Assessing and Mitigating Impacts of Anthropogenic Sound on Marine Mammals

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Talk Overview

- Background and defining the issue
- Local case study: Planned (ultimately cancelled) 2012 Diablo Canyon Seismic Survey
  - Assessment, monitoring, and mitigation of impacts to marine mammals
- Give perspective on:
  - Data gaps and important unanswered questions
  - Challenges
  - Designing effective strategies
- Discussion / questions?
Background
Effects of sound on marine mammals

- Marine mammals rely on sound to sense their environment, forage, communicate

- Anthropogenic sound can adversely affect marine mammals in multiple ways:
  - Behavioral disruption
  - Hearing loss
  - Adverse impacts on prey species
  - Stress, injury, death

- Some species known to be more sensitive than others:
  - Beaked whales (navy sonar / seismic surveys)
  - Harbor porpoise (pile driving operations)
  - Melon-headed whales (mass strandings associated with sonar activities)
Common mitigation strategies

Planning:
- Adjust seasonal timing to reduce overlap (migratory species)
- Avoid breeding/feeding periods
- Keep duration of activities as short as possible
- Minimize exposure of most sensitive species

Operational:
- Ramp up sound gradually to allow animal to move away before sound is loud enough to cause injury
- Monitor for marine mammals in real-time (ship/air/acoustic)
- Suspend activities if animals are detected nearby (until animals leave area)

Operational Paradigm: Allowing animals to move away from sound source will reduce risk of injury
Failure of Paradigm: For some populations, this paradigm is inadequate, and may indeed cause harm.

Key considerations:
- Are there small populations?
- Do they have suitable habitat outside of impact zone?
- What are risk factors they will be exposed to?
  - Reduced foraging success
  - Bycatch in fisheries
  - Increased stress
  - Mass stranding
  - Inter-specific aggression
  - Increased predation
- Potential population-level consequences, yet we have little or no data to estimate effects.

Cotter et al. (2011)
Defining the Issue

What sounds?
- Sonar
- Seismic surveys
- Renewable energy facilities (e.g. pile-driving)
- Vessel traffic, other...

What species?
- Some more sensitive to sound than others
- What other factors are important (e.g. small local populations)?
- What do we know (or not) about impacts? (individual, cumulative, 'Soundscape' concepts)
- How can we address key information needs?
Diablo Canyon Seismic Surveys (Fall 2012)

- PG&E proposed 3-D high energy seismic surveys to assess risks associated with offshore fault zones.
- SWFSC became involved during summer 2012 to ensure adequate monitoring for species protected by the MMPA and ESA.
- Limited time to develop and implement plan

Monitoring Program Overview
- Our concerns
- Key components
- Lessons learned
Our Primary Concerns

1. Large Whales

- Foraging habitat for several ESA-listed species
  - Humpback whales
  - Fin whales
  - Blue whales

- Gray whale
  - Migrate through area beginning in December
Our Primary Concerns

2. Harbor Porpoise
- The "Morro Bay Stock" of ~2000 porpoises
- Sensitive to anthropogenic disturbance (e.g. sound, vessels)
- Displacement into secondary habitat for days to weeks
- Adverse impacts on foraging abilities and thus health and survival?
Our Primary Concerns

2. Harbor Porpoise

- The "Morro Bay Stock" of ~2000 porpoises
- Sensitive to anthropogenic disturbance (e.g. sound, vessels)
- Displacement into secondary habitat for days to weeks
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Diablo Canyon Seismic Survey
Monitoring Program Overview

- **Objective:** to assess potential impacts of seismic surveys

- **Methods:**
  - 3 Phases: pre-, during, and post-seismic survey data collection
  - 3 Components
    1. Aerial surveys
    2. Passive acoustics
    3. Active beach surveillance and stranding response

Photo: Solvin Zankl
1. Aerial Surveys

Objectives:
- Detect north/south or inshore/offshore displacement of harbor porpoises
- Assess distribution and abundance of ESA-listed whales and other marine mammals

Pre-survey conditions:
- Provides baseline for comparison to ‘during’ and ‘post’ seismic survey.
1. Aerial Surveys

Objectives:
- Detect *north/south* or *inshore/offshore* displacement of harbor porpoises
- Assess distribution and abundance of ESA-listed whales and other marine mammals

Pre-survey conditions:
- Provides baseline for comparison to ‘during’ and ‘post’ seismic survey.
2. Passive acoustics

- Objectives: To assess harbor porpoise distribution and movements, and to document ambient noise
- Deploy porpoise click detectors (CPODs) to monitor north/south occurrence patterns
- Some CPODs deployed with ambient sound recorders (DSG model)
2. Passive acoustics - CPOD data summaries

- 5 moorings deployed
  Oct/Nov - Dec/Feb
- Highly variable porpoise detections
- Some dolphins detected
- Analysis after retrieval (not real-time)

Goal: Identify displacement from seismic survey area to areas north or south, if it occurs?
3. Active Beach Surveillance and Stranding Response

Objectives:

- Detect and efficiently respond to live and dead stranded marine mammals and sea turtles
  - Walk index beaches
  - Fly the study area
- Determine cause of death:
  - Rule out disease
  - Expand knowledge about the impacts of sound
Diablo Canyon Seismic Survey Monitoring Program Conclusions

- The completed pre-seismic survey monitoring indicates the plan was feasible (but... we got lucky with the weather)

- Was it effective? Unclear...
  - Short time window of base-line surveys (weeks)
  - Since seismic survey cancelled, did not learn whether the level of monitoring would have been adequate to detect impacts
  - Monitoring was focused on detecting displacement or strandings of individuals. What about other (more subtle) effects?

- Effective programs require advanced planning & coordination (years, not weeks)
Perspectives on Designing Effective Monitoring Programs

- Data gaps and unanswered questions
  - Species (and population) responses to sound differ
  - Effective mitigation requires some knowledge of these population-level responses
  - Thresholds for ‘effects of concern’ (e.g. how much displacement is a problem? For how long?)

- Challenges
  - Anthropogenic sound is increasing in the marine environment (globally)
  - Limited understanding of how sound affects individuals, populations, and ecosystem health
  - Small, localized populations present a particular challenge
How do we design effective monitoring/assessment programs?

- Coordinated early planning
- Identify key habitats, species, times of concern
- Evaluate any existing baseline data (e.g. stranding rates, animal distribution and movements, etc)
- Design appropriate monitoring program (e.g. using aerial surveys, passive acoustics, tagging studies, etc)
- Multi-year baseline studies with pre-, during, and post-impact components are essential
Conclusions

- Great need to understand impacts of anthropogenic sound on marine mammals (and other marine species).
  - Southern California Behavioral Response Study
  - Multi-year studies of porpoises in the North Sea

- Given that many human activities generate sound...
  - Conduct well-designed, advanced studies to understand potential responses to sound stimuli
  - Design real-time monitoring to detect potential effects quickly, and guide immediate mitigation actions.
  - Coordinate with other users of marine environment, e.g. to reduce risk of bycatch in adjacent areas

- New NOAA initiatives that recognize these needs (e.g. Ocean Noise Strategy); working towards understanding and managing impacts more effectively.
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Thank you!
Questions? Comments?

Some sounds may be stranger than others....