Contrasting diel distribution patterns of reef-associated fishes around standing and toppled oil and gas platforms in the northern Gulf of Mexico.

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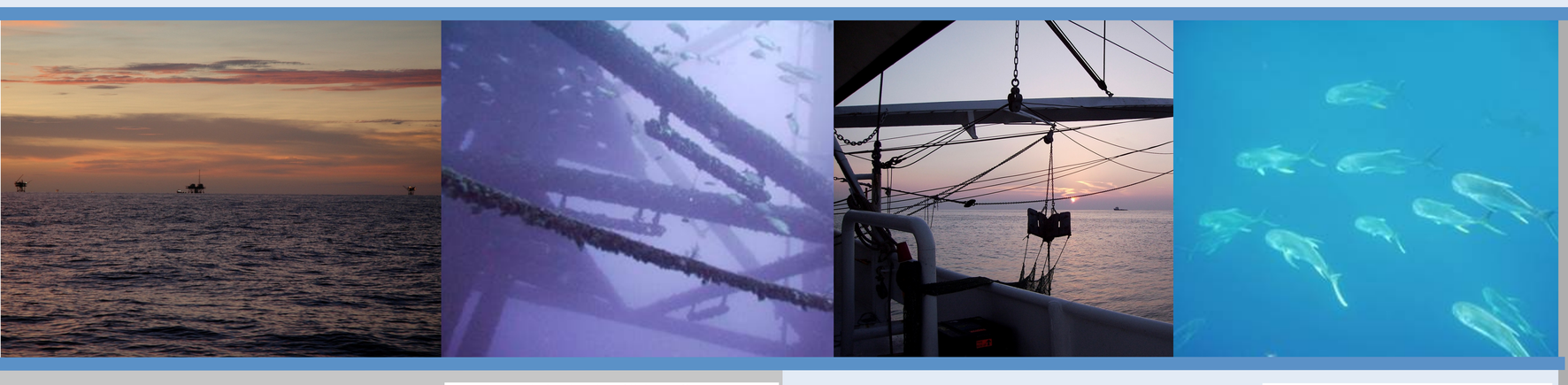
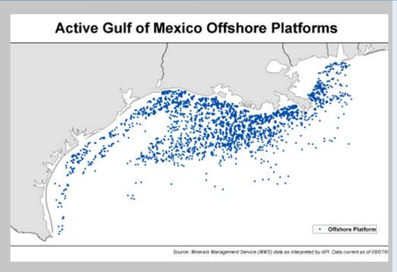


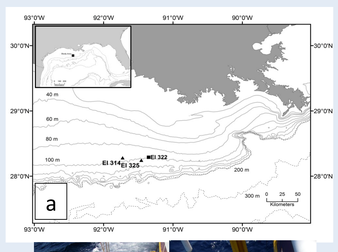
Introduction



- Over 3000 oil and gas platforms create the largest *de facto* series of artificial reefs in the world
- 300 of these structures have been toppled to create artificial reefs
- Understanding the movement patters of reef-associated fishes around artificial reefs is important to our understanding of how these structures function in the ecology of these species
- Diel differences in abundance of reef-associated fishes have been observed around artificial reefs in the North Sea, the Mediterranean Sea, and in the Gulf of Mexico (GOM)
- Observations of diel variability in fishes have reported peaks in biomass from around midnight to between 2 and 6 am, which may be a behavior adapted to forage and/or avoid visual predators
- **The goal of this project was to examine the diel distribution of reef-associated fishes around standing and toppled oil and gas platforms**

Methods

- Two standing and one toppled platform sampled (Fig 1a) for 48 continuous hours
- Mobile hydroacoustic approach using three frequencies (70, 120, 200 kHz)
- 10 transects run in circular pattern around platform site (Fig 1b)
- dB differencing and z-score method (De Robertis et al 2010) used to identify broad classes of scatterers in GOM: fish, large pelagic predators (LPP), schooling planktivores* (SP) and zooplankton* (* not discussed here)
- Changes in S_v for each class analyzed over 24-hour period using a LOESS regression and spectral analysis
- Distribution of each class contrasted between habitats and analyzed with hour of day, depth and distance from structure using a GLM



