Input from Malaysia on Anthropogenic Underwater Noise

1. Challenges posed by anthropogenic underwater noise

- Anthropogenic underwater noise originated from the underwater sounds produced by man-made activities either near shore or in-water activities. The said activities include activities such as near or in-water constructions; e.g. piling activities and sea-bed rock blasting, fishing-related sources such as illegal fish bombing, floating vessel-related noises such as from running engines & propellers and even tourism-related activities.

- The generally shallow-water depth for Malaysia (about 40m average depth in Malacca Strait & 200m for the South China Sea excluding the Sabah Trough area) as it is mainly on the continental shelf produced what can acoustically be termed as the “piping effect”. This is where the man-made noises produced are amplified due to multiple reflections from the sources to/from the seabed and sea-surface.

- These anthropogenic underwater noises are certainly affecting the natural underwater eco-system in the Malaysian waters, especially near the many marine parks which are the main fish spawning and breeding areas. The migration paths of travelling mammals, such as dolphins and dugongs, are certainly affected.

- The quality degradation of the coral areas will directly affect the quality and quantity of fish populations, hence directly affecting the fishing industry for the country. This is an example of direct impact of man-made underwater noises. The collateral and undetermined effects need to be urgently investigated.

- The “underwater noises” will also make it very difficult for underwater vessel such as submarine and autonomous underwater crafts. The reliance of good quality acoustic signal/reflection from underwater objects such as underwater mounts and valleys will have significant impact for proper underwater navigation. From the defense or military point of view, this situation is very undesirable.

Effects of AUN

- The AUN also affects the larvae of a broad range of coral reef fish families that are attracted to the natural noises from coral reefs as they use sound to find suitable habitats during their settlement stage

- Therefore since fish and coral larvae uses sound as orientation to find reefs and settle, any underwater noise pollution could have implications for settlement and population dynamics in coral reef habitats. This is especially
so for boat traffic noise. For example, boat noise has been shown to disrupt the orientation behaviour in coral reef fish larvae, cause stress and create avoidance behaviours (Holles et al. 2013). If coral and fish settlement and recruitment are disrupted, this could potentially endanger the functions of the coral reefs as a food source and national income. In Malaysia, boats are usually fast and loud over and near coral reefs, and this should be minimised.

- Dugong conservation is an issue of concern in Malaysia as they are an endangered species. These animals respond to boat traffic and unfortunately for the dugongs they are usually found in shallow areas, due to their food source of seagrasses, which exposes them to high boat traffic. Therefore there is a high potential for boats to alienate the dugongs from their critical seagrass feeding areas.

- AUN e.g. boat noise could also affect dugong vocalisation and communication between individuals within their herd. Marine mammals such as dugongs rely on sound for communication, prey detection and predator avoidance. Therefore other noise could interfere with an animal's hearing and use of sound signals.

- Dugongs in waters of Pulau Sibu-Tinggi and Sg Johor, Malaysia has been suggested to be in danger from AUN i.e. acoustic pollution.

- As for cetaceans, there is also currently a lack of data for dugongs, and a precautionary approach to management and regulation is recommended. The management strategy should include minimal usage of noisy boats and minimal boat traffic within known areas of dugong presence and feeding areas.
2. **Steps and activities, including research activities that have been undertaken at the national, regional and global levels with regard to AUN, in particular those undertaken to address adverse impacts**

   - There have not been any significant research activities at the national and regional level regarding anthropogenic underwater noise. For the ASEAN region, the issue and impact of man-made underwater noises (i.e. acoustic perspective) have not been properly and significantly addressed. Researches for underwater eco-system were mainly on marine organisms, algae bloom occurrences, novel aquaculture technology, bathymetric mapping and coral biotas.

   - Studies on underwater noise sources classification from small boats and fishes have been conducted by two local Universities, namely Universiti Kebangsaan Malaysia (UKM) and Universiti Malaysia Terengganu (UMT) in the last few years. The underwater research group in Universiti Sains Malaysia (USM), meanwhile, has been working on developing ocean-going robotics platforms and acoustic sensor for the past 18 years.

   - Experiments to determine the effects of anthropogenic noise on seahorses were conducted in both field and aquarium settings by University Malaya (UM). Seahorses exposed to anthropogenic noise exhibit primary, secondary and tertiary stress responses at behavioural and physiological levels. The primary response of seahorses affected by anthropogenic noise is the observable increase in respiration rate followed by abandonment of location away from noise when in the wild. The exposure to the anthropogenic noise comes at a cost to growth, condition and immune status especially over a prolonged period such as in captivity (Anderson, *et al.* 2011). Therefore anthropogenic noise serves as a chronic stressor to marine fishes, particularly seahorses which would severely hamper the fish health and growth conditions.
3. **Any suggestions for further action to address the adverse impacts of AUN**

- The most important task for Malaysia and ASEAN countries is to conduct a comprehensive acoustic base-line study in the Malaysian/ASEAN waters e.g. Coastal areas of the South China Sea and, especially, along the Malacca Straits. The completion of a comprehensive acoustic base-line study will provide true and realistic of the current underwater noise levels from sources such as ports activities and at the shipping lanes. The baseline will also enable proper enforcement, mitigation and enhanced future acoustic-noise regulations.

- The setting-up of **in-situ acoustic** listening stations at/along strategic locations will also provide real-time acoustic observations for occurrences of excessive underwater noise emission. The data gathered will be useful for many strategic and economic aims. These matters are all directly covered under UNCLOS. In order to mitigate the anthropogenic underwater noises, the socio-economic activities related to the seas/oceans must also be discussed and regulated.

- It is also recommended that a **detailed map of the distribution** of economically and ecologically important marine species should be made; especially endangered species like dugongs, turtles and dolphins. This can then be used for planning and management of shipping, etc activities.

- In addition, the establishment of **marine parks and marine protected areas** for habitats, as well as migratory routes, of the marine species sensitive to underwater noise could also reduce/mitigate the impacts of AUN on marine life.

- Research should adopt a **multi-species approach** within the priority areas to quantify the species’ spatial distribution and changes in behaviour in relation to levels of sound at the source, levels of sound at set distances from the source, and received sound levels.

- Future research could be on **noise source descriptions** for surface ship noise spectra and it should include frequency content, pressure time series, duration, repetition rate, directionality, and other key parameters.

- More researches are needed of vessel noise within the frequency range of marine mammal echolocation (1 to 100 kHz) for the protection of marine mammal habitat. These studies should investigate the effects of vessel size, propulsion type, operating speed, and other operating parameters on noise levels.
• A long-term monitoring program is needed to track future changes in ocean noise. Acoustic data should be included in global ocean observing systems.