

# Passive Listening, Active Mitigation

## Passive Acoustic Monitoring of Oceanic Delphinids and Mitigation Of Interactions with Net Trawl Operations on NOAA's R/V Pisces

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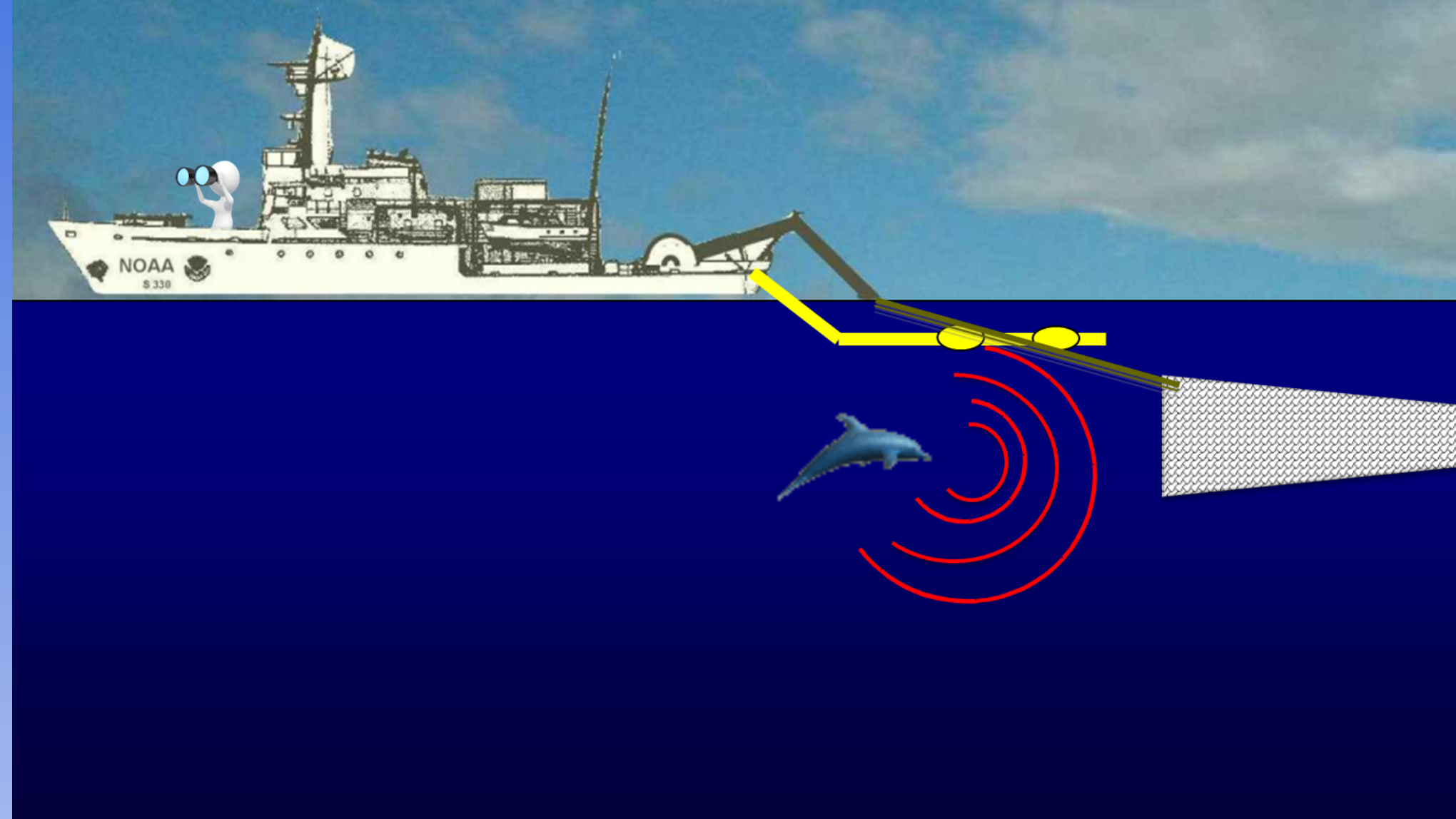
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### Introduction

Oceanic dolphins occasionally interact with net-tows conducted as a part of NOAA research operations in the Gulf of Mexico. Monitoring and mitigation measures are needed to reduce or eliminate negative interactions (e.g. incidental catches) with net-tows and dolphins. We used a passive acoustic monitoring (PAM) monitoring approach with a towed hydrophone array system to monitor and detect dolphins prior to net deployments, so that mitigation actions could be taken to prevent incidental catches.

