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DREA Q-266 SEA TRIAL
Marine Mammal Impact Mitigation Plan

John Bottomley
James A Theriault

Defence R&D Canada

Technical Memorandum
DREA TM 2002-032
February 2002

National Defence Défense nationale

Canada

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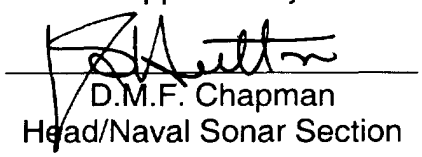

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Head/Naval Sonar Section

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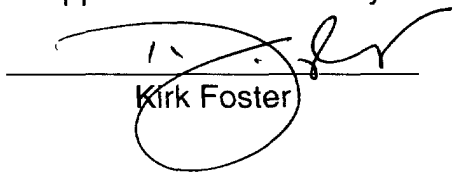

Kirk Foster

Abstract

The Canadian Navy has a continuing requirement to acoustically detect both surface vessels and submarines. The Defence Research and Development Branch (DRDB) through the Defence Research Establishment Atlantic (DREA) is embarking on the first phase of development of the next generation of operational sonars for the Canadian Navy: the Towed Integrated Active Passive Sonar (TIAPS). The TIAPS Technology Demonstrator (TD) will demonstrate basic sonar capability and will serve as a testbed for concept development. Q266 is the fourth in a series of sea trials that are required to develop and demonstrate this capability. Since acoustic energy will be transmitted during the trial, a Marine Mammal Impact Mitigation Plan has been developed to detail the procedures to be used. This document describes the procedures.

Résumé

La marine du Canada a un besoin continuer de détecter par voie acoustique tant des navires de surface que des sous-marins. La Direction de la recherche et du développement pour la défense (DRDD), par l'intermédiaire du Centre de recherches pour la défense Atlantique (CRDA), aborde la première phase de développement de la prochaine génération de sonars opérationnels pour la marine canadienne: le sonar remorqué intégré actif et passif (TIAPS). Le démonstrateur de la technologie TIAPS fera la démonstration de la fonction de sonar de base et servira de banc d'essai pour le développement du concept. Le Q266 est le quatrième d'une série d'essais en mer requis pour mettre au point cette fonction et en faire la démonstration. Puisque de l'énergie acoustique sera transmise durant ces essais, un plan d'atténuation des risques pour les mammifères marins a été élaboré pour préciser les la marche à suivre. Le présent document décrit les problèmes et les méthodes.

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Executive Summary

The Canadian Navy has a continuing requirement to acoustically detect both surface vessels and submarines. The Defence Research and Development Canada (DRDC) through the Defence Research Establishment Atlantic is embarking on the first phase of development of the next generation of operational sonars for the Canadian Navy: the Towed Integrated Active Passive Sonar (TIAPS). The TIAPS Technology Demonstrator (TD) will demonstrate basic sonar capability and will serve as a testbed for concept development. The TIAPS TD project (1cm) will integrate both active and passive sonars in a single system. By lowering the frequency from traditional hull mounted sonar frequencies and by giving the sonar a variable depth capability, longer range active detections can be achieved. Passive sonars have the advantage of being covert and allowing for the possibility of positively identifying a class of target by its acoustic signature. Not only will both active and passive capabilities be included in TIAPS, but also a high priority is placed on combining their capabilities. TIAPS will make use of the Sonar Information Management System to fuse sonar data with information from the ship's Command & Control system, and will in turn provide information for the Command & Control function. In developing such a system, a number of sea trials are required. Q266 is the fourth in the series of R & D trials. Though Q266 is not a full sonar trial, acoustic transmissions are to be used to meet the trial objectives. In order to minimize potential impact on marine mammals, an impact mitigation procedures will be exercised during for the trial. This technical memorandum documents the mitigation efforts to be used during the trial.

John Bottomley; 2002; DREA Q266 Sea Trial Marine Mammal Impact Mitigation Plan; DREA TM 2002-032;
Defence Research Establishment Atlantic.

