



Walter M. X. Zimmer

# Passive Acoustic Monitoring of Cetaceans

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# Passive Acoustic Monitoring Of Cetaceans Walter Zimmer

**A. KNOWLES**



## **Passive Acoustic Monitoring Of Cetaceans Walter Zimmer:**

*Passive Acoustic Monitoring of Cetaceans* Walter M. X. Zimmer, 2011-04-21 Passive acoustic monitoring is increasingly used by the scientific community to study survey and census marine mammals especially cetaceans many of which are easier to hear than to see PAM is also used to support efforts to mitigate potential negative effects of human activities such as ship traffic military and civilian sonar and offshore exploration Walter Zimmer provides an integrated approach to PAM combining physical principles discussion of technical tools and application oriented concepts of operations Additionally relevant information and tools necessary to assess existing and future PAM systems are presented with Matlab code used to generate figures and results so readers can reproduce data and modify code to analyse the impact of changes This allows the principles to be studied whilst discovering potential difficulties and side effects Aimed at graduate students and researchers the book provides all information and tools necessary to gain a comprehensive understanding of this interdisciplinary subject

*A Resonant Ecology* Max Ritts, 2024-08-30 In *A Resonant Ecology* Max Ritts traces how sound s integration into the environmental politics of Canada s North Coast has paved the way for massive industrial expansion While conservationists hope that the dissemination of whale songs and other nature sounds will showcase the beauty of local wildlife for people around the world Ritts reveals how colonial capitalism can co opt sonic efforts to protect the coast He demonstrates how digital technologies allow industry to sonically map new shipping lanes and facilitate new ways of experiencing sound premised not on listening but on sound s exploitable status as a data resource By outlining how sound can both perpetuate and refuse capitalist colonialism Ritts challenges the idea that the sonic realm is inherently liberatory and reveals sound to be a powerfully uncertain object Through a situated geographical approach he makes the case that only a decolonial and multigenerational environmental politics can counter the false promise of sustainable marine development held up by industry and the state

**The Journal of the Acoustical Society of America** Acoustical Society of America, 2002 **The Passive Acoustic Coding and Tracking of Cetaceans** Raymond Walter Browne, 1998 **Passive Acoustic Monitoring of Cetaceans at Intertidal Weirs in Minas Basin, Nova Scotia** Monica L. Reed, 2014 *Advancement of Methods for Passive Acoustic Monitoring : a Framework for the Study of Deep-diving Cetacean* Alba Solsona Berga, 2019 Marine mammals face numerous anthropogenic threats including fisheries interactions ocean noise ship strikes and marine debris Monitoring the negative impact on marine mammals through the assessment of population trends requires information about population size spatiotemporal distribution population structure and animal behavior Passive acoustic monitoring has become a viable method for gathering long term data on highly mobile and notoriously cryptic marine mammals However passive acoustic monitoring still faces major challenges requiring further development of robust analysis tools especially as it becomes increasingly used in applied conservation for long term and large scale studies of endangered or data deficient species such as sperm or beaked whales Further challenges lie in the translation of animal presence into quantitative population density

estimates since methods must control for variation in acoustic detectability of the target species environmental factors and for species specific vocalization rates The main contribution of this thesis is the advancement of the framework for long term quantitative monitoring of cetacean species applied to deep divers like sperm and beaked whales Fully automated methods were developed and implemented to different populations of beaked whales in different conditions This provided insight into generalization capabilities of these automatic techniques and best practices However implementing these tool kits is not always practical and alternative methods for additional data processing were developed to expeditiously serve multiple purposes including annotation of individual sounds evaluation of data in order to provide a highly dynamic technique and classification for quantitative monitoring studies This work also presents the longest time series of sperm whale presence using passive acoustic monitoring for over seven years in the Gulf of Mexico Echolocation clicks were detected and discriminated from other sounds to understand the spatiotemporal distribution and structure of the population A series of steps were implemented to provide adequate parameters and characteristics of the target population for density estimation using an echolocation click based method This allowed for the study of the Gulf of Mexico s sperm whale population providing significant progress towards the understanding of the population structure distribution and trends in addition to potential long term impacts of the well known catastrophic Deepwater Horizon oil spill and other anthropogenic activities The emergence of innovative approaches for detecting the presence of marine mammals and documenting human interactions can provide insight into ecosystem change These species can be used as sentinels of ocean health to ensure the conservation of their marine environment into the next epoch

