

**Sonic Booms and Marine Mammals:
Informational Status and Recommendations**

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**Presentation at NASA HSR Sonic Boom Workshop
NASA Ames Research Center
May 12 - 14, 1993**

Figure 1

Outline of presentation.

SONIC BOOMS AND MARINE MAMMALS

Bill Cummings

Oceanographic Consultants

INTRODUCTION TO MARINE MAMMALS

Baleen Whales

Toothed Whales

Seals & Sea Lions

Sea Otter

Polar Bear

Manatees

MARINE MAMMAL HEARING

Baleen Whales

Toothed Whales

Seals & Sea Lions

NOISE EFFECTS

Explosives

Other

SONIC BOOMS

In Air (understood)

In Water

SONIC BOOM EFFECTS ON MARINE MAMMALS

Real Stimulus

Simulated Stimulus

PREDICTIONS

Submerged or Swimming

Hauled Out (Pinnipeds)

RECOMMENDATIONS

Contact With NRC, NMFS and MM Commission

Symposium (with SMM)

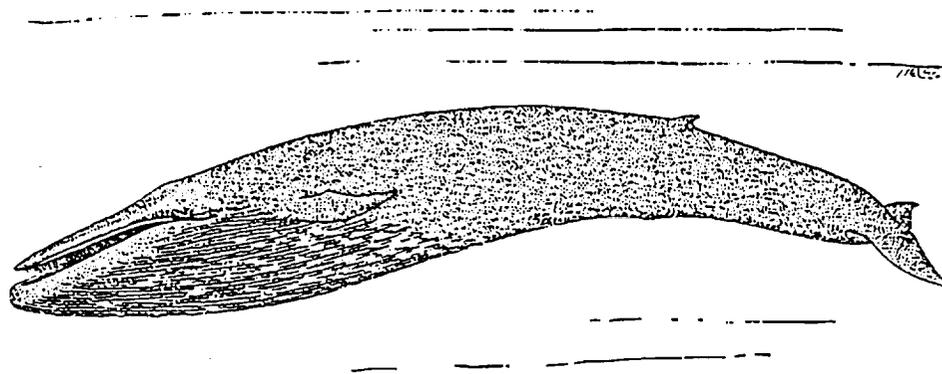
SSB Tests on Captive Porpoises & Pinnipeds

Habituation Tests

Figure 2

Examples of baleen (blue whale, top) and toothed (bottlenose dolphin, bottom) whales.

Balaenoptera musculus



Tursiops truncatus

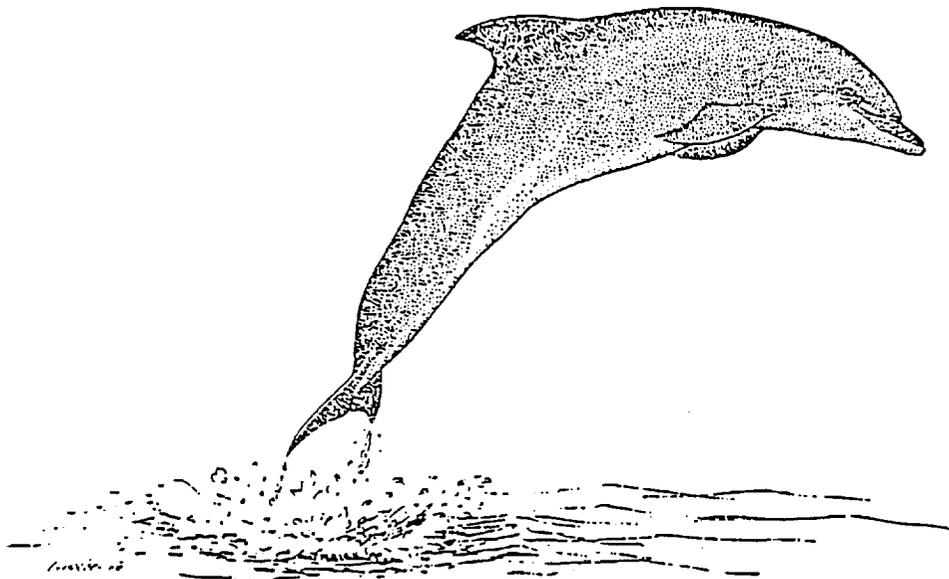
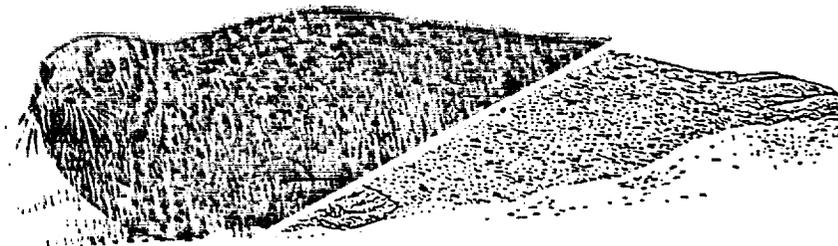