Sommaire

La marine du Canada a un besoin continuer de détecter par voie acoustique tant des navires de surface que des sous-marins. La Direction de la recherche et du développement pour la défense (DRDD), par l'intermédiaire du Centre de recherches pour la défense Atlantique (CRDA), aborde la première phase de développement de la prochaine génération de sonars opérationnels pour la marine canadienne: le sonar remorqué intégré actif et passif (TIAPS). Le démonstrateur de la technologie TIAPS fera la démonstration de la fonction de sonar de base et servira de banc d'essai pour le développement du concept. Le projet du démonstrateur de la technologie TIAPS intégrera des sonars actifs et passifs en un seul système. En réduisant la valeur des fréquences classiques du sonar de coque et en permettant au sonar de fonctionner différentes profondeurs, on peut obtenir des détections actives à plus grande distance. Les sonars passifs ont l'avantage d'être discrets et de permettre d'identifier sans ambiguité une classe de cibles d'après sa signature acoustique. Une grande priorité est accordée à la combinaison des caractéristiques des sonars actifs à celles des sonars passifs. Le TIAPS fera appel au système de gestion de l'information sonar pour intégrer les données sonar à l'information du système de commandement et de contrôle du navire et fournira à son tour de l'information à ce système-ci. Le développement d'un tel système nécessite un certain nombre d'essais en mer. Le Q266 est le quatrième d'une série d'essais de R & D. Bien que le Q264 ne soit pas un essai intégral du sonar, on a utilisé des transmissions acoustiques pour atteindre les objectifs de l'essai. En vue de réduire au minimum l'incidence potentielle sur les mammifères marins, on suivra un plan d'atténuation de cette incidence pendant l'essai. Le présent document technique fait rapport des efforts d'atténuation qu'on utilisera pendant l'essai.

John Bottomley; 2002;
DREA TM 2002-032;
Centre pour la Recherche de la Défence Atlantique.

Acknowledgements

The plan for marine mammal impact mitigation set out in this document is based on the previous plans developed and published by James Theriault, Group Leader, Sonar Data Systems in the Naval Sonar Section of DREA. Those plans were based upon the principles used in a 1998 CAN/UK LFA sea trial and an approach put forward through The Technical Co-operation Panel (TTCP) Maritime Technical Panel - 9. Dr. E. Harland (formally of DERA/Winfrith & now with QinetiQ in the UK) contributed the major part of the methodology. Further input came from LCdr. W. Nolan and D. Jones of DREA. Previous versions of this approach were used for trials Q248(2000), Q258 (2001) and Q264(2001).

Table of contents

1. Introduction

To meet the Canadian Navy's continuing requirement to acoustically detect both surface vessels and submarines, it is necessary to improve the performance of both passive towed array sonars and active sonars. In searching for the modern, quiet submarine, the detection range of current active sonars is inadequate; the emerging solution involves low frequency active (LFA) sonars. Low frequency (LF) sound propagates better in the ocean and is more difficult to counter using anechoic coatings. Typically, a shipborne tactical LFA sonar would employ a towed array receiver and a towed LF source

The Canadian Navy's requirement for a tactical sonar has driven the frequency to be significantly higher than a surveillance system A lower frequency surveillance system would have greater detection range, but would also be larger and more difficult to employ based on the Canadian Navy's vessel assets and roles Whatever advantages an LFA sonar may provide, there remains a role for the covert, passive towed array sonar. The full requirement for acoustic detection is therefore met by an integration of an LFA sonar with a passive towed array sonar· a Towed Integrated Active/Passive Sonar (TIAPS) [1].

DREA Cruise Q266 is the fourth in a series of sea trials that are planned during technical development and demonstration of this LFA sonar. Underwater Acoustic transmissions will be a necessary part of the tests during this development project. While DREA has been conducting LFA trials in these waters since 1992 with no adverse affects reported [2], it is believed that some cetaceans could be affected by high power sonar transmissions. Although there is no conclusive evidence to support this, LFA sources can be very loud and the precautions set out in this document are aimed at minimizing any potential impact. The precise manner in which sounds (loud or soft) might lead to harm in marine mammals is not fully understood, although it stands to reason that placing a very loud sound source too close to the ear of a any animal could be injurious.

This document sets out the precautions to be observed during the Q266 sea trial in order to minimize potential hazards of low frequency energy on the marine mammal population in the trial areas. Although this mitigation plan is specific to sea trial Q266, it builds upon lessons learned from previous trials of LFA projectors and contains several generic elements that provide the basis for similar mitigation plans for future trials. Note that these procedures do not apply to the vessel's navigational sonars such as depth sounder or doppler current meter.

