PAME II-2013 Agenda Item 4.6(b)
AMSA Recommendation II(G)
AOR Final Report Recommendations 11 & 12
NOAA's Cetacean (CetMap) and Sound Mapping Effort (CetSound) as a Template to Support Multilateral Cetacean Risk Assessments in the Arctic[1]

BACKGROUND

AMSA Recommendation II(G) provides:

> *"That Arctic states decide to engage with relevant international organizations to further assess the effects on marine mammals due to ship noise, disturbance and strikes in Arctic waters; and consider, where needed, to work with the IMO in developing and implementing mitigation strategies."*

AOR Final Report Recommendation 11 provides:

> *"The Arctic Council should increase collaboration with IMO, IWC and NAMMCO for information sharing and cooperation between their respective working groups and sub-groups on cetacean-related issues such as ocean noise and ship strikes and consider Ecocystem-based Management (EBM). Additionally, Arctic states should consider taking more proactive efforts in the IMO, IWC and NAMMCO on these issues such as by contributing to the IWC ship strike database."*

AOR Final Report Recommendation 12 provides:

> *"Arctic states, to the extent practicable, should continue to create and/or share seabird and marine mammal density and distribution maps, including through common databases such as the National Oceanic and Atmospheric Administration (NOAA) CetMap for Cetaceans (http://cetsound.noaa.gov/index.html) and CAFF's CBird online tools for timely tracking of seabird populations (www.caff.is/seabids-cbird/seabird-information-network)."*

PAME I-2013 adopted a record of decision (RoD) inviting the USA to give a presentation at PAME II-2013 on the work of the U.S. Cetacean Density and Distribution Mapping Working

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Group related to the Group's current work to create an online portal to access information on cetacean density, distribution, and biologically important areas.

Pursuant to AMSA Recommendation II(G), AOR Final Report Recommendations 11 & 12, and the above mentioned RoD, the USA provides this report on the work of the U.S. Cetacean Density and Distribution Mapping Working Group and the U.S. Underwater Sound-field Mapping Working Group to inform the United States' planned presentation on such work at PAME II-2013.

EXECUTIVE SUMMARY

Marine animals, including whales, rely heavily on sound to communicate with each other and sense their environment (including predators, food, mates, navigation cues, etc.). Underwater noise produced by ships, offshore construction activities, oil and gas exploration and extraction and other human activities is impeding the ability of marine animals like whales to use sound. The U.S. has been working to better understand underwater noise and its adverse impacts on marine mammals. To this end, it has been developing mapping tools that illustrate the distribution of underwater noise contributed by various human activities and the distribution of various whale, dolphin and porpoise species (known as "cetaceans"). The goal of this work is to support more comprehensive efforts to reduce the impacts of noise on cetaceans throughout waters subject to U.S. jurisdiction, including in the Arctic.

DISCUSSION

The Arctic is a unique region of seasonal extremes and sensitive ecosystems that sustains a rich diversity of wildlife, including several marine mammal species. As the retreating ice provides new opportunities for transport and access to resources, interest in the region for shipping, tourism, oil and gas and other industries continues to grow. Supporting sustainable Arctic development requires the use of best available scientific information to reduce adverse interactions among industrial activities and marine mammals, and to support traditional relationships between marine mammals and indigenous peoples. To be most useful, that information must also be shared and standardized among Arctic nations, as both cetaceans and stressors associated with human activities in the Arctic span national jurisdictions. Maps are important tools for reducing conflicts between human activities and marine species. The foundation of risk assessments are maps of the distributions (locations) and densities (quantities) for both species of concern and potential threats they face associated with various human activities.