### Towed Hydrophone Arrays for Mitigation

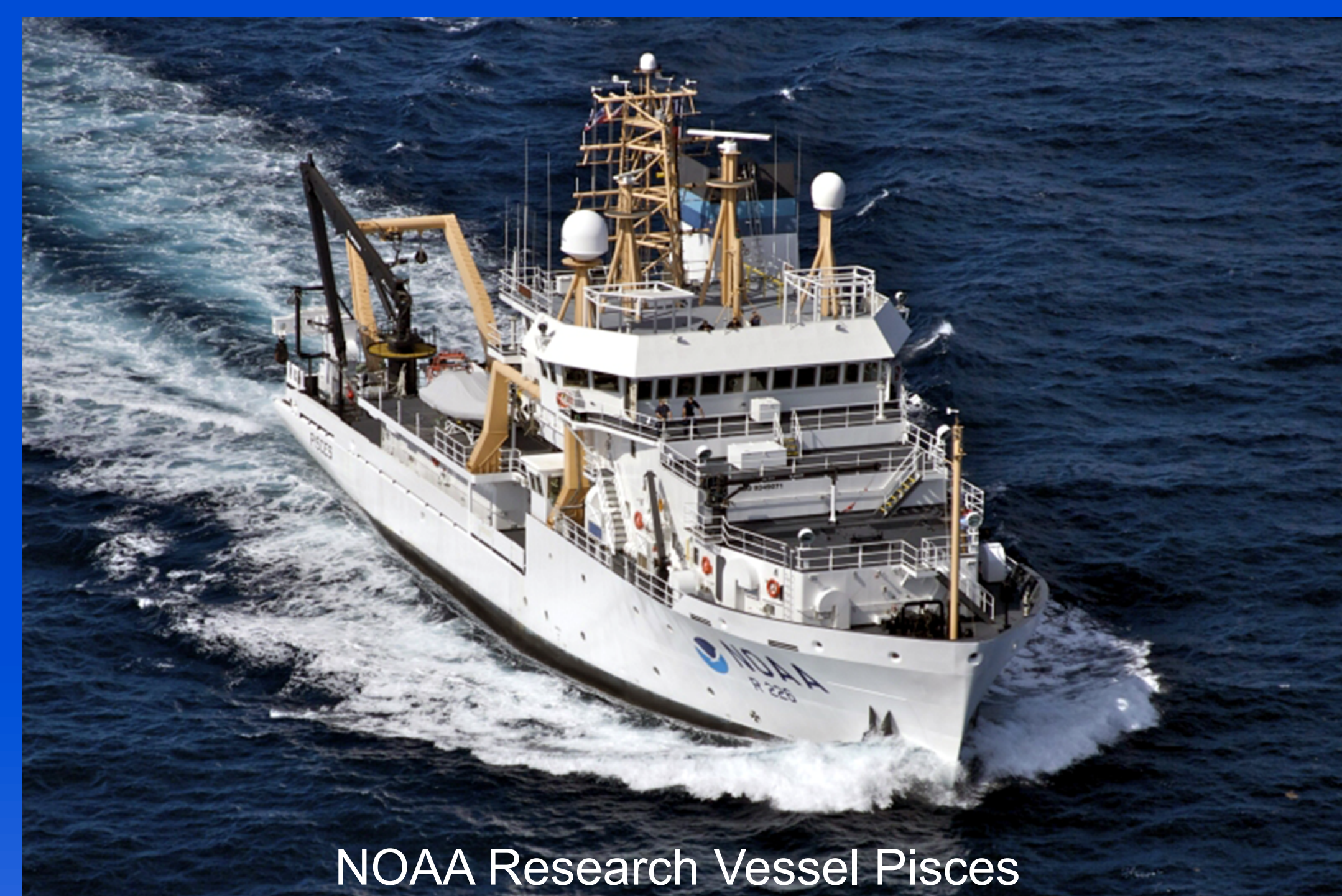
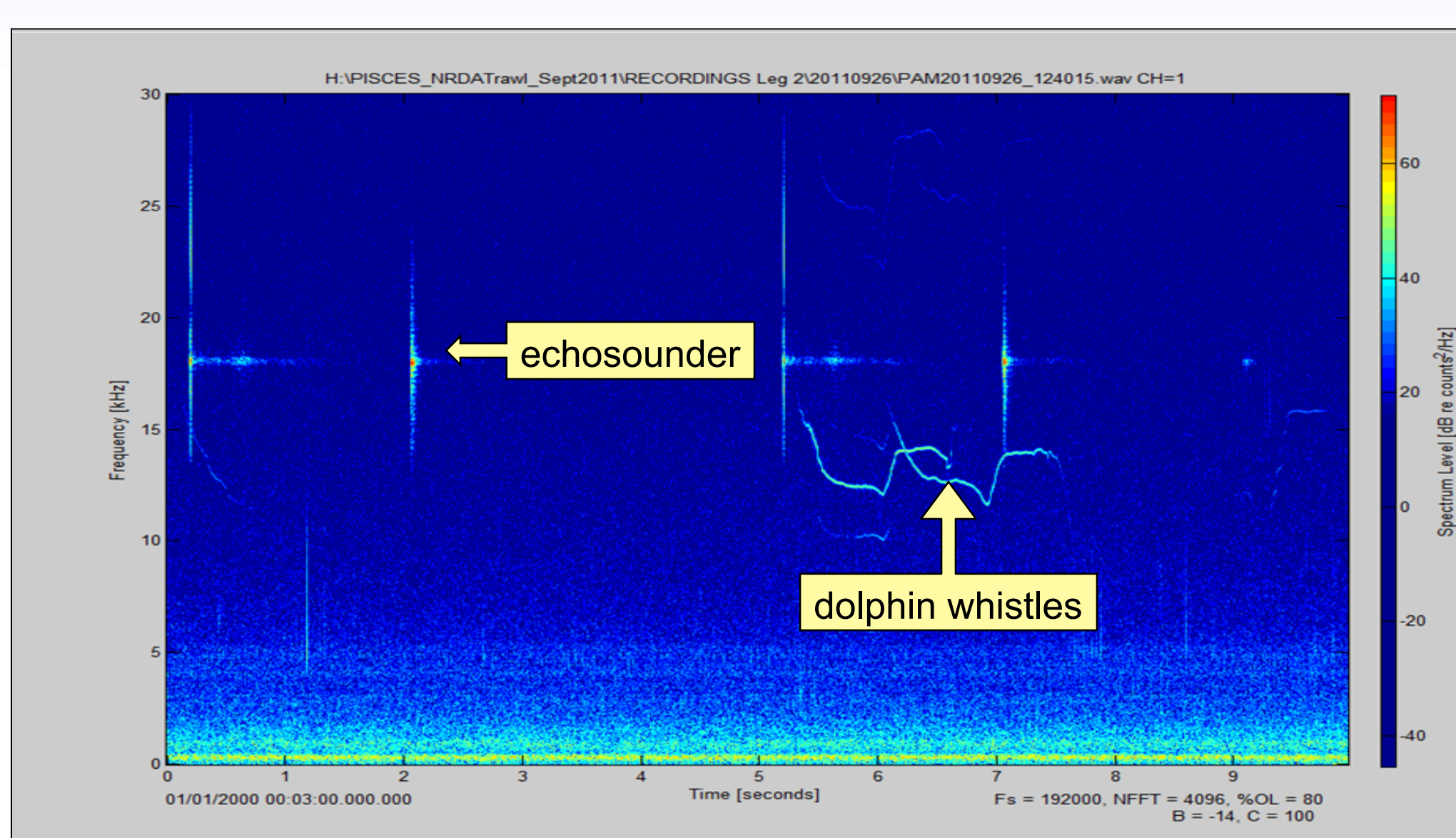


