—	—	—	—
	Frequency, mid (Hz)	1	1545	—	—	—	—
	Frequency, end (Hz)	1	1624	—	—	—	—
FHA (Hz)		1	1695	—	—	—	—

Call 30 is a monophonic call and consists of two call parts. P1 is the common short and broadband pulse. P2 increases up to a local maximum, decreases again slightly for short time and finally increases again sharply. Because this call type was only found once in acceptable quality during the two encounters, calculation of means, SD's, C.V.'s, minimum and maximum values for call parameters was unfortunately not possible. The parameter values for the single call are listed in the table.

Call 31

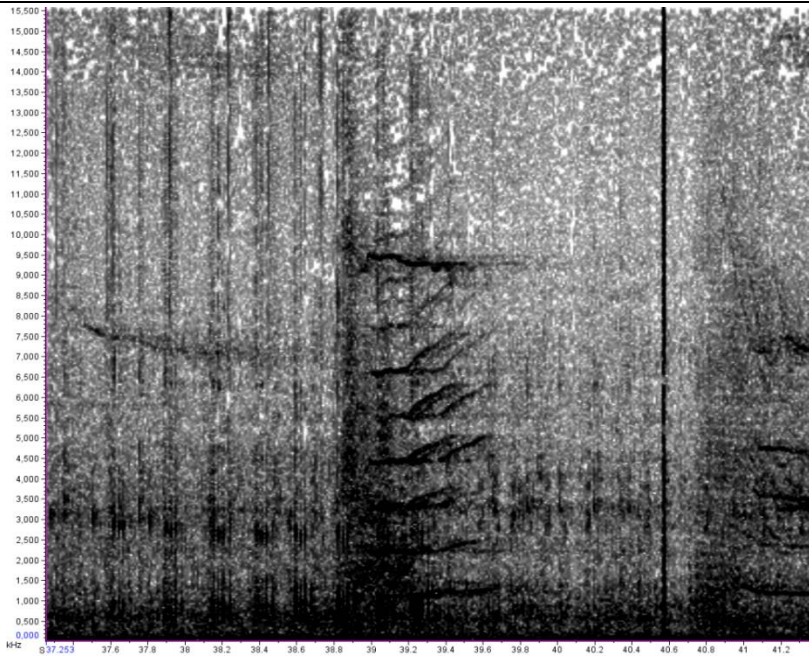


Parts:

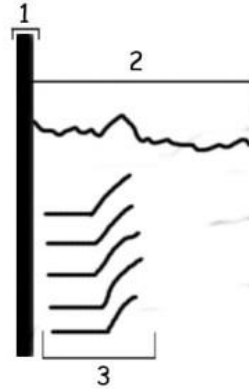
?

Call 31 consists of at least three parts. The last part is an isolated short high frequency tone, which sets this call apart from the other types. This call occurred only three times in a sequence. The samples were not of sufficient quality to derive detailed information on signal structure and did not allow parameter measurements.

Call 32



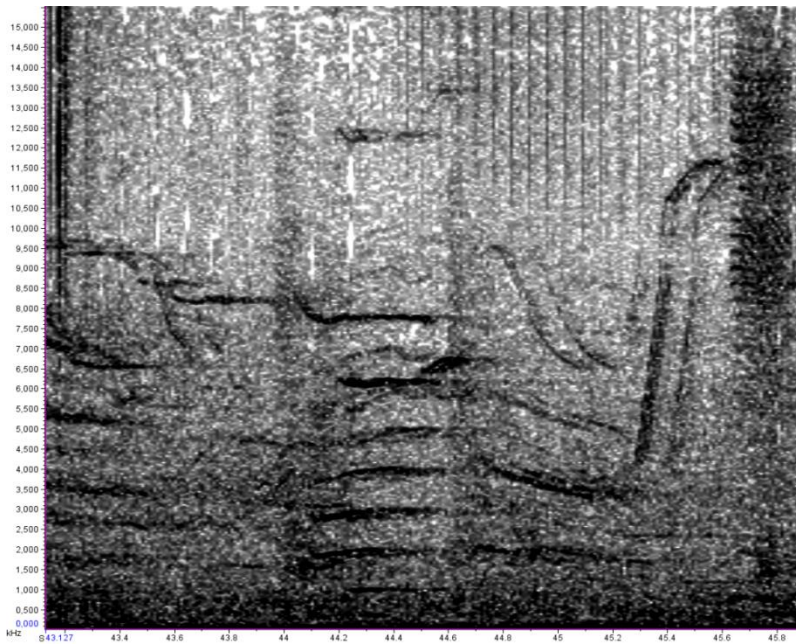
Parts:



