SURTASS LFA:
Technical Background &
Marine Mammal Scientific Research Program

Presented by:

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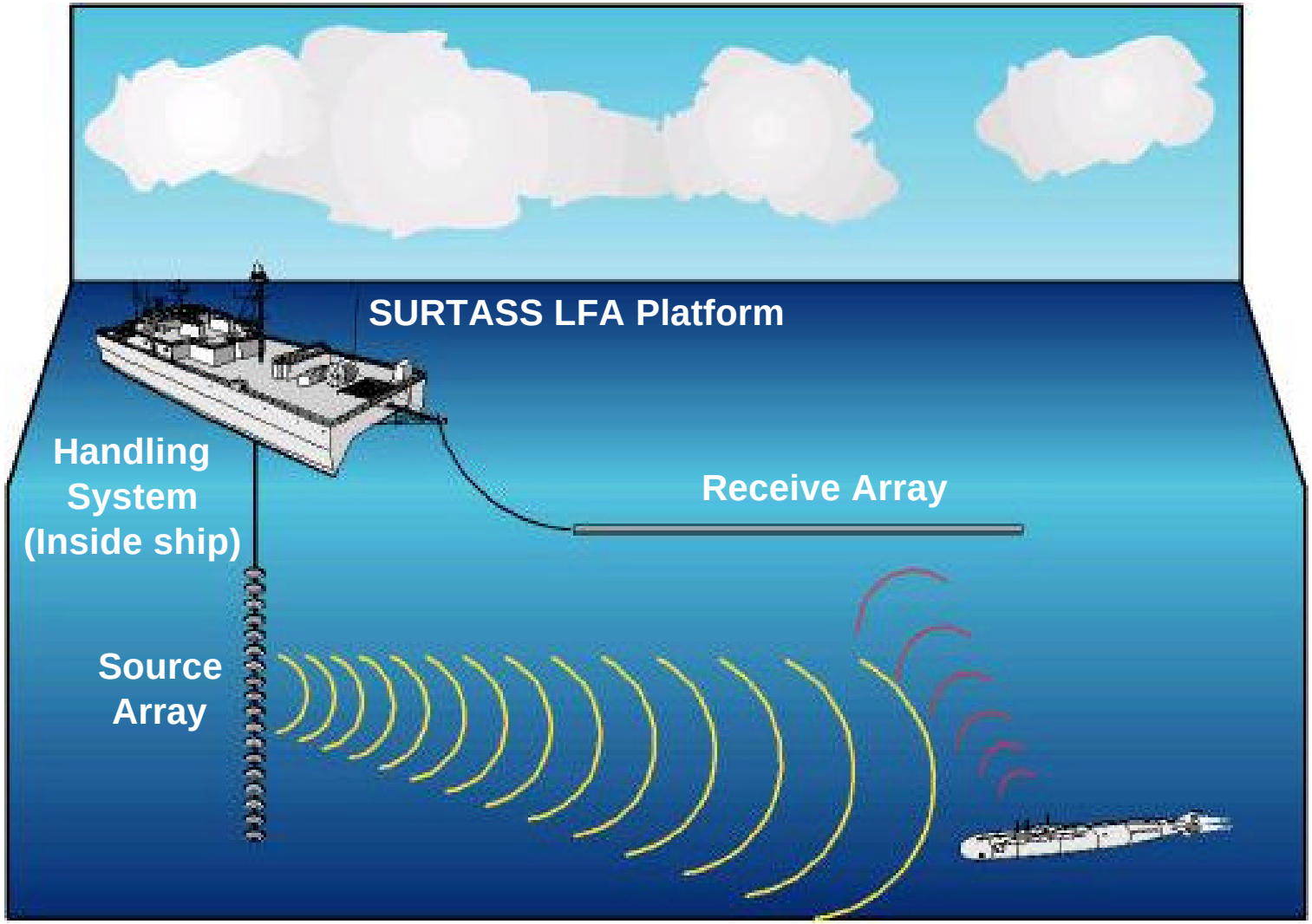
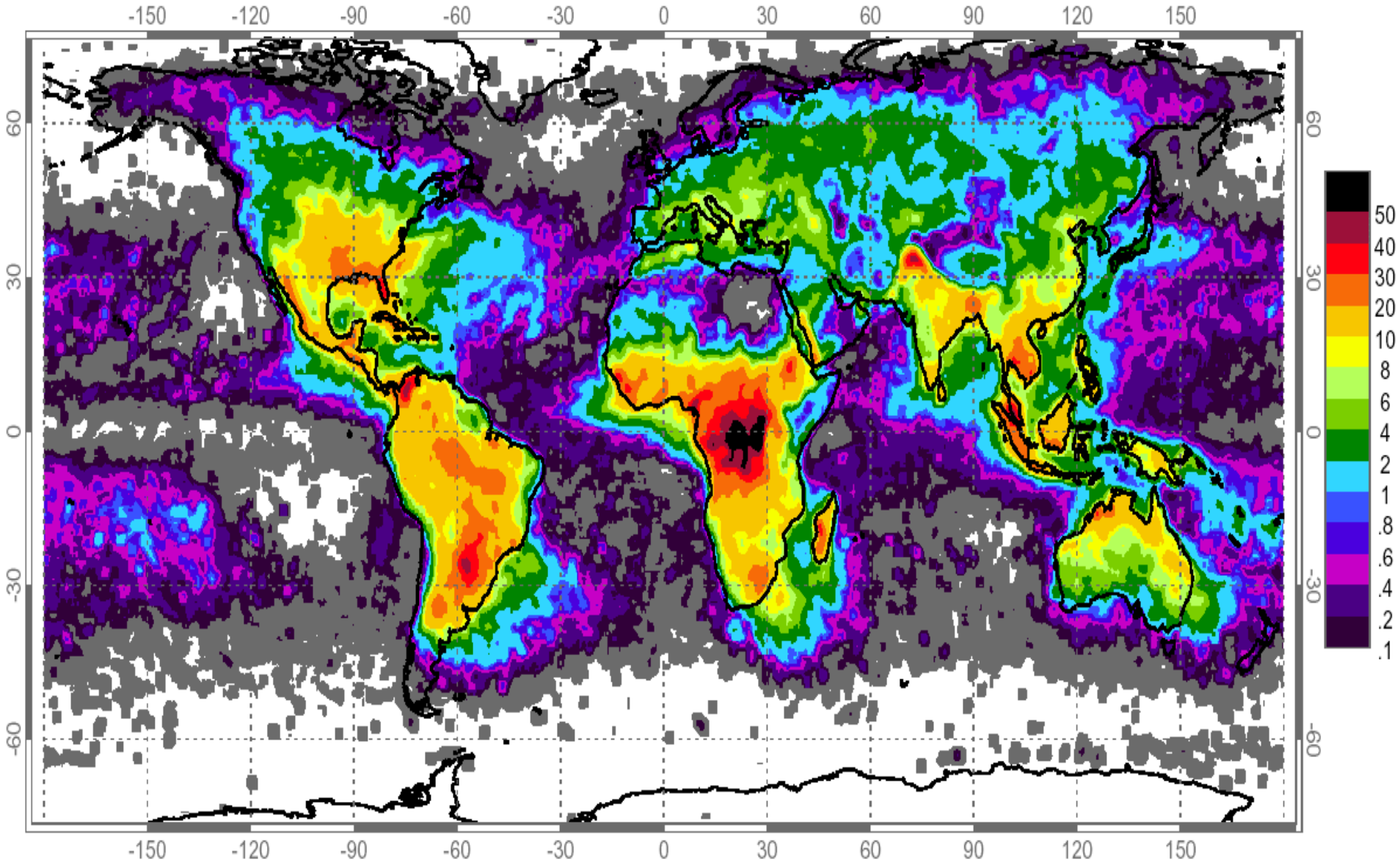
Office of Protected Resources
Marine Mammal Conservation Division

