Inter Pulse Interval analysis of Sperm Whale (*Physeter macrocephalus*, Linnaeus 1758) "clicks" recorded in Mediterranean Sea between 1996 and 2011: Population structure and distribution of sizes

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The population of Mediterranean sperm whales (*Physeter macrocephalus*) appears to be partially segregated and a genetic divergence with Atlantic populations is evidenced by preliminary genetic studies. To date, in Mediterranean Sea, no animals have been estimated to be longer than 14 meters by using IPI (*Inter Pulse Interval*) analysis; this is in contrast with the length reported in literature for sperm whales in other oceans of the world; the size of adult males in Atlantic and Pacific Ocean is reported to reach 17-18 meters. A Stable *Inter Pulse Interval* can be identified among pulses that compose a single click, and thus the size of the spermaceti can be estimated. Then it is possible to determine the whole size of the animal by using some experimental equations. But the sample of IPI analyzed Mediterranean sperm whales is limited in the literature. With this research, trying to fill a literature gap, we aimed to analyze unexplored recordings made by C.I.B.R.A between 2000 and 2011 in the Mediterranean Sea, provided they had the required quality. Furthermore, we analyzed historical recordings already present in the literature. The acoustic estimate of sperm whale size provided information on the population structure and evidenced the presence of specific size classes. The distribution of size classes could provide useful information on the structure of the population and its trends. Analysis required the selection of suitable recordings, sperm whales sounds with good quality and eligible *Signal to Noise Ratio*, and was based both on manual examination with visual inspection of waveforms and of high resolution spectrograms, and on automatic methods developed in Matlab, mainly based on Cepstrum analysis. Available algorithms have been tested. In optimal cases, automatic analysis provided good data and required minimal time to perform IPI verification. In less than optimal recordings, only manual analysis provided reliable results.

Keywords: acoustics; behaviour; breeding; communication; conservation; distribution; ecology; habitat use; life history; photo-ID; physiology; population dynamics; social interactions; sperm whales; clicks; inter pulse interval; Mediterranean Sea