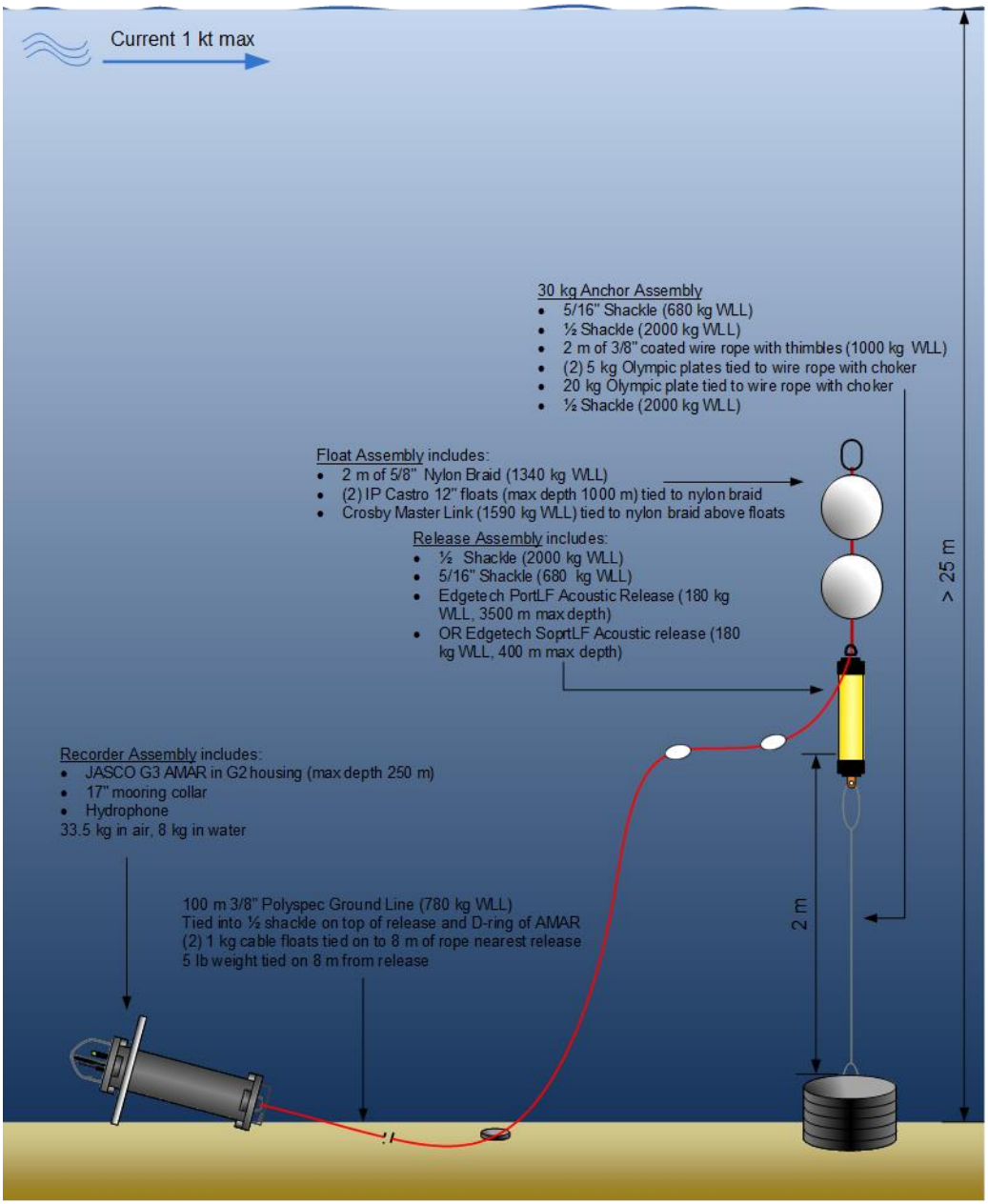
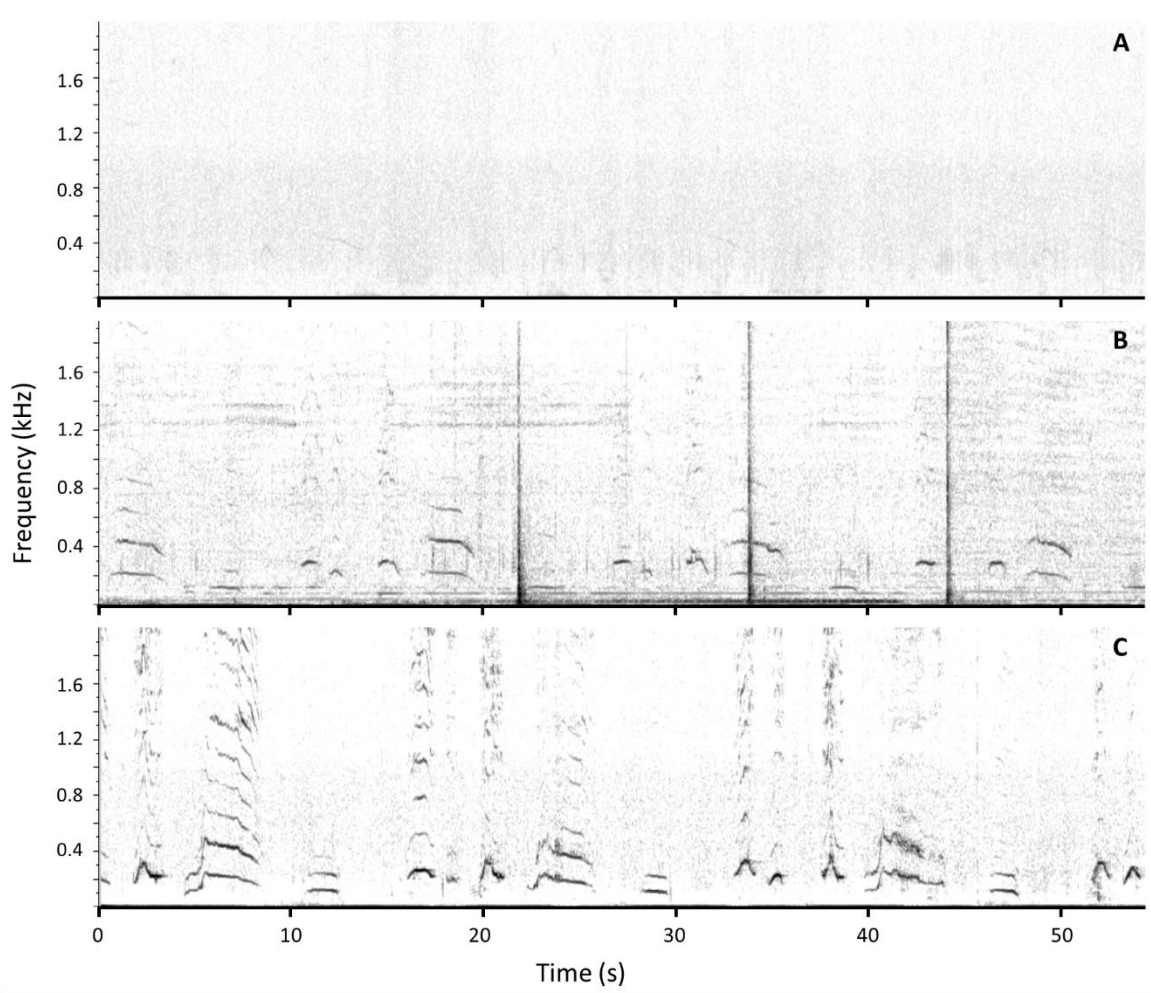
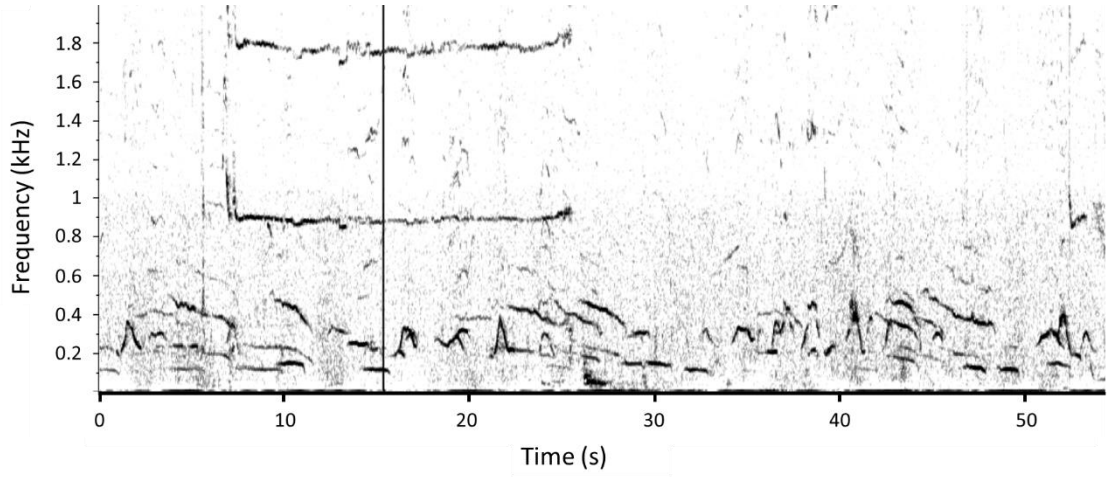
# *Supplementary Material*



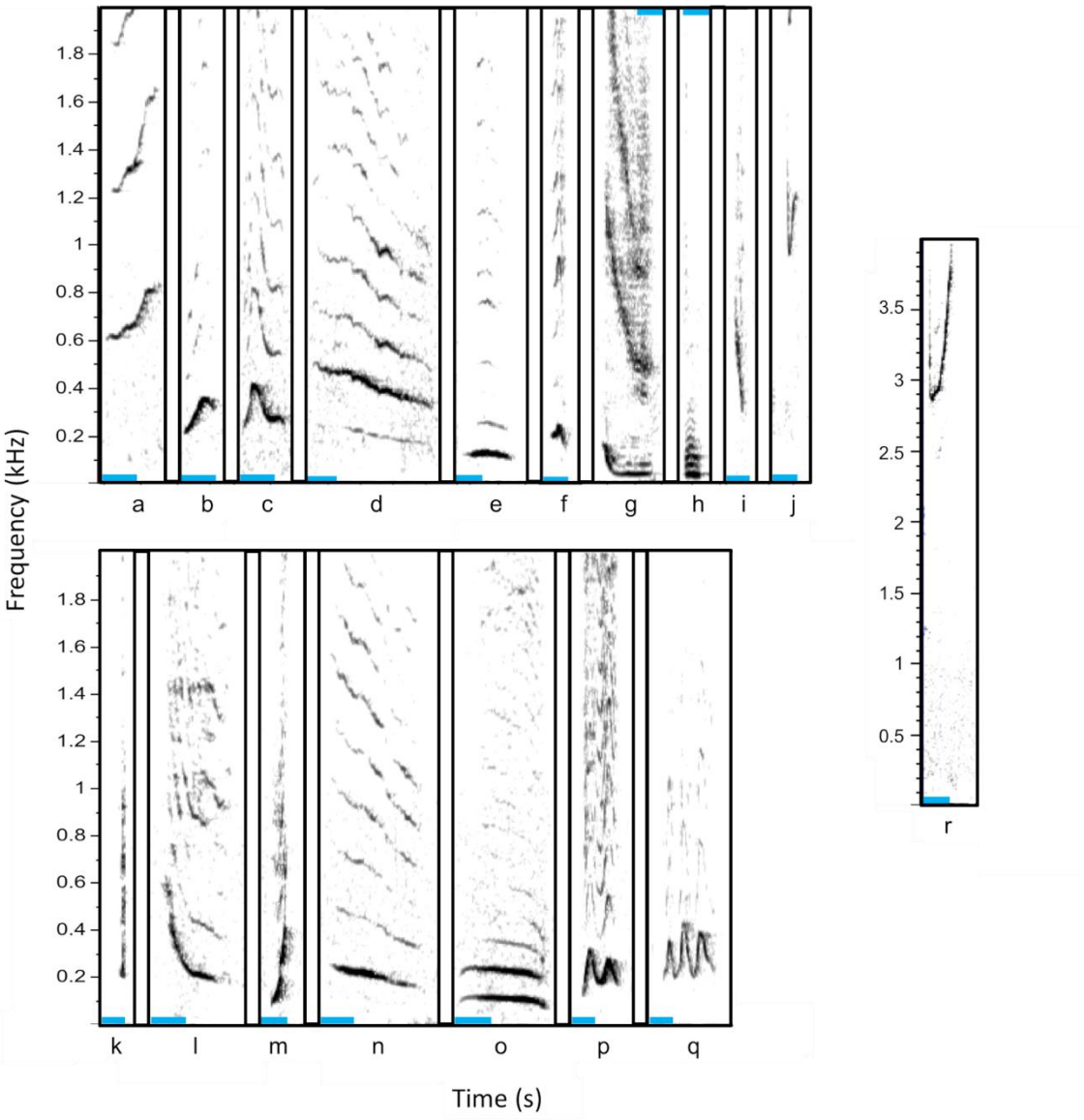

**Supplementary Figure 1.** AMAR G3A as deployed on Challenger Bank and Sally Tucker in this study. The recorder composed of the AMAR and hydrophone are connected through a rope (with some weights attached) to the release assembly (Edgetech Sport LF Acoustic Release) and float assembly, both of which are held down by weights (anchor assembly). © JASCO.




**Supplementary Figure 2.