

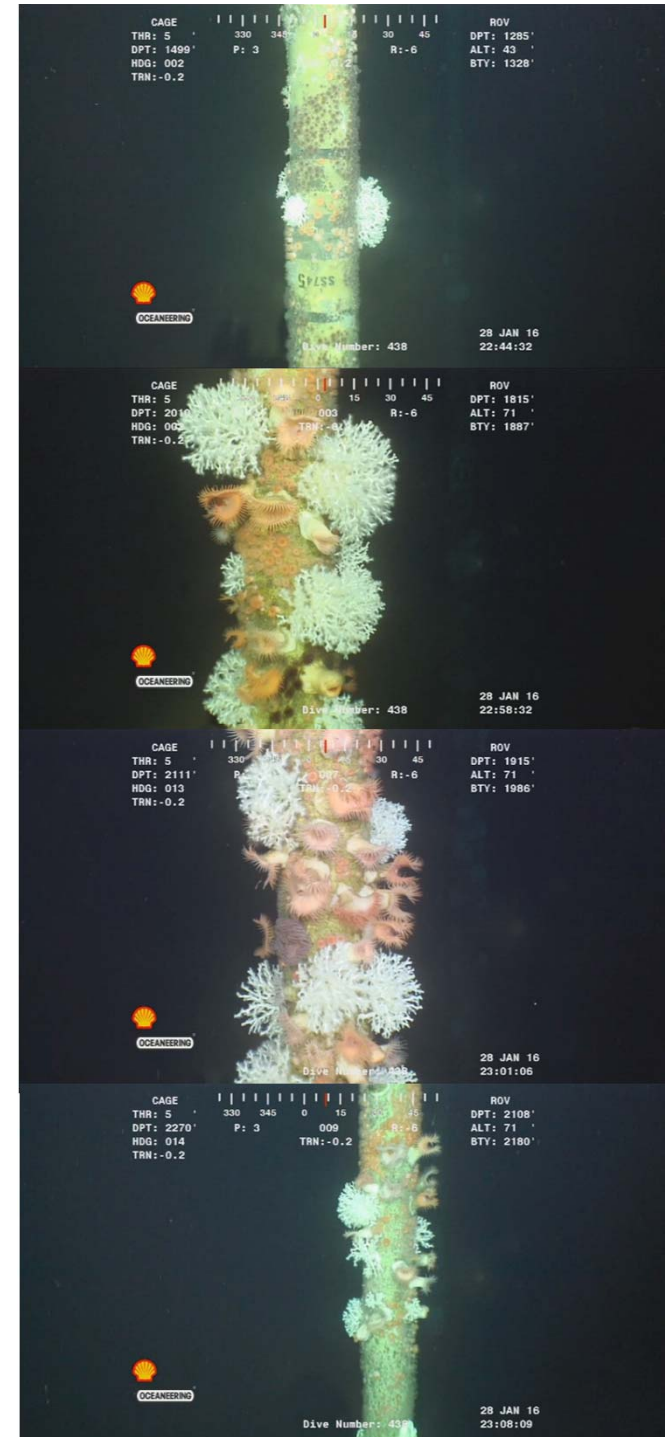
The Vertical Distribution of the Deepwater Coral *Lophelia pertusa* Derived from ROV Riser Inspection Videos

