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TNO report

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Comparison of ASW sonar risk assessment and mitigation between six different nations -- a report by the SDI ASRM Group

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Summary

In recent years atypical stranding of marine life have created a public interest in military sonar use. In order to maintain this essential military capability, there is a need to ensure that active sonar systems are used in an environmentally responsible way when preparing for operational missions. Although there is NATO environmental protection policy and most NATO naval forces actively consider mitigation actions towards protecting marine mammals, further research has been necessary in order to ascertain the effects and revise mitigation procedures. NATO established the Active Sonar Risk Mitigation Smart Defence Initiative in 2014 to verify common practices regarding mitigation actions and to recommend a NATO UNCLASSIFIED and public releasable publication regarding procedures.

This report completes the first objective of the Initiative, in the benchmarking of 6 nations' (DNK, DEU, GBR, NLD, NOR, USA) mitigation procedures.
The benchmarking involved a comparison of procedures and output against a specified scenario as well as generic policy comparisons. Similarities were noted between nations, including visual observations, planning considerations and the use of Mitigation Action Zones. Also some differences in reporting procedures, personnel qualifications and sonar usage practices were noted. Nonetheless the opportunity now exists to generate revised NATO policy in which to harmonize these procedures and inform the public about efforts that NATO takes to avoid disturbance and disruption to marine life.

Contents

1 Introduction

Background of topic
In 1996, an atypical mass stranding of beaked whales occurred in proximity to naval ships operating with active sonars during NATO testing of new sonar technology. This (and other later stranding events) triggered concern and public attention to the use of sonar systems by NATO navies. Now, 20 years later, in both the US and Europe, legislation concerning underwater sound has become stricter and more explicit; whereas military operations are often not subject to direct, formal regulation, defence organisations are still expected to ensure that they operate in an environmentally responsible way. As a standard, military organisations have also developed explicit policy about their environmental goals.

Further relevance
In addition to legal and social obligations, NATO has directed environmental protection policy through a Military Committee directive: MC0469, *"NATO Military Principle and Policies for Environmental Protection"*, which defines the responsibilities of NATO commanders regarding environmental protection and policy. Protection of the environment is the responsibility of every Commanding Officer. Legal and political obligations and guidelines have to be reflected in the planning of every operation or exercise. All reasonable precautions must be taken to avoid damage and pollution to the environment, infrastructure and military or civil property.

History
An action following the 1996 stranding was a research programme started at the NATO underwater research centre (originally named the SACLANTCEN, then NATO Undersea Research Centre – NURC – and now named as the Centre for Maritime Research and Experimentation – CMRE) in La Spezia, Italy.
This long-term programme, in combination with national research programmes, has provided nations with initial information needed to develop suitable mitigation measures.

A main aim of this research programme was to provide information for experimentation and training within the Mediterranean basin area, but the centre also served as a focal point for scientific expertise on this topic. The NATO research programme was concluded at the end of 2014 with the issuing of the NATO Integrated Decision Aid, a marine mammal risk software application available to nations. This left no central focal point for NATO regarding mitigation action research since 2014.

Rationale for starting the ASRM initiative
When the NATO marine mammal programme was about to be concluded, Headquarters Supreme Allied Commander Transformation (HQ SACT) assessed the status of this issue within NATO. Whilst NATO environmental protection (EP) policy is laid down in document MC0469 *"NATO Military Principles and Policies for Environmental protection"*, an additional NATO document endorsed by the Military Committee describes the specific issue of active sonar risk mitigation: MC0547 *"Code of Conduct for the Use of Active Sonar to ensure the protection of Marine Mammals within the framework of Alliance Maritime Activities*", dated 26 August

2015. It was realised that, in practice, there was no common process across NATO Nations regarding the use of military-specific sound underwater and the subsequent risk mitigation to marine fauna: different nations applied different techniques throughout their risk assessment process. This is partly because MC0547 is currently a classified document and on the specific issue of environmental protection this is seen by many nations as an impracticable publication. It was also clear that legislation would likely remain strict (or even intensify), and that it would be necessary for NATO to continue to study the effects of underwater sound and develop adequate mitigation measures. HQ SACT chose to initiate a Smart Defence Initiative on Active Sonar Risk Mitigation: SDI ASRM.

Progress of SDI ASRM

An initial meeting to explore interest of nations was organised in early 2014. Interested nations then included the USA, UK, Germany, The Netherlands and Norway. Later Denmark joined and Sweden, France, Italy, Spain and Canada have shown interest and have contributed to discussions. It was decided that the group would aim to develop and establish a practical NATO Risk Assessment Guideline (including mitigation advice). Three main objectives were defined in the overall project description of the SDI:

1. Compare NATO Nations' current risk assessment processes on military sonar on marine mammals – focusing on risk identification, evaluation and mitigation.
2. Develop NATO UNCLASSIFIED Releasable to the Public NATO Risk Assessment Guideline for NATO-led maritime activities.
3. Staff the NATO Risk Assessment Guideline through the appropriate NATO body for approval by the Nations.

The SDI initially considered whether to address the effects of underwater sound and explosions on marine life, but the group decided to focus first on the effects of sonar. To develop the comparison study of Objective 1, the group held a number of teleconference meetings and worked on documents by correspondence. A series of meetings have occurred for the group, both internally and in the wider community of interest, including the Effects of Sound in the Ocean on Marine Mammals (ESOMM) in September 2014 and the Sea Mammals and Sonar Symposium (3S) at the University of St. Andrews in October 2015.

Output

To achieve objective 1, a two-fold approach was taken: participating nations utilised a specific scenario (details in Chapter 2) in order to enable comparison of procedure and output; next to running this scenario, an overview was made of the generic approach taken by nations (a matrix analysis). The group subsequently discussed national perspectives and rules and was able to make an analysis/comparison of national procedures and techniques. Completing this analysis means that objective 1 is achieved, and this report gives an overview of the following:

- An inventory of national policies/key documents, risk assessment tools and processes and associated mitigation measures (also called 'the matrix') (Appendix A);

- An inventory of processes and mitigation measures for the defined scenario (appendices B-G);
- A detailed overview of the type of procedures used by nations, based on a scenario and matrix approach (tables 3.1/3.2);
- An analysis of the risk assessment process and mitigation actions of participating nations, including an overview of observed similarities and differences

Future

This report is to be distributed to nations via the NATO Smart Defence Initiative processes. The Group is a Tier 2 SDI, with no designated Lead Nation (SDI code 2.77). This does not however preclude the group from making recommendations and the subsequent publishing of new NATO doctrine and policy.

Follow on work for the Group will address objectives 2 and 3: the formation and publication of a Risk Mitigation and Assessment Guideline, to be made available in the NATO UNCLASSIFIED Public domain.

All nations are encouraged to participate in the development of the Risk Mitigation and Assessment Guidelines and subsequent recommendations.

2 Method - Matrix and scenario analysis

2.1 Overall approach taken

The first objective of the SDI was to compare NATO Nations' current risk assessment of military sonar's effect on marine mammals, the group elected to conduct a two-fold approach to obtain an overview of the process, which ranges from policy to practical measures during activities taken by different nations.

The group started a comparison by making a matrix providing an overview of each nation's generic policy, description of responsibilities within the organization, and the general approach to mitigation, including pre-planning, planning, operation and the post-operation phase (providing a top down comparison).

A more bottom-up comparison is made through focusing on the mitigation action taken by nations for a specific, simple scenario. The scenario comparison enables the facilitation to the understanding of differences and similarities in both procedures and output across the participating nations.

The objective of both approaches was to provide an overview of policy taken by nations and enable identification of commonalities and differences – the scenario simply providing information for a specific, comparable case study.

During analysis of the scenario outputs, it was observed that much of the information provided (for instance, prescribed mitigation measures) was not specific to the scenario per se. The main differences observed from the information provided are:

- Not all nations were able to provide numeric examples of the risk assessment executed for these scenarios. Software tools for either prediction of sound propagation or risks for marine mammals and fish were run by NLD, NOR, DEU and USA. GBR would normally run their tool, but this was not done here, because no specific platform and sonar was selected. DNK does not have a software based tool for risk assessment available at present.
- For the USA two entries were made in the table, distinction was made between geographic areas or activities where the risk assessment is incorporated in the permitting/consultation process of US environmental laws, and geographic areas or activities where a different risk assessment process is employed.

2.2 Analysis

A generic comparison was made between all procedures of different nations.
A matrix was made with nations on one axis and mitigation measures related to the different phases of an operation (pre-planning, planning, operational, post operational and other issues) on the other axis. All nations then completed the columns before the group made a quantitative comparison across nations.
The matrix is at Appendix A.

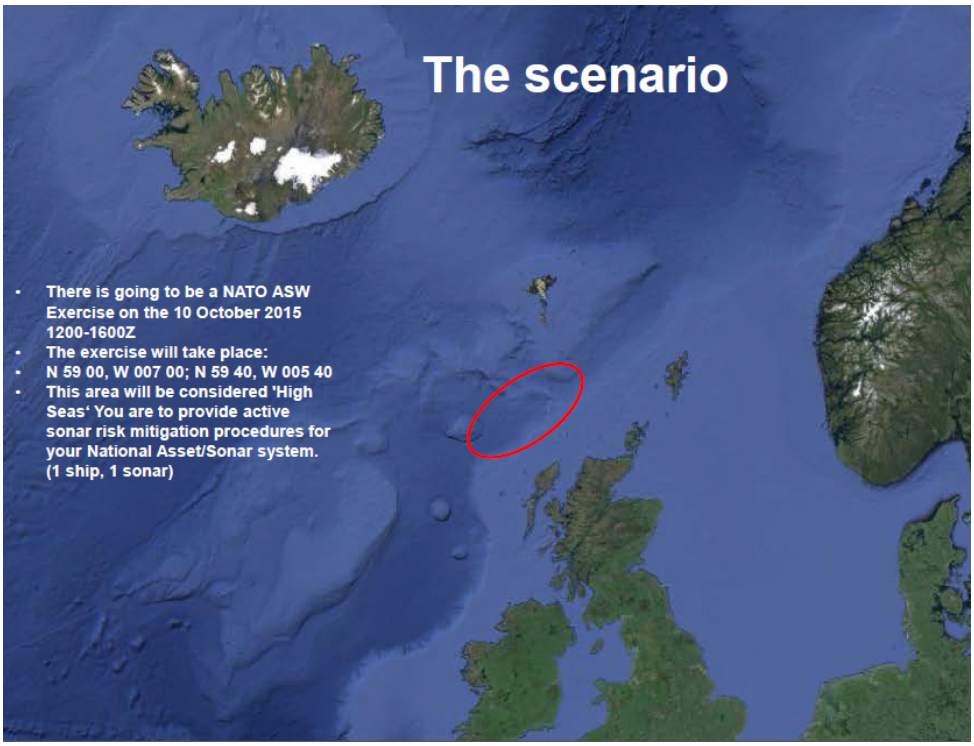
In addition to the matrix a basic scenario description was designed, which all nations would use to run their mitigation tools and provide advice for a sonar

operation, assuming that this would be an operation executed by one of their own units.

The scenario was described as follows:

- A NATO ASW Exercise is planned for 10 October 2015 between the hours 1200-1600Z;
- The exercise will take place in the area bounded N 59 00 and N 59 40 and between W 007 00 and W 005 40;
- The area will be considered as 'High Seas' (i.e. the water space does not belong to any nation, nor in the territorial seas or Exclusive Economic Zone. Thus no nation would impart jurisdiction and regulation covering the water);
- Each nation is to provide an active sonar risk mitigation procedure for own National Asset/Sonar system (1 ship, 1 sonar).

Where it was necessary to provide additional parameters nations should make a reasonable choice that would best mimic the national contribution in a real life situation and describe these assumptions in their document.



Each nation (DEU, NLD, GBR, DNK, USA, NOR) provided a detailed brief on their response to the scenario, which was a very useful and informative exercise to the participants. However, the format of the national products needed to be standardized to fit into a comparison report. For this report each nation therefore summarized the scenario analysis using the following format:

1. Scenario (define scenario)
2. Assumptions (additional information/assumptions needed as input, e.g. sonar, environmental parameters, operational parameters, legal issues).
3. Pre-planning phase (keep the description short and conceptual)

4. Planning (describe process and/or tools)
5. Operation (operational procedures/mitigation measures, specify which measures are general and which are scenario specific).
6. Post-operation (what is reported to whom)?
7. Additional information (model output etc. in separate appendices).

The detailed listing of similarities and differences in the scenario is provided in Chapter 3.

3 Results from matrix and scenario analysis

When referring to nations in the text below, it is assumed that the participating nations in the SDI ASRM are the representing NATO navies.

Essential definitions
Many national responses to risk assessment consider the use of a Mitigation Action Zone (MAZ) around the transmitting unit and the consideration of Permanent and Temporary Threshold Shifts (PTS/TTS) for the establishment of the MAZ. For greater clarity, these definitions are expanded here.

TTS: a temporary threshold shift is a temporary shift in the auditory threshold which typically occurs over the frequency band(s) closely associated with that of the exposure. It may occur suddenly after exposure to a high level of noise, a situation in which most animals experience reduced hearing sensitivity. A temporary threshold shift results in a temporary loss or reduction in hearing/sensory sensitivity that will gradually recover over time, usually within a timeframe of minutes to days. A temporary reduction in hearing sensitivity in some frequency bands may not impair overall hearing function if other frequency bands are unaffected and capable of compensating.

PTS: a permanent threshold shift is a permanent shift in the auditory threshold, which typically occurs over the frequency band(s) closely associated with that of the exposure. It may occur suddenly or develop gradually over time. A permanent threshold shift results in a permanent loss or reduction in hearing/sensory sensitivity that does not fully recover even after extended periods of time post-exposure. A permanent reduction in hearing sensitivity in some frequency bands may not impair overall hearing function if other frequency bands are unaffected and capable of compensating. PTS can often be ascribed to the exposure to extremely high levels of sound, which would typically only occur at close range.

MAZ: a Mitigation Action Zone is a defined exclusion zone (or ‘safety zone’) with a radius around the sonar source within which real-time mitigation measures are implemented if animals are detected.

Comparison of results
Exclusion zones vary considerably by nation and can depend on the type of sonar in use. A 200-500 m (or yards) exclusion zone is typical but may be extended up to 2000 yds. Visual Observation of the MAZ through the use of Marine Mammal Observers (MMO), designated lookouts or watch standers, is commonplace to monitor the MAZ. These personnel are trained to varying degrees, dependant on national policy, but will be operational in all weathers and visual conditions, day or night. However it is to be noted that monitoring of ranges up to 2000 yds at night, in fog or precipitation may hamper the efficacy of these procedures.

Overview of comparisons from the matrix and scenario analysis is given in the tables below. The complete matrix is provided in Appendix A.

3.1 Detailed comparison of procedures – scenario independent

Table 3.1 Overview comparison of actions and guiding principles identified in the scenario analysis but which are considered not to be scenario-specific, as of September 2016.

	Measure	Germany	Netherlands	United Kingdom	Denmark	USA (under permit)	USA (not under permit)	Norway
1	**Pre-planning**							
A	Regulated by others than military authorities	No	No	No	No	Yes	No	No
B	Consider between single and multi-ship	Yes	No	Yes	Yes	Yes (>2)	Yes (>2)	Yes (>1)
C	Shore planning unit must be involved in planning of all sonar activity	No	No	No	Yes	No	No	No
D	Are environmental considerations (selection of suitable area/ seasons) made when a shore planning unit schedules an activity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
E	Biological data available for selection of area/ season	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F	Identification required of geographical features that increase risk (of stranding)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
G	Geographical information available to identify geographical features that increase risk (of stranding)	No	No	No	No	Yes	Yes	No

	Measure	Germany	Netherlands	United Kingdom	Denmark	USA (under permit)	USA (not under permit)	Norway
H	Consideration of marine protected areas	Yes	Yes	Yes	Yes	Yes	No	No
I	Information of marine protected areas available	Yes	No	Yes	Yes	Yes	Yes	Yes
J	Consideration of areas of ecological significance that may be affected by sound	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K	Information on areas of ecological significance available	Yes	Yes	Yes	Yes	Yes	Yes	Yes
L	Turtles	No	No	No	Yes	Yes	Yes	No
M	Birds	No	No	No	Yes	Yes	No	No
N	Fish	No	No	No	Yes	Yes	No	Yes
O	Human Divers	No	Yes	Yes	No	Yes	Yes	No
P	Addresses physical effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Q	> Criteria available	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R	Addresses disturbance/ displacement	Yes	Yes	No	Yes	Yes	Yes	Yes
S	> Criteria available	No	No	No	No	Yes	Yes	Yes
2.	**PLANNING**							
A	Sound modelling based on expected conditions of operating area	Yes	Yes	Yes	No	Yes	Yes	Yes
B	Ability for sound modelling based on actual conditions in operating area	Yes	Yes	Yes	No	Yes	Yes	Yes

	Measure	Germany	Netherlands	United Kingdom	Denmark	USA (under permit)	USA (not under permit)	Norway
C	Lower source level considered	Yes	Yes	Yes	Yes	Yes	Yes	No
D	Length of time of transmission considered	Yes	Yes	Yes	Yes	Yes	Yes	Yes
E	Visibility requirements (or included in RA)	Yes	No	Yes	No	Yes	Yes	Yes
F	Night time restrictions (or included in RA)	Yes	No	Yes	No	Yes	Yes	Yes
3.	**Operation**							
A	Dedicated or increased number of observers	No	No	Yes	No	Yes	Yes	No
B	MMO task of existing observers	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C	Trained observers	No	No	Yes	No	Yes	Yes	No
D	Other crew qualification/ certification	No	No	No	No	Yes	Yes	No
E	Pre-operation observers	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F	Pre-described reaction when marine mammals detection in defined zone around transmitting unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes
G	Ramp-up used	Yes	Yes	Yes	Yes	No	No	Yes
H	Use of ‘through the sensor’ passive acoustic detection, before transmissions, between pings and after the operation of the sonar	Yes	Yes	Yes	No	Yes	Yes	No

	Measure	Germany	Netherlands	United Kingdom	Denmark	USA (under permit)	USA (not under permit)	Norway
I	Dedicated passive acoustic detection systems	No	No	No	No	No	No	No
J	Described measures to reduce stranding risk	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	**Post operation**							
A	Reporting of activity inside MoD	Yes	Yes	Yes	No, but logged	Yes	Yes	No (but logged)
B	Reporting outside MoD	Yes	Yes	Yes	No	Yes	No	No
C	Reporting of incidents	Yes	Yes	Yes	Yes	Yes	Yes	Yes
D	Marine mammal sighting reports	Yes	No	Yes	No	Yes	No	No

3.2 Detailed comparison of procedures – scenario dependent

Table 3.2 Overview/Comparison of scenario specific actions based on the scenario analysis, as of September 2016.

	Measure	Germany	Netherlands	United Kingdom	Denmark	USA	Norway
A	Area specific risk assessment	Yes	Yes	Yes	Yes	Yes	Yes
B	Use of dedicated RA-tools	No	Yes	Yes	No	Yes	Yes
C	Tool identifier	n/a	SAKAMATA	ERMC/ S2117	n/a	PMAP/ NAEMO	SONATE
D	Propagation model used	Yes	Yes	Yes	No	Yes	Yes
E	Overview available of most abundant and/or sensitive marine mammals	Yes	Yes	Yes	Yes	Yes	Yes
F	Including season dependent density data	Yes	Yes	Yes	No	Yes	Yes
G	Area specific mitigation advice	Yes (identification of most sensitive species, avoidance of part of area, limitation to transmission duration)	Density maps available indicating highest density	Yes	Yes	Yes	High density expected requiring procedures to be followed

4 Observations, conclusions and recommendations

4.1 Observations

All observations that are described are based on input received by the nations by September 2016 that participated in the NATO ASRM initiative (DEU, NLD, GBR, DNK, USA, NOR). So 'all nations' should be read as 'all nations that contributed to this document'.

Main similarities observed between participating nations:

1. In general, participating navies are responsible for the self-regulation of sonar use; but all validate that they comply with national, and where relevant, international law;
2. The risk mitigation process is being applied by participating nations for sonar testing and training;
3. Where activities are planned by shore planning units, already at this stage the risks for the planned operating area are considered;
4. Participating nations aim to minimize risk of stranding, physiological impact and most address disturbance;
5. Participating nations require avoidance of geographic areas that may enhance stranding risk, but in general these areas are not well described and the areas are not identified in advance of planning the activity;
6. Duration of an activity is normally considered in a risk assessment;
7. Criteria to determine physiological impact exist and are utilized by participating nations, however these are not standardized;
8. Processes to determine disturbance effects exist, however these are not standardized; there are no commonly accepted criteria to determine whether biologically significant effects may occur;
9. Participating nations require consideration of areas that may be sensitive to noise. In general these areas should be avoided as far as reasonable and practicable, and typically there is relevant information available at the national level to identify these areas, but not necessarily available to naval planners;
10. Most participating nations consider the presence of protected areas or areas that have some special status. Often there is no indication that these areas are sensitive to sonar and there is no readily available reference, as individual nations categorise special status areas in different ways;
11. Participating nations require protection of marine mammals, some nations extend this to other species (e.g. fish, turtles or birds) or human divers;
12. Most participating nations make use of passive acoustic systems for detection of marine mammals. Normally this is conducted using already existing operational sensors (sonar), as no dedicated sensor is employed solely for detection of marine mammals;
13. The majority of participating nations have dedicated risk assessment software tools, including propagation loss models;
14. Participating nations require visual observation directly before and during sonar use;
15. Participating nations require consideration of the maximum source level needed to achieve the objectives of the specific activity;
16. Participating nations describe a mitigation action zone surrounding the source, stating action to be taken when animals are observed within the zone. Actions typically include reducing power and/or shutting down the sonar;

Main differences observed:

1. Not all navies prescribe use of “ramp-up procedures” to limit the risk of physiological effects (like PTS, TTS) to marine mammals, and where they do, the application of ramp-up can be very different, e.g. duration ranging from a few minutes to a half hour;
2. Personnel qualification requirements for mitigation teams vary significantly by participating nations. Partly this is also reflected by the naming of visual observers as MMOs, lookouts, watch standers, etc.;
3. Not all participating nations provide explicit guidance for night time or other conditions of restricted visibility;
4. Not all participating nations report marine mammal sightings as standard (although this is prescribed in ATP32, *NATO Military Oceanographic and Rapid Environmental Assessment Support Procedures*, Chapter 2);
5. Not all participating nations report sonar use outside of their MOD, and those that do report do not use a common standard;
6. US Federal Law requires independent regulatory oversight for US Navy sonar use, whereas most other navies are fully self-regulating. As a result, the US overall approach to risk assessment will be different, such as evaluating all impacting activities collectively rather than individually. The US approach results in "permits" for an extended period which covers all sonar training and testing activities in a defined area.

4.2 Conclusions

As can be seen from the list of similarities, the nations that have contributed to the comparison initiative (DEU, NLD, GBR, DNK, USA, NOR) to a large extent use similar risk mitigation measures. Some key differences were also noted. These may be of different character: some reflect different policy views (e.g. about restricting source level or use of ramp-up) that would require extensive discussion to come to a common approach; some are procedural differences (e.g. on reporting or how to consider duration of an activity) for which it may be easier to come to a single approach for NATO led activities.

The ASRM SDI Group concludes that there is sufficient commonality between the nations’ policies and practices that it should be possible to agree on a single sonar risk assessment procedure with minimum mitigation standards for use with NATO led active sonar activities.

4.3 Recommendations

It is recommended that a NATO Risk Assessment and Mitigation Guideline at the NATO UNCLASSIFIED level is developed (Objective 2). All efforts will be made to ensure that the Group’s proposals reflect the latest understanding by nations of what level of precaution is appropriate when deploying active sonar, but to keep any adopted guidance current, especially when considering the disturbance of protected species, regular review by nations will be necessary.

In support of the work on Objective 2 NATO nations and Partners will be approached to investigate sonar use within or in proximity to protected areas or areas in their national waters that have some special status and how this may be incorporated into naval exercise planning. All NATO nations are actively encouraged to contribute.

It is further recommended that preparatory work begins on Objective 3, staffing the proposed guidelines through appropriate NATO bodies.

5 Definitions and acronyms

ACCOBAMS	Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area
ACO	Allied Command Operations
ACOMEX	ACO METOC information exchange
ACT	(NATO) Allied Command Transformation
AO	Area of Operations
ASCOBANS	Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas
ASRM	Active Sonar Risk Mitigation
ASW	Anti-Submarine Warfare
ATP	Allied Tactical Publication
C6F/CTF 6	U.S. Navy Commander, Sixth Fleet/Commander, Task Force Six
CCIR	Commander Critical Information Requirements
CINCGERFLEET	Commander in Charge German Fleet
CINCRNLN	Commander in Charge Royal Netherlands Navy
CMRE	Centre for Maritime Research and Experimentation
CPOE	Comprehensive Preparation of the Operational Environment
CoN	Coordinating Nation
COP	Common Operational Picture
DDG	Guided Missile Destroyer
DDEIO	Danish Defence Estates and Infrastructure Organisation
DEU	Germany
DIPCLEAR	Diplomatic Clearance
DK, DNK	Denmark
DMGIC	Defence Maritime Geospatial Intelligence Centre
DoD	Department of Defense
DSA	Defence Situational Awareness
EDA	European Defence Agency
ERMC	Environmental Risk Management Capability (known internally as S2117) software tool (UK)
ESOMM	Effects of Sound in the Ocean on Marine Mammals
EU	European Union
EXOPLAN	Exercise Operational Plan
EXOPRD	Exercise Operational Order
FFG	Frigate, Guided Missile
GBR	United Kingdom (Great Britain)
GLM	Generalized Linear Model
HMS	Hull Mounted Sonar
HN	Host Nation
HQ-SACT	Headquarters, Strategic Allied Command Transformation
IAW	In Accordance With
ICES	International Council for the Exploration of the Sea
IDA	Integrated Decision Aid
IMETOC	Integrated METOC
JFC	Joint Force Command
JMC	Joint Meteorological Centre (Canada)

JNCC	Joint Nature Conservation Committee (UK)
JOA	Joint Operations Area
LFTAS	Low Frequency Towed Active Sonar
LN	Lead Nation
MARCOM	Allied Maritime Command
MarKdo	Marinekommando - Maritime Operational Command (MOC) (DE)
MAZ	Mitigation Action Zone
MC	Military Committee
MCWG	Military Committee Working Group
MEIC	Maritime Environmental Information Centre (NLD)
METOC	Meteorological and Oceanographic
MFAS	Mid-Frequency Active Sonar
MILOC	Military Oceanography
MM	Marine Mammal
MMO	Marine Mammal Observer
MOC	Maritime Operational Command (DE)
MOCASSIN	MOnte CArlo SchallStrahlen INtensitäten (German Sound Propagation Model)
MoD / MOD	Ministry of Defence
MPA	Marine Protected Area
MSAT	Marine Species Awareness Training
MSFD	Marine Strategy Framework Directive (EU)
MSFD	Military Strategy Framework Directive (UK)
NAC	North Atlantic Council
NAVEDTRA	U.S. Navy Education and Training (Command)
NCOP	NATO Common Operating Picture
NCS	NATO Command Structure
NFS	NATO Force Structure
NLD	the Netherlands
nm / nmi	Nautical Mile(s)
NO / NOR	Norway
NSODB	NATO Standard Oceanographic Data Base
OML	Outline Mark-up Language
OPCOM	Operational Command
OPCON	Operational Control
OPLAN	Operation Plan
OPORD	Operational Order
OPP	Operations Planning Process
PoMM	Protection of Marine Mammals (EDA project with associated marine mammal database including abundance, sightings and densities)
PMAP	Protective Measures Assessment Protocol (USN)
PN	Participating Nation
PQS	Personnel Qualification Standard
PRIMA APP	Portable Registration and Identification of Marine Animals; Android App used by RNLN for reporting MM sightings
PTS	Permanent Threshold shift
RA	Risk Assessment
REA	Rapid Environmental Assessment
REAC	REA Coordinator

REACdr	REA Commander
REA DH	REA Data Hub
REASCL	REA Support Cell
REP	Recognised Environmental Picture
RES	Relative Environmental Suitability Index
RN	Royal Navy (UK)
RNLN	Royal Netherlands Navy
RNoN	Royal Norwegian Navy
RMP	Recognised Maritime Picture
S2117	see ERMC (UK)
SAKAMATA	Software tool used to support mission planning and operation and the calculation of risk mitigation measures (RNLN)
SDI	Smart Defence Initiative
SDI ASRM	Smart Defence Initiative on Active Sonar Risk Mitigation
SEL	Sound Exposure Level
SHAPE	Supreme Headquarters Allied Powers Europe
SL	Source Level
SLOC	Sea Lines of Communication
SMO	Staff METOC Officer
SONATE	Decision aid tool to mitigate the impact of sonar operations on marine life (RNoN)
SOFA	Status of Forces Agreement
SPL	Sound Pressure Level
SPORTS	Sonar Positional Reporting System (USN) electronic database
SRA	Sonar Risk Assessment
SSC	Single Service Command
TAS	Towed Array Sonar
TDA	Tactical Decision Aid
TNO	Netherlands Organization for Applied Scientific Research
TTS	Temporary Threshold Shift
UAS	Unmanned Aerial System
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UNCLOS	U.N. Convention on the Law of the Seas
US/USA	United States of America
USN	United States Navy
UUV	Unmanned Underwater Vehicle
WHOI	Woods Hole Oceanographic Institute
WOA	World Ocean Atlas

6 The SDI ASRM Working Group

Through the writing of this report, the SDI ASRM Working Group consisted of the following members:

- LCdr René Dekeling, Defence Materiel Organisation, The Netherlands
- Dr. Frans-Peter Lam, TNO, The Netherlands
- Dr. Petter Helgevold Kvadsheim, Norwegian Defence Research Establishment, Norway
- Rod Jones, Navy Safety Centre, United Kingdom
- Yvonne Mather, Defence Science and Technology Laboratory, United Kingdom
- Ron Filipowicz, USN Sixth Fleet, United States
- Danielle Kitchen, USN CNO- Energy and Environmental Readiness Division, United States
- Darja Poleshuk, Danish Defence Estates and Infrastructure Organisation, Denmark
- Dr. Stefan Ludwig, Bundeswehr Technical Centre WTD 71, Germany
- Cdr (RN) Tim Hutchins, HQ SACT

Observer

- Dr. Mathias Andersson, Swedish Defence Research Agency, Sweden
- Dr. James Theriault, Defence R&D, Canada

A Matrix tables

Appendix A- Comparison Matrix

The comparison matrix was designed to allow Nations to document the end to end process required to operate sonar in the marine environment. It also serves as a quick look guide to the participating Nation's processes and practises. Therefore, allowing the reader to quickly identify the similarities of the nations, as such allowing comparisons to be drawn.
Each stage has a number of questions to quantify the process, the stages identified were:

1. Preplanning
2. Planning
3. Operational
4. Post Operation
5. Miscellaneous

The following tables show the output from the comparison Matrix.