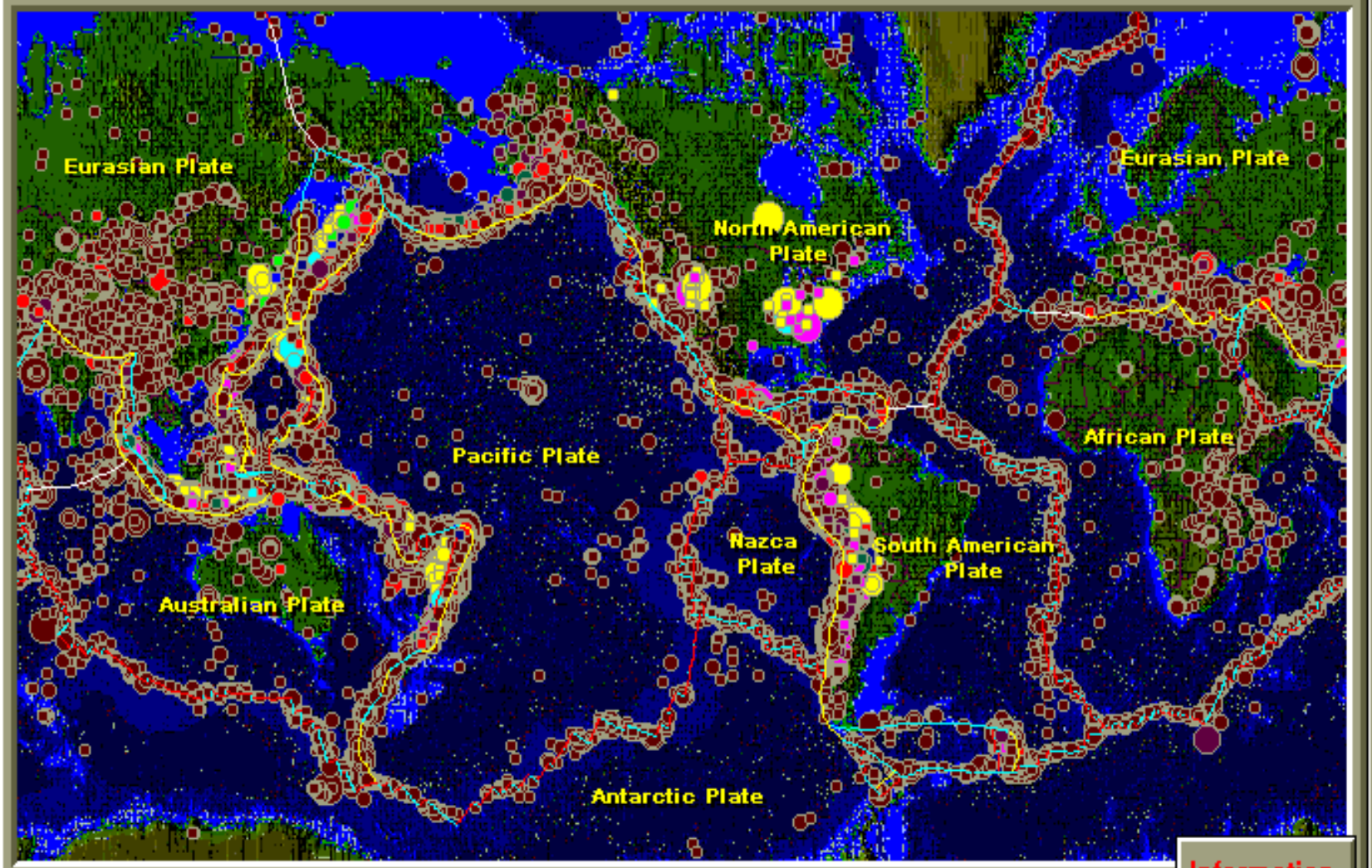
SURTASS LFA
Sonar Description



Lightning Strikes (Km^2/Year)



World Earthquakes & Volcanic Eruptions, 1960 to present



Key

Earthquakes

58683

Magnitude Depth(km)