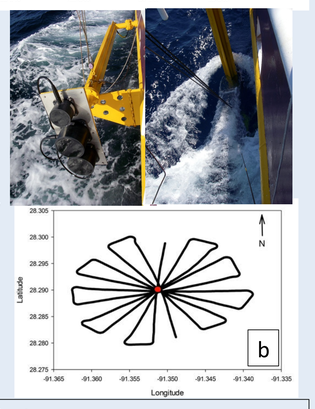
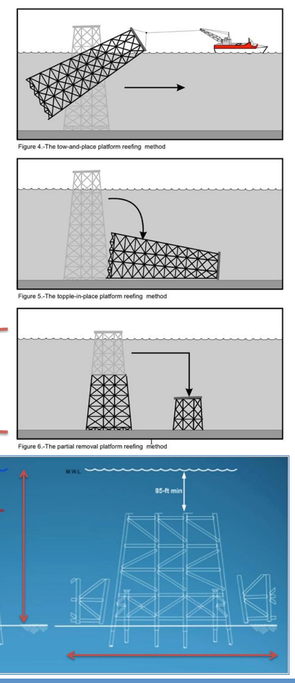


Fig. 1
a. Location of sampling sites in the Gulf of Mexico. Triangles– Standing, Square– Toppled
b. Approximation of cruise track around platform sites

Standing vs. Toppled Platforms

Decommission platforms must be removed 1 year after termination of the lease

- **Standing**
  - Provides Structure throughout water column
  - Greater vertical component
- **Toppled**
  - Upper 30m of water column contains no structure
  - Greater horizontal component
  - Greater footprint on seabed



Discussion

- Diel distribution around large artificial reefs varied with habitat (standing vs. toppled), water depth, and acoustic class of fishes.
- Fish S_v differed between habitats with hour of day, with higher S_v in the upper water column during the day at the toppled platform, and higher S_v in the middle water column during the day at standing platforms; S_v at standing platforms was significantly lower during the day.
- Decreased S_v for fish in the upper water column during the day at standing platforms may be due to the increased presence of predators. Increased S_v for fish in the upper water column at night at standing platforms may be due to the light emitted from the working platforms.
- Patterns of LPP diel distribution was similar between habitats, showing a strong diel signal, and increased S_v during the day in the both upper and middle water column.
- The LPP class consists of large visual predators, accounting for the higher S_v in the upper water column during daylight hours.
- Both fish and LPP had consistent patterns of S_v in the lower water column, with no strong diel signal. This is likely indicative of a unique demersal fish community.

Results

- Significant differences in S_v with hour of day, depth and the interactions of habitat, hour, and depth.
- Spectral analysis indicated diel cycle is strongest, when peak exists

Fish

Standing

- Higher S_v in surface waters at night and middle water column during the day
- Strong diel signal in middle water column, with weak diel signal in surface and bottom waters
- LOESS regression indicates higher S_v during in the morning hours with lower S_v in the afternoon

Toppled

- Weaker diel signal overall
- Stronger diel signal in upper water column
- Weak diel signal and lower S_v in middle and bottom waters
- LOESS regression indicates midday peak in S_v

Large Pelagic Predators (LPP)

Standing

- Strong diel signal in upper and middle water column
- Weak diel signal in bottom waters
- LOESS regression indicates higher S_v in early morning

Toppled

- Strong diel signal in upper middle water column
- Weak diel signal in bottom waters
- LOESS regression indicates peak in S_v in the afternoon, with lower S_v around midnight

