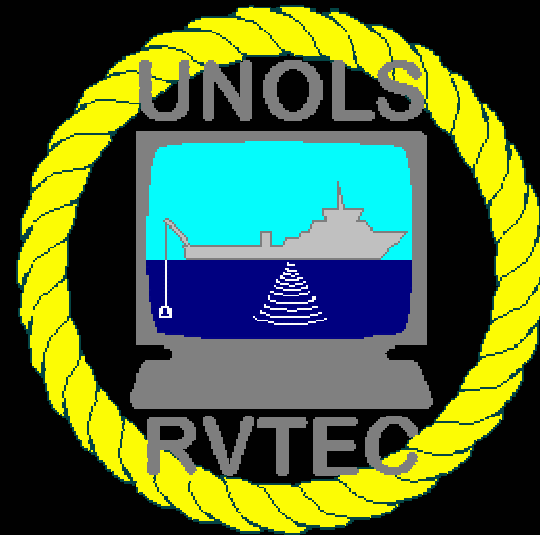
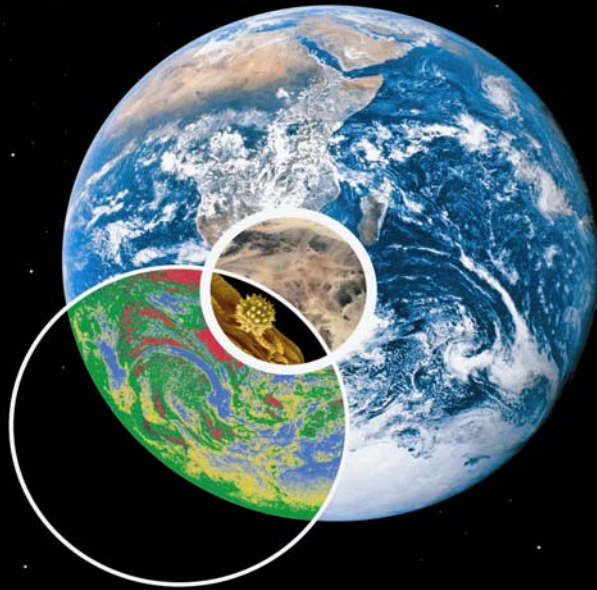


LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY



UNOLS Seismic Operations:
Permitting, Observers, other requirements

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L-DEO Procedural Steps

Preliminary Assessments

Environmental Assessments [-> NSF -> NMFS -> Biological
Opinion / ITS]

IHA applications

Monitoring / Mitigation

Post-Cruise Reports

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Before a Survey:

Before funding or scheduling:

Preliminary Assessments

After funding:

Environmental Assessments [-> NSF -> NMFS ->
Biological Opinion / ITS *& Foreign, as required*]

IHA applications

Scheduling

Pre-surveys

protocols/observer's guides, crew orientation

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During a Survey:

Monitoring & Mitigation:

Qualified visual & Acoustic monitors [5 per cruise]

Visual monitoring – all days

Visual & passive monitoring 30 min before & during survey activities

Rampup – 6 dB per minute = 20 – 30 minutes

Safety radius maintained by power-down or shut down

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After a Survey:

Followup Surveys, as required

90-day reports to NMFS, foreign states



L-DEO IHAs issued 2003 - 2005

Marine Animal Factors

- Population Assessment
- Habitat
- Temporal Activities
 - Mating
 - Foraging
 - Migration corridor
 - Nesting (Incl Migration): Sea Turtles

Marine Mammal Observers

- Lead Observer
- 2 Visual Observers (L-DEO/Foreign)
- 1-2 Passive Acoustic Monitors (PAM)
- (Possible additional for foreign progs.)
- MMO has authority to Power Down or Shut Off guns
- PAM is verified by Visual Observation

Visual Observation Factors

- **Beaufort Scale**

Yucatan: Force 2 but modified to Force 4 (17 Kts).