### Objectives

To use passive acoustic monitoring to detect dolphins day and night in order to mitigate negative interactions with mid-water net trawl operations.

Objectives:

- Monitor for dolphins whistles and ultrasonic clicks.
- If animals are detected - take mitigation measures.
- Assess the effectiveness of mitigation measures.



NOAA Research Vessel Pisces

### Methods

#### Hardware

- Towed hydrophone array (oil filled).
- Four hydrophones (two sets of paired elements).
- Paired elements spaced approximately 3 m apart.
- Towed approximately 100-200 m behind the ship.

#### Software

- *Ishmael*
  - near real-time processing to estimate bearings.
  - real-time spectrograms and waveforms.
- *Whaletrack II*\*
  - geo-map display of data (see figure to right -> )
  - bearings used to localize animal positions.
  - distances to localizations measureable.

\* *Whaletrack II* was developed by Dr. Glenn Gailey.

### Passive Acoustic Monitoring and Mitigation Protocols

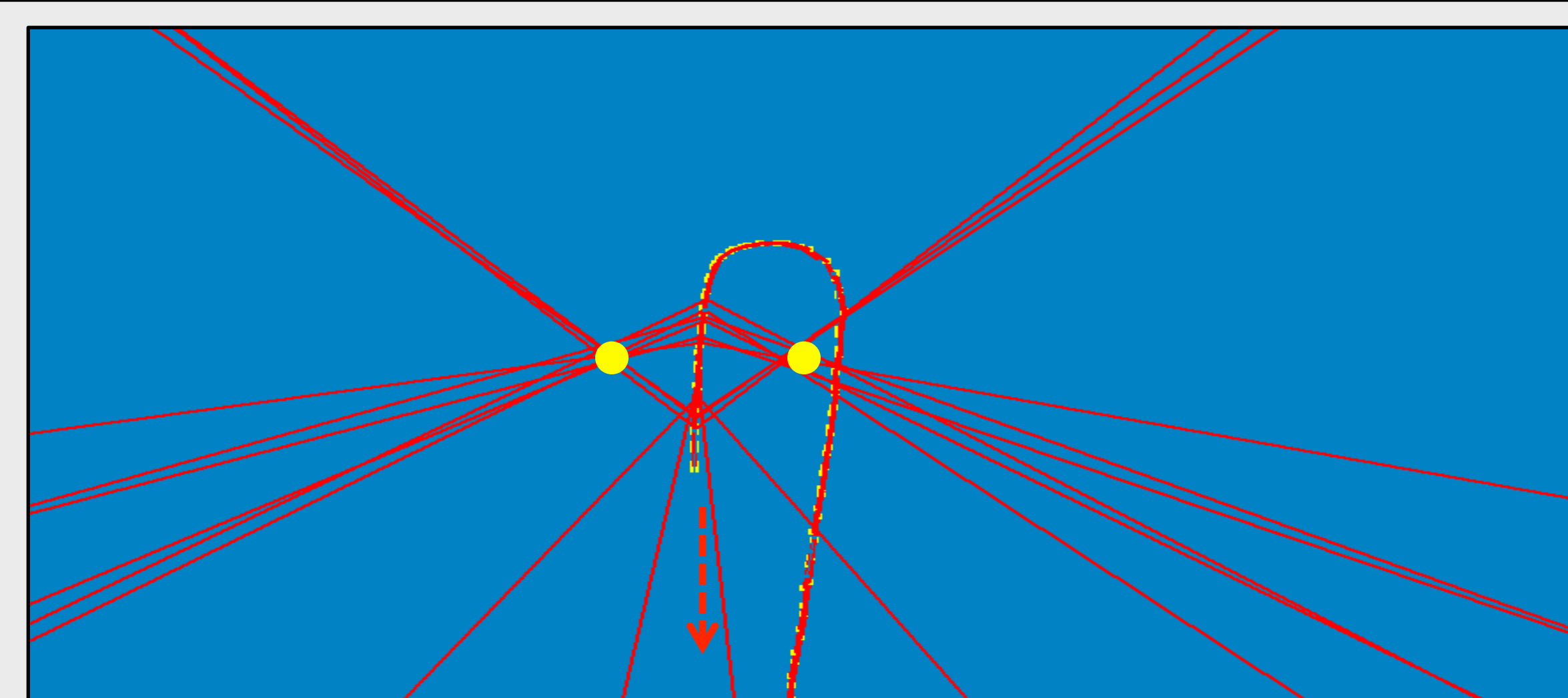
- Passive Acoustic Monitoring (PAM) was conducted for at least 30 minutes before every net deployment:
- PAM operators attempted to localize any animals or groups.
- Distance to localization assessed quantitatively, if possible.
- If not possible, a qualitative estimation of approximate range was made based on knowledge of general detection ranges by call type and/or species.

When mammals were detected near (~ 3.2 km radius ) the ship, the following mitigation measures were taken:

- Deployment of nets was delayed (or cancelled).
- Net deployment was not resumed until the animals were acoustically estimated to be > 2 km from ship, or were not detected again for at least 30 min.

Additional measures (taken at the discretion of PAM operator):

- ship was turned left or right 20-45 degrees in order to facilitate localization or to resolve left/right ambiguity of localizations.
- ship was directed away from estimated locations of animals.



Map display of localization (yellow dots). Two localizations are due to left/right ambiguity of linear array. Ship track indicated by curved red/yellow dashed line. Distance from ship to localization can be measure by PAM operator using a cursor.

### Outcome

- A total of 33 days of effort conducted.
- > 100 monitoring events during operations.
- 36% of events had acoustic detections.
- 39% of detection events required mitigation action.

#### NO INCIDENTAL CATCHES OF DOLPHINS DURING NET TOWS!

Leg	Leg Start Date	Total Effort (Days)	# of Monitoring Events	Total Monitoring Time (hours)	Average Monitoring Time per Event (minutes)	Percent of Monitored Events with Acoustic Detections	% of Events Monitored with Mitigation Effort	% of Days with Monitoring Effort
1	6/22/11	16	47	32:41	0:42	23%	82%	98%
2	9/8/11	17	60	53:43	0:53	47%	21%	100%
Both		33	107	86:24	0:48	36%	39%	99%



### Recommendations and Future Work

- Monitor during entire net-operations (including retrieval)
- Dual arrays (resolve left/right ambiguity)
- Long-baseline arrays to allow instantaneous localization
- Improvements to software (e.g. latest PAMGuard ver.)



NOAA R/V Pisces crew members fixing nets in between tows.

### Acknowledgements

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