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Seasonal and diurnal variations of ambient noise due to the snapping shrimp sound in the coast of southern sea of Korea

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1. Introduction

The ambient noise in the ocean shows very different dependences on marine life as well as on wind, rainfall, and shipping. The sources of ambient noise in the deep ocean are clearly identified in a summary of a large body of data gathered during the 1940s. According to this summary, the primary sources of ambient noise in the deep ocean are distant shipping and ocean surface wind. The ambient noise in the coastal sea is more complex than ambient noise in the deep ocean due to the breaking waves in the surf zone and the marine life as well as the shipping and wind. Since the biological noise due to the marine life has very high diurnal dependence and seasonal variation, it has a greater effect on ambient noise than others. In particular, it is well known that the sounds of dolphins and snapping shrimp affect sonar ping signals. In the coastal sea, where snapping shrimps live, their sounds always coexist with ambient noise such as the noise due to shipping and wind. Therefore, the sound of snapping shrimps can effect ambient noise and sonar detection performance more than the sound of dolphins. For this reason, many researchers have measured and analyzed the snapping shrimp sound. [1,2]

In this study, we investigated seasonal and diurnal variations of ambient noise due to the snapping shrimp sound in spring, summer, and autumn in the coast of southern sea of Korea.

2. Experimental Measurement

The experimental site in the coast of the southern sea of Korea was 34° 58.51'N and 128° 48.49'E, where the snapping shrimp lived. The experiment was carried out in spring (April), summer (August), and autumn (November) 2001. The ambient noise was measured for 30 minutes at 3-hour interval throughout 24 hours for each season.

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Figure 1 shows the schematic and block diagrams of the experimental setup for acoustic measurement of the ambient noise. The hydrophone (Bruel&Kjaer 8106) used in this experiment has a nearly omni-directional receiving sensitivity of -174 dB re 1V/μPa within +0.5 and -3.5 dB in the frequency range between 3 Hz and 20 kHz. It was lowered to depth of 25 m from sea surface. The ambient noise received from the hydrophone was amplified by an acoustic measuring amplifier (Bruel&Kjaer 2636) with an amplification accuracy within ± 0.5 dB in the frequency range from 2Hz to 200 kHz. The amplified ambient noise was recorded in a digital tape recorder (Sony PC208Ax) at a sampling rate of 48 kHz and stored on a personal computer (Hewlett-Packard 9340KR) using 12 bit analogue to digital converter (National Instrument DAQCard-6062E) when the tape recorder was played in laboratory. A 1/3 octave analysis to obtain the mean noise spectra of the stored ambient noises was carried out. The duration of analysis of each ambient noise was 1 s.

3. Results and Discussion

Figure 2 shows the normalized mean spectra of the ambient noises observed at the experimental site in spring, summer, and autumn. As shown in **Fig. 2**, the snapping shrimp sound strongly affected the ambient noise levels over the frequency range from 3 to 20 kHz in spring and summer. The mean bottom seawater temperatures in spring and summer were 12 and 23 °C, respectively. Generally the snapping shrimps are active in these seawater temperatures. Therefore, the snapping shrimp sounds can affect the ambient noise levels. However, they did not almost affect the ambient noise levels in autumn, although the mean bottom seawater temperature was 17 °C. Recently, Kim *et al*. reported that the snapping shrimp sound in Ieardo Ocean Research Station can not affect the ambient noise levels as the Beaufort Number increased.[3] In this study, the mean Beaufort Numbers in spring and summer were 3 and 2, respectively. It was 5 in autumn. Beaufort Number 5 indicates relatively high wind speed as a sea state 4. Therefore, the ambient noise levels in autumn in **Fig. 2** can not be influenced by the snapping shrimp sound. This means that the snapping shrimps are inactive in high Beaufort Number.

