NATO OTAN NURC
a NATO Research Centre
un Centre de Recherche de l'OTAN
NURC
PARTNERING FOR MARITIME INNOVATION

Special Publication **NURC-SP-2009-002**

NATO Undersea Research Centre Marine Mammal Risk Mitigation Rules and Procedures

Kendra L. Ryan

November 2009

About NURC

Our vision

- To conduct maritime research and develop products in support of NATO's maritime operational and transformational requirements.
- To be the first port of call for NATO's maritime research needs through our own expertise, particularly in the undersea domain, and that of our many partners in research and technology.

One of three research and technology organisations in NATO, NURC conducts maritime research in support of NATO's operational and transformation requirements. Reporting to the Supreme Allied Commander, Transformation and under the guidance of the NATO Conference of National Armaments Directors and the NATO Military Committee, our focus is on the undersea domain and on solutions to maritime security problems.

The Scientific Committee of National Representatives, membership of which is open to all NATO nations, provides scientific guidance to NURC and the Supreme Allied Commander Transformation.

NURC is funded through NATO common funds and respond explicitly to NATO's common requirements. Our plans and operations are extensively and regularly reviewed by outside bodies including peer review of the science and technology, independent national expert oversight, review of proposed deliverables by military user authorities, and independent business process certification.

NURC-SP-2009-002

NATO Undersea Research Centre
Marine Mammal Risk Mitigation
Rules and Procedures

This document, which describes work performed under Marine Mammal Risk Mitigation Project of the NURC Scientific Programme of Work, has been approved by the Director.

Intentionally blank page

NATO Undersea Research Centre Marine Mammal Risk Mitigation Rules and Procedures

Kendra L Ryan

Executive Summary: The NATO Undersea Research Centre (NURC) Marine Mammal Risk Mitigation Rules and Procedures provides the policy and the procedures to scientific planners, Scientists-in-Charge (SIC), researchers and the Masters of NURC vessels which address potential adverse effects on marine mammals of sea trials involving underwater sound. As a matter of policy, the Centre will take precautionary and preventive measures to circumvent harm to marine mammals from underwater sound by institution of procedures outlined in Staff Instruction 77. As new information becomes available from continued research by the Marine Mammal Risk Mitigation project, as well as other documented sources, these procedures will be reevaluated and modified as appropriate.

During the last decade, mass strandings of beaked whales in close spatial and temporal proximity to active sonar experiments and military exercises increased concern about the possible effects of active sonar (specifically 1-10 kHz) on marine mammals. The NURC Marine Mammal Risk Mitigation project has as its goals the development of risk mitigation protocols, tools, and technologies to mitigate risk to marine mammals during sonar or other noisy experiments and naval exercises. To accomplish these goals the project has accumulated years of biological and environmental data into a standardized geo-referenced database. These data, supplemented with new information collected during NURC sea trials and data mined from historical documents provide the baseline for the major scientific goals of the project.

Intentionally blank page

NATO Undersea Research Centre Marine Mammal Risk Mitigation Rules and Procedures

Kendra L Ryan

Abstract: The NATO Undersea Research Centre (NURC) Marine Mammal Risk Mitigation Rules and Procedures provides the policy and the procedures to scientific planners, Scientists-in-Charge (SIC), researchers and the Masters of NURC vessels which address potential adverse effects on marine mammals of sea trials involving underwater sound. As a matter of policy, the Centre will take precautionary and preventive measures to circumvent harm to marine mammals from underwater sound by institution of procedures outlined in Staff Instruction 77. As new information becomes available from continued research by the Marine Mammal Risk Mitigation project, as well as other documented sources, these procedures will be reevaluated and modified as appropriate.

This report supersedes the previous NURC report (NURC-SP-2008-003) which included both marine mammal and human diver risk mitigation procedures. These procedures are now separate reports.

Keywords: marine mammal, risk mitigation, active sonar

Contents

1
Introduction

During the last decade, mass strandings of beaked whales in close spatial and temporal proximity to active sonar experiments and military exercises increased concern about the possible effects of active sonar (specifically 1-10 kHz) on marine mammals. Explosive and other pulse sounds may also, in some circumstances, have a detrimental effect.