2 Geographic Areas

The trials will be conducted in a number of a large geographic areas. Table 1 lists the operating areas. Figure 1 shows geographical location of the planned trial areas. After leaving Halifax, CFAV Quest will transit to the Bahamas before deploying equipment.

Figure 1: Q-266 Trial Areas

Much of the acoustic work will take place in Exuma Sound (Area 1). Anecdotal evidence from previous trials had suggested that if any, there were only a small number of mammals in the deep water of the Sound. From evidence gathered using aerial surveys and with the aid of the Bahamas Marine Mammal Survey vessel during

DREA Cruise Q258 coupled with our experiences during Q264, this assumption has been proven incorrect [2, 3, 4, 5]. Additional discussion is included in Section 3.2.

Operating Areas	Bounded by Geographical Coordinates	
Area 1: Deep Sheltered (Exuma Sound)	24°43'N	76°47'W
	24°49'N	76°25'W
	23°50'N	75°25'W
	23°35'N	75°45'W
Area 2: Deep Ocean	36°13'N	71°05'W
	35°47'N	70°36'W
	34°43'N	72°05'W
	35°10'N	72°35'W
Area 3: Deep Ocean	40°28'N	64°24'W
	40°35'N	64°51'W
	41°27'N	63°57.5'W
	41°31'N	64°25'W
Area 4: Shallow Ocean (Emerald Basin)	43°16.5'N	63°07'W
	43°26'N	63°31'W
	43°52'N	62°41'W
	44°13'N	62°35.5'W
	44°17'N	63°03'W

Table 1: Q-266 Trial Areas

3 Species

3.1 Mysteceti

This sub-order of the order cetacea, the whales and dolphins, includes all the baleen whales, from the blue whale down to the minke whale. This group is characterized by the baleen plates used instead of teeth to filter their food from the water. They are passive feeders which operate by taking large quantities of water into their mouths and then forcing it back out through the baleen to filter out plankton and other small organisms. Because they do not have to chase their prey they have not developed echolocation. The only sounds they make are used for inter-animal communication and perhaps for long range navigation. The sounds are in the frequency range 10 Hz to 5 kHz, with the largest species producing the very low frequencies. The best known member of this group is the humpback whale, which produces very complex acoustic "songs" during the mating season. It is unlikely that any of these whales will be found in Area 1(Exuma Sound) where the majority of TIAPS acoustic transmissions are planned. It is interesting to point out that a Fin whale was stranded on Eleuthra Island in March 2000. These whale species are more likely to be found north of the Bahamas. A main breeding ground for the humpback whale is Silver Bank, between the Dominican Republic and the Turks and Caicos Islands. As a result, encounters with humpback whales during transit segments of the trial may be possible. The sei

whale has been observed from Davis Strait to Venezuela and the Gulf of Mexico. The Bryde's whale is often mistaken for a sei whale and is common south of Georgia in deep water. The rare Northern right whales, which are usually found in the Bay of Fundy during the summer, move south from December to March. Although they have been sighted near Bermuda and in the Caribbean, the primary migratory path follows the coastal areas of Georgia and the Carolinas to the Gulf of Mexico. In the general area Emerald Basin (Area 4), a number of these whales may be evident. Although Minke Whales are concentrated here in the summer, conclusive evidence of leaving the area for the winter is not available. Sei whales, blue whales, fin whales, and humpback whales are believed to migrate south for the winter. It is not expected that any Northern Right Whales will be in the area, however, summer feeding grounds exist in the Bay of Fundy and Browns Bank. These animals are the most likely to be affected by high power sonar transmissions. Because they do not transmit their own high power echolocation signals they have not had to cope with very loud acoustic signals. When these animals are detected within the trials area the precautions identified in Section 5 must be observed.

3.2 Odontocetes

This cetacean sub-order includes all the toothed whales, ranging from the sperm whale down to the harbor porpoise. Unlike the baleen whales, this group has teeth and actively chase their prey, which include fish and squid. In order to find their prey in the limited visibility encountered underwater they have evolved a system of echolocation in which a short high power acoustic pulse is emitted and echoes from the prey animals are detected to provide positional information. This echolocation system works on frequencies varying from 140 kHz for the harbor porpoise down to 2 kHz for the sperm whale. In addition to echolocation, many species within this sub-order also produce tonal signals for inter-animal communication. Depending on the species, these frequencies range between 1kHz and 25 kHz. Some animals within this group are capable of producing a third type of sound which is produced in a manner similar to echolocation pulses. These sounds are transmitted at lower power with a higher repetition rate (> 1000 repetitions per second). The sounds have variously been described as ratchets, squawks and mews.

