

Text S1. Click Measurements

A sample of clicks identified as TBW/GBW was analyzed to characterize ICI, peak frequency, 10-dB bandwidth and the 10-dB bandwidth lower endpoint. Consecutive clicks within distinct click trains were annotated in a selected subset of 23 sound files (three per station and deployment except two at Stn6 in the 2015-16 dataset) using the acoustic analysis software PAMLAB (JASCO). These files were separated by weeks and selected based on click signal to noise ratio (SNR; > 10 dB). ICI greater than 0.5 s represented intervals between non-consecutive clicks or adjacent click trains and were excluded. ICI was calculated by subtracting the time of peak energy of consecutive clicks. Spectral features were automatically extracted from manual annotations using PAMlab via the following method:

- 1) Find the absolute maximum of the waveform within the timeframe of the annotation.
- 2) Expand or retract the annotation selection in time such that the new selection has a duration of 0.00256 s centered on the absolute maximum calculated in step 1. Using 0.00256 s of data conforms to methods employed elsewhere (e.g., Baumann-Pickering et al. 2013, Stanistreet et al. 2017). At the same time, expand the annotation selection in frequency up and down by 5% of the original annotation frequency bandwidth, where the minimum bottom frequency is 100 Hz. This results in the entire annotation being systematically expanded.
- 3) Create a final selection based on 95% of the total energy of the expanded selection. This is done separately in frequency and time from the expanded selection.
- 4) Calculate click characteristics based on the final selection.

This method accounts for any analyst variability in creating the original annotation and standardizes the selection used to calculate metrics. When interpreting results and comparing to other studies, it should be considered that some click parameter extraction methods make a selection (determine the start and end of a click) based on a Teager energy detector (e.g., Soldevilla et al. 2008), whereas here 95% energy was used, likely producing comparable but slightly different results to other approaches. Where these characteristics are based on annotations (automatically modified to eliminate inconsistency), they are expected to be reliable. Peak frequency was calculated using a Fast Fourier Transform (FFT) with a Hann window. The FFT size was increased through zero padding to the lowest power of 2 that resulted in a FFT bin size less than 100 Hz. The middle frequency of the FFT bin with the maximum power spectral density was the peak frequency. To determine the 10 dB bandwidth, the algorithm stepped up and down in frequency from the peak until an upward and downward level was reached that was 10 dB below peak. The difference in the 10 dB upward and downward frequencies equals the 10 dB bandwidth. Annotation boxes were drawn to include all visible energy in the spectrogram and encompass all of the waveform signature of the click.

Table S1. Classification features of the click detector. ZC: Zero-crossing; Var: variance; Cov: covariance; TK: Teager-Kaiser; NBW: Northern bottlenose whale; CBW: Cuvier’s beaked whale; TBW: True’s beaked whale; GBW: Gervais’ beaked whale; BW-STP: BWG-like click; BBW: Blainville’s beaked whale; SBW: Sowerby’s beaked whale.

Metrics	NBW	CBW	TBW/GBW	BW-STP	BBW	SBW
Mean Number of ZC (NZC)	11.981106	12.171429	11.321937	83	6	14.130919
Mean time between ZC (ZCT)	1.85E-05	1.27E-05	1.12E-05	7.15E-06	2.72E+00	7.71E-06
Mean change in time between ZC (ZCS)	-4.28E-02	-3.18E-02	-4.17E-02	-8.85E-03	-7.76E-02	-2.32E-02
Variance of NZC	5.25E+00	3.38E+00	7.53E+00	3.12E+02	2.53E-01	1.00E+01
Variance of ZCT	2.09E-12	8.48E-13	1.54E-12	1.04E-12	1.36E-12	3.53E-13
Variance of ZCS	6.13E-04	5.94E-05	3.64E-04	1.29E-05	8.67E-04	1.40E-03
Covariance of NZC and ZCT	-6.10E-07	-1.03E-06	-2.03E-06	-1.07E-05	6.07E-08	-2.45E-07
Covariance of NZC and ZCS	9.80E-03	8.41E-03	6.14E-03	2.32E-02	3.09E-03	3.20E-02
Covariance of ZCT and ZCS	3.25E-09	-5.21E-09	2.32E-09	-3.15E-09	4.09E-09	-5.04E-10
HighPass Filter Frequency	25000					50000
TK Threshold Level	20					
TK Pre-Window	0.0005					
TK Post-Window	0.001					
TK Lock-Out	0.003					
TK Time Step (s)	0.0003334					
dB Below Peak Threshold	9					
Peaks That Can Be Below Threshold	2					
Maximum Mahalanobis Distance	4					

