United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea

Nineteenth meeting

18 to 22 June 2018
(United Nations Headquarters)

Panel discussion
"Anthropogenic underwater noise"

Biographies and abstracts of panellists

Segment 1: Sources and environmental and socioeconomic aspects of anthropogenic underwater noise

Monday, 18 June 2018

3 – 6 pm

Dr. Christopher Clark
Director and Imogene Johnson Senior Scientist for the Bioacoustics Research Program, Cornell University

Bio
Dr. Christopher W. Clark, an engineer and biologist, was the founding Director and Imogene Johnson Senior Scientist for the Bioacoustics Research Program at the Cornell Lab of Ornithology and is a research professor in the Department of Neurobiology & Behavior, Cornell University. When asked what he does, his answer is simple: "I listen to this singing planet!" Dr. Clark helped develop and apply advanced acoustic technologies to advance understandings of animal communication and the health of wildlife populations around the globe. He has listened to and studied whales for over forty years, with a focus on endangered whales. He has a long history of successfully working at the interface between science, applied engineering, industry, and regulations–all with the specific objective of using science to understand the potential impacts of human activities on marine mammals and to inspire and enable the scientific conservation of marine wildlife and habitats. Most recently he has devoted considerable effort to scientific advocacy through documentary films and outreach.

Abstract
"***Scientific overview of sound, its sources and how it propagates underwater***"
Two basic features of sound are pitch (acoustic frequency) and loudness (sound level typically measured in decibels, dB). The loudness of a sound as it travels through the ocean depends on its acoustic frequency and the physical properties of the ocean. The physical features of the ocean that enable the sound of a ship, a seismic airgun explosion or a military sonar signal to be heard (perceived/detected) throughout an ocean area are the same features that enable us to listen to a singing blue whale, a whistling killer whale or an echolocating dolphin throughout an ocean area. Each sound source produces a sound field and an aggregate collection of sound fields can be visualized as a dynamically fluctuating, three dimensional acoustic environment (scene). This presentation will provide visualizations of acoustic scenes for vessels and seismic airguns, individually and in aggregate, at a variety of spatial, temporal and frequency scales as a way of illustrating concepts about acoustic interference and to demonstrate the ranges over which anthropogenic sound sources might reduce the abilities of animals to successfully engage in essential life activities (e.g. navigate, communicate, echolocate, avoid predators).

Dr. Richard Hale
Director, EGS Survey Group

Bio
B.Sc. Mathematics and Physics, University of Bristol
M.Sc. Geophysics, University of Birmingham
Ph.D. Statistics and Earth Sciences: "Quantifying the Accuracy of Measurements in the Earth Sciences", University of Hong Kong

Since 1976, Richard Hale has worked on geophysical, oceanographic and environmental survey projects around the globe. Since becoming a director of the EGS group of survey companies in 1991, Dr. Hale has been based on Hong Kong. He now mainly works on planning and surveying routes for submarine power cables and telecommunications cables.

Abstract

"Underwater Sounds from Submarine Cable and Pipeline Operations"

The United Nations' Global Goals for Sustainable Development have targets to improve the quality of life on our planet. At all levels, working towards these goals often requires scientific, cultural, environmental and economic information from distant parts of the world. Much of the information is accessed through the internet via submarine telecommunications cables. Submarine cables are a vital infrastructure, important for socio-economic progress consistent with the UN's Sustainable Development Goals.

Submarine cables have an environmental impact. Some impacts are ecologically positive. Routine practices mitigate adverse impacts, so that residual impacts are small, temporary and reversible. One residual impact is underwater sounds generated during cable surveys and installation. This paper will describe the extent and duration of these sounds. It will show that their duration and acoustic footprint is small compared with other marine engineering operations, particularly compared with offshore construction and seismic surveys for energy exploration.

The acoustic characteristics of survey operations for submarine pipelines are similar to cable surveys. Sounds from submarine pipeline installations are intermediate between cable installation and offshore construction.

Environmental regulators have an important role in ensuring that the world's seas and oceans are not damaged by offshore operations. The United Nations has encouraged this forum to provide information to environmental regulators about sounds made during offshore operations. The aim should be to ensure that the regulations are calibrated to the extent required for different types of offshore activities.

Dr. Lee Kindberg

Head of Environment, Health, Safety and Sustainability, Maersk Line in North America

Bio

Lee Kindberg is Head of Environment, Health, Safety and Sustainability for Maersk Line in North America. Maersk Line is the world's largest container shipping company.

She currently serves on the Marine Board of the US National Academies of Science. She served on the US Environmental Protection Agency's Clean Air Act Advisory Committee and Mobile Source Technical Review Subcommittee, and co-chaired the EPA Ports Workgroup from 2014-2016. She is also active in Business for Social Responsibility's Clean Cargo Working Group, a global group dedicated to assessing and improving the environmental impact of shipping.

Dr. Kindberg has a B.S. in Chemistry from the University of Alabama and a Doctorate in Chemistry from the University of South Carolina. She joined Maersk Line in 2005.

Abstract

"Shipping as a Source of Anthropogenic Underwater Sound"

Commercial vessels have been identified as sources of underwater sound, with cavitation related to propulsion systems making the primary contribution. This presentation will cover sources of

sound from commercial shipping vessels, mitigation approaches, and 2017 studies which tested mitigation approaches at full scale in commercial services.

Since 2015 Maersk Line has modified a number of commercial container vessels to improve energy-efficiency. In 2017 Maersk worked with Scripps Institution of Oceanography to define the impact of the retrofits on underwater radiated noise. The study found significant reductions in sound in the low and mid-range frequencies which are believed to impact marine mammals. The estimated underwater sound pressure levels of the five selected vessels were lower for post-retrofitted vessels by a median of 6 dB in the low-frequency band (8 - 100 Hz) and a median of 8 dB in the higher-frequency band (100 - 1000 Hz). These reductions may result from less cavitation due to both the retrofitted propellers with boss cap fins, and from propeller operation at greater depth where ambient pressure is higher. Operating conditions optimizing both energy efficiency and sound generation have not been fully defined, however reductions of ship source sound pressure levels due to changes such as those employed by these retrofits may result in ocean-basin-wide noise reductions.

Dr. Jill Lewandowski
Chief, Division of Environmental Assessment, Bureau of Ocean Energy Management, United States Department of the Interior

Bio
Dr. Jill Lewandowski holds a Ph.D. in Environmental Science and Public Policy from George Mason University. She currently serves as BOEM's Chief of the Division of Environmental Assessment where she leads a national-level team of experts in providing environmental science and policy advice to decision-makers. In this role, Jill also manages strategic initiatives to improve scientific rigor, stakeholder engagement, readability and effectiveness of BOEM's environmental analyses.

Jill previously served as BOEM's subject matter expert on protected species and marine sound issues and also managed the Division's compliance with environmental consultations. Prior to joining BOEM in 2005, Jill worked as a marine biologist with the National Marine Fisheries Service and a conservation programs administrator for the National Wildlife Federation.

About the Office of Environmental Programs
BOEM's Office of Environmental Programs (OEP) sets national policy and provides guidance to ensure that environmental protection informed by science and law is a foremost concern and an indispensable consideration in BOEM's decision-making. The environmental program covers the three major areas that BOEM regulates on the outer continental shelf: oil and gas, renewable energy, and non-energy minerals such as sand and gravel or hard minerals. The program coordinates headquarters and regional activities.

About OEP's Division of Environmental Assessment
BOEM conducts environmental assessments to evaluate the potential impacts of activities BOEM permits by using science, engaging stakeholders, and working with governmental partners and tribal communities.

Abstract
"Different Sources of Sound: Offshore Energy Development"
As human presence in the offshore environment has grown, so have the anthropogenic sound levels. Current science shows us that some of these sounds may adversely impact marine life in certain situations. Some sounds can interrupt important biological behaviors (courtship, nursing, feeding and migration) and can interfere with communication between animals. In more extreme instances, exposures to sounds at high levels or for extended periods of time can lead to

physiological effects, including hearing loss and mortality. Research shows that the same level of sound may have a different impact on the same species of marine life depending where in the ocean the sound occurs, and the behavioral context in which the animal encounters the sound.

Understanding potential impacts of human-induced sound on marine life is complex. One of the beginning steps in coming to this understanding is to characterize the sources making potentially impactful noise. This presentation will focus on three sound sources used in the development of offshore energy. These include: (1) airgun arrays for seismic surveys to define geologic structures with potential for oil and gas deposits; (2) pile driving for the construction of wind facilities; and (3) explosives for the removal of oil and gas structures. A general overview is provided for each of these sources as well as information on protective measures normally required to reduce the potential for effects. In addition, emerging and available 'quieting' technologies are discussed as these are aimed at reducing potential sound outputs, and thus impacts, to marine life from these sources.

