Supplementary Information for

Lower St. Lawrence Seaway Amphibious Seismic Network for earthquakes and marine soundscape monitoring

By

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Table S1. Station information including coordinates and operation periods.

Page 1: OBS (Y1 and Y2).
Page 2: MG13-16.
Page 3: nodal sensors.

Table S2. Preliminary seismicity catalogs.

Page 1: NEDB catalog from September 14 to October 31, 2023.
Page 2: nodal catalog from September 14 to October 15, 2023.
Page 3: OBS + land broadband catalog from October 1 to October 31, 2023.

Table S3. 1D velocity model (Plourde and Nedimović, 2022) used for developing the OBS and nodal catalogs.

Depth (km)	Vp (km/s)	Vs (km/s)
0	6.07	3.43
8	6.45	3.65
17	6.60	3.73
24	6.69	3.78
30	6.83	3.86
36	7.04	3.98
38	7.25	4.10
40	7.80	4.41
45	7.87	4.45
60	7.99	4.52

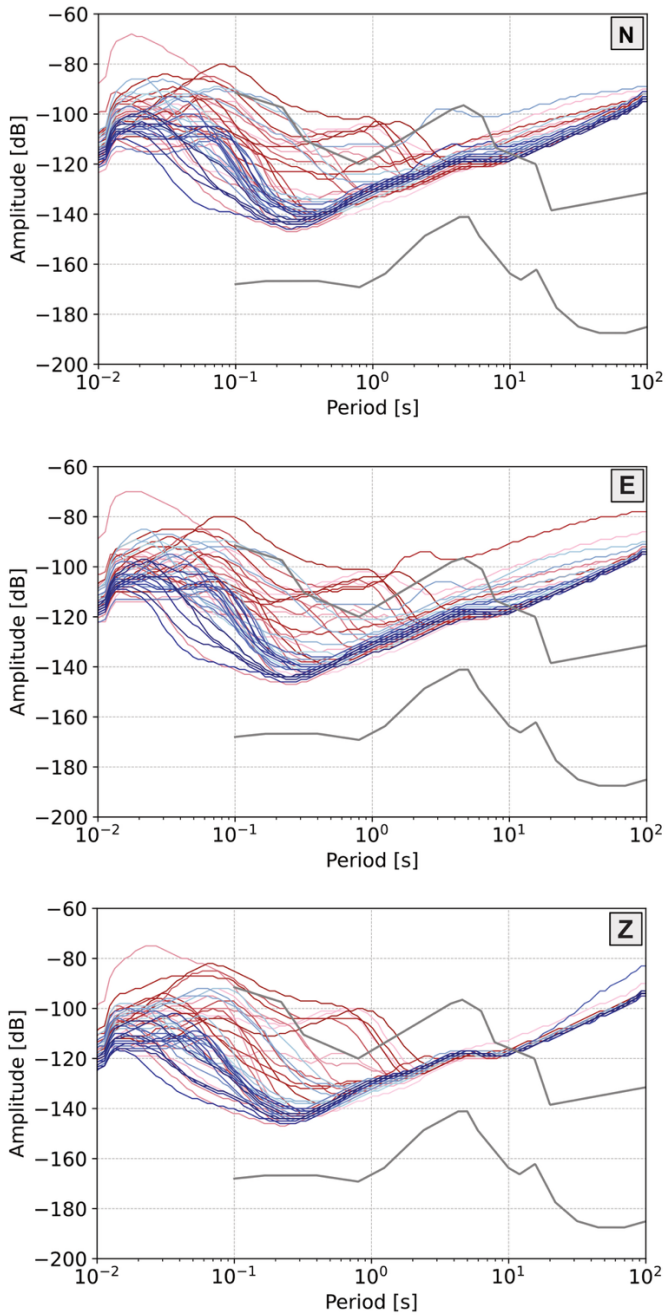

Figure S1. Median PPSDs at all nodal stations (CH1/N, CH2/E, CH3/Z components): Solid blue lines (light to dark) represent nodes going downstream from S01 to S24 along South Shore. Dashed pink lines (light to dark) represent nodes going downstream from N01 to N24 along North Shore. Gray lines are NHNL and NLNL (McNamara and Buland, 2004).