Marine mammals exhibit a wide range of behavioral responses to anthropogenic sound including alterations in respiration rate, vocalization, locomotion speed and direction, diving pattern, and distribution of individuals within a group. These responses vary in severity from minor and brief modifications to severe and extensive alterations depending on various species and sound characteristics. However, the specific sound characteristics resulting in the stranding of beaked whales is unknown and consequently this document considers potential strandings of beaked whales as the worst case scenario requiring special attention. Intense or prolonged sounds impact the physiology of marine mammals in various ways; for example, sounds may interfere with mammals' ability to hear biologically significant signals or communications, a condition called auditory masking. The mammals may also undergo a threshold shift of their hearing capabilities, either temporarily or permanently, as a result of auditory fatigue or damage to auditory components such as sensory hair cells or ear membranes. Practical and ethical constraints limit the number of studies regarding anatomical structure, hearing sensitivity, and behavioral responses to a small number of marine mammal species. Limits of anthropogenic sounds that are outlined in this document are extrapolated from these data and applied to all species. They are deliberately conservative, or precautionary, and may be modified to reflect the results of future studies.

The Marine Mammal Risk Mitigation (MMRM) project was initiated to develop the scientific foundation needed for the development of procedures, decision aids and associated tools to help mitigate the acoustic risk on marine mammals. The MMRM project will maintain the NURC policy and risk mitigation rules to conform to best available techniques and environmental practices.

2 Policy

As a matter of policy, the Centre will take precautionary and preventive measures to circumvent harm to marine mammals from underwater sound by institution of procedures outlined in Staff Instruction 77. In addition, all operations conducted on vessels or from shore are to be conducted in accordance with applicable environmental laws, local regulations and accepted maritime practice. This policy is in support of NATO's principles and policies of environmental protection.

The Scientist in Charge (SIC), supported by the MMRM Project Leader, is responsible for ensuring that the requirements of Staff Instruction 77 are fulfilled and that any related risk mitigation procedures are briefed to the Master of the research vessel prior to the experiment. Copies of the Monitoring Record (Annex B) and Sighting Report (Annex C) must be submitted to the MMRM Project Leader and included as an annex to the Cruise Report. When the Centre's vessels are operating together with other research vessels, all units will adhere to the same environmental policy. This policy will either be the NURC policy outlined here or one that is stricter. The policy to be used is to be agreed upon before the sea-going activity commences.

All personnel involved in the sea trial will adhere to the procedures in SI77 in order to minimize the risk of physiological injury or behavioral change to marine mammals that may result from sound sources. It is recognized that the implementation of the policy and procedures will present some difficulties at sea which could cause delays to experiments and may require additional resources, as well as specific training. Furthermore, the difficulty of undertaking effective acoustic and visual monitoring programs with the systems and personnel available is understood. SIC and the research vessel Masters are, however, to make the best effort possible to minimize the risk to marine mammals.

The Centre has a lengthy history of using sound for research in the Mediterranean Sea. Many of our institutional objectives require the transmission of sound energy into the marine environment; it must be done prudently and consistent with our conservation objectives. Since the establishment of this policy, no deleterious effects as a result of Centre research are known to have resulted. Continued application of this policy and recommended mitigation measures will minimize the potentially harmful effects of sounds on marine mammals.

3 Procedures

The following procedures are detailed in support of the policy stated above. The objectives of these procedures are twofold:

- To minimize *the potential risk of beaked whales stranding* as a result of the use of sound sources. It is hypothesized that beaked whale strandings may result from a behavioral response to sound sources at levels significantly below those which cause direct physical impact; however, the specific cause and effect relationship between sonar use and mammals stranding is still unknown. NURC's precautionary policy is therefore to reduce the temporal and spatial interactions of sounds and beaked whales.

- To minimize the *risk to a marine mammal of auditory injury* that may result from the use of sound sources. For the purposes of this document, temporary threshold shift (TTS) of hearing capabilities is the lowest known experimental level above which auditory injury may occur.

3.1 PLANNING PHASE

Marine mammal risk mitigation is primarily achieved in the planning phase prior to the accomplishment of the sea trial. During this process, consult with the MMRM Project Leader as appropriate. Planning will culminate in the completion of an Environmental Scoping Study (ESS) which will be included in the sea trial plan.

