DEFENCE DÉFENSE

Low Frequency Active Sonar in Canada

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Recent news reports on the testing and proposed operation of Low Frequency Active (LFA) sonar and the potential harm to marine life have focused on the activities of the US Navy and NATO. What is Canada's role in the research and development of LFA sonar systems, and what is being done in Canada to ensure that our activities are environmentally responsible? In this article, the authors will answer these and other questions. We will review the requirement for LFA sonar, describe related aspects of the Canadian LFA Research and Development (R&D) effort, and outline our management of the associated environmental risk.

Does the Canadian Navy use Low Frequency Active sonar?

At this time, the Canadian Navy does not have an operational LFA sonar, nor is it testing one; however, Defence Research and Development Canada (DRDC), which is the R&D Agency within the Department of National Defence, is running a project to investigate and demonstrate this technology. Components of the system are undergoing sea trials lasting 4–5 weeks at roughly six-month intervals. The complete system will undergo trials in about 2003 and the project will probably conclude in about 2004. This information will be available to the Canadian Navy to guide them in future sonar acquisitions.

Why are submarines considered a threat?

For all navies, it is important to be able to operate covertly, whether the vessels are on the surface or below the surface. Submarines are considered to be especially valuable, owing to the difficulty of detecting their presence. (Spy satellites and radar have difficulty seeing into the ocean!) During the Cold War, navies were most interested in stalking the missile-carrying submarines, often nuclear-powered, belonging to the other navies. With the thawing of the Cold War, the nuclear-powered submarine threat appears to have decreased, and there is now reduced emphasis on tracking submarines throughout the world's oceans. However, the navies of 46 countries — large and small — still operate more than 600 diesel-electric attack submarines, each of which poses a potential threat to both commercial and naval ships. There is a risk that hostilities might break out, threatening regional peace almost anywhere in the world at almost any time. The requirement to find submarines, although decreased, has not been eliminated.

Why do navies need to continually improve their sonars?

Anti-submarine warfare is a cat-and-mouse game. As the cats get better at finding and catching mice, the mice develop new ways to elude the cats. Although quiet, a nuclear-powered submarine — with its power plant running constantly — is noisier than a modern diesel-electric submarine, which can run quietly on batteries or even sit virtually silent on a shallow seabed for a time. It is possible to gain information about submarines by listening underwater without making noise oneself. This is "passive" sonar. However, to localize a submarine well enough to attack usually calls for an "active" sonar that pings and listens for echos. As sonar engineers improve passive and active sonar to find submarines, the submarine builders find ways to make their boats more quiet and equip them with improved echo-reducing measures.

Why do navies need Low Frequency Active sonar?

As the submarine interest shifts from the nuclear boats to the inherently quieter diesel-electric boats, the cat-and-mouse game of undersea warfare changes, to the advantage of the mice. The smaller diesel-electric boats are quieter, and they are harder to find with passive sonars and conventional active sonars. The cats are countering through the development of Low Frequency Active (LFA) sonar. LFA sonar works the same as other active sonars, but at much lower frequencies. Low frequencies are absorbed less rapidly, and it is much more difficult for a submarine to reduce its echo strength at low frequencies. These improvements extend the range of active sonar, overcoming some of the limitations of passive sonar in trying to detect the quieter submarines. Improved submarine-launched weapons (torpedoes and missiles) also increase the desire to deal with submarines at greater distance.

How “low” in frequency is LFA sonar?

The term “low” as applied to active sonars applies to a wide range of frequencies, as there are several LFA sonar concepts, depending on the application. Conventional active sonars operate in the range 3,000–30,000 Hertz (that is, cycles per second). Compared with the piano keyboard, these notes are at the top right hand end, and beyond. Though there is no universal definition, “low” frequency active sonars, depending on the maker, operate anywhere below 3,000 Hertz. The LFA “notes” are around the middle of the piano keyboard and to the left. The lower the frequency, the larger the sound sources and electronics racks need to be. The lowest-frequency, largest, and most powerful LFA sonars are those proposed for ocean basin surveillance; these generally require purpose-built ships, probably only affordable by the world’s major sea powers.