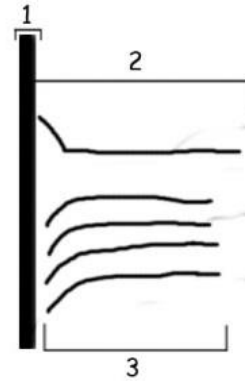
	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	3	694.00	39.15	0.06	663	738
P1	Dur (ms)	3	111.67	22.03	0.20	97	137
	FHA (Hz)	3	5388.67	5572.90	1.03	204	11282
P2	Dur (ms)	3	534.00	104.59	0.20	432	641
	Frequency, start (Hz)	3	9227.33	280.45	0.03	8925	9479
	Frequency, mid (Hz)	3	8840.67	374.69	0.04	8521	9253
	Frequency, end (Hz)	3	7950.33	1365.31	0.17	6530	9253
P3	Dur (ms)	3	443.00	16.37	0.03	425	457
	Frequency, start (Hz)	3	2310.67	507.28	0.22	1890	2874
	Frequency, low (Hz)	3	2184.67	403.26	0.18	1790	2596
	Frequency, end (Hz)	3	2798.00	676.85	0.24	2067	3403
	FHA P2 & P3 (Hz)	3	3046.00	277.70	0.09	2820	3356

Call 32 is a biphonic call composed of three parts. P1 is again the short and broadband pulse and P2 is similar to the HFC of call type 1.2. P3 starts with a constant frequency and increases sharply after a while.

Call 33



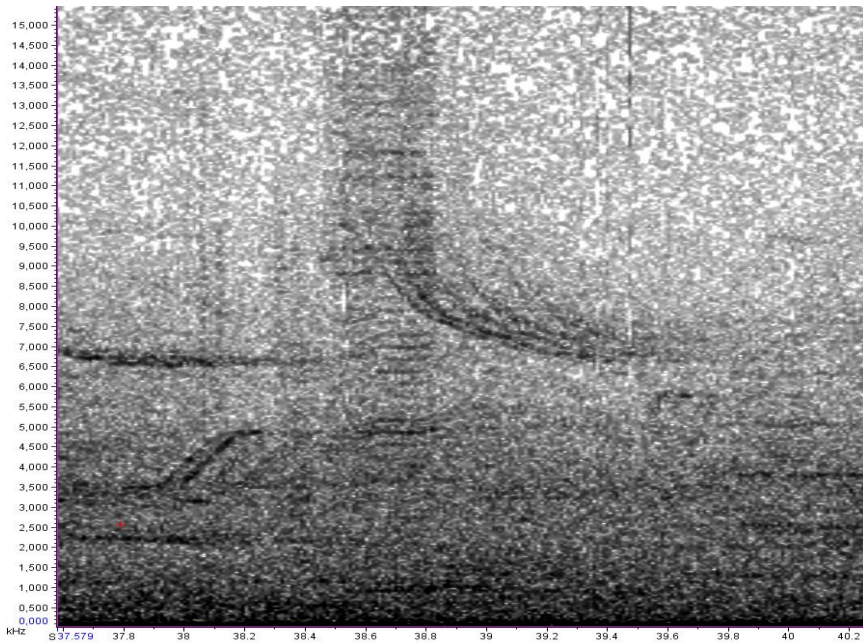
Parts:



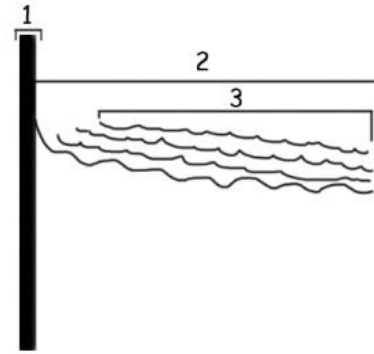
	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	3	646.00	114.53	0.18	573	778
P1	Dur (ms)	3	79.00	25.00	0.32	54	104
	FHA (Hz)	2	1677.50	1615.74	0.96	535	2820
P2	Dur (ms)	3	530.33	64.38	0.12	475	601
	Frequency, start (Hz)	3	8571.67	480.74	0.06	8269	9126
	Frequency, low (Hz)	3	7639.00	380.47	0.05	7286	8042
	Frequency, end (Hz)	3	7882.67	338.36	0.04	7639	8269
P3	Dur (ms)	3	432.00	61.00	0.14	371	493
	Frequency, start (Hz)	3	2083.67	315.22	0.15	1865	2445
	Frequency, mid (Hz)	3	2134.33	248.71	0.12	1966	2420
	Frequency, end (Hz)	3	2268.67	396.41	0.17	1840	2622
	FHA P2 & P3 (Hz)	3	3125.00	1613.27	0.52	1686	4869