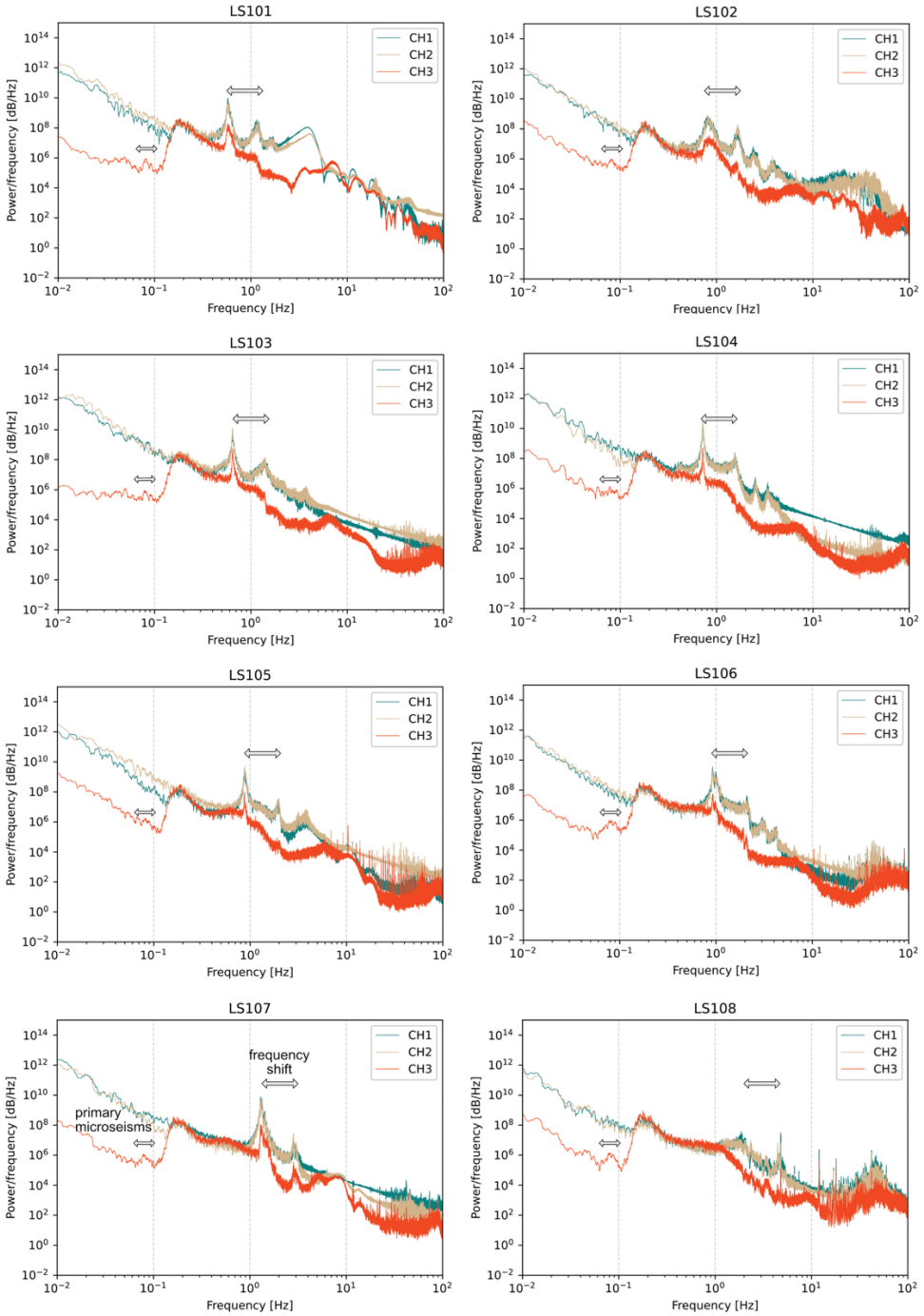

Figure S2. Periodograms of 1-hour waveforms (00:30:00 to 01:30:00 on October 30, 2023) at Y1 stations LS101-108. Note the synchronized frequency shift of two amplitude peaks between frequencies ~0.5 and 3 Hz (~0.3-2 s, marked by double-headed arrows), and the primary microseism peak at CH3 components between ~0.06 and 0.1 Hz (~10-16 s), most visible at downstream stations LS106, 107, 108.