** Exemplary spectrograms of recordings containing a single singing whale which were allocated the low **(A)**, medium **(B)** and high-quality **(C)** category depending on the sound intensity and presence and intensity of ambient noise. The high-quality category was assigned when the entire song contained units with high intensity and was clearly visible on the spectrogram with very little ambient noise. Spectrogram parameters: fast Fourier transform (FFT) size = 2048 points, overlap = 75%, sample rate = 16000 Hz, frequency resolution = 7.8 Hz and time resolution = 32 ms.




**Supplementary Figure 3.** An 18-second-long cry on 8 April 2018 in the presence of multiple asynchronously singing whales was observed, which could have been from a humpback whale. Spectrogram parameters: fast Fourier transform (FFT) size = 2048 points, overlap = 75%, sample rate = 16000 Hz, frequency resolution = 7.8 Hz and time resolution = 32 ms.




**Supplementary Figure 4.** Unit types displayed as spectrograms of the 18 visually and aurally distinct units contained in the seven analysed humpback whale songs recorded at Challenger Bank in 2018. Each unit is labelled with its alphabetical code. The blue scale bars represent 1 second on every spectrogram. Spectrogram parameters: fast Fourier transform (FFT) size = 2048 points, overlap = 75%, sample rate = 16000 Hz, frequency resolution = 7.8 Hz and time resolution = 32 ms.

**Supplementary Table 1.** Transcribed songs from seven different recordings, each around a week apart from the next. The 14 complete song cycles encountered in the seven analysed recordings were transcribed at the unit level using the 18 alphabetically coded units (**Supplementary Figure 4**), and at the phrase level by numerically coding the unit sequences (according to **Table 1**). Whales with more than one song cycle cyclically repeated the theme order whereby the duration of the song cycles of the same individual varied due to the varying number of repeated phrases during a song cycle. The occurrence of phrase 6 is marked in blue.