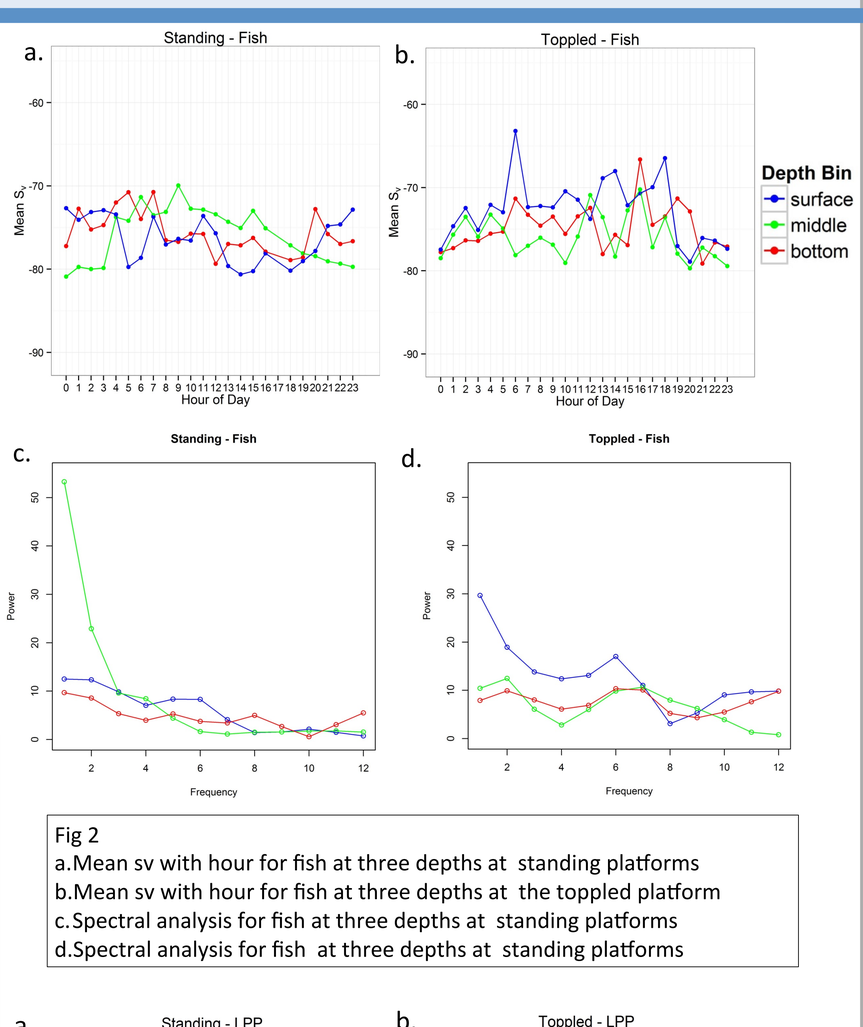


Fig 2
a. Mean sv with hour for fish at three depths at standing platforms
b. Mean sv with hour for fish at three depths at the toppled platform
c. Spectral analysis for fish at three depths at standing platforms
d. Spectral analysis for fish at three depths at standing platforms