- **Nighttime Shooting**

No Startup

MMO Observations (NVD)

Prohibition (Mexico)

Safety Radii (meters from Gun Array)

Water Depth(m) <100 100-1000 >1000

180 dB (Cetaceans)

2 GI Gun 400 82 54

20 Air Guns 3500 1350 900

Marine Protected Areas (MPA)

Sea lion Haulouts: 750

Sea Turtle Nesting & Migration: 750

Surface Vessel/Aircraft Monitoring

- **Surface Vessel**

Warn fishing vessels

Check for Injured Animals

- **Aircraft**

Presence of Marine Animals

Injured Animals along track and on adjacent coastline

Mitigation Effects

- Delayed Start-ups
- Nighttime Shooting
- Shutdowns

5 Cruises affected by Shutdowns

3 Less than 10; Yucatan: 12 (weather)

ETP: 12 MM's; 87 for Turtles

Mitigation Results

Permits Issued & Cruises Completed:

NMFS IHA: 12 Mexico: 1

Total Kms Shot: 20,513

Marine Mammals Observed

Groups 359

Individuals 3,767

Sea Turtles Observed

Groups 136

Individuals 147

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R/V LANGSETH

Facilities and Support of Marine Mammal Activities

Visual Monitoring

Passive Acoustic Monitoring

Active Monitoring

Additional Mammal Activity Support:

Direct Scientific Research on Marine Mammals

Calibration of Air Gun Arrays and Procedures

Permitting

Visual Marine Mammal Observation





Passive Monitoring

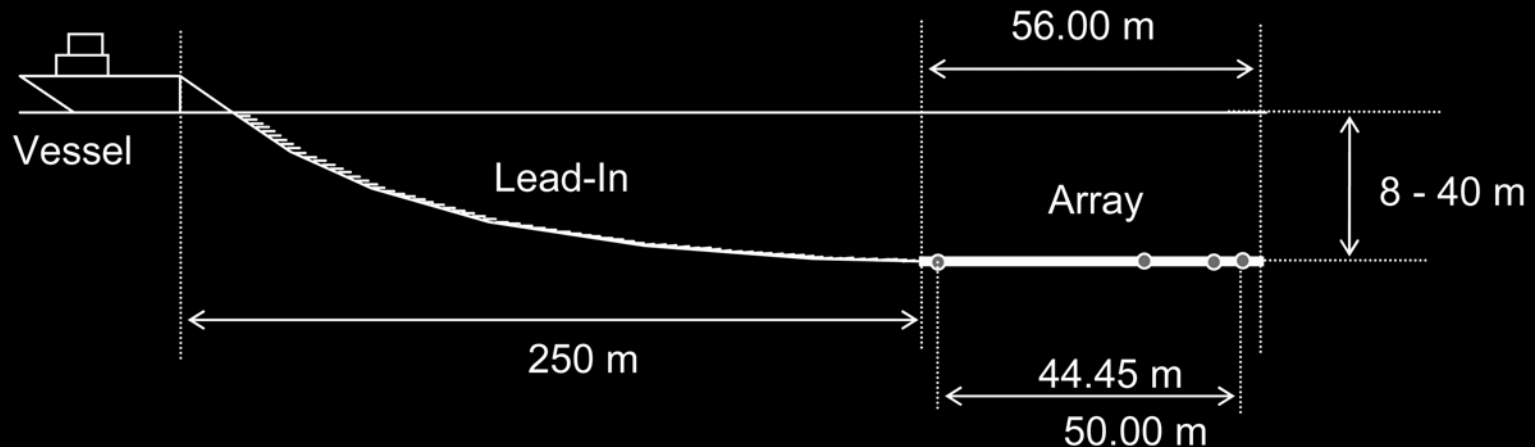
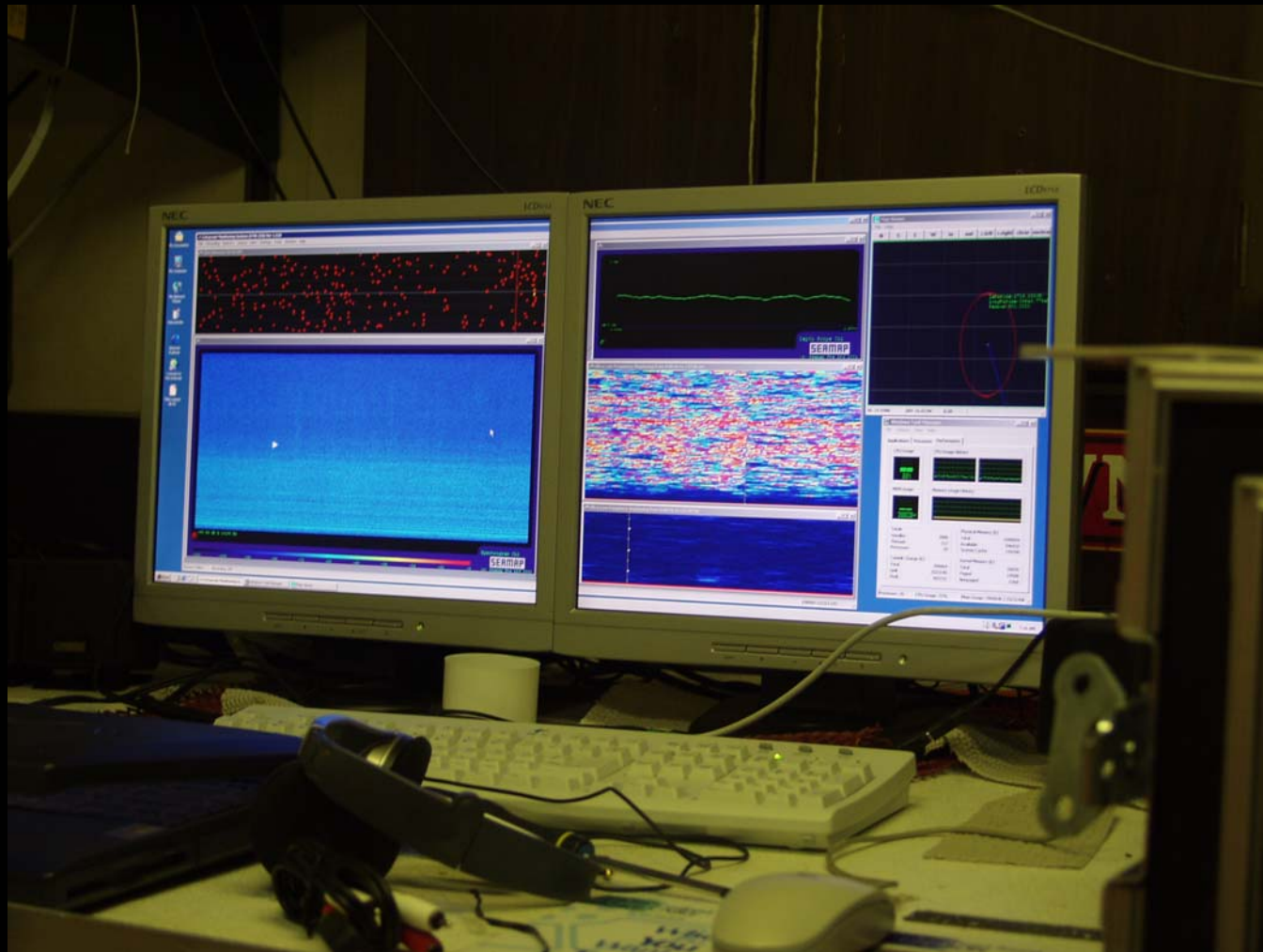


Fig 1c. Standard Towing Configuration

The in-water part of the passive acoustic system is a 4-channel hydrophone array. Each channel has a single, high bandwidth hydrophone.



The SeaMap onboard software provides a variety of screens and identification aids which help locate and identify mammal species, even at night.