Preplanning Stage - This phase begins with Doctrine, Organisation and Training. Specifically to what National and M/DoD policy and processes are engaged and what organisation and training are in place to execute that policy. The phase ends when the Nation's planning cycle begins, be that on a periodic basis or operation driven.

Phase of risk process	Element to compare		DEU	NLD	GBR	DNK	USA	NOR
Risk Identification	Applicability	Who	All TAS units	ASW unit	All TAS units	All TAS units <180kHz	All TAS units	All TAS units <10kHz >160dB Source level
		What	Marine mammals	Marine mammals , Human Divers in water	Marine mammals Also human divers in the water.	Species or nature types protected under the Habitat and Birds Protection directives	Marine mammals, sea turtles,	Marine mammals, fish
		Where	Protection, feeding and breeding zones as well as in closed areas without escapes, coastal areas without shelves and steep topography. Units and personnel follow the host nation's environmental rules and mitigations. If such guidelines do not exist, the National guidelines will apply.	Worldwide, outside ports and coastal areas where there are no regulations by local authorities. units and personnel follow the host nation's environmental rules and mitigations If such guidelines do not exist, the National guidelines will apply	Worldwide. Units and personnel follow the host nation's environmental rules and mitigations If such guidelines do not exist, the National guidelines will apply	The Danish EEZ. For activities outside the Danish EEZ, the instruction is to follow the relevant nation's assessments and processes or international standards.	Worldwide, In territorial waters and FEEZ's, U.S. Navy units and personnel follow the host nation's environmental rules and mitigations If such guidelines do not exist, the National guidelines will apply	Norwegian territorial waters and Norwegian units abroad. Norwegian units operating outside Norwegian waters will comply with the prevailing guidelines of the host nation. If such guidelines do not exist, the National guidelines will apply
		When	During TAS	During TAS	During TAS	All activities which may affect environment	During TAS training	All maritime training related to who
	Responsible department for sensitive species		Maritime Operational Command MOC (MarKdo)	MoD	MoD	MoD	US Navy/ NMFS	Commanding officer of the Norwegian Navy (GIS)
	Driver		EU Initiatives and treaties (ASCOBANS) & national policy	EU Initiatives & national policy	EU initiatives & national policy	EU initiatives. & national policy	US Federal law & national policy	National military policy

Risk Identification	**Impact on**		All marine mammals	All marine mammals	All marine mammals	Species or nature types protected under the Habitat and Birds Protection directives	All marine mammals & Sea turtles	All marine mammals & fish
	Types of effects….		TTS/PTS, disturbance & stranding	TTS/PTS disturbance & stranding	TTS/PTS & stranding	PTS , disturbance & stranding	TTS/PTS, disturbance & stranding	TTS/PTS, disturbance & stranding
Assessment	**Approach for risk assessment**		Planning & Execution	Planning & Execution	Planning & Execution	Planning	Predetermined due to EIA Process	Planning & Execution
Mitigation	**Training**	**who**	ASW personnel	ASW personnel	Command teams , Sonar operators, MMOs	-	ASW personnel	ASW officers are trained in environmental risk and operational procedures
		how	In house training	In house training	In house training	No training given	In house training	In house training
	Standing mitigation (space and time)	**in place**	Yes	Yes	Yes	No	Yes	Yes
		what	The use of active sonar shall be avoided in protection, feeding and breeding zones as well as in closed areas without escapes, coastal areas without shelves and steep topography.	Description for sound sensitive areas are defined and therefore, these sites should be avoided as far as reasonable and practical	SRA includes the identification of all sound sensitive marine protected areas. These would normally be avoided by sonar transmissions dependant on location	For sonar use there are no standing mitigations prescribed.	Any existing temporal/spatial restrictions are predetermined through EIS process	Sonar restrictions in sound sensitive habitats are pre-defined in time and space

Planning Stage -This phase begins when the responsible organisation either begins their periodic assessment or operation specific tasking. This phase ends when the mitigation measures are produced.

Phase of risk process	Element to compare		DEU	NLD	GBR	DNK	USA	NOR
Other	**Defining the task**	**When**	Risk mitigation process in operations, trials & exercises. NATO policy	Risk mitigation process in operations, trials & exercises. NATO policy	Risk assessment and mitigation process in operations, trials, training & exercises.	Risk mitigation process in operations, trials & exercises. DDEIO guidance	Risk mitigation process in operations, trials & exercises. USA command guidance	Risk mitigation process in operations, trials & exercises. NOR command guidance
		Overriding policies	In case of collision of antagonizing measures and safety precautions, safety precautions have priority.	Human/ vessel safety precautions and operational imperatives have priority	SRA will be conducted but mitigation may be curtailed if the operational requirement is a high priority.	Human/ vessel safety precautions	Human safety takes precedence in the event of conflict between marine mammal mitigation measures and operations.	Human/ vessel safety precautions and operational imperatives have priority
Tool	**Format**		Document based & PC software	PC Software	Document based & PC software	Document based	Document based & PC software	Online & PC software
	Data inputs		Input for the software is platform, sonar system, environmental parameters (seabed, water column etc.), target, date, time, location and duration of operation. Marine mammal abundance and distribution	Input for the software is platform, sonar system, environmental parameters (seabed, water column etc.), marine mammal distribution, marine protected areas, date, time, location and duration of operation.	Input for the software is platform, sonar system, environmental parameters (seabed, water column etc.), marine mammal distribution, marine protected areas, date, time, location and duration of operation.	Use most recent scientific findings	Marine species density; sonar: PTS, TTS, behavioural, acoustic modelling which include information such as bathymetric, surface roughness, sound speed profiles, bottom roughness, etc. platforms, typical operating parameters, speeds of the vessels, number of sources, etc. and qualitative and quantitative data about marine species population abundances, distribution, life history characteristics, hearing capabilities, habitat requirements, etc.	Input for the software is platform, sonar system, environmental parameters (seabed, water column etc.), marine mammal distribution, date, time, location and duration of operation. fishery and other commercial activity (fish farms, tourism, whaling)

Tool	**Modelling steps**		Sound propagation is calculated, based on input parameters (model MOCASSIN), and output can display various sound parameters (including potential risk zones for marine mammals, e.g. > 160 or 180 dB SPL re 1µPa).	Operator inputs Ship, Sonar type, Signal parameters, location and date, time and duration - runs the assessment - unfavourable results leads to changes to intentions and assessment rerun until adequate mitigation is in place.	Operator inputs Ship, Sonar type, Signal parameters, location and date, time and duration - runs the assessment - unfavourable results leads to changes to intentions and assessment rerun until adequate mitigation is in place.	Depends on external advisor and specific activity being assessed. From simplest “rule of thumb” sound propagation estimates to nearest sensitive area, to spherical sound propagation from moving source coupled with possible density of mobile animals.	All acoustic modelling for sonar is conducted in the Navy Acoustic Effects Model (NAEMO). For individual event risk assessments, the scope (amount of sonar to be used and the period planned) and location are identified. Environmental Planners access oceanographic and animal density databases to qualitatively evaluate the level of risk. A graduated scoring system is then used to determine an overall score. This score is translated into levels of risk (Low, Moderate, and High).	Other than propagation loss There is no real time modelling. All risk assessments, including sensitive species, sensitive areas etc. are predetermined.
	Key metrics output		SRA output parameters and some sort of quantification schema for risk.	SRA output parameters and some sort of quantification schema for risk.	SRA output parameters and some sort of quantification schema for risk.	SRA output parameters and some sort of quantification schema for risk.	SRA output parameters and some sort of quantification schema for risk.	SRA output parameters and some sort of quantification schema for risk.

Assessment	**Documentation**		In general there is no obligation to create a report or output for every sonar use. Available information has to be considered during planning, following the MSGID-FLEETGEN 08-14. For specific exercises a report with final recommendations is created during the planning phase.	The result of the RA-process including advice using a traffic light exported to ppt/pdf for briefing/archive	The assessment is accepted and electronically signed by command which is stored in software database.	Impact assessment report including a consideration of mitigation measures. - DDEIO assessment and instructions to operative units, referring to and distilling Impact assessment.	The modelling output is incorporated in the EIS/OEIS, Letter of Authorization Application, Endangered Species Act Consultation Package, and any other relevant environmental compliance documentation. -For individual event risk assessments, the name of the document is unique to each exercise as in "Mid-Frequency Active Sonar Risk Assessment for XXX Exercise 2016" - Normally, due to the nature of the information presented in the risk assessment these documents are classified and not releasable to the public.	Environmental briefing with sonar restrictions for specific operations
Assessment	**Duration**		Dependent on the complexity of the scenario, trial area and the abundant marine mammal species. Outputs of MOCASSIN modelling (see 15) are short-term available and can be realized also during executing the exercise to adapt the procedure.	Single ship risk assessment can be produced in approx. 15 minutes. The lead time for conducting the SRA will depend upon time available, complexity of the planned transmissions and the operational value of the intended activity.	Single ship risk assessment can be produced in approx. 15 minutes. The lead time for conducting the SRA will depend upon time available, complexity of the planned transmissions and the operational value of the intended activity.	Varies as dependent on organizations structural composition and process demands, as several key actors are involved – External Advisor, DDEIO and Navy. Historically: 3-6 weeks from scenario has been sent to the DDEIO from operational unit, to the answer was sent back to operational unit. Now: After recent restructuring it is calculated that it will take approximately 4 month from the DDEIO receives scenario to the operational units have an answer.	The entire EIS/OEIS process from pre-planning to receipt of any associated permits typically takes 4 years. Each individual Risk Assessment normally takes 3 weeks from receipt of the exercise scenario to production of the assessment document. An additional 1-2 weeks is required to brief C6F leadership	Risk is predetermined in time and space in a 2 year cycle. Risk assessment for a specific operation takes hours to produce.

Mitigation	**Mitigation**		During sonar missions the lowest possible sound level shall be used. Apart from the ramp-up procedure, during the transmission duration there should be a level of xx percent of pauses in between the transmissions.	Advice is provided on alternatives, including transmission parameters (frequency, source level, duty cycle, alternative data, ramp-up); further the standard mitigation measures (look outs, mitigation zone, PAM, etc. are provided)	Cetacean and pinniped PTS/TTS ranges and local conditions (such as visibility) determine scale of risk. Changes to date location duration of activity as well as transmission parameters can be suggested by the SRA tool or manually amended.	Typically: only use sonar level (frequency, dB and number of sonar used at once) that is needed, avoid sensitive locations (incl. costal avoidance), location driven by risk results, visual inspection, ramp-up.	A standard set of mitigation measures are applied regardless of location which include lookouts, passive acoustic monitoring, mitigation zones and geographic restrictions. Some activities will include additional measures as warranted due to conditions present.	Avoid intensive sonar exercises in areas/periods expected to have a high abundance of marine mammals, whaling or whale safari. Limit source level, number of active units and duration of transmissions within affected areas.

Operation Stage -This phase begins when the operating unit/force receive the mitigation measures. This phase ends when the operation of the sonar has been completed.

Phase of risk process	Element to compare		DEU	NLD	GBR	DNK	USA	NOR
Assessment	Real-time assessment	real time assessment takes place	Yes	Yes	Yes	Yes	Yes	Yes
		What	A real-time assessment is not prescribed. But there is the possibility on-board of the most units to re-calculate sound propagation and ranges using a model (MOCASSIN), and using e.g. real-time measured data, if available. This can be used to adapt the risk mitigation.	A final assessment can be conducted using as many real time parameters as are available to the ship's staff to verify the initial assessment is adequate..	Usually a final assessment is conducted using as many real time parameters as are available to the ship's staff.	Only visual inspection, where observation of animal in predefined zone would lead to an adjustment of operation (typically repeated ramp-up).	Commanding Officers are tasked with considering the same six risk factors mentioned previously just prior to use of sonar. Additionally, Navy's Protective Measures Assessment Protocol (PMAP) tool shall be used to provide the on scene mitigation measures that are to be employed during the use of sonar.	Real time assessment of effected (sonar) area
	Outputs to operator		There is no dedicated output to the operator. Model (MOCCASIN) output is available	The result of the RA-process including advice using a traffic light exported to PPT/Pdf for briefing/archive	The output is a percentage chance of TTS and PTS for duration of transmission and a single ping, it also shows Standoff ranges (the distance at which harm is likely to occur)	Observed presence/no presence of individuals of protected species within a specified zone, output of real time assessment is available	Operators receive an output that lists the specific mitigation measures to be employed for the specified activity, time, and location. This output is in the form of a report that includes the activity to be performed, a geographic depiction of the location of the event, the specific mitigation measures to be employed	Propagation loss output is available

Phase of risk process	Element to compare		DEU	NLD	GBR	DNK	USA	NOR
Mitigation	**Pre-sonar operation mitigation**	**PAM**	Yes	Yes	Yes	No	Yes	Yes
		Dedicated MMO	NO	No	Yes	No	Yes	No
		Visual	Yes	Yes	Yes	Yes	Yes	Yes
		What	Half an hour prior to use, the surrounding is checked while passive sonar is used for acoustical detection. During night hours, infrared cameras or other night vision goggles are used when possible. Whenever possible, a 30-min. ramp–up-sequence, starting at lower dB sound level - or the lowest available level, is applied. When sighting marine mammals within one nautical mile, the ramp up procedure is not conducted.	Prior to transmission PAM and MMO are deployed where possible from surface units; 30 minutes Aircraft deploying active sources conduct visual sweep prior to deployment but duration is determined by the activities	Prior to transmission PAM and MMO are deployed where possible from surface units; 30 minutes <200m depth and 60 minutes >200m depth. Aircraft deploying active sources conduct visual sweep prior to deployment but duration is determined by the activities.	Sonar: Visual inspection, positioning of ship in relation to predefined sensitive areas.	Ships >65 ft in length have two Lookouts. Ships <65 ft and minimally manned ships have one. Visual searches conducted within the prescribed mitigation zone (normally 2000 yds.). Passive sonar is used to assist with visual search. If animals are present in the mitigation zone, lookouts must verify the animal has exited the mitigation zone or the ship must wait 30 minutes after the last sighting of the animal prior to using active sonar.	Use of lookouts 30 minutes before operation
	During sonar operation	**Ramp up**	Yes	Yes	Yes	Yes	No	Yes
		Ramp up duration	Up to 30 mins	5 mins	5 - 30 mins	30 mins	None	3-5 mins

Phase of risk process	Element to compare		DEU	NLD	GBR	DNK	USA	NOR
	mitigation - use of sonar	**Explanation**	The observers on the bridge look out for marine mammals, using standard detection equipment; sightings shall be reported using the marine mammal sighting protocols of MarKdo GeoInfo branch. If available, passive acoustic monitoring shall be used as well as infrared of night vision goggles during night time	Once on task ramp up is utilised where available. Should marine mammals be detected within a nominal mitigation action zone vessels will alter transmissions. If animals are detected too close the vessel transmissions will be stopped.	Once on task ramp up is utilised where available. Should marine mammals be detected within a nominal mitigation action zone vessels will alter transmissions or course of vessel to avoid impacts. If animals are detected too close the vessel transmissions will be stopped.	Ramp-up, minimizing (for mission aim) emission, frequency and level of sound and number of sources, if possible, directionality. Ships distance to coastal areas maximized. Sightings of animals require a rerun of ramp-up until animals are not sighted.	Active sonar transmission shall not begin if concentrations of floating vegetation (Sargassum or kelp paddies) are observed in the mitigation zone. For sources able to be powered down (e.g., hull-mounted): this will be species specific	Use of ramp-up scheme (3-5min) or restriction of source level, shut-down when marine mammals are detected at close range (500m), or within 500-1000m of fishing vessels and fish farms. Transmission budgets in sensitive areas.

Mitigation	**During sonar operation mitigation - sensors**	**PAM**	Yes	Yes	Yes	No	Yes	Yes
		Dedicated MMO	No	No	Yes	No	No	No
		Visual	Yes	Yes	Yes	Yes	Yes	Yes

		Explanation	Use of visual and passive acoustic monitoring (if available).When sighting marine mammals within the vicinity of one nautical mile, transmission has to be stopped. If sonar transmission is interrupted for more than half an hour during the exercise, the ramp-up-sequence has to be repeated. During the mission conduct, the lowest possible sound level shall be used. The use of active sonar during night shall be minimized.	Only non-acoustic mitigation (PAM), as is the use of upper deck marine mammal observers.	Only non-acoustic mitigation (PAM), as is the use of upper deck marine mammal observers.	Visual inspection (prescribed prior to operation and ramp-up, but so far no instruction from DDEIO on how the inspection must be carried out). Speed limitations have not been applied so far in relation to sea mammal-protecting mitigations.	Ships 65ft in length or greater shall have two Lookouts at the forward position of the vessel. Ships less than 65ft in length and ships that are minimally manned shall have one Lookout at the forward position of the vessel. During the use of active sonars, visual searches are conducted within the prescribed mitigation zone (normally 2000 yds.) for presence of marine mammals. Passive sonar is used to assist with the visual search. If animals are present in the mitigation zone, the power-down and shut-down scheme presented in answer 24 applies.	Use of lookouts, speed limitations, limitations in confined areas
	Special measures		Sonar: The use of active sonar during night shall be minimized. Passive systems shall be used, if available (passive systems, underwater telephone).	None	The acceptability of the risk assessment is partly determined by local conditions such as visibility and acoustic conditions.	None	Visibility is one of the factors considered when conducting the Risk Assessment and if the event requires the use of sonar during reduced visibility or at night that factor is scored accordingly.	Reduced visibility implies speed limitations and limitations on operations in confined areas. Ramp up becomes mandatory.
		PAM	Yes	No	No	No	Yes	No
		Dedicated MMO	No	No	Yes	No	No	No
		VISUAL	Yes	Yes	Yes	No	Yes	No

Mitigation	**After sonar operation mitigation**	**Explanation**	Half an hour after completion of the usage of active sonar the surrounding has to be checked for presence of marine mammals while passive sonar shall be used for acoustical detection. If there is the indication of harm, the responsible branch for marine mammal reporting (MarKdo GeoInfo) has to be informed	After sonar is switched off MMO's remain for 30 mins to monitor unusual mm behaviour	MMO remain on deck for 30(60) minutes after transmissions have ended.	None	Lookouts are continuously manned on board U.S. Navy ships and as such there is no additional measures necessary after active sonar has been turned off. When passive sonar is employed it too is constantly monitored.	Nothing specific

Post operation stage –this phase begins when all operation of sonar is complete. It provides details on who is informed on the sonar activity.

Phase of risk process	Element to compare	DEU	NLD	GBR	DNK	USA	NOR
Other	**Reporting**	The standard procedure is that documents (marine mammal sightings using the dedicated protocol, information of incidents etc.) are to be sent to MarKdo, Mission Department, GeoInfo branch. Incoming data are added to a marine mammal database archiving all sightings from the German Navy. These data can be used for future assessments of trial areas and improvement of knowledge about marine mammal occurrence in combination with other data sources of the database.	Completed sonar activity is reported to MWC this data will go to UW noise register for MSFD GES11	All marine mammals' sightings are recorded and reported to UKHO. SRA acceptance form is stored within the software and retained within MOD. Since May 2015 RN, non-classified, active sonar transmissions have been reported to UK Underwater Noise Register as part of the MSFD, GES 11.	Transmission reports and incident reports may be requested after operations involving specific sonar-systems. These are sent from operation unit to DDEIO.	There are no requirements to report general marine mammal sightings in the C6F Area of Operations. Marine mammal sightings are only required to be reported during the execution of mitigation activities during Major Training Exercises/ Major Testing (MTEs) A list of MTEs is defined in each permit for each geographic area. Per Navy wide policy all active sonar transmissions used for training, testing, and maintenance are to be reported in the Sonar Positional Reporting System (SPORTS) electronic database. (The SPORTS database is maintained by U.S. Fleet Forces Command and is a classified database).	Sonar transmissions are recorded and data stored. No reports to 3rd party. Marine mammal sightings are in principle reported to Institute of Marine Research via FFI

Miscellaneous – this section provides information as to maintenance cost, responsible person, third party inputs and incident response.

Element to compare		DEU	NLD	GBR	DNK	USA	NOR
Cost to maintain system process		Unable to quantify	Unable to quantify	Unable to quantify	Unable to quantify	Unable to quantify	Unable to quantify
3rd Party inputs	**3rd party inputs**	NO	NO	YES	YES	YES	YES
	If yes, who	-	-	Industry provides the SRA software and statutory nature conservation bodies provide independent scientific input.	Civilian advisor is used in relation to biological assessments and guidance.	National Marine Fisheries Service, the U.S. Fish and Wildlife Service, the Environmental Protection Agency and public input on the development and finalization of any EIS/OEIS.	Ministry of Fisheries and Ministry of Environment are consulted
Responsible person/org	**The person, dept., org responsible for RA process**	Maritime operational Command MOC (MarKdo)	Commander of RNLN	NCHQ	DDEIO	Chief of Naval Operations (N45)	Commander of Royal Norwegian Navy
	Does this change through the process	Commander of vessel (execution)	Operational Commander (Execution)	Operational commander	-	Fleet Commanders	operational commander
		MoD Research for trials conducted by BW Centre (planning and execution)	MHQ for RA in planning phase	-	-	-	-
	Support for responsible person	Bundeswehr Technical Centre (planning of certain exercises)	NL Defence Materiel Organisation (supports Cdr RNLN)	Dstl	--	Future operations dept. - environmental planner- commander task force xx - ship (operation)	Naval METOC & FFI (Provide support)
		-	Hydrographic office	UK Hydrographic office	-	-	-

Incident response procedure in place	**Is there an incident response procedure?**	Yes	Yes	Yes	Yes	Yes	Yes
	What is the incident response procedure?	Operational units (commanders) to report to the Maritime operational Command (MarKdo), Mission Department (GeoInfo branch)	Operational units to report if there is indication that sonar operation has caused harm.	If noted by a transmitting unit transmission will cease unless operationally critical. If reported by 3rd party response is determined and controlled by the senior operational commander.	All incident response procedures that may be in action relate to specific actions or exercises.	During the Operations phase the individual units are tasked with reporting any incidents using a standard process and format that is defined in navy instruction	Procedure in place to report and analyse/reconstruct incidences to address cause effect relationships.
	When in the phase of the operation is it defined?	Pre-planned	Pre-planned	Pre-planned	During planning	Predetermined by Navy wide Standard Operating Procedures (SOPs) that are part of the Pre-Planning phase.	Pre-planned

B Approach of risk assessment for Germany

Working Paper for the NATO Active Sonar Risk Mitigation (ASRM) Group, SD 2.77 (following the proposed procedure in the minutes of the 6th meeting, St. Andrews, UK)

Short summary of a German risk assessment approach for a NATO active sonar (ASW) exercise scenario (Extract from final draft of Technical Report WTD 71 – 0110/2015 WB)

B.1

B.1.1 Scenario

There is going to be a NATO ASW Exercise on the 10 October 2015 from 1200 to1600 Z.

The exercise will take place in the area: N 59 00, W 007 00; N 59 40, W 005 40.

This area will be considered 'High Seas'.

Each participating nation shall provide the active sonar risk mitigation procedures for their national asset / sonar system (1 ship, 1sonar).
Germany provides the procedure for

a) the hull-mounted sonar (HMS) DSQ21, by default on-board the German frigates F123, and

b) the Low Frequency Towed Active Sonar (LFTAS), an experimental sonar type that is not introduced into the fleet and at current only used occasionally (research sonar trials).

Because of no special requirements for this scenario regarding design of sonar runs etc., a general approach for the sound propagation modelling and assessment of potential risk for abundant marine mammals was made, based on the scenario area.

B.1.2 Assumptions

The risk assessment procedure is based on the general order for the German Navy fleet to minimize the influence caused by sonar on marine mammals and the marine habitat (see Annex, MSGID-FLEETGEN 08-14).

The standard sound propagation model used by the German Navy is MOCASSIN (MOnte CArlo SchallStrahlen INtensitäten). For this ASRM scenario the sound propagation for two active sonars was modelled to display the received sound pressure levels (SPL).

The SPL (root mean square - rms) values for both systems were calculated for a typical pulse length and displayed (Annex). The following parameters were used:

1) HMS DSQ21: sensor depth = 3 m, mid frequency sonar, standard source level (SL), CW pulse

2) LFTAS: sensor depth = 80 m, low frequency, standard source level, HMS pulse

The calculations were made for October, at the position 59° 20’ N, 6° 20 W (centre point of ASRM scenario box). Good environmental conditions were chosen as input parameters (no significant disturbance through wind speed or wave heights), temperature and sound speed profile were chosen from the included MOCASSIN program database.

All marine mammal sightings in the dedicated scenario area were requested from a German database of marine mammals (Bundeswehr, WTD 71).

B.1.3 Preplanning

The risk mitigation applies to the influence of underwater noise, focused on ASW active sonars and including explosives. The current risk mitigation (MSGID FLEETGEN 08-14, see Annex) aims to minimize the influence on marine mammals, but also the marine habitat (so far not specifying other groups than marine mammals). The use of active sonar shall be avoided in protection, feeding and breeding zones as well as in closed areas without escapes, coastal areas without shelves and steep topography (not specifying certain territories). This is applicable to all units using active sonar or explosives, and depending if there are other regulations by local authorities that have to be followed (e.g. exercise lead by other nation). The GER mitigation rules mitigate impact on all marine mammals.

The current risk mitigation shall prevent physical harm and permanent threshold shift (PTS), and because of standoff ranges also prevent preferably temporary threshold shift (TTS). A stranding risk, when identified, should be prevented (e.g. closed areas without escapes).

The Naval Command (MarKdo) is responsible for planning operations and risk assessment needs, and commanders of operations during execution. Depending on the task, the Bundeswehr Technical Centre is involved in setting up specific risk mitigation measures.

B.1.4 Planning

For the planning of a designated scenario, the risk mitigation regulations apply to training and exercise, in line with standing NATO policy. In case of conflict between antagonizing measures and safety precautions, safety precautions have priority. If antagonizing measures conflict with mission defaults, a decision will be taken by the task group leader or ships commander.

The following information was collected and analysed to evaluate the potential risk for marine mammals in the chosen scenario area:

Marine Mammal Species in the Sea Area

The following marine mammal species are expected to be abundant in the selected sea area in the NE Atlantic (area: 59° 00’ N, 7° 00’ W; 59° 40’ N, 5° 40’ W) for the specified NATO active sonar scenario during fall The listed species are based on the analysis from the identification tables of marine mammals (Ludwig 2011) and the atlas of marine mammals (Ludwig and Nissen 2014), used by the Navy fleet and the Bundeswehr Technical Centre ships (WTD 71). All species listed below can be

encountered in general throughout the whole year. This information for sonar risk assessment is focussed on cetacean species (whales, dolphins and porpoises). In total, 23 species can be encountered, some of them only occasional / seldom. The main habitat (occurrence) of the species is listed below, either with a preference for coastal or offshore waters. Some species are abundant in both habitats, on the continental shelf and in deeper waters.

Abundance: Regular abundant Cetacean Species:

1) Toothed Whales	***Scientific Name***	**Occurrence**
Common dolphin	*Delphinus delphis*	coastal / offshore
Striped dolphin	Stenella coeruleoalba	(mainly) offshore
White-beaked dolphin	*Lagenorhynchus albirostris*	coastal / offshore
Bottlenose dolphin	*Tursiops truncatus*	coastal / offshore
Risso's dolphin	*Grampus griseus*	offshore
Atl. White-sided dolphin	*Lagenorhynchus acutus*	offshore
Long-finned pilot whale	*Globicephala melas*	coastal / offshore
Killer whale	*Orcinus orca*	coastal / offshore
Harbour Porpoise	*Phocoena phocoena*	coastal
Sperm whale	*Physeter macrocephalus*	offshore
Northern Bottlenose whale	*Hyperoodon ampullatus*	offshore

2) Baleen Whales	***Scientific Name***	**Occurrence**
Minke whale	*Balaenoptera acutorostrata*	coastal / offshore
Fin whale	*Balaenoptera physalus*	(mainly) offshore
Sei whale	*Balaenoptera borealis*	offshore

Abundance: Occasional / seldom abundant Cetacean Species:

1) Toothed Whales	***Scientific Name***	**Occurrence**
False Killer whale	*Pseudorca crassidens*	offshore
Short-finned pilot whale	Globicephala macrorhynchus	offshore
Pygmy sperm whale	*Kogia breviceps*	offshore
True's beaked whale*	*Mesoplodon mirus*	offshore
Blainville's beaked whale*	Mesopodon densirostris	offshore
Sowerby's beaked whale*	*Mesopodon bidens*	offshore
Cuvier-beaked whale*	*Ziphius cavirostris*	offshore

2) Baleen Whales	***Scientific Name***	**Occurrence**
Blue whale	*Balaenoptera physalus*	offshore
Humpback whale	*Megaptera novaeangliae*	coastal / offshore

*So far there is no well-grounded knowledge about the frequency of occurrence especially of the beaked whale species
For the risk assessment, the focus is on the regular abundant whale and dolphin species in the trial area and on the species that are expected to be more sensitive related to military active sonar.

Marine Mammal Sightings
All marine mammal sightings in the dedicated scenario area were requested from the German database of marine mammals the analysed data (see examples in the Annex) were divided into specific cetacean (whales, dolphins and porpoises) groups.

The registered sightings of deep diving species are mainly concentrated along the 1000 m water depth contour or in deeper waters. Most beaked whale sightings are apparently sightings of Northern bottlenose whales, a species that occurs in that region, mainly during migration in late summer / autumn and late winter / early spring.

Most baleen whale sightings from the database in the scenario area are minke whales, they were observed predominantly in shallower waters on the shelf.
The other baleen whale records occurred in deeper waters.

The sighting records of the regular abundant dolphin species show a separation, coinciding with habitat preferences. Sightings of the Atlantic white-sided dolphin are concentrated in deeper offshore waters whereas white-beaked dolphins were registered very frequently in coastal waters. Both species are the most frequently registered dolphin species in the area, based on the database entries. Sightings of harbour porpoises are concentrated in coastal waters up to 200 m water depth.
A few sightings were recorded in deeper water areas.

Prediction of Marine Mammal Densities
The Northern bottlenose whale, a regular abundant beaked whale species, is expected to be one of the most sensitive cetaceans related to active sonar use in the trial area of the ASRM scenario. The original model data used for the assessment are based on a “Relative Environmental Suitability Index (RES), pointing out values between 0 and 1 (1 = most suitable habitat) in a 0.5 x 0.5 grid. The Model was improved using a Generalized Linear Model (GLM) to show probabilities of the density of animals / km² (model from SRMU, St. Andrews, e.g. Quick 2008).

The highest predicted density of Northern bottlenose whales is situated in the north-western part of the scenario area, close to the 1000 m depth contour (see Annex).

Sound Propagation modelling
The calculations were made for October, at the position 59° 20’ N, 6° 20 W (centre point of ASRM scenario box). Good environmental conditions were chosen as input parameters (no significant disturbance through wind speed or wave heights), temperature and sound speed profile were chosen from the included MOCASSIN program database.

The sound propagation was displayed for two different water depths, close to the surface (10 m) and at sensor depth of LFTAS (80 m) (see Annex). The direction of the vertical profiles is East to West (90°- 270°). The modelled sound propagation for the HMS shows a received SPL of 146 dB (re 1µPa) at a distance of 500 m from the source. The sound exposure level for animals at the 500 m distance from the source is 149 dB re 1 µPa²s, based on the chosen signal type.

The modelled sound propagation for the experimental, towed sonar (LFTAS) shows a received SPL of 160 dB (re 1µPa) at a distance of 2000 m from the source, the SPL at a distance of 500 m is 167 dB (re 1 µPa) and the SEL is 170 dB re 1 µPa²s for this signal type.

Recommendations based on results of planning
Based on the analysed data of regular abundant marine mammals, the Northern bottlenose whale (group beaked whales) is expected to be the most sensitive species in the exercise scenario area. Sonar use in their main habitat close to the 1000 m depth contour or deeper waters (especially canyons and steep slope areas) in the north-western sub-area of the scenario should be minimized or avoided, depending on operational needs. Various dolphin species can be encountered regularly in the area.

The received sound pressure level for the HMS signals at 500 m distance from the source is 146 dB re 1µPa (sound exposure level, SEL = 149 dB re 1µPa²s).
It allows a good coverage of visual and acoustic measures in the potential impact area in immediate vicinity of the source. A temporary threshold shift (TTS) for the whale and dolphin species is unlikely and a physical harm (e.g. PTS) is not expected to occur due to these sound levels, and if the direct surrounding of the source is monitored attentive. All mitigation measures pointed out in the MSGID FLEETGEN 08-14 for the German Navy fleet should be followed (see Annex). During the mission conduct, the lowest possible sound level shall be used. Transmission duration apart from ramp-up-sequence shall be at a level of 10 percent or less of the pauses in between to avoid severe cumulative effects.

The received sound pressure level for the LFTAS signals is higher than for the HMS, at 500 m distance from the source the SPL is 167 dB re 1 µPa (SEL = 170 dB re 1 re 1µPa²s). The SPL at 2000 m distance is 160 dB re 1µPa (SEL = 163 dB re 1 re 1µPa²s). Physical harm (e.g. PTS) is not likely if the animals are not located in immediate vicinity of the source, monitoring should be attentive and risk mitigation measures should be applied if needed (e.g. if there is more specific equipment available for mitigation, lower the source level in x dB steps, if there are encounters of cetacean species within potential impact zones of SEL > 180 dB and of SEL > 160 dB for beaked whales). All procedures pointed out above shall be used.

To conclude:
- the Northern bottlenose whale is considered be the most sensitive species in the area,
- because of topography and habitat characteristics minimize activities in the north-western area of the scenario box,
- Transmission duration of 10 percent or less of pauses in between to avoid severe cumulative effects (e.g. 1 - 2 sonar pings / min, depending on signal type).

B.1.5 Operation
During the operation in the scenario area the procedures of the MSGID FLEETGEN 08-14 (see Annex) shall be followed (exception: In case of conflict between antagonizing measures and safety precautions, safety precautions have priority.

If antagonizing measures conflict with mission defaults, a decision will be taken by the task group leader or ships commander).

A real-time assessment is not prescribed. But there is the possibility on-board of the most units to re-calculate sound propagation and ranges using MOCASSIN using e.g. real-time measured data, if available. This can be used to adapt the risk mitigation (e.g. evaluate SEL levels).

Before sonar use:

Half an hour prior to the use of active sonars, the surrounding has to be checked for presence of marine mammals while passive sonar shall be used for acoustical detection. During night hours, infrared cameras or other night vision googles shall be used for visual detection, when possible. Whenever possible, a 30-min. ramp–up-sequence (with slowly increasing sound levels), starting at XXX dB sound level - or the lowest available level, shall be applied. When sighting marine mammals within the vicinity of one nautical mile, the ramp up procedure shall not be conducted.

During sonar use:

Use of visual and passive acoustic monitoring (if available).When sighting marine mammals within the vicinity of one nautical mile, transmission has to be stopped (if more specific equipment for mitigation is available, lower source level or shut-down, based on SEL values). If sonar transmission is interrupted for more than half an hour during the exercise, the ramp-up-sequence has to be repeated. During the mission conduct, the lowest possible sound level shall be used. The use of active sonar during night shall be minimized.

After sonar use:

Half an hour after completion of the usage of active sonar the surrounding has to be checked for presence of marine mammals while passive sonar shall be used for acoustical detection. If there is the indication of harm, the responsible branch for marine mammal reporting (MarKdo GeoInfo) has to be informed.

B.1.6 Post-Operation (what is reported to whom)

The standard procedure is that documents (marine mammal sightings using the dedicated protocol, information of incidents etc.) are to be send to MarKdo, Mission Department, GeoInfo branch. Incoming data are added to a marine mammal database archiving all sightings from the German Navy. These data can be used for future assessments of trial areas and improvement of knowledge about marine mammal occurrence in combination with other data sources of the database.
The data in the protocols include ship data, environmental parameters (weather conditions), information about the type of sound source, observations of marine mammals, including further details (if recorded: species, number, behaviour, observed reaction to sound source, type of recording etc.) and about the observer platform.

B.1.7 Additional information

Following additional information is provided:

- Appendix B.2 German Navy Fleet Order
- Appendix B.3 Examples of marine mammal sightings and density in scenario area
- Appendix B.4 Examples of sound propagation modelling (HMS, LFTAS)

B.2 German Navy Fleet Order

MSGID FLEETGEN 08-14 (unclassified version)
1. All flying asset and units afloat are hereby ordered to minimize influence caused by sonar on marine mammals and the maritime habitat.

2. Nevertheless in any case mission objectives will continue to have overall priority.
2.1. Units will be obliged to look out for marine mammals and fill out detection reports whenever possible.

2.1 The format for marine mammal sighting report will be available via Ops rooms of the respective flotilla or as a softcopy via intranet page of the Naval Office (HTTP://143.68.40.59 Service/Documents and “formats + METOC CODES”)

2.2. After completion of the mission, documents are to be send to MarKdo, Mission Department, GEO Info branch

3. When using active sonar suites, the following rules apply:

3.1 While planning the use of active sonar, information on possible presence of marine mammals within the relevant area has to be collected from CINCGERFLEET GEOINFO. The use of active sonar shall be avoided in protection, feeding and breeding zones as well as in closed areas without escapes, coastal areas without shelves and steep topography. The use of active sonar during night shall be minimized.

3.2 When sighting marine mammals within the vicinity of one nautical mile, transmission has to be stopped. The ramp up procedure (see 3.4) shall not be conducted.

3.3 Half an hour prior to the use of active sonars, during the use of active sonar as well as half an hour after completion of the usage of active sonar the surrounding has to be checked for presence of marine mammals while passive sonar shall be used for acoustical detection. During night hours, infrared cameras or other night vision googles shall be used for visual detection, when possible. Special attention is required when using higher speed to avoid chasing marine mammals.

3.4 Whenever possible, a 30-min. ramp–up-sequence (with slowly increasing sound levels), starting at XXX dB sound level - or the lowest available level, shall be applied. If sonar transmission is interrupted for more than half an hour during the exercise, the ramp-up-sequence has to be repeated.

3.5 During the mission conduct, the lowest possible sound level shall be used. Transmission duration apart from ramp-up-sequence should be at a level of XX percent of the pauses in between.

4. Underwater detonations may be conducted only when taking into account the following rules and procedures:

4.1 Sections 3.1 and 3.3 are to be followed respectively. When sighting marine mammals within two nautical miles, detonation has to be delayed until clear indications are available that the animals have left this area.

4.2 Half an hour prior of a detonation, as far as possible, antagonizing measures have to be conducted using active sonar (see 3.4) and underwater telephone. Prior to the detonation, 15, 10 and 5 minutes underwater acoustic signals (e.g. XXX) have to be set off respectively, beginning with low charges, cumulative up to a maximum of XXX.

5. Safety precautions/protective means:
In the case of collision of antagonizing measures and safety precautions, safety precautions have priority. If antagonizing measures collide with mission defaults, decision will be taken by the Task Group Leader or ship's Captain. The decision and rational will be recorded to the ship's log. Insights on the effectiveness of antagonizing measures will be noted to the safety protocol.

6. POC: MARKDO UA GEOINFO

B.3 Examples of marine mammal sightings and density in scenario area

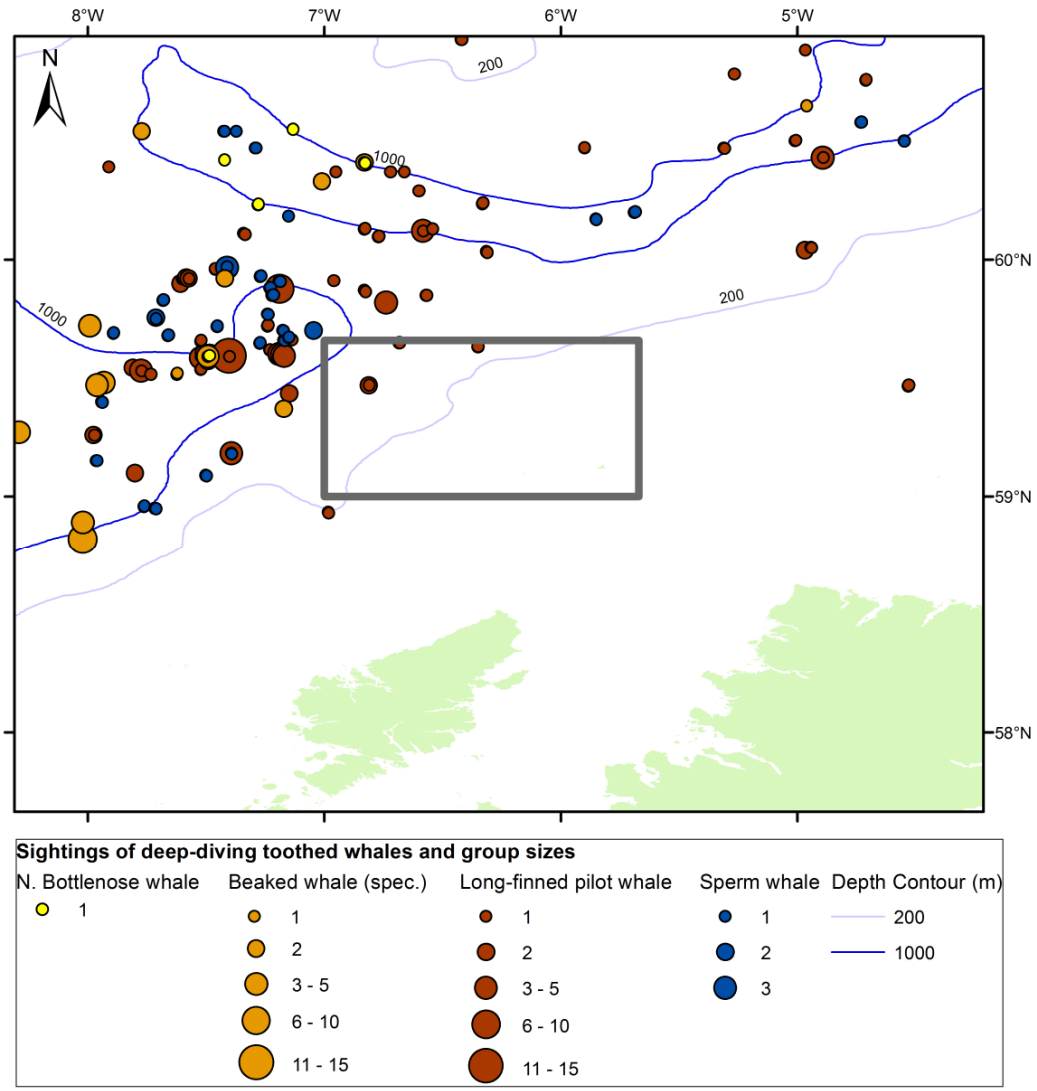


Figure B.1. Sightings of regular abundant deep diving toothed whale species during fall (Sep-Nov). The ASRM scenario area is marked (grey rectangle). Most beaked whale sightings are apparently sightings of the Northern Bottlenose whale.

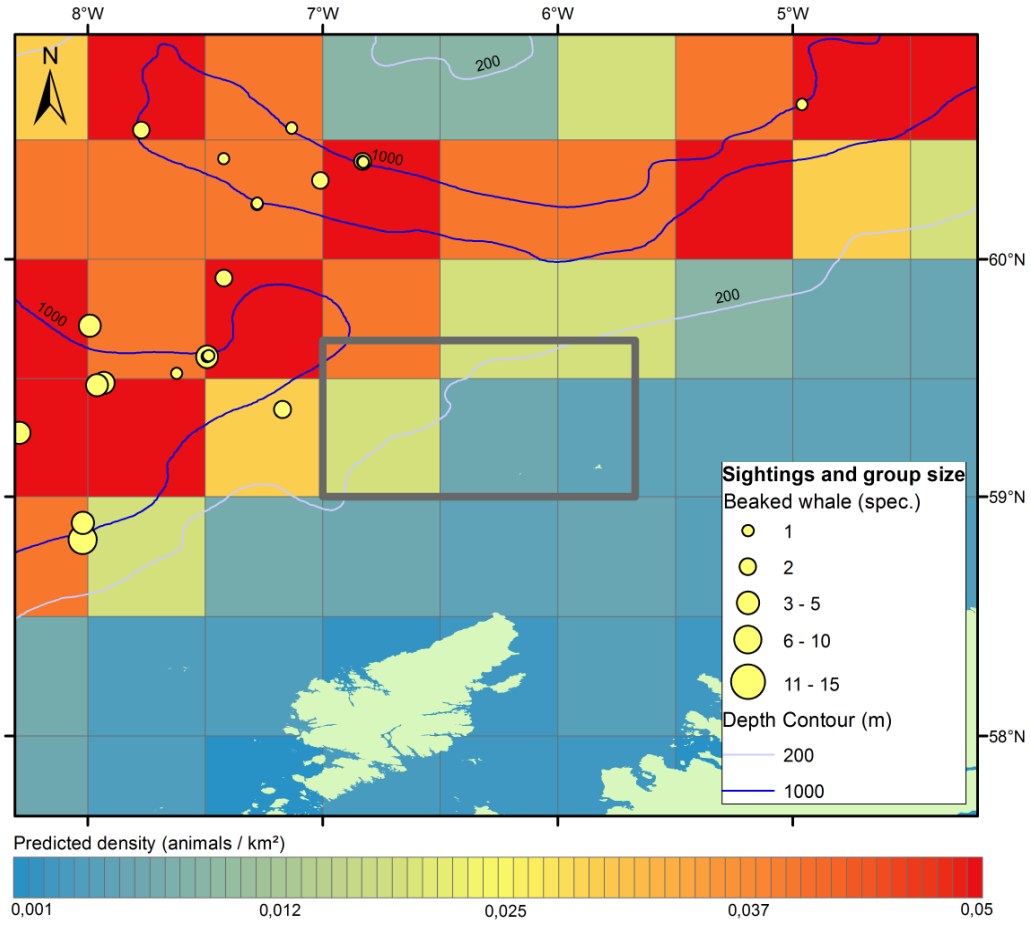


Figure B.2. Predicted density of the Northern bottlenose whales beaked whale and sightings during fall (September-November). The scenario area is marked (grey rectangle). Higher prediction values and sighting records are concentrated at about ≥ 1000 m water depth.

B.4 Examples of sound propagation modelling (HMS, LFTAS)

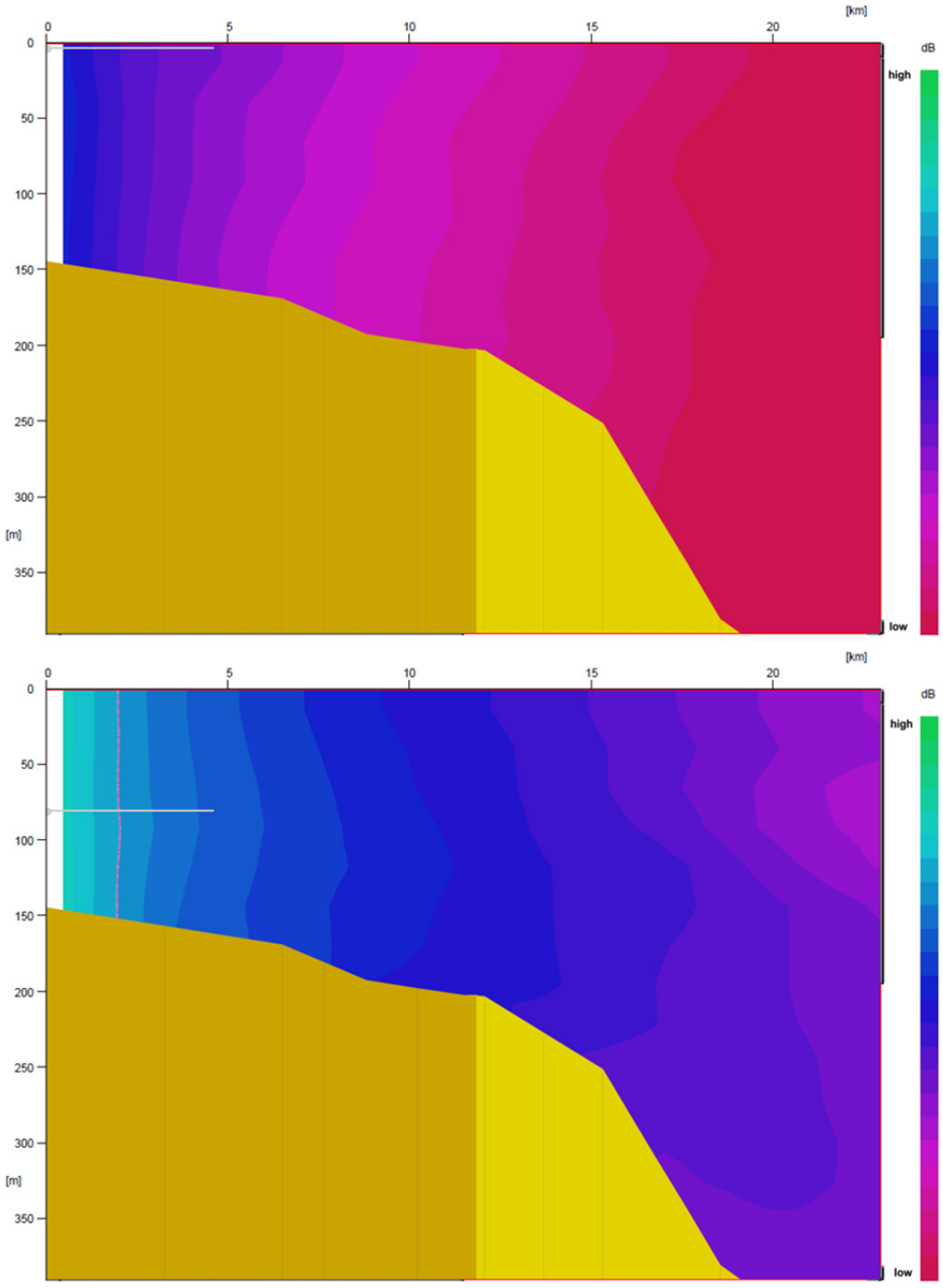


Figure B.3. Sonar DSQ21 vertical profile of SPL from East to West (270°), at sensor depth 3m (upper fig.) and LFTAS vertical profile of SPL from East to West (270°), at sensor depth 80 m (lower fig.). The SPL at a distance of 500 m from the source is 146 dB re 1µPa for HMS and < 168 dB re 1µPa for LFTAS. The dotted vertical line at 2000 m distance shows the 160 dB value (lower fig.).

C Approach of risk assessment for The Netherlands

C.1

C.1.1 Scenario (define scenario)

Scenario date, time and area: 10 October, 1200-1600Z; 5900N 00700W 5940N 00540W

The risk mitigation system of the Royal Netherlands Navy (RNLN) requires a number of additional data to be defined, including data on the operational parameters and environmental data. The following additional parameters were chosen by NL:

- one ship, for two different sonar systems:
    - Generic Hull mounted sonar/6-7 kHz FM sweep, duty cycle 1s every 20s, as in 3S, Source Level (SL) of 220dB re 1 μPa m
    - Socrates II-LF/1-2 kHz FM sweep, duty cycle 1s every 20s, as in 3S, SL = 214dB re 1 μPa m, towed at depth 70m (roughly halfway water column)

The operational risk mitigation tool (SAKAMATA) includes a database with system parameters and settings of RNLN operational sonar systems. This is a nationally classified database. For the purpose of this comparison study (that needs to be unclassified) it was not practical, but also considered unnecessary, to make a scenario analysis using the classified database. The tool also includes the possibility for the end-user to define sonar parameters (enabling assessments of other systems than the pre-defined systems) and for this comparison study, above-mentioned parameters were chosen, that can be seen as representative for operational sonar systems but without compromising classified data.

Environment choices: wind speed of 15 knots, sea floor is modelled as sediment consisting of coarse sand. Temperature/salinity data from WOA climatology. Starting position is 5930N 00600W with course of 225 and speed of10 knots.

C.1.2 Assumptions

Additional information/assumptions were needed as input in the risk assessment process, e.g. type of sonar, environmental parameters, operational parameters, legal issues.

Would run the risk assessment tool of the operational navy (SAKAMATA). Some general model assumptions (see report for full details, Von Benda-Beckmann et al., 2012) for SAKAMATA are:

- Single ship
- Straight course
- Flat sea floor

C.1.3 Pre-planning phase (keep the description short and conceptual)

General principles, according to RNLN instruction (VCZSK DOPS MWC 230 Responsible use of active sonar)

Aim of the NL mitigation instruction

- Prevent/minimize effects on marine mammals
- Prevent unnecessary restrictions of essential systems

These rules apply to:

- Units carrying active ASW sonars/use and preparation
- Staff using/preparing ASW operations
- Foreign units under NL OPCON

These rules should be applied world wide, unless suitable local regulation available

Original background/aim of NL mitigation instruction

- Prevent hearing damage
- Prevent response leading to stranding of beaked whale

General approach:
Units planning use of active sonar should follow the risk assessment process using the RNLN SAKAMATA tool.
This uses standard RA steps: identification of risk, an explicit exposure assessment, effect assessment, risk characterization (in accordance with Boyd et al., 2008[1]).
The SAKAMATA tool will provide an advice for mitigation. In this advice the operator will see whether certain thresholds are exceeded using a 'traffic light'. These thresholds are based on possible occurrence of hearing damage in marine mammals (see original aim of the NL Navy regulation):

- If it is assessed that occurrence of PTS is likely, the tool will advice that conditions are unfavourable
- If it is assessed that occurrence of TTS in a certain number of marine mammals is likely, the tool will advice that conditions are marginal
- Otherwise the tool will advice that conditions are favourable

The tool describes possible mitigation measures in the last step of the risk assessment; units should check whether it is possible to change exercise parameters in the case of an unfavourable assessment.

C.1.4 Planning (describe process and/or tools)

Planning actions according to RNLN instruction (VCZSK DOPS MWC 230):

- Calculate number of exposed animals using SAKAMATA tool using sonar parameters and animal distribution from databases
- Traffic light to display any PTS (red), TTS yellow/green
- Calculations can be repeated for several modifications of the scenario, changing:
  - Area/location
  - Duration of transmission time
  - Season of operation
  - Source parameters (e.g. source level)
  - Sailing speed
  - Including/excluding ramp-up of sonar transmissions
- SAKAMATA output; **General mitigation advice:**
  - Determine if the operational area is a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route

[1] Boyd, I., Brownell, B., Cato, D., Clarke, C., Costa, D., Evans, P. G. H., Gedamke, J., Genrty, R., Gisiner, B., Gordon, J., Jepson, P., Miller, P., Rendell, L., Tasker, M., Tyack, P., Vos, E., Whitehead, H., Wartzok, D. & Zimmer, W. 2008. The effects of anthropogenic sound on marine mammals – a draft research strategy. European Science Foundation -Marine Board.

- Avoid the area if it is a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route.
- Use a buffer zone around a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route.
- Determine if there are specific restrictions or requirements for the chosen operational area.
- In the habitat range of Cuvier's beaked whales, analyze the bathymetric conditions of the area.
- Take note of steep features such as canyons, sea mounts, or shelf breaks which often tend to be feeding locations for some marine mammal species.
- Use sonar at the lowest practicable source level to achieve training requirements.
- Determine the acoustic propagation loss of active sonars in order to provide a recommendation of the minimum monitoring range.
- Regularly update the acoustic propagation loss of active sonars in order to provide a recommendation of the minimum monitoring range.
- Observe and record from at least 30 minutes before operations.
- Maintain extra vigilance during poor visibility conditions.
- Minimize intensity of sound pressure level of operations upon detection of marine mammals within monitoring range.
- Suspend operations if any known injured or stranded marine mammal is identified.
- Maintain open egress for marine mammals to prevent embayment. Embayment may occur when marine mammals are driven into enclosed areas.
- Report to the NATO Commander, national authorities, and NURC, via the chain of command, any known or suspected injured or stranded marine mammal.
- Continue to observe and record until 30 minutes after operation.
- Report sightings/acoustic identification in the Sighting Report to NL Hydrographic Office/MEIC.
- Trained visual and acoustic monitors are on station, briefed, and equipped.
- When available, aircraft and helicopters are on station to aid visual monitoring.

C.1.5 Operation

(operational procedures/mitigation measures, specify which measures are general and which is scenario specific)

According to RNLN instruction (MWC 230):

- SAKAMATA can be re-run to check for any modifications to scenario
- Visual/acoustic observations
  - Using available equipment
  - ID and registration with PRIMA APP (Android tablet)

C.1.6 Post-operation (what is reported to whom)

- Activities involving actual sonar use (transmissions) to be reported in ship log;

- Results of SAKAMATA risk assessment (including full scenario description, see Appendix C.2) to be archieved on board;
- Some operation-specific parameters (area/positions, date/time, type of sonar, some of the transmission data) will be reported to CINCRNLN to be included in (inter)national register of loud sound generating activities (ICES; monitoring of loud, impulsive noise for Marine Strategy Framework Directive MSFD).
- Sighting data: standard marine mammal observation report (PRIMA APP)
- Standard incident/accident report if indication that sonar transmissions of RNLN units under NL command caused incidents with marine mammals.

C.1.7 Additional information (model output etc. in separate appendices)

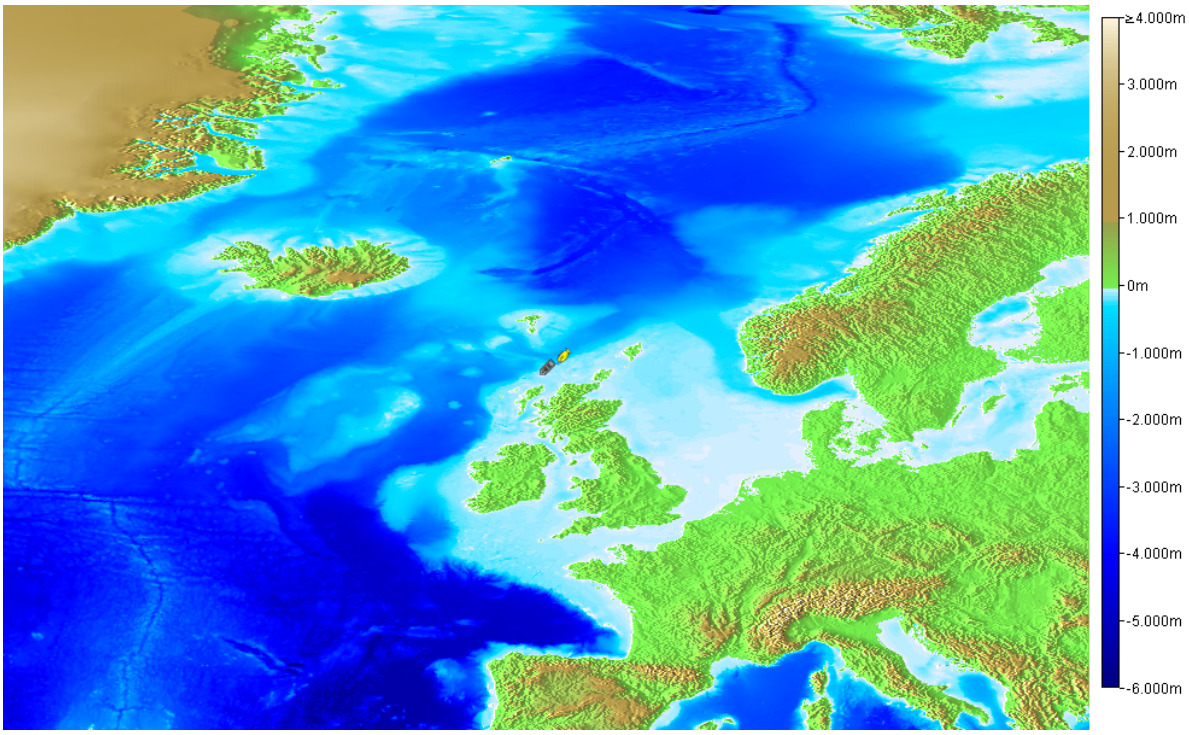
Full scenario description of SAKAMATA and output in Appendices C.2 and C.3.

C.2 SAKAMATA scenario report towed LFAS system

Risk Assessment

Author: René
Creation date: 20 oktober 2015
Classification: UNCLASSIFIED

1. Parameters



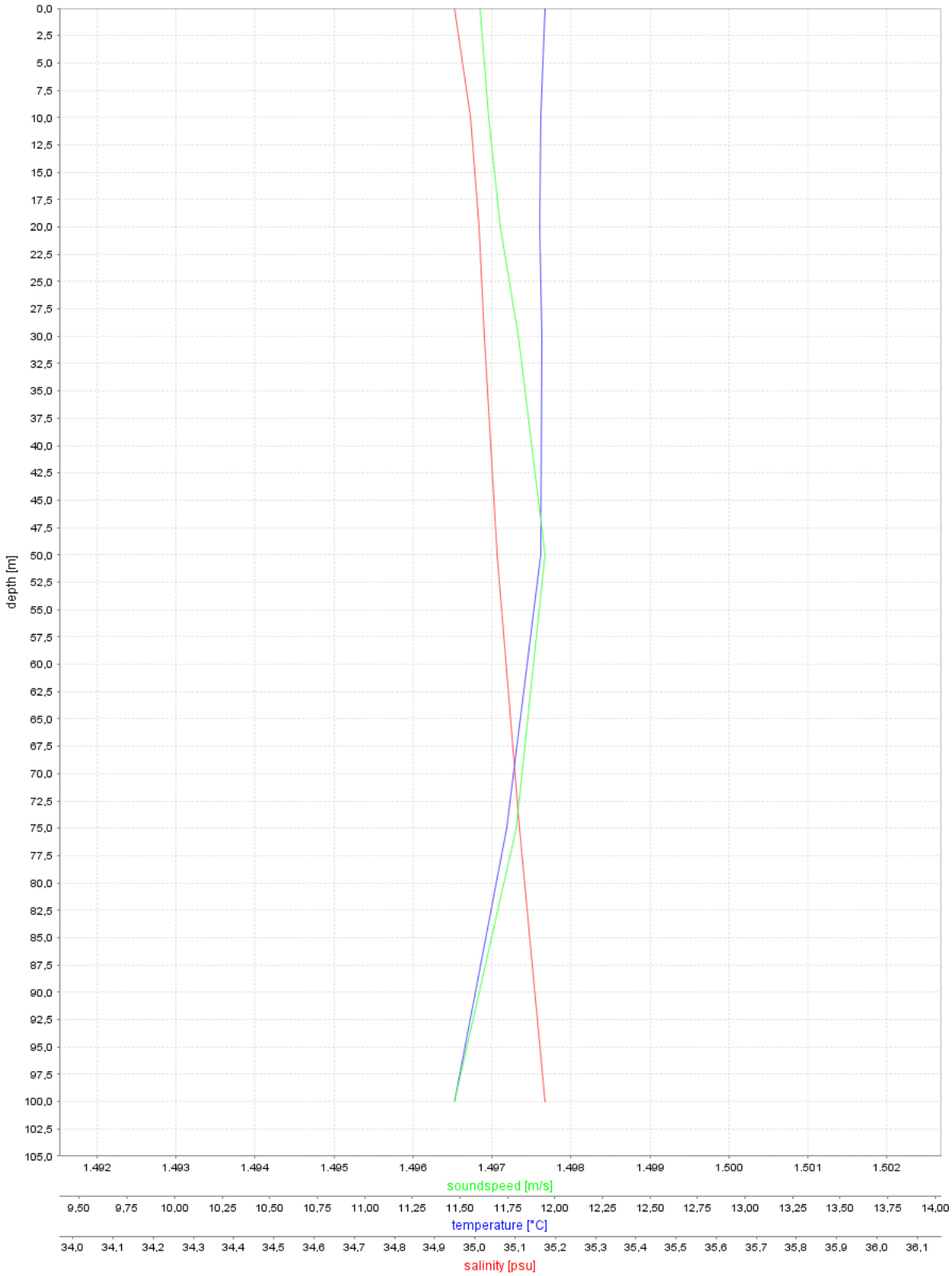
Location	
Latitude	59º30'00"N
Longitude	006º00'00"W
Date	10-10-2015
Duration [hh:mm]	04:00
Operation stage	During operation

Environment	
Water depth	137 m
Wind speed	15 kts
Bottom type	Coarse sand
Rain intensity	0 mm/hr
Shipping intensity	Low

2. Sonar overview

Sonar	
Name	Socrates II - LF
Type	Towed free flooded ring
Configuration	Configuration
Pulsetype	FM
Source level	214.0 dB re µPa²
Operation depth	70.0 m
Pulse repetition	20 s
Pulse length	1.0 s
Bandwidth	1000.0 Hz
Center frequency	1500.0 Hz

3. Profiles


depth [m]
0,0
2,5
5,0
7,5
10,0
12,5
15,0
17,5
20,0
22,5
25,0
27,5
30,0
32,5
35,0
37,5
40,0
42,5
45,0
47,5
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57,5
60,0
62,5
65,0
67,5
70,0
72,5
75,0
77,5
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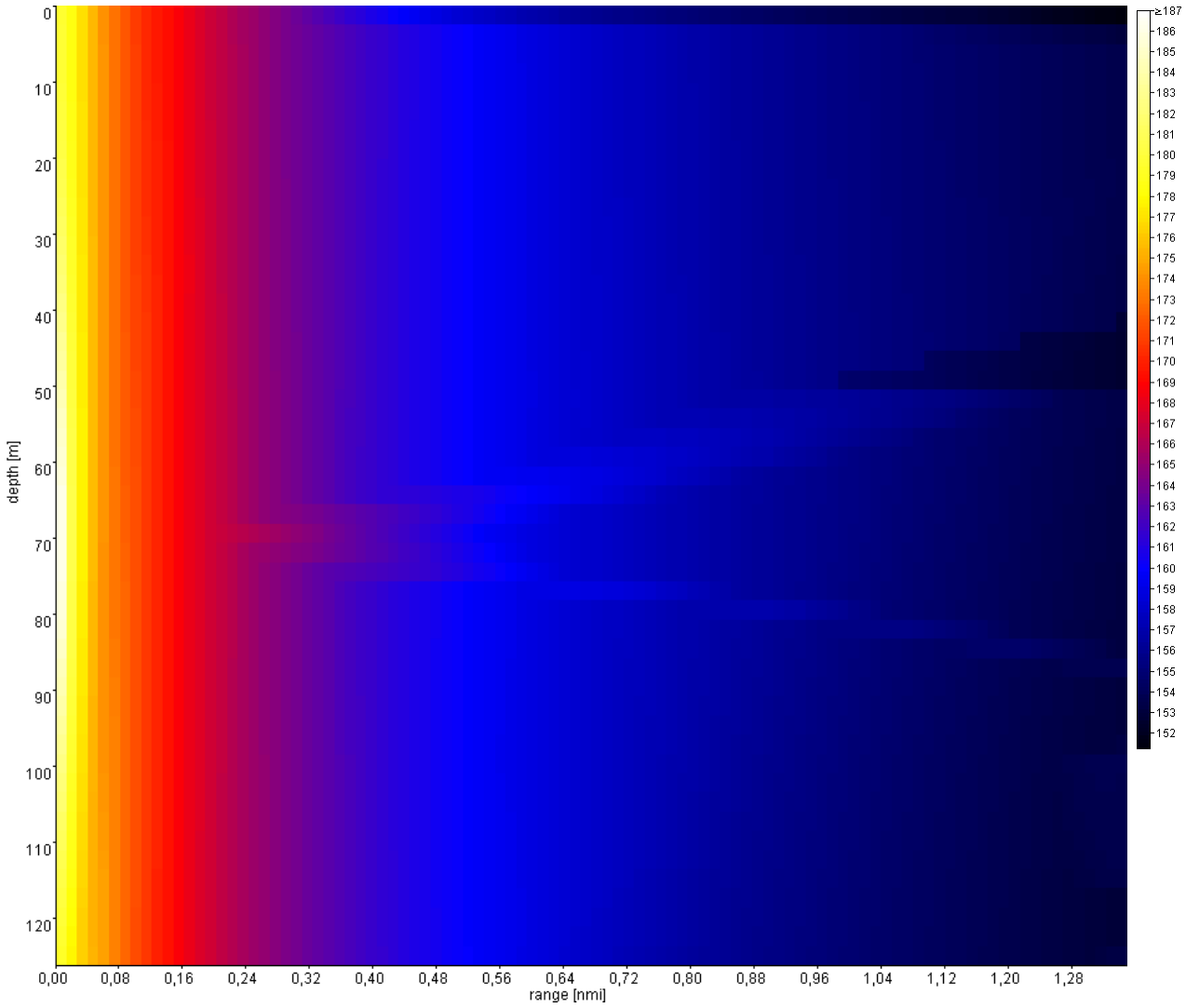
82,5
85,0
87,5
90,0
92,5
95,0
97,5
100,0
102,5
105,0
1.492
1.493
1.494
1.495
1.496
1.497
1.498
1.499
1.500
1.501
1.502
soundspeed [m/s]
9,50
9,75
10,00
10,25
10,50
10,75
11,00
11,25
11,50
11,75
12,00
12,25
12,50
12,75
13,00
13,25
13,50
13,75
14,00
temperature [°C]
34,0
34,1
34,2
34,3
34,4
34,5
34,6
34,7
34,8
34,9
35,0
35,1
35,2
35,3
35,4
35,5
35,6
35,7
35,8
35,9
36,0
36,1
salinity [psu]

4. Mammals

Assessment based on mammal database version 2.4.0

Group	English Name	PTS SEL threshold [dB re 1µPa² s]	TTS SEL threshold [dB re 1µPa² s]	Disturbance threshold [dB re 1µPa²]	Density [#/km²]
1a	Blue whale	215,0	195,0	165,4	0,0000
1a	Humpback whale	215,0	195,0	165,4	0,0001
1b	Fin whale	215,0	195,0	165,4	0,0044
1b	Minke whale	215,0	195,0	165,4	0,0653
1b	Sei whale	215,0	195,0	165,4	0,0027
2a	Killer Whale	215,1	195,1	145,6	0,0069
2a	Northern Bottlenose whale	215,1	195,1	165,3	0,0143
2a	Sperm whale	215,1	195,1	165,3	0,0035
2b	Long-finned Pilot Whale	215,1	195,1	165,3	0,1647
2b	Bottlenose dolphin	215,1	195,1	165,3	0,0189
2b	Short Beaked Common dolphin	215,1	195,1	165,3	0,0731
2b	Dwarf Sperm Whale	215,1	195,1	165,3	0,0000
2b	False Killer Whale	215,1	195,1	165,3	0,0000
2b	Pygmy Sperm whale	215,1	195,1	165,3	0,0000
2b	Risso's dolphin	215,1	195,1	165,3	0,1339
2b	Striped dolphin	215,1	195,1	165,3	0,0129
2b	White-beaked dolphin	215,1	195,1	165,3	0,0947
2b	Atlantic White-sided dolphin	215,1	195,1	165,3	0,3742
2b	Short-finned Pilot Whale	215,1	195,1	165,3	0,0102
2c	Cuvier's Beaked whale	215,1	195,1	120,0	0,0012
2c	Sowerby's beaked whale	215,1	195,1	120,0	0,0027
2c	True's beaked whale	215,1	195,1	120,0	0,0002
2c	Blainville's Beaked Whale	215,1	195,1	120,0	0,0002
2d	Harbour porpoise	192,1	172,1	120,0	0,8212
4a	Gray Seal	203,0	183,0	165,4	0,1233
4a	Harbour Seal	203,0	183,0	165,4	0,1119
4a	Hooded Seal	203,0	183,0	165,4	0,0185

5. Received level



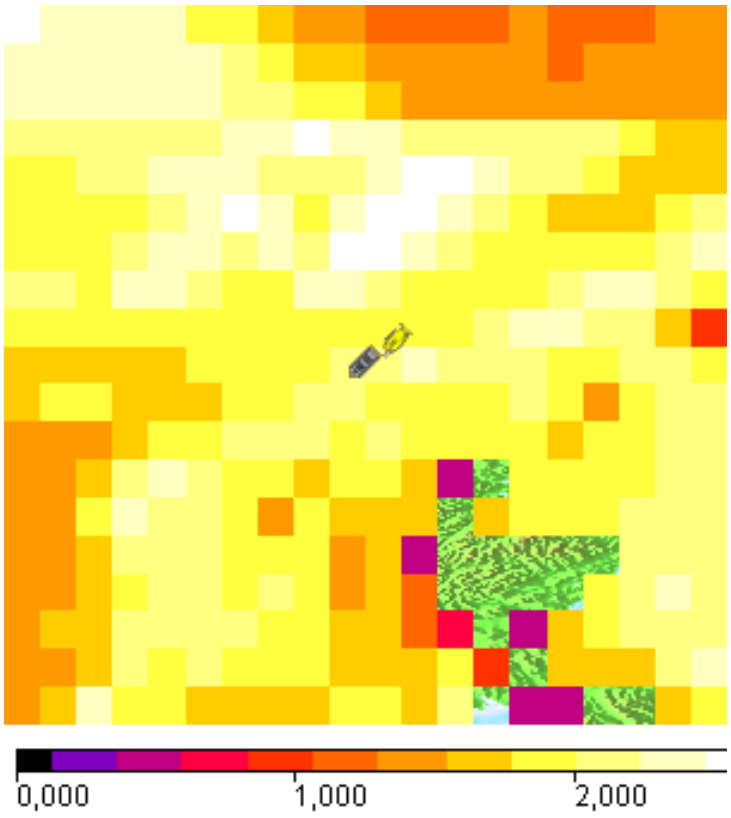
6. Risk Assessment

Operation stage: During operation

6.1. Mitigation scenarios

Mitigation scenario	PTS	TTS	Possible Disturbance
No Rampup	0,00	79,84	7099,93
30% speed decrease	0,00	55,54	5843,52
30% speed increase	0,00	73,00	8356,33
-3 dB source level	0,00	18,59	5592,55
PRT increase	0,00	31,22	7099,93
Shorter pulse	0,00	18,57	7099,93

6.2. Cumulative density [#/km²]



6.3. Standoff ranges for divers and mammals

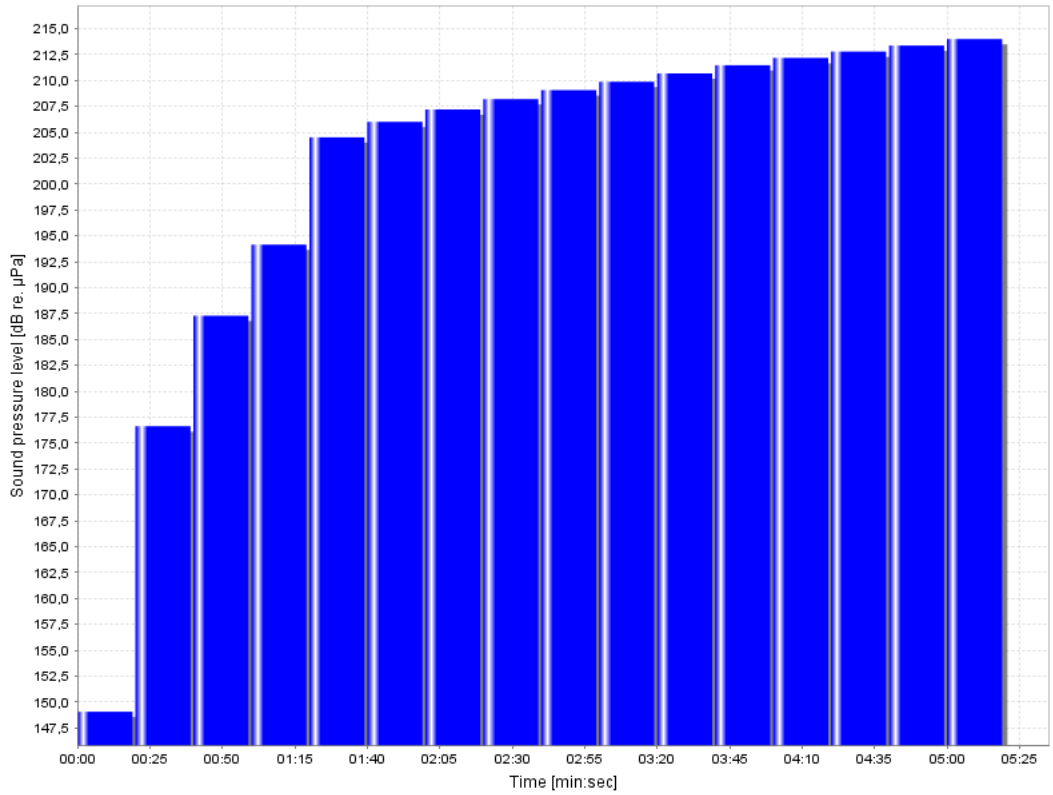
Type	Standoff range [nmi]
Unhooded diver	1,30 nmi
Hooded diver	0,59 nmi
Offshore Toothed Whales	0,00 nmi
Large Toothed whales	0,00 nmi
Large Baleen Whales	0,00 nmi
Beaked whales	0,00 nmi
Small Baleen Whales	0,00 nmi
Inshore and Small Toothed Whales	0,34 nmi
Hair Seals	0,02 nmi

6.4. General mitigation advice

- Determine if the operational area is a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route
- Avoid the area if it is a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route.
- Use a buffer zone around a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route.
- Determine if there are specific restrictions or requirements for the chosen operational area.
- In the habitat range of Cuvier’s beaked whales, analyze the bathmetric conditions of the area. Take note of steep features such as canyons, sea mounts, or shelf breaks which often tend to be feeding locations for some marine mammal species.
- Use sonar at the lowest practicable source level to achieve training requirements.
- Determine the acoustic propogation loss of active sonars in order to provide a recommendation of the minimum monitoring range.
- Regulary update the acoustic propagation loss of active sonars in order to provide a recommendation of the minimum monitoring range.
- Observe and record from at least 30 minutes before operations.
- Maintain extra vigilance during poor visibility conditions.
- Minimize intensity of sound pressure level of operations upon detection of marine mammals within monitoring range.
- Suspend operations if any known injured or stranded marine mammal is identified.
- Maintain open egress for marine mammals to prevent embayment. Embayment may occur when marine mammals are driven into enclosed areas.
- Report to the NATO Commander, national authorities, and NURC, via the chain of command, any known or suspected injured or stranded marine mammal.
- Continue to observe and record until 30 minutes after operation.
- Report sightings/acoustic identification in the Sighting Report to NL Hydrographic Office/MEIC.
- Trained visual and acoustic monitors are on station, briefed, and equipped.
- When available, aircraft and helicopters are on station to aid visual monitoring.

6.5. Rampup advice

Rampup advice chart



Rampup advice table

Nr.	Time [s]	SPL [dB]
0	0,00	149,07
1	20,00	176,62
2	40,00	187,30
3	60,00	194,16
4	80,00	204,51
5	100,00	206,01
6	120,00	207,20
7	140,00	208,20
8	160,00	209,06
9	180,00	209,87
10	200,00	210,68
11	220,00	211,47
12	240,00	212,17
13	260,00	212,79
14	280,00	213,37
15	300,00	214,00

6.6. Assessment

PTS: 0,00 TTS: 78,34 Possible Disturbance: 7099,93

Affected mammals: 7178

Monitoring range: 0,00nmi (based on group 2b : Offshore Toothed Whales)

6.7. Mitigation measures

Mitigation measure	Planned value	Used value
Date		
Location		
Rampup		
Speed		
Source level		
PRT		
Pulse duration		
Operation duration		

6.8. Approval

Date Name Signature

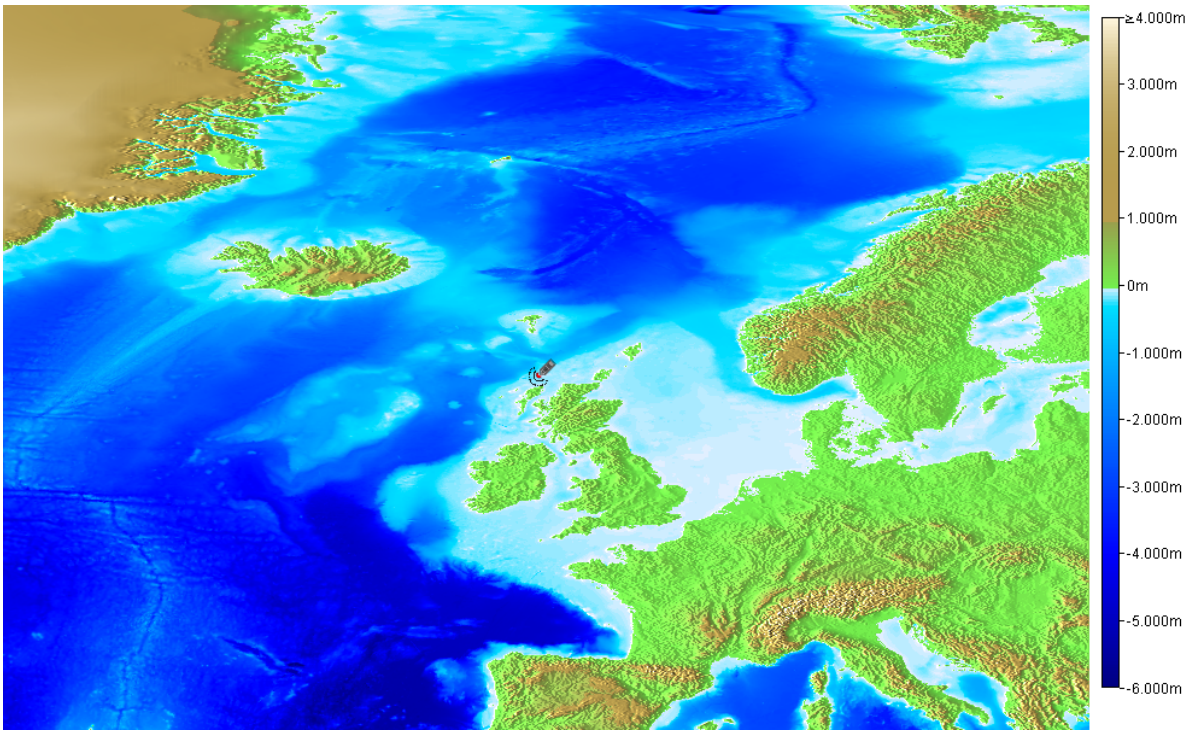
_____ _____ _____

C.3 SAKAMATA scenario report Hull Mounted Sonar

Risk Assessment

Author: René
Creation date: 20 oktober 2015
Classification: UNCLASSIFIED

1. Parameters



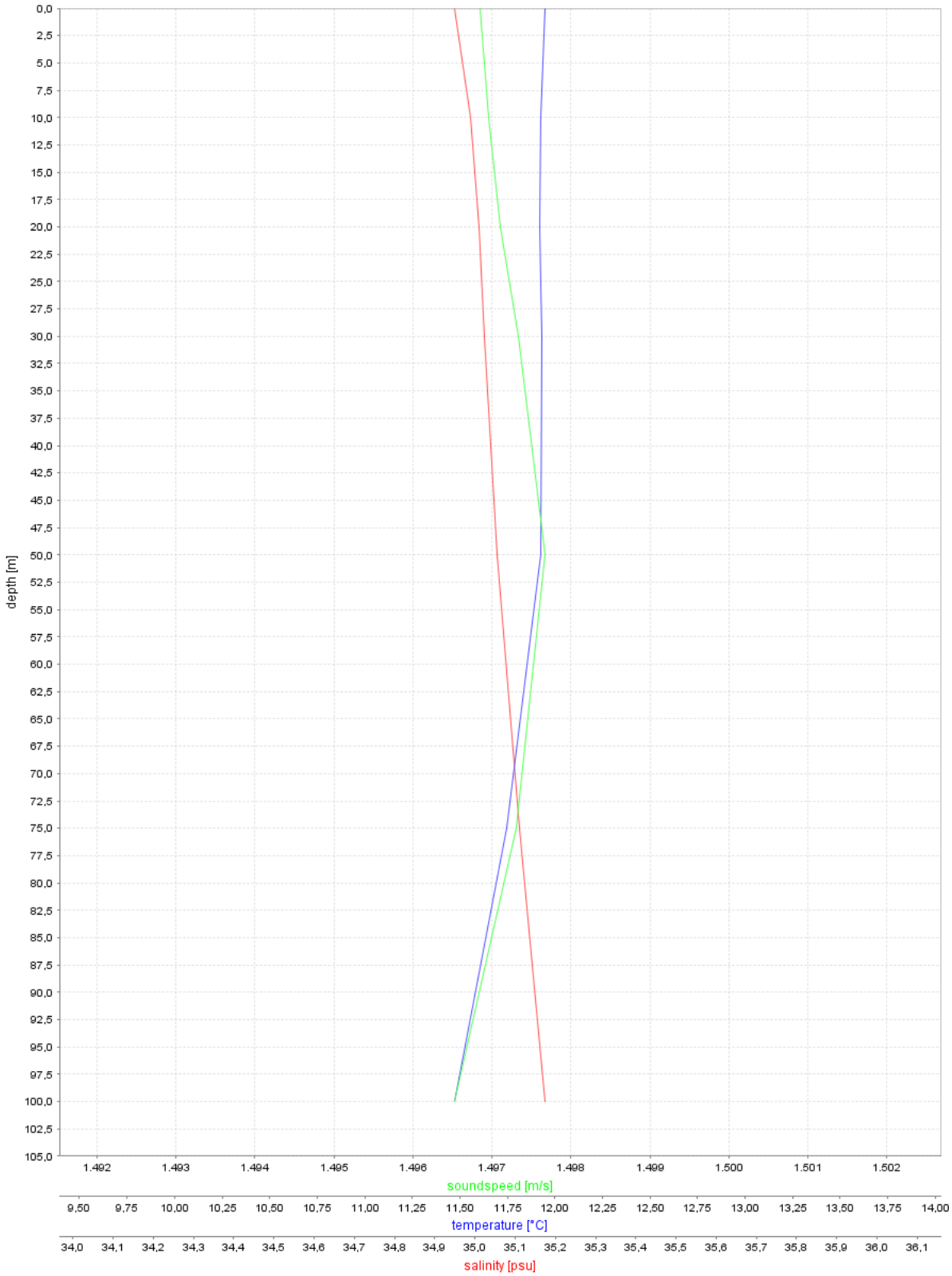
Location	
Latitude	59º30'00"N
Longitude	006º00'00"W
Date	10-10-2015
Duration [hh:mm]	04:00
Operation stage	During operation

Environment	
Water depth	137 m
Wind speed	15 kts
Bottom type	Coarse sand
Rain intensity	0 mm/hr
Shipping intensity	Low

2. Sonar overview

Sonar	
Name	Generic HMS
Type	HMS-ASW
Configuration	Configuration
Pulsetype	FM
Source level	220.0 dB re µPa²
Operation depth	5.0 m
Pulse repetition	20 s
Pulse length	1.0 s
Bandwidth	1000.0 Hz
Center frequency	6500.0 Hz

3. Profiles

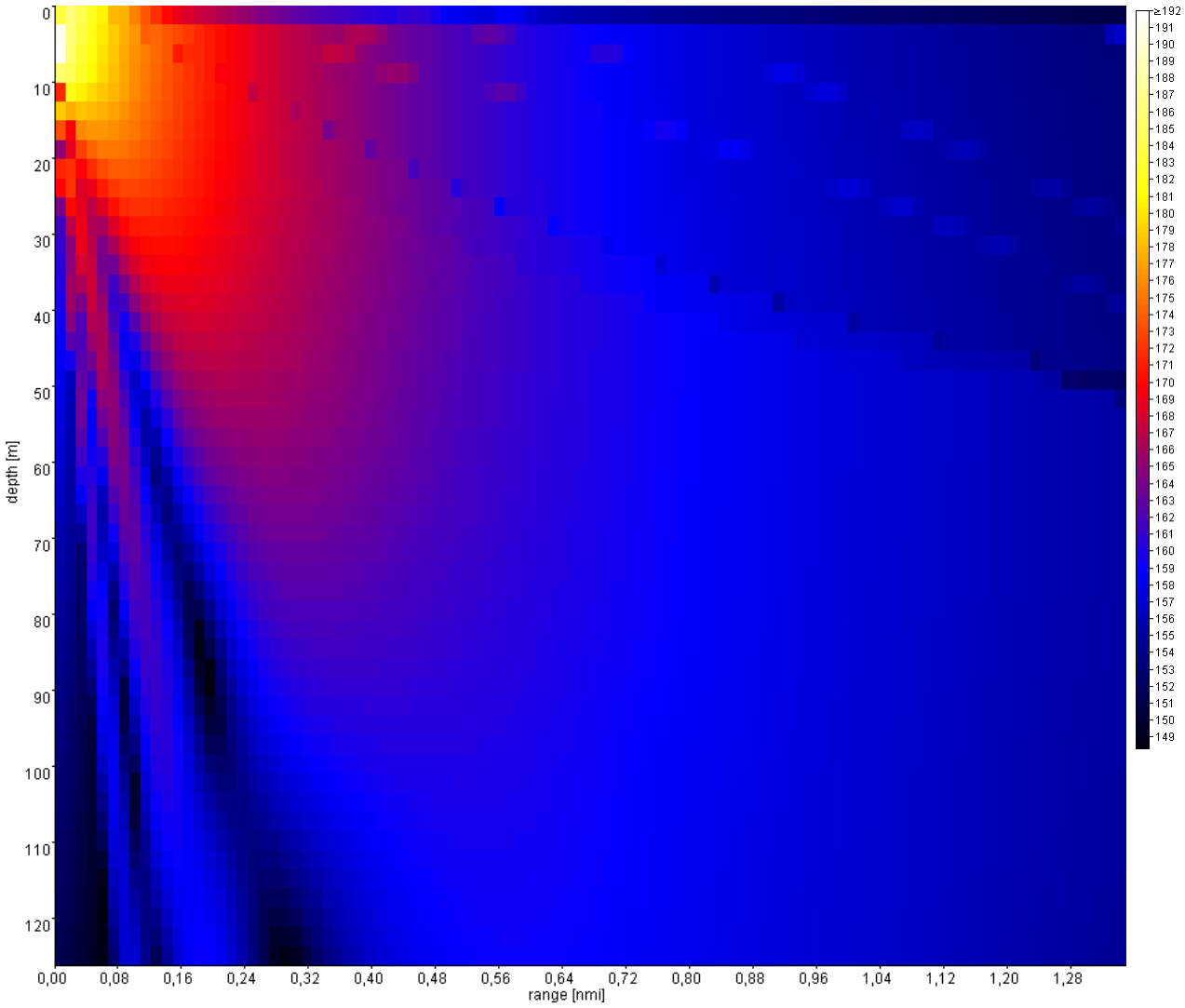

depth [m]
0,0
2,5
5,0
7,5
10,0
12,5
15,0
17,5
20,0
22,5
25,0
27,5
30,0
32,5
35,0
37,5
40,0
42,5
45,0
47,5
50,0
52,5
55,0
57,5
60,0
62,5
65,0
67,5
70,0
72,5
75,0
77,5
80,0
82,5
85,0
87,5
90,0
92,5
95,0
97,5
100,0
102,5
105,0
1.492
1.493
1.494
1.495
1.496
1.497
1.498
1.499
1.500
1.501
1.502
soundspeed [m/s]
9,50
9,75
10,00
10,25
10,50
10,75
11,00
11,25
11,50
11,75
12,00
12,25
12,50
12,75
13,00
13,25
13,50
13,75
14,00
temperature [°C]
34,0
34,1
34,2
34,3
34,4
34,5
34,6
34,7
34,8
34,9
35,0
35,1
35,2
35,3
35,4
35,5
35,6
35,7
35,8
35,9
36,0
36,1
salinity [psu]

4. Mammals

Assessment based on mammal database version 2.4.0

Group	English Name	PTS SEL threshold [dB re 1µPa² s]	TTS SEL threshold [dB re 1µPa² s]	Disturbance threshold [dB re 1µPa²]	Density [#/km²]
1a	Blue whale	215,7	195,7	165,4	0,0000
1a	Humpback whale	215,7	195,7	165,4	0,0001
1b	Fin whale	215,7	195,7	165,4	0,0044
1b	Minke whale	215,7	195,7	165,4	0,0653
1b	Sei whale	215,7	195,7	165,4	0,0027
2a	Killer Whale	215,0	195,0	145,6	0,0069
2a	Northern Bottlenose whale	215,0	195,0	165,3	0,0143
2a	Sperm whale	215,0	195,0	165,3	0,0035
2b	Long-finned Pilot Whale	215,0	195,0	165,3	0,1647
2b	Bottlenose dolphin	215,0	195,0	165,3	0,0189
2b	Short Beaked Common dolphin	215,0	195,0	165,3	0,0731
2b	Dwarf Sperm Whale	215,0	195,0	165,3	0,0000
2b	False Killer Whale	215,0	195,0	165,3	0,0000
2b	Pygmy Sperm whale	215,0	195,0	165,3	0,0000
2b	Risso's dolphin	215,0	195,0	165,3	0,1339
2b	Striped dolphin	215,0	195,0	165,3	0,0129
2b	White-beaked dolphin	215,0	195,0	165,3	0,0947
2b	Atlantic White-sided dolphin	215,0	195,0	165,3	0,3742
2b	Short-finned Pilot Whale	215,0	195,0	165,3	0,0102
2c	Cuvier's Beaked whale	215,0	195,0	120,0	0,0012
2c	Sowerby's beaked whale	215,0	195,0	120,0	0,0027
2c	True's beaked whale	215,0	195,0	120,0	0,0002
2c	Blainville's Beaked Whale	215,0	195,0	120,0	0,0002
2d	Harbour porpoise	192,0	172,0	120,0	0,8212
4a	Gray Seal	203,0	183,0	165,4	0,1233
4a	Harbour Seal	203,0	183,0	165,4	0,1119
4a	Hooded Seal	203,0	183,0	165,4	0,0185

5. Received level



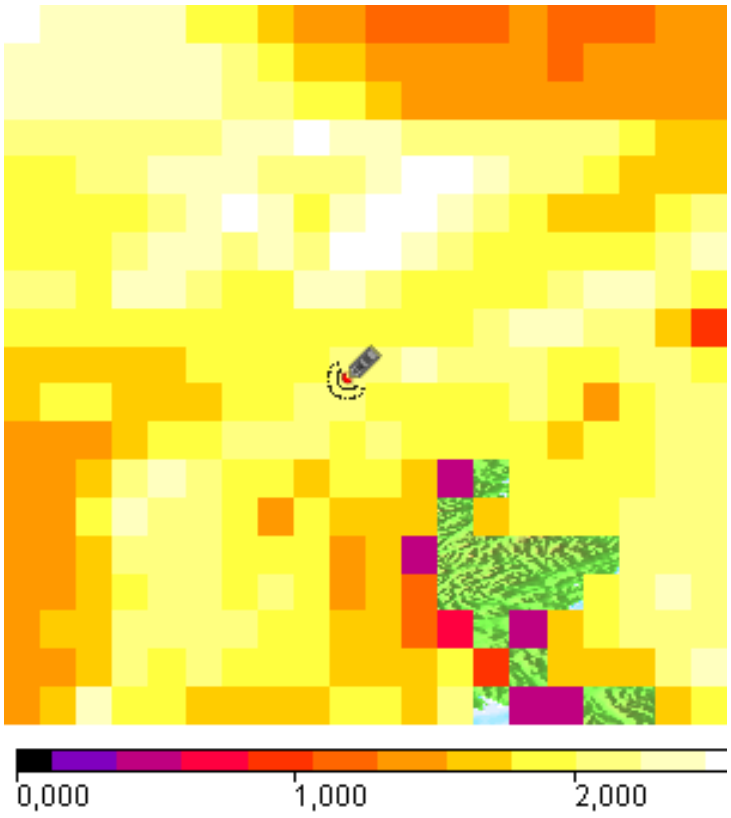
6. Risk Assessment

Operation stage: During operation

6.1. Mitigation scenarios

Mitigation scenario	PTS	TTS	Possible Disturbance
No Rampup	0,00	84,07	3387,60
30% speed decrease	0,09	121,11	2657,85
30% speed increase	0,00	77,55	4117,35
-3 dB source level	0,00	33,09	3011,79
PRT increase	0,00	46,35	3387,60
Shorter pulse	0,00	33,00	3387,60

6.2. Cumulative density [#/km²]



6.3. Standoff ranges for divers and mammals

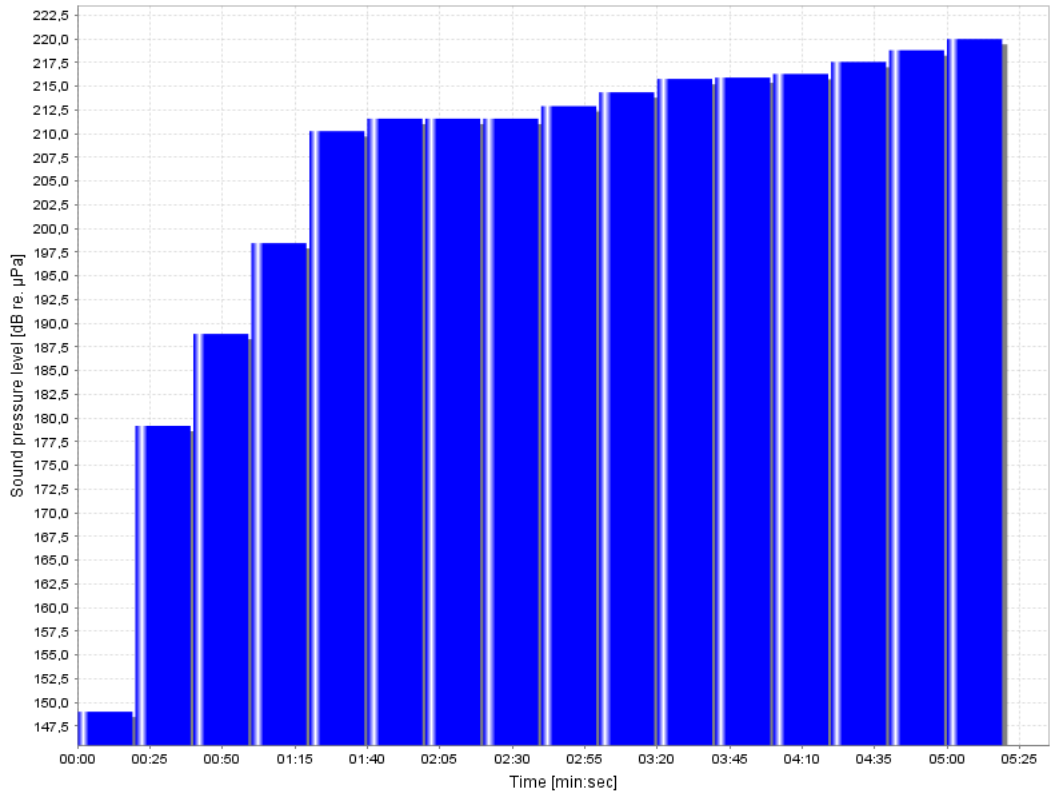
Type	Standoff range [nmi]
Unhooded diver	1,00 nmi
Hooded diver	0,47 nmi
Offshore Toothed Whales	0,00 nmi
Large Toothed whales	0,00 nmi
Large Baleen Whales	0,00 nmi
Beaked whales	0,00 nmi
Small Baleen Whales	0,00 nmi
Inshore and Small Toothed Whales	0,34 nmi
Hair Seals	0,07 nmi

6.4. General mitigation advice

- Determine if the operational area is a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route
- Avoid the area if it is a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route.
- Use a buffer zone around a known marine mammal habitat, breeding, calving, or feeding grounds or migratory route.
- Determine if there are specific restrictions or requirements for the chosen operational area.
- In the habitat range of Cuvier’s beaked whales, analyze the bathmetric conditions of the area. Take note of steep features such as canyons, sea mounts, or shelf breaks which often tend to be feeding locations for some marine mammal species.
- Use sonar at the lowest practicable source level to achieve training requirements.
- Determine the acoustic propogation loss of active sonars in order to provide a recommendation of the minimum monitoring range.
- Regulary update the acoustic propagation loss of active sonars in order to provide a recommendation of the minimum monitoring range.
- Observe and record from at least 30 minutes before operations.
- Maintain extra vigilance during poor visibility conditions.
- Minimize intensity of sound pressure level of operations upon detection of marine mammals within monitoring range.
- Suspend operations if any known injured or stranded marine mammal is identified.
- Maintain open egress for marine mammals to prevent embayment. Embayment may occur when marine mammals are driven into enclosed areas.
- Report to the NATO Commander, national authorities, and NURC, via the chain of command, any known or suspected injured or stranded marine mammal.
- Continue to observe and record until 30 minutes after operation.
- Report sightings/acoustic identification in the Sighting Report to NL Hydrographic Office/MEIC.
- Trained visual and acoustic monitors are on station, briefed, and equipped.
- When available, aircraft and helicopters are on station to aid visual monitoring.

6.5. Rampup advice

Rampup advice chart



Rampup advice table

Nr.	Time [s]	SPL [dB]
0	0,00	149,01
1	20,00	179,17
2	40,00	188,88
3	60,00	198,46
4	80,00	210,27
5	100,00	211,59
6	120,00	211,59
7	140,00	211,59
8	160,00	212,92
9	180,00	214,37
10	200,00	215,78
11	220,00	215,93
12	240,00	216,31
13	260,00	217,58
14	280,00	218,80
15	300,00	220,00

6.6. Assessment

PTS: 0,00 TTS: 81,14 Possible Disturbance: 3387,60

Affected mammals: 3469

Monitoring range: 0,00nmi (based on group 2b : Offshore Toothed Whales)

6.7. Mitigation measures

Mitigation measure	Planned value	Used value
Date		
Location		
Rampup		
Speed		
Source level		
PRT		
Pulse duration		
Operation duration		

6.8. Approval

Date Name Signature

_____ _____ _____

D Approach of risk assessment for United Kingdom

D.1

D.1.1 Scenario

The scenario as described in the ASRM task would be insufficiently detailed to complete a UK SRA.

D.1.2 Assumptions

For a complete assessment to be prepared the following additional information would be needed:

- The type of ship and the sonar equipment to be used.
- The signal parameters to be transmitted (Hz, dB, duty cycle, pulse characteristic, duration).

D.1.3 Preplanning phase

Responsibility for conducting the SRA is entirely the Commanding Officer's.
He is provided with the tools (inc software SRA tool) and trained staff to undertake this. There is no need for external approval or authority to conduct TAS transmission. The decision to transmit rests with the CO. This process is based on giving the operational Commander the maximum freedom of action in planning and undertaking the task.
Ideally pre-planning includes understanding constraints and flexibility (especially timing and geographic location) in conducting the task so that any limitations on the availability of mitigation choices can be set. If there is a lot of flexibility then undertaking a very early initial SRA may be practical in order to identify the optimal time and place to conduct the activity.

D.1.4 Planning (describe process and/or tools)

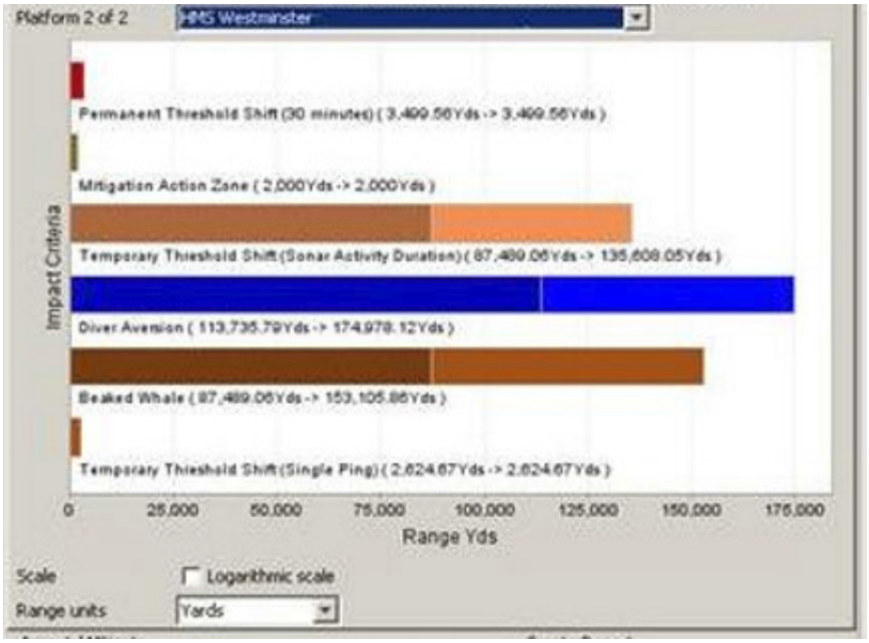
Planning will begin as soon as is practical to allow for changes should the SRA highlight unfavourable (high risk to marine mammals) conditions. All planning is conducted by ships staff using BAE's Environmental Risk management Capability (ERMC) (known internally as S2117) software tool. For major multi-platform ASW activity the responsible planning authority will undertake a combined SRA.
This however is not conducted entirely within the ERMC tool but requires interpretation of the data to formulate a combined assessment if impact.
Individual Commanding Officers are still required to conduct their own SRA and sign this off prior to transmission within a multiple unit serial. In addition planners are required to avoid certain geological features (shallow bays, "whale traps" steep shelf breaks near to shore) and ways of operating near to the coast which might risk causing embayment, screening, herding or similar behavioural reactions of any MM encountered (but not necessarily detected?) whilst on task.

For the planned event, the operator will input the intended location, date and utilise predicted parameters held within S2117 for oceanographic information, weather and sound propagation loss. Marine mammal seasonal density and other biological information such as hearing thresholds for groups of animals is also held within the S2117. The operator will also then need to select the vessel, sonar type and active

transmission parameters of the intended activity to allow the software to undertake the assessment.

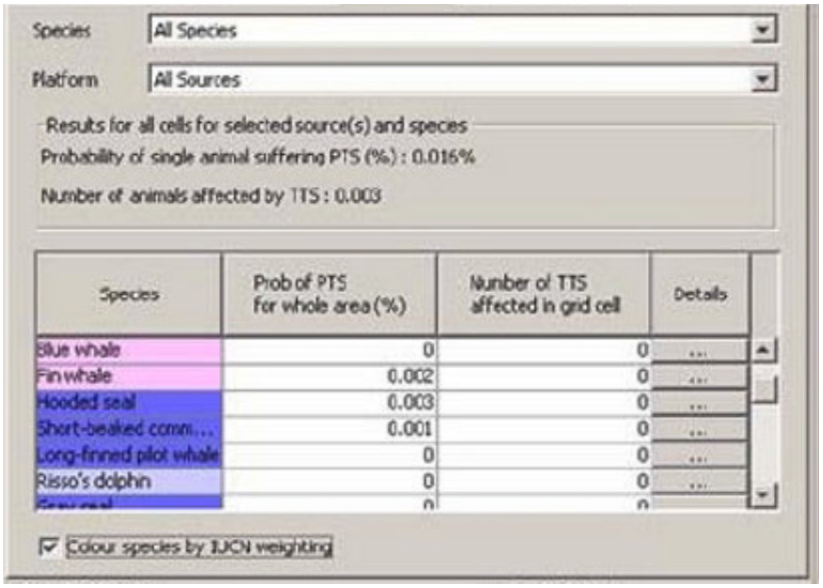
Charts within S2117 indicate marine protected areas and show a buffer zone around them. The 50m contour is also highlighted and depths below this generically accepted as an area with high levels of human diving activity.

The process provides a prediction of risk in the form of:
a. Standoff ranges when MM and always beaked whales might be affected by TTS and PTS for the intended serial duration but also TTS for a single *ping*. Human diver aversion distances are also shown. Assessments showing PTS and TTS ranges to be greater than 2000 yards (nominal Mitigation Action Zone (MAZ)) are considered High Risk; PTS range<MAZ<TTS Range considered Medium risk and PTS and TTS ranges < MAZ considered Low risk.



(Not scenario related)

b. A percentage and number of animals by species that might be affected by PTS or TTS. The percentages are categorised High (30-100%), medium (10-30%) or Low (<10%).



Any scenario above Low is required to be further mitigated and considered in conjunction with standoff ranges and effectiveness of visual and acoustic detection. High risks and high standoff ranges will only be accepted when there is overriding operational requirement to do so. For training serials it is usual for only low risk scenarios are accepted.

D.1.5 Operation

In the hours before the intended transmission the scenario will again be run through the software but with observed information such as weather and visibility. It is this "real time" SRA that is accepted by the Command and stored as proof of acceptance of the predicted risk for the planned serial.

30 minutes prior to start of active transmissions (60 minutes in water >200m depth) locally trained observers (MMO) are in place on the upper deck. They remain there throughout transmission and for 30 (60) minutes after cessation. MMO report observations through the bridge team to the warfare controller in the Operations Room on board. Concurrently passive monitoring will be undertaken but not all vessels have automated MM detection software and any detection or identification is conducted by the sonar operator. Transmission will only start after MMO and passive operators report no detections for 30 minutes.

All sonars capable of soft start (ramp-up) utilise this unless real combat scenario dictates otherwise.

If, during transmissions, animals are detected within the MAZ (nominally 2000 yards) power or signal will be reduced or stopped until animal is out of the MAZ.

D.1.6 Post-Operation (what is reported to whom)

After the TAS operation records of the planned activity are maintained within the SRA software but are not currently centrally reported.

However, from May 2015, RN has been reporting unclassified TAS transmissions within UK waters to the UK wide Statutory Nature Conservation Body, JNCC, in support of MSFD UK Underwater Noise Register. These reports are in the form of: *Date – O&G Licensing Block Reference – Active Sonar transmission or Active Sonar check*.

These records will be made publically available as part of EU wide Underwater Noise Registry.

Any marine fauna (and notably cetaceans) should be centrally reported by UK warships to the UKHO Defence Maritime Geospatial Intelligence Centre These reports should be compiled whether radiating on TAS or not.

E Approach of risk assessment for Denmark

E.1

E.1.1 Scenario

Group task:

"There is going to be a NATO ASW Exercise on the 10 October 2015 1200-1600Z. The exercise will take place: N 59 00, W 007 00; N 59 40, W 005 40. This area will be considered 'High Seas'. You are to provide active sonar risk mitigation procedures for your National Asset/ Sonar system. (1 ship, 1 sonar)"

Initiating assessment, the scenario is described through a predefined table. This would be done by the operative unit that is going to carry out the activity. The table would then be sent to DDEIO, who in this case would send it for a biological assessment outside the MoD. Below is the part of the table with information on the scenario sent for an assessment.

Parameter	**[Unit]/Type**	
Area(s)	[x] (x)	Area: Outside the coast of Scotland. N 59 00, W 007 00; N 59 40, W 005 40
Time of activity	[week/date]	10th of October 2015 (at 1200 -1600 Z).
SONAR		
Parameter	**[Unit]/Type**	
Number of sonar systems used	[no.]	1 (of own unit – others unknown)
Type(s)[2]	F.eks. ASO94, CTS36/39	Danish ASW sonar
Direction of transmission and sector	[º rel. true north]	Omni / 360deg
Source level (SL on 1 m)	[dB re 1 µPa rms/	XXX / YYY dB re 1 µPa rms

[2] Specified if possible. Alternativtly the operative frequency interval is stated.

	dB re 1 µPa peak/ dB re 1 µPa peak-peak]	
Duration of single ping	[msek]	50-600 msek
Repetition rate or duty cycle	[pulses pr. sekund] or [%]	Duty cycle <4% (Range 4-12km)
Duration of transmission	[minuts]	Max. 4 hours

Further to be noted
E.g. planned mitigation measures
No mitigation measures planned yet.

E.1.2 Assumptions

It is assumed that no repetition of the activity is made in the same area.
The biological assessment does not encompass other units' sonar activities in the area, so the assessment is made "as-if" no other sonar systems are being used under the exercise.
The assessment is made on the basis of implementation of the Habitat and Birds directives of the EU. Therefore effects from the sonar operation, on species and nature types protected under these directives are assessed. No assumptions relating to weather are made. A simplistic "rule of thumb" is used for sound propagation, with an attenuation of approximately 7 dB per doubling meter.

E.1.3 Preplanning

The assessment process has been agreed on pre-planning:

Operative units fills out distributed table (the one above), sends it to DDEIO and relevant command. DDEIO is responsible for making an assessment on what mitigation measures would be legally required, based on a biological assessment made by external advisor.
Formerly used mitigation measures have been catalogued and are incorporated in the operational plan during the assessment phase, through a dialogue between operative unit, DDEIO and external advisor. DDEIO delivers a statement on what requirements need to be fulfilled (if any) before operation con be considered legal and which measures can be implemented additionally for nature protection reasons.

E.1.4 Planning

Look above.
Any analysis tools considered necessary and which is available to external, biological advisor, is used to make the biological impact assessment. The advisor is required to use the newest available, scientific knowledge. So far only worst case, simple, spherical sound propagation calculation models coupled with sea mammal motion or rule of thumb propagation models have been applied.

E.1.5 Operation

The biological assessment made for the scenario, states that no mitigation measures are necessary for the activity to comply with legal requirements.
The mitigation measures DDEIO would recommend for the operative unit to reduce the risk of negative impact on vulnerable species, would be:

- Visual inspections for sea mammals are to be carried out before initiating ramp up. If any sea mammals are detected, ramp up is to be halted until no sea mammals can be visually observed.
- Ramp up is to be carried out before other use of the sonar
    - Ramp-up is to be carried out over 30 min.
    - Ramp-up is initiated by shorter pulses (e.g. 50 ms) at lowest possible level (e.g. 180 dB re. 1 µPa peak).
    - Visual inspection and ramp up procedure is to be repeated, if any break longer than 15 min between signals occur.
- Direct sonar away from near-by habitat areas, if this is compatible with the goal of the exercise.
- If compatible with the goal of exercise, do not sail towards coastal areas while using the sonar.
- Ensure the use of lowest amount of pings, shortest pings, highest frequency and lowest source level compatible with the goal of the exercise.
- Only use the sonar in the context of the specified NATO exercise. No testing of equipment or additional use before and after the exercise should happen. If this is considered a possible necessity, this particular use must be subject to a new environmental impact assessment.

E.1.6 Post-Operation (what is reported to whom)

The position of ship, the sonar use (time, position, SL, frequency, duration and if relevant directionality) is reported to DDEIO after exercise. If mitigation measures are not complied with or other observed incidences are made during the exercise, this is also reported to the DDEIO.

E.1.7 Additional information

See biological assessment in Appendix E.2.

To be noted while reading this: DDEIO use external advisors and therefore a new advisor may be chosen within a certain interval of time. This has just been the case with the assessment for the scenario at hand. In the shift between the old and new advisor, there are some clarifications on e.g. relevant factors, possibilities and thresholds that have not been settled when the assessment was carried out. This may have affected the particular assessment made.

E.2 Natura 2000 screening

Intended for
Forsvarsministeriets Ejendomsstyrelse

Document type
Memo

Date
October, 2015

ANTI-SUBMARINE WARFARE EXERCISE OFF SCOTLAND

NATURA 2000 SCREENING

RAMBØLL

Revision	**1**
Date	**06/10/2015**
Made by	**Marie Frandsen, Ditte Marie Mikkelsen**
Checked by	**Michael Olesen**
Approved by	**Ditte Marie Mikkelsen**
Description	**Natura 2000 screening**

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CONTENTS

1. INTRODUCTION

As part of a NATO exercise, the Danish Defence is planning an anti-submarine warfare (ASW) exercise off Scotland in October 2015.

This memo consists of a Natura 2000 screening, and an assessment of impacts to strictly protected species.

The Natura 2000 screening examines the likely effects of an anti-submarine warfare (ASW) exercise off Scotland, either alone or in combination with other projects or plans. The assessment involves a description of the project, identification of potential effects and an assessment of any significant effects on Natura 2000 sites.

The assessment of impacts to strictly protected species has focus on species listed in Annex IV to the Habitats Directive.

2. PROJECT DESCRIPTION

The ASW exercise involves the use of a single sonar off Scotland (see Table 2.1). The exercise is scheduled for the 10th of October 2015 at 12.00 – 16.00 (maximum 4 hours). A technical description of the sonar is presented in Table 2.1. The ASW exercise will be carried out at two positions (Area 1 and Area 2) off North Scotland, see Figure 2-1.

Table 2.1 Coordinates for area 1 and 2 and technical description of the sonar.

Parameter	Details
Impact areas	Area 1: N 59 00, W 007 00; Area 2: N 59 40, W 005 40
Sonar type	Unknown
Direction of transmission	Omni/360 degrees
Source level	210/220 dB re 1 µPa rms
Duration of pings	50-600 msec.
Duty cycle	< 4% (range 4-12 km)
Length of transmission	Maximum 4 hours

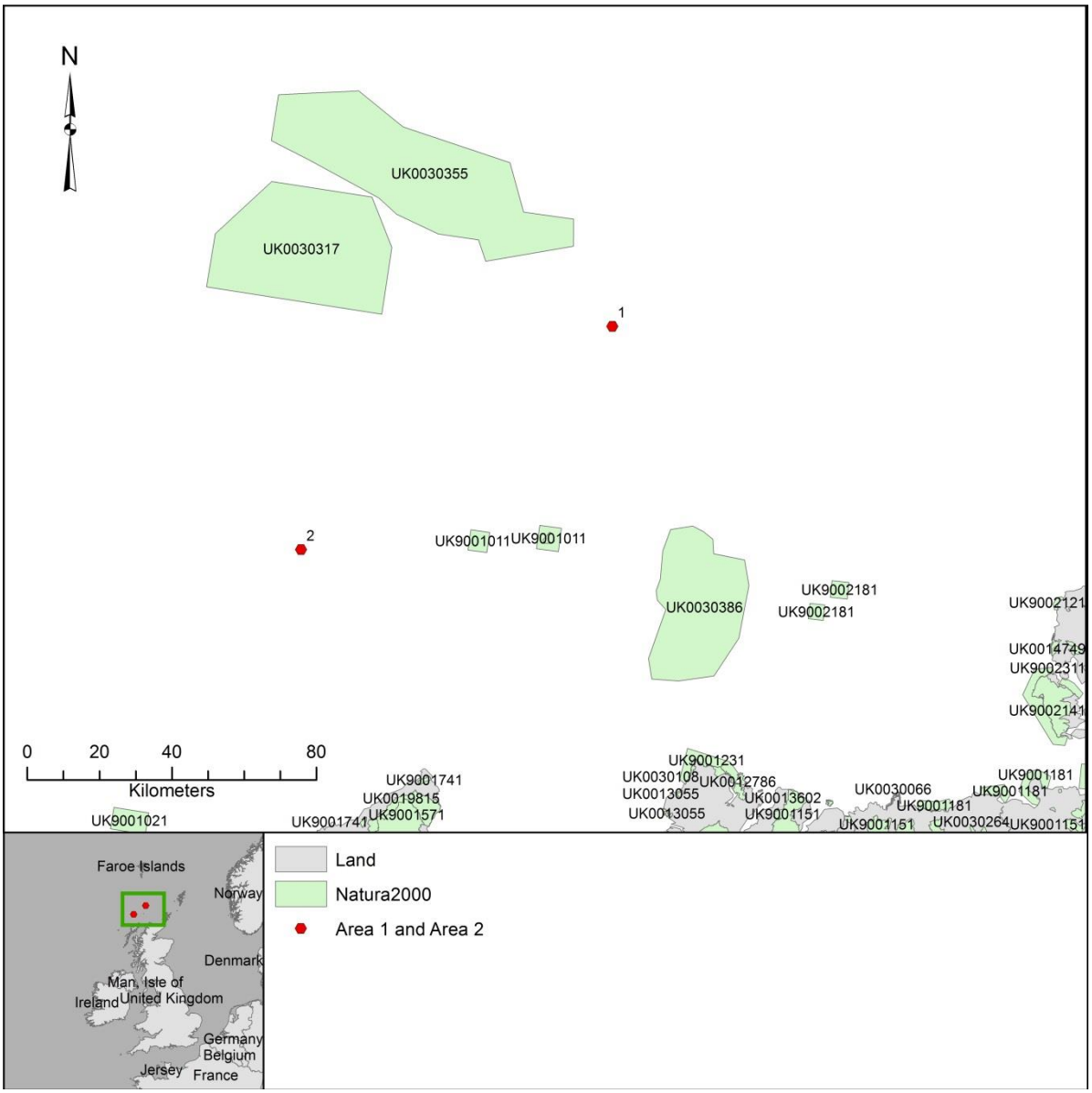

Figure 2-1 Location of ASW exercise area 1 and 2 and Natura 2000 sites.

3. NATURA 2000 SCREENING

Article 6 (3) of the Habitats Directive (Council directive 92/43/EEC of 21 May 1992) requires that "*Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*".

The designation of habitat areas is implemented in Danish low under the Order 408 dated 01/05/2007 [Bekendtgørelse nr. 408 af 1. maj 2007].

Activities carried out by the Danish defence are subject to Order 1458 dated 14/09/2010 [Bekendtgørelse nr. 1458 af 14 september 2010].

This Natura 2000 screening examines the likely effects of an Anti-submarine Warfare (ASW) exercise off Scotland, either alone or in combination with other projects or plans, upon a Natura 2000 site and considers whether it can be objectively concluded that these effects will not be significant.

3.1 Natura 2000 sites and designations

The closest Natura 2000 site is situated approximately 26 km from area 1. Approximate distances between the impact areas and surrounding Natura 2000 sites, as well as designated habitats and species, are presented in Table 3.1 (Special Areas of Conservation, SACs) and Table 3.2 (Special Protection Areas, SPAs).

Table 3.1 Special Areas of Conservation (SAC) including designated species and habitats as well as approximate distance to the impact areas.

SAC ID	SAC name	Approximate distance (km) to area 1	Approximate distance (km) to area 2	Habitats (Annex 1)	Species (Annex 2)
UK0030317	Darwin Mounds	65	70	1170: Reef	-
UK0030355	Wyville Thomson Ridge	26	95	1170: Reef	1349 *Tursiops truncates* -
UK0030386	Solan Bank Reef	60	>100	-	1364 *Halichoerus grypus* 1352 *Phoca vitulina* 1352 *Phocoena phochoena*[i]

Table 3.2 Special Protection Areas including designated bird species as well as approximate distance to the impact areas.

SPAs ID	SPA name	Approximate distance (km) to area #1	Approximate distance (km) to area #2	Bird species (Annex 1)
UK9001011	North Rona and Sula Sgeir	50-65	50-100	A200 *Alca torda* A204 *Fratercula arctica* A009 *Fulmarus glacialis* A014 *Hydrobates pelagicus* AS187 *Larus marinus* A016 *Morus bassanus* A015 *Oceanodroma leucorhoa* A188 *Rissa tridactyla* A199 *Uria aalge*

3.2 Habitats and species

This section describes designated habitats and species as well as criteria for favourable conservation status and threats for habitats and species in one or more Natura 2000 sites.

3.2.1 Habitat types

Favourable conservation status of habitat types requires that:

- Its natural range and areas it covers within that range are stable or increasing, and;
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and;
- The conservation status of its typical species is favourable

Reef is the only designated habitat in the Natura 2000 sites.

Reefs are defined as rocky areas or concretions made by marine animals arising from the surrounding seafloor. There are three main types of Annex I reef: Bedrock reef, stony reef and biogenic reef. Bedrock and stony reefs occur where the bedrock or stable boulders and cobbles arise from the surrounding seabed creating a habitat that is colonised by several different marine flora and fauna species. Rocky reefs can be very variable in terms of both their structure and the communities that they support. Biogenic reefs are created by the animals themselves, including coral reefs, made by cold-water corals. Biogenic reefs can also be made by reef-building worms and mussels.

The Darwin Mounds is an extensive area of sandy mounds formed by seabed fluid expulsion, each of which is capped with multiple thickets of cold-water coral. These thickets qualify as Annex I Reef. The number of thickets vary per mound and may be between one and several metres wide and high. The individual reefs on each mound provide a habitat for various species of larger invertebrates such as sponges and starfish. The mounds were officially discovered in 1998, and have a "good conservational status" /5/.

The reef at Wyville Thomson Ridge is composed of extensive areas of stony reef interspersed with gravel areas and bedrock reef along its flanks. It supports diverse biological communities representative of hard substratum in deep water including a range of sponges, corals, sea urchins, sea cucumbers and sea spiders. The stony reef is thought to have been formed by the ploughing movement of icebergs through the seabed at the end of the last ice age. Reefs at Wyville Thomson Ridge have a "good conservational status".

Several potential threats are recognised including fishery, sand and gravel extraction and pollution. A full list of pressures and threads can be found here /2/.

3.2.2 Marine mammals

For species, favourable conservation status is defined as when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and;
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and;
- There is, and will probably continue to be, a sufficiently large habitat to maintain its population on a long term basis.

Four marine mammals are designated for the Natura 2000 sites: Common bottlenose dolphin (*Tursiops truncates)*, harbour porpoise (*Phocoena phocoena*), grey seal (*Halichoerus grypus)* and harbour seal (*Phoca vitulina*).

Common bottlenose dolphins occur in estuaries, coastal and offshore waters, on and off the continental shelf. This species is known to be able to adapt to changing environmental conditions as individuals appear to have a high level of plasticity in their behaviour and diet. The habitats (e.g. feeding and breeding areas) vary temporally and spatially and are influenced by natural and anthropogenic factors. Some studies in UK coastal waters have found that bottlenose dolphin occurrence hotspots are usually characterised by uneven topography and/or strong tidal currents. Main threats to the species include bycatch in fishing nets, chemical pollution, noise pollution and military activities. Population of the species within Wyville Thomson Ridge are considered "non-significant". The UK population shows a stable trend /2/.

In UK **harbour porpoise** mainly occurs (but not exclusively) over water depths of 20-200 m. The species feed on a range of fish species and significant porpoise aggregations may reflect food availability. Elsewhere in the world, harbour porpoises tend to concentrate their movements in small focal regions, which often approximated to particular topographic and oceanographic features and associated with prey aggregations. Consequently, habitat use is highly correlated with prey density rather than any particular habitat type. Main threats to the species include bycatch in fishing nets, chemical pollution, noise pollution and military activities. Population of the species within Solan Bank Reef are considered "non-significant". The UK population shows a stable trend /2/.

The **grey seal** tend to be based at specific haul out sites but will occasionally move to a new haul-out and begin foraging in a new region. The species feeds on benthic organisms but major changes have been observed in diet in relation to changes in fish stock abundance. Grey seals come ashore on outlying islands and remote coastlines to pup in the autumn and to moult in the late winter and spring. Satellite tracking of individual seals has shown that they can feed up to several hundred miles offshore during foraging trips lasting several days. Main threats to the species include fishery, fauna removal and introduction of diseases. Population of the species within Solan Bank Reef are considered "non-significant". The UK population shows a decreasing trend /2/.

Harbour seal (common seal) requires suitable haul-out sites where they rest, moult, give birth and raise their pups. They haul-out at low tide on intertidal sandbanks, skerries or beaches. The species regularly use the same haul-out sites and prefers to use sheltered sites. Recent studies have indicated that the harbour seal forage much further offshore than previously thought. However, in Scotland, the seals tend to be site-faithful with relatively short foraging trips. Main threats to the species include fishery, fauna removal and introduction of diseases. Population of the species within Solan Bank Reef are considered "non-significant". The UK population shows a decreasing trend /2/.

3.2.3 Birds

A total of 9 seabird species are designated for the Natura 2000 sites. Knowledge on underwater hearing in diving seabirds is sparse. In general, seabirds are not considered sensitive noise due to their mobile nature and ability to relocate from impacted areas. In addition, birds are able to regenerate cells in the inner ear so potential impacts to their hearing are considered temporary. Studies have shown that no physical damages or behavioural response could be detected for seabirds foraging close to seismic activities /6//7/.

Given the small area, the short duration of the project and the general small effect from noise on diving seabirds, no adversely negative impact cause by noise exposure from the ASW exercise is expected on the designated bird species as well as the integrity of the SPAs of concern. The subject will not be treated further in this report.

3.3 Assessment of impacts

Impact cause by the ASW exercise with a potential effect on the Natura 2000 sites relates to noise exposure from the sonar. As described in section 2 the underwater noise exposure will take place within maximum 4 hours. Underwater sound can be recorded over great distances from the sources. However, the sound pressure levels are strongly attenuated as the distance from the source increases. Sound pressure levels that may cause physical damage is only observed close to the source, while impacts to behaviour may extend further. In general, underwater noise will attenuate with approximately 7 dB per doubling meter /4/.

Habitats

Habitats designated within the relevant Natura 2000 sites include reefs. Reefs at Darwin Mounds and Wyville Thomson Ridge both provide a habitat for various species of larger invertebrates such as sponges and starfish etc. The reef habitats are not considered particularly vulnerable to noise pollution. However vertebrates (e.g. fish species) can be sensitive to noise disturbance. The knowledge concerning noise disturbance on fish species are sparse. In addition, some fish species are able to regenerate cells in the inner ear causing potential physical damages to be temporal /8/.

Given the small area and the short duration of the ASW exercise and the distance between the exercise areas and the Natura 2000 sites, no negative impacts to habitat types are expected from the noise exposure from the ASW exercise.

Marine mammals

Designation of marine mammals includes 4 species: Common bottlenose dolphin (*Tursiops truncates)*, harbour porpoise (*Phocoena phocoena*), grey seal (*Halichoerus grypus)* and harbour seal (*Phoca vitulina*).

Marine mammals (especially cetaceans) are considered to be the most sensitive receptors in relation to acoustic disturbance in the marine environment, due to their use of echolocation and vocal communication using a broad bandwidth of sound (being responsive at frequencies from 100 Hz to 170 kHz and possessing sensitive hearing over the frequency range from 20 kHz to 150 kHz).

Concerning noise disturbance on marine mammals, four zones of noise influences are defined, depending on the distance between source and receiver.

- Zone of physical damage, the zone within which the noise cause hearing loss or other severe damage;
- Zone of masking, the area within which noise is strong enough to interfere with detection of other sounds, such as communication or echolocation clicks;
- Zone of responsiveness, the region in which the animal reacts; and
- Zone of detection, the area within which the animal is able to detect the sound.

Physical damage (hearing loss, injury or death) can be caused by relative high exposure levels, such as those typical close to underwater explosive operations or offshore impact piling (pile driving) operations. In some cases the exposure can lead to a Temporal Threshold Shift (TTS) from with the animal can recover during a period of restitution. In other cases the exposure may lead to a Permanent Threshold Shift (PTS) where the physical damage is irreversible and the animal cannot recover /3/.

Severe impacts include lethal or physical injury defined as TTS and PTS. Threshold criteria for relevant marine mammals (common bottlenose dolphin, grey seal, harbour seal and harbour porpoise) are presented in Table 3.3. The presented criteria are based on a literature review and have been used in a number of environmental impact assessments and appropriate assessments /3/.

Table 3.3 Threshold criteria for relevant marine mammals exposed to noise within a 24-h period /3/.

Recipient	M-weighting	Threshold criteria					
		Permanent threshold shift (PTS)		Temporal threshold shift (TTS)		Behavioural response	
		rms SPL	**SEL**	**rms SPL**	**SEL**	**rms SPL**	**SEL**
	Source level	dB re: 1µPa	dB re: $1\mu Pa^2$-s	dB re: 1µPa	dB re: 1µPa2-s	dB re: 1µPa	dB re: 1µPa2-s
Pinnipeds	M_{pw}	218	186	212	171	212	171
Cetaceans	M_{hf}	230	198	224	183	224	183

The closest Natura 2000 area designated for any marine mammal is situated 26 km from the ASW exercise areas. Given the relative large distance between the ASW exercise areas and the Natura 2000 sites, it is unlikely that noise will cause any PTS, TTS or behavioural response on the marine mammals within the designated sites due to noise attenuation /4/. As a worst case scenario, there may be a behavioural response of common bottlenose dolphin in Wyville Thomson Ridge. The response would be expected to occur during the exercise, which has a maximum duration of 4 hours, and is considered to be temporary /3/. Temporary displacement of individuals may thus take place, but there will be no impact to the populations of marine mammals in the areas.

It is unlikely that marine mammals within the designated Natura 2000 sites will be subjected to any severe impact caused by noise from the sonar, though temporary displacement may occur. Overall, no significant impacts to marine mammal populations are assessed to occur from noise exposure from the ASW exercise.

3.4 Cumulative impact

No repetition of the exercise is planned, it is assessed that there will not be cumulative impacts from ASW exercises in the area.

No plans and projects in the area that can cause any cumulative effects related to impacts on the Natura 2000 sites in known. In general, anthropogenic activities (shipping, seismic surveys, sonar systems and offshore construction) are increasing the level of sound in the oceans, causing concern about potential effects on marine mammals and marine ecosystems. Sound is important to marine mammals for communication, individual recognition, predator avoidance, prey capture, orientation, navigation, mate selection, and mother-offspring bonding. Thus, any impacts from the ASW exercise should be assessed with the existing noise impacts in the area. Given the relative short duration and geographic extent of the ASW exercise no significant negative impact cause by noise exposure from the ASW exercise in connection with background noise is expected on the marine mammals within the designated sites.

3.5 Conclusion

No significant negative impacts from the ASW exercise is expected on the designated habitats and species, nor to the integrity of the Natura 2000 sites (see Table 2.1).

Table 3.4 Assessment of potential significant effects on designated habitats and species for relevant Natura 2000 sites.

Recipient	Likely significant effect (Y/N)	Cumulative effects (Y/N)
Habitats	N	N
Birds	N	N
Cetaceans	N	N
Pinnipeds	N	N

4. STRICTLY PROTECTED SPECIES

Article 12 of the Council Directive 92/43/EEC on the protection of species states that. Member States shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV (a) in their natural range, prohibiting:

a) All forms of deliberate capture or killing of specimens of these species in the wild;
b) Deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration;
c) Deterioration or destruction of breeding sites or resting places.

Activities carried out by the Danish defence are subject to Order 1458 dated 14/09/2010 [Bekendtgørelse nr. 1458 af 14 september 2010].

In this section, an assessment of impacts to strictly protected species is undertaken. Species relevant to the ASW exercise in Scotland include all whales, in particular harbour porpoise and bottlenose dolphin.

4.1 Bottlenose dolphin

Based on the current understanding of near-shore bottlenose dolphin population and community structure, the ASCOBANS/HELCOM small cetacean population structure workshop advised that the following populations are each proposed as separate management units /11/.

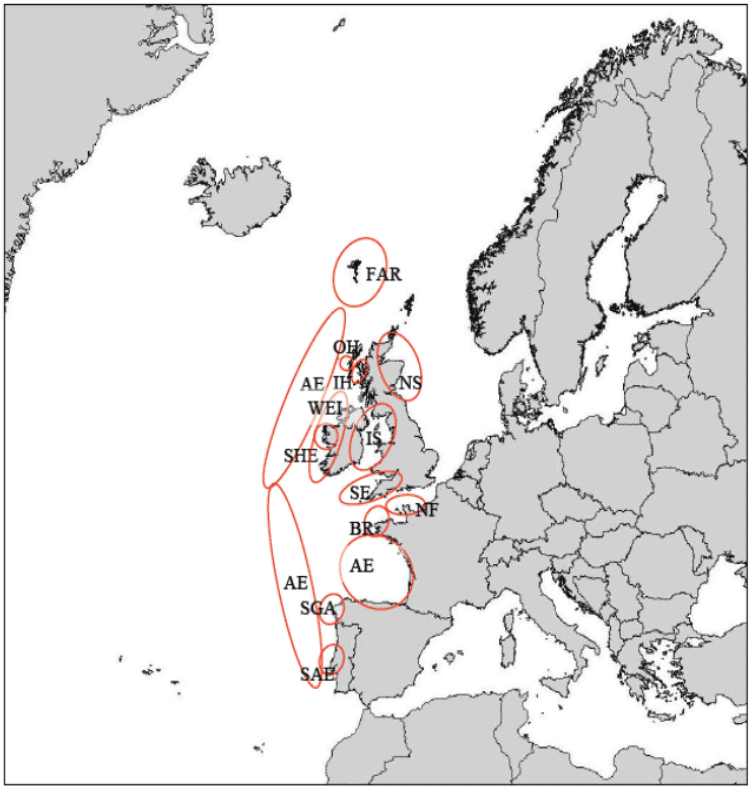

Figure 4-1 Areas which are relevant as management units for bottlenose dolphin

The area where the ASW exercise is planned is not located near any bottlenose dolphin areas.

4.2 Harbour porpoise

The harbour porpoise is the most commonly recorded cetacean in UK waters, primarily occurring on the continental shelf. In coastal waters, they are often encountered close to islands and headlands with strong tidal currents /12/. While sighted throughout the year, peak numbers of harbour porpoise are generally recorded in summer months from June to October.

The abundance and distribution of harbour porpoise is shown in Figure 4-2, based on three categories /11/:

- Category 1: Locations where porpoises have been recorded over several years, with a presence in every month of the year, and concentrations (mean standardized sightings rates >50/hour) in at least four months during the important period April-September.
- Category 2: Locations where porpoises have been recorded over several years, with a presence generally recorded in most months of the year, and concentrations (mean standardized sightings rates >50/hour) in at least two months during the important period April-September.
- Category 3: Locations where porpoises have been recorded over several years, with a presence in at least three months of the year, and concentrations (mean standardized sightings rates >50/hour) in at least two months, though not necessarily between April and September.

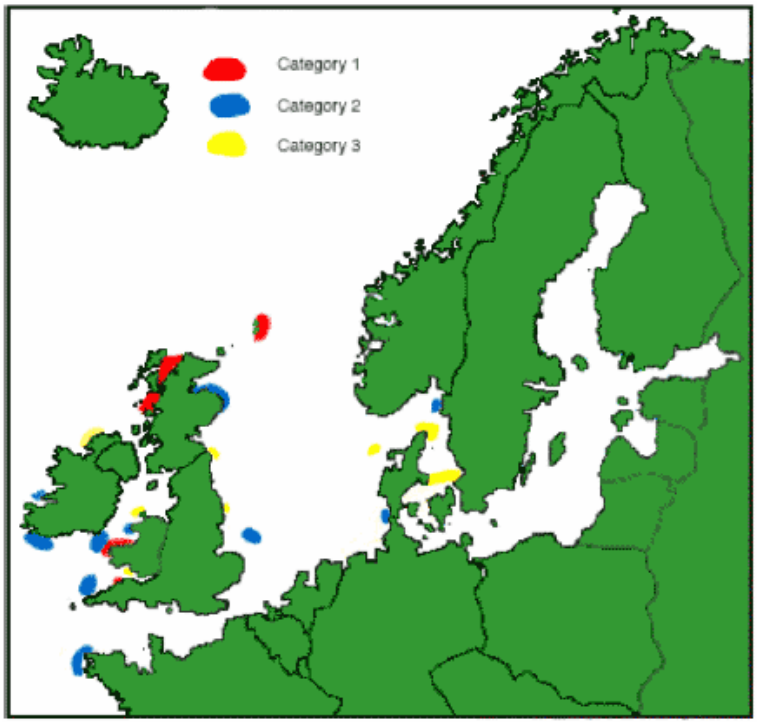

Figure 4-2 Map showing primary harbour porpoise areas /11/. For an explanation of the three categories, please refer to the text.

The area where the ASW exercise is planned is not located near any harbour porpoise areas.

4.3 Assessment of impacts

Potential impacts to strictly protected species from the ASW exercise are related to underwater noise. Impacts to marine mammals range from detection of the sound, to a behavioural response or physical injury.

The ASW exercise is planned to be undertaken with sonar with a duration of maximum four hours. The exercise is planned in an area which is not appointed as important to harbour porpoise or bottlenose dolphin, but individuals may be present in the area.

If individuals are present near the ASW exercise within the four hours where the sonar is active, there may be a disturbance of these species. The disturbance to marine mammals is expected to consist of temporary displacement. In the offshore marine environment, there will usually be adjacent areas for marine mammals to move to that are within the natural range of their populations, and hence compensate for the loss of, or displacement from, a particular area of habitat /10/. However, it should be noted that the movement of populations over a considerable distance would result in excessive use of energy and/or physical stress /10/.

The ASW exercise will not include deliberate capture or killing of specimens, nor result in deterioration or destruction of breeding sites or resting places. The ecological functionality of the area will not be impacted.

4.4 Conclusion

Species relevant to the ASW exercise in Scotland include all whales, in particular harbour porpoise and bottlenose dolphin. The exercise is planned in an area which is not appointed as important to harbour porpoise or bottlenose dolphin, but individuals may be present in the area.

There may be a temporal displacement of individual species to adjacent areas, but the ecological functionality of the area will not be impacted. The ASW exercise will not include deliberate capture or killing of specimens, nor result in deterioration or destruction of known breeding sites or resting places for the strictly protected species.

5. MITIGATING MEASURES

No mitigating measures are required in order to avoid significant negative impact on the designated Natura 2000 sites.

However, in principle, environmental effects of anthropogenic underwater noise may be reduced or avoided by reducing the source level and/or the propagation of noise or by restricting noise generating activities to areas and times not bearing sensitive species.

The following list, prepared by the OSPAR commission /9/ contains options that may be taken into account when considering noise mitigation measures independent of the sort of activity planned:

- If possible, refraining from applying activities generating harmful noise;
- General exclusion of noise generating activities for a certain time of the year or spatio-temporal exclusion or limitation of noise causing activities (e.g. to protect harbour porpoises from disturbance at most sensitive time of their life cycle);
- Using alternative techniques with lower sound emissions;

A recent review by DCE /13/ lists mitigating measures for a number of defence activities. Relevant to the ASW exercise are the following:

- Direct the sonar away from near-by habitat areas
- Ramp-up of sonar from <200 dB re 1µPa^{2}s for more than 10 minutes

In addition to the measures described by OSPAR and DCE, mitigating measures include monitoring of marine mammals prior to initiating activities. If any animals are observed within a safety zone, the activities should be postponed and the animals scared away (e.g. by use of pingers or seal scarers).

6. CONCLUSION

The Danish Defence is planning an anti-submarine warfare (ASW) exercise off Scotland in October 2015. The exercise involves the use of a single sonar for a maximum 4 hours.

A Natura 2000 screening has shown that there will is no risk of significant negative impacts to designated habitats and species as well as the integrity of the Natura 2000 sites.

Furthermore, no impacts to strictly protected species (annex IV species) are expected. There may be a short-term displacement of individuals, but it is assessed that there will not be any impacts to the ecological functionality of the area.

7. REFERENCES

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F Approach of risk assessment for USA

F.1

F.1.1 Scenario

NATO ASW Exercise 10 October 2015, 1200Z – 1600Z; Area: 59 00N – 007 00W, 59 40N – 005 40W
Platforms: 1 U.S. DDG with an AN/SQS-53 Hull-mounted Mid-Frequency Active Sonar (MFAS) system

F.1.2 Assumptions

The U.S. Navy has two different and distinct processes in its approach to minimizing the impact to the marine environment and compliance with U.S. environmental law. In the majority of U.S. territorial waters and operating areas near the contiguous U.S. coast Navy employs a programmatic approach toward compliance and mitigation. This approach is driven by extensive study of the environment (Environmental Impact Statements and Biological Opinions) and consultation with regulators, which culminate in the issuance of “permits” that allow a certain limited amount of “takes” while conducting the required activities.
It is intended that this same approach be phased into all areas of the world in which the Navy trains or tests. Not all of these areas have undergone the full programmatic approach and permitting process.
In the areas where Navy trains and tests which have not yet undergone a full programmatic study and resulting permitting process, Navy employs an approach of minimizing the risk to the environment to the extent possible while still meeting its training and testing requirements by conducting a “Risk Assessment” of the activity. This particular scenario falls under this assumption. No programmatic studies have been completed and therefore no permits for the ASW exercise have been issued. As such Navy will treat this scenario under the Risk Assessment approach which will be described here. Significant differences that may exist between the two approaches will also be highlighted to help clarify U.S. Navy’s methodology.
Operational and Environmental Assumptions:

- Assume 2 hours of daytime and 2 hours of nighttime active sonar use.
- Assume that there is a potential for surface ducting at this location and time of year.

F.1.3 Pre-planning phase

Commander, SIXTH Fleet and Commander, Task Force 6 (C6F/CTF 6) Operational Order (OPORD) 4000/7001 – 15 Appendix 1 to Annex L provides the Active Sonar Employment Requirements for the C6F/CTF 6 Area of Operation (AO).

- MFAS use requires prior approval from C6F.
- Use of Protective Measures Assessment Protocol (PMAP) software tool is required for exercise pre-planning.
- Risk Assessments include risk to environment as well as impact on readiness.
- Level of authorization is dependent on scope of exercise (i.e., unit level events can be approved at the O-6 level (NATO grade OF-5); larger scope events require Flag Officer approval).

- The risk to marine mammals is based on six factors that were specifically defined to reflect the appropriate biological, physical and oceanographic conditions which may exist in a proposed location.
- Commanding Officers are responsible for conducting in situ risk assessments.
- Ship Lookouts, Bridge watchstanders, Aircrews, Commanding Officers and Executive Officers are all required to complete the Navy's Marine Species Awareness Training (MSAT) Program on at least an annual basis.

F.1.4 Planning

Applicability:

- Risk Assessments are not required for the use of MFAS for operations, navigation, or maintenance.

Request Process:

- The training use of MFAS, including for exercises and unit level purposes, within the C6F/CTF AO requires prior approval from C6F/CTF 6 staff.
- Unit level MFAS training requests shall be submitted to C6F/CTF 6 via message traffic no later than seven (7) days prior to commencement of the training. Unit level training events shall not be conducted until approved.
- MFAS training requests will clearly articulate the need for the training event and assess the presence of conditions which, in their aggregate, may contribute to greater risk to marine mammals.
- Request messages are not required for C6F/CTF 6 "named exercises". Environmental planning for named exercises will be conducted as part of the formal exercise planning process and approval for MFAS use will be incorporated into the associated exercise approval and Exercise Operational Order (EXOPRD).
- C6F/CTF 6 Environmental Planner and Legal Counsel will work through the appropriate CTF and unit Commanding Officer to resolve any conflicts with requested MFAS use. Adjustments to the location or type of training will be made as necessary to minimize the risk as much as possible.

Approval Process:

- All training use of MFAS will be assessed for risk with respect to potential marine mammal impacts as well as impact on a unit if training is not completed.
- MFAS training events that have multiple sonar platforms operating at the same time and within the same general areas have a higher risk of impact on marine mammals. Therefore, all training events that involve two (2) or fewer units employing hull-mounted MFAS will be reviewed at the O-6 directorate level. All events with three (3) or more units participating will be reviewed at the Flag Officer level.
- Unit level training approvals and requirements will be provided via message traffic with either a MFAS letter of instruction message or with a Tasking Order.

Planning Considerations:

- When planning MFAS training, Commanding Officers shall be attentive to factors which, when combined, may increase the risk to marine mammals. The Navy routinely evaluates risks to marine mammals in relation to its

training exercises and uses this analysis to modify exercises as needed and to develop exercise-specific protective measures as appropriate. The risk factors used for this analysis are derived based on lessons learned from previously studied stranding events in the Bahamas (2000), the Madeiras (2000), the Canaries (2002), and Spain (2006). The six factors described below were specifically defined to reflect appropriate biological, physical and oceanographic conditions which may exist in a proposed location. Risk may be significantly increased when some or all of the following factors are present:

  - High Bathymetric relief. Areas of at least 1,000 meter (m) depth near a shoreline where there is a rapid change in bathymetry on the order of 1000-6000 m occurring across a relatively short horizontal distance (e.g., 5 nautical miles (nm)).
  - Multiple sonar platforms. Cases for which multiple ships or submarines (three or more) operating MFAS in the same area over extended periods of time (six hours or longer) in close proximity (less than or equal to ten nm apart).
  - Limited egress. An area surrounded by land masses, separated by less than 35 nm and at least ten nm in length, or an embayment, wherein operations involving multiple ships/subs (three or more) employing MFAS near land may produce sound directed toward the channel or embayment that may cut off the lines of egress for marine mammals.
  - Strong surface duct. Though not as dominant a condition as bathymetric features, the historical presence of a strong surface duct (i.e., a mixed layer of constant water temperature extending from the sea surface to 100 or more feet).
  - Presence of marine mammals. An area where marine mammals (especially endangered or sensitive species) are present in the proposed location. Endangered marine mammals are defined as those listed under the U.S. Endangered Species Act or the International Union for Conservation of Nature Red List. Marine mammals that are theorized to be sensitive to MFAS are those that are deep divers, such as beaked whales, pilot whales, dwarf sperm whales and harbor porpoises.
  - Low visibility. MFAS training conducted between dusk and dawn and in adverse weather conditions. Poor visibility decreases the effectiveness of visual protective measures for hull-mounted or dipping platforms, therefore increasing potential risk.

- Numerous assets and tools are utilized when considering the six factors described above. Electronic databases are used to help evaluate the prevailing and historic oceanographic conditions such as Sound Speed Profiles (surface duct evaluation), wave height and weather (visibility), bottom topography (bathymetric relief and egress), as well as databases containing the best available science concerning animal density data.
- A graduated scoring system is then used, based on the six factors described above, to determine an overall score. The score is rated as a level of risk (Low, Moderate, and High).
- Analysis is conducted by Navy Biologists and Exercise Planners and the resulting risk assessment and exercise is evaluated for legal risk by Navy

Environmental Legal Counsel before being presented to C6F/CTF 6 leadership for final decision.

- The last part of the planning stage occurs after the risk assessment is completed and has been approved. The type of exercise, its location and time of year is entered into the Protective Measures Assessment Protocol (PMAP) software tool which generates a report containing the specific mitigation measures to be employed when using MFAS. These measures are time and location specific to minimize the risk to the environment as much as possible when conducting the activity.

F.1.5 Operation

Commanding Officers must run a Protective Measures Assessment Protocol (PMAP) report prior to each MFAS training use, and complete all required protective measures (pre, during and post-exercise) as directed.

Mitigation Measures:

- Lookouts shall conduct visual observation immediately before and during the activity.
- Ships 65 feet in length or greater shall have two Lookouts at the forward position of the vessel.
- Active sonar transmission shall not begin if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone.
- For sources able to be powered down (e.g., hull-mounted):
    - If a sea turtle (only applies during the use of sources < 2kHz for sea turtles) or a marine mammal is sighted within 1,000 yd. sonar shall be powered down by 6 dB
    - If a sea turtle (for sources < 2kHz only) or a marine mammal is sighted within 500 yd., sonar shall be powered down by an additional 4 dB
    - If a sea turtle (for sources < 2kHz only) or a marine mammal is sighted within 200 yd., active transmission shall cease.
    - If the need for power-down should arise as detailed above, the unit shall follow the requirements as though they were operating at 235 dB - the normal operating level (i.e., the first power-down will be to 229 dB, and the second power-down will be to 225 dB, regardless of what level above 235 dB the sonar subsystem was being operated).
    - If the initial power level of the sonar subsystem being operated is below 225 dB (e.g., SQS-56), these power-downs do not apply. However, active transmission shall still cease if a sea turtle (for sources <2 kHz only) or a marine mammal are observed within 200 yd.
- For sources unable to be powered down (e.g., towed or unmanned):
    - If a marine mammal or sea turtle is sighted within 200 yd., active transmission shall cease.

- Re-Commencement shall occur if any of the following are met:
    - The animal is observed exiting the mitigation zone
    - The animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source
    - The mitigation zone has been clear from any additional sightings for a period of 30 min.
    - The vessel has transited more than 2,000 yd. (400 yds. for sources unable to be powered down) beyond the location of the last sighting
    - The ship concludes that dolphins are deliberately closing in on the ship to ride the vessel's bow wave (and there are no other marine mammal sightings within the mitigation zone).

Protective Measures for All Geographic Areas:

- Standard Operating Procedures:
    - All bridge watch personnel, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, mine warfare helicopter crews, anti-submarine warfare helicopter crews, civilian equivalents and Lookouts shall successfully complete the Introduction to the U.S. Navy Afloat Environmental Compliance Training Series and the U.S. Navy Marine Species Awareness Training (MSAT) prior to standing watch or serving as a Lookout.
    - Navy Lookouts shall qualify in accordance with the Lookout PQS (NAVEDTRA 12968-D) and execute their duties IAW the Lookout Training Handbook.
    - Lookouts shall be trained in the most effective means to ensure quick and effective communication within the command structure to facilitate implementation of protective measures if marine species are spotted.
    - While on watch, personnel shall employ visual search techniques, including the use of binoculars, using a scanning method in accordance with the Lookout Training Handbook. After sunset and prior to sunrise, watch personnel shall employ night visual search techniques, which include the use of night vision devices.

- The protective measures contained in the PMAP shall form the minimum requirements absent definitive guidance from the applicable SOFA (or other bilateral agreement(s)), U.S. fleet commander, or U.S. operational commander. However, routine training and minor exercises within a foreign nation territorial sea are only conducted with the concurrence of the host nation. In the event of conflict between the protective measures contained in the PMAP and those provided by the applicable SOFA (or other bilateral agreement(s)), U.S. fleet commander, or U.S. operational commander, the more stringent protective measures shall apply.

F.1.6 Post-operation (what is reported to whom)

The Navy shall follow internal chain of command reporting procedures as promulgated through Navy instructions and orders.

There are two post operational reporting requirements with respect to marine mammal risk mitigation, one is required for all uses of MFAS during training and the other report is conditional pending any marine mammal incidents which may occur during training.

- All training use of MFAS shall be logged into the Sonar Positional Reporting System (SPORTS) electronic database.

- All units shall report marine mammal incidents via a standardized specially formatted naval message. Incidents include strandings observed or reported to have occurred within 100 nm of, and within 48 hours of the training use of MFAS. Units are to provide as much information as possible in order to allow for an accurate reconstruction of the incident.

F.1.7 Additional information

2 U.S. Navy documents are included below:

- Appendix F.2: Mock Risk Assessment 20151028.docx [Planning]
- Appendix F.3: PMAP Mitigation report, PMAP Report 2016-02-26 06-10-47.docx [Planning/Operation]

F.2 Mock Risk Assessment

Risk Factor 1: Surface Ducting

This factor is assessed based on the probability of a substantial surface duct occurring the region of the exercise during the proposed dates.
Scoring: This factor is assigned an N if there is little to no probability of surface ducting; a P if there is a slight to moderate chance of ducting; and a Y if there is a moderately high to high chance of ducting.
This mock exercise is being conducted in high latitude waters during a seasonally complex month. Depending on weather conditions and temperatures in the area, as well as time of day during which the exercise is conducted, there is a moderate chance of surface ducting occurring in the exercise area. If a surface duct occurs, the cutoff frequency is likely to be below 3 kHz, potentially ducting MFA transmissions. **This factor was therefore assigned a P.**

Risk Factor 2: Bathymetry

Areas of high bathymetric relief such as the continental shelf, canyons, and seamount can offer favorable conditions to marine mammals and can indicate an increased risk to MFAS exposure. Areas of high bathymetric relief are described as being areas of at least 1000m depth, near the shoreline, and a rapid change of bathymetry occurs on the order 1000-6000m over a relatively short horizontal distance (e.g. 5nm).
Scoring: Study area is less than 25% areas of high bathymetric relief = N; study area is between 25% and 75% areas of high bathymetric relief = P; study area is greater than 75% areas of high bathymetric relief = Y.
In the study area provided (N 59 00, W 007 00; N 59 40, W 005 40), which is located just north of the United Kingdom, absolute depth ranges from approximately 100m to 1000m and does not drop off rapidly or contain seamounts and submarine canyons (e.g. no areas of high bathymetric relief). **Based on this information, less than 25% of the study area occurs in areas of high bathymetric relief; therefore this factor is assigned an N.**

Risk Factor 3: Multiple Platforms
Multiple platforms (ships, submarines, sonobuoys) operating MFAS concurrently in close proximity can increase the risk to marine mammals as it increases the amount of sound in the water and limits egress options for marine mammals.
Scoring: Less than 3 platforms operating MFAS concurrently = N; More than 3 platforms operating MFAS concurrently, for less than 6 hours = P; More than 3 platforms operating MFAS concurrently, for more than 6 hours = Y.
The mock exercise involves a single DDG; therefore, this factor was assigned an N.

Risk Factor 4: Limited Egress
Areas of limited egress can prevent marine mammals from escaping exposure to MFAS and increase the risk of stranding. Areas of limited egress are defined as areas surrounded by landmasses, separated by less than 35nm and at least 10nm in length, or an embayment where multiple platforms are operating.
Scoring: Study area is less than 25% areas of limited egress = N; study area is between 25% and 75% areas of limited egress = P; study area is greater than 75% areas of limited egress = Y.
The mock study area provided (N 59 00, W 007 00; N 59 40, W 005 40), which is located just north of the United Kingdom, is at all points further than 35nm from land and as suck contains no areas of limited egress. **Based on this information, less than 25% of the study area occurs in areas of limited egress; therefore this factor is assigned an N.**

Risk Factor 5: Presence of Marine Mammals
Regular occurrence of marine mammal in the study area, particularly those that are considered sensitive to MFAS or are endangered under various environmental laws/policies can increase the risk (sensitive to MFAS) or severity (e.g. a critically endangered species) of a stranding event. Regular occurrence is assessed based on a review of species distribution and seasonal relative animal density where available.
Scoring: Sensitive or endangered marine mammals are not likely to be present in the study area = N; sensitive or endangered marine mammals may be present in the study area occasionally = P; sensitive or endangered marine mammals are commonly found in the study area = Y.
Based on the mock study area location, **Table 1** enumerates the species expected to occur commonly in the study area and indicates if they are considered sensitive to MFAS and if they are listed as endangered under the Endangered Species Act or by the International Union for the Conservation of Animals.

Table 1

Common Name	Scientific Name	IUCN Status	ESA Status	Occurrence
Blue whale	*Balaenoptera musculus*	EN	EN	Regular
Fin whale	*Balaena mysticetus*	EN	EN	Regular
Humpback whale	*Megaptera novaeangliae*	EN	EN	Regular
Sei whale	*Balaenoptera borealis*	EN	EN	Regular
Sperm whale	*Physeter microcephalus*	VU	EN	Regular
MFAS Sensitive Species				
Cuvier's beaked whale	*Ziphius cavirostris*	LC	--	Regular
Blainville's beaked whale	*Mesoplodon densirostris*	DD	--	Regular
Sowerby's beaked whale	*Mesoplodon bidens*	DD	--	Regular
Northern bottlenose whale	*Hyperodon ampullatus*	DD	--	Regular
Harbor porpoise	*Phocoena phocoena*	LC	--	Regular

Note: IUCN = International Union for the Conservation of Animals

ESA = Endangered Species Act

EN = Endangered

Seasonal density for these species was not examined due to time constraints. However, given the number of species present that are considered sensitive to MFAS or endangered it is reasonable to assume that some subset of these species could occur regularly in the study area during the month of October (the timeframe for the mock exercise). **Based on this information, the factor was assigned a Y.**

Risk Factor 6: Limited Visibility

Operating MFAS during low visibility conditions (e.g. nighttime) reduces the ability to detect marine mammals visually and enact mitigation measures designed to protect them. Operating MFAS in low visibility conditions increases the risk to marine mammals for a stranding event.

Scoring: No MFAS during low visibility conditions = N; operating MFAS for less than 6 hours during low visibility conditions = P; operating MFAS for more than 6 hours during low visibility conditions = Y.

During this mock exercise 2 hours of MFAS are planned during low visibility conditions (nighttime operations). **Based on this information, the factor was assigned a P.**

Risk Factor Analysis:

Risk factors 2-5 are assigned 0 points for N, 2 points for P, and 4 points for Y. Risk factors 1 and 6 are assigned 0 points for N, 1 point for P, and 2 points for Y. These points are then summed up to determine the overall risk category for the exercise. Risk categories are Low (0-5 points), Moderate (6-11 points), Moderate-High (12-16 points), and High (17-20 points).

Based on the information provided for this mock exercise, the scoring is as follows:

Factor	**Score**
1 - Surface Ducting	P
2 – Bathymetry	N
3 - Multiple Platforms	N
4 - Limited Egress	N
5 - Presence of Marine Mammals	Y
6 - Low Visibility	P
Total Points	6

This places the exercise in the Moderate risk category overall and assumes all PMAP mitigations are being enacted. Alternative scenarios, such as not operating MFAS during low visibility conditions, would change the scoring and potentially lower the risk category. In this case, not operating during low visibility conditions would change factor 6 to an N and lower the total points 5, changing the overall risk category to ‘Low’ for the exercise.

F.3 PMAP Mitigation Report

C.3 PMAP Mitigation Report

Created On 26 February 2016 06:10
This report is only valid for events that occur on or before 27 March 2016. For events occurring after 27 March 2016, you will need to check for updates to PMAP within 30 days of conducting this event and create a new report.

Approval/ Acknowledgement:	Signature: _____ _____ Ship/Squadron Commanding Officer or Test Director Date
Event:	Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar during Anti-Submarine Warfare and Mine Warfare
Event Date:	Start: 10/10/2015 End: 10/10/2015
Description:	Full power active sonar maintenance, testing, and training from surface combatants and submarines. Training may include anti-submarine warfare training, mine warfare training, and other training activities. Sonar system maintenance and testing activities may be conducted pierside or at-sea.
Location:	**Target Latitude:** 59 00' 00" N **Target Longitude:** 007 00' 00" W
After Action Reporting Requirements:	**ALL FLEET TRAINING EVENTS**: Enter all sonar use information into Sonar Positional Reporting System (SPORTS) located at http://sports.navy.smil.mil . **USFF TRAINING EVENTS**: Report all munitions expenditures to USFF via email to USFFRCST@navy.mil and include the following: 1) OPAREA event number, 2) Number of rounds expended, 3) NALC (Navy Ammunitions Logistics Code)/DODIC (Department of Defense Identification Code), 4) If munitions have the option of either Air Burst or Surface Detonating, specify which setting was selected, and 5) If outside the OPAREA specify Latitude/Longitude. **SYSCOM TESTING ACTIVITIES**: 1) Report all permitted sonar use, airgun use, and high explosive munitions expenditures by using the SYSCOM Letter of Authorization (LOA) Tracking Tool. 2) If the test requires the use of existing Fleet systems (i.e., a sonar source already installed that would normally be reported by the ship or sub) then it is to be reported by the supporting Fleet unit.- Instruction shall be provided by the Test Director that the SPORTS Report "PURPOSE" indicates "TEST" and the "NARRATIVE" must include language that indicates that the usage in the report is part of a test (The name of the test is preferable). 3) If it is a system that is newly installed solely for the purpose of a specific test event (and will be removed after the test completion) then the reporting responsibility falls to the Test Director and the LOA Tracking Tool will be used to meet the reporting requirement. If a conflict exists, such as when a Commanding Officer of a Fleet unit insists that any sonar transmitted by his/her ship or sub will be reported by his sailors in SPORTS then it is recommended that the Test Director abide by the Commanding Officers wishes.
Lookout Requirements:	Ships 65 ft in length or greater shall have two Lookouts at the forward position of the vessel. Ships less than 65 ft in length and ships that are minimally manned shall have one Lookout at the forward position of the vessel. Ships and surfaced submarines conducting active sonar activities while moored or at anchor (including pierside) shall maintain one Lookout. The Lookout(s) must be watchstander(s) fulfilling lookout duties (can be fulfilling all lookout responsibilities, not only marine species mitigation). Lookouts shall conduct visual observation immediately before and during the activity.
Mitigation Measures:	Active sonar transmission shall not begin if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. For sources able to be powered down (e.g., hull-mounted): • If a sea turtle (only applies during the use of sources < 2kHz for sea turtles) or a marine mammal is sighted within 1,000 yd. sonar shall be powered down by 6 dB • If a sea turtle (for sources < 2kHz only) or a marine mammal is sighted within 500 yd., sonar shall be powered down by an additional 4 dB • If a sea turtle (for sources < 2kHz only) or a marine mammal is sighted within 200 yd., active transmission shall cease. • If the need for power-down should arise as detailed above, the unit shall follow the requirements as though they were operating at 235 dB - the normal operating level (i.e., the first power-down will be to 229 dB, and the second power-down will be to 225 dB, regardless of what level above 235 dB the sonar subsystem was being operated). • If the initial power level of the sonar subsystem being operated is below 225 dB (e.g., SQS-56), these power-downs do not apply. However, active transmission shall still cease if a sea turtle (for sources <2 kHz only) or a marine mammal are observed within 200 yd. Re-Commencement shall occur if any of the following are met: • the animal is observed exiting the mitigation zone • the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source • the mitigation zone has been clear from any additional sightings for a period of 30 min. • the vessel has transited more than 2,000 yd. beyond the location of the last sighting • the ship concludes that dolphins are deliberately closing in on the ship to ride the vessel's bow wave (and there are no other marine mammal sightings within the mitigation zone). For sources unable to be powered down (e.g., towed or unmanned): • If a marine mammal or sea turtle is sighted within 200 yd., active transmission shall cease Re-Commencement shall occur if any of the following conditions is met:

	• the animal is observed exiting the mitigation zone • the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source • the mitigation zone has been clear from any additional sightings for a period of 30 min. • the vessel has transited more than 400 yd. beyond the location of the last sighting.
Additional Information:	**C6F AOR:** The training use of active sonar and EER/IEER, including for exercises and unit level purposes, within the C6F/CTF 6 AO requires prior approval of C6F/CTF 6 per ANNEX L of OPORD 4000/7001 - 15. Training requests shall be submitted to C6F/CTF 6 via message traffic no later than seven (7) days prior to commencement of the training. Individual units participating in C6F/CTF 6 named exercises do not need to submit approval requests, named exercise active sonar approvals will be provided in the corresponding exercise Environmental Letter of Instruction (LOI). This policy does not apply to use of active sonar for operations, navigation, or maintenance. Unit Commanding Officers retain approval authority for these uses.
Protective Measures Applicable to All Geographic Locations:	**PROTECTIVE MEASURES FOR ALL GEOGRAPHIC AREAS** **Standard Operating Procedures** 1. All bridge watch personnel, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, mine warfare helicopter crews, anti-submarine warfare helicopter crews, civilian equivalents, ELCAS (M) assigned personnel, and Lookouts shall successfully complete the Introduction to the U.S. Navy Afloat Environmental Compliance Training Series and the U.S. Navy Marine Species Awareness Training (MSAT) prior to standing watch or serving as a Lookout. MSAT can be accessed from the PMAP Website at 2. Navy Lookouts shall qualify in accordance with the Lookout PQS (NAVEDTRA 12968-D) and execute their duties IAW the Lookout Training Handbook. 3. Lookouts shall be trained in the most effective means to ensure quick and effective communication within the command structure to facilitate implementation of protective measures if marine species are spotted. 4. While on watch, personnel shall employ visual search techniques, including the use of binoculars, using a scanning method in accordance with the Lookout Training Handbook. After sunset and prior to sunrise, watch personnel shall employ night visual search techniques, which include the use of night vision devices. **Operating Procedures and Collision Avoidance** 1. Prior to major exercises, a Letter of Instruction, Naval Message or Environmental Annex to the Operational Order shall be issued to further disseminate the personnel training requirement and general marine species mitigation measures. 2. Commanding Officers shall make use of marine species detection cues and information to limit interaction withmarine species to the maximum extent possible consistent with safety of the ship. 3. While underway, surface vessels (including full power propulsion testing) and surfaced submarines shall have at least one Lookout with binoculars. This Lookout must be awatchstander fulfilling lookout duties (can be fulfilling all lookout responsibilities, not only marine species mitigation). Lookouts already posted forsafety of navigation and man-overboard precautions satisfy this requirement. Navy surface ships greater than 65 ft in length shall have at least one additional person standing watch. Additional Lookouts may be required during active sonar operations – refer to the Lookout requirements in the section above. Visual observations of applicable marine species shall be communicated immediately to the appropriate watch station for information dissemination and appropriate action. 4. On surface vessels equipped with active sonar, pedestal mounted 'Big Eye' (20x110) binoculars (if installed) shall be used to assist in the detection of marine mammals and sea turtles in the vicinity of the vessel. 5. If the presence of marine mammals is detected acoustically, Lookouts posted in aircraft and on surface vessels shall increase the vigilance of their visual observation. 6. While in transit, naval vessels shall be alert at all times, use extreme caution, and proceed at a 'safe speed' so that the vessel can take proper and effective action to avoid a collision with any sighted object or disturbance, including any marine mammal or sea turtle, and can be stopped within a distance appropriate to the prevailing circumstances and conditions. 7. When whales have been sighted in the area, Navy vessels shall increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals. 8. Vessels shall avoid approaching marine mammals head on and shall maneuver to maintain a mitigation zone of 500 yd. around observed whales and 200 yd. around all other marine mammals (except bow riding dolphins), providing it is safe to do so. No further action is necessary if a non-whale marine mammal continues to close after the vessel has made one course and/or speed change. 9. Floating weeds, algal mats, Sargassum rafts, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals shall be taken where these are present. No sound-producing items shall be placed within 200 yds of a marine mammal or sea turtle. 10. Navy aircraft participating in exercises at sea shall conduct and maintain, when operationally feasible and safe, surveillance for marine mammals and sea turtles as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections shall be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship shall likely result in a closing of the distance to the detected marine mammal. 11. All vessels shall maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records shall be kept in accordance with TYCOM guidance and for a period of at least 30 days following completion of a major training exercise. PMAP records are to be retained for two years, IAW COMNAVAIRFORINST 5090.1/COMNAVSURFORINST 5090.1 (series), as applicable.

Coordination and Reporting

1. The Navy shall follow internal chain of command reporting procedures as promulgated through Navy instructions and orders.
2. During the training and testing activities that involve explosives, if a marine mammal is injured or killed as a result of the Navy activities (e.g., instances in which it is clear that munitions explosions caused death), Commanders shall suspend activities immediately and report such incidents to the chain of command via OPREP-3 in accordance with OPNAVINST 3100.6 series.

PMAP Applicability in Foreign Nation EEZs and Foreign Nation Territorial Seas

The protective measures contained in the PMAP shall form the minimum requirements absent definitive guidance from the applicable SOFA (or other bilateral agreement(s)), U.S. fleet commander, or U.S. operational commander. However, routine training and minor exercises within a foreign nation territorial sea are only conducted with the concurrence of the host nation. In the event of conflict between the protective measures contained in the PMAP and those provided by the applicable SOFA (or other bilateral agreement(s)), U.S. fleet commander, or U.S. operational commander, the more stringent protective measures shall apply.

G Approach of risk assessment for Norway

G.1

G.1.1 Scenario

A joint NATO anti-submarine-warfare exercise is planned on October 10th between 12:00 and 16:00 zulu. The exercise will take place at high seas between the coordinates 59°00'N–07°00'W and 59°40'N–05°40'W. Each nation participates with 1 ASW unit. The following describes the Norwegian risk assessment for this operation, and the mitigation measure which would apply to the Norwegian unit.

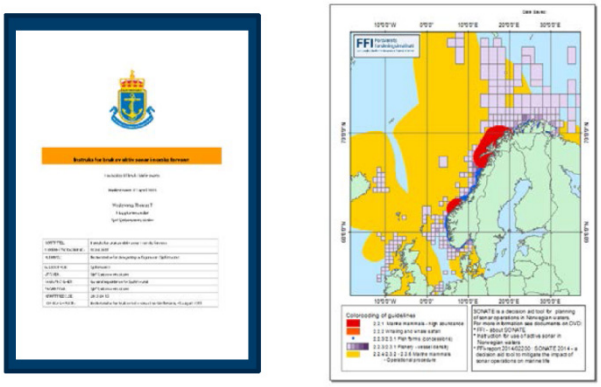
The exercise area between Scotland and the Faroe Islands. The area covers shallow shelf areas and extends northwards across shelf break and into deep blue ocean. Norway participate with 1 Nansen-class ASW frigate.

G.1.2 Assumptions

The analysis is performed under the assumption that Norway will participate with 1 Nansen-class frigate operating towed variable depth sonar transmitting at 1-2 kHz, and hull mounted sonar transmitting at 5-8 kHz. Norwegian operational authorities would normally request the host nation to define restrictions on sonar transmissions. For the sake of the analysis it is assumed that the entire exercise will take place outside of any territorial water, and that no diplomatic clearance is needed. Thus, no instruction from any host nation.

G.1.3 Preplanning

The Norwegian navy has a planning and operational decision aid tool: SONATE. The tool is web based but an off-line solution assures continuous access on all naval vessels. SONATE contains cartographic information on distribution and density of marine mammals in time and space.



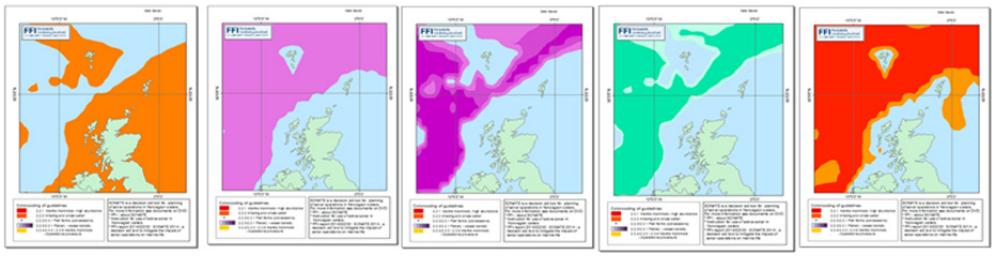
Based on new knowledge the «Instruction for use of sonar in Norwegian waters» (left) is updated in a 2 year cycle. The “Sonar instruction” is issued in Norwegian with an English translation. The SONATE tool for planning and execution of sonar operations is updated every 2nd year with new «Instructions» and updates on environmental data (right).

There is also information about fish and fisheries. The chief of the Norwegian navy issues an *“Instruction for use of active sonar in Norwegian waters”*. This applies to all units which employ active sonar transmitting in the frequency range from 500 Hz to 10 kHz at source levels (SL) above 160 dB (re µPa·m), including visiting foreign units within Norwegian territorial waters. International operations under the leadership of NATO will be run according to NATO guidelines or host nation guidelines. If such guidelines do not exist, the Norwegian guidelines will apply to Norwegian units operating also outside of Norwegian waters. Operations within the recommendations given by SONATE for different areas and time periods ensure that the operations will be executed in compliance with the sonar instruction

G.1.4 Planning

In the planning phase the SONATE tool with the appurtenant *“Sonar instruction”* would be used to define the sonar mitigation restrictions for this specific operation. This is a multi-unit exercise of relatively short duration, but still considered to be an *«intensive sonar exercise»* according to the Norwegian sonar instruction. *Intensive sonar exercises is* defined to involve sonar transmission from more than one platform or that one vessel are actively transmitting sonar signals for more than 12 hrs. within an affected area defined by the 140 dB sound pressure level (SPL) isobar from the source.

Since SONATE generally does not have good data coverage in this area, additional data from host nation are requested. In this case, data on marine mammal density from UK Hydropgraphic Office are accessed from the PoMM database. According to SONATE one must expect a high density of porpoises and medium density of killer whales in the shallow part of the area, and medium densities of sperm whales, bottlenose whales, and pilot whales in the deep part. In total this adds up to an expected high density of marine mammals in the entire operation area.



Densities of porpoises, killer whales, sperm whales, bottlenose whales, and pilot whales in October. The overall density of marine mammals in the operation area is expected to be high

To reduce the risk of inflicting direct injury to marine mammals, procedures for sonar transmission should be used in areas with such high expected density of marine mammals. Thus, the Norwegian unit can operate active sonar, but with some operational restrictions. The bottlenose whale and sperm whale feeding habitat triggers an additional restriction on the exercise duration since this is a multi unit *intense* sonar exercise.

G.1.5 Operation

During the specific operation the following mitigation measures apply to the Norwegian frigate:

- ***Exercise duration should be limited to 12 hrs***

The risk of biological significant behavioural responses increases at received levels above 140 dB (re1µPa, SPL). Minke whales and bottlenose whales are identified as particularly sensitive species. The severity of behavioural responses always depends on the duration of the response. Many biological processes are diurnal, but responses might endure beyond the duration of the exposure. Exposures of durations exceeding 12 hrs are therefore associated with more risk than exposures shorter than 12 hrs.

- ***Safety distance from fishing vessels***

A safety distance of 500 m from fishing vessels actively engaged in fishing should be maintained to avoid negative effects. If speed is less than 5 knots or duty cycle exceeds 10%, the safe distance should be increased to 1000 m.

- ***Safety distance from marine mammals (monitoring)***

Look outs and a safety distance of 500 m from marine mammals required during active transmissions. If speed is less than 5 knots or duty cycle exceeds 10%, the safe distance should be increased to 1000 m. During active sonar transmission at source levels (SL) above 200dB, the danger zone defined by the safety distance should be monitored visually and/or using available passive acoustic sensors. Check in particular for presence of bow riding dolphins. If marine mammals appear within the danger zone, transmissions shall be ceased, or source level reduced to 200 dB, until the animal is outside of the danger zone.

- ***Ramp-Up procedure***

Whenever feasible and if transmitted source level exceeds 200 dB, sonar transmissions should be initialized by the following ramp-up procedure: Reduce speed, preferably to less than 8 knots. Start transmissions at reduced source level (maximum 180 dB) and gradually increase the source level over a period of at least 3 min. Use short inter-ping intervals (less than 10 s) and ping durations of 0.3-1 sec. If transmissions are interrupted for more than 5 min, the Ramp-Up procedure shall

be repeated. If visual conditions do not allow for visual control of the danger zone, the Ramp-Up procedure should always be used.

- ***Transmissions at high speed (monitoring)***

If the vessel speed and the transmission interval imply that the vessel covers more than 200 m between two successive transmissions (pings), or the speed exceeds 15 knots, one must at all times have a strong focus on presence of marine mammals in the travelling direction of the animal.

G.1.6 Post-operation (what is reported to whom)

All use of active sonar and observations of marine mammals and fishing activity in areas of active transmission will be logged. Any infringement from the sonar instruction will also be documented, with the cause of the infringement. All logs are archived for at least 1 year, but nothing is reported unless there was a negative incident and data is requested from operational authorities.

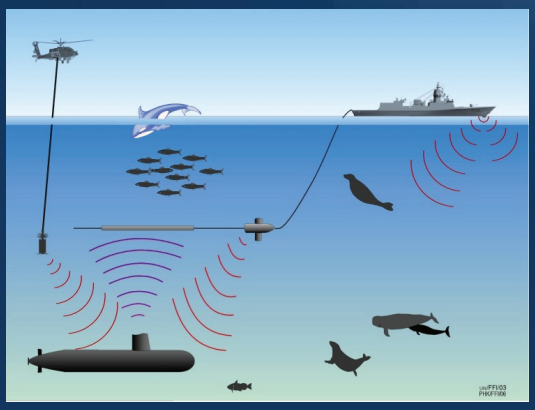
G.1.7 Additional information

Norwegian presentation and RNoN guidelines as pdf in G.2

G.2 Norwegian response to scenario analysis

FFI Forsvarets forskningsinstitutt

Norwegian response to scenario analysis



SD ASRM 6th Meeting

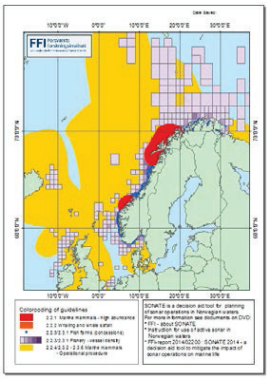
Petter Kvadsheim

The scenario

- There is going to be a NATO ASW Exercise on the 10 October 2015 1200-1600Z
- The exercise will take place:
- N 59 00, W 007 00; N 59 40, W 005 40
- This area will be considered 'High Seas' You are to provide active sonar risk mitigation procedures for your National Asset/Sonar system. (1 ship, 1 sonar)

Pre-planning

- Based on new knowledge the «Instruction for use of sonar in Norwegian waters» is updated in a 2 year cycle.
- The SONATE tool for planning and execution of sonar operpations is updated every 2nd year with new «Instructions» and updates on environmental data.

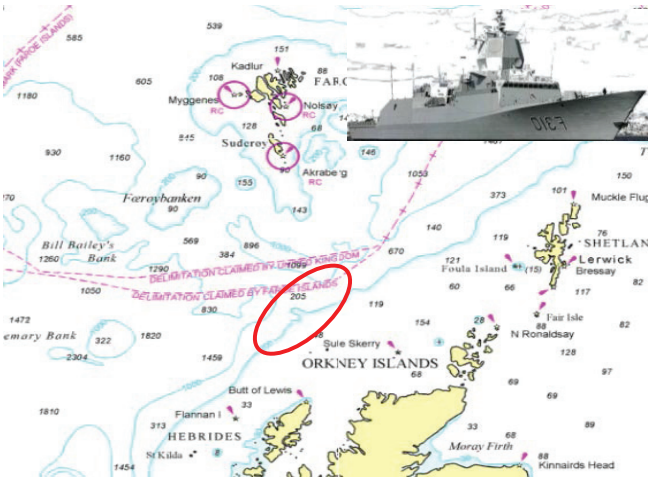


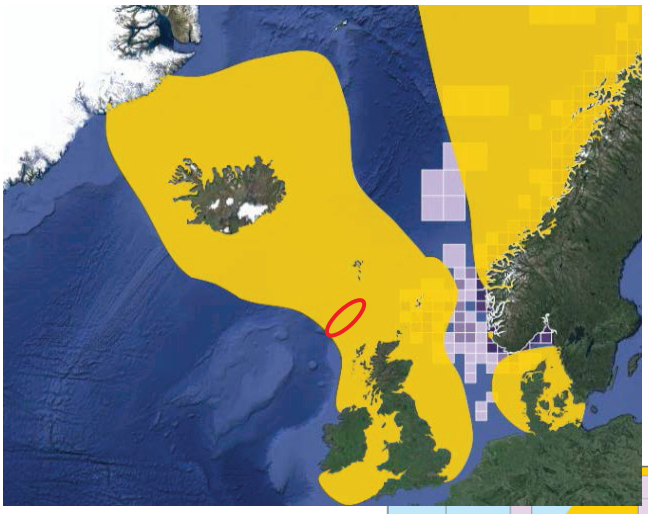
Planning

- The exercise area is at high seas between Scotland and the Feroe Islands.
- Mostly within the EEZ of UK, but might extend into the EEZ of Denmark (Feroe Island).
- The area covers shallow shelf areas and extends northwards across shelf break and into deep blue ocean.
- Norway participate with 1 Nansen-class frigate planned to operate towed VDS at 1-2 kHz or HMS at 6-7 kHz.
- Multiunit exercise, short duration (Intensive sonar exercise)

- The sonar instruction dictates that *«Norwegian units operating outside Norwegian waters will comply with the prevailing guidelines of the host nation. If such guidelines do not exist, the Norwegian guidelines will apply".*

- Contact host nations (UK and Denmark) to request instructions/restrictions for use of sonar and environmental data.



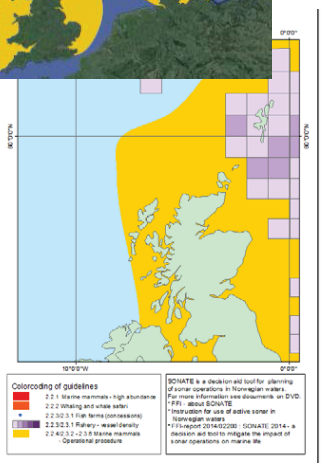


SONATE

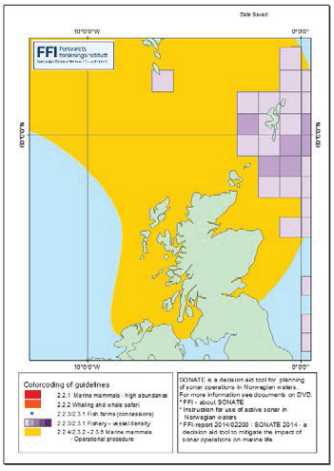
Ref «Instruction for use of sonar in Norwegian waters» section 2.2.4

To reduce the risk of inflicting direct injury to marine mammals, procedures for sonar transmission should be used in all areas/periods where marine mammals are expected to be encountered (see section 2.3.2-2.3.6).

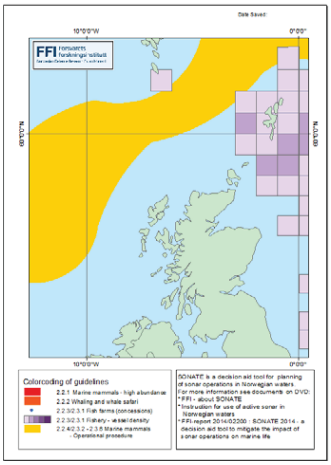
Marine mammals are an issue. NOR units can operate active sonar, but with some operational restrictions / procedures



High density of porpoises in the shallow part of the area



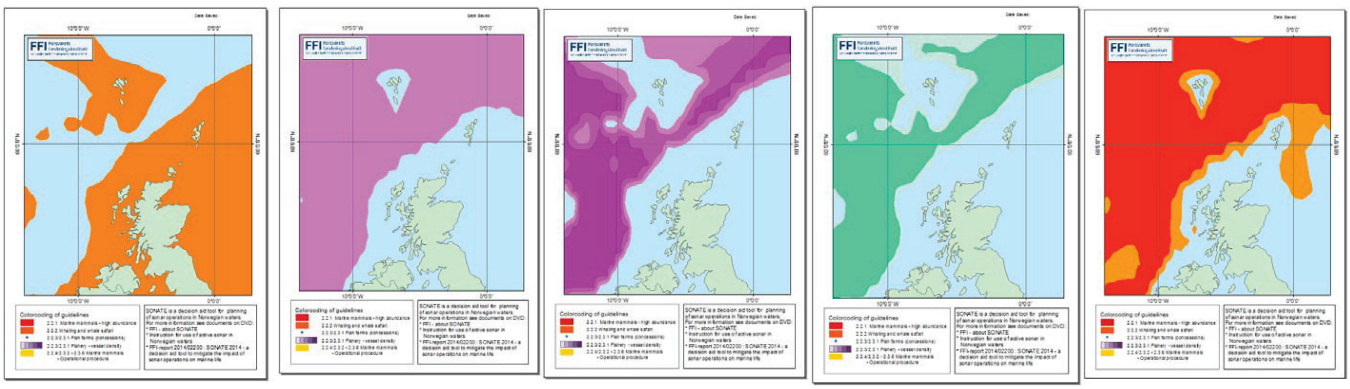
Medium density of killer whales following the herring



Medium density of sperm whales in the deep part

UK data

- Since SONATE does not have good data coverage in this area, addtional data from host nation is requested.
- Data from UKHO confirms the Norwegian data
- Relevant addtional information on bottlenose whales and pilot whales .



Densities of porpoises, killer whales, sperm whales, bottlenose whales, and pilot whales in October

SONATE outcome

- The overall density of marine mammals is high.
- NOR units can operate active sonar, but with some operational restrictions / procedures.(2.2.4)
- The bottlenose whale and sperm whale feeding habitat triggers specific restrictions (2.2.1). Exercise duration <12 hrs

SONAR Instruction

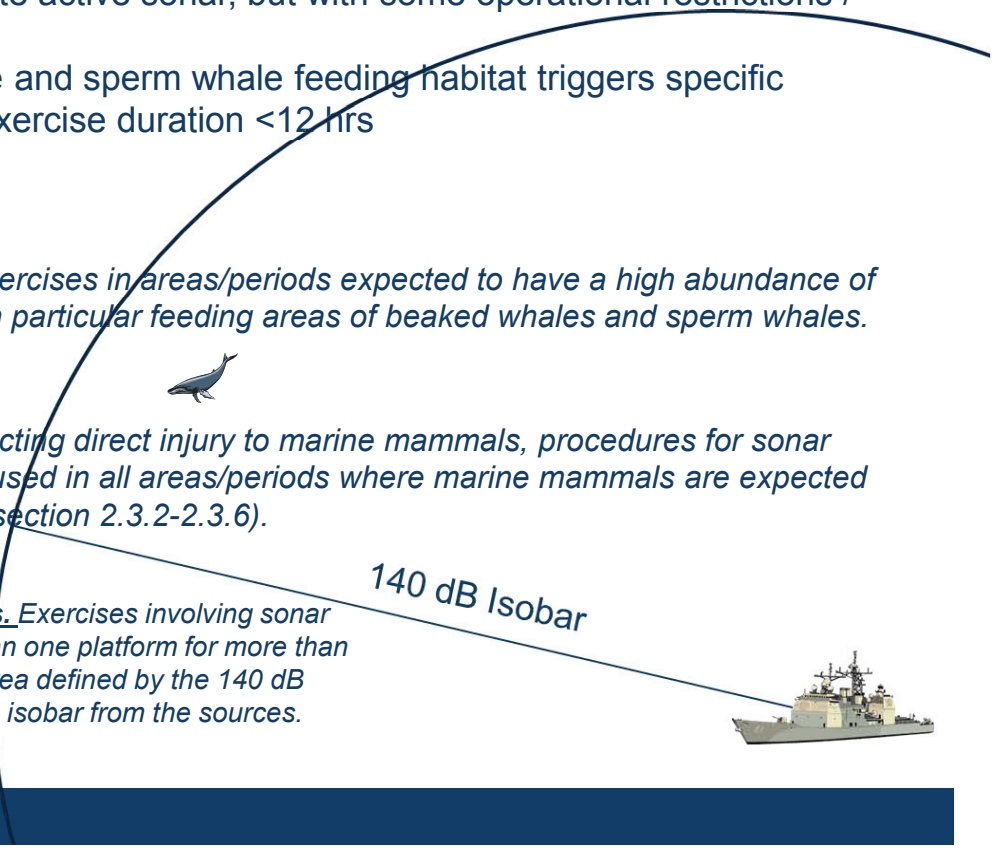
Section 2.2.1

Avoid intensive sonar exercises in areas/periods expected to have a high abundance of marine mammals, and in particular feeding areas of beaked whales and sperm whales.

Section 2.2.4

To reduce the risk of inflicting direct injury to marine mammals, procedures for sonar transmission should be used in all areas/periods where marine mammals are expected to be encountered (see section 2.3.2-2.3.6).

Intensive sonar exercises. *Exercises involving sonar transmission from more than one platform for more than 12 hrs within an affected area defined by the 140 dB sound pressure level (SPL) isobar from the sources.*



NOR active sonar risk mitigation procedures NATO ASRM EXERCISE

- ***2.2.1 Exercise duration should be less than 12 hrs***

- ***2.3.1. Safety distance from fishing vessels***

A safety distance of 500 m from fishing vessels actively engaged in fishing should be maintained to avoid negative effects. If speed is less than 5 knots or duty cycle exceeds 10%, the safe distance should be increased to 1000 m.

- ***2.3.2. Safety distance from marine mammals (monitoring)***

A safety distance of 500 m from marine mammals. If speed is less than 5 knots or duty cycle exceeds 10%, the safe distance should be increased to 1000 m. During active sonar transmission at source levels (SL) above 200dB, the danger zone defined by the safety distance should be monitored visually and/or using available passive acoustic sensors. Check in particular for presence of bow riding dolphins. If marine mammals appear within the danger zone, transmissions shall be ceased, or source level reduced to 200 dB, until the animal is outside of the danger zone.

- ***2.3.3. Ramp-Up procedure***

Whenever feasible and if transmitted source level exceeds 200 dB, sonar transmissions should be initialized by the following ramp-up procedure: Reduce speed, preferably to less than 8 knots. Start transmissions at reduced source level (maximum 180 dB) and gradually increase the source level over a period of at least 3 min. Use short inter-ping intervals (less than 10 s) and ping durations of 0.3-1 sec. If transmissions are interrupted for more than 5 min, the Ramp-Up procedure shall be repeated. If visual conditions do not allow for visual control of the danger zone, the Ramp-Up procedure should always be used.

- ***2.3.4. Transmissions at high speed (monitoring)***

If the vessel speed and the transmission interval imply that the vessel covers more than 200 m between two successive transmissions (pings), or the speed exceeds 15 knots, one must at all times have a strong focus on presence of marine mammals in the travelling direction of the vessel. Transmissions at high speed should be avoided if visual control of the danger zone is difficult.