

**MARINE
MAMMAL
OBSERVER
AND PASSIVE
ACOUSTIC
MONITORING
HANDBOOK II**

MARINE MAMMAL OBSERVER AND PASSIVE ACOUSTIC MONITORING HANDBOOK II

Victoria L.G. Todd and Ian B. Todd

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We would very much welcome constructive comments to this edition and should you wish to contribute to a future edition by way of data, sightings, research or other material experience please contact us on: mmonoandpamhandbook@osc.co.uk

‘If you can meet with Triumph and Disaster
And treat those two impostors just the same’
From ‘*If*’ by Rudyard Kipling

‘It is the green-eyed monster which doth mock’
From ‘*Othello*’ by William Shakespeare

‘Anger, resentment and jealousy doesn’t change the heart of others –
it only changes yours’
Shannon Alder

‘The dolphins gonna dive, dive, dive, dive, dive,
And the sea lions bark and jive, jive, jive, jive, jive,
But me? I’ll just glide, glide, glide, glide, glide
I shake it off, I ride the tide’
Anonymous

*For Ian Todd —
my best friend, wisest sounding board, and co-conspirator
in all things life.*

*To our daughter, Petra Todd —
a brilliant whirlwind of laughter and logic,
who never knows what day it is.*

*To the late Bill (William A.) Watkins —
for believing in me and for being the only mentor I ever
had.*

*To my dear Friend Phil Clapham —
who gave me my husband.*

*And in loving memory of Eugenia Ramsay —
beautiful in spirit and in form, and forever missed.*

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Dr. Victoria Todd & Ian Todd – Founders, Ocean Science Consulting Ltd.

Dr. Victoria Todd and Ian Todd are the visionary co-founders and Managing Directors of Ocean Science Consulting Ltd. (OSC), an independent, globally recognised marine science company headquartered in Dunbar, East Lothian, Scotland. Together, they have built OSC into a pioneering force in marine mammal research, monitoring, underwater acoustics, and environmental consultancy, with operations extending across the UK, Greece, and New Zealand Asia Pacific.

Victoria Todd, a British–Greek marine biologist/oceanographer, has charted an extraordinary path through academia and applied science. Her early fascination with marine life led her to a B.Sc. in Marine Biology from the University of Liverpool, followed by an M.Sc. in Oceanography at Woods Hole Oceanographic Institution (WHOI) and the National Oceanography Centre (NOC), and a Ph.D. from the University of Leeds. Her career has spanned continents and extremes – from Arctic expeditions and Galápagos fieldwork to UNEP collaborations and BBC Wildlife scripting. A commercial diver and relentless innovator, she founded OSC in 2004 to bridge rigorous science with real-world conservation through working with offshore industries (and to get out of academia!), enabling her to pursue independent research while delivering high-impact consultancy. Victoria is a Research Fellow at the Institute of Sound and Vibration Research (ISVR) at the University of Southampton.

Ian Todd, a Scottish–Dane engineer, is a former Third Engineer Officer in the Merchant Navy, where he served deep-sea with P&O Nedlloyd, once the world's largest container-shipping company. He is also a trained Health & Safety Officer, SCUBA instructor, BSAC first-class diver, and powerboat skipper. He holds degrees in Marine Resource Development & Protection (Heriot-Watt University) and Business & Economics (University of Edinburgh), as well as diplomas in Agricultural and Marine Engineering from Glasgow College of Nautical Studies. In addition, he possesses a



Class IV Officer Certificate from the UK Maritime & Coastguard Agency. Bringing a wealth of operational and technical expertise to OSC, Ian's maritime background laid the foundation for his transition into marine science consultancy. Since joining OSC in 2005, he has served as Director of Operations, overseeing logistics, safety, and project delivery across hundreds of offshore campaigns. His leadership has been instrumental in shaping OSC's reputation for excellence in acoustic monitoring and environmental compliance.