Table S2. Northern bottlenose whale (NBW) automated performance by station and year. P: precision; R: recall; P, R and Threshold (minimum detection count per file) apply to 64 s sound files. # Files: the number of files in the validation sample; MD (manual detection) and AD (automated detection) are the number of files in the sample containing a NBW manual and automated detections, respectively. ND: Not detected.

<i>Station</i>	<i>Year</i>	<i>Threshold</i>	<i>P</i>	<i>R</i>	<i>MCC</i>	<i># Files</i>	<i>MD</i>	<i>AD</i>	<i>Exclusion periods</i>
4	2015–16	8	0.05	1	0.21	121	1	49	None
	2016–17					ND			
5	2015–16					ND			
	2016–17					ND			
6	2015–16	15	0.86	1	0.91	119	18	44	None
	2016–17	32	0.95	0.91	0.91	131	22	69	None
13	2015–16	1	0.94	0.97	0.9	121	60	62	None
	2016–17	19	0.97	0.93	0.88	132	74	84	None
15	2015–16	5	0.88	0.92	0.87	122	24	31	None
	2016–17	22	0.95	0.97	0.94	132	36	59	None
16	2015–16	14	0.8	0.95	0.83	119	21	49	None
	2016–17	41	1	0.85	0.9	132	27	66	None
17	2015–16	38	1	0.86	0.9	117	21	58	None
	2016–17	19	0.7	1	0.78	132	26	58	15 Sep–31 Dec 2016
19A	2015–16	10	1	0.98	0.98	117	51	61	None
19B	2016–17	45	0.94	0.9	0.84	131	52	87	None
23	2015–16	14	0.83	0.91	0.85	122	11	41	None
	2016–17					No Data			
24	2015–16	37	1	0.9	0.78	126	90	101	None
	2016–17	42	0.97	0.91	0.79	161	108	122	None

Table S3. As for Table S2, but for Sowerby’s beaked whales.

Station	Year	Threshold	P	R	MCC	# Files	MD	AD	Exclusion periods
4	2015–16	1	0.90	1.00	0.94	120	9	10	None
	2016–17	1	1.00	1.00	1.00	126	7	7	None
5	2015–16	2	1.00	1.00	1.00	120	3	4	None
	2016–17	2	0.50	0.50	0.49	126	2	10	None
6	2015–16	1	1.00	1.00	1.00	120	10	10	None
	2016–17	2	1.00	1.00	1.00	132	9	10	None
8	2015–16					ND			
	2016–17	1	0.1	1.00	0.31	131	1	10	None
15	2015–16	1	1.00	1.00	1.00	119	2	2	None
	2016–17	1	1.00	1.00	1.00	131	10	10	None
16	2015–16	1	0.89	1	0.94	118	8	9	None
	2016–17	1	0.9	0.75	0.81	132	12	10	None
17	2015–16	1	1.00	0.90	0.94	120	10	9	None
	2016–17	1	0.9	1	0.94	132	9	10	None
18	2015–16	2	0.4	1.00	0.51	115	1	5	None
	2016–17					ND			
19A	2015–16					ND			
19B	2016–17	1	1.00	1.00	1.00	132	10	10	None
23	2015–16	1	0.93	0.82	0.86	112	17	15	None
	2016–17					No Data			
24	2015–16	1	0.88	0.70	0.69	127	43	34	None
	2016–17	1	0.87	0.65	0.71	174	31	23	None

Table S4. As for Table S2, but for Cuvier’s beaked whales.