The Odontocetes are usually tolerant of sources of loud noise. Occasionally they will come and investigate loud noise sources even when the transmissions are at a very high level. On several occasions during sonar development trials, the commencement of transmissions has been followed by a number of animals approaching the ship to investigate the noise. This behaviour should not be interpreted as meaning they are not affected by such noise sources. Like most creatures they will investigate strange new sounds that appear in their environment but may be forced to move away from the area by the intensity of the sound.

A large number of species may be encountered through the transit areas between Nova Scotia, the Bahamas and Florida. The species most likely to be found throughout the transit areas and near the Bahamas include sperm whales, short-finned pilot whales,

Cuvier's beaked whales, common dolphins (most likely near the Gulf Stream), striped dolphins, Atlantic spotted dolphins, Risso's dolphins, Blainville's beaked whales, and bottlenose dolphins. The species found in the Northern transit area include the, Sowerby's beaked whales, Pygmy Killer whales, long-finned pilot whales, Killer whales, Bottlenose dolphins, and Atlantic white-sided dolphins Other species including pygmy sperm whales, dwarf sperm whales, Gervais' beaked whales, False Killer Whales, short-snouted spinner dolphins, long snouted spinner dolphins, pantropical spotted dolphins, and rough toothed dolphins may be found in the southern transit areas and near the Bahamas.

At least nineteen species of Odontocetes are known to have stranded in Bahamian waters to the east [6], but little has been reported in the coastal areas of Exuma Sound. Stranding of bottlenose dolphins, Cuvier's beaked whales, sperm whales, Atlantic spotted dolphins and short-finned pilot whales are the most common and have been reported in Puerto Rico, the United States and the British Virgin Islands Ken Balcomb of the Bahamas Marine Mammal Survey [7] indicates that twenty three species have been observed in Bahamian waters. Claridge [8] and Wilson [9] describe some of the more commonly observed species. Carwardine [10] provides a general description of both toothed and baleen whales. Ridgeway and Harris [11] suggest that Cuvier's Beaked whales are rarely observed from ships, and may be more likely seen off the stern of a ship.

Anecdotal evidence from previous trials suggested that a large population of marine mammals is absent from Exuma Sound. This evidence consists of the lack of observed food sources in the deep water and the absence of acoustic and visual biological contacts. This hypothesis was independently suggested by marine biologists at Dalhousie University [12]. More recent information from Ken Balcomb of the Bahamas Marine Mammal Survey [13] has contradicted this hypothesis. In order to clarify the facts, an extraordinary survey effort was undertaken during DREA's Q258 sea trial in Exuma Sound (March 2001) [2, 3, 4, 5]. Aerial Surveys were conducted using chartered aircraft and liaison was established with the Bahamas Marine Mammal Survey team who provided marine mammal reports to Quest from their RIB (Rigid Inflatable Boat) - Dolphin Research.

Figure 2 shows a chart of the Exuma Sound area with the Q258 sightings indicated. by capital letters in the figure. Table 2 provides amplifying details with respect to those sightings.

The previous lack of biological contacts may be due to poor long range acoustic propagation conditions in the area. Unless both a biological source (whale) and the receiver were both in an acoustic duct, any sound transmitted from the biological source would interact with the high loss bottom in the area [14]. Due to reciprocity, the same loss mechanisms that affect the transmission of sound from a whale to a receiver also affect the transmission of sound from the LFA source to the whale (assuming the receiver and the LFA source are collocated). At short ranges, the marine mammals may be avoiding the vessel, but may also simply be quiet.