4 5 6 7 8 9

0 100 200 300 400 500

Play | Rew. | 2001 Dec 09 | F.Fwd | Repeat | Pause

Back

1960 Jan 01 — 2001 Dec 31

Step | Step

1 month/sec

5.0 EQ Cutoff

1 Eruption Cutoff

Earthquakes

Eruptions

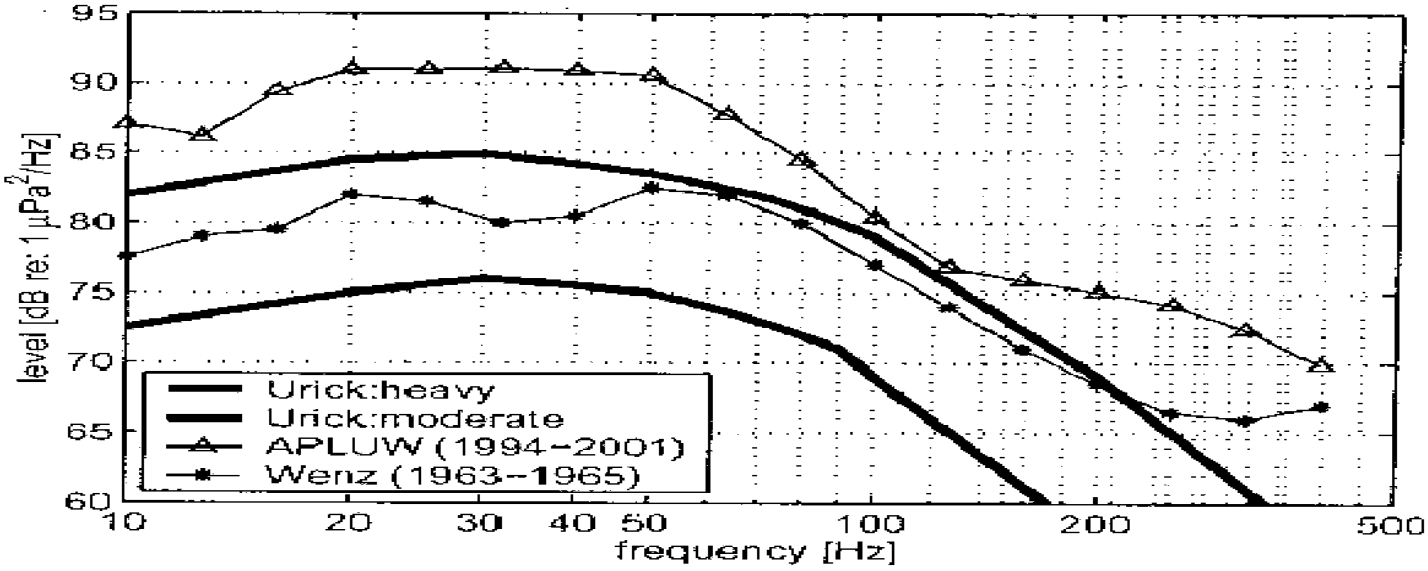
Info boxes

Plates

Evidence that ambient noise is increasing

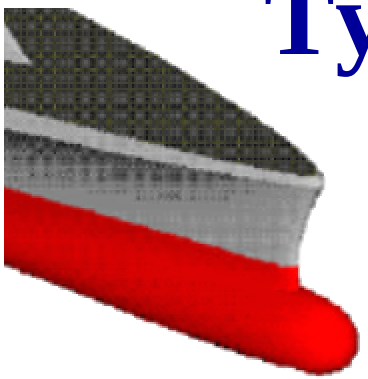
Thirty Three year comparison at Pt. Sur, California shows

- **10 dB increase in 20-80 Hz band (shipping)**
- **3 dB increase at 100 Hz**
- **9 dB increase at 200-300 Hz (unknown cause)**



Andrew, R.K., B.M. Howe, and J.A. Mercer, April 2002. Acous. Res. Let. Online 3(2):65-70.

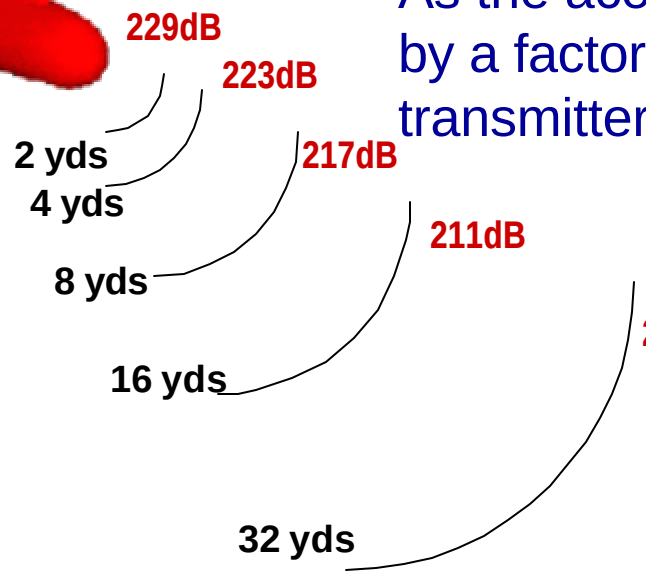
Navy Active Sonars
Typical Sound Pressure Levels



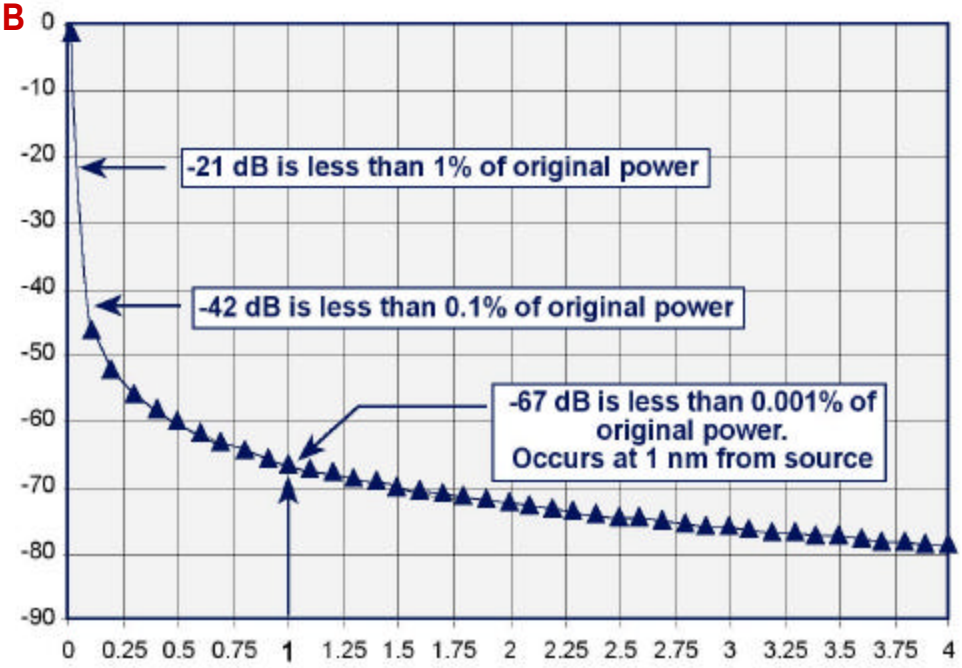
The source level of 235dB is measured at 1 yd from the transmitter.