3.2 ENVIRONMENTAL SCOPING STUDY (ESS)

The ESS will focus on gathering and analyzing data in support of the following objectives:

3.2.1 Objective 1

Objective 1 focuses on the potential risk of beaked whales stranding as a result of the use of sound sources. As the specific behavioral reaction that results in the stranding of beaked whales in proximity to the use of sounds is unknown, the risk mitigation of NURC focuses on avoiding the habitat of beaked whales.

Analyze the proposed area to determine the presence of known or potential beaked whale habitat. Within the known distribution range of the species, the following features have been found to be associated with their habitat:

- Previous beaked whale sightings
- 1000 m isobath +/-300 m
- Steep slope
- Sea mounts and canyons
- Strong upwelling

These features provide a baseline indicator of suitable habitat for beaked whales; actual distribution patterns within the area of interest need to be assessed, wherever possible, by also considering local factors (sightings and local predictors), as well as their variability in space and time.

- Determine the ranges at which the received sound pressure level is less than or equal to130 dB re 1 μPa on average over the entire water column. This range is the minimum distance from beaked whale habitat (described above) that operations should occur. Establish the operational area outside of this range from any beaked whale habitat. If unable to establish the area outside of beaked whale habitat, consult the MMRM Project Leader for further guidance as additional mitigation measures may be advised. Recent behavioral response studies indicate a measurable behavioral change in beaked whales from receipt of sound pressure levels of 130 dB re 1 μPa. This level is therefore adapted as the precautionary reference level.
- Detail the ship track lines to:
    - Operate on track lines that progress from shallower to deeper water.
    - Operate so to avoid embayment of marine mammals (i.e., ensure that an egress route is maintained so that the animal is not located between the source of transmissions and any physical land features).
- Determine alternate operational area to be used in case of beaked whale sighting.

3.2.2. Objective 2

Objective 2 focuses on minimizing the risk to a marine mammal of auditory injury that may result from the use of sound sources. TTS is a function of the intensity, duration, and frequency of the signal. Therefore, planning efforts, detailed below, focus on the relationship between the characteristics of the sound source and the received energy at the animal. During the planning process, determine:

- Data from any previous studies of the proposed trial area.

- Shut down range using guidance in Annex A. The shut down range is, in general, a function of sound exposure at the animal and is the range at which the received sound pressure level or sound energy level match the damage risk criteria listed in Annex A. Acoustic propagation modeling is to be used for converting transmit to received sound levels.
- Details of sound sources (explosives, sonars, seismic systems, etc.) to be used, including transmission source levels, pulse types, frequencies, duration, time of day, and location.
- Visual and acoustic monitoring plan to include the establishment of a 2 km monitoring range.
- Night operations plan (if applicable).
- Ramp-up plan.

In addition, the SIC should Maintain records of all environmental precautionary activities.

3.3 AT SEA

Risk mitigation at sea is primarily achieved by executing the plan outlined in the ESS. However, additional operational practices outlined below will support the objectives of mitigating risk of physical injury and potential strandings.

3.3.1 PRIOR TO SOUND TRANSMISSION

Prior to energizing the sound source, the following risk reduction measures must be accomplished:

3.3.1.1 Monitoring

- Trained visual and acoustic monitors are on station, briefed and equipped. (Marine mammals are difficult to detect visually and acoustically. The amount of time cetaceans spend on the surface is minimal and depends on the species and the activity (i.e., feeding, etc.). Feeding seabirds can sometimes indicate the presence of marine mammals. Some marine mammal species may also be sighted around boats, autonomous vehicles, or towed arrays. Acoustic identification of cetaceans may be possible from the detection of echolocation clicks, whistles, creaks, chirps and moans made by the mammals.)
- When available, aircraft and helicopters are on station to aid visual search.
- Record visual and acoustic detections of marine mammals in the Monitoring Record (Annex B) 30 minutes prior to the commencement of source transmissions.
- Alert other units involved to establish visual and acoustic watches as above; agree on reporting procedures.

3.3.1.2 Clearing the Area

- 30 minutes prior to transmissions, transit work area with trained visual lookouts and passive listening systems (i.e., array, sonobuoy) deployed.