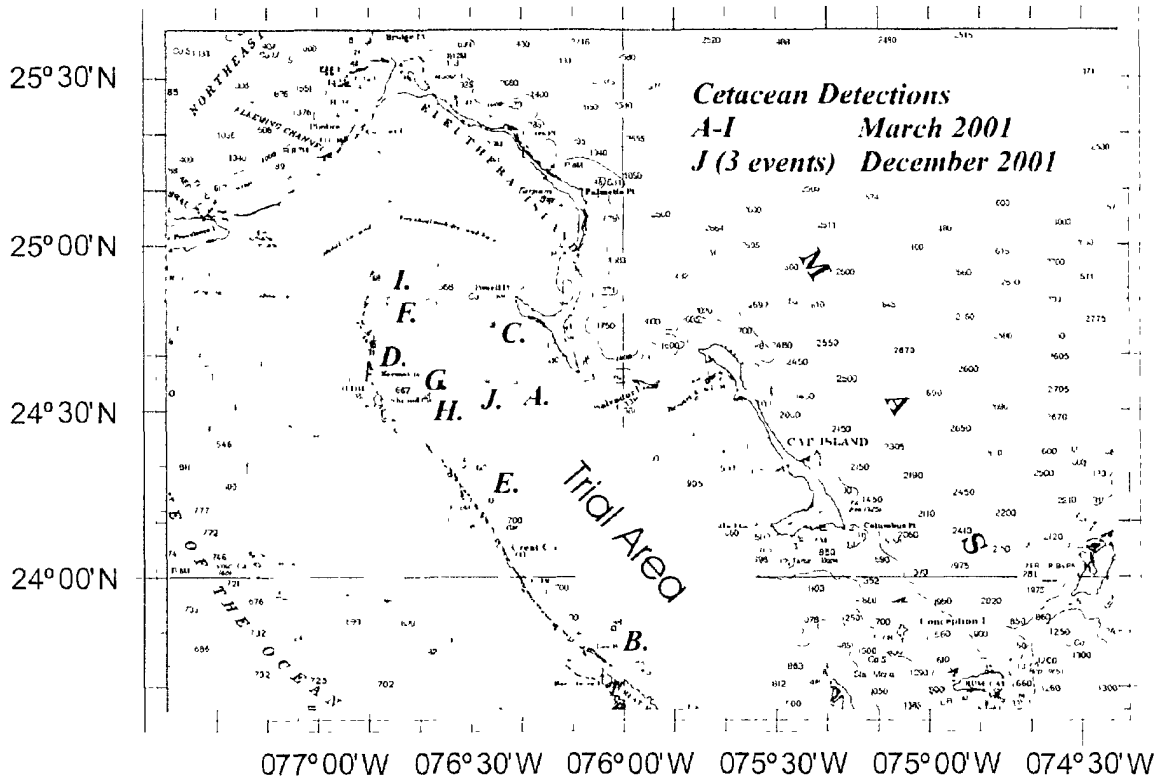

Figure 2: Marine Mammal Sightings in Exuma Sound During Q-258

Observation	Source	Date/Time (Zulu)	Description
A	Seaplane	2001-03-26 15:06	1 Sperm Whale
B	Seaplane	2001-03-26 15:57	30 Pilot Whales
C	Seaplane	2001-03-27 14:34	2 Whales - Probably Sperm Whales
D	BMMS	2001-03-27 14:34	19 Risso Dolphins
E	Seaplane	2001-03-27 15:58	7 Pilot Whales
F	Seaplane	2001-03-27 16:35	12 Pilot Whales
G	BMMS	2001-03-27 16:35	4 Beaked Whales Unknown species
H	BMMS	2001-03-27 16:35	6 Pygmy Sperm Whales
I	Seaplane	2001-03-27 16:49	15 Pilot Whales
J	QUEST	2001-12-01 17:35	3 Whales - Possibly Sei Whales

Table 2: Q-258 Marine Mammal Observations

Some marine mammal activity may be observed in Area 4 (Emerald Basin) where Pygmy Sperm Whales, Risso's dolphins, Atlantic white-sided dolphins, white-beaked dolphins and the Long-finned Pilot whale are normally observed near the shelf edge. It is possible that they may be observed in the deep basin as well. The Common Dolphin may be observed in the area, but since it is normally only observed in areas with surface water temperatures between 10°C and 28°C, it seems unlikely during the winter or spring.

The Harbour Porpoise spends most of its summer inshore but is thought to move offshore for the winter, sometimes moving south. The Northern Bottlenose whale is believed to be in abundance in "The Gully" to the north with at least some animals wintering over. None are expected in Emerald Basin. Little is known regarding the migration of the Sowerby's beaked Whale, but that it probably lives some distance offshore. The Blainville's Beaked Whale is rarely observed. It is conjectured that they prefer the deep waters to the east. True's Beaked Whales are often associated with the Gulf Stream and are not expected in the area. Killer whales prefer deep water and do not demonstrate any regular migrations. There is a small possibility that Killer whales may be in the area.