As the acoustic energy spreads the level drops by a factor of 4 every time the distance from the transmitter doubles.

After only 64 yds of travel the level is less than 200 dB.

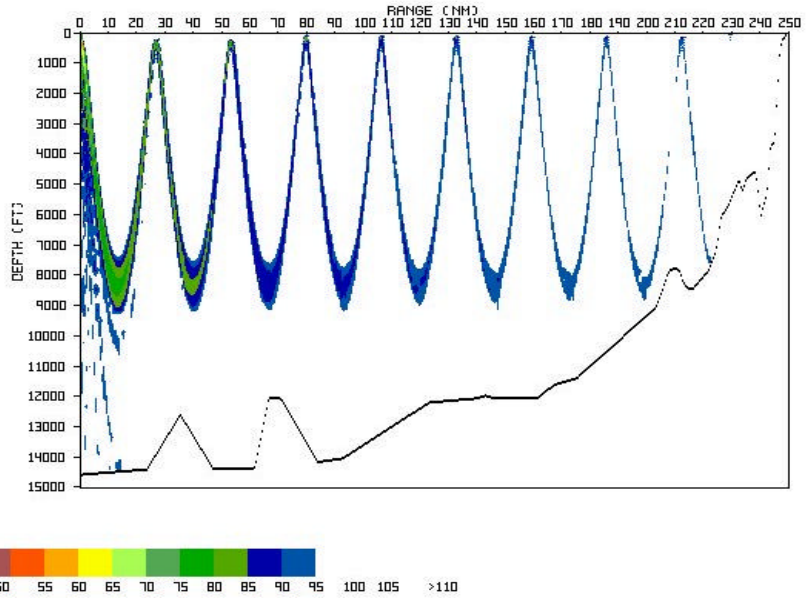


- **Sonars can vary their frequency, pulse type, pulse length and power level.**
- **235dB typical search mode.**

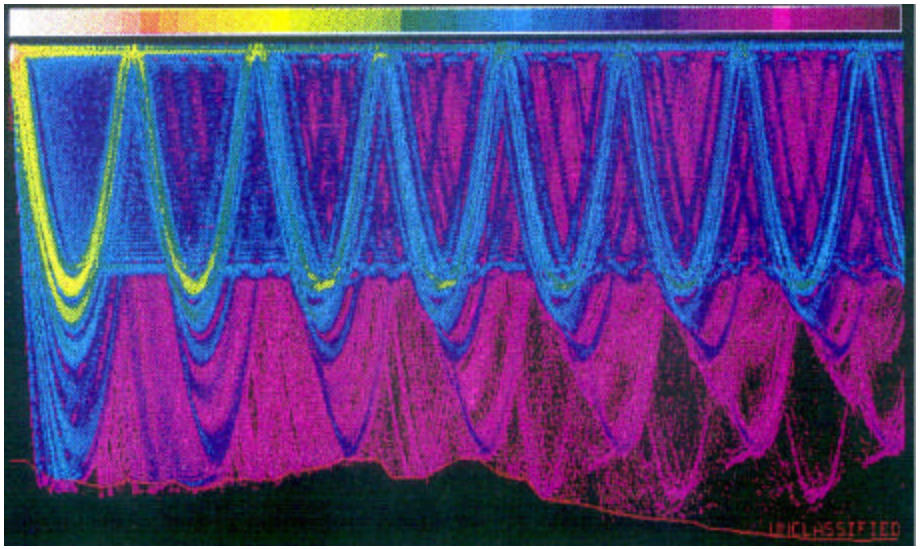


Acoustic Propagation in a Convergence Zone (CZ) & Surface Duct

Convergence Zone



Surface Duct



U.S. Navy Marine Mammal Scientific Research Program

- Marine mammals rely on sound for a wide variety of critical functions (much as terrestrial animals use light).

- Baleen whales use low frequency (LF) sound
  Selected as indicator species for a 3-phase Scientific Research Program (SRP).

4 species of baleen whales were studied in the SRP:

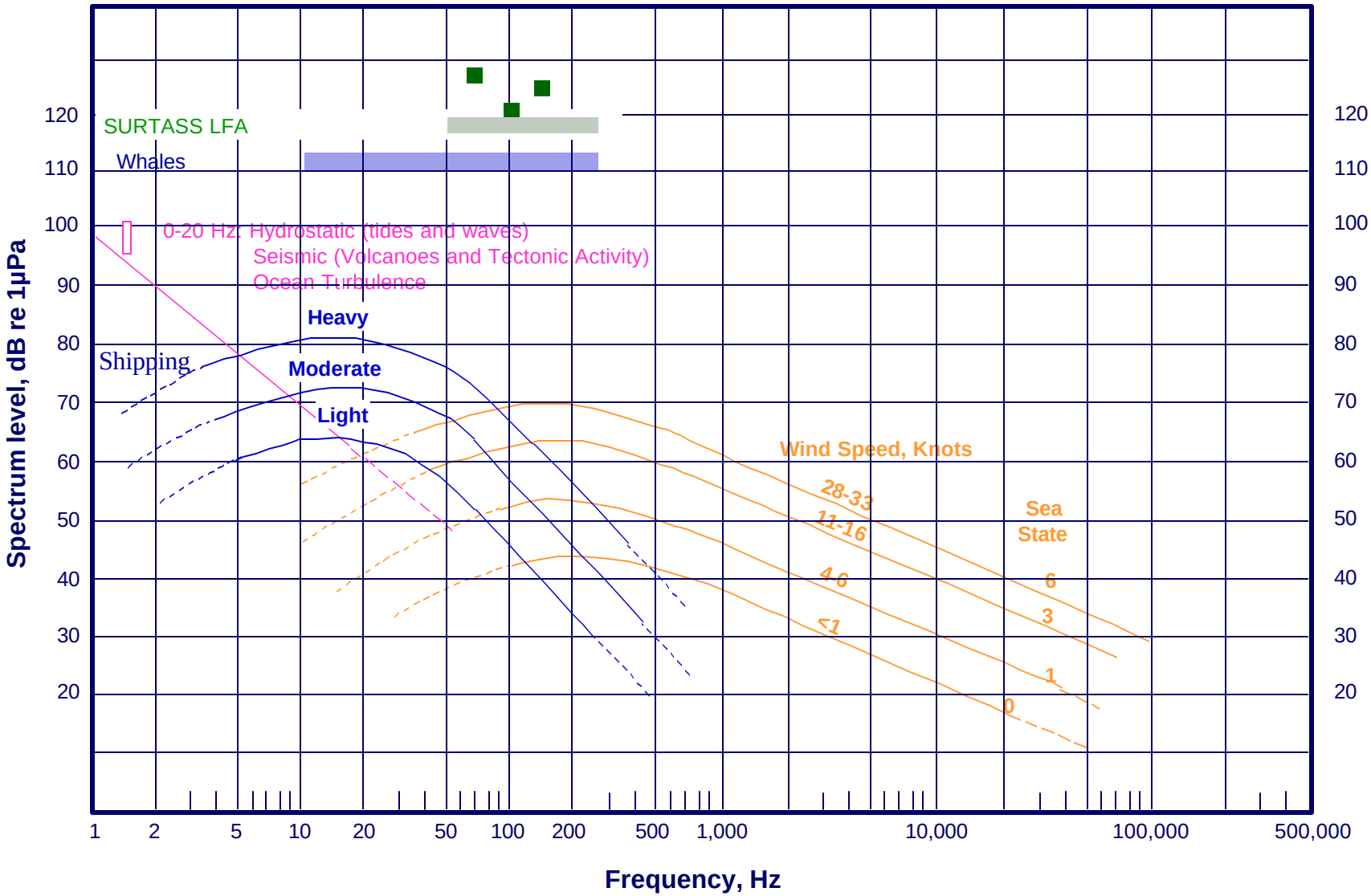
Phase I: Blue whale

Phase I: Fin whale

Phase II: Gray whale

Phase III: Humpback whale

Ambient Noise Spectra

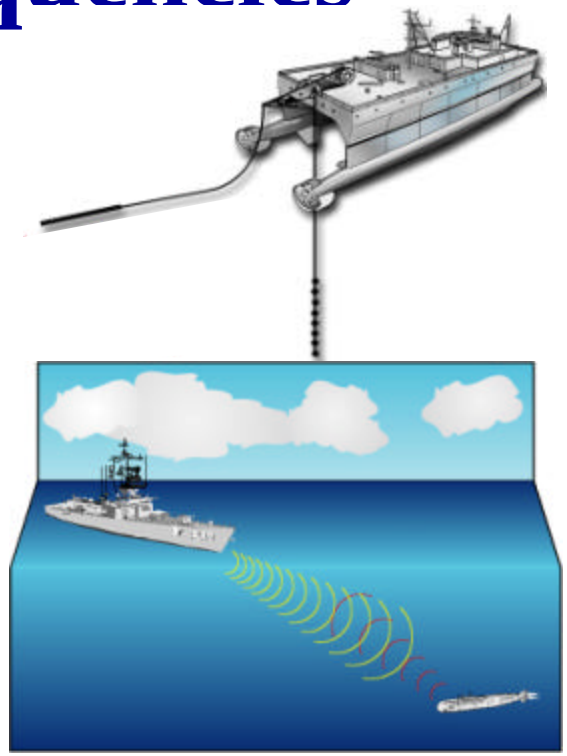


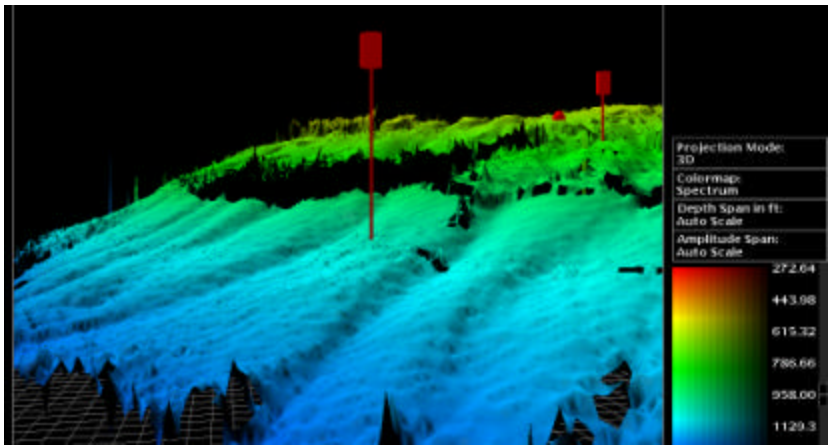
Active Sonars:
Low, Mid, High Frequencies

Low Frequency < 1kHz
Long Range Search & Surveillance
Less Attenuation
Typical Ranges 10s to 100s of NM