Figure 3

Examples of pinnipeds: harbor seal (top), California sea lion (bottom).

Phoca vitulina



Zalophus californianus

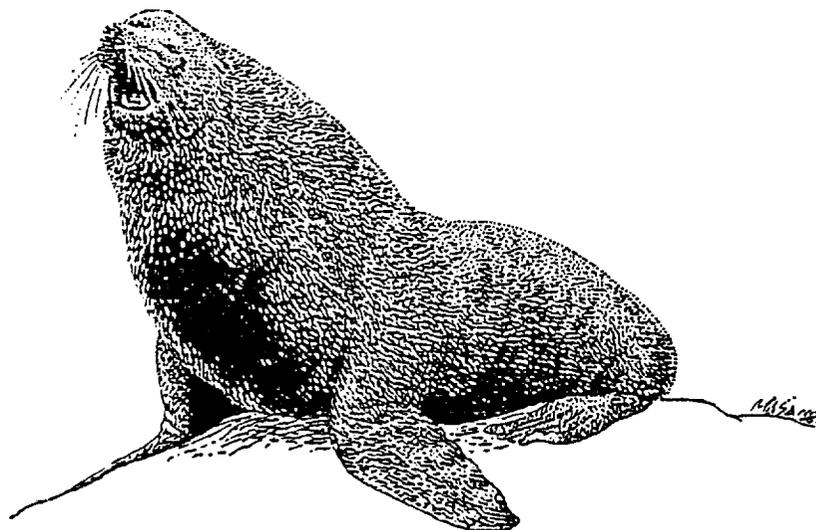


Figure 4

Examples of other marine mammals: Amazon manatee (top), sea otter (bottom).