Together, the Todds have authored the original *Marine Mammal Observer & Passive Acoustic Monitoring Handbook*, a globally adopted reference that has elevated industry standards. Since 2004, their company has delivered hundreds of commercial offshore projects worldwide, supporting sectors from offshore renewables and defence to oil

and gas, and contributing to scientific understanding through peer-reviewed publications and international collaborations.

Their shared life – both personal and professional – embodies a rare synergy of scientific rigour, entrepreneurial spirit, and deep commitment to marine conservation. As they present the second edition of the Handbook, their legacy continues to shape the future of marine mammal science and acoustic monitoring.



Foreword

The often-repeated fact that the Earth's surface is more than 70% water is a simple observation that should remind us of the importance of the aquatic environment to the planet as a whole. Yet the relative opacity of the ocean makes it a mysterious inaccessible world that presents a great many challenges when seeking to understand the physical processes and ecosystems that exist within it.

In recent years, having significantly depleted the Earth's land-based resources, there has been a technological focus on greater exploitation of the marine environment, with the associated danger of further degrading the ecosystems within it. Potentially damaging anthropogenic activities include: the ever-expanding use of maritime transport; large-scale fisheries; aquaculture; offshore renewable energy; and extraction of hydrocarbons and other mineral resources. Additionally threats to the marine ecosystem can arise from anthropogenic terrestrial activities, leading to pollution, for example from microplastics, and global warming, which not only change the temperature of the seas, but higher CO₂ concentrations in the atmosphere leading to acidification of the ocean. Understanding and mitigating the impacts of these activities on marine ecosystems is an imperative.

Marine mammals occupy a special place in the general public's consciousness: something that is seemingly a widely held cultural artefact. The reasons behind this iconic status are debatable. The giant size of the great whales is almost certainly one contributing factor, whilst the intelligence and inquisitiveness of various dolphin species may be another. These animals' occasional appearances at the water surface, forced on them by their continued need to breathe air, affords the fortunate casual observer the opportunity to see these creatures. Most other marine fauna remain hidden beneath the waves: the occasional unexpected appearance of marine mammals may be another reason for their favoured position in the public's psyche. Alternatively, one might speculate that this stems from a collective sense of guilt associated with the hunting to near extinction of some of the larger whale species, associated with widespread commercial whaling that has been greatly curtailed since the mid-1980s.

For those seeking to study the behaviour of marine mammals, the fleeting glimpses they offer at the sea surface provide a very incomplete view of their world. Workers in this field can be heard to bemoan these problems, comparing their relative lack of opportunity for observation with those whose study species are terrestrial, and frequently have much greater opportunity to observe directly their chosen subjects for extended periods. This overlooks the challenges associated with studying the non-air breathing oceanic species, such as marine fishes, where direct observation is even more challenging. Indeed, one factor that makes marine mammals an important species group to investigate is the relative ease with which they can be monitored when compared to many other large marine animals. Furthermore, as top predators, marine mammals are well suited as an indicator of broader marine ecosystem health.

The cultural significance, and the growing need to be able to assess the health of marine ecosystems, means that the protection of marine mammals is legally mandated in most of the world and, consequently, their protection has both commercial and ethical importance, reinforced by strong public opinion. The enforcement of these protections leads to the need to be able to observe and monitor marine mammals. Both factors have led to a continued growth in the need to observe and record the presence of these animals.

The traditional method of visually observing marine mammals, typically from vessels, remains an important tool; however, recent years have seen a significant rise in the use of passive acoustic monitoring, which is particularly effective as a tool for toothed whales, who tend to be more vocal than other marine mammals. This increased use has been driven by the greater availability of reliable, cost-effective instruments that can be deployed for extended periods, alongside a growing legislative requirement to conduct such monitoring.

Passive acoustic techniques offer the advantage of long-term, traceable data collection. Nonetheless, they face limitations: accurately estimating range to an animal is difficult, distinguishing between certain species can be unreliable, and the method depends on animals actively vocalising. As a result, the most effective monitoring strategies integrate both visual and acoustic approaches.