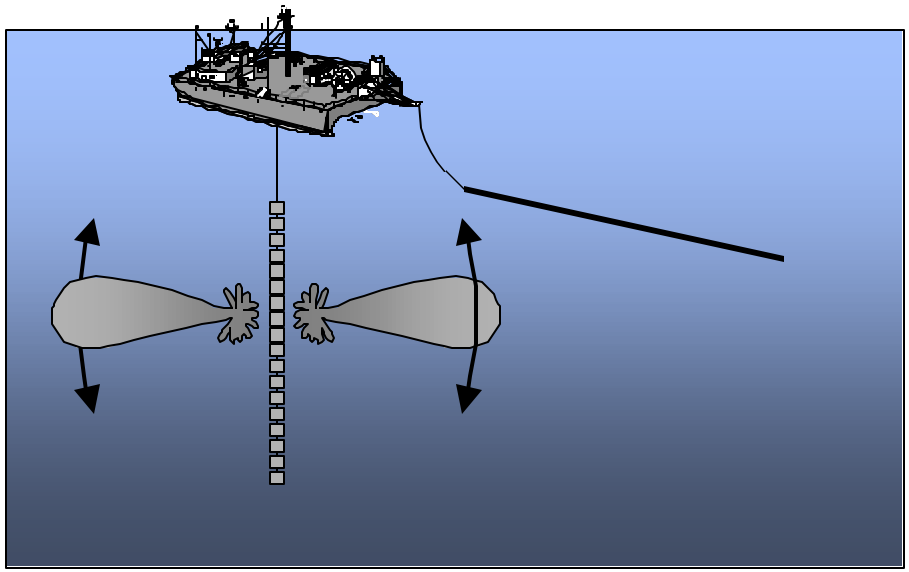
Mid-Frequency 1kHz-10kHz
Ship & Submarine Sonars
Force Protection & Tactical
Moderate Attenuation
Typical Ranges 1-10 NM

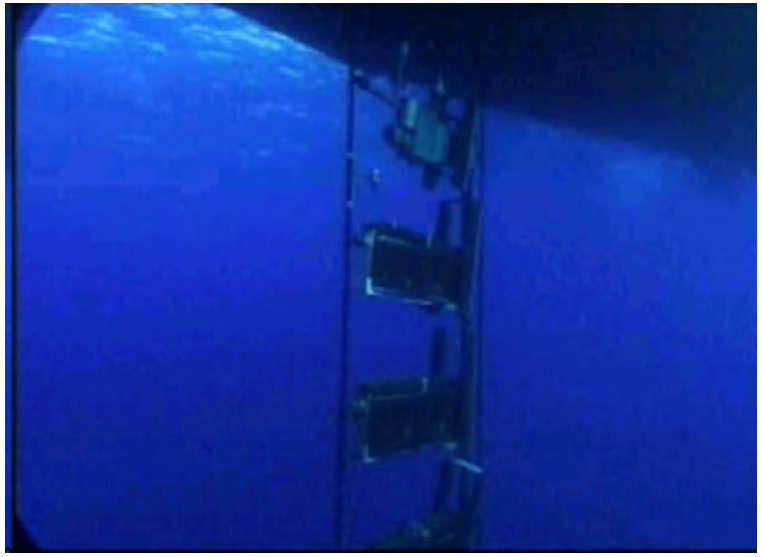
High Frequency >10kHz
Mine Hunting Sonars
Torpedo Sensors
Acoustic Energy Greatly Attenuated
Typical Ranges<5nm