What is unique about the Canadian LFA sonar?

In the near term, an LFA sonar must fit on existing ships. Moreover, the “stealth” of a warship is viewed as one of its best defences. “Pinging” an active sonar immediately broadcasts its presence, so LFA sonars will probably be used only when absolutely necessary. In this sense, DRDC’s LFA concept is a *tactical* sonar with a detection range better than the current active sonars, but much less than the very long detection ranges of the LFA systems being considered for ocean *surveillance*.

What is TIAPS?

A combined active-passive sonar retains the advantages of passive sonar while also offering an option to “go active” when needed. DRDC, the R&D agency within the Department of National Defence, is investigating this technology under the TIAPS (Towed Integrated Active-Passive Sonar) Project.

What are the characteristics of the LFA sound source used in TIAPS?

The output level of the TIAPS LFA source does not exceed that of the hull-mounted active sonars already in use. The centre frequency is variable – usually about two octaves above middle C. Typical sonar pulses include a “pure” tone of constant pitch, and a “swept” tone that rises or falls over a narrow range of frequencies. The source is towed behind the ship, at variable depth depending upon water conditions and water depth.

Is the TIAPS LFA source a hazard to marine life?

There has been much media attention on the potential harm of sonars on marine life, such as whales. Much of the recent concern focussed on the US Navy’s Low Frequency Active research sonar and the sound sources used for the Acoustic Tomography of the Oceans (ATOC) project. The precise manner in which sounds (loud or soft) can lead to harm in marine mammals is not fully known, although it stands to reason that placing a very loud sound source too close to the ear of any animal could be injurious. The zone for potential physical damage to the ears and other tissues lies close to the source; the louder the source, the greater the danger zone. At lower sound levels, sound may not physically damage a creature, but could yet startle the animal or mask its sonic communications. Mindful of the potential harm to marine mammals, DRDC is conducting the TIAPS project with due diligence to the requirements of the Canadian Environmental Assessment Act.

How do the TIAPS investigators manage the environment risk?

Our approach to managing environmental risk of LFA sonar involves learning about the issues, preparing experimental procedures to minimize effects, and ensuring that the procedures are followed during trials.

TIAPS Environment Risk Management

In the planning stage, trial sites are chosen to minimize probable contact with marine mammals. In cases where our research ship must transit through an area with known environmental sensitivity, acoustic transmissions are forbidden.

We maintain visual watches and keep a log of marine mammal sightings

Where possible, we maintain an acoustic "watch" using our own underwater listening devices. This acoustic "watch" also allows us to detect other sudden loud natural noise sources such as underwater volcanoes, earthquakes and even icebergs.

We do not commence experiments if marine mammals are detected.

When we begin experiments, we gradually increase the sonar output level over 30 minutes providing the opportunity for all mammals to leave the locality before full-strength tests commence.

By consulting with the principal investigators involved in all tests, the required sonar output level is independently determined for each experiment or test: If a test can be performed at less than full output level, we reduce the level to the minimum required.

If we detect marine mammals entering the area, we cease transmission.

TIAPS will be demonstrated from the research vessel CFAV Quest

In trying to better understand marine mammal sensitivities, DRDC scientists collaborate with university, government, and private research units in the United States, England, Italy, and Australia. DRDC scientists are assisting with some aspects of research on better acoustic detection and tracking of marine mammals.

Conclusion

Submarines remain a potential threat to the navies of the world, and so far, sonar is the best available countermeasure. DRDC is conducting an R&D project to investigate a promising new concept in active-passive sonar, including a tactical low frequency active capability. DRDC is mindful that the use of sonar could potentially harm underwater life, and is aware of the public concern over this. In fulfilling its responsibility to the Navy, DRDC recognizes its dual duty to minimize environmental impact, and to practice due diligence.

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