Trichechus inunguis

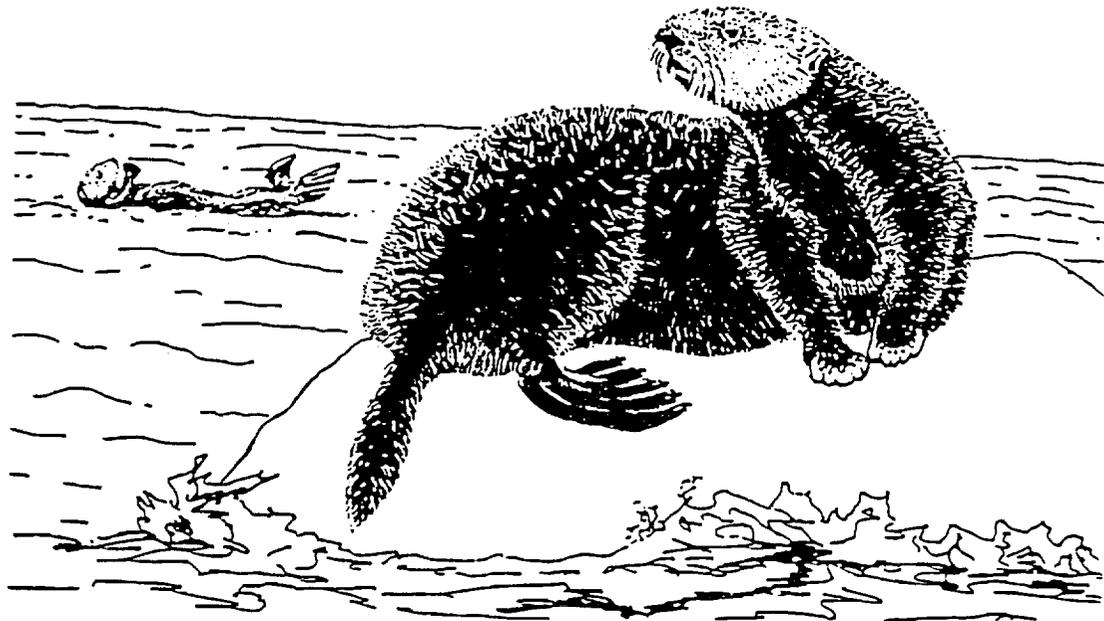
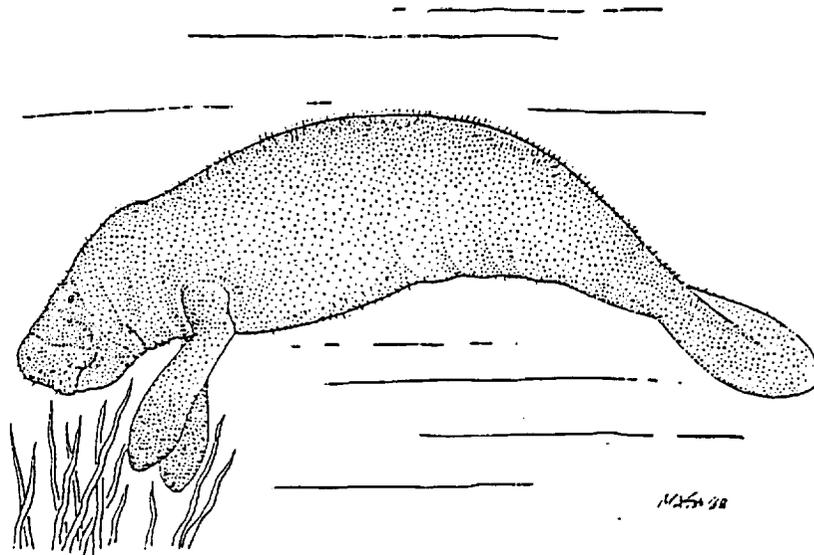


Figure 5

Estimated population sizes of selected large whales (from Gaskin).

| WHALE | POPULATION SIZE |
|----------------|-------------------------|
| Sperm Whale | over 567,800 |
| Bowhead Whale | about 2,500 |
| Right Whale | about 3,500 |
| Gray Whale | between 7,000-15,000 |
| Humpback Whale | between 3,000-5,000 |
| Blue Whale | between 7,000-13,000 |
| Fin Whale | about 88,000 |
| Sel Whale | about 130,000 |
| Bryde's Whale | over 80,000 |
| Minke Whale | between 113,000-646,780 |

THE BEST ESTIMATES OF LARGE WHALE POPULATION SIZES (DATA FROM GASKIN 1982).