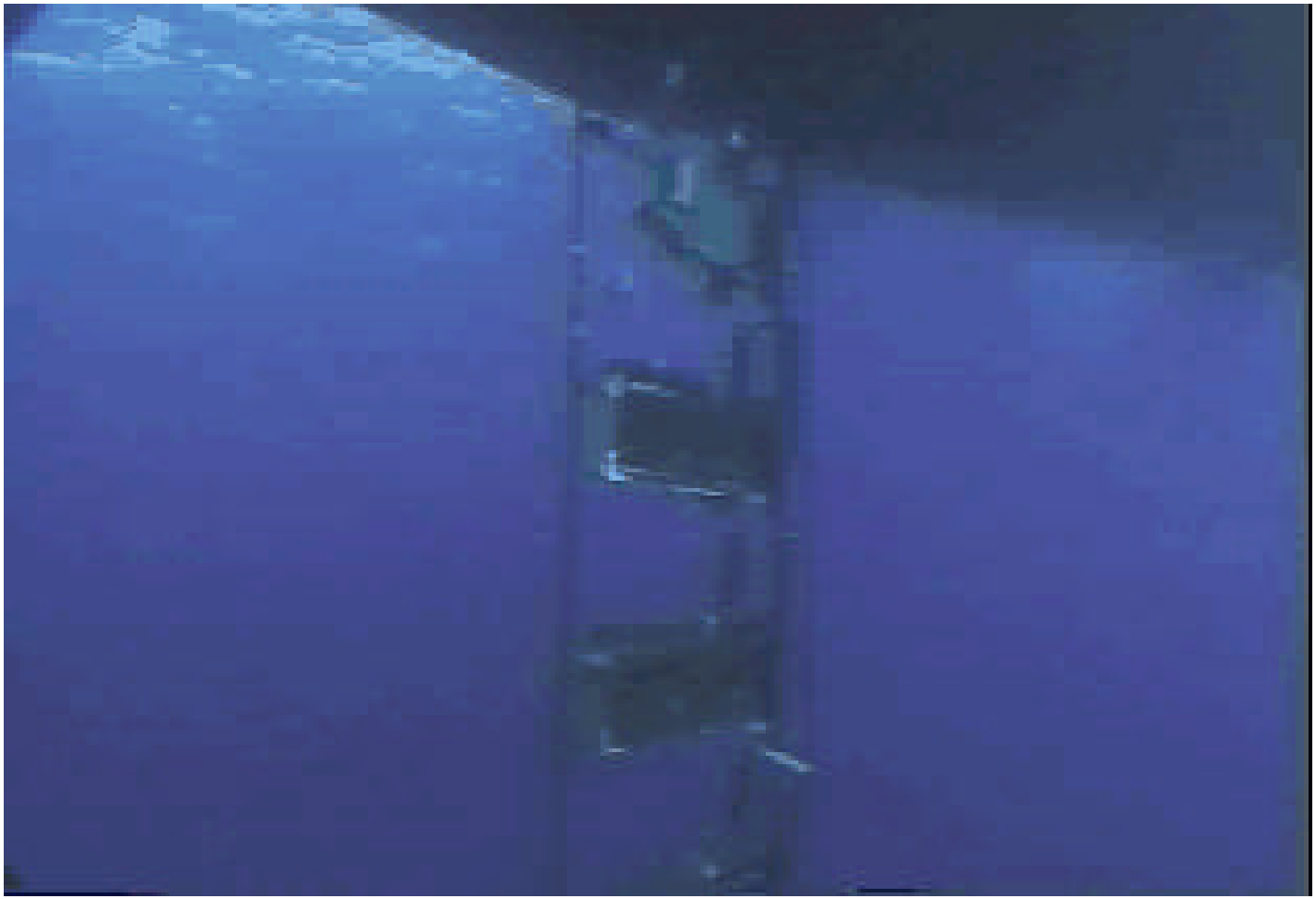


SURTASS LFA Sonar Description





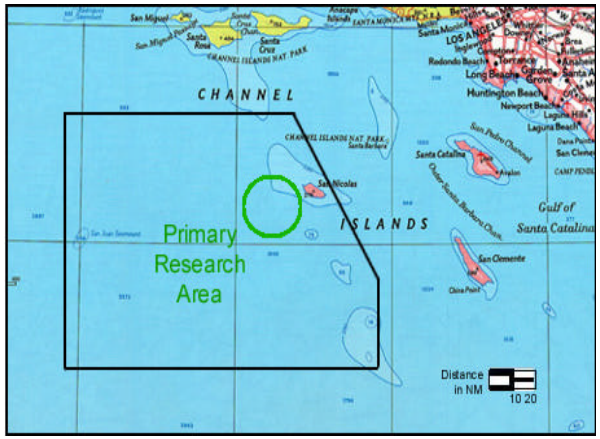
SURTASS LFA
Transmit Array



U.S. Navy Marine Mammal Scientific Research Program

An independent scientific team, under controlled experimental conditions, played SURTASS LFA signals and observed whale behavior.

