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A Comparison of Acoustic Based Line-Transect Density Estimates for Sperm Whales and Minke Whales in the Northern Marianas Islands

Tom Norris*, Tina Yack, Elizabeth Ferguson and Kerry Dunleavy

Bio-waves Inc. 364 2nd St., Suite #3 Encinitas, CA 92024

*thomas.f.norris@bio-waves.net

Density was estimated for minke whales (*Balaenoptera acutorostrata*) and sperm whales (*Physeter macrocephalus*) using archived acoustic data recorded from a towed hydrophone array during a vessel based line-transect survey. This acoustic and visual survey was conducted in the winter/spring and encompassed a large study area (616,000 km^2) in the Northern Marianas Islands. Greater than 65% of the visual survey effort was conducted in Beaufort sea states of five or higher, thus visual efforts were greatly compromised. The towed array system was used during daylight hours in all conditions up to, and sometimes exceeding, Beaufort 6 sea state. For sperm whales, semi-automated detection and localization was conducted using PAMGuard software. This resulted in more than twice the number of acoustic localizations than were obtained in the field, and encounter rates that were about four times greater than used in the visual based density estimates. The acoustic based estimate was 0.84 animals/1000 km^2, compared to the visual based estimate of 1.23 animals/1000 km^2. More importantly, the CV of the acoustic estimate (CV = 26%) was 34% lower than that of the visual estimate (CV= 60%). We were able to post-stratify results by click-type, allowing separate estimates for males (0.11 animals/1000 km^2) versus females and juveniles (0.73animals/1000 km^2). For minke whales, data were post-processed using a customized algorithm to detect, localize and estimate distances to animal calls. This resulted in over 30 acoustic localizations which were used to estimate densities of 0.13 (CV= 38%) and 0.15(CV=40%) animals/1000 km^2 (based on a detection function that was right truncated, or both left and right truncated, respectively). To our knowledge, this is the first acoustic-based density estimate of minke whales using line-transect methods. We will use examples from these analyses to highlight some important issues for acoustic based line-transect density estimation methods and will provide recommendations to improve these methods.

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