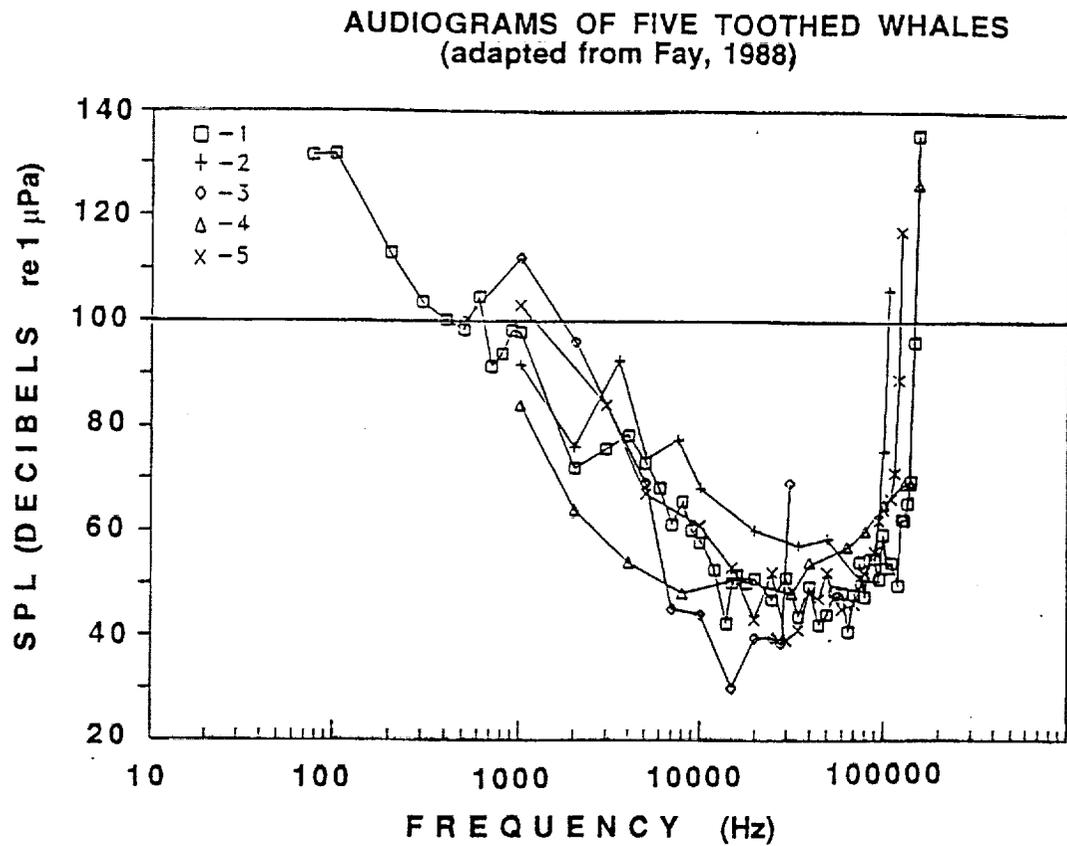
Figure 6

Sound source levels of selected species of marine mammals (various sources).

| MARINE MAMMAL SOUND SOURCE LEVELS | |
|--|---------------------------------------|
| | <u>dB re 1 μPa, 1m</u> |
| Baleen Whales | 131 - 189 |
| Toothed Whales | 135 - 200 |
| Seals | 95 - 180 |
| Sea Lion, Walrus | 157 - 172 |

Figure 7

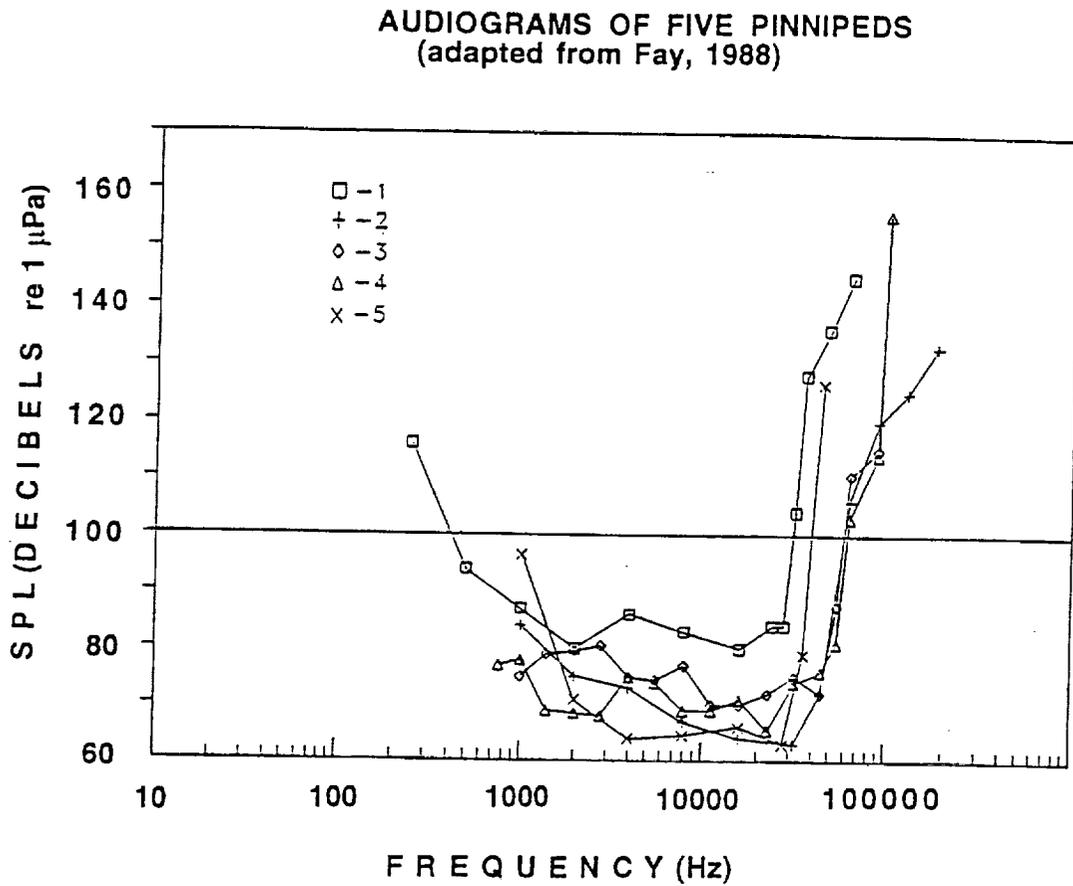
Audiograms of five toothed whale species (from indicated sources).



