

Underwater Acoustics in the Canadian Archipelago.
by
R. Verrall, Defence Research Establishment Pacific

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In order to predict the behaviour and performance of sonar equipment in the Arctic, the Defence Research Establishment Pacific in Victoria has made acoustic measurements in Arctic waters since the late 1950's. Although some of the early work was done in the Arctic Ocean proper, most of our interest has centred on the straits within the Arctic Islands.

One of the important parameters is the ambient (or naturally occurring) noise that exists in the water. The magnitude of this noise is much more variable in the Arctic than it is in other oceans. In the winter and spring, when the straits are covered with unmoving, shore-fast ice, the noise levels are very low. Most noise produced during this period is either biological in origin or is caused by the wind-driven snow. On the other hand, during periods of break-up and freeze-up the noise level is very high. Ice floes grinding together produce much noise. During the noisiest periods, the energy in the water is some 70 dB higher than it is during the very quiet spring periods.

Because of the climate, underwater research in the Arctic is much different than it is in other oceans. For example, the simple process of placing equipment into the water is slowed by the necessity of drilling through the ice. Getting the equipment back after the hole is refrozen can be even more troublesome.

The logistics of field operations are relatively easy in the spring. We set up temporary field camps on the sea ice, and do our experiments from there. In the late summer, some of the channels are relatively ice-free, and experiments may be performed from ice breakers or ice-strengthened vessels. Other seasons of the year are more hostile. During periods of break-up and freeze-up, the ice is too heavy for a ship but not solid enough for a camp. In the winter, the perpetual darkness makes it impossible for an aircraft to land on the ice.

In order to measure year-round ambient noise in the water, we have developed Recoverable Instrument Packages (RIP). They are placed on the sea bed in the summer and are recovered the following summer after having recorded a year's worth of data.

More recently, we have cabled underwater hydrophones to shore camps in order to get 'real time' data. This will give us more control over the data processing. Two problems have been associated with this undertaking. The first is that of building

quiet underwater structures. Since the noise is so very low, extremely quiet systems must be developed to measure it. The second problem is that the ice sometimes destroys cables where they cross the foreshore. We have ongoing programs to study both these problems, and we have made some progress on both fronts.

At some locations in the more northerly islands, permanent ice plugs lie locked between the sides of long, narrow fjords. Usually, a foot or two of the ice surface melts every summer, and an equivalent amount freezes to the bottom of the plug in the winter. Although it increases and decreases in thickness, the plug as a whole never breaks up. It has, therefore, the potential of being a semi-permanent platform for acoustic equipment. At one location (Nansen Sound) we have placed hydrophones through holes drilled in the plug. The acoustic signals are telemetered by a radio link to the shore. Thus, we have access to the data at the shore whenever there is enough light to land an airplane. This is particularly advantageous in the summer when it is impossible to land on the water-covered ice. A summary of the acoustic data is also sent south to the lab via satellite. As well as providing valuable information, the satellite link keeps us informed as to the health of the system.

Our future plans include making measurements from ice shelves. These bodies of floating ice are 40 to 50 metres thick - as thick as a 15 story building is high. (Ordinary first-year ice is only 2 metres thick.) We are presently developing hot water techniques to drill through these massive ice chunks.