Station	Year	Threshold	P	R	MCC	# Files	MD	AD	Exclusion periods
4	2015–16	4	0.90	0.90	0.88	121	21	30	18 Aug to 13 Nov 2015
	2016–17	6	0.58	0.93	0.69	125	15	38	None
5	2015–16	2	1.00	0.78	0.85	121	27	28	None
	2016–17	3	0.86	0.86	0.81	124	29	41	None
6	2015–16	5	0.91	0.80	0.81	119	25	36	None
	2016–17	5	0.80	0.63	0.66	132	19	33	None
13	2015–16								ND
	2016–17								ND
15	2015–16	1	0.87	0.87	0.84	121	23	23	None
	2016–17	1	0.76	1.00	0.84	132	25	33	None
16	2015–16	4	0.79	0.83	0.77	119	18	31	None
	2016–17	5	0.86	0.92	0.86	132	26	46	None
17	2015–16	5	0.91	0.91	0.90	118	11	15	24 Aug 2015 – 14 Mar 2016
	2016–17	1	0.83	0.83	0.82	132	12	12	8 Aug 2016 to 23 Mar 2017; 16 June to 21 Jul 2017
19A	2015–16	5	0.57	0.67	0.59	117	6	13	25 Aug 2015 to 10 April 2016
19B	2016–17	8	0.50	0.33	0.39	132	3	31	None
23	2015–16								ND
	2016–17								No Data
24	2015–16	4	0.04	1.00	0.16	128	1	50	None
	2016–17	9	0.88	0.58	0.69	166	12	38	10 Aug to 15 Nov 2017

Table S5. As for Table S2, but for True’s/Gervais’ beaked whales.

Station	Year	Threshold	P	R	MCC	# Files	MD	AD	Exclusion periods
4	2015–16	18	0.52	1.00	0.67	121	11	55	None
	2016–17	46	0.79	0.73	0.72	126	15	37	6 Sep 2016 – 9 Feb 2017
5	2015–16	19	0.75	0.9	0.8	121	10	46	None
	2016–17	18	0.76	0.76	0.7	132	21	54	28 Sep – 20 Nov 2016
6	2015–16	25	0.50	1.00	0.70	119	1	46	None
	2016–17	19	0.5	1	0.7	132	4	16	1 Oct 2016 – 27 May 2017
16	2015–16	28	0.80	0.80	0.79	119	5	18	1 Nov 2015 – 10 May 2016
	2016–17	44	0.75	0.75	0.74	132	4	31	5 Nov 2016 – 9 Jun 2017

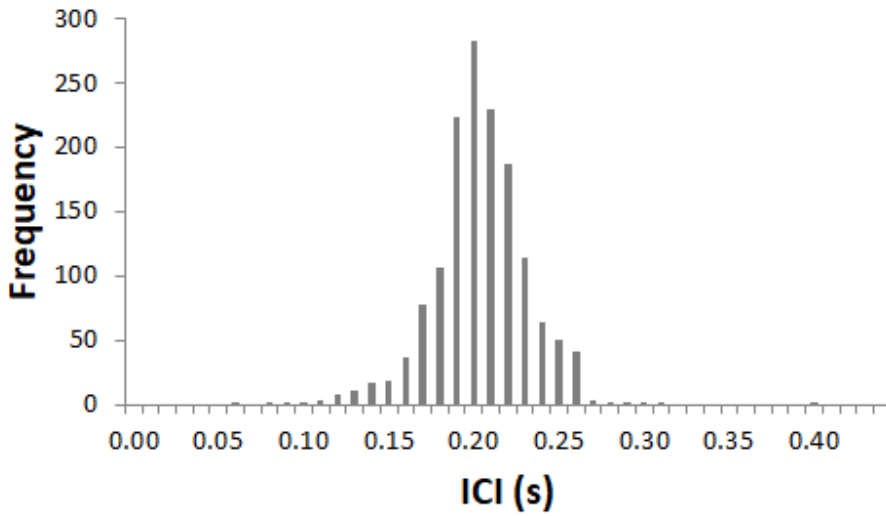


Figure S1. Histogram of Inter-click interval (ICI; $n=1484$) for TBW/GBW click trains recorded at Stn 4, 5, 6 and 16 between Aug 2015 and July 2017.