

Animals present interesting challenges in noise and vibration because their senses operate differently from humans. Some animals' hearing extends to frequencies 5-10 times higher than humans, and animals cannot tell us what may be annoying, painful or disruptive. Animal issues can require specialized instrumentation as well as the ability to think beyond the limits and biases of our own senses. Below are some of our projects addressing the needs of animals in research laboratories and wild settings.



**US Army MRICD** (Aberdeen Proving Ground, MD): Full vibration and acoustical design for a \$430M, 526,000GSF major replacement facility (left) for the Medical Institute for Chemical Defense. The project included a 23,000SF vivarium. Special analyses were performed to accommodate the needs of the animals. Many different species were present, requiring

analyses across multiple frequency and amplitude regimes. Stressors included in the analyses included mutual antagonism; human voice impact to primates; ultrasonic emissions from electronics components; and future construction / maintenance at the facility. Our design focused on creating high-quality animal spaces to maximize research productivity.

**Jackson Labs** (Sacramento / Bar Harbor): Environmental baselines for a mouse breeding colony. The Laboratory wanted to develop data describing the current condition in their vivaria. We performed testing of noise and vibration of the building as well as inside cages. Due to the nature of mouse hearing, we employed a specialized instrument set capable of measuring noise up to 95kHz (about 5× higher than the highest frequencies used in human settings). The results yielded multiple surprises, especially in the ultrasonic regime.



**Open Space Preserves**, Midpeninsula Regional Open Space District (San Francisco Bay Area): Noise measurements and planning to support trail construction projects in Preserve areas with endangered species habitats. The California Department of Fish and Game requires noise analyses for work near these kinds of habitats, with the intention of preventing disruption of breeding as well as other behaviors. We conducted ambient noise surveys, reference noise measurements of District construction equipment,

and developed simple-to-implement models for the District to use for planning purposes.

**Bethel Island Replacement Bridge** (Contra Costa County) and **Klamath River Bridge Hinge Replacement** (near Klamath, CA): Underwater noise monitoring during in-water pile-driving and demolition work. Semi-attended hydrophone monitoring allowed immediate feedback to Project Engineers and daily reporting to multiple regulatory bodies. Controls on hydroacoustic emissions serve to prevent not only breeding disruption but also fatal exposure to high-energy concussive impacts.