- 1- Bottlenose dolphin (Johnson)
- 2- Amazon River dolphin (Jacobs & Hall)
- 3- Killer whale (Hall & Johnson)
- 4- Harbor porpoise (Andersen)
- 5- Beluga whale (White et al.)

Figure 8

Audiograms of five pinnipeds (from indicated sources).



- 1- California sea lion (Schusterman et al., 1972)
- 2- Harbor seal (Mohl, 1968)
- 3- Ringed seal (Terhune & Ronald, 1975)
- 4- Harp seal (Terhune & Ronald, 1972)
- 5- Northern fur seal (Schusterman & Moore, 1978)

Figure 9

Sound spectra from a sonic boom at the water's surface and at depths indicated, compared to spectra of typical, low and high oceanic ambient noise (after Cook).

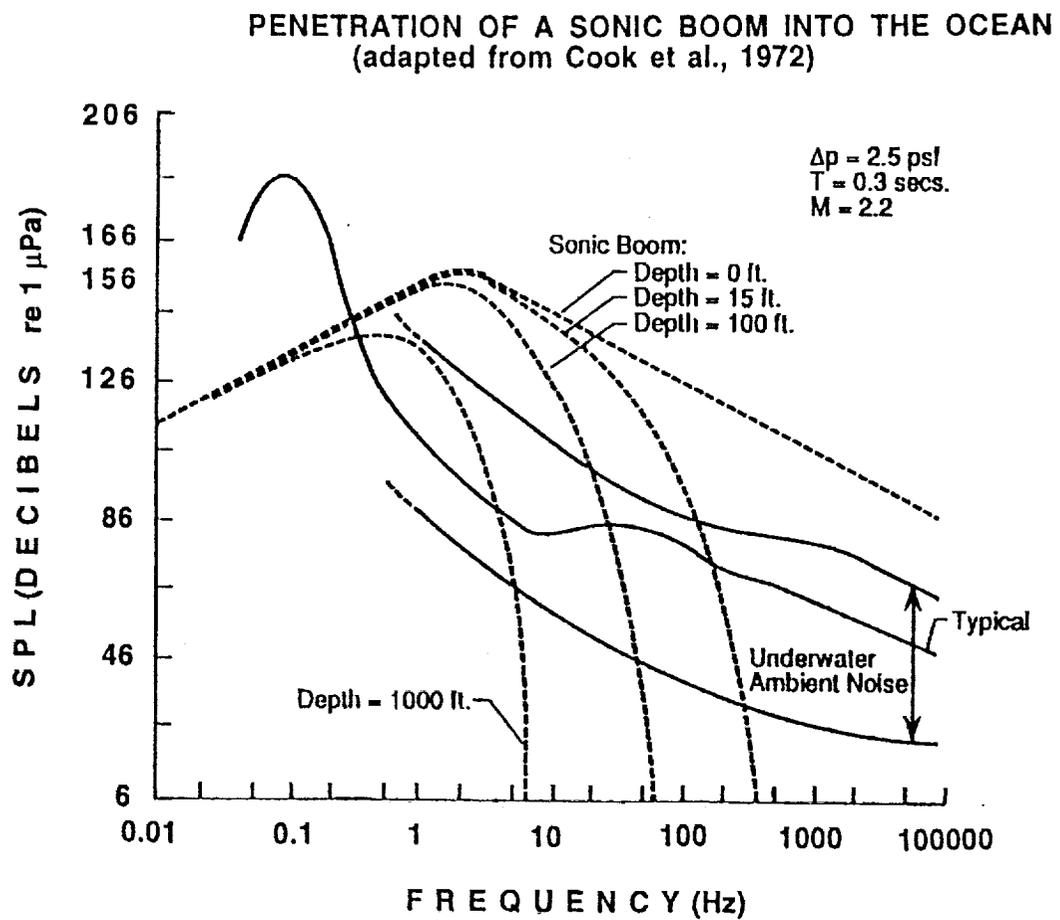


Figure 10

Sound spectrum of a sonic boom as measured at 15 ft depth, compared to average hearing curves of selected pinniped and toothed-whale species.

