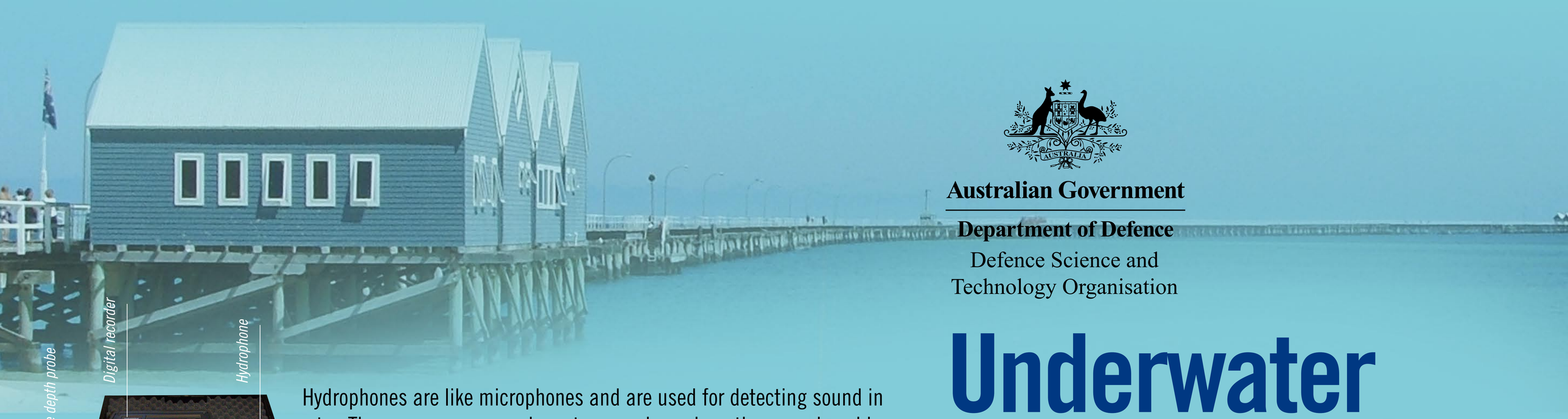


Australian Government

Department of Defence

Defence Science and Technology Organisation

Underwater Acoustic Noise at Busselton Jetty

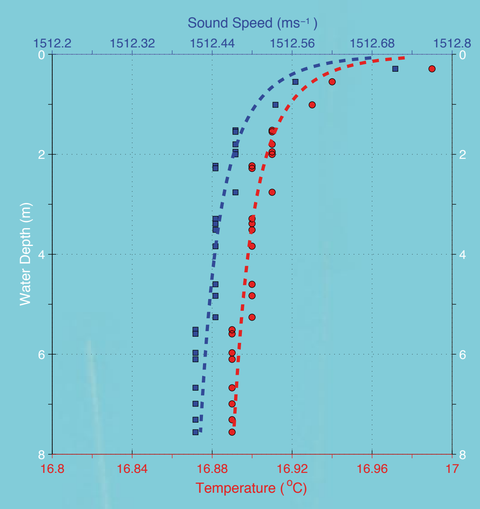
Defence Science & Technology Organisation

HMAS Stirling Rockingham
Western Australia

Equipment used to record underwater sound at the jetty.

Hydrophones are like microphones and are used for detecting sound in water. They can measure underwater sounds such as those produced by dolphins, whales and even shrimps. The picture on the left shows recording equipment used to collect underwater sounds at Busselton Jetty.

Sound travels through water at different speeds which can change with depth. It is useful to have a record of the sound speed to accompany underwater sound recordings. In order to do this a small device called a temperature depth probe can be used. This can record temperatures and depths every second for several days. This information can then be converted to give a sound speed-depth plot as shown on the right. The data collected at Busselton Jetty shows that the speed of sound in the water was 1512 ms^{-1} at the time of the recordings.



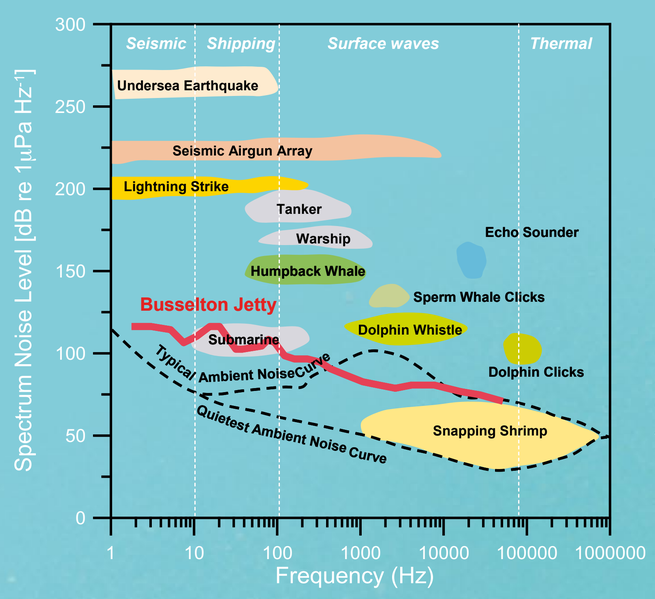
A sound speed depth plot. Sound speed is shown in blue and water temperature in red.

Sound travels very efficiently through the ocean and suffers much less attenuation, or loss, in water than in air. This means sound sources far away can contribute significantly to overall ambient noise[1], which can be separated into three main causes:

(1) **Water Motion:** Usually the dominant source in open, deep water and is directly related to weather conditions.

(2) **Marine Life:** Produced by crustaceans and vertebrates, it is very dominant in shallow waters such as Busselton Jetty and can vary daily and seasonally.