Sound is the most effective means for marine species to communicate and sense their environment underwater, and is critical to multiple life functions for many marine animals. With increased understanding of how noise generated by human activities can limit the ability of marine species to hear and communicate, NOAA, the U.S. agency charged with managing impacts (including noise) on marine wildlife and habitats within its jurisdiction, has recognized the need to undergo a fundamental shift towards a more integrated and comprehensive strategy for measuring, managing and reducing chronic noise impacts. As a

result of NOAA's commitment to improve tools to evaluate the impacts of human induced noise on cetacean species, NOAA convened two data and product driven working groups in 2011: the Cetacean Density and Distribution Mapping Working Group (CetMap) and the Underwater Sound-field Mapping Working Group (SoundMap). CetMap is working to provide regional time and species-specific cetacean density and distribution maps in U.S. waters. SoundMap is developing tools to map the contribution of human sound sources to underwater ocean noise in waters subject to U.S. jurisdiction. The effort, collectively known as CetSound, hosts a website at http://cetsound.noaa.gov/index.html.

CetMap

CetMap's objective is to create comprehensive and easily accessible regional cetacean density and distribution maps that are time and species-specific using survey data and, when available, models that incorporate predictive environmental factors. To augment the more quantitative density and distribution products and provide additional context for marine mammal impact analyses, CetMap also asked regional experts to identify, through the best available scientific information, a range of biologically important areas (BIAs), which include feeding and reproductive areas, migratory corridors, and areas in which small and resident populations are found.

Given the inherent variability (over time and space) in marine ecosystems, developing a functional understanding of how cetaceans use marine regions requires years if not decades of data collection; however, CetMap's vision is to improve the quality, accessibility and interpretation of data that has been collected by undertaking five specific tasks:

- identifying a hierarchy of preferred density and distribution information types;
- conducting a cetacean data availability assessment that includes making data with previously limited accessibility available through this effort;
- modeling or re-modeling density using the highest quality or "habitat-based" density models in some critical areas, based upon updated methods and/or new data;
- creating standardized output file types from the new modeling results and other existing modeling results; and
- developing a NOAA website that organizes these datasets and maps to highlight the best available information type, making them searchable by region/species/month, and providing many of the files for download.

CetMap first identified and broadly evaluated the information types and modeling methods available, and then ranked them based on their ability to accurately predict density, distribution or presence of marine mammals in U.S. waters. Data resources were ranked, from highest to lowest quality in the following order: 1) habitat-based density models; 2) stratified density models; 3) probability of occurrence models; 4) records of presence, which include visual observations, acoustic detections, or tagging indicators; and 5) expert knowledge.

Second, CetMap undertook a data availability assessment in which it identified and compiled existing cetacean density models and indicators of cetacean presence (including visual observations, acoustic detections, and tagging data). The results of the data availability assessment were organized in a manner that allows the user to search by region and/or species and quickly identify what type of information is available each month of the year and where information gaps exist.

In addition to the compilation described above, CetMap identified and undertook two key modeling efforts (expected to be finalized in the coming months) to improve the understanding of cetacean density and distribution in the U.S. EEZ. One of these is relevant to the Arctic. In the Beaufort and Chukchi Seas in the U.S. Arctic, CetMap is using a long-term dataset of aerial surveys to produce habitat-based density models for the species commonly found there; this type of model was not previously available for Arctic cetaceans.

Finally, the dedicated CetMap website was built to host the newly created, standardized GIS products (shapefiles) and model results, as well as the methods, assumptions and metadata associated with the maps. Figure 1 shows a screen-shot from the CetMap website (http://cetsound.noaa.gov/cetacean.html).