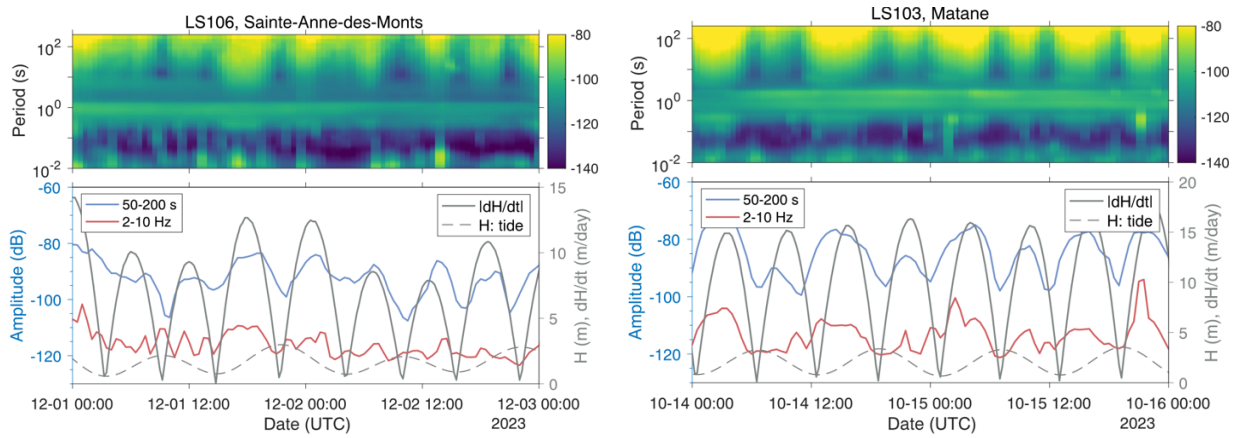

Figure S3. Sample spectrograms and temporal variation of power amplitudes at selected frequency ranges at stations (left) LS106 and (right) LS103. Tidal height (H) predictions are downloaded from https://tides.gc.ca/en/stations at Sainte-Anne-des-Monts (close to LS106) and Matane (clost to LS103).

