
AIS for Marine Mammal Studies

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09-14-23

Objective

Literature search on research using AIS data to **examine the relationship between ships and marine mammal populations/behavior**, with emphasis on **analytical techniques** and **data visualizations** that may be applicable to SWFSC SAEL data.

Literature Search



- 97 papers that mention or use AIS for marine mammal research
- Date range: 2008-2023
- 4 theses, 2 conference papers, 3 reports, 3 review articles about applications of AIS in research

Vessel Threats to Marine Mammals



Shipstrike

- Relative shipstrike risk, effectiveness of speed restrictions
- Encounter rate equations or simulated encounters



Noise Pollution

- Risk of noise exposure, loss of communication space
- Individual behavior or vocalization response to ship noise

Approaches

Analytical-Based

- Vessel and marine mammal density
- Summarized values depicted by raster cells (ex. 1x1 km)
- Good for large-scale assessments and consistent framework

Agent-Based

- Vessel and marine mammal positions
- Movement in space/time shown by lines or points
- Requires detailed data
- Good for individual behavior or vessel or animal

Analytical-Based Approach

Fais et al. 2016

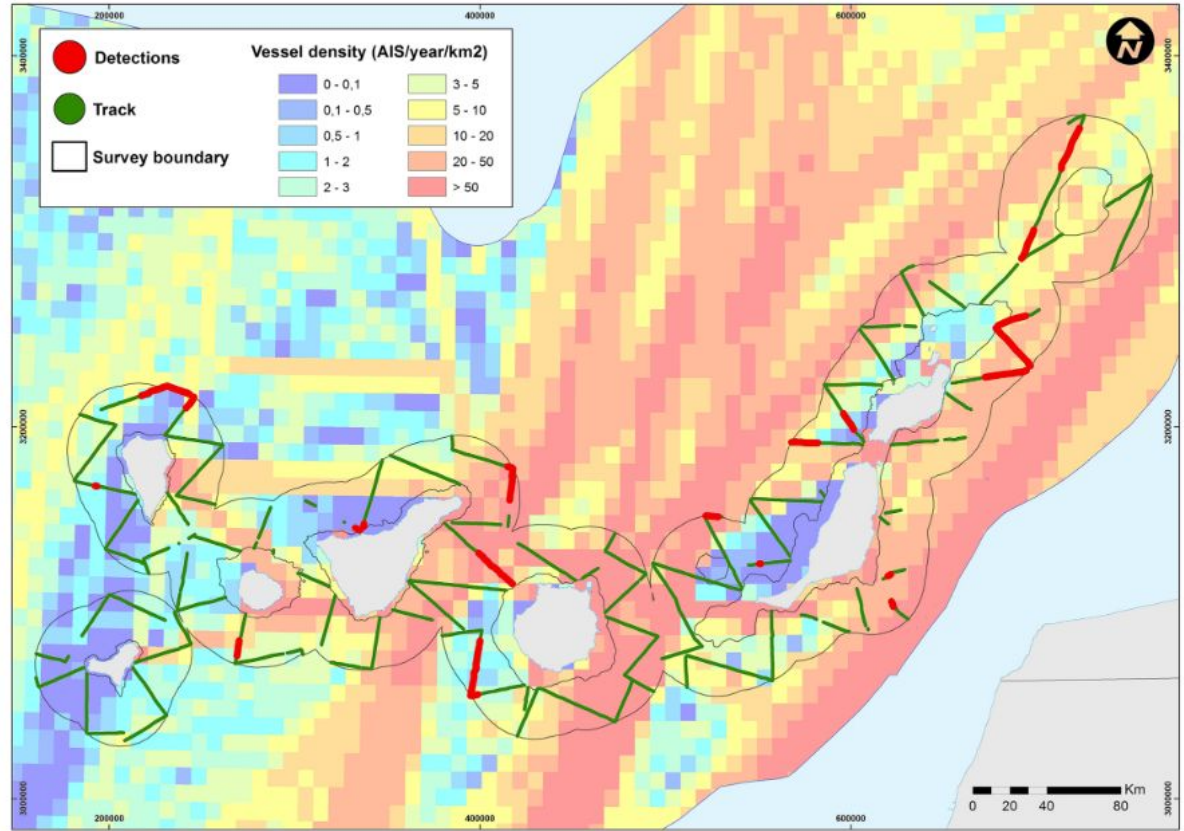
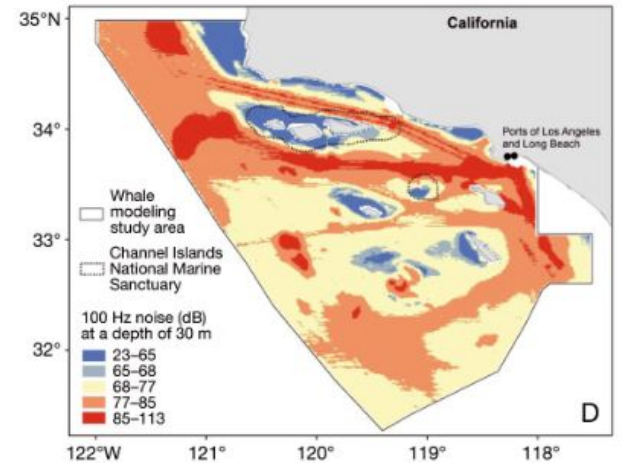
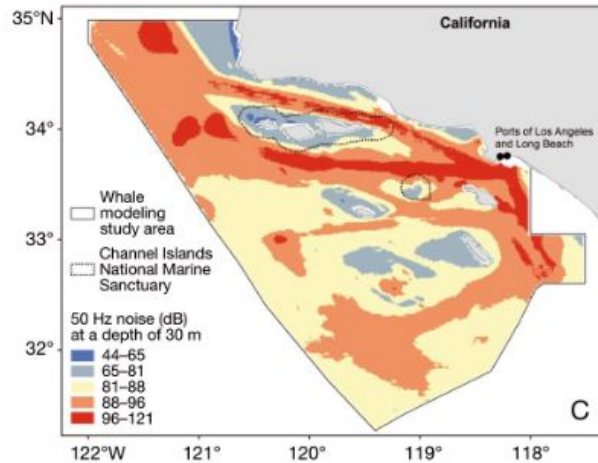
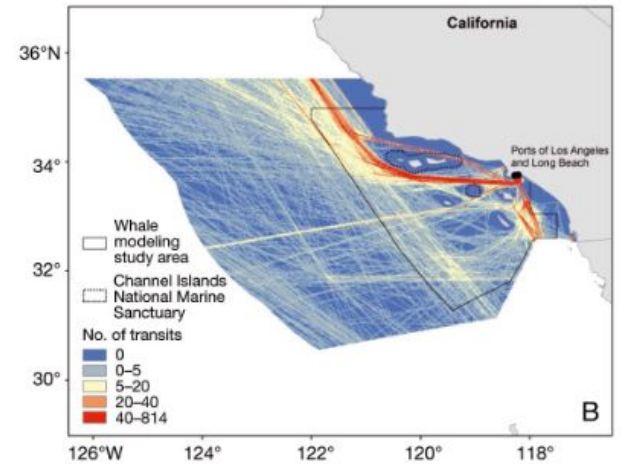
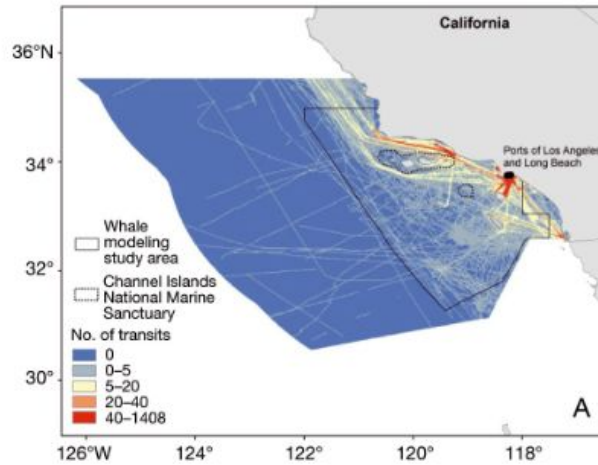