3.3.1.3 Ramp-Up Procedures

- If no indication of marine mammal presence is detected within the ranges determined from Annex A and no indication of beaked whales within monitoring range, commence ramp-up.
- Ramp-up source gradually from source level of 150 dB re 1 μ Pa @ 1m, or lowest possible setting if higher than 150 dB re 1 μ Pa @ 1m, to the final sound level in equal increments over a 30 minute period.
- Similar procedures will be used when explosives are being utilized as the sound source, progressing from smaller to larger charges, or using alternative broadband sources for ramp-up.
- Transmit at operational sound level after ramp-up. If marine mammals are detected within shut down range during this ramp-up procedure, stop transmissions, and then repeat the area clearance and ramp-up procedures. If beaked whales are detected within visual sighting range, stop transmissions, and consult the MMRM Project Leader prior to resuming operations.

3.3.2 DURING TRANSMISSION OF SOUND

- Keep source level as low as possible, consistent with achieving the work.
- Repeat ramp-up procedures if transmissions stop for more than 30 minutes.
- For active transmissions during the night, the transmissions must commence at least 30 minutes prior to sunset to allow for a 30 minute area clearance and applicable ramp-up period. If transmissions cease for more than 30 minutes during the night, they may not begin again until after an area clearance and ramp-up are performed after sunrise.
- Stop transmissions and use of explosives upon detection of marine mammals within the shut down range. The shut down range is, in general, a function of exposure at the animal and will be determined from Annex A during the planning process.
- Recommence area clearance and ramp-up procedures and then operations after the animal has cleared the shut down range.
- Stop transmissions and use of explosives if a beaked whale is identified within the monitoring range. Contact the MMRM Project Leader prior to resuming operations.

- Complete Monitoring Record (Annex B) and the Sighting Report (Annex C) during experiment. Include forms in post-cruise report and send copies to the MMRM Project Leader for inclusion in the sightings data base.
- Photograph or video sightings when possible.
- Inform the Incident Action Team (IAT; Annex E) if there is suspicion that a marine mammal stranding incident could be linked to the research activity

3.3.3 AFTER TRANSMISSION OF SOURCE

- Monitor for marine mammals until 30 minutes after the termination of transmissions.

3.4 POST EXPERIMENT

- Give a copy of all monitoring and sighting documents to MMRM Project Leader.
- Provide MMRM Project Leader with a list of lessons learned.

Annex A
Risk Criteria to Mitigate Auditory Impact

The scientific data that support broad and simple guidelines regarding the interaction of marine mammals and sound do not yet exist. The level of current knowledge in the field dictates that the criteria put forward will have limitations and be applicable for specific purposes.

The purpose of the criteria presented below is to mitigate the onset of temporary threshold shift. The criteria below do not address the purpose of mitigating the potential risk of stranding by beaked whales. Proper planing, as outlined in the main document, to avoid beaked whale habitat will more effectively mitigate this risk. The following categories and definitions are to be used only for the purposes of this instruction.

Sounds are classified into two categories: 1. Pings – tonal, continuous or intermittent, such as active sonar 2. Pulses – brief, broadband, atonal transients such as an explosion, airgun, watergun, or pile strike.[1]

Shut down ranges will be determined prior to commencing an experiment. The shut down range is the distance from the transmitting source where the maximum instantaneous received peak sound pressure level (SPL in dB_{peak} // 1 μPa) or integrated received sound exposure level (SEL in dB // 1μPa^2 s) is equivalent to or less than the damage risk criteria (DRC) listed below.[2] [3] Peak sound pressure is the maximum absolute value of the instantaneous sound pressure during a specified time. Sound exposure level is a measure of the physical energy of the noise that accounts for both intensity and duration. The shut down ranges are not listed here as they will vary according to the sound propagation modeling performed for each specific experiment.

The received *SPL/SEL* of a single pulse/ping may be estimated according to the following procedure. To estimate the SPL, obtain the peak sound pressure level SPL_0 from documentation of the sound source. To estimate the *SEL,* integrate the transmitted instantaneous sound pressure squared, p^2, over the duration of the ping, *T*. Reference sound pressure is p_{ref} = 1 μPa. Subtract the modeled transmission loss TL(R) to obtain the desired received level:

---

[1] Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientificrecommendations. *Aquatic Mammals*, 33(4).571

[2] The sound exposure level values listed in this staff instruction are adapted from those presented in Southall et. al 2007. The values in the staff instruction are more conservative because they do not apply a weighting factor that excludes energies outside of the functional hearing capabilities of the various species.