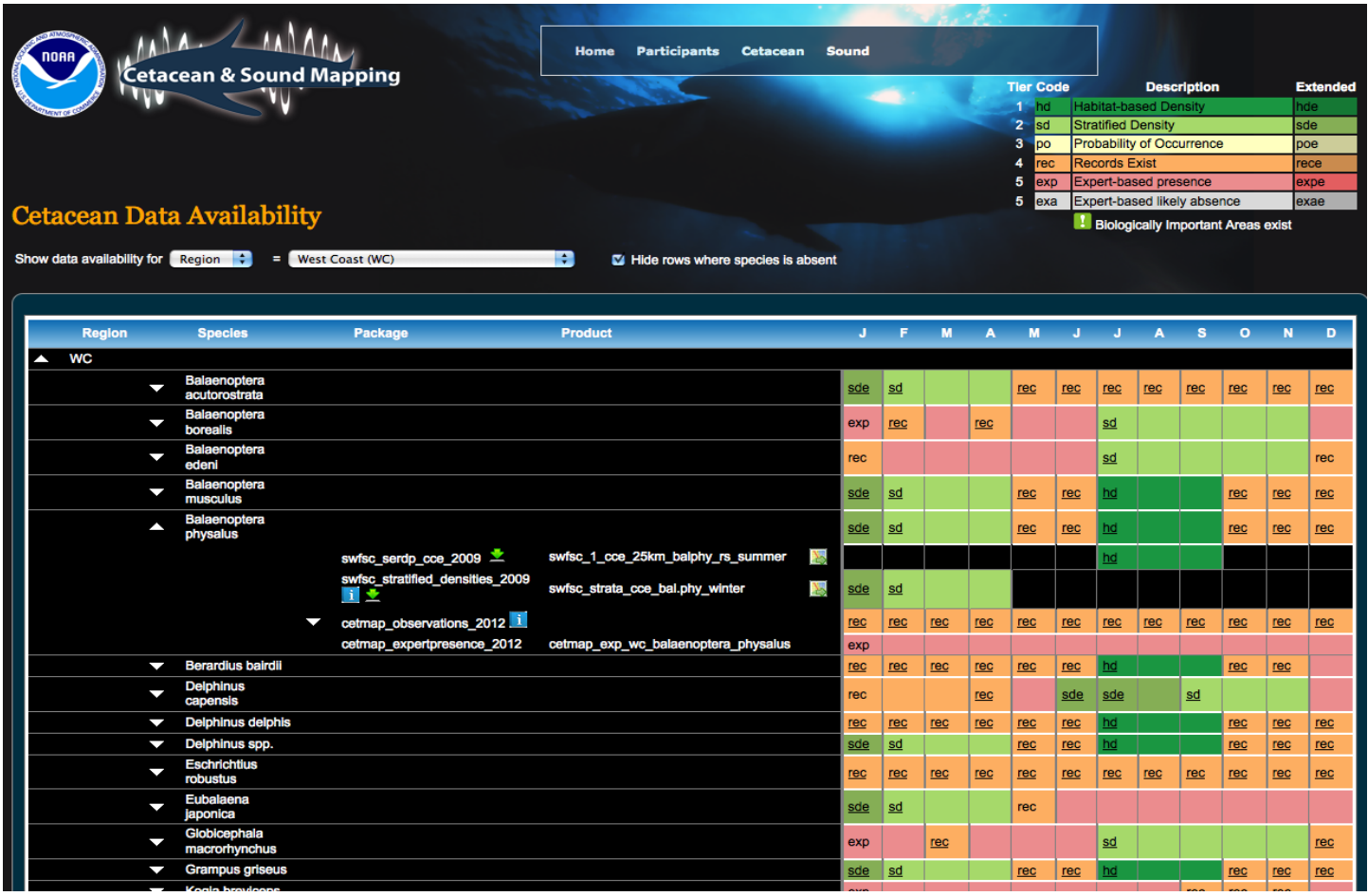

Figure 1. Screen shot from CetMap website showing searchable format for accessing density and distribution data with associated downloadable files and source information.

The biologically important areas (BIAs) component of CetMap is designed to supplement the quantitative information on cetacean density, distribution, and occurrence by: 1) identifying areas where cetacean species or populations are known to concentrate for specific activities, or be range-limited, but for which there is not sufficient data to reflect the importance of these areas in the quantitative mapping effort; and 2) providing additional context with which to examine potential interactions between cetaceans and human activities. For the BIA exercise, regional experts were asked to compile the best available information from scientific literature (*e.g.,* books, peer-reviewed articles, and government or contract reports), unpublished data (sighting, acoustic, tagging, genetic, photo identification), and expert knowledge to create written summaries and maps highlighting areas within the boundaries of the U.S. EEZ that are biologically important to cetacean species or populations, either seasonally or year-round.