### **Impacts of Environment-Dependent Acoustic**

**Propagation on Passive Acoustic Monitoring of Cetaceans** Carolyn M. Binder, 2018 Significant effort has been made over the last few decades to develop automated passive acoustic monitoring PAM systems capable of classifying cetaceans at the species level however these systems often require tuning when deployed in different environments Anecdotal evidence suggests that this requirement to adjust a PAM system s parameters is partially due to differences in the acoustic propagation characteristics The environment dependent propagation characteristics create variation in how a cetacean vocalization is distorted after it is emitted If these differences are not accounted for it could reduce the performance of automated PAM systems An aural classifier developed at Defence R accurate results are obtained by using perceptual signal features that model the features employed by the human auditory system In this thesis a combination of an at sea experiment and simulations with bowhead and humpback whale vocalizations was conducted to investigate the robustness of the classifier performance to signal distortion as a function of propagation range It was found that in many environments classification performance degraded with increasing range largely due to decreased signal to noise ratio SNR however in some environments as much as 40% of the performance reduction was attributed to signal distortion resulting from environment dependent propagation It was found that sound speed profiles resulting in considerable boundary interaction

were important for producing sufficient signal distortion to affect PAM performance relative to the impacts of SNR. Therefore in some environments the ocean acoustic properties should be taken into account when characterizing performance of automated PAM systems. For the environments in which signal to noise issues dominate the use of multi element arrays is expected to increase the performance of automated recognition systems beyond the minor improvements to be gained from adjusting a PAM system's parameters. Nonetheless propagation modelling should be used to complement PAM experiments to account for bias in probability of detection estimates resulting from environment dependent acoustic propagation.

*Passive Acoustic Monitoring of Arctic Cetaceans* Joshua M. Jones, 2021 Arctic marine mammal habitats are changing rapidly while marine shipping is increasing in some areas of the Arctic. Passive acoustic monitoring can increase understanding of Arctic marine mammal responses to change and to stressors like ship traffic. The strength of inference from underwater sound recordings is limited by several factors that I address in this dissertation with the aim of improving the usefulness of acoustic monitoring findings for Arctic marine resource management. I provide spatial context for acoustic detections of bowhead whale sounds enabling direct comparisons of acoustic presence across different locations and environmental conditions. Ice cover and noise substantially reduce the predicted listening area around underwater sound recorders. Spatially normalized acoustic detections reveal that bowhead whales utilize an area at least 140 km north of Alaska during their spring migration migrating through large areas of 90% sea ice cover. I describe acoustic characteristics of beluga and narwhal echolocation clicks which differ substantially in frequency content and rhythmic patterns. Sound absorption by seawater and apparent changes in animal orientation strongly affect frequency spectra of recorded clicks. Finally I measure the underwater soundscape within a narwhal summer habitat and quantify underwater noise added by commercial ship traffic. The natural soundscape excluding periods with nearby ships is relatively quiet in an acoustically sheltered fiord. Distant sounds from regional shipping are apparent at a less sheltered location open to long range sound propagation. When ships pass the recording locations sound levels are elevated above the median levels of natural sounds for periods ranging from 30 minutes up to 4 hours with each transit. Icebreaker and tanker ships radiate more underwater noise than general cargo and bulk carrier ships. Ship sounds overlap with common social sounds produced by narwhals and ringed seals at distances of 5 to 30 km from passing ships possibly interfering with animal communication. Improved detection distance estimates and understanding of detection probability estimation coupled with increased confidence in detection and identification of beluga narwhal and bowhead sounds will facilitate passive acoustic density estimation of Arctic marine mammals investigation of their relationships with habitat and studies of their behavioral responses to ship traffic.

