

sufficiently, and the vaquita population will continue to decline. The second option is a larger area that includes most but not all of the vaquita's range; there is a 90% probability that the population will be larger by 2012 under this option. For the third area proposed for protection, which includes all of the currently known range of the vaquita, there is a 96% probability that the population will grow by 2012 if the plan is implemented promptly and completely. Given the uncertainties, vaquita bycatch will have to be eliminated or at least reduced over 90% in order to have a high probability that the population will recover.

### Zones of masking from hopper dredging impact the risk of vessel collisions with manatees

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Acoustic characteristics of hopper dredging in the St. Johns River, Duval Co., Florida were measured to determine potential noise impacts with respect to manatee hearing. Of particular interest, was the extent and range that dredging noise may mask the sounds of approaching commercial and recreational vessels. Ambient noise surveys, site-specific bathymetric and active noise propagation measurements were conducted where dredge recordings were made. Site-specific acoustical and physical data were integrated with behavioural hearing data to evaluate impacts and estimate zones of masking surrounding hopper dredging activity. Tidal mixing resulted in isothermal conditions and iso-sound speed velocities across depths. In the dredged channel, acoustical transmission loss was spherical up to 100 meters. Boundary effects were apparent at lower frequencies in shallower water and mid-range frequencies, (2 kHz to 10 kHz) propagated with the best efficiency across depths. Three discernable continuous noise sources (1) cavitation from dredge propellers, (2) draghead vacuuming and, (3) noise from the submerged slurry pump out pipeline were evaluated. Estimated source levels at 1 meter were for frequencies > 1,000 Hz were, 172 dB re 1mPa for cavitation, 177 dB re 1mPa for draghead vacuuming and, 169 dB re 1mPa for slurry pump out noise. Dredging noise effectively masked the sounds of fast approaching watercraft at ranges > 250 m. The zone of masking for a slow approaching vessel was > 2.5 miles away from the hopper dredge. Mitigation techniques suggested to abate noise radiation include; ship quieting reducing propeller cavitation, insulating and elevating slurry pipelines, and minimizing the number and distance of transects to pump out stations. With respect to the effects on boat noise a most cost effective mitigation is to attach a low intensity, directional alarm (in a bandwidth above the masking frequencies) to the bows of slow and fast moving vessels.

### Anaesthesia of New Zealand's largest endemic animal, adult male NZ sea lions (*Phocartos hookeri*)

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The New Zealand (NZ) sea lion (*Phocartos hookeri*) is one of the world's rarest otariids with current population estimates showing it is in severe decline. Most NZ sea lions live in the uninhabited NZ sub-Antarctic. Less than 1% (eleven breeding aged females and up to 150 males) breeding on the coast of Otago, South Island, NZ, near NZ's 5th largest city, Dunedin. Unlike the sub-antarctic populations which main human impacts is direct (death) and indirect (resource competition) fisheries interactions, the small population at Otago deals with very different threats due to the proximity of large human populations. The increasing interactions between humans and NZ sea lions in the Otago area, lead to the need for safe and practical ways of capturing, handling and potentially moving all age classes of animals including adult males that can reach up to 450kg. This research undertook to establish a technique to safely capture, place under anaesthesia and manage large NZ sea lions. Six adult males, up to 330kg in weight, were initially chemically

anaesthetised using Zoletil® by dart delivery and then kept under general anaesthesia using a portable isoflurane ventilator on Enderby Island, Auckland Island during the austral summer January/February 2009. Enderby Island is an isolated, uninhabited island 500 km from mainland New Zealand. This research is the first ever reported capture and general anaesthesia of large NZ sea lions and a first for large Otariids in an extremely remote, unsupported environment.

### Source levels and spectral analysis of Southern sea otter (*Enhydra lutris nereis*) scream vocalizations

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Although many of the vocalizations emitted by sea otters are thought to be used for short-range communication at the surface, scream calls are relatively loud signals with potentially large effective communication distances. These harsh calls are produced by individuals of both sexes and all age classes under conditions of stress, and can be heard by human listeners up to a kilometer away. The ranges over which these signals may be detected by conspecifics is unknown, in part because the source levels of these calls have not been measured. We recorded aerial scream vocalizations of captive sea otters and sampled three categories of individuals: adult females, adult males and dependent pups. Vocalizations were analyzed to determine source level (in peak pressure), frequency range, frequency with maximum energy, and duration. All screams were broadband and harmonic in structure, with durations varying from 0.5 to 2 seconds. Adult female screams had a frequency of maximum energy ranging from 6-8 kHz, and source levels ranging from 110-118 dB peak re 20 µPa. Adult male screams had a frequency of maximum energy ranging from 2-6 kHz, and source levels from 93-107 dB peak re 20 µPa. Dependent pups had a frequency of maximum energy ranging from 4-7 kHz, and source levels from 108-111 dB peak re 20 µPa. The harmonic structure and frequency range of these high-amplitude calls may be optimal for detection by conspecifics in coastal environments that are dominated by ambient noise below 1 kHz. Future measurements of the auditory sensitivity of sea otters, when considered with respect to these vocalization parameters, will allow the functional communicative ranges of these signals to be determined.

### Marine mammal sightings in the Pacific Ocean observed during the Voyage of the *Odyssey*

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The Voyage of the *Odyssey* was a five-year journey circumnavigating the globe in temperate and tropical waters that collected sperm whale skin biopsies from whales in 16 different regions of the Pacific, Indian and Atlantic Oceans and the Mediterranean Sea. The intent of the study was to determine baseline levels of marine contaminants globally using the sperm whale as an indicator species because of its worldwide range and its status as an apex predator. The Voyage travelled to a number of regions that had seldom been surveyed for marine mammals. Here we present the marine mammal sightings for the Pacific Ocean during that Voyage. The *Odyssey* was in the Pacific Ocean from 1999-2001 and worked in the Sea of Cortez and the waters around the Galapagos, Papua, New Guinea and Kiribati. In these locations we had cetacean sightings of: 769 *Physeter macrocephalus* (sperm whale), 37 *Tursiops truncatus* (bottlenose dolphin), 22 *Stellena attenuata* (spotted dolphin), 19 *Grampus griseus* (Risso's dolphin), 17 *Globicephala macrorhynchus* (short-finned pilot whale), 15 *Stenella longirostris* (spinner dolphin), 7 *Lagenodelphis hosei* (Fraser's dolphin), 6 *Delphinus delphis* (common dolphin), 3 *Balaenoptera physalus* (fin whale), 3