This dual methodology underscores the value of this book, which comprehensively addresses both visual and acoustic monitoring. The extensive practical experience of the authoring team brings the subject to life, offering an accessible and authoritative resource on these vital areas of marine mammal research.

Prof. Paul White
Institute of Sound and Vibration Research
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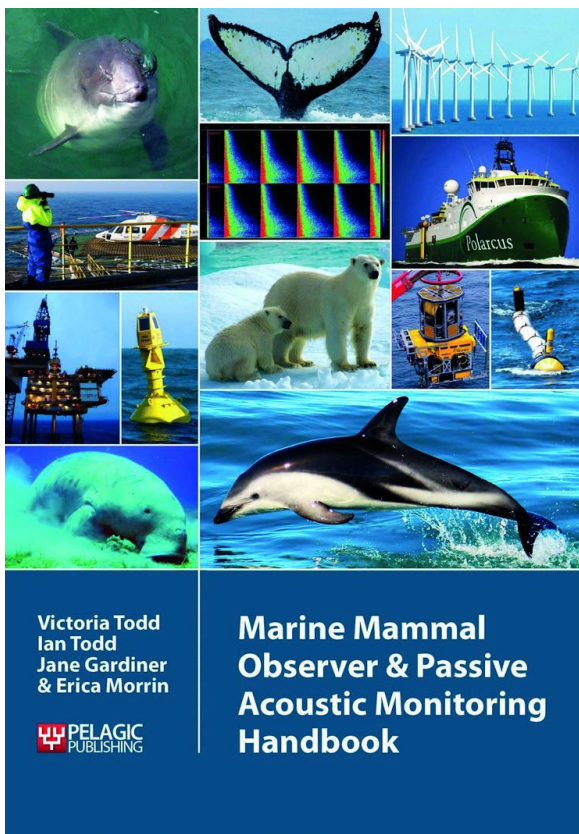
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Thank you to Dr. Bob Carling, who initiated this process for the first edition of the book, and without whom we could not have brought the second edition to completion. Bob's precision, accuracy, attention to detail, and tireless hard work make him a brilliant editor, and a highly knowledgeable publisher. Bob, you are a gem.

Ocean Science Consulting Ltd.

Ocean Science Consulting Ltd. (OSC) is proud to present the second edition of the *Marine Mammal Observer and Passive Acoustic Monitoring Handbook*. As the first publication of OSC Publishing House®, this volume reflects a commitment to sharing knowledge, supporting best practice, and advancing the marine science and offshore sectors for the benefit of current and future practitioners and researchers.

When OSC entered the field, it recognised the need to standardise marine mammal observation and acoustic monitoring practices, which were previously inconsistent. Driven by a commitment to scientific integrity and environmental protection, OSC un-



dertook a four-year journey to produce the first edition. Though this non-profit effort impacted company revenues significantly, it was a necessary investment to ensure the highest standards. The first edition has since become an industry benchmark, adopted widely by practitioners, regulators, and researchers. This second edition builds on this legacy, incorporating the latest scientific advancements and practical insights to further enhance effectiveness and consistency.

Although OSC has received multiple acquisition offers from larger organisations over the years, it remains an independent, privately owned international marine science consultancy, headquartered in Dunbar, East Lothian, Scotland. Founded in 2004 by Dr. Victoria and Ian Todd, OSC specialises in underwater noise impact assessment, marine mammal risk mitigation, and rigs-to-reefs decommissioning studies across offshore industries including Oil and Gas (O&G), renewable energy, ports, aquaculture, and defence. With bases in the UK, Greece, and New Zealand, OSC delivers a comprehensive suite of scientific and environmental services.

