Evaluation Form – Proposal 0002058

Reference No. 0002058

Title: Novel methodologies for measuring shipping underwater radiated noise in the Mediterranean Sea

Principal Investigators: Prof Boris Katsnelson, University of Haifa

Dr Yaniv Brick, Ben Gurion University of the Negev

Call of proposal: Call for proposals in the field:
Environmental Sciences for 2021 - Marine sciences

Topic: a. Monitoring of noise pollution or b. marine memmals and migratory species in the sea.

Part A

1. Scientific merit

Description: clarity and quality of the research proposal itself – presentation of the topic, definition of research objectives, presentation of research methodology and detailed program of work

Reviewer comments: Cost effective of noise level in sea is mandatory.
As mentioned in the proposal, a lake of data may impact biodiversity. The proposal offers several combined systems, from Green's function estimation to ship tracking. The objectives are clear and methodology are realistic, as well as the gant.

2. Originality and novelty of the proposed research

Description: Originality and novelty of the proposed research compare to the most update knowledge in the world

Reviewer comments: Use of natural sources to estimate Green's function is not usual. The complete pipeline from AIS / boat tracking to the green's function and then URN is orginal.

3. methodology

Description: Does the proposed methodology fit to address the research questions; does the methodology adequately detailed? Feasibility of the proposed methodology.

Reviewer comments: Some algorithm, and or some graphics could be more explicit or detailed. Otherwise the methodology is straight forward and realistic.

4. Potential applicability

Description: what are the applicable impacts of the research outcome; will it contribute to future (even in the long range of time) technological development or impact on policy development in the future?

Reviewer comments: The Gant and the cost of the different stages of the project are realistic.The applicability of such system and impact are highly probable.

5. Competence of the researchers

Description: Competence of the researchers to do the research based on the experience, former achievements and skills, and the access of the researchers to the required resources;

Reviewer comments: The bibliography of the team is showing good adequation between heir competences and the general goal.

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Part A

1. Scientific merit

Description: clarity and quality of the research proposal itself – presentation of the topic, definition of research objectives, presentation of research methodology and detailed program of work

Reviewer comments: I had some difficulty in determining the precise methods and goals that the applicants' intent to pursue (see also comments in the Methodology section). The two main goals outlined in the Abstract, the development of a cost-effective method to determine the source levels of ship noises and the development of a rea-time noise map would be valuable contributions.
 Work Package 1 will link the AIS information of ships to their acoustic recordings made at the same time using a directional hydrophone array.   It is unclear if only times when single ships are present within 10 km are required to conduct these analyses.
 Work Package 2 will determine the noise from the ships that is above the ambient noise levels. Two common 1/3 octave band levels will be measured (63 and 125 Hz). These are common indicator frequencies for comparing shipping noise levels. Figures 5, 8 and 10 however, suggest that other frequencies would also be analyzed, however. Otherwise, it would be better to use a lower sampling rate on the recorders.
 Work Package 3 will lead to predicting the underwater radiated noise levels of vessels. The inclusion of calibrations using vessels of known source levels is a very important component of these studies.
 Work Package 4 will study the performance of the previous methods in water <30 m deep. Finally, the new techniques will be used to expand the geographic range to develop a noise map of a larger area, the Mediterranean Sea. If the noise maps only include the 63 and 125 Hz 1/3 octave frequency bands, the maps would be of no use for assessing the potential shipping noise impact on marine mammals such as dolphins and porpoises that are very insensitive at those frequencies.

2. Originality and novelty of the proposed research

Description: Originality and novelty of the proposed research compare to the most update knowledge in the world

Reviewer comments: The Abstract suggests that the goal is to develop a system capable of "passive continuous monitoring of shipping noise levels and construction of live updating noise maps". Certainly, there is a need for such systems as this type of information would permit active management of the underwater noise levels in harbours, along shipping routes and in marine protected areas. Being able to predict/estimate the noise levels based on the numbers and locations of ships in the area (via AIS) would be necessary to facilitate active management of shipping noise.
It will also be important to develop protocols to measure the source levels of individual ships under normal operating conditions, and without the express assistance of the ships in question. The current protocols (ISO 17208-2:2019) are impractical for general use. Determining source levels of ships is difficult and dependent upon many factors. It is not unusual for the ship noise to be higher at greater distances from a recorder than at a closer range. A greater understanding of the factors that influence sound transmission losses (as per Work Package 3) will be a great benefit.