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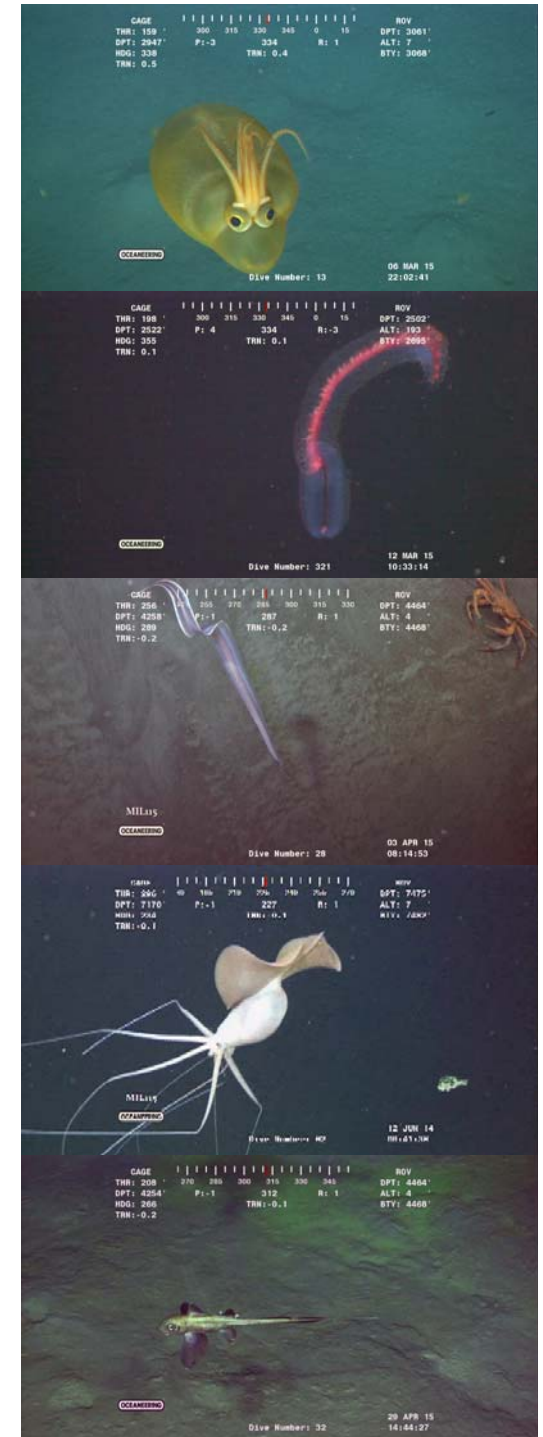
COLLEGE OF THE COAST AND ENVIRONMENT

LOUISIANA STATE UNIVERSITY



Gulf SERPENT

- Partnership between LSU, the oil and gas industry, and BOEM to study deep-sea biodiversity in the Gulf of Mexico
- Part of the global SERPENT Project
- Funded by BOEM from 2007 – 2017 with in-kind match from industry based on value of contributed ROV time
- Objective: Establish a deepwater observing system using industrial ROVs during operational standby time
 - What species are present?
 - Where do they occur?
 - When do they occur?
 - What are they doing?