Phase I



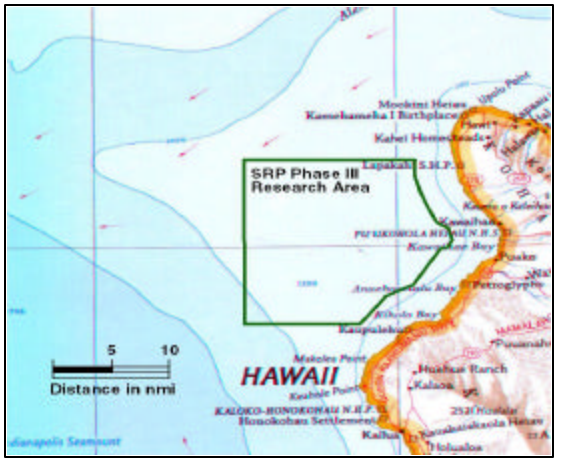
Blue whale

Fin whale

Phase II

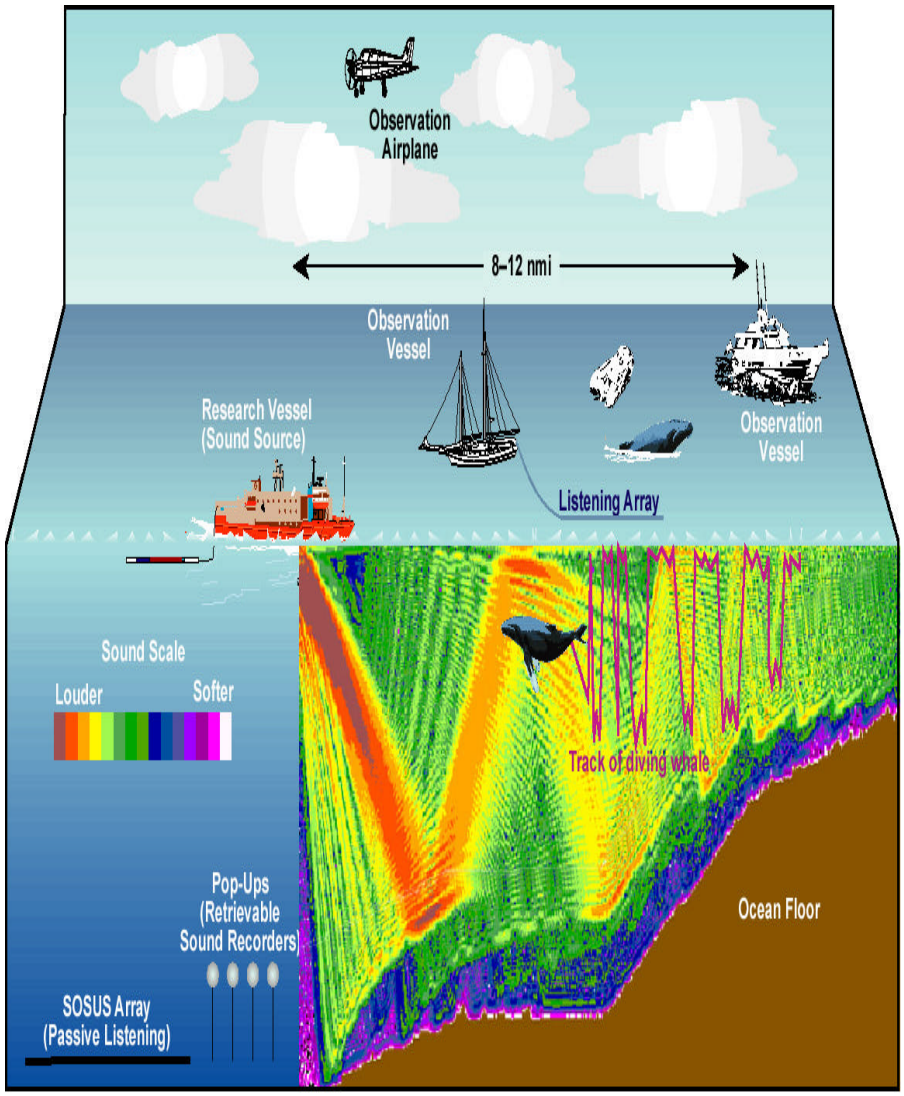
Gray whale

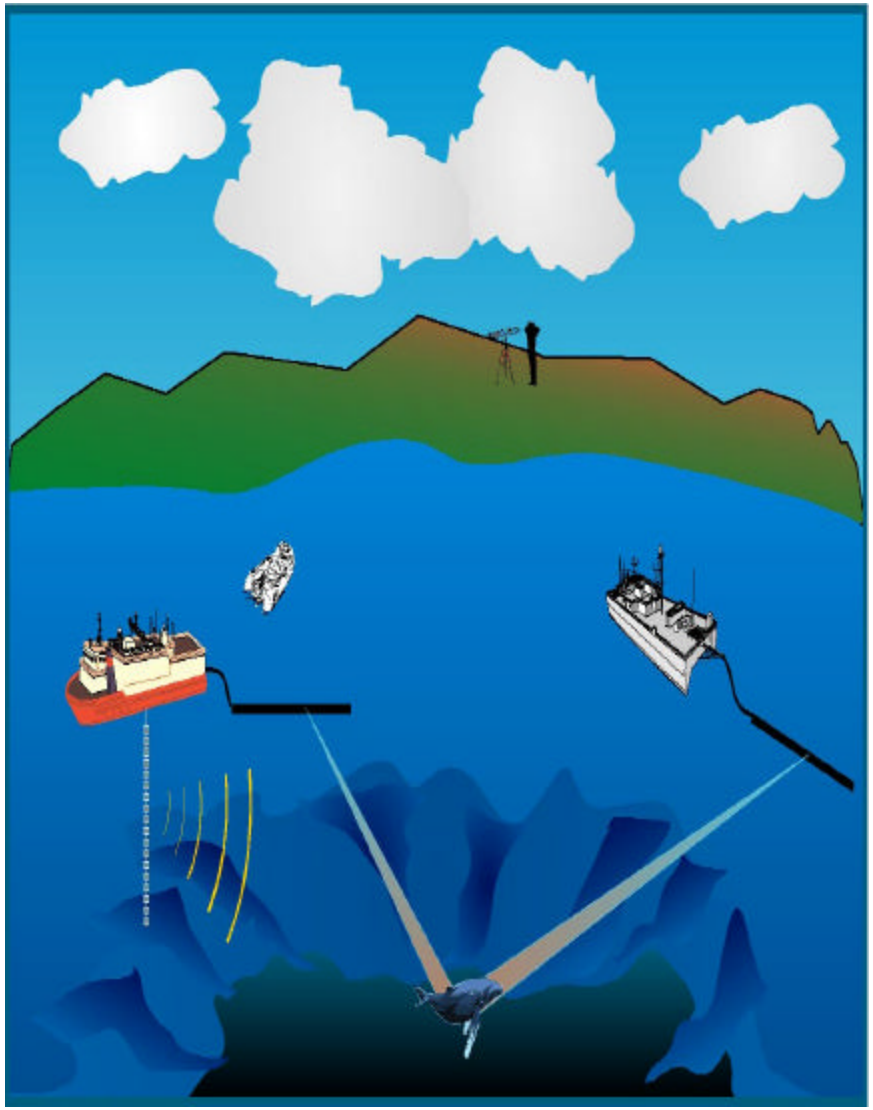
Phase III



Humpback whale

SRP Assets

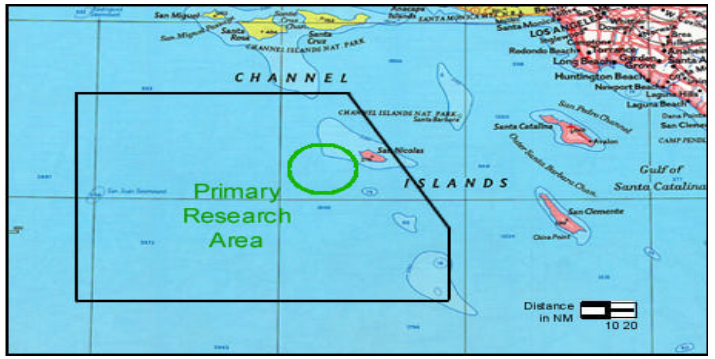

Observation Airplane
8–12 nmi
Observation Vessel
Research Vessel (Sound Source)
Observation Vessel
Listening Array
Sound Scale
Louder
Softer
Track of diving whale
Pop-Ups (Retrievable Sound Recorders)
Ocean Floor
SOSUS Array (Passive Listening)



SRP Results

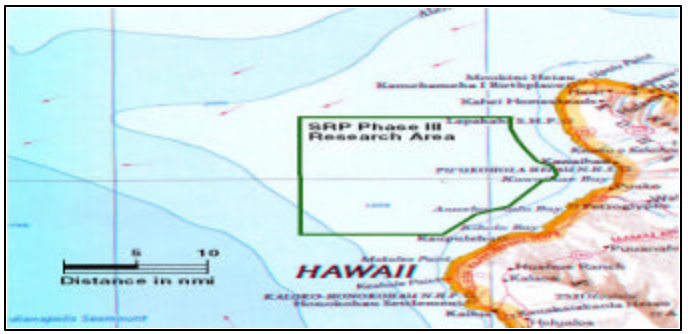
PHASE I – BLUE WHALE & FIN WHALE FEEDING

- 19 animal observations
- No overt behavioral responses
- No changes in whale distribution could be related to LFA operations



PHASE II – GRAY WHALE MIGRATION

- Source in migration corridor:
  Avoidance Observed- whales changed course
- Source farther offshore at higher noise level to achieve same received level in migration corridor:
  No Avoidance Observed- whales did not change course

PHASE III – HUMPBACK WHALE BREEDING

- Approx. 1/2 whales observed visually ceased singing during transmissions
  - Many did so while joining a group of whales (when singers usually stop their songs)
- All interrupted singers resumed singing within tens of minutes
- Overall patterns of singer and cow-calf abundance were the same throughout the experiments