For cetacean species with distinct migrations that separate feeding and breeding areas, three types of biologically important areas were identified:

- *Reproductive areas* - areas and months within which a particular species or population selectively mates, gives birth, or is found with newborns or other sensitive age classes;
- *Feeding areas* - areas and months within which a particular species or population selectively feeds; these areas may be found either consistently in space and time, or may be associated with ephemeral features that are less predictable but can be delineated and are generally located within a larger identifiable area; and
- *Migratory corridors* - areas and months within which a substantial portion of a species or population is known to migrate; the corridor is typically delimited on one or both sides by land or ice.

A fourth type of biologically important area was also identified to include species that do not necessarily undertake distinct migrations separating breeding and feeding areas:

- *Small and resident population* - areas and months within which small and resident populations occupying a limited geographic extent exist.

For each region and species or population with known areas of biological importance, information is presented in a written summary with an associated map and metadata table. The metadata table details the type and quantity of information used to define the important area, providing a transparent method for evaluating the important area designation. Caveats and assumptions associated with the development of the biologically important area are described on the website. CetMap is currently preparing to submit the results of the biologically important area (BIA) effort to a journal for peer-review. In the meantime, areas of Hawaii have been posted on the website as an example of the results from this exercise.

SoundMap

SoundMap's objective is to develop and apply mapping methods to depict temporal, spatial, and spectral characteristics of underwater noise resulting from human activities throughout the U.S. EEZ. These predicted soundscapes are an initial step towards assessing chronic anthropogenic noise impacts on the ocean's varied acoustic habitats and the animals utilizing them. The sound mapping tools use environmental descriptors (*e.g.,* bathymetry, sea surface roughness, bottom composition, sound speed profiles) and available data on the distribution, density, and acoustic characteristics of human activities within U.S. waters (*e.g.,* data from World Meteorological Organization Voluntary Observing Ships Scheme for global shipping, NOAA Fisheries Observer database for fishing activity, U.S. Bureau of Ocean Energy Management data on seismic surveys) to develop first-order estimates of their contribution to background noise levels at multiple frequencies, depths and spatial/temporal scales.

The effort focused on developing feasible methods that could be implemented within the initial one-year time frame of the CetSound working group. To achieve this, a variety of informed approximations and assumptions were made to increase computational feasibility and to bridge data gaps. All extrapolations and assumptions made in developing these products have been explicitly documented in methodology summaries that are available online. An overview of the regions throughout the U.S. EEZ where sound field maps were produced is show in Figure 2. More information and access to all products can be found on the CetSound website: (http://cetsound.noaa.gov/sound_data.html).