Dr. Larry Mayer
Director, School of Marine Science and Ocean Engineering, Director Center for Coastal and Ocean Mapping, University of New Hampshire

Bio
Larry Mayer is a Professor and Director of the School of Marine Science and Ocean Engineering and The Center for Coastal and Ocean Mapping at the University of New Hampshire. He received a Ph.D. from the Scripps Institution of Oceanography in Marine Geophysics in 1979. After being selected as an astronaut candidate finalist for NASA's first class of mission specialists, Larry went on to a Post-Doc at the School of Oceanography at the University of Rhode Island where he worked on the early development of the Chirp Sonar and problems of deep-sea sediment transport and paleoceanography. In 2000 Larry became the founding director of the Center for Coastal and Ocean Mapping at the University of New Hampshire. Larry has participated in more than 95 cruises (over 75 months at sea!) during the last 38 years, and has been chief or co-chief scientist of numerous expeditions including two legs of the Ocean Drilling Program and nine mapping expeditions in the ice-covered regions of the high Arctic. He is the recipient of the Keen Medal for Marine Geology and an Honorary Doctorate from the University of Stockholm. He was a member of the President's Panel on Ocean Exploration and chaired National Academy of Science studies on national needs for coastal mapping and charting and the impact of the Deepwater Horizon Spill on ecosystem services in the Gulf of Mexico. He was the co-chair of the NOAA's Ocean Exploration Advisory Working Group, the Vice-Chair of the Consortium of Ocean Leadership's Board of Trustees, and is currently the Chair of the National Academies of Science's Oceans Studies Board, a member of the State Dept.'s Extended Continental Shelf Task Force, the Navy's SCICEX Advisory Committee, and Vice Chair of the Board of the Ocean Exploration Trust. In 2016 Larry was appointed by President Obama to the Arctic Research Commission, in 2017 he was elected to the Hydrographic Society of America Hall of Fame, and in 2018 he was elected to the National Academy of Engineering. Larry's present research deals with sonar imaging and remote characterization of the seafloor as well as advanced applications of 3-D visualization to ocean mapping problems and applications of mapping to Law of the Sea issues, particularly in the Arctic.

Abstract
"Sonar Imaging and Ocean Mapping"
Mapping is the fundamental process by which we explore, navigate, engineer, exploit, protect, and understand the world around us. Through the great advances of modern remote sensing technology, it is now relatively simple to image and map the one-quarter of the earth's surface that is readily visible to optical sensors on satellites. This is not the case, however, for the three-quarters of the earth's surface that lies beneath the oceans where the electromagnetic waves used for earth imaging have very limited propagation. We must, therefore, use other sensors to map

the ocean depths and image sub-surface ocean processes. For thousands of years, the only sensor available to measure ocean depths was a piece of lead at the end of a long line. In the early 20th century, single beam echo sounders were developed, directly introducing anthropogenic sound into the oceans. Over the past one hundred years, ocean mapping technology has evolved from single beam echo sounders to sidescan sonars to large and powerful multibeam echo sounders that produce wide swaths but beam-form to achieve high-resolution. Multibeam sonars (and sidescan sonars) have a fundamentally different geometry from single beam sonars. Long (in the along-ship direction) arrays are used to produce a swath that is very narrow (typically 1 deg. or less) in the along-track direction and a wide (typically 120 to 150 deg) in the across track direction. Mapping multibeam sonars operate over a wide range of frequencies (typically from about 12 kHz to 455 kHz) with the physical size of the sonar, output power, and achievable ranges increasing as the operating frequency decreases. Concern about the potential impact of multibeam echo sounders on marine mammals has focused on the low-frequency systems which are too big to bring into calibration tanks, and thus until recently, the best we could do to understand their potential impacts was to model their radiation patterns. Lurton (2016) has provided the best models we have for deep water multibeam systems and, taking into account the extreme directivity (in the along-ship direction) and short pulse lengths, he concludes that even for worse-case scenario (12 kHz) "the computation of ranges corresponding to impact thresholds accepted today shows that impacts in terms of injury are negligible for both SPL and SEL; however behavioural response impacts cannot be excluded and should require specific experimentation." We have followed this modeling effort with a field experiment at the U.S. Navy hydrophone array off San Clemente Island California (SCORE). We collected 12 kHz multibeam sonar data over this array to directly measure the far-field radiation pattern of the multibeam. In doing this experiment, we were also able to monitor the foraging behavior of Cuvier's beaked whales in a manner identical to those studies that clearly demonstrated the impact of Navy mid-range sonar on beaked whale foraging (Tyack, et al., 2011). Using the same analytical approach applied to the Navy sonar studies, the initial analysis of these data indicate that for the metrics measured (group vocalization number, group vocalization duration), the multibeam sonar appears to have no impact on the foraging behavior of the whales.

Tuesday, 19 June 2018

10 am – 1 pm

Dr. Rudy Kloser
Commonwealth Scientific and Industrial Research Organisation (Australia)

Bio
Dr. Rudy Kloser is a senior research scientist and leader of the acoustics and pelagic ecosystem characterisation team within the ecosystem characterisation group and marine resources and industry program at the CSIRO's Marine and Atmospheric Research Division, Hobart, Australia. The team provides scientific advice about the structure, function and dynamics of pelagic ecosystems in light of climate change, variability and human use. Rudy's specific research area is investigating reflected and ambient acoustic signals in the ocean with associated optical and physical sampling to make ecological inferences about the water column and the seabed, and more broadly to learn about ecosystem function and dynamics. A recent research area is the development of bio-acoustic methods for local and basin scale characterisation of macro zooplanktonic and micronektonic communities using ships of opportunity including fishing and research vessels (http://imos.org.au/basoop.html). Current research is focused on utilisation of this information into ecological models and indicators as well as the development of acoustic, optical and capture methods.

Abstract
"Potential anthropogenic underwater noise impacts on zooplankton to whales a general overview"
For most marine animals, sound is important for communication, locating particular features, prey, peers, predators and for short and long-range navigation. Anthropogenic sound (noise) in the marine environment is derived from many sources including marine traffic, marine installations, petroleum and mineral exploration and extraction, and defence operations. Noise created by these activities is increasing world-wide with varying acute and chronic impacts on a wide range of species from zooplankton to whales, with impacts depending on the exposure area, sound level, duration, distance and frequency. Species impacts observed range from the extremes of tissue injury and death, to permanent or temporary threshold shifts, to masking of vocal communication and disruption of normal behaviours. At the population level, the impacts of changes to feeding and reproduction and, in association, individual health and fitness are less well understood. Such population effects are likely influenced by not only the temporal period and spatial extent of exposure but also the population generation time. For example the documented impacts of sound generated during exploratory surveys for oil and gas on zooplankton may only exist at the population level for a short period of time (days and months) due to their high reproduction rate and ocean circulation. In comparison, impacts on longer lived mammal and fin fish species are likely to exist at the population level over larger spatial and longer time scales. Broader population and ecosystem impacts are difficult to quantify due to the difficulties of long term in situ cause and effect studies. To assess the scale of cumulative impacts of anthropogenic noise on marine ecosystems requires a framework that can evaluate risks across individuals to populations and overall ecosystems across appropriate temporal and spatial scales and within overall sound scapes for those ecosystems. Such a risk assessment framework would need to incorporate the multiple stressors acting on the ecosystem and be part of an overall management and governance arrangement that has appropriate balance of burden of proof and precaution.

Dr. Lindy Weilgart
OceanCare and Department of Biology, Dalhousie University

Bio
Lindy Weilgart has been specializing in underwater noise pollution and its effects on marine life since 1994. She has studied whales since 1982, primarily sperm whales, and her M.Sc. (Memorial Univ. of Newfoundland), Ph.D. (Dalhousie), and post-doctoral studies (Cornell) were all in the field of whale acoustic communication in the wild. Lindy has served as invited expert on several panels, workshops, and committees concerned with underwater noise impacts (e.g. Department of Fisheries and Oceans Canada, U.S. Marine Mammal Commission, International Whaling Commission, etc.). She has met with members of NATO, the European Parliament, the European Commission DG Fisheries, the Convention on Biodiversity, and the United Nations to discuss ocean noise issues, given many lectures on this topic and others, and published numerous peer-reviewed papers. She is currently a Research Associate in the Department of Biology, Dalhousie University, Canada, and was previously employed as Scientific Advisor by the private foundation Okeanos. She co-organized five Okeanos-sponsored scientific workshops on noise: 1) Alternative Technologies to Seismic Airgun Surveys for Oil and Gas Exploration and their Potential for Reducing Impacts on Marine Mammals; 2) Assessing the Cumulative Impacts of Underwater Noise with Other Anthropogenic Stressors on Marine Mammals; 3) Noise from Shipping Operations and Marine Life: Technical, Operational and Economic Aspects of Noise Reduction; 4) Noise-Related Stress in Marine Mammals; and 5) Spatio-Temporal Management of Noise. She also serves as Scientific Advisor for the International Ocean Noise Coalition, is Ocean Policy Consultant for OceanCare, a Swiss NGO, and was a Scientific Expert on the German government's Antarctic Commission.