Fig 5. Sperm whale survey effort and detections overlaid on map of marine traffic density. Acoustically surveyed tracks are shown as green lines, while tracks in red show when sperm whales were acoustically detected. Marine traffic data were obtained from AIS data and coloured by traffic density (given as AIS signals/km²/year).

doi:10.1371/journal.pone.0150660.g005

Analytical-Based Approach

Redfern et al. 2017



Agent-Based Approach

Guzman et al. 2013

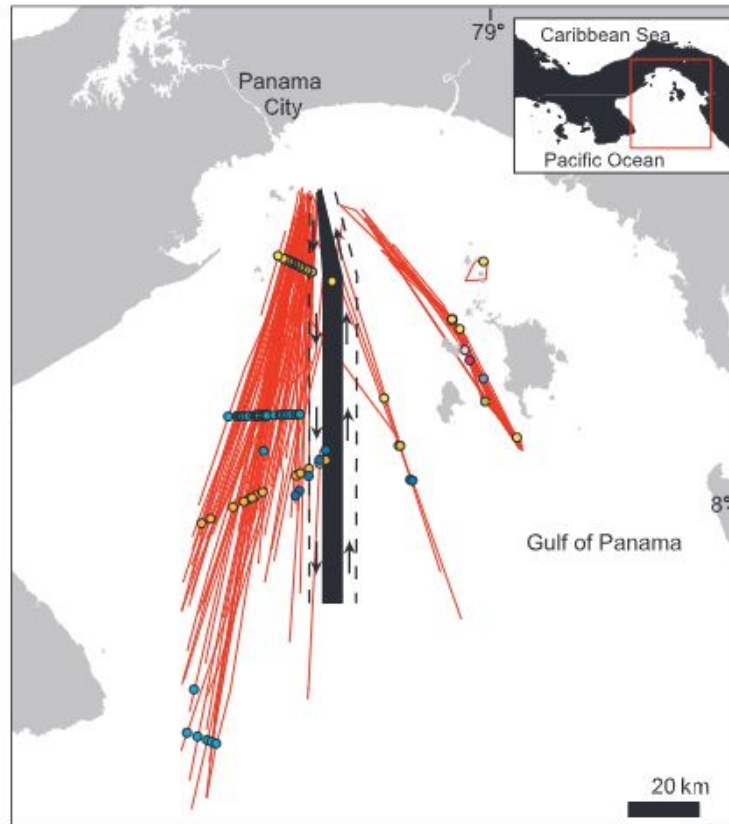
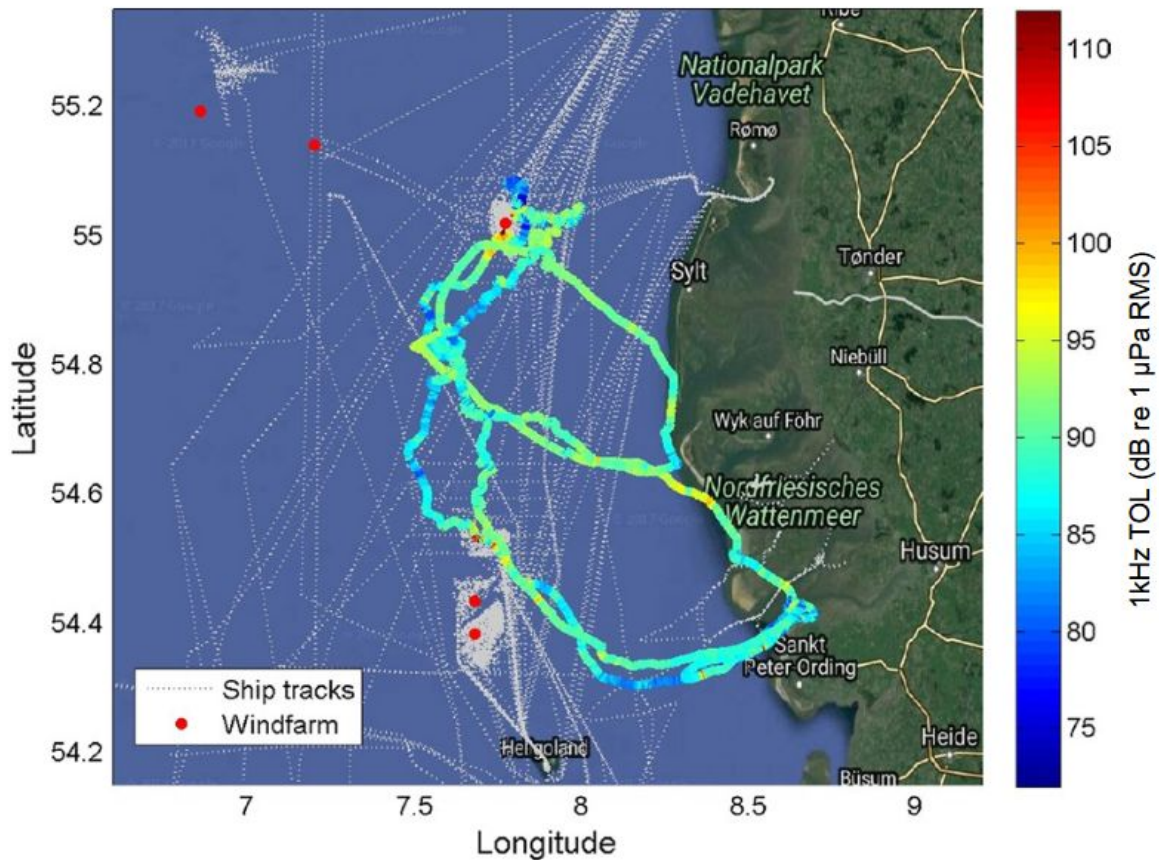


Figure 2. Tracks of 81 vessels and the spatial distribution of the 97 interactions with eight different whales (see Table 3) plotted over the suggested two-way Traffic Separation Scheme for ship routing of ca. 120 km (65 nmi) between parallels 8.8°N and 7.0°N in the Gulf of Panama, Panama. Each dot represent an interaction and each color an individual whale.

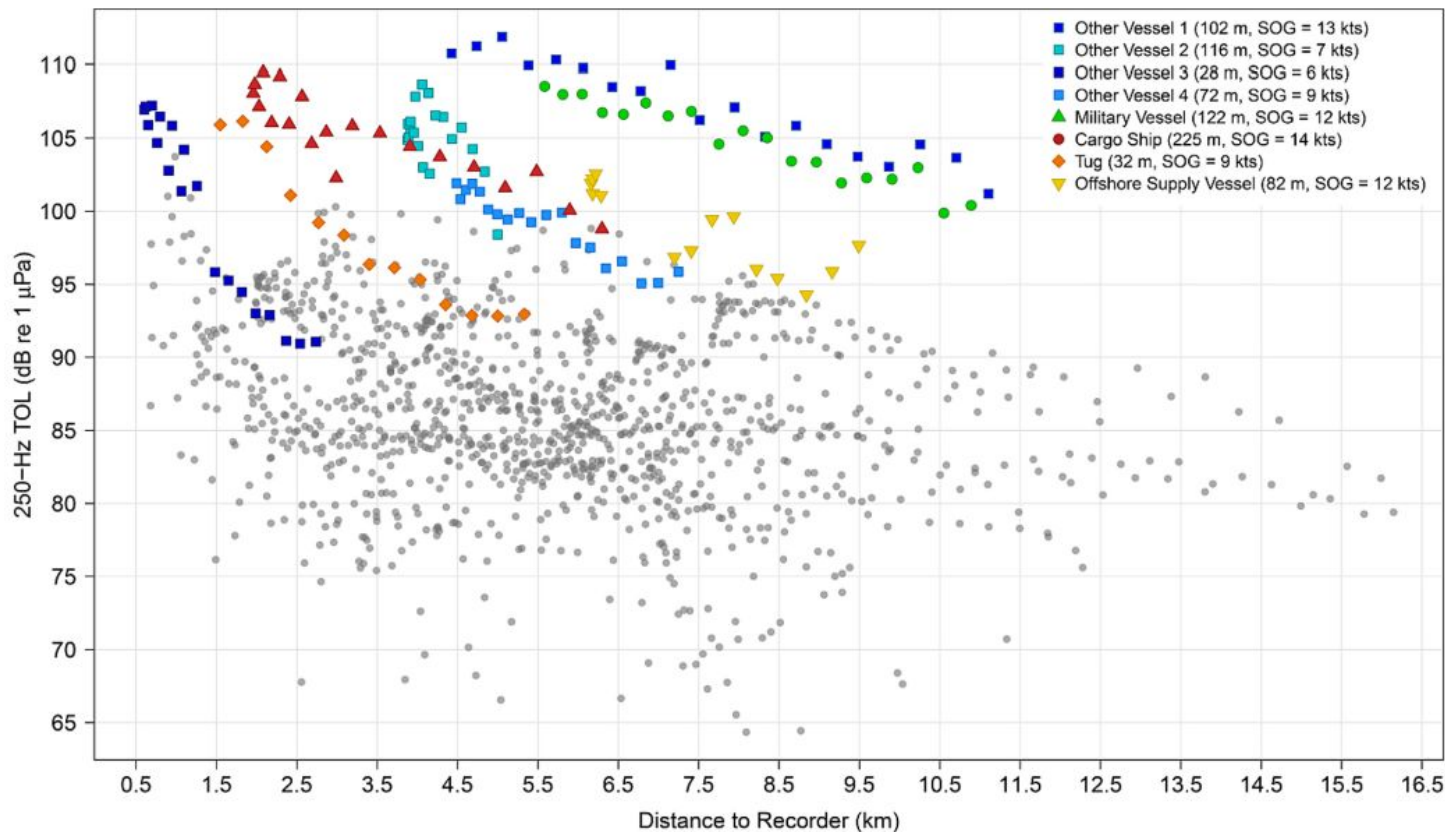
Agent-Based Approach

Mikkelsen et al. 2019



Vessel Contribution to Soundscape

No direct use
of marine
mammal
presence data



Escajeda et al.
2023

Additional observations for AIS

- AIS data are problematic and much are omitted (McGillivray et al. 2009)
- Other vessel tracking methods help fill gaps
 - Radar (Cope et al. 2021)
 - Aerial surveys (Thornton et al. 2022)
 - Land-based observational studies (Oakley et al. 2017)
 - Theodolite tracking (Hermannsen et al. 2019, Williams et al. 2021)
 - Satellite AIS (Greig et al. 2020, McWhinnie et al. 2021)
- Many studies used pre-processed AIS data

Other Notable Visualizations

Jones 2021

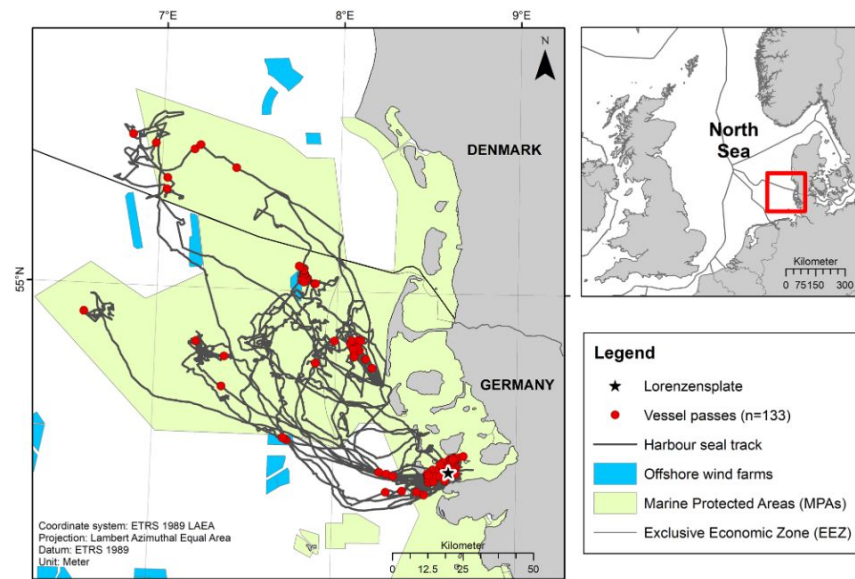
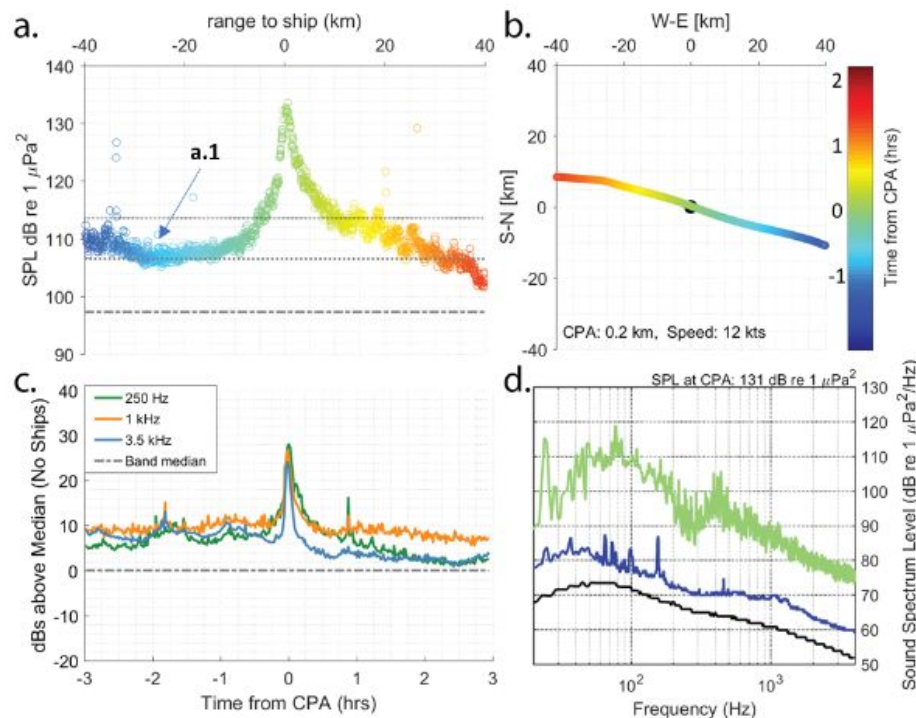


Figure 2. Tracks of harbour seals (n=9) in the North Sea. The red dots illustrate the locations of high level vessel passes during on-effort periods (n=133). The tagging site Lorenzensplate is indicated by a black star. Harbour seals were tagged in three catches over two consecutive years. The map was created using ESRI ArcGIS, version 10.5.

Nachtsheim et al. 2023

Conclusions + Implications for SAEL

- The role of AIS ranges from general cumulative presence to detailed movements of individual vessels by type
- Drifting buoys are similar to tagged animals (both mobile receiver), which are more commonly used with AIS
- Few articles automate their methods, even fewer provide direct links to their scripts
- GAMs for marine mammals + AIS + soundscape metrics + environmental variables (McKenna et al. 2021, Carome et al. 2023)

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