[3] Mooney, T.A., Nachtigall, P.E., Breese, M., Vlachos, S., Au, W.W.L. 2009. Predicting temporary threshold shifts in a bottlenose dolphin (*Tursiops truncates):* The effects of noise level and duration. *Journal of Acoustical Society of America, 125(3*), 1816-1826.

For estimating SPL (dBpeak // 1 μPa)
$SPL\ (R) = SPL - TL\ (R)$

and for estimating SEL (dB // 1μPa^2 s)

$$SEL(R) = 10\log_{10}\frac{\int_0^T p^2(t)dt}{p_{ref}^2} - TL(R)$$

Transmission loss modeling should include the minimum and maximum frequencies to be used, and should result in the average received levels and energies over the entire water column, and the maximum received levels and energies over all azimuth angles.

The predictions of transmission loss should be performed by using reliable prediction tools known to produce results close to other alternative models, i.e. ensure inter-model consistency of the modeling results from the planned exercise area. Further, the prediction tools should be operated by an experienced person who knows the impact of the model input parameters on the transmission loss and has access to environmental description for the planned exercise area and season. Alternatively, contact the MMRM Project Leader for guidance in proper transmission loss estimates.

A.1 Pings or non-pulse type signals

When tonal sources (i.e., active sonar, acoustic deterrent devices, acoustic tomography sources) are employed in conjunction with marine mammals, the following SEL values shall not be exceeded in order to avoid a temporary threshold shift of animals in the vicinity (TTS; Table 1).

Table 1: *Nonpulse Damage Risk Criteria*

Category of Marine Mammal	**Received Sound Exposure Level of *Single Ping* (dB re 1 μPa^2-s)[4]**	**Received Sound Exposure Level for Multiple Exposures (dB re 1 μPa^2-s)**
Cetaceans	195	195 - 5log$_{10}$(N)
Pinnipeds in water	183	183 - 5log$_{10}$(N)

Where N is the ping rate received by the animal, measured as pings/day.

[4] Finneran, J. J., Schlundt, C. E., Dear, R., Carder, D. A., & Ridgway, S. H. (2002b). Temporary shift in masked hearing thresholds (MTTS) in odontocetes after exposure to single underwater impulses from a seismic watergun. *Journal of the Acoustical Society of America*, *111*, 2929-2940.

The range at which the calculated SEL corresponds to the damage risk criteria, or maximum allowed received SEL value given in Table 1, will then be applied as the shut down range according to the procedures outlined in section 3 of this document. This range will typically apply when using a moving ping-type source.

A.2 Pulse type signals

When pulse sources (i.e., air gun, water gun, pile strike, explosives) are used in presence of marine mammals, the following SPL shall not be exceeded for avoiding TTS of animals in the vicinity (Table 2).

Table 2: *Pulse Damage Risk Criteria*

Category of Marine Mammal	Maximum Received SPL Single Exposre (dB re 1 µPa^2-s)[4]	Maximum Received SPL Muliple Exposures (dB re 1 µPa^2-s)
Cetaceans	224	224 - 5log$_{10}$(N)
Pinnipeds in water	212	212 - 5log$_{10}$(N)

The pulse DRC is based on the peak pressure to reflect the particular sensitivity of the mammalian ear to impulsive sounds. The pulse DRC is therefore more conservative to the ping DRC for tonal sound sources.

A.3 Multiple Exposures

To account for the cumulative effect on the animal of multiple exposures, the correction -5log$_{10}$(N) will be applied.[5] Cumulative effects from multiple exposures may occur if the situation includes one of the following:

- A stationary source and animals are present
- A mobile source and animals travelling with the source

Therefore, in the planning process, determine new shut down ranges accounting for multiple exposures.

[5] Richardson W.J., C.R. Greene Jr., C.I. Malme, D.H. Thomson. Marine Mammals and Noise. Academic: San Diego, CA. 1995

For example, if it is planned to transmit from a stationary sound source 1000 – 2000 pings/per day of 1 second each, the reduction in integrated received SEL risk criteria for cetaceans exposed to multiple pings will be:

Table 3: *Multiple Exposure Damage Risk Criteria*

Pings/Day	**Reduction of SEL Risk Criteria (dB)**	**SEL Risk Criteria (dB re 1 µPa^2-s)**
1	0	195
1000	15	180
2000	16.5	178.5

Annex B
Monitoring Report

Latitude/ Longitude	Area of Operations (i.e., Ligurian Sea)	Wind (Beaufort)	Cetacean Watch Time On/Time Off	Type of Source	Operating Characteristics (Frequency, source level, duty cycle, etc.)