Abstract
"*The impacts of anthropogenic underwater noise on invertebrates, fish, cetaceans and ecosystems in general*"
Most marine animals use sound for vital functions. Cetaceans can avoid important habitat, reduce their feeding and reproduction, alter their migrations, fatally strand, and die from ice entrapment due to noise. Noise impacts on fish and invertebrate development include body malformations, higher egg or immature mortality, developmental delays, delays in metamorphosing and settling, and slower growth rates. Zooplankton suffered dramatically high mortality in the presence of noise. Anatomical impacts from noise involve massive internal injuries, cellular damage to statocysts and neurons, causing disorientation and even death, and hearing loss. Damage to hearing structures can worsen over time even after the noise has ceased, sometimes becoming most pronounced after 96 hrs. post-noise exposure. Even temporary hearing loss can last months. Stress impacts from noise have been demonstrated by higher levels of stress hormones, greater metabolic rate, oxygen uptake, cardiac output, parasites, irritation, distress, and mortality rate, sometimes due to disease and cannibalism; and worse body condition, lower growth, weight, food consumption, immune response, and reproductive rates. DNA integrity was also compromised, as was overall physiology. Behaviorally, animals showed alarm responses, increased aggression, hiding, and flight reactions; and decreased anti-predator defense, nest digging, nest care, courtship calls, spawning, egg clutches, and feeding. Noise caused more distraction, producing more food-handling errors, decreased foraging efficiency, greater vulnerability to predation, and less feeding. Schooling became uncoordinated, unaggregated, and unstructured due to noise. Masking (obscuring of signals of interest) reduced communication distance and could cause misleading information to be relayed. Some commercial fish catches dropped by up to 80% due to noise, with larger fish leaving the area. Bycatch rates also could increase, while abundance generally decreased with noise. Ecological services performed by invertebrates such as water filtration, mixing sediment layers, and bioirrigation, which are key to nutrient cycling on the seabed, were negatively affected by noise. Noise also increased invasive species on ship hulls, potentially weakened the connectivity between fish populations, potentially changed predator-prey interactions and the community structure, compromising food web dynamics and stability,

and risked ecosystem productivity. Noise harmed species which graze on toxic bacteria, keep corals and algae in balance, and decrease eutrophication. Once the population biology and ecology are impacted, it is clear fisheries and even food security for humans are also affected.

Professor Daya Edirisinghe
Chairman, National Aquatic Resources Research & Development Agency, Sri Lanka

Bio
[to be provided]

Abstract
"*Acoustic pollution and its impacts on marine life*"
Acoustics is, however, a broad compilation of interlacing disciplines ranging from the arts to engineering, from seismography to psychology. Noise pollution has been reported both in terrestrial and aquatic environment. Noise emitted from transportation is one of four main sources of environmental noise, the others being noise from construction and building services, domestic and leisure activities, and industries. Noise causes several adverse health effects on human. Most of these effects may occur at exposure to noise levels of more than 70 dB. Sound can travel long distances underwater, sometimes hundreds or even thousands of kilometers Therefore, unwanted sound can have a large impact on the marine environment, because noise can blanket a very large area, potentially preventing fish or whales from hearing their prey or predators, finding their way, or connecting with mates, group members, or their young. Though, the oceans are naturally noisy environments, anthropogenic underwater noise is a relatively recent addition to the marine environment. Among them, commercial shipping is a major source of acoustic pollution which most likely affects marine biodiversity. The noise excess due to shipping, relatively to natural ambient level, can reach 70 dB. In addition to shipping, Submarines could affect marine life over an area of about 3.9 million km2 avoiding fish and whales. The loudest part of the background noise heard underwater is detected due 3,000 km away from the seismic airgun noise created by oil and gas exploration. Most marine animals, particularly marine mammals and fish, are very sensitive to acoustic pollution, using sound for almost all important aspects of their life including reproduction, feeding, avoiding hazards like predators, and navigation. Especially for long-lived species, such as whales, and where human-made background noise levels are rapidly rising, animals are not likely to adapt these changes. Seismic airguns have been shown to extensively damage fish ears at distances of 500 m to several kilometers. The decline in cetacean (whale and dolphin) species diversity has been reported with an increase in the intensity of seismic survey activity. Noise in the form of naval sonar or seismic surveys can be deadly to cetaceans in at least some cases. Further, the transient species of dolphins moved out, accounting for the decreased species diversity. Whales appear to die from bleeding in their brain and heart, perhaps as a result of decompression sickness from an altered dive pattern induced by a panic response to the noise. Codfish also have showed increased food consumption for more than a month following seismic noise exposure, as well as an alteration of gene expression in the brains of the exposed cod. Reduced catch rates of 40-80% and fewer fish near seismic surveys have been reported for cod, haddock, rockfish, herring, and sand eel. The marine mammal hot spots for particularly blue whales are located near proximity of the one of the busiest shipping lanes which runs close proximity to the south coast of Sri Lanka. However, impact of acoustic pollution created by commercial shipping on theses valuable has not been studied. Thus, precaution has to be made for the sustainability of these valuable living resources around the seas of Sri Lanka studying the impact caused by acoustic pollution formed by commercial shipping.

Dr. Jonathan Vallarta
Senior Underwater Acoustics Consultant, JASCO Applied Sciences; Senior Lecturer Iberoamericana University

Bio
Dr. Jonathan Vallarta is a senior underwater acoustics engineer and scientist with a range of expertise and field work experience. In 2009, Dr. Vallarta earned his PhD in Underwater Acoustics at Heriot-Watt University in Edinburgh, Scotland. He specialized in the design of new configurations for hydrophone arrays and development of localization algorithms using passive sonar techniques that accurately track the migratory patterns of cetaceans in areas where there is increased seismic and drilling activity. He worked for JASCO Applied Sciences from 2009 to 2014. Currently, Dr. Vallarta conducts PAM training courses in all Latin America and is now JASCO's key contact in Mexico. His interest continues to be in marine conservation issues, especially in reference to threatened species, noise pollution and mitigation. Dr. Vallarta also holds studies of General Biology from the Sciences Faculty of UNAM and a BEng in Electronics and Communications, from the University Iberoamericana of Mexico City, where he currently teaches the subjects of Theoretical Linear Systems and Advanced Signal Processing.

Abstract
"***Underwater Acoustic Soundscape of Paradise Reef, Cozumel: A Tool for Assessment, and Conservation Planning"***

Tourism is one of the many ecosystem services provided by healthy coral reefs. The economic benefits derived from these services sustain coastal cultures and social structure, contributing several billion dollars annually to local and national economies. In 2017 alone, the island of Cozumel received almost five million cruise ship visitors, with up to eight ships per day, drawn mainly to its coral reefs. Diving and snorkeling tourism in the National Reef Park of Cozumel is its main economic driver. Given the relative importance of this ecosystem service, identifying and maintaining healthy coral reefs is essential. Soundscape measurement using non-invasive, passive acoustic monitoring (PAM) is an emerging technology in biological assessment of coral reefs. JASCO in partnership with the Parque Nacional Arrecifes de Cozumel, deployed an Autonomous Multichannel Acoustic Recorder (AMAR) on Paradise Reef in July 2017. The AMAR recorded more than one month of continuous underwater acoustic data. The objectives of the study included characterizing both the anthropogenic and natural soundscapes of this location that is heavily trafficked by cruise ships and dive boats and is home to the IUCN red-listed Splendid toadfish (Sanopus splendidus). The largest contributor to the reef soundscape at this location is anthropogenic rather than biological sound, indicating a largely degraded coral reef. The highest amount of acoustic energy recorded at the reef during the day is from anthropogenic low frequency sources between 20 to 200 Hz. These sources include numerous small tourist boats and cruise ships during port arrival and departure. The constant sound of boat traffic may be masking toadfish and other species vocalizations, which could impact the behavior of the toadfish and the overall health of the reef. The data collected during this study can be used to inform reef conservation and management, as well as facilitate the identification of additional Splendid toadfish habitat in future deployments. Ocean users and resource managers are encouraged to work cooperatively to design policy that leads to success by developing appropriate measures to avoid, minimize and mitigate the possible significant adverse impacts of anthropogenic underwater activities. This initial study is demonstrating the power of acoustics as a tool for assessment and conservation planning.

Mr. Adrián Madirolas
Head of the Hydroacoustic Research Office, National Institute of Fisheries Research and Development, Argentina

Bio
Having just finished his degree on Electrical Engineering at the University of La Plata, Argentina, in 1987, he moved to the city of Mar del Plata to occupy a scientist position at the National Institute for Fisheries Research and Development (INIDEP) and in order to undertake Fish stock assessment by mean of Acoustic methods. Since then, he dedicated exclusively to the study of the remote sensing of the ocean by mean of sound waves. His background now comprises thousands of days carrying out Acoustic surveys, at sea and in several fresh water bodies, mapping the spatial distribution of organisms, describing their habitat and studying their behavior, in the underwater landscape. He has written numerous Reports and several scientific articles on the subject and presently occupies the position of head of the Hydroacoustics Lab at INIDEP.

Abstract
"Review on the impacts of anthropogenic underwater noise on fish"
The oceans and the fresh water bodies offer a physical medium that permits sound to propagate underwater efficiently and through long distances while being opaque to other type of energies, as it is the case for light and electromagnetic waves. Therefore, it is not surprising that most marine creatures are well adapted to the use of sound underwater. Fish relies on sound perception for key activities like communication or prey detection/predator avoidance. Some species even produce sound to locate their congeners at the time of reproduction. Then, it is not surprising either that anthropogenic underwater noise can interfere with their sound perception of the surrounding environment or even harm them under certain circumstances. A review based in a wide range of published articles is presented to shortly describe how fish perceive sound underwater and how sound stimuli caused by different man activities can trigger fish reactions and even harm them.

Dr. Peter Tyack
Professor of Marine Mammal Biology, Sea Mammal Research Unit, University of St Andrews

Bio
Peter Tyack is a Professor of Marine Mammal Biology at the University of St Andrews. His research focuses on behavioral ecology, especially acoustic communication and social behavior in marine mammals. He has studied the role of vocal learning in reproductive advertisement in baleen whales and individually distinctive contact calls in toothed whales, and echolocation in deep diving toothed whales. He has developed new methods to sample behavior continuously from marine mammals, including the development of sound-and-orientation recording tags, and has used these to study communication and echolocation. He has developed a series of studies on responses to anthropogenic sounds, including effects of oil exploration on baleen and sperm whales, and the effects of naval sonar on toothed whales. He chaired a committee of the US National Academy of Sciences Ocean Studies Board which wrote a 2017 report on "Approaches to Understanding the Cumulative Effects of Stressors on Marine Mammals."

Abstract
"Environmental aspects of anthropogenic underwater noise, including impacts on different marine species and ecosystems (cumulative impacts)"
Early marine conservation efforts focused on managing the number of fish or whales intentionally killed by humans. During the 20th century, fisheries biology aimed to maintain populations at levels set for efficient harvest. Even where declining catch per unit of fishing effort indicated the need for recovery, managers often failed to maintain healthy stocks of many harvested species. Managing individual species is problematic both because of economic factors and also because

changing the abundance of one species may change the ecosystem into a new state that becomes difficult to return to a state that we desire. As we industrialize the oceans, restoring the health of marine species and ecosystems demands understanding the effects of many different stressors, including new stressors that have not received enough attention. Underwater noise has recently been accepted as a significant stressor, as it can lead to the death of some animals and can have broader non-lethal impacts. Focused experiments document precisely how marine species respond to measured dosages of specific sounds, enabling the development of probabilistic dose:response functions. The impacts of noise interact with other stressors such as directed hunt, bycatch, toxic compounds, pathogens, and changes in physical and biological features of the ocean that are affected by climate change. We have neither the data nor the theory required to understand how these stressors are likely to interact, which means that we cannot predict when anthropogenic and natural changes to stressors threaten the survival of some species and the health of marine ecosystems. Rather than managing each stressor or species separately, managing modern marine ecosystems demands analyzing which stressors can be reduced to most effectively recover reduced populations and to maintain healthy ecosystems that will be resilient to combinations of stressors they are likely to face in the future.

Tuesday, 19 June 2018

3 – 4:30 pm

Dr. Joseph Appiott
Associate Programme Officer, Secretariat of the Convention on Biological Diversity

Bio
Joseph Appiott is an Associate Programme Officer at the Secretariat of the Convention on Biological Diversity (CBD). At the CBD Secretariat, Joseph works with governments, international organizations and other stakeholders to facilitate the implementation of the Convention with regards to marine and coastal biodiversity. This work includes facilitating the description and mapping of ecologically or biologically significant marine areas (EBSAs), coordinating capacity building activities, and synthesizing scientific and technical advice related to pressures on marine biodiversity (e.g., underwater noise, marine debris) and planning/management tools (e.g., marine spatial planning, area-based management). Joseph's work also includes coordination with, and input to, other UN agencies and multilateral processes with regards to issues related to marine and coastal biodiversity. Joseph has a Ph.D. and M.S. in Marine Policy from the University of Delaware, and a B.S. in Marine Biology from the University of Miami.

Abstract
"*Work Under the Convention on Biological Diversity on Understanding, Minimizing and Mitigating the Impacts of Anthropogenic Underwater Noise on Marine and Coastal Biodiversity*"
Parties to the Convention on Biological Diversity (CBD) have clearly acknowledged the threat that anthropogenic underwater noise poses to marine and coastal biodiversity, and have also emphasized the need for further work to better understand the nature of this threat and measures to address it. This presentation will review the ongoing work under the CBD on synthesizing the state of knowledge on the sources and impacts of anthropogenic underwater noise on biodiversity and ecosystems (as well as socio-economic implications), and identifying available tools and approaches to mitigate these impacts, with a view to achieving the Aichi Biodiversity Targets and Sustainable Development Goals.

Mr. Nicolas Entrup
Ocean Policy Expert, OceanCare

Bio
Nicolas Entrup is the principle Director of Shifting Values. He has served as a professional consultant to OceanCare on ocean noise for many years. In a career spanning more than two decades of conservation work, Nicolas has stood at the forefront of political advocacy for ocean noise mitigation in the last ten years, working through international process to build recognition of the issue and increase political commitment to its management and control. He has served as an expert advisor within a number of international ocean noise-related working groups and regularly meets with decision-makers in government and industry to progress this issue. In addition, he has amassed deep experience in the process of international diplomacy and advocacy, having participated in more than 20 different international biodiversity forums for a wide range of conservation issues.

Abstract
"*Socio-economic and cumulative impacts*"
The recognition of a socio-economic impact from ocean noise has lagged far behind the science, even though the logical extrapolation of what we know about ocean noise tells us that the impact on livelihoods and food security, by extension, is likely significant. To date, the industries generating this noise have given little consideration to the consequence of their activities.

Governments have all recently recommitted to global efforts to achieve healthy, sustainable oceans and restore fish stocks, through the 2030 Agenda for Sustainable Development.

The evidence is mounting and the underlying reality is clear. We need to quantify the impact of ocean noise on fisheries and conservation, and develop guidance for decision-makers, across the sectors, about the socio-economic risk posed to human livelihoods and food security. Absence of evidence is not evidence of absence.

Dr. Andrew Carroll
Assistant Director, Marine and Antarctic Geoscience, National Earth and Marine Observations Branch, Geoscience Australia

Bio
Dr Andrew Carroll is a marine ecologist at Geoscience Australia (GA), with research expertise in the management and conservation of marine biodiversity and the assessment of anthropogenic stressors on marine fauna. Andrew completed a Bachelor of Applied Science (Hons) and a PhD at Southern Cross University (Australia), where he studied patterns of coral reproduction and larval ecology on the Great Barrier Reef, Lord Howe Island, New Caledonia and French Polynesia. Since joining GA in 2012, Dr Carroll has applied his research and management expertise to address multiple government initiatives and strategic priorities as they relate to the management of Australia's marine estate, providing scientific advice on environmental considerations for sub-seabed geological storage of CO2, and the potential impacts of seismic surveys on marine fish and invertebrates. He has led and participated in several national and international seabed mapping surveys and is involved in the delivery of national biodiversity datasets through Australia's National Environmental Science Program (NESP) – Marine Biodiversity Hub, and other work programs at GA.

Abstract
"***The role of science in domestic policy-making on anthropogenic underwater noise: case studies from Australia"***
Geoscience Australia (GA) is a Commonwealth Government agency that provides impartial scientific advice to Government, industry and regulators to inform decision making on domestic activities and policy, including offshore exploration and resource development. In Australia, offshore petroleum exploration and development activities outside designated state and territory coastal waters are governed by the Commonwealth Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) (OPGGS Act) and associated regulations. Potential impacts on matters of national environmental significance (MNES) from marine seismic surveys are also regulated through the Environmental Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) and regulations (including EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales). Marine seismic surveys are a fundamental tool for geological research and resource exploration, but the sound generated during these surveys represents a significant source of noise pollution in the marine environment. Seismic surveys may negatively affect some cetaceans, fish and invertebrates, although the extent of these impacts remains uncertain for many species. During the last five years, the impacts of anthropogenic underwater noise has been a significant issue nationally and a focus of research and advice by GA. In this presentation, I will describe GA's environmental mitigation strategies as they relate to marine seismic surveys, using a recent survey of the Lord Howe Rise in the south Coral Sea as a case study. I'll then use the

Gippsland Marine Environmental Monitoring project to critically assess an integrated multi-disciplinary investigation of the potential impacts of marine seismic operations on fish and invertebrates, particularly in the context of future research and management priorities for Australian marine resources.

Segment 2: Cooperation and coordination in addressing anthropogenic underwater noise

Tuesday, 19 June 2018

4:30 – 6 pm

Ms. Heidrun Frisch-Nwakanma
Convention on Migratory Species

Bio
Heidrun Frisch-Nwakanma has a degree in environmental geography, with a focus on sustainable development and community involvement in rural areas of developing countries. Her thirteen years with UNEP/CMS have allowed her to develop her expertise in marine species conservation.

Heidrun has been coordinating the Secretariat of the Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (UNEP/ASCOBANS) from early 2007 until December 2016. The Agreement's Work Plan covers all threats to cetaceans in the region, including anthropogenic ocean noise. In January 2017, she took over coordination of a regional instrument focusing on marine turtles in the Indian Ocean and South-East Asia (IOSEA Marine Turtles MOU). Her role also includes providing technical and scientific support to the Aquatic Species Team of the UNEP/CMS Secretariat, focusing on cross-cutting issues such as underwater noise, bycatch, pollution including marine debris, aquatic bushmeat and boat-based wildlife watching.

Abstract
"CMS Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities – a tool for decision-makers"
Applying the emerging knowledge on the effects of underwater noise on marine species in local and national decision-making is a challenge. Those entrusted with granting approvals and permits for activities in the marine environment need ways of assessing in advance what the impact on marine life will be, which can best be achieved by making effective use of Environmental Impact Assessments (EIA).

The presentation will provide an overview of a set of guidelines detailing the requirements for EIAs that allow managers to make informed decisions, which were endorsed by the Government Parties to the Convention on the Conservation of Migratory Species of Wild Animals (CMS) in October 2017 through Resolution 12.14. The Guidelines cover the most important noise sources, such as military and civil high-powered sonar, shipping and vessel traffic, seismic surveys, construction works, offshore platforms, playback and sound exposure experiments, pingers, and other noise-generating activities such as acoustic data transmission, wind, tidal and wave turbines, and future technologies.

The Guidelines, which are accompanied by detailed, policymaker-friendly Technical Support Information (CMS/COP12/Inf.11), are designed as a tool for Governments wishing to improve their ability to assess, regulate and address the impacts of underwater noise on marine life. They can be used in national and regional contexts, and applying them in EIAs allows the assessment of impacts across the full area impacted, which will often be across national boundaries.

Dr. Stefan Micallef and Mr. Frederik Haag
Assistant Secretary-General/Director, and Head, Office for the London Convention/Protocol and Ocean Affairs, Marine Environment Division, International Maritime Organization

Bio
Dr. Stefan Micallef graduated with a Ph.D. in marine toxicology from the University of Wales, UK. He started his career with the UN in 1990 as Programme Officer at the UNEP/IMO - Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC) based in Malta. In 2000, he joined UNEP's Division of Environmental Policy Implementation in Nairobi, Kenya, as Chief of the Disaster Management Branch. In 2004, he moved to the Headquarters of the International Maritime Organization in London, UK, as Head of the Chemical & Air Pollution Prevention Section in the Marine Environment Division. In 2007, he became Deputy Director of the Sub-Division for Pollution Response and Technical Co-operation within the Division and is currently the Director of the Division, a post he has held since January 2012. As Director of the Marine Environment Division, he is responsible for the Secretariat functions behind all the regulatory and capacity-building matters relating to the protection of the marine and atmospheric environment from ship-source pollution by oil, noxious and hazardous substances, sewage, garbage, alien invasive species and anti-fouling systems, as well as the prevention of air pollution and the control of greenhouse gas emissions from ships. He also serves as Secretary to the Marine Environment Protection Committee (MEPC) and is the Administrative Secretary of the UN Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP). In January 2018, the Secretary-General of the IMO appointed him Assistant Secretary General.

Mr. Fredrik Haag graduated with a Phil. Lic from University of Uppsala, Sweden, in earth sciences, focusing on applied environmental impact assessments and coastal zone management. He also holds a Master of Maritime Affairs from the World Maritime University (WMU). Whilst working for the Swedish Maritime Administration, he was transferred to IMO on secondment in 2006, initially working as GESAMP Officer, coordinating the work of GESAMP. In 2008, he moved to the GEF-UNDP-IMO GloBallast Partnerships Project as Technical Adviser, and took over the management of the project as its Chief Technical Adviser in 2011. In IMO he has been dealing with a variety of issues, such as dumping of wastes at sea, ballast water management, GHG emissions from ships, Particularly Sensitive Sea Areas (PSSAs), noise, marine litter, sustainable development issues and SDGs, and other UN-wide initiatives. In late 2012, he joined the Office for the London Convention/Protocol and Ocean Affairs, and since August 2017 holds the post of Head of the Office.

Abstract
"IMO's work in relation to underwater noise"
The International Maritime Organization's (IMO) work in relation to noise, began with addressing the effects of noise on humans aboard ships in the early 1980s, through the adoption of a Code on noise levels on board ships. In 2004, in response to the growing body of research that was emerging on the issue, the Marine Environment Protection Committee (MEPC) commenced discussions on the harmful impacts of underwater noise from ships on marine life. As a result of this work, IMO, in 2014, recognizing that underwater noise associated with shipping was an issue that could be mitigated and addressing concerns about its short and long-term negative impacts on marine life, especially marine mammals, approved guidelines for commercial ships on ways to reduce underwater noise. This non-mandatory instrument entitled Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life (MEPC.1/Circ.833) is intended to provide general advice on the matter to designers, shipbuilders and ship operators. Recently, at MEPC 72 (2018), the Committee encouraged Member States to continue to share their experiences in dealing with the reduction of underwater noise from shipping and indicate their interest in collaborating on a proposal for a new output on this issue to a future session of the Committee.

The issue of underwater noise and its effects on marine life is also taken into account through IMO adopted "Particularly Sensitive Sea Areas" (PSSAs). These are areas considered to deserve special protection, due to their recognized ecological or socio-economic or scientific significance, and which may be vulnerable to damage by ships. The 2005 Revised guidelines for the identification and designation of Particularly Sensitive Sea Areas, recognizes that noise from ships can adversely affect the marine environment and living resources of the sea. Noise has also been discussed in the context of the work of the London Convention and Protocol on the protection of the marine environment from pollution from dumping of wastes and other matter, noting that dredging activities, being the main source of wastes dumped at sea under these treaties, are also a source of anthropogenic noise. Through the Scientific Groups of the London Convention and Protocol delegations have been sharing information, with the view to build a better understanding of the issue.

Dr. Rebecca Lent
Executive Secretary, International Whaling Commission

Bio
Rebecca Lent joined the IWC in January of this year as the Executive Secretary. Trained as a marine economist, Rebecca served as Executive Director at the U.S. Marine Mammal Commission for the five years prior to joining the IWC. She has also worked in international fisheries at NOAA, focusing on multilateral management of highly migratory target species. Rebecca started her career as a professor in economics at Université Laval in Quebec.

Abstract
"Addressing impacts of underwater noise on cetaceans: the global approach of IWC"
For over 70 years the International Whaling Commission has been the global authority on cetaceans, providing science as well as monitoring and mitigation recommendations to address the major threats to marine mammals. Underwater noise can have serious impacts on cetaceans that depend on the acoustic environment for communication, for locating prey and predators as well as members of their own group. The impact of underwater noise on cetaceans has been the subject of research and review by the IWC's Scientific Committee for over a decade, with clear recommendations calling for measures to reduce the impacts at the individual and population-level through improved monitoring, data collection, and research. The Scientific Committee has noted compelling evidence that chronic anthropogenic noise is affecting the marine acoustic environment in many regions. The IWC and its members have worked through IMO, CMS, ASCOBANS and ACCOBAMS and other partners, and its work is relevant to the Aichi Targets of the CBD, the efforts of the IUCN on Marine Protected Areas, and to efforts at the regional level, such as the EU's Marine Strategy Framework Directive. Working with the Scientific Committee, the IWC's Conservation Committee will continue to address anthropogenic sound through collaborative approaches.

Wednesday, 20 June 2018

10 am – 1 pm

Cdr. René Dekeling
Co-chair of the European Commission expert group TG Noise

Bio
Cdr. René Dekeling is a navy officer with an operational background in the Netherlands Naval Air Service. He also obtained a degree in environmental sciences and he has worked on marine environmental protection issues for more than 15 years for the Royal Netherlands Navy. He is currently coordinator of the research programme on effects of underwater sound in the marine environment in the Netherlands Defence Materiel Organisation. He is also member of the team set up between Dutch government ministries to develop and implement the national Marine Strategy in the Netherlands, and he is the policy lead for management of effects of sound in the marine environment at the Ministry of Infrastructure and Water Management. International activities include co-chairing the European expert group TG Noise, tasked by the European Commission to provide guidance to EU member states to implement monitoring and management of underwater noise, and membership of the Strategic Advisory Board of the European Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI-Oceans).

Abstract
"***Cooperation at European Union level- implementation of the European Marine Strategy"***
Until 2008, there was no European regulation that explicitly mentioned underwater noise as environmental threat requiring management, although it was implicitly covered by overarching regulation, e.g. directives on biodiversity conservation, or directives on assessing and managing the impact of industries. This changed when the European Marine Strategy Framework Directive came into force in 2008; this Directive defines human-induced marine underwater noise as a pollutant and requires European Union member states to ensure that anthropogenic noise is at levels that do not adversely affect the marine environment. The Directive further requires European Union member states to address the effects at an ecosystem level and to ensure coordination in marine regions, leading to programs of measures that achieve or maintain good environmental status (GES) in all European seas.

As there was insufficient knowledge available, an expert working group was established in 2011 to provide advice to European Union member states. This Technical Group on Underwater Noise (TG Noise) made several guidance documents to come to methodology that would be unambiguous, effective and practicable. As monitoring of underwater noise was a priority, TG Noise developed a common approach to monitoring, which was described in the Monitoring Guidance for Underwater Noise in European Seas, published in 2014. Since then, significant progress has been made with implementation of monitoring of underwater sound, making use of regional scale registers for impulsive noise-generating activities and setting up joint monitoring programs for continuous noise. Present work of the TG Noise includes ensuring consistency between monitoring programs, both inside and outside Europe, and developing common methodology for assessment of the data obtained in monitoring programs.

Dr. Nathan Merchant
Principal Scientist, Noise and Bioacoustics Team, Centre for the Environment, Fisheries and Aquaculture (United Kingdom)

Bio
Dr Nathan Merchant is a principal scientific advisor on underwater noise to the UK Department for Environment, Food & Rural Affairs (Defra), co-convenor of the OSPAR Intersessional Correspondence Group on Noise, and a member of the European Technical Group on Noise, which advises on the implementation of the EU MSFD.

Abstract
"*Regional Approaches (OSPAR)"*
In recent years, OSPAR has made substantial progress in coordinating the monitoring, assessment, and management of underwater noise pollution in the North-East Atlantic. The 2010 Quality Status Report included an overview of the available science, and in 2014 a dedicated technical group, the Intersessional Correspondence Group on Underwater Noise (ICG-NOISE), was established. To aggregate and harmonise data on impulsive noise sources collected by OSPAR Contracting Parties, the OSPAR Impulsive Noise Registry was commissioned in 2015. This registry provides an overview of reported impulsive noise activity in the OSPAR Maritime Region, and formed the basis of the 2017 Intermediate Assessment, which presented the first international assessment of anthropogenic pressure from impulsive noise sources. To address monitoring and assessment of continuous noise sources including shipping, OSPAR has developed an ambient noise monitoring strategy (published 2015) and is supporting the development of joint monitoring programmes. To assist Contracting Parties to reduce underwater noise pollution at source, OSPAR has produced inventories of noise mitigation techniques for different noise sources. Looking ahead, OSPAR is currently developing an indicator to quantify the risk of impact from impulsive noise on key species. This work may facilitate the setting of targets for impulsive noise activity, in alignment with the requirement to set noise thresholds under the EU Marine Strategy Framework Directive.

Ms. Loúrenne Jones
Manager, Ecosystems Management Division, National Environment and Planning Agency (Jamaica)

Bio
Loúreene Jones is a marine scientist with over 15 years experience in Natural Resource Management. Her experience extends to the management of coastal and marine resources, coral reef monitoring and data management. Her work experience includes the Institute of Jamaica, the Discovery Bay Marine Laboratory and the Centre for Marine Sciences of the University of the West Indies, Mona. She is currently employed in the Ecosystems Management Branch of the National Environment & Planning Agency where she has direct responsibility for assisting with the management and protection of Jamaica's natural resources.

Abstract
"Cooperation and coordination in addressing anthropogenic underwater noise"
Ocean noise refers to sounds made by human activities that can interfere with or obscure the ability of marine animals to hear natural sounds in the ocean. While there have been several studies done on the topic in recent years, response and management efforts related to the phenomenon is largely underrepresented in Jamaica's management strategy. The impacts are however not foreign as activities which have been documented as being major sources of ocean noise occur within the island's marine waters.

Management efforts have been mainly concentrated on the impacts of seismic surveys on resource users and marine life in general. This has been based on industry best management practices. There is however a need for knowledge acquisition and capacity building to guide the response and management strategies in the subject area.

Dr. Mariana Melcon
Group leader bioacoustics research line, Fundacion Cethus

Bio
Dr. Mariana Melcon earned her degree of Biological Sciences at the University of Buenos Aires, Argentina. Immediately after she proceeded to specialize in bioacoustics and behavior and graduated from her PhD program at the University of Tuebingen, Germany. She conducted a first postdoc in neurobiology at the Weizmann Institute of Science, Rehovot, Israel and a second one studying marine mammals and impact of noise on some species at Scripps Institution of Oceanography, San Diego, CA. Dr. Melcon started to collaborate with Fundacion Cethus, Argentina, officially in 2010, opened the bioacoustics research line and leads it while mentoring students. In 2014 she also earned an MBA at the University of California, San Diego, which has helped in many aspects of the projects Fundacion Cethus carries out.

Abstract
"*Studying anthropogenic underwater noise and its effects on marine mammals in the Argentine Sea and/or in the Southern Ocean"*
Fundacion Cethus started using bioacoustics as a methodology to study marine mammals and noise impact in 2010. Lack of resources by being the first ones in the country doing this type of research brought some challenges to our team that uncovered our creativity. We established strong connections with research groups abroad (e.g. Scripps Institution of Oceanography, San Diego, CA), collaborating with different institutions within Argentina, starting training local people in field work, analytics, but also to start building our own equipment. As a result, we were able to describe sounds for the first time from several local species of cetaceans (for Argentina's coast we described some sounds proceeding from Commerson's dolphins, Franciscana dolphins and Burmeister's porpoises; for the Southern Ocean we described new sounds proceeding from a beaked whale)-which is a requirement to study noise impact if we rely on the sounds of the animals to study them-, characterize ambient and anthropogenic noise in few coastal areas, and have our first measurements of impact on Commerson's dolphins. What we aim for today is to collect sound recordings for a long enough period to better assess impact of noise on cetaceans. While there is still more work to do, we are thankful to every piece of our network, since otherwise all our accomplishments wouldn't have been possible.

Ms. Carrie Brown
Director, Environmental Programs, Vancouver Fraser Port Authority

Bio
Carrie Brown is a member of the leadership team at the Vancouver Fraser Port Authority serving as Director, Environmental Programs. Carrie provides strategic leadership and develops and maintains environmental policies and programs. In her role, Carrie leads a multi-specialist department of environmental scientists, biologists, and engineers that develop and implement programs to promote sustainable port development and operations to reduce impacts to air, land and water, marine mammals, fish and wildlife habitats, surrounding communities and Indigenous groups. Carrie oversees the work of the ECHO Program team and is a core member of the ECHO Program's Advisory Working Group.

Carrie has over 20 years of experience in geoscience and environmental management. Since joining the Vancouver Fraser Port Authority in 2003, she has filled various roles in contaminated

sites, environmental impact assessment, adaptive management strategies and project development.

Carrie holds a Bachelor of Sciences degree (B.Sc.) majoring in Physical Geography and an executive management certificate, both from the University of British Columbia. She is a registered professional geoscientist in the province of British Columbia, Canada.

Abstract

"ECHO Program – A collaborative initiative to address underwater noise from the shipping industry on Canada's Pacific south coast"

The Enhancing Cetacean Habitat and Observation (ECHO) Program is a Vancouver Fraser Port Authority-led collaborative initiative aimed at better understanding and managing the impact of shipping activities on at-risk whales throughout the southern coast of British Columbia, Canada.

The primary shipping routes to the Port of Vancouver transit critical habitat for an iconic and endangered southern resident killer whale population comprising just 76 individuals. The ECHO Program brings together key regional interested parties including maritime industries, conservation and environmental groups, scientists, First Nations individuals and government agencies from Canada and the U.S.A. to help focus program efforts, and set goals and objectives. The program is advancing a series of research projects and trials to inform the development of voluntary mitigation, management and policy options that will lead to a quantifiable reduction of underwater noise impacts from vessels in this region.

The presentation will provide an overview of the ECHO Program, its partners and select research projects, including a voluntary vessel slowdown trial which took place in a key killer whale feeding area last summer. Highlights will include insights into the ECHO Program's successful collaborative framework and the real world implementation and large scale testing of vessel noise reduction measures and how these results may help inform broader policy among global ports and the maritime industry.

Wednesday, 20 June 2018

3 – 6 pm

Dr. Zo Lalaina Razafiarison
Program General Coordinator, Ocean State Secretary, Madagascar

Bio
Name: RAZAFIARISON Zo Lalaina

Sex: Male

Profession: Program General Coordinator, Ocean State Secretary, Government of Madagascar

Lecturer in Faculty of Sciences at the University of Antananarivo. Madagascar.

Lecturer in the « Institut Superieur de la Science de l'Environnement et du developpement Durable » University of Toamasina. Madagascar.

Academic training: University of Antananarivo (Ms)(Madagascar), University of Shizuoka (Ms)(Japan), Hitotsubashi University (PhD)(Japan)

Other training: United Nations University, Tokyo, Japan

Fields of Interest**:** Plant ecology and biology, Landscape ecology, Environment assessment and monitoring

Abstract
"Madagascar: Challenge to tackle anthropogenic underwater noise"
A mass sinking of a hundred melon-headed whales in Madagascar in 2008 gave rise to an international survey. The International Whaling Commission and an Independent Scientific Review Panel (ISRP) in 20131 determined that mapping sonar systems would be the cause. Lessons learned from this experience include: i) lack of national scientific expertise to investigate underwater noise pollution, ii) lack of clear policy, national laws and regulations to prevent underwater noise pollution, iii) lack of international and regional cooperation and coordination (6 years to produce the final report). In addition to marine scientific research carried out in the maritime areas of Madagascar, other potential sources of noise pollution that makes marine natural resources vulnerable, are identified. These include: (i) significant shipping traffic in the southwest region of Madagascar, (ii) Seismic profiling used for oil and gas exploration iii) Industrial activities such as cable laying.

In order to prevent and protect marine biodiversity, two strategies are proposed: i) enhancing International and Regional scientific and technologic cooperation and coordination through building awareness, sharing knowledge and accelerating practical action to protect marine biodiversity by creating an International Partnership for underwater pollution, ii) this field of cooperation would be based on capacity building for national experts and technicians in order to able to make policy conception, laws and regulations writing and good practice for ocean exploitation.

[1] Final report of the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales (*Peponocephala electra*) in Antsohihy, Madagascar. Panel Members: Southall, B.L., Rowles, T., Gulland, F., Baird, R. W., and Jepson, P.D. 2013.

Cdr. René Dekeling
Ministry of Infrastructure and Water Management, Department for Marine and International Water Policy (The Netherlands)

Bio
Cdr. René Dekeling is a navy officer with an operational background in the Netherlands Naval Air Service. He also obtained a degree in environmental sciences and he has worked on marine environmental protection issues for more than 15 years for the Royal Netherlands Navy. He is currently coordinator of the research programme on effects of underwater sound in the marine environment in the Netherlands Defence Materiel Organisation. He is also member of the team set up between Dutch government ministries to develop and implement the national Marine Strategy in the Netherlands, and he is the policy lead for management of effects of sound in the marine environment at the Ministry of Infrastructure and Water Management. International activities include co-chairing the European expert group TG Noise, tasked by the European Commission to provide guidance to EU member states to implement monitoring and management of underwater noise, and membership of the Strategic Advisory Board of the European Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI-Oceans).

Abstract
"International cooperation by the Netherlands building the capacity for management of underwater noise"
Underwater noise was identified as an emerging topic by both the European Union and the Netherlands in the early 2000's, and was included in the European Marine Strategy Framework Directive as new theme. As required by this Directive, the Netherlands developed its first national Marine Strategy in 2012. Although at that time it was clear that underwater noise produced by human activities had increased significantly, it was unclear to what extent such noise would cause problems for populations or ecosystems and what its (cumulative) effects would be as the use of the sea intensified. To address this, the Netherlands government has identified and addressed knowledge gaps and a number of research projects have been carried out, when possible with international cooperation.

Over the course of the last years, new knowledge has been developed and where needed regulation has been adapted based on scientific findings. Nevertheless, knowledge gaps remain. Some examples of specific themes where continued international cooperation is beneficial include assessing cumulative effects of offshore construction, research to enable regulation to ensure responsible use of military sonar, international harmonization of regulation and standardization of terminology. Setting up monitoring of underwater sound is needed to enable assessment of the state of the marine waters on a regular basis, and both for impulsive as for continuous noise monitoring has started through international cooperation.

A Joint Monitoring Programme for Ambient Noise in the North Sea was initiated in 2018; seven North Sea countries participate in this project, which is led by the Netherlands. As monitoring of underwater sound is a relatively new topic, methodology will continue to be developed in the coming years. To increase common knowledge on sound levels in the oceans (and the potential effect of increased levels of anthropogenic noise) consistency between methodologies used in monitoring programmes is needed to ensure that the obtained data can be compared. International cooperation, both within joint monitoring programmes and between these international programmes, is therefore essential.

Mme. Véronique Nolet
Program Manager, Green Marine

Bio
Véronique Nolet is a marine biologist who graduated from the Université du Québec à Rimouski in Canada. She has worked for a major part of her career for the protection and conservation of marine mammals in the St. Lawrence River. She had a leadership role in producing A Mariner's Guide to Whales in the Northwest Atlantic, as well as having collaborated in creating other similar educational and awareness tools for the shipping industry. Ms. Nolet joined Green Marine in 2014 to work specifically on projects related to assessing and mitigating underwater noise generated by shipping activities and their impacts on marine mammals. She has given several training sessions aboard commercial ships to raise the awareness of mariners regarding the presence of whales. From 2014 to 2017, she led a binational workgroup on underwater noise, gathering various expert representatives (scientists, marine architects, port authorities, ship owners, acousticians and governmental agencies) to develop Green Marine's new performance indicators regarding underwater noise. She also conducted a study on behalf of Transport Canada to provide the Canadian government with a summary report on this issue. Now working as a program manager for Green Marine, the North American environmental certification program for the shipping industry, she is in charge of everything related to whales, underwater noise, and waste management.

Abstract
"Green Marine: addressing the underwater noise generated from shipping activities through a voluntary, multistakeholder reporting initiative"
Sources of anthropogenic underwater noise have significantly increased over the past 50 years, which has led to international recognition of underwater noise as an emerging issue that has adverse effects on marine life. During the past three years, Green Marine has worked closely with multiple stakeholders to address this issue as part of its voluntary environmental certification program for the maritime industry. A thorough investigation of the issue, numerous discussions, industry leadership and patience resulted in the release of two new performance indicators in 2017 for ship owners and port operators to respectively address this issue as part of the Green Marine program. This presentation will relay how a team effort among people with differing expertise and perspectives can lead to positive change with a greater understanding of an important environmental issue and the steps required to minimize the problem and/or mitigate its impacts.