As a precautionary measures the procedure set out in section 5 shall be followed if any animals are observed within the vicinity of the ship. Although some experts theorize that Odontocetes are be less affected than baleen whales by high intensity sound, circumstantial evidence (mass strandings correlated with high power sonar research trials and military exercises) has suggested that toothed whales can be adversely affected by high power acoustic transmissions.

3.3 Pinnipeds

This group of animals includes all the seals and associated species. The pinnipeds seem fairly tolerant of high sound levels. Attempts to scare them away from fish farms are usually only successful for a short period until the animals become habituated to the sounds. Although it is unlikely that the transmissions made during this trial will affect any pinnipeds the precautions set out below will be followed.

4 Monitoring for Marine Mammals

4.1 Visual Monitoring

During periods of sonar transmissions, a visual watch for marine life will be maintained and the "reporting forms" included in this document will be properly maintained. All sightings shall be reported to the Chief Scientist immediately in order to facilitate the implementation of the appropriate mitigation procedures. Where possible, the animals should be identified with the aid of an identification book. There shall be a log entry for every watch, including those where there were no marine mammal sightings. It is also important to identify the total sighting effort even when animals are not seen. A summary form for sighting effort will be provided together

with guidance notes on how to complete the form. Where possible photographs or videos of the animals should be taken to confirm identification. At night, the visual watch shall be maintained using night vision binoculars.

4.2 Acoustic Monitoring

An acoustic watch will be kept by trial personnel monitoring information from sonobuoys or towed hydrophones. This will assist with the detection of baleen whales, Sperm whales, Bottlenose whales and vocalizing dolphins.

Beaked whales have only been recorded vocalizing when stranded. Sperm whales on the other hand are quite vocal and employ a variety of sound patterns in a predominant frequency range between 10kHz and 16 kHz but they have been observed to use frequencies as low as 200Hz and as high as 32kHz. Pygmy and Dwarf Sperm whales are less vocal but may make use of a very directional echolocation scheme.

Bottlenose whales range in the northern waters off Nova Scotia. They have been recorded using a variety of chirps, clicks and tones usually around 4 kHz.

It is very unlikely that seals will be detected acoustically.

Reporting and recording of acoustic contacts will use the same procedure as visual sightings. Any potential biological contacts will be immediately brought to the attention of the Chief Scientist. Assistance from any embarked Naval Acoustic Operators in classifying acoustic sources will aid the Chief Scientist in making marine mammal mitigation decisions. An acoustic operator should be available for acoustic consultation during any period where active sonar transmissions are being made (Note: During Q266, CFAV Quest may only have one professional sonar operator on board). Acoustic contacts identified as being man made shall also be logged.

5 Precautions to be Taken

The first precautionary component is to ensure that active, acoustic transmissions are not made without scientific or technical objectives and that the source levels specified shall be the minimum necessary to meet the scientific or technical objectives of the test or experiment. The specification of required source levels shall be undertaken during the planning stages through requirement definitions and awareness of the principal investigators and their technical support staff.

At the start of a period of sonar transmissions a thirty minute "Whales Away" sequence will be transmitted. The sequence has been designed to alert animals to the presence of an increasingly loud acoustic source - in the hope that it will compel any marine life disturbed by the sound to avoid the area around the transmitting vessel. "Whales Away"' will normally commence with the on-axis source level starting at 160 dB re 1 μPa @ 1m and will build up to the maximum power to be used during the test or experiment. The "Whales Away" procedure shall be repeated if any break in

transmissions lasts for more than two hours. Special care shall be taken to ensure that the ramp up transmissions do not exceed the intended source levels to be used in the experimental session.

- If any baleen whales are observed within 1 nautical mile of the transmitting ship, all active transmissions shall cease. Any subsequent "Whales Away" sequence must not start until the animals are at least 1nm away from the ship.

- If any other species of marine mammals close to within 6 cables (~ 1 kilometre) of the transmitting ship, then active transmissions shall be suspended until the animals clear the area.