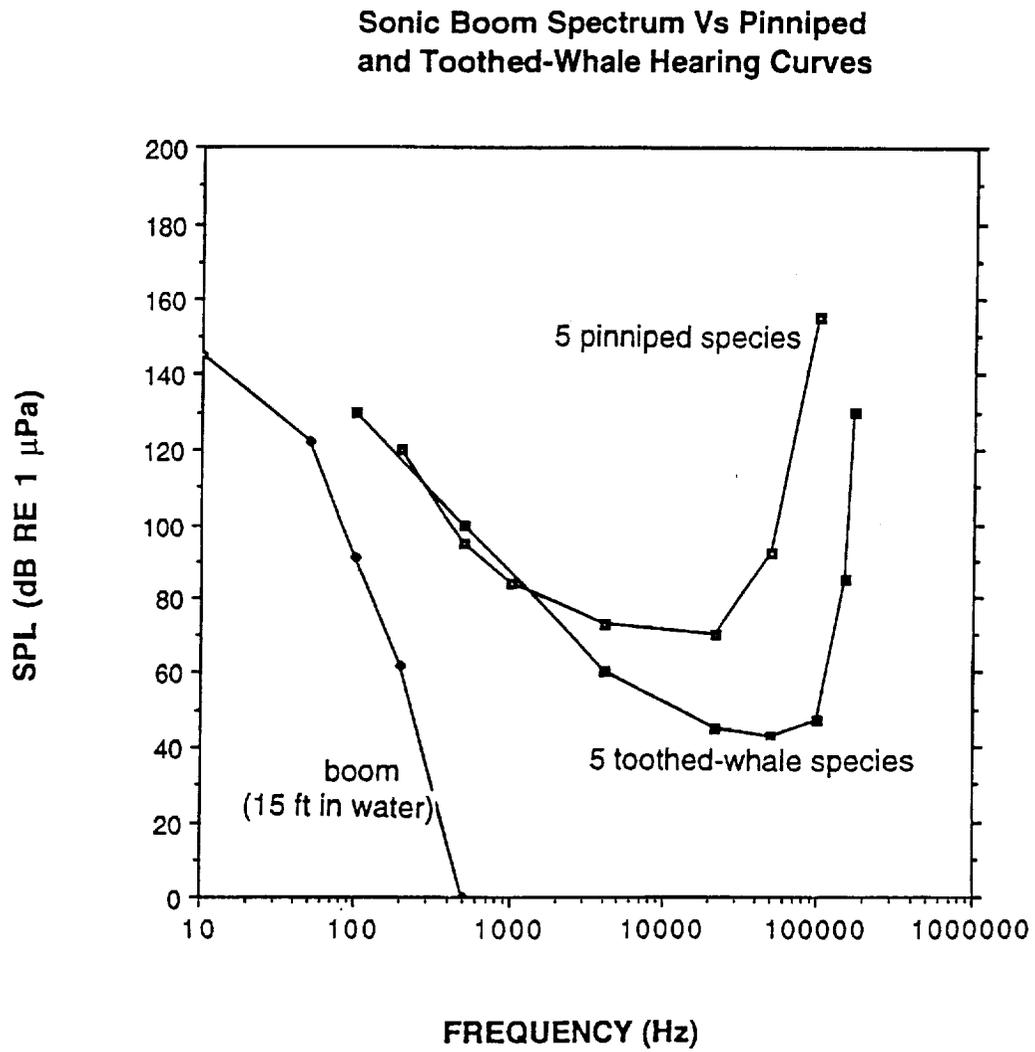


Figure 11

This study showed that marine mammal distributions will coincide with SS aircraft sonic booms. Depending upon the species and location, marine mammals will sense, not sense, or questionably sense sonic booms. Marine mammals probably will not be harmed physically. It is not probable that whale or swimming pinniped behavior will be significantly affected by sonic booms. Hauled out pinnipeds may or may not be affected by booms possibly depending upon species, age, and behavior at the time of the boom. There is little doubt that marine mammals will habituate to some extent.

CONCLUSIONS

COINCIDENCE +

SENSATION + - ?

DIRECT PHYSICAL HARM -

BEHAVIORAL EFFECTS

Whales -

Swimming Pinnipeds -

Hauled-Out Pinnipeds + - ?

HABITUATION + ?

Figure 12

There has only been one experimental study (Sea World) on one species of pinniped using simulated sonic booms and none based upon real booms. No studies have been undertaken on the effects of sonic booms on any other marine mammals. I recommend early contacts with the National Research Council and Acoustical Society of America committees, with the regulatory authorities at the National Marine Fisheries Service, and with the Marine Mammal Commission. Low cost, comparatively easily facilitated studies may be undertaken on captive porpoises and pinnipeds using simulated booms for the purpose of determining any effects or habituation. However, regulatory authorities may not require such studies. A marine mammal permit should be applied for well before any decision is made regarding technical feasibility of the overall program.

RECOMMENDATIONS

EARLY CONTACTS (NRC, ASA, NMFS, MM COMMISSION)

CONDUCT SYMPOSIUM (CONJUNCTION WITH SMM)

SSB TESTS ON CAPTIVE PORPOISES & PINNIPEDS
(ONLY IF REQUIRED BY NMFS)

HABITUATION TESTS
(ONLY IF REQUIRED BY NMFS)

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

| | | | | |
|---|---|--|--|--|
| 1. AGENCY USE ONLY (Leave blank) | | 2. REPORT DATE February 1994 | 3. REPORT TYPE AND DATES COVERED Conference Proceedings | |