Annex C
Sighting Report

Date	Time	Latitude/ Longitude	Area of Operations (i.e., Ligurian Sea)	Wind (Beaufort)	Species	Number of Animals	Adult/ Juvenile	Animal's bearing from vessel	Animal's distance from vessel	Activity (i.e., traveling, resting, breaching)	Notes

Annex D
Marine Mammals of the Mediterranean and Black Seas

English name	Italian name	Latin name	IUCN Category [6]
Mediterranean Monk seal	Foca monaca	*Monachus monachus*	CR
Fin whale	Balenottera comune	*Balaenoptera physalus*	EN
Sperm whale	Capodoglio	*Physeter macrocephalus*	VU
Striped dolphin	Stenella striata	*Stenella coeruleoalba*	LR lc
Cuvier's beaked whale	Zifio	*Ziphius cavirostris*	LR lc
Bottlenose dolphin	Tursiope	*Tursiops truncatus*	LR lc
Risso's dolphin	Grampo	*Grampus griseus*	LR lc
Common dolphin	Delfino comune	*Delphinus delphis*	LR lc
Harbour porpoise	Focena comune	*Phocoena phocoena*	LR lc
Rough-toothed dolphin	Steno	*Steno bredanensis*	LR lc
Short-finned Pilot whale	Globicefalo	*Globicephala macrorhynchus*	DD
Long-finned Pilot whale	Globicefalo	*Globicephala melas*	DD
Blainville's Beaked whale	Mesoplodonte di De Blainville	*Mesoplodon densirostris*	DD
Killer whale	Orca	*Orcinus orca*	DD
False Killer whale	Pseudorca	*Pseudorca crassidens*	DD

[6] IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. <www.iucnredlist.org>. Downloaded on **03 November 2009**.

Critically Endangered (CR): a species with an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN): a species not Critically Endangered but with a high risk of extinction in the wild in the medium-term future.

Vulnerable (VU): a species not Critically Endangered or Endangered but with a high risk of extinction in the wild in the medium-term future.

Lower Risk (LR): a species that has been evaluated but does not satisfy the criteria of any of the categories Critically Endangered, Endangered or Vulnerable. Species included in the lower risk category can be separated into three subcategories:

- Conservation Dependant (cd)
- Near Threatened (nt)
- Least Concern (lc)

Data Deficient (DD): a species with inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.

Annex E
Incident Action Team

E.1 INTRODUCTION

Marine mammal stranding incidents are rare in the NURC operating areas. Nevertheless, it is important for the Centre to be prepared to respond to these incidents quickly and without confusion to determine if actions by Centre personnel may have contributed to the incident, assist national authorities analyze its cause, and assess the oceanographic conditions related to the incident. The Incident Action Team (IAT) was established to quickly respond to information related to these types of incidents.

E.2 COMPOSITION

The team is made up of the following, supported as necessary by other Centre personnel:

1. MMRM Project Leader (PL)
2. Head, Information Services Branch (ISB)
3. Head, PG
4. Head ST or AR, if their department personnel are involved in the incident.
5. Security Officer (Italian) for coordination with Italian military authority where required.
6. Relevant Program Officer, if not already at sea.

E.3 DECISION TREE

1. Notify the MMRM PL upon knowledge of a mass marine mammal (2 or more animals) incident in the area of operation. Notification of an incident may come from local residents, a MMRM partner, newspaper, or direct observation from vessel.

2. MMRM PL will obtain information on the location and operation of NURC ships and the specifics of the incident. The MMRM PL will notify other member(s) of IAT.