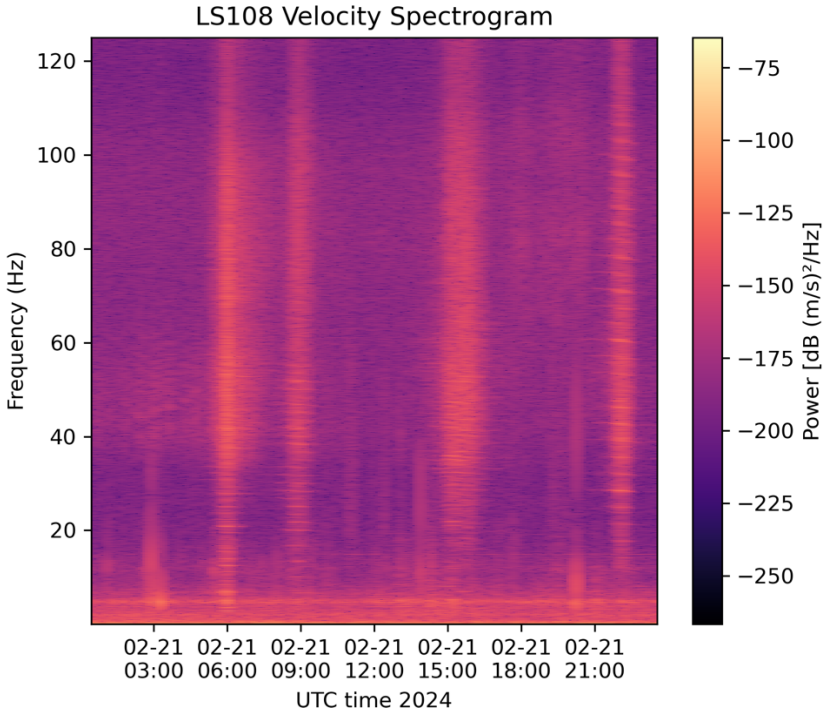

Figure S4. Velocity spectrogram (24-hour) on February 21, 2024, at station LS108. Note the energy bursts extending up to the Nyquist frequency of 125 Hz with intersecting harmonic patterns. See 1-hour zoom-in spectrograms in Figure S5.

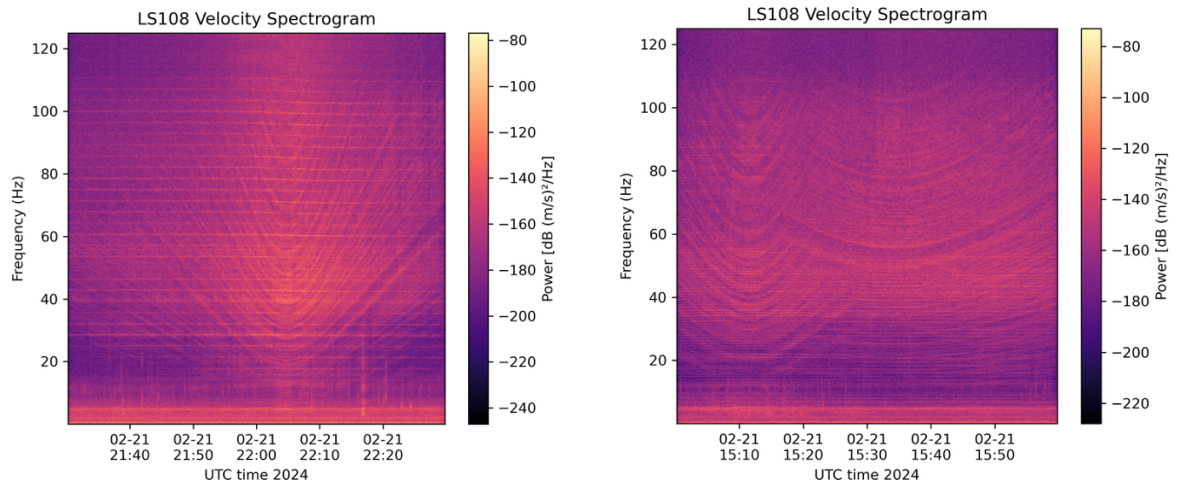

Figure S5. One-hour spectrograms showing the Doppler effect and multipath inference patterns from passing vessels.