5.1 Acoustic Modelling

Transmission loss can be modeled for the experiments that require all but very low source levels. Modelling can often be undertaken in direct support of an experiment where there are specific concerns about the environmental impact. A fundamental requirement for realistic acoustic modeling is having accurate knowledge of the properties of the water column in which one is working. Accurate water temperature profiles from the sea surface to the bottom are vital for forecasting acoustic propagation. The expendable bathythermograph (XBT) is the primary tool for acquiring temperature profiles and XBTs will be taken at regular intervals (at least daily) during sea trials. If high variability is observed, a higher deployment rate will be used. SSO METOC [14] supplied classified bottom loss figures for the Exuma Sound Area. Nominally, it can be shown that the transmission loss at one kilometre for a 1 kHz sonar will be ~60dB (assuming spherical spreading).

6 Post Trial Follow-up

In addition to keeping acoustic and visual watch for marine mammals and recording all observations it is planed that transmitting will occur at source levels no higher than necessary for the planned experiment or test. Any marine mammal problems (including strandings) that occur after the first transmission and within two weeks of the last transmission in the trial area will be followed up and investigated by DREA Staff.

7 Summary

The DREA sea trials in support of the TIAPS technology demonstration project require the transmission of acoustic energy in order to meet technical and scientific objectives. With the transmission of acoustic energy comes awareness for potential impact on the marine environment. This document specifies the procedures that will be used during the sea trials with the aim of mitigating any potential impact on marine mammals.

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Annexes

Annex A
Guide to Using the Marine Mammal Recording Forms

There are two forms to be completed. The first records basic information on where you looked for marine mammals and how long you looked ("Location and Effort Data"). The second reports information on each sighting of marine mammals ("Record of Sightings").

A.1 Location and Effort Data

One line on the "Location and Effort Data" form should be filled in for every watch period, regardless of whether you actually saw any marine mammals or not. This form includes basic information such as date, observer name, ship's position and weather. It is important to note the length of time during each watch that the sonar transmitter was operating. Wind direction should be given to the nearest compass point in knots. Visibility should be recorded as poor (i.e. less than 1km), moderate (1-5km) or good (greater than 5 kms.

A.2 Record of Sighting

The sighting form must be completed when you see marine mammals. The required details are self-explanatory, but details regarding some items are provided here for clarification.

Position - This is the latitude & longitude at time of sighting.

Projector Depth - This should be in metres.

Species - Identify species as far as possible - if you cannot identify the actual species then put down what you can. For example, if you know it's a whale and not a dolphin, but you are not sure what type of whale, put down 'whale'. Useful categories are "whale", "large whale", "medium whale", "small whale", "dolphin", "patterned dolphin", "seal" etc. It can also be useful to eliminate species you know it isn't e.g.: "medium-sized whale but not killer whale". A guide for cetaceans will be provided to help identification.

Total number - If it is difficult to tell exactly how many animals are present then estimate minimum and maximum number e.g. 5-8.

Number of adults/number of juveniles - If it is difficult to tell how many of each age group there are, an estimate of the minimum e.g. at least 3 adults, at least 2 juveniles, should be made.

Description - It is useful to include a description of the animal, even if you are certain which species it is. Try to describe the features you used to identify it e.g. "hourglass pattern on flanks". If you are uncertain of the species then the more detail you give the better. Features to describe are suggested on the form. A rough sketch on the back of the form, may be useful (e.g. shape of fin, shape of patterning).

Photograph or video taken - This will help later with identification.

Behaviour - If there is more than one sort of behaviour, then record all behaviours observed. Examples of behaviour are: Normal swimming Fast swimming porpoising Breaching (animal launches itself clear of the water) tail slapping (animal slaps tail on water surface) sky pointing (animals almost vertical in water with head pointing toward the sky) feeding resting avoiding ship bow riding Plus any other behaviour you may see

Ship's activity - e.g. transiting, deploying equipment, towing HPA etc

Sonar operating - This is important information. Even if you think it's obvious from the activity of the ship, fill in whether the sonar is transmitting or not when the animal(s) are sighted.

Closest Point of Approach (CPA) - This should be filled in whether or not the sonar is operating when animals are observed. The CPA should be given in range and bearing from the ship e.g. Starboard beam 200 metres or Port quarter 500 metres. Be sure to specify range units (metres, yards, cables, miles etc)

Queries regarding the use of the forms should be addressed to the Chief Scientist, Cruise Q-266, DREA, Halifax.

Completed forms shall be submitted to the Chief Scientist.