3. Decision Points:
    a. No NURC involvement and no NURC ship in area.
        i. MMRM PL may collect pertinent oceanographic information from Centre assets and other supporting

organizations. This information may be offered to national authorities to assist in the analysis into the causes of the incident.

ii. MMRM PL gives feedback to notifier where appropriate.

iii. No further action required.

b. Possible NURC involvement or NURC vessel in area of marine mammal incident.

i. MMRM PL generates memorandum for record (copy to D, DD, CS, PG).

ii. IAT assesses issues and makes recommended course of action to CS/DD/D.

iii. D/DD/CS notifies SIC of decision.

c. Probable NURC involvement

i. MMRM PL generates memorandum for record.

ii. SIC retain all records and recordings made during sea test.

iii. IAT convene board of inquiry in consultation with D, DD, and appropriate Department Head. Board may consist of outside experts.

iv. IAT produce report of findings of board of inquiry.

Document Data Sheet

Security Classification		Project No.
RELEASABLE TO THE PUBLIC		MMRM
Document Serial No.	**Date of Issue**	**Total Pages**
NURC-SP-2009-002	November 2009	23pp.

Author(s)

Ryan, K.L.

Title

NATO Undersea Research Centre Marine Mammal Risk Mitigation Rules and Procedures

Abstract

The NATO Undersea Research Centre (NURC) Marine Mammal Risk Mitigation Rules and Procedures provides the policy and the procedures to scientific planners, Scientists-in-Charge (SIC), researchers and the Masters of NURC vessels which address potential adverse effects on marine mammals of sea trials involving underwater sound. As a matter of policy, the Centre will take precautionary and preventive measures to circumvent harm to marine mammals from underwater sound by institution of procedures outlined in Staff Instruction 77. As new information becomes available from continued research by the Marine Mammal Risk Mitigation project, as well as other documented sources, these procedures will be reevaluated and modified as appropriate.

This report supersedes the previous NURC report (NURC-SP-2008-003) which included both marine mammal and human diver risk mitigation procedures. These procedures are now separate reports.

Keywords

Marine mammal, risk mitigation, active sonar

Issuing Organization

NURC
Viale San Bartolomeo 400, 19126 La Spezia, Italy

[From N. America:
NURC
(New York) APO AE 09613-5000]

Tel: +39 0187 527 361
Fax:+39 0187 527 700

E-mail: library@nurc.nato.int

DISTRIBUTION LIST

NURC's Scientific Committee of National Representatives (SCNR) & National Liaison Officers

BELGIUM
DGMR SYS-N/M, Brussels
EGUERMIN, Oostende

CANADA
MOD CANADA
DRDKIM-2, Ottawa

DENMARK
MOD DENMARK
DANISH ACQUISITION AND LOGISTICS ORGANIZATION (DALO), Ballerup

ESTONIA
MOD ESTONIA

FRANCE
MOD FRANCE
O.N.E.R.A. (ISP), Chatillon

GERMANY
FIZBW - Bonn
FWG - BIBLIOTHEK, Kiel

GREECE
MOD GREECE
DEFENCE INDUSTRY & RESEARCH GENERAL DIRECTORATE, Holargos

ITALY
MOD ITALY
SEGREDIFESA - V° REPARTO, Roma

LATVIA
MOD LATVIA

NETHERLANDS
MOD NETHERLANDS
DEFENCE ACADEMY, Den Helder
ROYAL NETHERLANDS NAVY COMMAND, Den Helder

NORWAY
MOD NORWAY
NORWEGIAN DEFENCE RESEARCH ESTABLISHMENT - BIBLIOTEKET, Kjeller

POLAND
MOD POLAND
RESEARCH & DEVELOPMENT DEPARTMENT, Warsaw

PORTUGAL
MOD PORTUGAL
ESTADO MAIOR DA FORÇA AÉREA, Amadora

ROMANIA
MOD ROMANIA
ROMANIAN NATIONAL DISTRIBUTION CENTRE, Bucharest

SLOVENIA
MOD SLOVENIA

SPAIN
MOD SPAIN
SDG TECEN/DGAM, Madrid
INSTITUTO HIDROGRAFICO DE LA MARINA, Cadiz

TURKEY
MOD TURKEY
MILLI SAVUNMA BAKANLIĞI (MSB), Ankara
TURKISH NAVY RESEARCH CENTRE COMMAND, Istanbul

UNITED KINGDOM
DSTL KNOWLEDGE SERVICES, Salisbury

UNITED STATES
MOD USA
DEFENSE TECHNICAL INFORMATION CENTER (DTIC), Fort Belvoir, VA.