3. methodology

Description: Does the proposed methodology fit to address the research questions; does the methodology adequately detailed? Feasibility of the proposed methodology.

Reviewer comments: Some of the descriptions of the various methods are incomplete or vague, while others are more comprehensive. For example, Figure 1 part 4 and the text in section 1.3 Methodology, indicates that there will be three 12 month monitored locations while in WP4 (page 7) there is mention of two long term deployments. Section 1.8, Equipment, mentions the development of a "drifter" while the other references to recorders indicate they are bottom-mounted. In WP4 (page 7), it is stated "data acquisition for real-time detection of vessels and recordings of their raw acoustic signature,": does this mean that there is a wifi link to shore (as with the "Four floating marine platforms with extended Wifi connection capability", page 10) such that the data are analyzed in real time or is the data from the recorders downloaded every two months and then later matched with the AIS data? Will there be two or three long-term deployments along the Israel coastline?
It is not clear from the work plans if the development of a real-time noise mapping system (as indicated in the Abstract) will be a direct result arising from the findings from these studies. It is also unclear which frequency ranges would be considered in the noise maps. The frequency ranges are important because the large whales are susceptible to vocalization masking at low frequencies while the dolphins communicate at much higher frequencies.

4. Potential applicability

Description: what are the applicable impacts of the research outcome; will it contribute to future (even in the long range of time) technological development or impact on policy development in the future?

Reviewer comments: It will be very important to be able to determine the source levels and

transmission characteristics of underwater radiated noise from large vessels, especially in the shallow waters typically associated with maritime ports and some shipping lanes. Linking noise levels to the numbers, types, and speeds etc. of ships will be a necessary step in assessing potential noise impacts and would be expected to lead to the development of mitigative measures and regulatory limits.

 The sampling rate of the acoustic recordings (96 kHz) will allow determining the 1/3 octave levels from 10 Hz to 40 kHz. Taking the hearing abilities of the listeners into account, will permit determining the broadband noise levels as perceived by the different types of marine mammals and potentially fish: similar to the dB(A) noise limits for human exposures. Auditory weighting functions will enable the conversion from unweighted (linear) noise levels to those as perceived by the animals. These functions are currently available for marine mammals: Southall et al., 2019. Marine mammal noise exposure criteria: undated scientific recommendations for residual hearing effects. Aquatic Mammals, 45: 125-232 doi: 10.1578/AM.45.2.2019.125. Converting unweighted noise maps to these auditory weighting functions should be straightforward. Such conversions, especially for dolphins and porpoises who have very insensitive underwater hearing at low frequencies, will be a necessary component of assessing underwater noise impacts on marine mammals.

 The development of a practical standardized method to determine the source levels of individual ships on an opportunistic basis (and in shallow water) will be beneficial to a range of users. Current noise level modelling often uses representative noise levels of different types of vessels which likely does not take into account the variability of the actual source levels and relative orientation between the ship and the recorder/listener. Noise maps that include the actual numbers of ships operating near a port or along a shipping route will be a useful tool in developing noise mitigative measures.

 Southall et al., (2019) present broadband noise exposure levels above which temporary hearing threshold shifts (TTS) and permanent threshold shifts (PTS) are in danger of occurring for different marine mammal species. These levels may be adopted by various regulatory agencies as disturbance thresholds and thus form the basis of regulatory noise limits. The availability of real-time noise maps in an area would facilitate the implementation of such regulations.

5. Competence of the researchers

Description: Competence of the researchers to do the research based on the experience, former achievements and skills, and the access of the researchers to the required resources;

Reviewer comments: All three investigators have published in directly related research areas and are building on their previous expertise in these projects. The currently available equipment and technical support required for the projects appears to be adequate.

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Part A

1. Scientific merit

Description: clarity and quality of the research proposal itself – presentation of the topic, definition of research objectives, presentation of research methodology and detailed program of work

Reviewer comments: The topic and question was very clearly presented, with clearly defined and achievable objectives of value for environmental monitoring. The proposers are very skilled underwater acousticians. One primary merit of the proposed work is the ability of the proposed system to measure the radiant sound field of vessels of opportunity, rather than requiring a dedicated system which would require expensive allocations of time for ships to be measured. The flexible type of system proposed will open the flood-gates for data to be collected on the radiant fields of ships in the study area. The researchers are correct, and careful, in stating that simple transmission loss methods will not function in the variable types of environments in which they propose to calculate source levels and resulting radiant sound fields. The proposers correctly identified several of the key challenges to the work, and demonstrated through preliminary work that they have workable solutions for those key identified problems.