Call 33 is also a biphonic call composed of three parts. P1 is the short and broadband pulse. P2 is a HFC decreasing sharply from the start frequency to a relatively constant frequency. The LFC P3 first slightly increases and then levels to a constant frequency contour.

Call 34



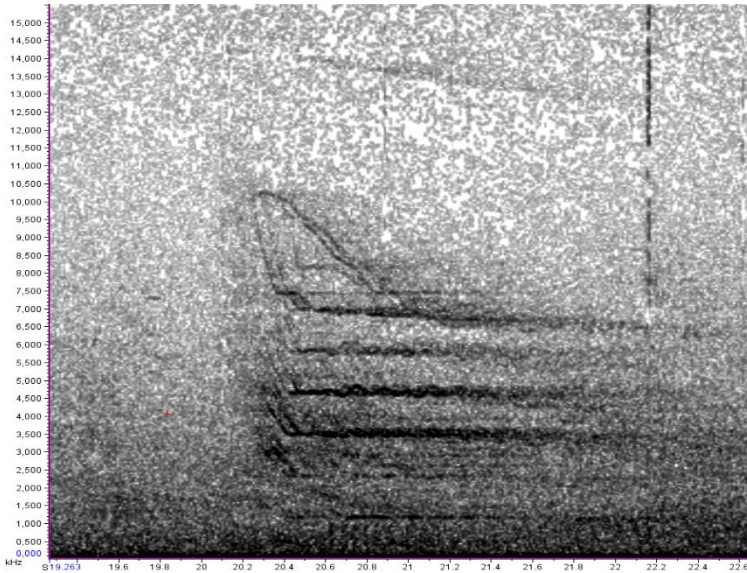
Parts:



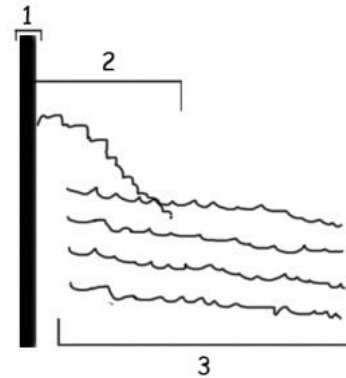
Measurements		n	Value	SD	CV	Min	Max
Dur, total (ms)		1	900	—	—	—	—
P1	Dur (ms)	1	299	—	—	—	—
	FHA (Hz)	1	4884	—	—	—	—
P2	Dur (ms)	1	821	—	—	—	—
	Frequency, start (Hz)	1	9530	—	—	—	—
	Frequency, mid (Hz)	1	7160	—	—	—	—
	Frequency, end (Hz)	1	6656	—	—	—	—
P3	Dur (ms)	1	407	—	—	—	—
	Frequency, start (Hz)	1	8647	—	—	—	—
	Frequency, mid (Hz)	1	7488	—	—	—	—
	Frequency, end (Hz)	1	6983	—	—	—	—
FHA P2 & P3 (Hz)		1	7327	—	—	—	—

Call 34 is a biphonic call composed of three parts. P1 is the short and broadband pulse and P2 is the HFC similar to that from for example call type 1. P3 is also a HFC and similar to P2, except that it starts later in the call. For P3 the highest visible harmonic was measured. Because this call type was only found once in acceptable quality during the two encounters, calculation of means, SD's, C.V.'s, minimum and maximum values for call parameters was unfortunately not possible. The parameter values for the single call are listed in the table. It is also possible that P3 is actually just the echo of P2, with what this call could be classified as call type 15.