MARINE MAMMAL RECORDING FORM
LOCATION AND EFFORT DATA

(May be reproduced locally)

Ship _____

Record the following information every watch, regardless of whether marine mammals are observed or not

Date	Observer	Ship's Position (Lat & Long)	Watch Hours		Length of time sonars were operating	Wind Speed & Direction	Visibility: P-poor M-moderate G-good
			Start	Finish			

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MARINE MAMMAL RECORDING FORM
RECORD OF SIGHTING
(May be reproduced locally)

Options in italics should be circled or underlined as appropriate.

<table>
<tr><td colspan="2">Date</td><td colspan="2">Time (GMT)</td></tr>
<tr><td colspan="2">Ship</td><td colspan="2">Observer</td></tr>
<tr><td colspan="3">Ship's Position</td><td>Water Depth (metres)</td></tr>
<tr><td colspan="2">Species</td><td colspan="2">Certainty of Identification
Definite/Probable/Possible/not known</td></tr>
<tr><td colspan="2">Total Number of Animals</td><td colspan="2">Number of Adults

Number of Young</td></tr>
<tr><td colspan="3" rowspan="2">Description (include features such as overall size; shape of head; colour and patterning; size, shape and position of dorsal fin, height, direction and shape of blow)</td><td>Photo/Video taken?

Yes/No</td></tr>
<tr><td>Direction of travel of animals relative to the ship:</td></tr>
<tr><td colspan="3">Behaviour</td><td>Direction of travel of the animals:</td></tr>
<tr><td>Activity of Ship</td><td>Sonar operating?
Yes/No</td><td colspan="2">CPA of the Animals</td></tr>
<tr><td>Other ships within 1 km?
Yes/No</td><td>Sea State</td><td colspan="2">Visibility</td></tr>
</table>

Please continue overleaf if more information is available

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DOCUMENT CONTROL DATA

(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1 ORIGINATOR (the name and address of the organization preparing the document Organizations for whom the document was prepared, e g Establishment sponsoring a contractor's report or tasking agency, are entered in section 8)

TIAPS Project Office
Defence Research Establishment Atlantic
PO Box 1012
Dartmouth, NS, Canada B2Y 3Z7

2 SECURITY CLASSIFICATION (overall security classification of the document including special warning terms if applicable)

UNCLASSIFIED

3 TITLE (the complete document title as indicated on the title page Its classification should be indicated by the appropriate abbreviation (S C R or U) in parentheses after the title)

DREA Q-266 SEA TRIAL - Marine Mammal Impact Mitigation Plan (U)

4 AUTHORS (Last name, first name, middle initial If military, show rank, e g Doe, Maj John E)

Bottomley, John and Theriault, James A.

5 DATE OF PUBLICATION (month and year of publication of document)	6a NO OF PAGES (total containing information Include Annexes Appendices, etc)	6b NO OF REFS (total cited in document)
Feb 2002	15 (approx.)	14

7 DESCRIPTIVE NOTES (the category of the document, e g technical report technical note or memorandum If appropriate, enter the type of report e g interim progress, summary, annual or final Give the inclusive dates when a specific reporting period is covered)

Technical memorandum

8 SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development Include address)

Defence Research Establishment Atlantic
PO Box 1012
Dartmouth, NS, Canada B2Y 3Z7

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Project TIAPS	

10a ORIGINATOR'S DOCUMENT NUMBER (the official document number by which the document is identified by the originating activity This number must be unique to this document)	10b OTHER DOCUMENT NOs (Any other numbers which may be assigned this document either by the originator or by the sponsor)
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The Canadian Navy has a continuing requirement to acoustically detect both surface vessels and submarines. The Defence Research and Development Branch (DRDB) through the Defence Research Establishment Atlantic (DREA) is embarking on the first phase of development of the next generation of operational sonars for the Canadian Navy: the Towed Integrated Active Passive Sonar (TIAPS). The TIAPS Technology Demonstrator (TD) will demonstrate basic sonar capability and will serve as a testbed for concept development. Q266 is the fourth in a series of sea trials that are required to develop and demonstrate this capability. Since acoustic energy will be transmitted during the trial, a Marine Mammal Impact Mitigation Plan has been developed to detail the procedures to be used. This document describes the procedures.

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Marine Mammals
Sonar
Mitigation Procedures

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