Dr. Howard Rosenbaum
Senior Conservation Scientist and Director of the Wildlife Conservation Society's (WCS) Ocean Giants Program

Bio
Dr. Howard Rosenbaum is a Senior Conservation Scientist and Director of the Wildlife Conservation Society's (WCS) Ocean Giants Program, which aims to secure the future of whales, dolphins, and other marine species. He is a Senior Scientist at the American Museum of Natural History, core faculty member at Columbia University, a member of the United States Delegation to the International Whaling Commission, and the IUCN Cetacean Specialist Group and Important Marine Mammal Area Task Force. Rosenbaum has led marine mammal conservation projects around the world, including the Indian, Pacific, and Atlantic Oceans and the Arctic. For 30 years, Dr. Rosenbaum's innovative science has helped protect marine species from current and emerging threats in their most important habitats. In the 1990s, he initiated WCS's work on whale and dolphin populations off the coasts of Madagascar and Gabon, and the Ocean Giants team continues to address current threats to these iconic marine species. Recently, Rosenbaum and colleagues organized 'At the Crossroads: Global Shipping Lanes and Whale Conservation'

side-event at the February 2017 UN Preparatory Meeting, with a key focus on Ocean Noise impacts. (see, https://sdg14.wcs.org/Events/Global-Shipping-and-Whale-Conservation).

Rosenbaum has also pioneered unique technological and molecular genetic approaches that provide valuable information concerning levels of genetic diversity and relationships among the most endangered large whales, the North Pacific and North Atlantic right whales. Rosenbaum's work has resulted in revisions in population structure, taxonomy and nomenclature for a number of living whales and dolphins. From these efforts, Rosenbaum has authored 90 peer-reviewed publications, co-edited a book on genomics, and his work has been featured widely in many popular media outlets. In the NY Bight, Rosenbaum leads WCS's efforts for research and conservation of marine mammals, which includes a collaborative effort to use state-of-the-art near real-time acoustic monitoring technologies to study whales and ocean noise.

Abstract

"Time is of the Essence: Effective Coordination and Cooperation for Mitigating Ocean Noise Impacts"

Sound is the primary sensory modality for most marine animals. It is essential for communication, orientation, foraging, and reproduction – functions of vital biological importance. Anthropogenic underwater noise is globally altering marine soundscapes and can negatively impact individual animals and marine ecosystems in various ways. Anthropogenic ocean noise, which is increasingly being recognized as a form of pollution, has been generally increasing since the advent of powered marine transportation, energy exploration and other industrial activities. During the preparatory meeting for the June 2017 United Nations Ocean Conference (UNOC) to discuss implementation of Sustainable Development Goal 14, the IUCN, The Wildlife Conservation Society (WCS) and the Government of France hosted a side event to raise awareness among United Nations member states and other stakeholders about global shipping and impacts of noise on whales and other marine mammals. A complete recording of the meeting and all documents related to outcomes and recommendations related to anthropogenic underwater noise can be found at: https://sdg14.wcs.org/Events/Global-Shipping-and-Whale-Conservation. Specific mention was subsequently made by member states of ocean noise in the final UNOC Call for Action. This event also initiated a collaborative effort that led to the formulation and registration of United Nations voluntary commitment #OceanAction18553, entitled "A commitment to reduce Ocean Noise Pollution." (https://oceanconference.un.org/commitments/?id=18553). Several recent publications (e.g., Nowacek et al. 2015; Nowacek and Southall 2016) that consider best practices for monitoring and mitigating noise impacts at a variety of scales have made specific recommendations, and should be considered by UNCLOS as potential starting points on this issue, including measures that provide an initial framework for a "new conversation" regarding ocean noise. Considerable research, monitoring, and regulatory measures related to ocean noise have been taken at national and regional levels. What is needed now is a coherent, collaborative, multi-sectoral, international collaborative effort that enlists industry, government, academia, IGOs, and NGOs. This type of collaboration will enhance and enable efforts to: (1) apply modern research and technology for better monitoring, understanding, and mitigating ocean noise impacts, and (2) utilize these findings in developing practical and effective best-practice strategies that form the basis of informed policy and management decisions. Potential outcomes for consideration include mitigation actions (e.g., technologies, operational management measures, area- and species-specific measures) in order to minimize ocean noise and associated impacts.

Dr. Frank Thomsen

Senior Scientist and Sales Executive, DHI

Bio

Dr Frank Thomsen has more than 25 years of experience in marine mammal science, bioacoustics and environmental impact assessment and risk mitigations. Dr Thomsen has advised marine

policy bodies in Europe and elsewhere. This included Defra, DECC (UK), BSH (Germany) and Naturstyrelsen (Denmark). On an international level, Dr Thomsen has consulted the United Nations, the International Maritime Organisation, OSPAR, the London Convention and the European Commission. Dr Thomsen is co-organiser of the fifth International Conference on the Effects of Noise on Aquatic Life, to be held in the Netherlands in 2019.

Abstract

"The role of industry in managing the impacts of underwater noise on marine life"

Marine industries such as shipping, oil and gas exploration, renewables, construction and dredging emit noise into the marine environment. This noise can affect marine life in a number of ways. However, noise effects cannot only harm marine life. Lack of knowledge about noise effects is often a significant risk for marine industrial or infrastructure operations too and can lead to delays and permitting issues. Industry can – and in many cases, this is already taking place – play an active role in protecting marine life in a variety of ways. First, in implementing best practices in assessing the impacts via regulatory processes (Environmental Impact Assessments, EIAs). Here a risk-based approach should be followed. Using such an approach Environmental issues can be identified early / throughout the project cycle to allow for integrated mitigation solutions that help protect marine life, ease environmental approval processes and reduce related scheduling and investment risks. Second, Industry plays a role in disseminating information on anthropogenic underwater noise and guideline documents via sectoral or even cross-sectoral associations. Examples are the CEDA position paper 'Underwater Sound in Relation to Dredging' (2011) and its successor the WODA Technical Guidance on Underwater Sound in Relation to Dredging (2013). Industry also makes an important contribution to increase in knowledge about underwater noise via direct funding from R&D resources or through industry programs such as the Joint Industry Program for Sound and Marine Life (JIP).

Dr. Mark Tasker

Vice-Chair, Advisory Committee of the International Council for the Exploration of the Seas

Bio

Since January 2008 (with a short gap), Mark has been a Vice-Chair of the Advisory Committee of the International Council for the Exploration of the Seas (ICES). This post evolved from the role of chair of ICES Advisory Committee on Ecosystems, to which he was elected in 2007: I had been a participating member of this committee since its foundation in 2000.

Mark recently (September 2016) retired from the UK's Joint Nature Conservation Committee (JNCC) where his final role was as Head of Marine Species Advice. He is now an Emeritus Principal Advisor for JNCC, carrying out work mainly on underwater noise and albatross conservation. In relation to underwater noise, he is co-chair of the main EU Advisory body on this issue – TG Noise. The Head of Marine Species Advice was a part time (75%) job and was based in Aberdeen, Scotland.

He is a past chair and vice chair of the Advisory Committee Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS).

Abstract

"***Underwater sound: the role and capacity of ICES"***

ICES is an international science organisation founded in 1902 and solidified by a Convention in 1964 to study and advise on all aspects of our seas. ICES comprises 20 member countries that span the North Atlantic and surround the Arctic. Around 1600 scientists participate annually in the work of ICES, most as part of its network of more than 100 expert groups. ICES provides peer-reviewed, internationally-adopted advice to the European Union, Regional Seas Conventions,

International Fisheries Management Organisations and to its Member States. The ICES Secretariat employs around 50 staff and is based in Copenhagen, Denmark. www.ices.dk

ICES has been involved in issues relating to underwater sound for many decades. Underwater sound is used in surveys of fish stocks and there is a long history of calibration of these sound sources to ensure consistency of survey. ICES has also published on design criteria for vessel noise to avoid the effects of vessels on fish (or at least to minimise and standardise those effects.

ICES has provided advice to the European Union on the effects of military sonar on marine mammals. ICES also published the work of a specialist group that advised on ways of assessing underwater sounds that may be harmful to marine life. This advice was subsequently adopted by the European Union as part of the implementation of its Marine Strategy Framework Directive. In further implementation of that Directive, the ICES data centre is home to the combined OSPAR/Helcom underwater noise register.

ICES has considerable capacity to aid in future international co-operation on addressing underwater sounds and its effects.