Call 35



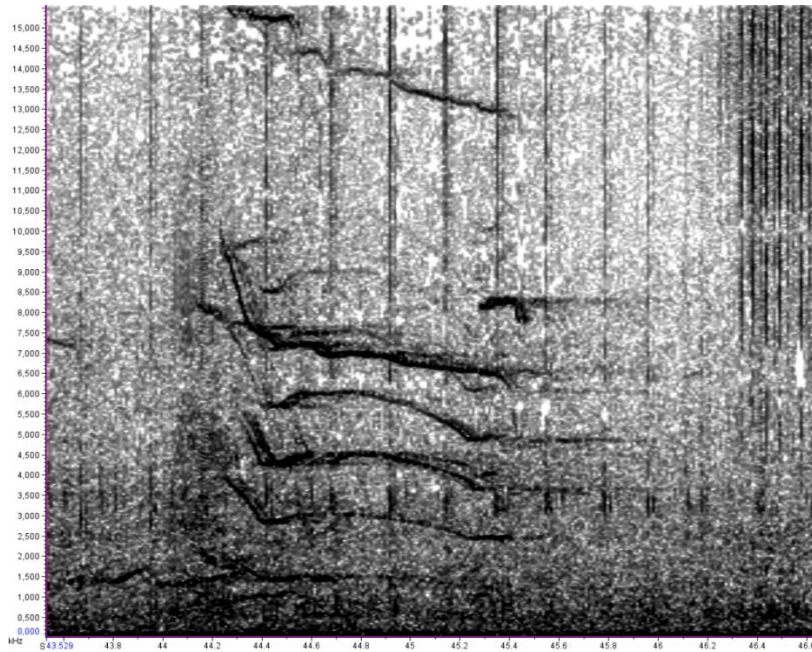
Parts:



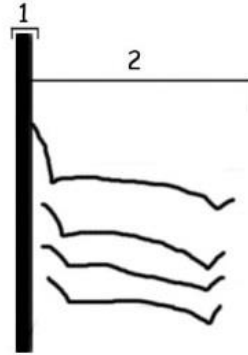
	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	2	1442	328.10	0.23	1210	1674
P1	Dur (ms)	2	162	25.46	0.16	144	180
	FHA (Hz)	0	—	—	—	—	—
P2	Dur (ms)	2	894.5	272.24	0.30	702	1087
	Frequency, start (Hz)	2	9000.5	1747.26	0.19	7765	10236
	Frequency, mid (Hz)	2	7778	1087.53	0.14	7009	8547
	Frequency, end (Hz)	2	6302.5	1140.56	0.18	5496	7109
P3	Dur (ms)	2	1224	305.47	0.25	1008	1440
	Frequency, start (Hz)	2	4058.5	214.25	0.05	3907	4210
	Frequency, mid (Hz)	2	3630	285.67	0.08	3428	3832
	Frequency, end (Hz)	2	3668	231.93	0.06	3504	3832
	FHA P2 & P3 (Hz)	2	3529	0.00	0.00	3529	3529

Call 35 is a biphonic call composed of three parts. P1 is the short and broadband pulse and P3 is a LFC similar to the LFC of many other call types. P2 features a sharply decreasing frequency contour with a constant and moderate pattern of frequency modulation. The overall duration of this call is relatively long compared to other call types.

Call 36



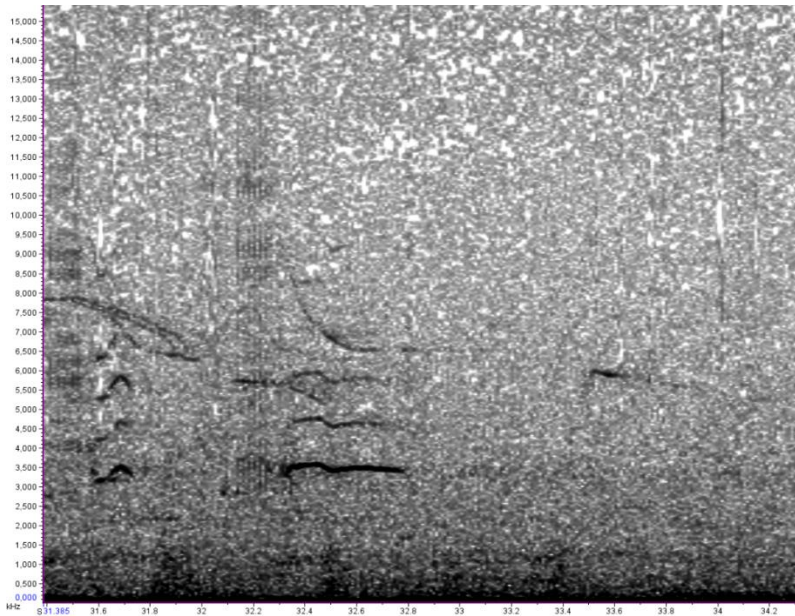
Parts:



	Measurements	n	Mean	SD	CV	Min	Max
	Dur, total (ms)	2	1112.5	392.44	0.35	835	1390
P1	Dur (ms)	2	109.5	17.68	0.16	97	122
	FHA (Hz)	2	1772.5	1704.83	0.96	567	2978
P2	Dur (ms)	2	952.5	328.80	0.34	720	1185
	Frequency, start (Hz)	2	2218	178.19	0.08	2092	2344
	Frequency, mid (Hz)	2	1373.5	160.51	0.12	1260	1487
	Frequency, end (Hz)	2	1184.5	106.77	0.09	1109	1260
	FHA (Hz)	2	2804.5	2139.00	0.76	1292	4317

Call 36 is a monophonic call build out of two parts. P1 is the short and broadband pulse. The frequency contour of P2 first decreases sharply from the start frequency, then increases faintly to a local maximum, then decrease again faintly and finally increases again over a short time.

Call 37



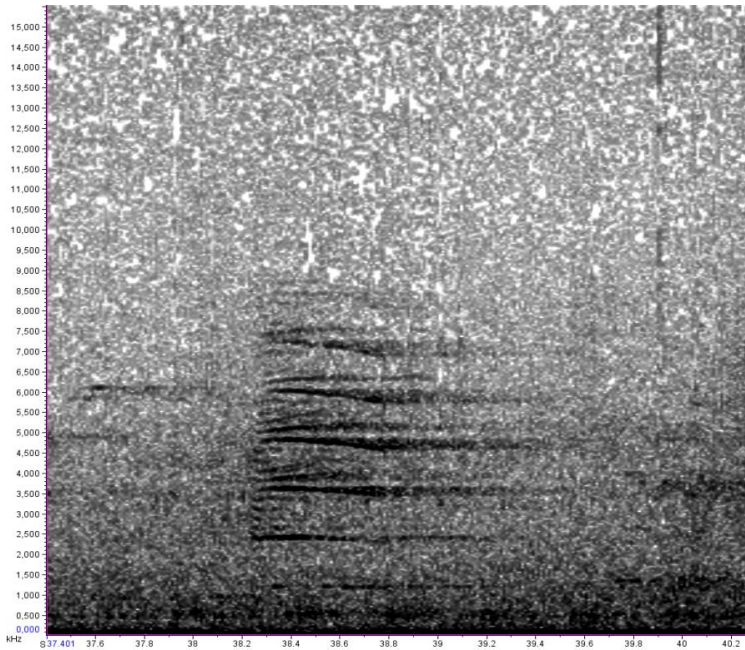
Parts:



Measurements		n	Value	SD	CV	Min	Max
Dur, total (ms)		1	742	—	—	—	—
P1	Dur (ms)	1	112	—	—	—	—
	FHA (Hz)	0	—	—	—	—	—
P2	Dur (ms)	1	627	—	—	—	—
	Frequency, start (Hz)	1	9253	—	—	—	—
	Frequency, mid (Hz)	1	6555	—	—	—	—
	Frequency, end (Hz)	1	6328	—	—	—	—
P3	Dur (ms)	1	479	—	—	—	—
	Frequency, start (Hz)	1	3428	—	—	—	—
	Frequency, low (Hz)	1	3353	—	—	—	—
	Frequency, end (Hz)	1	3277	—	—	—	—
FHA P2 & P3 (Hz)		1	3466	—	—	—	—

Call 37 is a biphonic call type composed of three parts. Due to the fact, that this call occurred only once in the whole data set it cannot be excluded that this represents an aberrant version of call type 20. P1 and P2 are similar to those of call type 20. P3 is m-shaped. Because this call type was only found present once during the two encounters, calculation of means, SD's, C.V.'s, minimum and maximum values for call parameters was unfortunately not possible. The parameter values for the single call are listed in the table.

Call 38



Parts:

?

Call 38 occurs only once in the whole data set. It therefore cannot be determined, whether call 38 represents an actual independent call type or if it is a variable call type. The structure of the call type signature is not similar to any structure of the other call types and no distinct call parts could be determined for this call type. Based on its distinct acoustic features, this call is still shown in this catalogue.