Silhouettes of Sound (Visualizing Animal Vocalizations for Species Identification)

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Marine mammals, such as cetaceans, rely significantly on sounds as their primary means of communication and perception of their environment. Acoustic signals are crucial for various social interactions, including mating, caring for offspring, alerting others of threats, and coordinating hunts. The study of sound waves in a solid medium, specifically the Chladni plate, provides a method to observe acoustic phenomena. It is hypothesized that by employing digital recordings of cetacean sounds to induce vibrations in a Chladni plate, distinct standing wave patterns would emerge. Those patterns could then be used to distinguish between different species. The Chladni sound wave patterns of various toothed (bottlenose dolphin, narwhals, beluga, sperm) and baleen (blue, humpback, North Atlantic right, fin, minke) whales were recorded. Various types of sounds, including tonal and impulsive sounds, give rise to distinct patterns. The variations enable distinct fingerprinting of cetacean sound structures. For instance, an unidentified 52-Hz-whale, an enigma for three decades, is discerned as possible kin of the humpback whale. The likeness in the standing wave patterns observed in blue whales across diverse oceanic regions indicates shared language traits within species. Additionally, they exhibit alternating circular- and square-core transitions. Structural transitions were also identified in humpback whale songs. Several wave patterns were consistently replicated across various sampling sources. The validation of the hypothesis introduces a promising novel method for differentiating species and/or lineages through Chladni acoustic patterns. The results help advance the knowledge of marine mammal vocalizations and raise awareness about other intelligent language-using species.

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