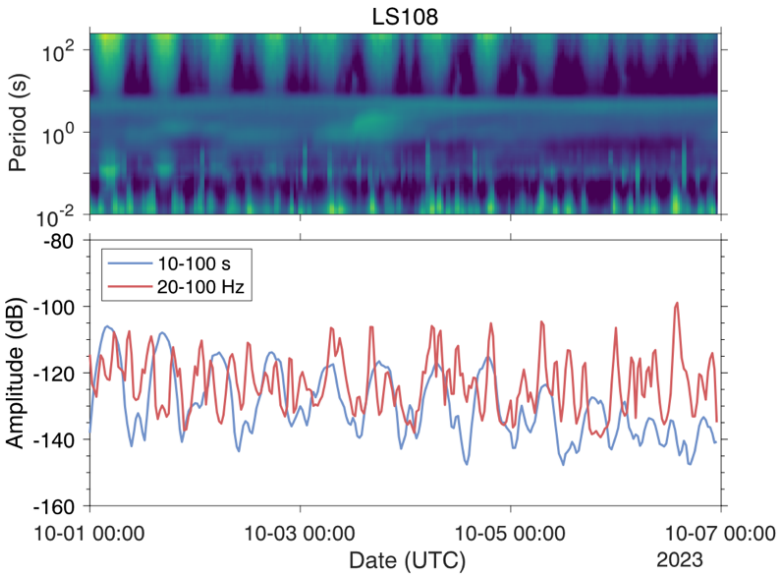

Figure S6. Spectrogram and power amplitude for 10-100s and 20-100 Hz at OBS station LS108, from October 1 to October 7, 2023. Note the long period (10-100 s) variation is correlated with tidal movement (dH/dt; Figure 7). The short period (20-100 Hz) temporal fluctuations may partly reflect marine traffic noise and/or processes related to riverbed currents.

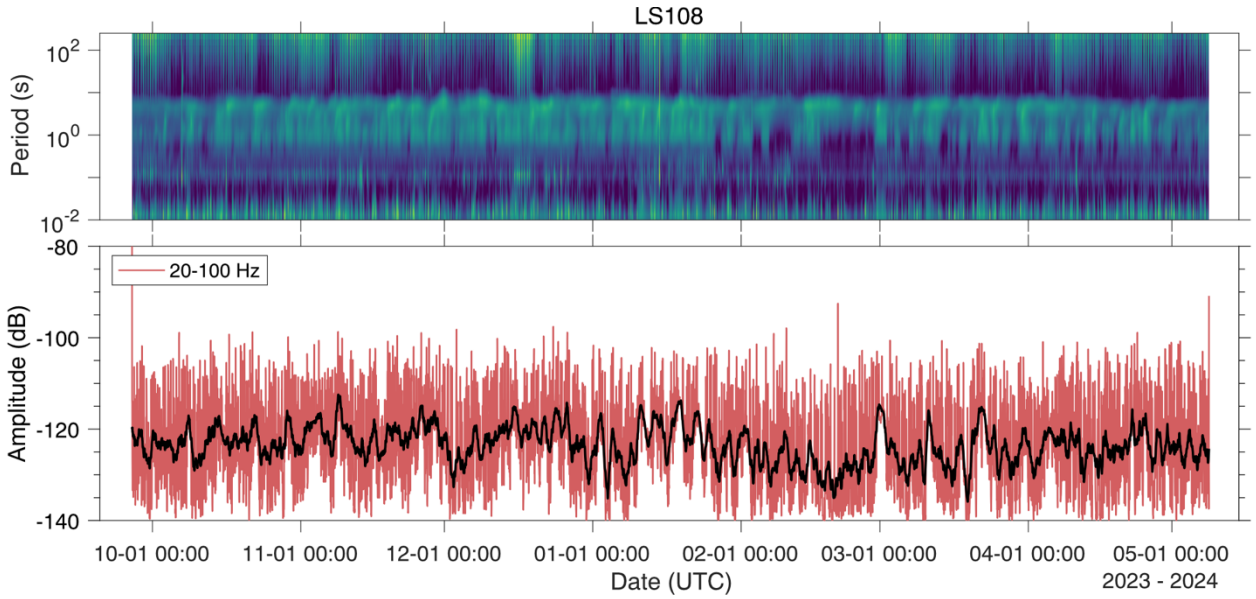

Figure S7. Spectrogram and power amplitude between 20 and 100 Hz at OBS station LS108, from September 26, 2023, to May 8, 2024. Black line is the daily average of the 30-min power amplitude (red line).