2. Originality and novelty of the proposed research

Description: Originality and novelty of the proposed research compare to the most update knowledge in the world

Reviewer comments:
The proposers are clearly familiar with the acoustic methodologies, and have cited relevant work related to their proposal. It was somewhat of a weakness that similar types of systems were not identified or cited in their proposal. The basic approach of measure URN from passing ships and relating it to AIS locations is not new, and it could have improved the proposal to identify other existing systems and relate the current proposal to more of the previous work carried out in this area. Similarly, published noise maps exist, which could have been cited in the proposal. Importantly , though, the proposal does have important novel elements which will advance the

field. For example, fast algorithms for scattering analysis and Green's function tabulation and other detailed analysis techniques have the potential to improve state-of-the-art approaches utilized in this field. I would suggest in future the applicants could more firmly place their work in relation to other work already carried out that had similar objectives.

3. methodology

Description: Does the proposed methodology fit to address the research questions; does the methodology adequately detailed? Feasibility of the proposed methodology.

Reviewer comments: The work packages are complete and inter-locking in the sense that they address the full set of proposed questions. There are some other higher-level issues – such as what to do about the effect of boat speed on URN – that are not included ion the proposed questions.   One important gap in the approach is that URN from vessels is crucially dependent upon the speed of the vessel. The proposal indicates measurements, presumably as the vessel is passing at a given speed, and then modelling URN of the vessels presumably able to travel at different speeds. I mention this specific point as an example of an important factor that can change from the time of URN measurement to the URN propagation that needs to be modelled to achieve the full project goals.

4. Potential applicability

Description: what are the applicable impacts of the research outcome; will it contribute to future (even in the long range of time) technological development or impact on policy development in the future?

Reviewer comments: As correctly noted by the proposers the work has the potential to build the technical backbone of a system that can measure and estimate URN in the specific habitats to be studied. These are areas with rich biological diversity that is constantly negatively impacted by URN – correctly identified as a type of underwater pollution.   The system could become a crucial tool for policy makers to quantify the scale of potential environmental risks posed by URN, including identification of key noisy hotspots in the predicted URN field. Thought not part of the current proposal, future applications could include merging the predicted URN fields, with identified habitats of species of concern for protection. The system could be used to quantify the effectiveness of mitigations, such as changes to shipping routes to move noisy activities away from key identified habitat. Any such mitigation would carry costs, and therefore would need the strongest possible empirical justification to be carried out effectively. The proposed work would build key components of such a potentially impactful tool.

5. Competence of the researchers

Description: Competence of the researchers to do the research based on the experience, former achievements and skills, and the access of the researchers to the required resources;

Reviewer comments: One of the strongest points of this proposal is the contributions that can be made by focusing the skills and experience of the project team to tackle and improve methods to measure and estimate URN. The methodology fits the research questions very well, and the expertise and knowledge of the proposers is clearly applied in proposing effective solutions to challenges such as noise identification and removal and data integration challenges. The researchers have access to key tools to carry out the work.   I congratulate the researchers

on their awareness of the issues posed by URN and their attention to possible solutions such as those proposed in this application.

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Part A

1. Scientific merit

Description: clarity and quality of the research proposal itself – presentation of the topic, definition of research objectives, presentation of research methodology and detailed program of work

Reviewer comments: Research aim is clear but the way to achieve these aims are described simply as "novel methods." It definitely lacks detailed program.

2. Originality and novelty of the proposed research

Description: Originality and novelty of the proposed research compare to the most update knowledge in the world

Reviewer comments: Most "novel methods" are not described in detail which hinders the reviewer to examine their originality.

3. methodology

Description: Does the proposed methodology fit to address the research questions; does the methodology adequately detailed? Feasibility of the proposed methodology.

Reviewer comments: Again, the "novel" proposed methods cannot be evaluated for its feasibility, but current existing methods can do the job (WP2, WP3 in the proposal) of achieving the project.

4. Potential applicability

Description: what are the applicable impacts of the research outcome; will it contribute to future (even in the long range of time) technological development or impact on policy development in the future?

Reviewer comments: There are numerous methods and research output to monitor the vessel's URN.

5. Competence of the researchers

Description: Competence of the researchers to do the research based on the experience, former achievements and skills, and the access of the researchers to the required resources;

Reviewer comments: Based on their research outputs so far, I believe the researchers have the experience and skills to achieve the aim of monitoring a vessel's URN, be it novel or not.