| Whale | Day | Unit Sequences | Phrase Sequences | Duration [min] |
|---|---|---|---|---|
| **1** | 6/4 | abcabcde-acacde-acacde-acacde-acacde-abcacdecg-fcgh-fcgh-fcgh-fcgiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiiijrkjrjrkjrkjrkjrkjrkjrr-ljrkjrjrkjrkjrkjrkjrrkjr-lkjrkjrjrkjrkjrkjrrkjr-looooooo-nooooo-nooo-ncde | 1-1-1-1-1-1-1/2-2-2-2-2/3-3/4-4-4-4/5-5-5-5/1 | 6.50 |
| | | acacde-acacde-acbacde-acacde-acacde-acbacde-acacdecgh-fcgh-fcghh-fcghhh-fcghhh-fcghhh-fcgh-fcgiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiijrkjrkjrkjrkjrkjrkkjr-lkjkkjrkkjrkkjrkkjr-looooooo-nooooo-nooooo-nooooo-noooo-noooo-noooo-noooo-noooo-ncde | 1-1-1-1-1-1-1-1/2-2-2-2-2-2-2-2/3-3/4-4-4/5-5-5-5-5-5-5-5-5-5/1 | 9.20 |
| **2** | 13/4 | noooo-ncde-acacde-acacde-apapde-acapde-apaqde-apapde-pcacdecghh-cghh-cghhhh-fcgghhhhhh-fcgghhhhh-fcghhhh-fcgiiiiiiiiiiiiiiiiiiiiiiiijrjr-iiiiiiiiiiiiiiiiiiiijrjrjrjr-iiiiiiiiiiiijrjrjrjrkjrkjrkjrrkjrkjr-lkkjrkjrkjrkkjrkjrkjr-looooooo | 5-5/1-1-1-1-1-1-1-1/2-2-2-2-2-2-2/3-3-3/4-4-4/5 | 7.35 |
| **3** | 20/4 | lkjrkkjrkjrkkjrkjrkjr-ljrkkjrkjrkjrjrkkjrkjrkjrkjrkjrkjr-lkjrkjjkjrkkjrkjrkjrkjrkjr-looooo-noooo-nooooo-node-abcabcacde-acabcacde-acbacde-acbacde-ccacde-ccdecg-bcg-bcgh-bcgh-bcghhh-bcghhh-bcgiiiiiiiiiiiiiiiiiijrjr-iiiiiiiiiiiiiiiiijrjrkjrjrkjrkjrjrkjrkjr | 4-4-4-4/5-5-5-5/1-1-1-1-1-1-1/2-2-2-2-2-2-2-2/3-3/4 | 7.2 |
| | | lkjrkjrkjrkjrkjrkjrkjr-lkjrkkjrjrkjkjrkjrkjrk-lkjrkkjrkkjrk-loooo-noooooo-noooo-nooooo-nooooo-nooooo-nooooo-noooo-node-acacde-abcabcdecg-bcgh-bcghh-bcghh-bcghh-bcghhh-bcghh-bcgiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiiijrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrkjrjrkjrkjrkjrkjr | 4-4-4-4/5-5-5-5-5-5-5-5-5/1-1-1/2-2-2-2-2-2-2-2/3-3-3-3/4 | 9.1 |
| **4** | 27/4 | looooooo-noooo-noooo-nooo-noo-ncde-acapde-acapde-apacde-acapde-cccdeph-fgh-fcgh-fcghh-cghhh-cghhh-cghhhh-ccghhhhhhh-ccgiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjr-iiiiiiiiiiiiiiiiiiiijrjrjrjrkjrkjrkrr-lkjrkjrkjrkjrkjrkjr-lkjrkjrkjrkjkjr | 4/5-5-5-5-5-5/1-1-1-1-1-1/2-2-2-2-2-2-2-2-2/3-3/4-4-4 | 7.5 |

| | | | | |
|---|---|---|---|---|
| | | looooo-nooo-node-bccde-abcapde-abcapde-acapde-bccdecg-cgh-cgh-fcghh-fcghhh-cgh-fcgiiiiiiiiiiiiiiiiiiiiiiiiiiijrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiijrjrjrkjrkjrkrrkrr-ljrkjrkjrkjrkkjrkjrkrkr-**lkmmmmmmkmm** | 4/5-5-5/1-1-1-1-1-1-1/2-2-2-2-2-2-2/3-3-3/4-4-**6** | 6.25 |
| **5** | 3/5 | fcgiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiijrjrkjrkjrkjkjrkjr-**lkmmmmmmmm**-looooo-nooooooo-nooooo-nooooooo-nooooo-nooooo-nooooo-nooo-npde-abcapde-abcacde-abcacde-abcapde-acabcde-abcacde-abcacde-accacdecgh-fcg-fcgh-fcgh-fcgh-fcgh-fcghh-ccghhh-ccghhhh-ccghhhh-ccgh-fcghh-fcghh-fcghh-fcghh | 2/3-3-3-3/4-**6**-4/5-5-5-5-5-5-5-5/1-1-1-1-1-1-1-1/2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2 | 12.15 |
| | | fcgiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiijrjrjrkjrkjkjkjkjkjkr-**lkmkmmmkmmmkmm**-looooo-nooooooo-nooooooo-nooooo-nooooo-noooo-nooo-ncde-acapde-accacde-acabcde-abcacde-acapde-abcapde-acapde-ccpdecg-fcgh-fcgh-fcgh-fcgh-fcghh-ccghhh-ccghhh-ccghhhh-ccghhhh-fcghhh-ccghhhhh-fcghhh-fcghhh-fcghh-fcghhh-ccgh | 2/3-3-3/4-**6**-4/5-5-5-5-5-5-5/1-1-1-1-1-1-1-1-1/2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2 | 11.35 |
| **6** | 11/5 | lkjrkjrkjrkkjrkkrk-lkjrkjrkjrkkjrkkjrk-looooooo-noooo-noooo-nooo-ncde-acacde-abcabcde-apapde-abcapde-abcabcde-abcacde-abcapde-acapde-acabcde-abcapde-apapde-abcabcde-acacde-acapde-acacde-acacde-apacde-abcabcdecg-fcgh-fcgh-fcgh-fcgh-fcgh-fcgh-fcghhh-fcghh-ccghhhh-fcgiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiijrjrjrkjrkjrkjrkkjrkjr | 4-4-4/5-5-5-5-5/1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1/2-2-2-2-2-2-2-2-2/3-3-3-3-3-3-3-3/4 | 16.15 |
| | | lkjrkjrkjrkkjrkjrkkjrk-looooooo-nooooooo-nooooooo-noooo-ncdde-acabcde-abcabcde-abcabcde-abcabcde-abcacdecg-fcgh-fcgh-fcgh-fcghhh-fcghh-fcghh-fcghhh-fcghhhh-fcgiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjr-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrjrkjrkjrkjrkjr | 4-4/5-5-5-5-5/1-1-1-1-1-1/2-2-2-2-2-2-2-2-2/3-3-3-3-3/4 | 9.35 |
| **7** | 18/5 | lkjrkjrkjrkjrkjrk-lnooooo-nooooo-ncde-apapde-apapdecg-fcgh-fcghh-ccghhh-fcghhhh-fcgiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjj-iiiiiiiiiiiiiiiiiiiiiijrjrj-iiiiiiiiiiiiiiiiiiiiiiijrjrkjkjrkjrk | 4-4/5-5-5/1-1-1/2-2-2-2-2/3-3-3-3-3/4 | 4.05 |
| | | lkjrkjrkjrkjrk-looooooo-nooooooo-nooooo-ncde-apapde-apapde-apapdecg-fcgh-fcgh-fcghhh-fcghhh-fcghhh-fcgiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrj-iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiijjj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrkjrkjrkjrkjrk | 4-4/5-5-5-5/1-1-1-1/2-2-2-2-2-2-2/3-3-3-3-3/4 | 7.20 |

| | | | |
|---|---|---|---|
| | lkjrkjrkjrkjrkkjrk-**lmmkmmkmm**-looooooo-nooooo-node-abcacde-abcabcde-apapde-acacde-acacde-apapdecg-fcgh-fcghhh-fcghhh-fcghhh-fcgiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjrj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrj-iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiijrjj-iiiiiiiiiiiiiiiiiiiiiiiiiijrjj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjrj-iiiiiiiiiiiiiiiiiiiiiiiiiiijrjj-iiiiiiiiiiiiiiiiiiiiiiiiiijrjrkjrkjrkkjrkjrk | 4-**6**-4/5-5-5/1-1-1-1-1-1-1/2-2-2-2-2-2/3-3-3-3-3-3/4 | 9.1 |