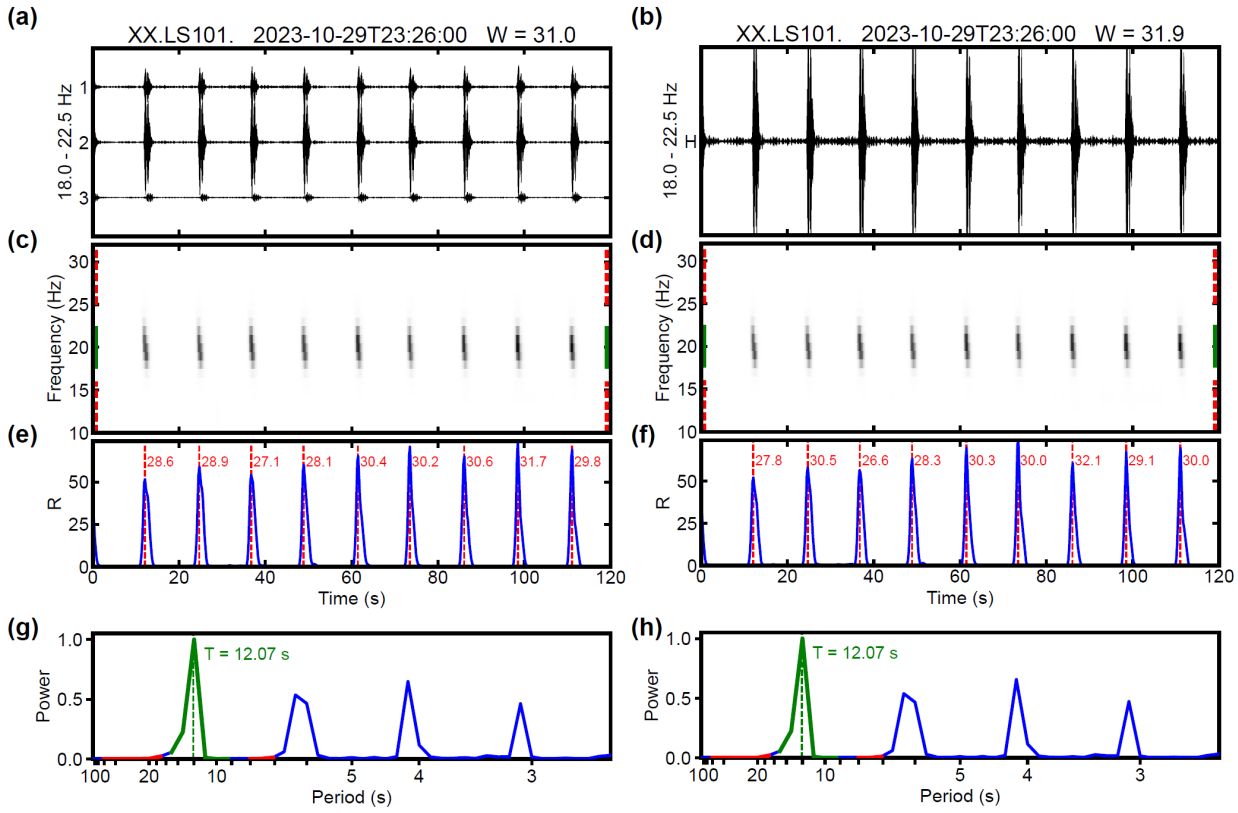

Figure S8. Example fin whale detections on LS101 on both the seismic (left) and hydrophone (right) channels. From top to bottom, the panels illustrate steps of the double-spectrogram detection method for detecting band-limited calls with a consistent internote interval (INI). (a,b) Two minutes of three-component seismic and hydrophone data, respectively, filtered to the fin whale target band (18 to 22.5 Hz). (c,d) Spectrograms of the seismic and hydrophone data, respectively. Solid green lines highlight the target band and dashed red lines highlight the adjacent bands used in the denominator of R(t). (e,f) The function R(t) measures a ratio of power in the 18 to 22.5 Hz band over adjacent frequency bands. Calls are labeled by red lines and their measured SNR in dB. (g,h) Periodogram of power in the fin whale target band. A second ratio W(t) looks for the characteristic INI in R(t), with the periods used in the numerator of the detection statistic (W) highlighted in green (labeled with a measured INI), and those from the denominator highlighted in red.

