

Preface

This Handbook concerns potential interferences of man-made (**anthropogenic**) noise sources with the **acoustic spectra** exploited by marine mammals, the mitigation steps taken by industry, regulatory authorities and ultimately Marine Mammal Observers (MMOs), Protected Species Observers (PSOs), Marine Fauna Observers (MFOs), and **Passive Acoustic Monitoring** (PAM) Operators. For brevity, MMOs, PSOs, MFOs and all other visual observers are referred to collectively as MMOs throughout the Handbook.

The purpose of this Handbook is to provide an all-in-one, comprehensive yet concise and simple user manual on the topic of marine mammal mitigation during industrial activities for all stakeholders, regardless of their experience. The Handbook aims to increase MMO and PAM standards universally, by bringing together all aspects of this discipline into one easily accessible resource. The manual serves as a platform to offer sound advice and dispel myths on what is achievable currently on marine mammal mitigation, considering physics of **sound propagation**, limitations of visual observation, and current industrial PAM technologies. If used correctly, the Handbook should edify the reader on how to understand sensible and practical mitigation techniques and to recognise substandard mitigation procedures and equipment in use currently throughout industry. Moreover, an MMO or PAM Operator armed with this book should be able to implement mitigation measures and respond knowledgeably to questions on the job, during general client liaison and project kick-off meetings, or when writing MMO and PAM reports. The Handbook has focused on visual and acoustic mitigation from vessels, and installations. For brevity, marine mammal aerial surveys are not discussed, as they are seldom used for mitigation in industry, and are more applicable to scientific research.

Detecting marine mammals in the field is always challenging; for example, visual watches are constrained typically by weather, whilst PAM relies firstly on animals vocalising in sufficient proximity to an underwater microphone (**hydrophone**), and in some cases, animals vocalising towards a hydrophone. Consequently, the use of MMO and PAM is not 100 per cent (%) effective, but with adequate training and knowledge, MMO and PAM Operators armed with a well-engineered, installed, optimised and properly configured PAM system, can offer the most effective mitigation solution available.

Intended readership:

- trainees and existing MMOs, PAM Operators, and fisheries observers;
- marine science and other discipline graduates considering entering the field;

- non-graduates (school-leavers) with no prior MMO or PAM experience;
- MMO/PAM trainers and course providers worldwide;
- PAM equipment manufacturers, suppliers, owners and distributors;
- environmental consultancies supplying MMO/PAM services;
- intermediary consultancies and recruitment agencies supplying MMO/PAM services;
- client and contractor representatives with job titles such as Health, Safety, Environment (HSE) and Quality Manager, Health and Safety (H&S) Advisor, Marine or Offshore Environment Manager, Environmental Development Manager, Environmental or Scientific Advisor, Environmental Policy Manager, Director of Environment, Environmental Coordinator, Regulatory Compliance and Environmental Manager, Environmental or Project and Consents Manager, Environmental Policy Analyst, Environmental Supervisor or Manager, Environmental and Community Relations Manager, Environmental Survey Manager, Operations or Project Manager, Marine or Offshore Project Officer or Manager, Technical Manager, Technical Superintendent, Technical Director, Permitting or Project Engineer, Permitting or Legal Advisor, Business or Product Development Manager, Sourcing or Procurement Manager, Commercial or Supply Chain Manager, Operations or Project Coordinator, Subcontractor Coordinator or Manager, Contracts Manager, Operations Manager, Vessel Manager or Superintendent, Dredging Supervisor or Superintendent, Hydrographic Party Chief or Manager, Chief Surveyor, Hydrographic Surveyor, Survey Engineer, Geophysicist, Geotechnical or Geophysical Engineer, Processing Geophysicist, Seismic Party Chief or Manager, Deputy Party Chief or Manager, Seismic Observer, Seismic Navigator, Air-Gun Mechanic, Navigation Officer (including vessel Master or Captain or Skipper or Coxswain), Offshore Installation Manager (OIM), Head of Mining Installation (HMI), Drilling Rig Manager, Head Drilling Engineer or Manager, Well Intervention Supervisor, Marine or Offshore Supervisor, Offshore Construction Manager (OCM), Military Exercise or Operations Manager, Research and Development (R&D) Manager, Fisheries Liaison Manager, and Reports Coordinator;
- governmental organisations such as Joint Nature Conservation Committee (JNCC) in the UK, National Parks and Wildlife Service (NPWS) in Ireland, Bureau of Minerals and Petroleum (BMP) in Greenland, National Environmental Research Institute (NERI) in Denmark, Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE) in the USA, Department of Fisheries and Oceans (DFO) in Canada, Department of the Environment, Water, Heritage and the Arts (DEWHA) in Australia and, most recently, Department of Conservation (DOC) in New Zealand;
- non-governmental organisations (NGOs) such as whale, dolphin and porpoise charities;
- scientists, research assistants, and universities;
- members of the public, e.g. amateur professionals;
- media, e.g. television, press and radio;
- tourism industry representatives such as wildlife-watching cruise operators; and,
- commercial charter vessel operators.

Chapter 1 familiarises the reader with different types and **species** of marine mammal, including a comprehensive table of worldwide distributions. The table permits the reader to identify quickly which species are likely to occur in the work area of interest.

Potential effects of **sound** on marine mammals are discussed, as are their hearing abilities. Where known, hearing ranges are summarised in a table.

Chapter 2 details mitigation techniques employed currently by offshore industries to minimise impact of noise on marine mammals, concluding with a table summarising current worldwide MMO and PAM guidelines.

Chapter 3 focuses on various sources of anthropogenic noise such as vessel engines, seismic surveys, piling and sound navigation and ranging (SONAR). Following a general introduction to each activity, typical noise levels and frequencies are reviewed, with reference to published noise measurements. Potential and known effects of each activity on marine mammals are addressed briefly, but the reader is directed to further reading.

Chapter 4 clarifies training and qualifications required to work as an MMO or PAM Operator worldwide. Prerequisites are listed, as are expected course contents, and details of offshore survival courses and medicals. The chapter concludes with writing Curricula Vitae (CV), and gaining offshore experience.

Chapter 5 prepares the reader for life offshore. All aspects such as packing, etiquette, mobilisation and demobilisation are discussed in relation to vessels and installations; operations, such as dredging, drilling or seismic, are reviewed separately.

Chapter 6 guides the reader through an MMO working shift, explaining equipment requirements, skills involved, data collection methods and marine mammal identification.

Chapter 7 outlines the physical basics of sound and units and highlights various ways sound is reported, and displayed visually.

Chapter 8 introduces types of marine mammal sounds, reviews potential functions, and presents vocalisation characteristics of all marine mammal species and **subspecies** (excluding freshwater marine mammals) in a comprehensive table. To assist in-field PAM species identification, literature for Odontocetes is expanded on in depth in the text.

Chapter 9 presents a brief review of PAM systems in use today, focusing on the use of towed PAM for industrial mitigation purposes. The chapter details PAM equipment set-up, deployment, operation and care from mobilisation to demobilisation. A detailed section on configuration, use and troubleshooting in Passive Acoustic Monitoring Guardianship (PAMGuard) software is presented. The reality of the chances of detecting a vocalising marine mammal in an industrial situation is also discussed.

Chapter 10 describes how to compose and structure simple and effective MMO and PAM reports.

This Handbook contains a number of abbreviations and technical terms listed in the acronyms and glossary respectively. Abbreviations are written in full on first mention, and then acronyms used throughout. Likewise, terminologies in the glossary are in bold on first mention, but not thereafter. Units follow the **International System of Units (SI)** and those referred to in text are included in the units list, and explained in detail in Chapter 7. Used throughout the Handbook, the term 'offshore' refers to any marine environment activities, including those in coastal areas.

This Handbook is organised into sections that facilitate quick and easy access to relevant information concerning any particular aspect of marine mammal mitigation. Sections provide the reader with topical background, knowledge and examples to assist with a fast and effective response to mitigation situations arising in the field. A competent PAM Operator requires moderate comprehension of the physics of sound propagation (and complete understanding of units used), but the Handbook does not

swamp the reader with equations, nor does it cover the wider field of anthropogenic sounds (and modelling), sound-related behaviour, or sound production and hearing capabilities of marine mammals. These topics are dealt with effectively in a plethora of scientific reviews, papers, reports and books, many of which are cited as further reading where applicable, and listed in the bibliography.

Scientific names of all marine mammal species are included in Tables 1.1 and 1.2, but for brevity, species are referred to using British common names throughout; sub-species are not discussed in text, but distributions, hearing and vocalisation ranges are addressed separately in Tables 1.2, 1.4 and 8.3 respectively.