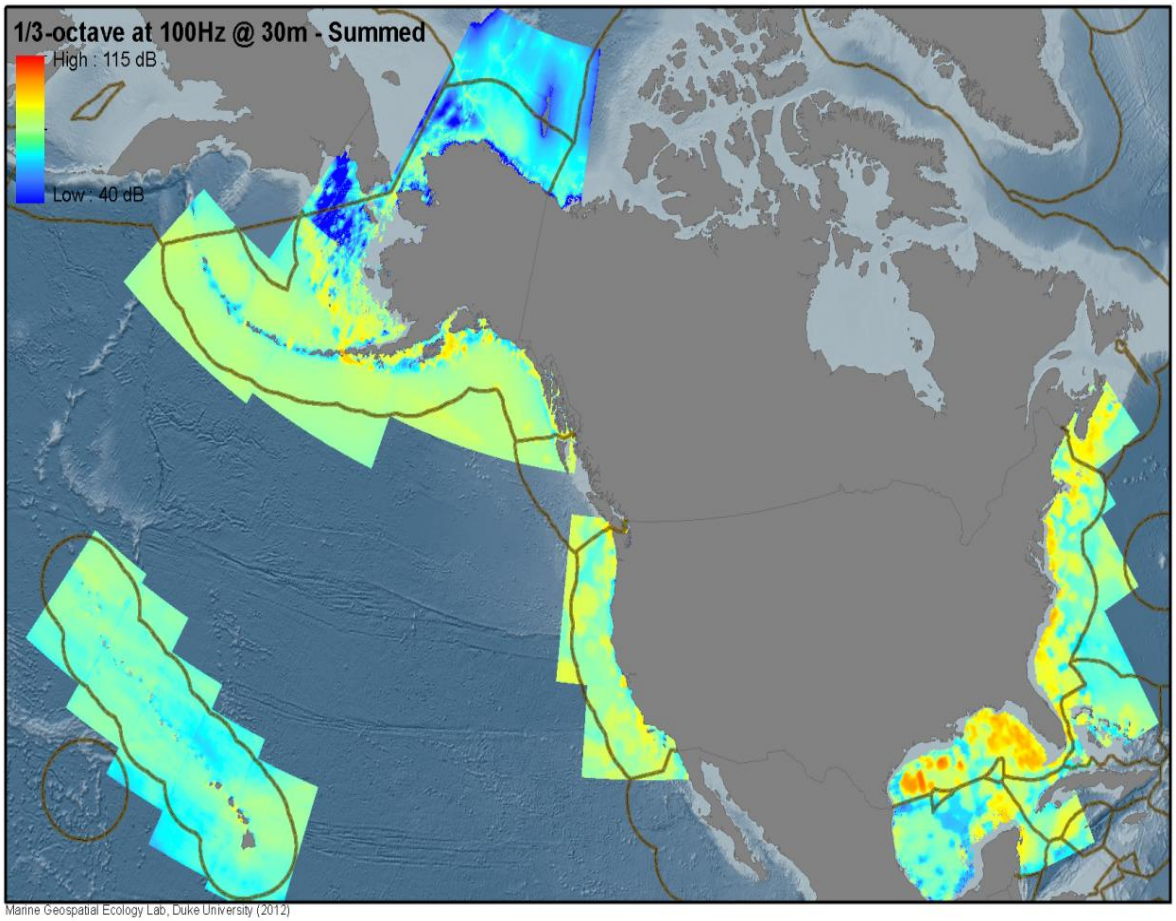

Figure 2. Overview map showing representative sound field maps produced throughout the majority of waters subject to U.S. jurisdiction.

RECOMMENDATIONS

As CetSound as a whole or in specific elements may be used as a model to strengthen data resources for ship strike and noise exposure risk assessments for cetaceans across the Arctic, the USA recommends that:

- PAME encourage member governments, building in particular upon AOR Final Report Recommendation 12, to create and/or share marine mammal density and distribution maps as well as sounds maps for the Arctic region. To this end, the USA recommends that PAME encourage member governments to view CetSounds's cetacean distribution and density and sound field mapping products as a potential model data portal to collect, model or access density, distribution, and sound information. This could include current or future sound fields produced by shipping or other development activities, cetacean density (number of individuals expected to be found in a given area), distribution, and biologically important areas (known areas of specific importance for cetaceans, such as reproductive areas, feeding areas,

migratory corridors and areas in which small or resident populations are concentrated). These products can be used by mariners when conducting voyage or other development planning and to support integration of data products amongst Arctic nations.

- PAME encourage member governments, in partnership with CetSound, to develop a robust data inventory of cetacean density and distribution information across Arctic States to provide managers and mariners with information of where cetaceans are when making management and voyage planning decisions. A comprehensive inventory across waters subject to the jurisdiction of Arctic States will illustrate the quality of current data and identify key data gaps. Arctic regional cetacean as well as sound field mapping products might be used to inform Arctic States' consideration, either individually or collectively, of the merits of possible IMO routing and reporting measure proposals for this region.

- PAME encourage member governments to build upon the existing dialogue among nations regarding salient features of underwater acoustic conditions, current modeling techniques, and methods for web or portal presentation of data holdings. For example, the International Whaling Commission's Scientific Committee recently recommended a jointly sponsored workshop with the International Quiet Ocean Experiment to discuss methods applied in SoundMap and the expansion of similar mapping efforts to other locations worldwide. The United States recommends that PAME member governments actively participate in the workshop.