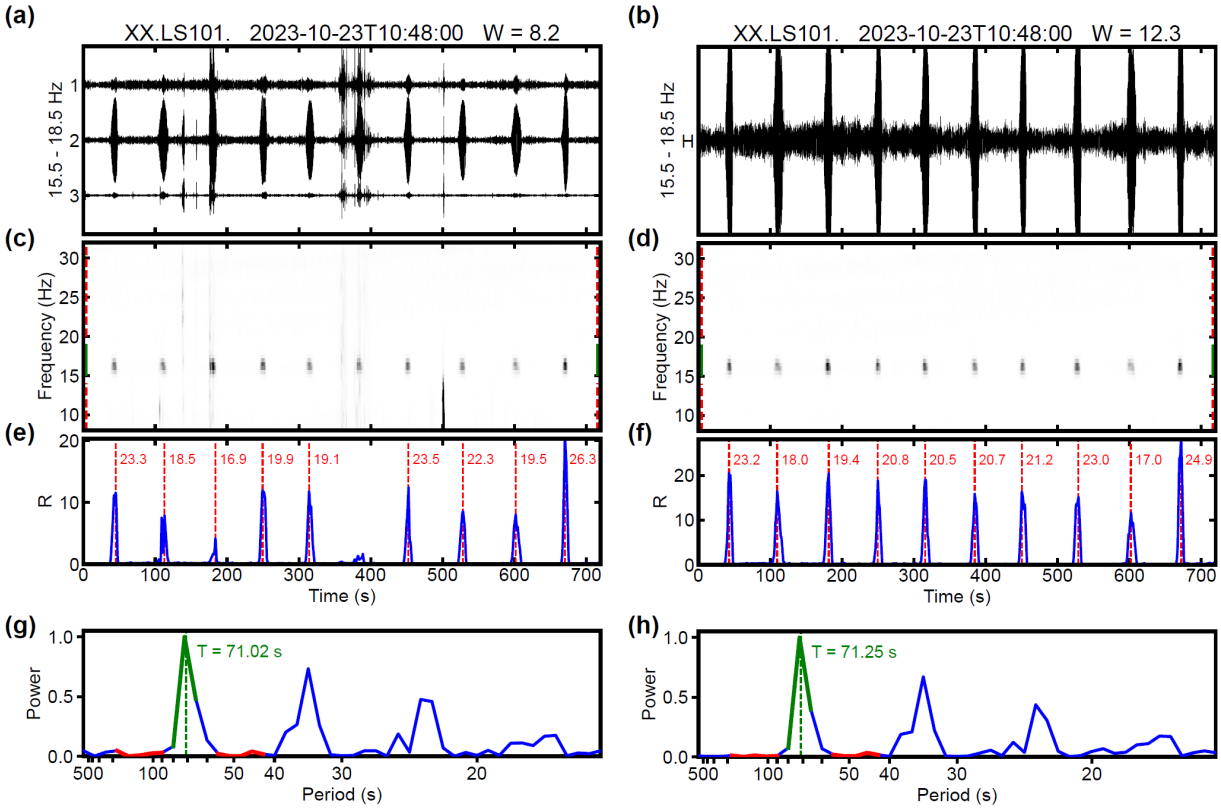

Figure S9. Example blue whale detections on LS101 on both the seismic (left) and hydrophone (right) channels. See Figure S8 for details.