

Bioacoustics of marine mammals; R/V *Hero* Cruise 70-3

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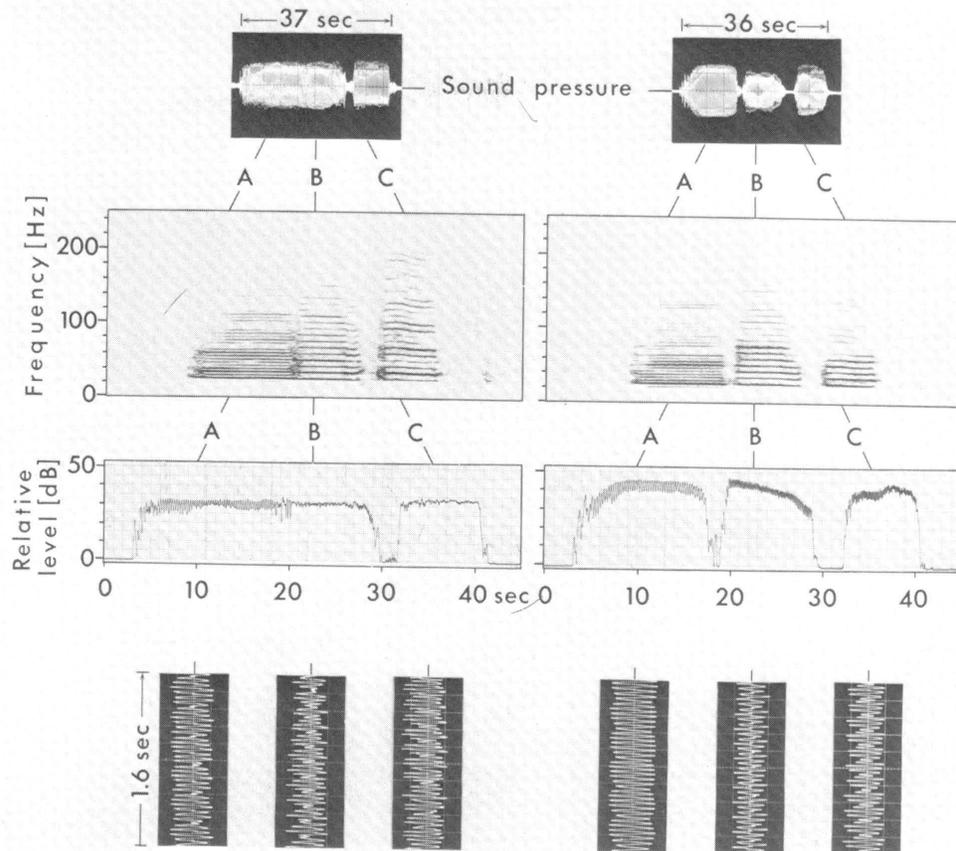
On May 15, 1970, the research vessel *Hero* left Punta Arenas, Chile, in search of marine mammals and birds along the Chilean archipelago and offshore islands. The main purpose of this phase of Cruise 70-3 was to study the sounds of marine mammals encountered from Punta Arenas to Valparaíso, Chile. Numerous sound recordings were made in the presence of blue whales, *Balaenoptera musculus*, South American fur seals, *Arctocephalus australis*, Guadalupe fur seals, *Arctocephalus philippi*, and South American sea lions, *Otaria flavescens*.

Sailing westward through the Strait of Magellan and then northward through the island chain, we made recordings from 32 locations. Half of these locations were inhabited by seals, porpoises, or large whales; the others were used as listening stations for monitoring any distant soniferous animals.

We found a large colony of South American fur seals in the Pierre Isles, 50°35.5'S. 74°59'W. All together, about 30 animals were concentrated on a small rocky isle. Underwater grunting and thumping sounds extending in frequency from 30 to 600 Hz were recorded from the nearby seals, using one of *Hero's*

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Comparison of sounds from blue whales I (left) and IV (right). Oscillograms (top) show sound pressure envelope and gross wave form. Corresponding spectrograms (second row) delineate the three parts (A, B, C) of each sound. Effective analyzing filter bandwidth for spectrograms was 1.4 Hz. Graphic level records (third row) for the same sounds were made with 75-Hz low-pass filtering for whale I and 150-Hz low-pass filtering for whale IV. Oscillograms (bottom) show a representative wave-form sample from each of the three parts of each sound.



boats. Two large male sea lions stayed ashore, apart from the fur seals.

A rare opportunity for underwater bioacoustics study occurred at Isla Guafo, southwest of Isla de Chiloé, where four blue whales were sighted on May 30 and 31. The underwater moanings from these animals were the most powerful sounds recorded from living animals—188 dB, re $1 \mu\text{N}/\text{m}^2$ at 1 m. By comparison, this is the same overall noise level as that of a U.S. Navy cruiser traveling at normal speed. Each blue-whale phonation consisted of three parts, the total duration being an average of 36.5 sec. The sounds were exceptionally low in pitch, their frequencies extending from 12.5 to 200 Hz. This combination of high power and low frequency would enable the blue whales' sounds to be audible from a hydrophone hundreds of miles from the whale. The moans from blue whales occurred in a repetitive pattern that was interrupted only when the vociferous whale surfaced to breathe. We were unable to detect any particular kind of behavior that was directly associated with sound production. Sometimes the whales appeared to be feeding; at other times they seemed to be in transit. A few other blue-whale signals occurred in the background, but we could see no other whales. Presumably, the others were beyond our visual range, but within range of the hydrophones. The four whales sighted were between 15 and 18 m long.

We noted a high correlation between changes in the blue whales' distances from the hydrophone and the amplitude of the signals, indicating that the high-level sounds were definitely from the whales under observation. All four of the blue whales occurred in relatively shallow water ranging in depth from 6 to 169 m.

These recordings are extremely valuable, because blue whales are scarce and we may not have another opportunity to work with them.

The Guadalupe fur seal, whose airborne bleating sounds were recorded during Cruise 70-3, was encountered in one of its last refuges—Isla Más-á-Tierra (Robinson Crusoe Island), about 650 km from the Chilean coast. Although the hydrophone was very close to swimming animals, we could not detect any underwater vociferations. We did not see any sea lions, and apparently only a few fur seals have survived the harvest of traders.

We recorded a variety of grunting sounds, growls, and barks from a large colony of South American sea lions at Metalqui Island ($42^{\circ}11.7'S$, $74^{\circ}10.5'W$.) off the northwestern coast of Isla de Chiloé. The principal energies of these phonations were in a bandwidth from about 40 to 1,000 Hz. With a hydrophone and a directional microphone it was possible to record air- and waterborne sounds simultaneously. These recordings were made as the animals swam at the surface of the water with their heads exposed. Metalqui ap-

peared to be a very favorable location for any type of field work on the South American sea lion. The colony contained about 300 animals, the beach was easily accessible, and the area was situated in sheltered waters.

The bioacoustics phase of Cruise 70-3 ended on June 18, 1970, as *Hero* neared Valparaíso, Chile. We are grateful for the assistance given us by Dr. Raymond M. Gilmore (senior scientist), Dr. Joseph R. Jehl, Jr. (ornithologist), and Mr. Steven L. Bowen (research assistant), all from the San Diego Natural History Museum. *Hero's* Master, Robert Carrow, and the crew did a splendid job of manning the ship and providing support, often under severe conditions. The work was supported by NSF grant AG-217.