Active Monitoring Sonar – Scientific Solutions' IMAPS

IMAPS

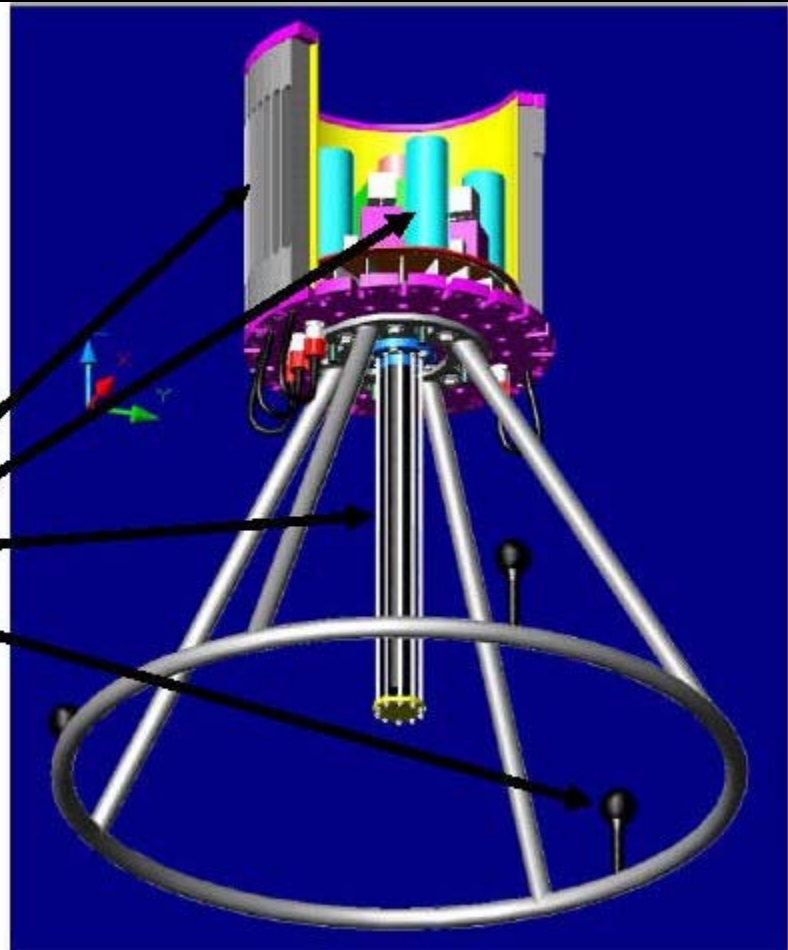
Integrated Marine
Mammal Monitoring
and Protection System

Features:

- 20-40 kHz, Max R of 2.5km
- Source level up to 210 dB re μPa @ 1m
- 60 Receivers, electronically steered
- Self-contained power amplifiers and receive electronics
- Vertical line array source
- Integrated passive receivers

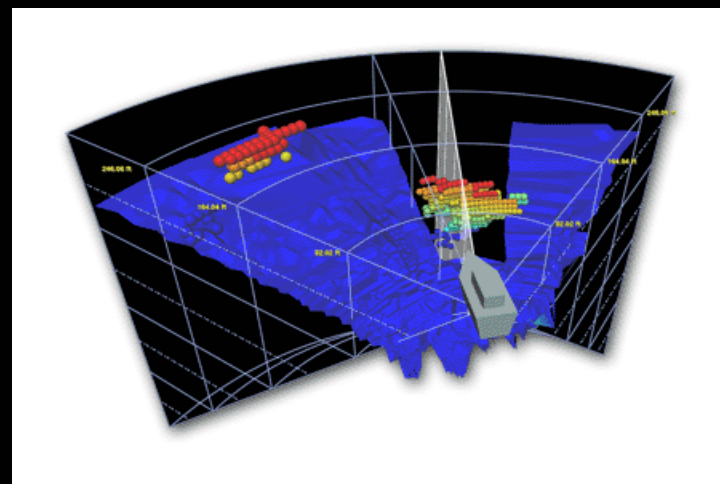
Benefits:

- Enhanced tracking
- Integrated low-frequency passive detection capability



Towed from vessel

Active Monitoring Sonar – Far Sounder



Hull Mounted