OSC is unique in reinvesting a significant portion of its profits into peer-reviewed scientific research, conducted by staff during paid company time. With over 80 publications at the time of this 2026 book, its work has influenced marine policy and licensing decisions globally. The company is expanding into product development, including systems for Passive Acoustic Monitoring (PAM), underwater noise measurement, and machine learning tools for imagery and acoustic data analysis. Core offerings include marine fauna mitigation and monitoring, with expertise in Marine Mammal Observers (MMOs), PAM Operators (PAMOs), Fisheries Liaison Officers (FLOs), and European Seabirds at Sea (ESAS) observers. OSC also provides internationally recognised MMO and PAM training, accredited by the UK's Joint Nature Conservation Committee (JNCC), New Zealand's Department of Conservation (DOC), the US National Marine Fisheries Service (NMFS), the Government of Taiwan, and the Institute of Marine Engineering, Science, and Technology (IMAREST). OSC leads in underwater noise measurement and modelling, offering real-time and autonomous monitoring, desk-based-propagation modelling, and bespoke software for visualisation and analysis. These services support Environmental Impact Assessments (EIAs), licensing, and mitigation planning. In decommissioning and rigs-to-reefs, OSC conducts marine growth assessments, Remotely Operated Vehicle (ROV) video analysis, taxonomic identification, and Net Environmental Benefit Analysis–Comparative Assessment (NEBA-CA). ROV and drone services support infrastructure inspection, marine mammal surveys, and environmental monitoring. OSC also offers bespoke experimental design, instrumentation advice, and statistical modelling, including Interim Population Consequences of Disturbance (iPCoD), Disturbance Effects on the Population Consequences of Noise (DEPONS), and Geographic Information Systems (GIS)-based species distribution and collision risk models. ISO-certified (9001, 14001, 45001), OSC is a trusted scientific partner delivering rigorous, policy-shaping marine environmental solutions.



When it comes to marine mammals and underwater noise, *'if you want to do it by the book, use the people who wrote the book™'*. For client enquiries about OSC's core services (www.osc.co.uk/services/), contact projects@osc.co.uk. For recruitment-related queries, please email recruitment@osc.co.uk.

Contributors

Dr. Petros Hadjichristodoulou is the head of OSC's Research & Development (R&D) department and is an electrical engineer and physicist with a Ph.D. in Physics, a M.Sc. in Electrical and Electronics Engineering, and an MBA. He has led R&D efforts in marine acoustic monitoring, working on towed, static, and remote passive acoustic monitoring systems. With expertise in electronics, sustainable energy systems, and optical systems, Petros combines academic rigour with practical engineering. His work has supported advancements in acoustic technology, development strategies, and system calibration for environmental monitoring and conservation.

Helen McLachlan is part of the Administration team at OSC and holds a B.Sc. in Molecular Biology & Biochemistry and M.Sc. in Molecular Biology & Pathology of Viruses. She also has a background in proofreading, having gained qualifications in this from the CIEP, and has worked on the copy-editing for the Handbook, together with OSC's portfolio of research papers.

Dr. Mario Rollo is Head of Acoustics at OSC, with over two decades of experience in bioacoustics and ecological research. He holds a Ph.D. in Zoology from the University of São Paulo (USP) and completed a doctoral research exchange at the Department of Ecology and Evolutionary Biology at the University of California, Santa Cruz. He has held academic positions at São Paulo State University (UNESP) and Umeå University in Sweden and has been a visiting researcher at the Coastal and Marine Resources Centre (CMRC) at University College Cork (UCC) in Ireland and at the National Institute of Biology in Ljubljana, Slovenia. His expertise spans terrestrial and underwater acoustics, sound propagation modelling, ecoacoustics, and the acoustic behaviour of a wide range of organisms, including marine mammals, fish, insects, and plants. Mario has contributed to international research and consultancy projects involving acoustic monitoring, environmental impact assessments, and long-term ecological studies, bringing a multidisciplinary and globally informed approach to

marine and environmental acoustics.

Rachel Watson is OCS's Report Coordinator. She has an M.Sc. in Applied Marine and Fisheries Ecology and a BA in Film and Media Arts. Prior to moving to Scotland to attend a master's programme, she lived in Los Angeles and worked in the film industry as an assistant editor. Rachel has an eye for detail and was responsible for updating the main marine mammal tables in Chapter 1, helped copyedit the entire Handbook, and wrangled staff to work on their assigned sections.

Dr. William Wu is a senior underwater acoustician at OSC and lecturer at the Institute of Sound and Vibration Research (ISVR) at the University of Southampton. With a B.Eng., a M.Sc., and a Ph.D. in underwater acoustics, his research interests focus on underwater acoustical signal processing, propagation modelling, and source characterisation, as well as electronic systems and fibre optic acoustical sensing. William was also a Marie Skłodowska–Curie Doctoral Fellowship holder, under which he was funded by EC H2020 to develop a non-invasive method of measuring fish swim bladder resonance, and to investigate underwater noise pollution in rivers flowing through urban areas.

Dr. Yang Yang is a senior underwater acoustician at OSC, specialising in both active and passive underwater acoustics. With extensive experience in acoustic surveys and data analysis, he has contributed to numerous projects supporting the sustainable development of offshore renewable energy – such as windfarm developments – and the responsible decommissioning of offshore structures, including oil platforms. His work focusses on the assessment of marine biological resources, fisheries, and underwater noise to better understand and mitigate the impacts of anthropogenic activities on marine life, through the lens of underwater sound.

Maria Zachariades is OSC's Senior Business Administrator, holding an M.Sc. in Landscape & Wellbeing from The University of Edinburgh, a Diploma in Architecture from UCL and recently qualified MMO from OSC. With diverse industry experience, Maria's role encompasses improving business systems and practices, administration aspects of OSC's MMO and PAMO courses, and occasional photography. Additionally, Maria is the overall coordinator for the second edition of the Handbook and OSC's 2025 Conference at the National Museum of Scotland.

Preface

The purpose of the second edition of this Handbook is to provide an all-in-one, comprehensive yet concise and, mercifully, simple user manual on the topic of marine mammal mitigation during offshore industrial activities for all stakeholders, regardless of their training, qualifications, or experience. Specifically, this Handbook concerns potential interferences of man-made (*anthropogenic*) noise sources with *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 Operators (PAMOs).

Drawing on the overwhelmingly positive feedback on the first edition, the second version aims to update and improve the *status quo* of MMO and PAM standards universally, by bringing together all aspects of this discipline into one easily accessible resource. The Handbook serves as a platform to offer clear and reliable advice and dispel myths on what is achievable currently in the industry field of marine mammal mitigation, considering the 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 PAMO 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 focusses on all forms of visual and acoustic mitigation from vessels and offshore installations (rigs and platforms), and includes a new section on use of drones, and other autonomous marine mammal detection methods, including exciting new (and as of yet, unpublished) content on Forward-Looking InfraRed (FLIR), Radio Detection And Ranging (RADAR), and SOund Navigation and Ranging (SONAR), specifically because the authors of this book at Ocean Science Consulting Limited (OSC) were chosen to perform *avant-garde* field trials for the Sound

and Marine Life Joint Industry Programme (JIP) (www.soundandmarinelife.org/).

Detecting marine mammals in field conditions 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, as for the harbour porpoise (*Phocoena phocoena*), animals vocalising towards a hydrophone. Consequently, use of MMO and PAM is not 100 percent (%) effective, but with adequate training and knowledge, MMO and PAMOs equipped with a well-engineered, installed, optimised and properly configured PAM system (no, that should not be an oxymoron), can offer the most effective mitigation solution available.

While a proficient PAMO should have a sound understanding of the physics of sound propagation (and a thorough grasp of units involved) the Handbook avoids overwhelming the reader with equations. It does not attempt to cover the broader domains of anthropogenic noise (and its modelling), noise-related behaviour, or mechanisms of sound production and hearing in marine mammals. These subjects are addressed comprehensively in a wide range of scientific reviews, papers, reports, and books, many of which are cited for further reading and listed in the bibliography; therefore, if you're an academic in pursuit of the universal panacea for underwater acoustics, complete with nested integrals, frequency-dependent absorption coefficients, and a generous helping of coupled wave equations (yes, we all know who you are, so no more Schadenfreuder-esque comments about why we didn't do this in the first edition – it was deliberately so!), then this is *not* the book for you. In fact, if your idea of a good time involves solving Helmholtz equations in spherical coordinates while debating the merits of parabolic equation models *versus* ray theory, you may find this book alarmingly simple, and THAT's the point. Our intended worldwide readership includes, *inter alia*:

1. Trainees, existing MMOs, PAMOs, and fisheries Observers;
2. Marine science (and other disciplines) and new graduates considering entering the field;
3. Non-graduate (school-leavers) with no prior scientific, MMO, or PAM experience;
4. MMO/PAM trainers and course providers;
5. PAM equipment manufacturers, suppliers, owners, and distributors;
6. Environmental consultancies supplying MMO/PAM services;
7. Intermediary consultancies and recruitment agencies supplying MMO/PAM services;
8. Client and contractor representatives with job titles such as Health, Safety, Environment, & Quality Manager ([HSEQ](#)), Health & 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 & Environmental Manager, Environmental or Project & 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, Captain, 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 & Development ([R&D](#)) Manager, Fisheries Liaison Manager, and Reports Coordinator;
9. Governmental organisations such as the United Kingdom's ([UK](#)) Joint Nature Conservation Committee ([JNCC](#)) and the Marine Management Organisation ([MMO](#)) – yes, we know, deeply unfortunate acronym for our industry, and we had ours first (!) – 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 USA, Department of Fisheries & 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;
 10. Non-Governmental Organisations ([NGOs](#)) such as whale, dolphin, and porpoise charities;
 11. Scientists, Research Assistants, and universities (but only if you don't give us a hard time for not including the Westervelt equation, and yes, while we do know about nonlinear propagation, diffraction, and thermoviscous losses, we're *still* not including it in this new edition, no matter how many times you ask us to);
 12. Members of the public *e.g.* amateur professionals;
 13. Media *e.g.* television, press, and radio;
 14. Tourism industry representatives such as wildlife-watching cruise operators; and,
 15. Commercial charter vessel operators.

Chapter 1 Introduction introduces marine mammal species and their global distributions, enabling readers to identify likely species in specific regions. It explores marine mammal hearing and potential impacts of anthropogenic noise. This foundational chapter equips readers with essential biological and acoustic context for understanding mitigation strategies discussed in subsequent chapters.

Chapter 2 Mitigation measures outlines global strategies to mitigate industrial noise impacts on marine mammals. It covers legislation, Marine Protected Areas (MPAs), planning, operational controls, and real-time monitoring. Techniques include acoustic deterrents, noise-reduction technologies, and SONAR. A global table of MMO and PAM guidelines highlights legal and ecological responsibilities, offering a structured, practical approach to effective marine mammal protection.

Chapter 3 Noise sources explores anthropogenic noise sources in marine environments, distinguishing between ambient and background noise. It categorises sound types – impulsive, continuous, and intermittent – and examines their acoustic properties and biological impacts. The chapter underscores the importance of understanding each industrial activity’s acoustic footprint to guide effective mitigation by MMOs and PAMOs.

Chapter 4 Training clarifies training, qualifications, and certifications required to become an MMO or PAMO. It covers global course standards, offshore survival, and medical requirements. A useful table summarises Personal Protective Equipment (PPE) and survival training across jurisdictions. The chapter also guides Curriculum Vitae (CV) preparation and highlights the importance of continual professional development and practical field readiness.

Chapter 5 Offshore life (www.youtube.com/@victoriatodd7765) offers a detailed guide to offshore life for MMOs and PAMOs. It covers contracts, mobilisation, safety, conduct, and operations on vessels and installations. Emphasis is placed on professional behaviour, health and safety, risk assessments, and PPE. The chapter prepares readers for real-world offshore conditions, including surveys, seismic work, and military SONAR.

Chapter 6 MMO theory and practice provides a comprehensive guide to MMO fieldwork, covering essential equipment, observation techniques, data collection, and marine mammal identification. It includes practical methods for range and bearing estimation, low-visibility detection tools (IR, RADAR, SONAR), and additional roles such as ROV and UAV support. A very useful table summarises MMO data recording procedures and behavioural classifications.

Chapter 7 PAM theory presents the physical principles of underwater sound relevant to PAMOs. It explains frequency, amplitude, sound pressure levels, propagation, and the (only!) SONAR equation. The chapter also covers visualisation techniques like spectrograms and waveforms. A convenient table summarises source levels of anthropogenic, biological, and natural noises, supporting practical understanding of acoustic environments encountered offshore.

Chapter 8 Vocalisations covers marine mammal vocalisations, detailing sound types, frequency ranges, and source levels across species. It supports PAMOs in species identification and acoustic analysis. A very helpful table summarises vocalisation characteristics for seals, sea lions, walruses, and other marine mammals, providing essential reference data for fieldwork and report writing.

Chapter 9 PAM practice gives practical guidance for PAMOs, covering equipment set-up, deployment, monitoring, troubleshooting, and demobilisation. It includes detailed procedures for Passive Acoustic Monitoring Guardianship ([PAMGuard](#)) configuration and fault resolution. A very convenient table summarises PAM detection metrics and operational responsibilities, helping operators maintain system integrity and respond effectively during industrial activities.

Chapter 10 Report writing explains how to write clear, professional MMO and PAM reports. It covers structure, content, and formatting for summaries, methodologies, results, and recommendations. A handy table outlines daily and weekly reporting activities for seismic surveys. The chapter emphasises brevity, clarity, and accessibility for non-specialist clients, supporting both contract and salaried roles in the field.

HOW TO USE THIS BOOK

This Handbook is structured to allow quick and easy access to relevant information on all aspects of marine mammal mitigation. Each section provides contextual background, practical knowledge, and illustrative examples to support timely and effective responses to mitigation scenarios encountered in the field.

For brevity, MMOs, PSOs, MFOs, and all other visual observers are referred to collectively as ‘MMOs’ throughout the Handbook.

A note on the use of the acronym MMO: within this Handbook, we have used the term MMO to mean Marine Mammal Observer, as this is in general use throughout the industry; however, there are, confusingly, two other organisations which use this acronym, and they have indicated that the following designations should be used, so be aware of this when reading around the subject elsewhere:

- MMOa – Marine Management Organisation: a UK Government body responsible for licensing, regulating, and planning marine activities in UK waters;

- MMOb – Marine Mammal Observer: a trained professional who monitors and mitigates potential impacts of industrial activities (e.g. seismic surveys, pile driving, dredging) on marine mammals;
- MMOA – Marine Mammal Observer Association: a professional membership-based organisation that supports and represents MMOs globally.

Abbreviations are written in full, and highlighted in **blue font** on first mention, and then acronyms are used thereafter; abbreviations and technical terms listed conveniently in the **Acronyms** and **Glossary of terms** sections. Likewise, terminologies in the glossary are in *italics* (excepting scientific names) on first mention, but not thereafter. Units follow the *International System of Units* (**SI**) and those referred to in the text are included in the units list and explained in detail in **Chapter 7 PAM theory**. The term ‘offshore’ refers to any marine environment activities, including those in coastal areas.

Scientific names of all marine mammal species are included in **Table 1.1** and **Table 1.2**; for brevity, species are referred to using British common names throughout, and therefore unlike scientific convention, are not presented on first mention in the core text. Likewise, subspecies are not discussed in text, but distributions, hearing, and vocalisation ranges are addressed separately in **Table 1.2**, **Table 1.4**, and **Table 8.3** respectively.

We hope you enjoy this Handbook and welcome all feedback – positive or constructive. Please send your comments to info@osc.co.uk, using the subject line ‘MMO & PAM Handbook feedback’. We’ll do our best to respond promptly.

Enjoy!

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