Figure 3 shows the diurnal variations of ambient noise levels due to the snapping shrimp sounds in spring and summer. As shown in **Fig. 3**, the snapping shrimp sound strongly affected the ambient noise levels at the time 21, 03, and 09 o'clock for spring. It also significantly affected the ambient noise levels at 23 and 08 o'clock for summer. These facts mean that the snapping shrimp can be more active in midnight and morning.

4. Conclusion

In this study, we showed that the seasonal variation of the ambient noise levels due to the snapping shrimp sounds at active seawater temperatures of snapping shrimps in the coast of the southern sea of Korea was related to the Beaufort Number. The diurnal variation of the ambient noise levels due to the snapping shrimp sound was dominantly appeared in midnight and morning.

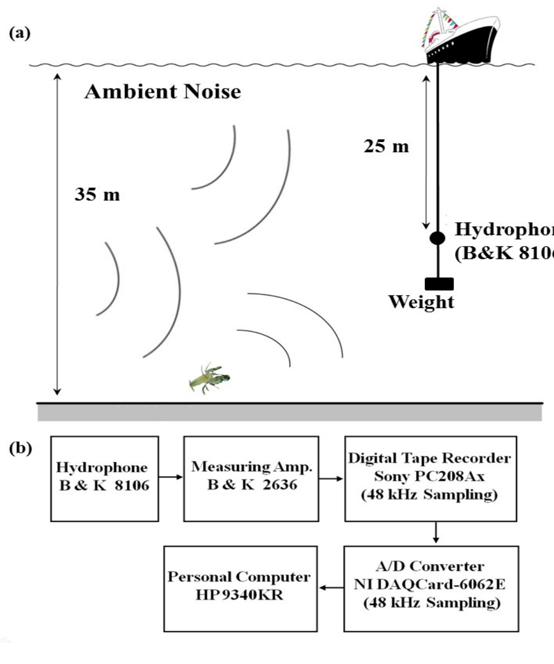

Fig. 1 (a) Schematic and (b) block diagrams of the experimental setup for acoustic measurements of ambient noise in the coast of southern sea of Korea

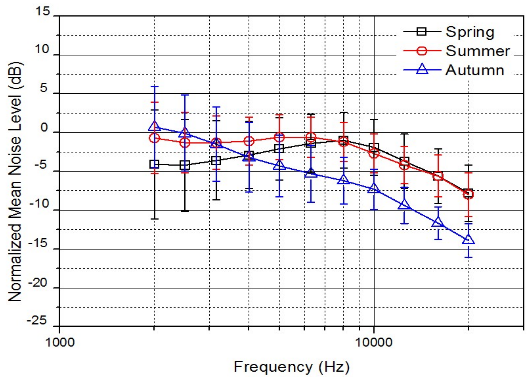

Fig. 2 Normalized mean spectra of the ambien noises observed at the experimental site in spring, summer, and autumn.

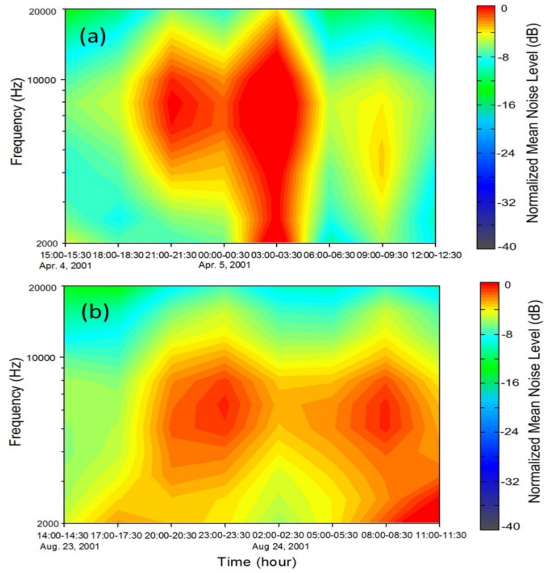

Fig. 3 Diurnal variations of ambient noise levels due to the snapping shrimp sounds in (a) spring and (b) summer.

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