(3) **Shipping and man made:** A dominant source of noise in busy harbours.



Comparison of noise sources in the ocean. The red line is a typical ambient noise curve at Busselton Jetty.

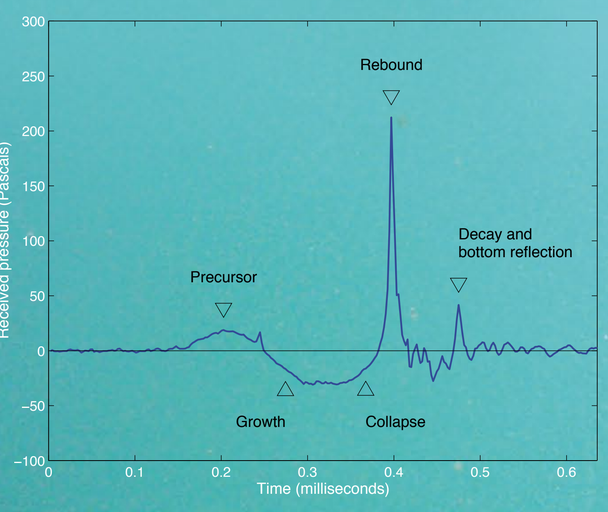
Graph constructed from data taken from, R. Coates, The Advanced Sonar Course, Seiche Technical Education. 2001.

The graph on the right shows how various sources of sound contribute to the overall ambient noise in the ocean. At Busselton Jetty sound is dominated by marine life, especially snapping shrimp, and weather conditions. Small fishing boats can also have a large contribution. The red curve shows a typical ambient noise curve for the jetty during a relatively windy day in September. The low frequency noise is quite high because of waves breaking on the pylons. As can be seen the red curve lies on the upper limit of the snapping shrimp region which, as anybody who has snorkelled here would know, is what you would expect.

[1]Ambient noise refers to the composite noise from all sound sources in a given environment excluding noise inherent in the measuring equipment and platform.

One significant contributor to noise in shallow waters is a very unlikely species, the snapping shrimp. This small crustacean grows to no more than 3 cm but can generate short snaps - pulses of sound at exceptionally high levels. Sustained snapping from a large number of shrimp can significantly increase ambient noise. At close range they sound similar to a twig being snapped while at larger distances they sound a little like chips frying. Each shrimp has one enlarged claw used for snapping. The claw can be larger than half it's body length as shown in the photograph.

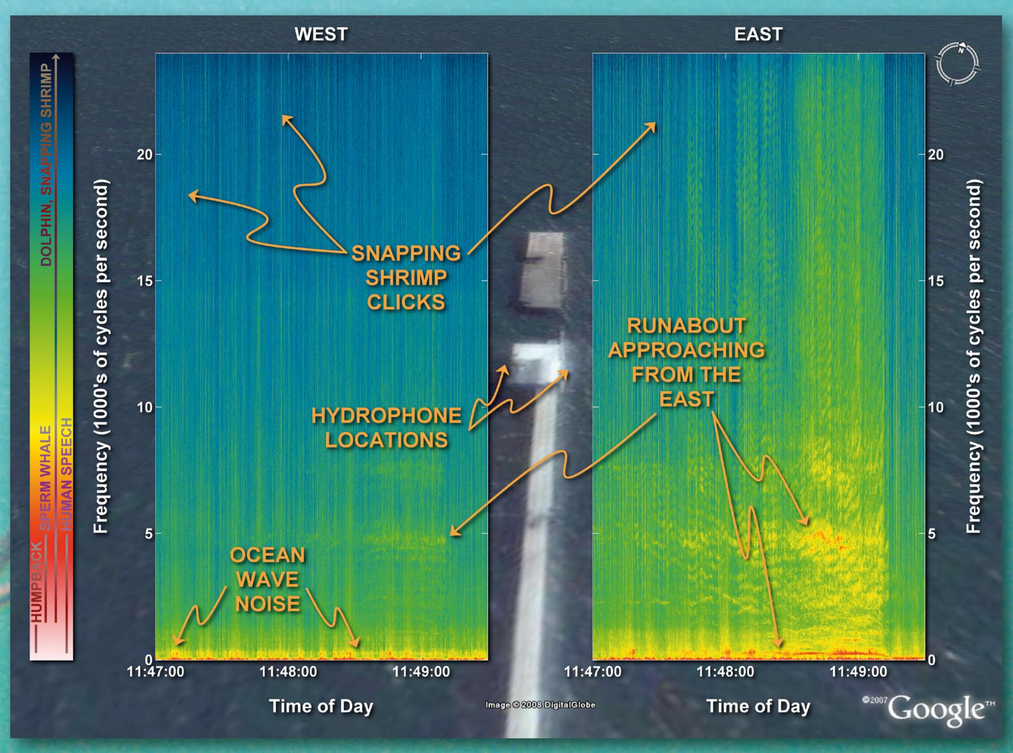
The Snapping Shrimp.



The signature of a single Snapping Shrimp click.

Snapping shrimp make sounds using cavitation bubbles. The shrimp start with their enlarged claw open, then the claw is closed very quickly and a plunger shoots a high speed jet of water into the surrounding water. The jet of water travels so fast that a bubble develops, collapses and then rebounds to produce a high pressure impulse which sounds like a snap.

The figure on the right shows a spectragram of the underwater noise collected at Busselton Jetty. Time of day is shown on the x axis and frequency on the y- axis. The intensity of the sound is shown by the colour; red corresponds to high intensity and blue to low. Various sound sources have been labeled on the diagram. A small boat approached the jetty from the eastern side at about 11.48. The green/yellow vertical stripes correspond to snapping shrimp.



Spectragram of the underwater acoustic sound on both sides of the jetty.

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