*Passive Acoustic Monitoring of Cetacean Distribution North-west of the Hebrides, 1997-1998* T. P. Lewis, Hebridean Whale and Dolphin Trust, 1998

**Passive Acoustic Monitoring for the Detection and Identification of Marine Mammals**, 2009 This project is intended to advance the state of passive acoustic monitoring. Improved methods of identifying cetaceans are developed in

order to contribute to the Navy's mitigation efforts *Acoustic Monitoring of Cetaceans: Feasibility Review Report A.* KNOWLES, 2002 Developing a Passive Acoustic Monitoring Network for Harbor Porpoise in California Eiren Kate Jacobson, 2017 Assessing the abundance of and trends in whale, dolphin, and porpoise cetacean populations using traditional visual methods can be challenging due primarily to their limited availability at the surface of the ocean. As a result, researchers are increasingly interested in incorporating non-visual and remote observations to improve cetacean population assessments. Passive acoustic monitoring (PAM) can complement or replace visual surveys for cetaceans that produce echolocation clicks, whistles, and other vocalizations. My doctoral dissertation is focused on developing methods to improve PAM of cetaceans. I used the Monterey Bay population of harbor porpoise *Phocoena phocoena* as a case study for methods development. In Chapter 2, I used passive acoustic data to document that harbor porpoises avoid bottlenose dolphins *Tursiops truncatus* in nearshore Monterey Bay. In Chapter 3, I investigated whether different passive acoustic instruments could be used to monitor harbor porpoise. I recorded harbor porpoise echolocation clicks simultaneously on two different passive acoustic instruments and compared the number and peak frequency of echolocation signals recorded on the two instruments. I found that the number of echolocation clicks was highly correlated between instruments, but that the peak frequency of echolocation clicks was not well correlated, suggesting that some instruments may not be capable of discriminating harbor porpoise echolocation clicks in regions where multiple species with similar echolocation signals are present. In Chapter 4, I used paired visual and passive acoustic surveys to estimate the effective detection area of the passive acoustic sensors in a Bayesian framework. This approach resulted in a posterior distribution of the effective detection area that was consistent with previously published values. In Chapter 5, I used aerial survey and passive acoustic data in a simulation framework to investigate the statistical power of different passive acoustic network designs and hypothetical changes in harbor porpoise abundance. As a whole, this dissertation used an applied approach to methods development to advance the use of PAM for cetaceans. Acoustic Recording System Shannon Rankin, Jay Barlow, 2011. Technological advances in both software and hardware have led to dramatic improvements in systems used for passive acoustic monitoring (PAM) of cetaceans from a variety of platforms. While these advances have vastly improved the quality and quantity of data, the rapid evolution of hardware and software have made it difficult to allow for standardization and collaboration between researchers. Recently, government scientists responsible for PAM of cetaceans have been coordinating efforts in an attempt to standardize methods, including hardware and software, to allow for collaboration and comparison of results. In addition, standardization of methods will allow the various organizations to make the most of limited resources. One component of this standardization was to create a portable acoustic recording system that would be the primary hardware package for standard shipboard surveys using towed hydrophone systems and would allow recordings from the full range of cetacean sounds up to 160 kHz.

**Static Acoustic Monitoring of Cetaceans** European Cetacean Society. Conference, 2006 *Static Acoustic*

*Monitoring of Cetaceans* R. H. Leeney, N. J. C. Tregenza, European Cetacean Society. Conference, 2006      Acoustic  
Monitoring of Cetaceans Along the Dorset Coast: an Interim Report C. OWEN, 2002      *Static Acoustic Monitoring of*  
*Cetaceans in Cardigan Bay, Wales* Hanna Katariina Nuuttila, 2012      **Passive Acoustic Monitoring of Toothed Whales,**  
**with Implications for Mitigation, Management and Biology** Line Anker Kyhn, 2010      **Passive Acoustic Monitoring**  
**of Large Whales in Offshore Waters of British Columbia** , 2010      **Passive Acoustic Monitoring of North Atlantic**  
**Fin Whales with the Use of Ocean Bottom Seismic Arrays** Laura Gilling, 2016

## **Passive Acoustic Monitoring Of Cetaceans Walter Zimmer** Book Review: Unveiling the Magic of Language

In an electronic era where connections and knowledge reign supreme, the enchanting power of language has are more apparent than ever. Its ability to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**Passive Acoustic Monitoring Of Cetaceans Walter Zimmer**," written by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we shall delve in to the book is central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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