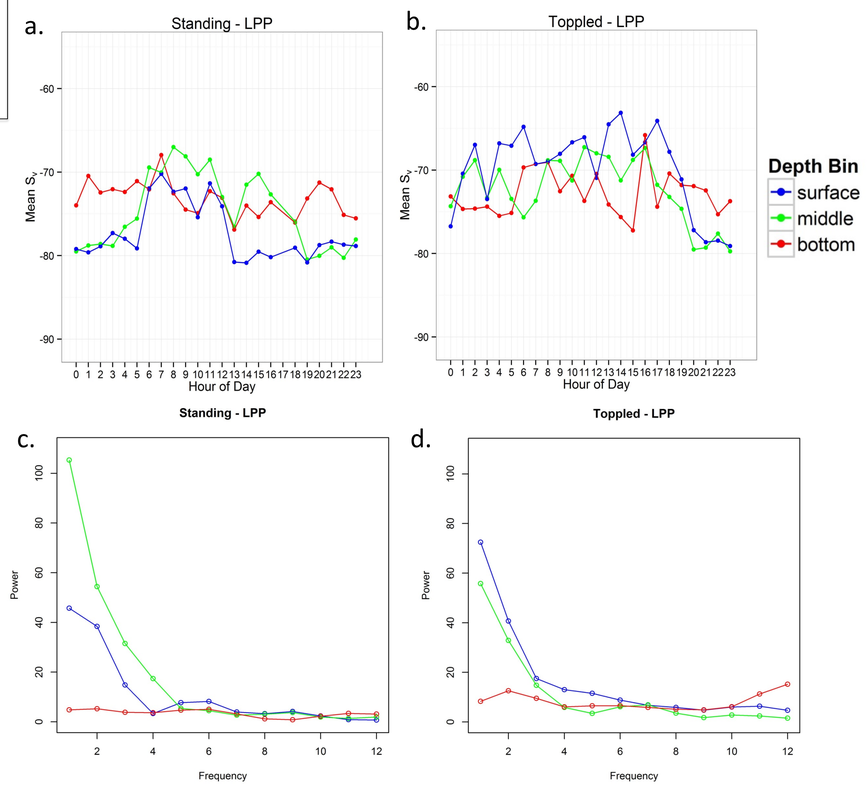


Fig 3
a. Mean sv with hour for LPP at three depths at standing platforms
b. Mean sv with hour for LPP at three depths at the toppled platform
c. Spectral analysis for LPP at three depths at standing platforms
d. Spectral analysis for LPP at three depths at standing platforms

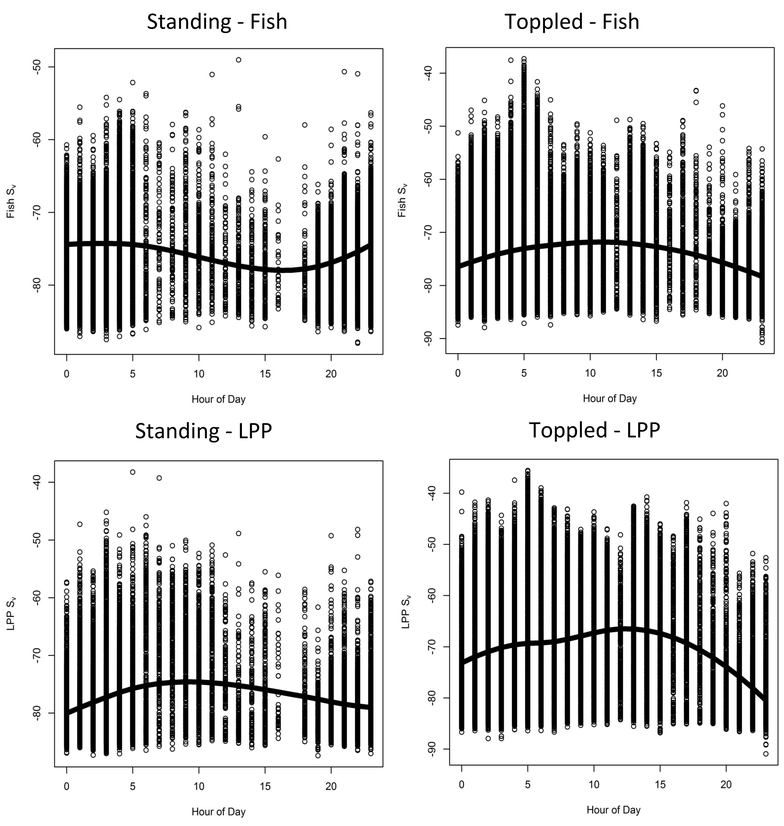


Fig 4 : Actual S_v values and LOESS predicted value of sv for each hour of the day.

Conclusions

- Strong diel patterns of distribution were observed around large artificial reefs in GOM, specifically from LPP
- Diel distribution and strength of diel signal depends on vertical structure, depth, and class of fishes
- Presence of predators, particularly in upper water column, likely affect distribution patterns
- Light emitted from working standing platforms may have an effect on distribution patterns at night

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