

THE MONOPULSE-NATURE OF SPERM WHALE SONAR CLICKS

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New, large aperture array recordings of regular clicks from foraging, male sperm whales off Andenes, Norway, show high directionality (DI ~27 dB) and record-high source levels (~235 dB rms re. 1 μ Pa) for clicks presumably recorded on-axis. Such levels require a peak power capability of 4 kW from a sound generator at the stated directionality. The latter may conceivably vary from click to click but the methods used preclude observations on this aspect. Less than 0.1 % of the clicks analyzed are of the on-axis type. This low yield is understood as a consequence of high directionality of the source and the unfavorable geometry of the recording situation (whales at about 1 km of depth, hydrophones near surface). The spectra of on-axis clicks are broadband (Q ~3), peaking in the 12 kHz region, and the classical, multi-pulsed pattern of the clicks is suppressed: 99.6 % of the energy is concentrated in one pulse having a duration of ~100 μ s between -10 dB limits of the envelope. In off-axis recordings of the same clicks, the multi-pulse structure is fully developed but the levels are ~40 dB below that of the on-axis click. The spectral properties place the on-axis click at the optimum frequency range for a long-range sonar looking for targets with cross-sections down to 5 cm. The combination of the pulse properties with the acoustic behavior of male sperm whales supports the conjecture that the clicks are used for sonar. Accordingly, only the on-axis, mono-pulsed version of a click is likely to benefit the animal, while the off-axis, multi-pulsed version (the 'classical' sperm whale click) may, from a sonar analysis point of view, be regarded as detrimental, clutter-generating noise.

SIGNATURE WHISTLES IN A LONG FINNED PILOT WHALE (*GLOBICEPHALA MELAS*) POD OFF VENTOTENE ISLAND (SOUTHERN TYRRHENIAN SEA, ITALY)

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Long finned pilot whale (*Globicephala melas*) has a various acoustic repertoire, associations between social behavioural context and vocalisation type have been documented, however little is known about the degree of stereotypy of whistles and data for the "signature" function are still limited. A single stable pod seasonally resident off Ventotene Island has been monitored since 1995 (Mussi et al. 2000). Through the years, whales' number in the pod decreased from 6 to 2. Acoustic recordings were synchronically collected with behaviour, photo and video data. The observations were carried out on board sailing boats, equipped with towed hydrophones (10 Hz- 20kHz frequency response). From 1995 to 2002, a total of 30 hours of extended recording were collected on a Hitachi 88EX and Sony TCD-D100 DAT recorders. Recordings were later digitised at 24 kHz and spectrograms made, using a real-time analyser. All whistles (n=899) were classified in different categories based on their shape, following the scheme of Taruski (1979) and Weilgart and Whitehead (1990). Calls were assigned to whales by observing air bubbles released simultaneously to the sound production (McCowan and Reiss, 1995) during bow ride behaviour. 723 whistles were consequently attributed to four different individuals: Cagliostro adult male, the "pilot", Santiago, adult male, Pan, juvenile male and Señora, adult female. Results showed that whales produced mostly (80%) their own signature call that remains stable over long periods of time and its frequency versus time "contour" shows a high degree of stereotypy. Male's individual calls were found to be predominant (90%).