| 4. TITLE AND SUBTITLE High-Speed Research: Sonic Boom, Volume I | | | 5. FUNDING NUMBERS 537-03-21 | |
| 6. AUTHOR(S) Thomas A. Edwards, Editor | | | | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Ames Research Center Moffett Field, CA 94035-1000 | | | 8. PERFORMING ORGANIZATION REPORT NUMBER A-94045 | |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, DC 20546-0001 | | | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER NASA CP-10132 | |
| 11. SUPPLEMENTARY NOTES Point of Contact: Thomas A. Edwards, Ames Research Center, MS 230-2, Moffett Field, CA 94035-1000; (415) 604-4465 | | | | |
| 12a. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified — Unlimited Subject Category 02 | | | 12b. DISTRIBUTION CODE | |
| 13. ABSTRACT (Maximum 200 words) The second High-Speed Research Program Sonic Boom Workshop was held at NASA Ames Research Center May 12-14, 1993. The purpose of this workshop was to provide a forum for government, industry, and university participants to present and discuss progress in their research. The workshop was organized into three sessions dealing with atmospheric propagation, acceptability, and configuration design. Attendance at the workshop was by invitation only. Volume I includes papers on atmospheric propagation and acceptability studies. Significant progress is noted in these areas in the time since the previous workshop a year earlier. In particular, several papers demonstrate an improved capability to model the effect of atmospheric turbulence on sonic booms. This is a key issue in determining the stability and, ultimately, the acceptability of shaped sonic booms. In the area of acceptability, the PLdB metric has withstood considerable scrutiny and is validated as a loudness metric for a wide variety of sonic boom shapes. The differential loudness of asymmetric sonic booms is better understood, too. | | | | |
| 14. SUBJECT TERMS Sonic boom extrapolation, Sonic boom acceptability, Sonic boom minimization | | | 15. NUMBER OF PAGES 238 | |
| | | | 16. PRICE CODE A11 | |
| 17. SECURITY CLASSIFICATION OF REPORT Unclassified | 18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT | |