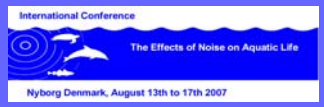
Do whales really care about conventional fisheries acoustics?



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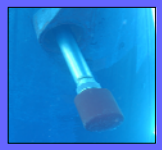
Introduction

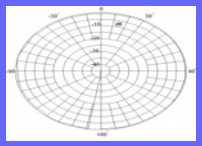
Acoustic monitoring is considered essential for the modern exploration and understanding of marine communities and ecosystems. Nevertheless, underwater noise pollution may have potentially negative effects, particularly on marine mammal and fish physiology and behaviour. This study aim to quantify how offshore whales and dolphins react on conventional fisheries acoustics from both a stationary and moving research vessel.

Material & Methods

An acoustic monitoring methodology was applied with conventional fisheries acoustic instrumentation. A three-frequency echosounder (38, 70 and 120 kHz) and an omnidirectional multibeam sonar (24 kHz) were connected to artificial drifting Fish Aggregating Devices (FADs) during an international scientific cruise (February 2004) in the western Indian Ocean. A moving vessel equipped with multi-frequency echosounders (18, 38, 70, 120 and 200 kHz) and multibeam (20-30, 110-120 kHz) sonars was also used during an ecosystem survey in the Norwegian Sea. Digital filming and ping-to-ping sonar tracking of animals were used to study marine mammal behaviour and possible reaction patterns to emitted sound from hydro-acoustic instrumentation.

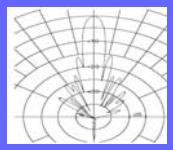


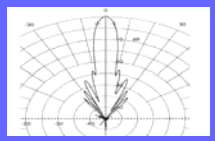
Sonar transducer.

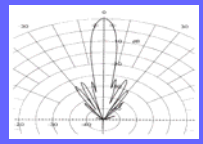


Horizontal directivity diagram.

Echosounder transducers.



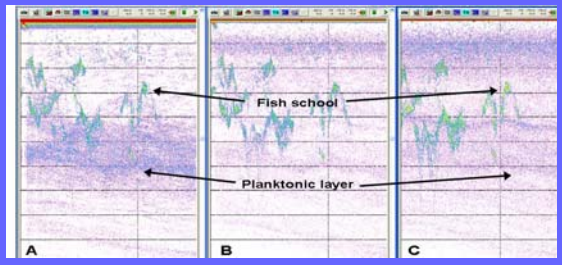




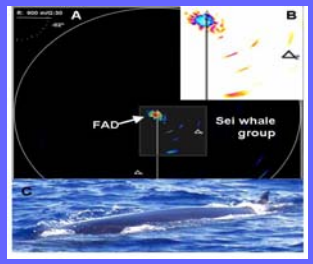
Longitudinal directivity diagrams of 38, 70 and 120 kHz Simrad EK60 transducers.

Results

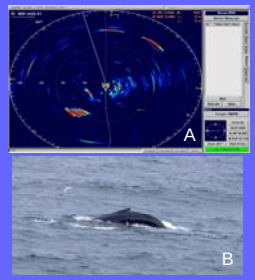
When using conventional fisheries acoustics in the Indian Ocean, a group of sei whale approached a stationary vessel, providing some evidence that the acoustic signals did not cause a measurable avoidance response by the whales. Similarly, large whales (fin, humpback and sperm whales), and dolphins (pilot and killer whales) did not show measurable behavioural responses and avoidance reactions towards a moving vessel. Groups of whales and dolphins were actively feeding on herring, mackerel and krill for 10-40 minutes simultaneously as the vessel was within 50-800 meters distance at different speed (2-12 knots). Our results suggest that many marine mammals in open oceans do not actively avoid stationary or moving vessels applying fisheries acoustics.



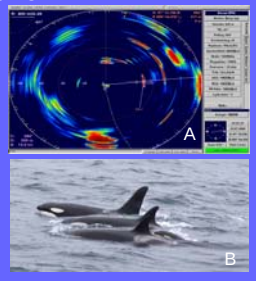
Echosounder multi-frequencies observations [from 0 to 100 m:(**A**) 38 kHz, (**B**) 70 kHz and (**C**) 120 kHz] allowed discrimination of deep scattering layers (DSL), large individual pelagic fish, as well as clearly detectable shoals and schools of fish in close distance to and near vicinity of the instrumented platform, here a FAD tied to a vessel in the Indian Ocean.



(A) Multibeam sonar allowed whale's detection in a diameter up to 1800 m. (B) Zoomed sonar picture of sei whale group visiting the FAD. (C) Sei whale (*Balaenoptera borealis)* observed at the surface beside the instrumented FAD.



(A) Multibeam sonar detection of two humpback whales (*Megaptera novaeangliae*) (B) picture of a diving humpback whale from the Norwegian Sea.



(A) Multibeam sonar detection of seven killer whales (*Orcinus orca*) hunting mackerel schools in the central Norwegian Sea. (B) corresponding picture.

Further studies are needed to find operational hydro-acoustic thresholds (intensity, time and frequency), according to species and area specific hearing sensibility and reaction patterns, and to enlighten the physical/physiological impacts of human induced acoustic stimuli on marine mammals. We stress the importance of defining "***Underwater Noise Tolerance Thresholds***", as other anthropogenic sounds may strongly influence marine mammal behaviour and physiology.

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