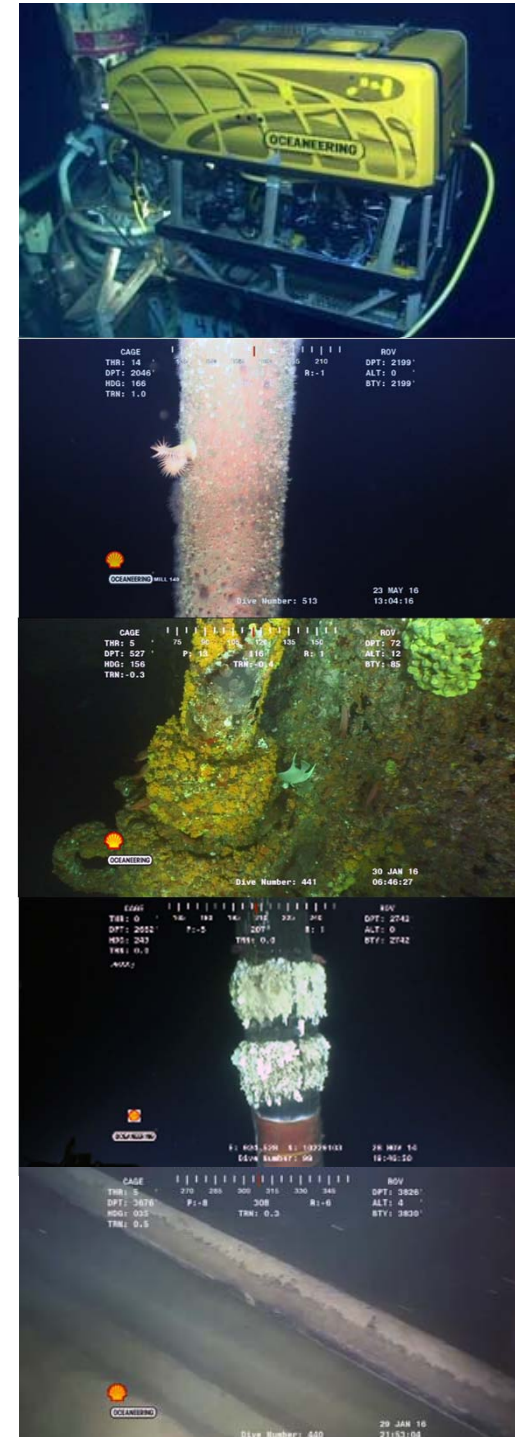
Approach

- Train offshore ROV teams to conduct surveys
 - Water column transects
 - Seabed radial transects
 - Opportunistic encounters
- ROV teams conduct surveys when possible
- Data (video) sent to LSU
- Since Macondo, it has become increasingly difficult to get offshore
- Remote training
- Currently working with Shell, BP, Anadarko



Value of Archived Video Data

- Companies use ROVs to conduct a variety of routine surveys
 - Pre-bottom surveys
 - Riser inspections
 - Other subsea structure inspections (tendons, anodes, caissons, etc)
 - Pipeline inspections
 - Acoustic receiver pre-/post-deployment surveys
- Provide an opportunity to collect time-series data on distribution of deepwater fauna
- Potential to quantify pre-impact conditions



Present Study

- Utilize production riser inspections at Shell's Mars platform (MC807A) to measure the vertical distribution of *Lophelia pertusa*
- Combine observed distribution pattern to climatological profiles of temperature, salinity, and measured ADCP current velocities
- Develop a model predicting *Lophelia* distribution as a function of environmental variables

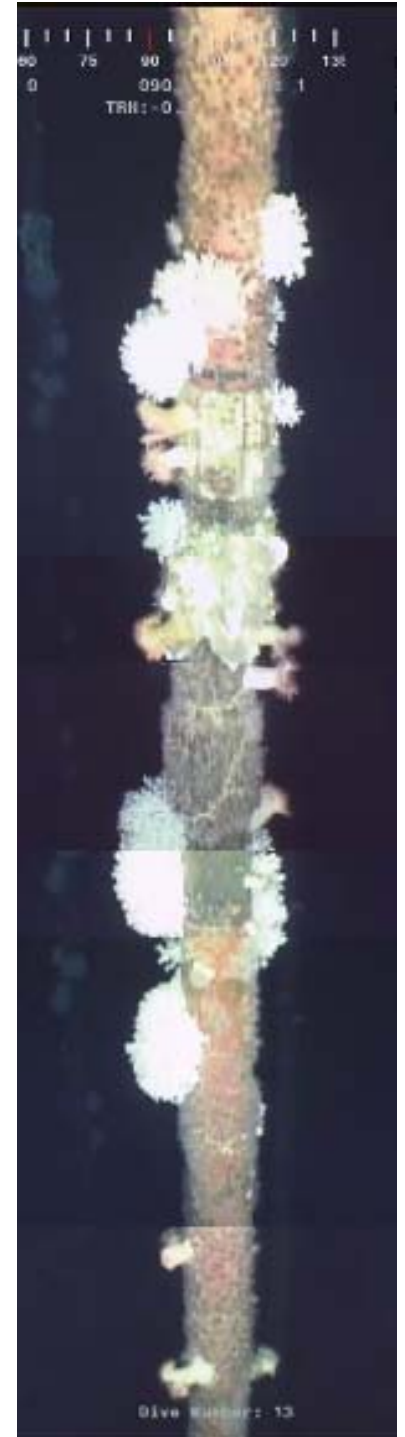
Study Site

- Mars (MC807A)
- Tension-Leg Platform that began producing 1996
- 896 m water depth
- 24 wells each connected to surface via production riser
 - 9 5/8 in/24.27 cm dia.
- Down-looking ADCP provides current data from 2005 - present



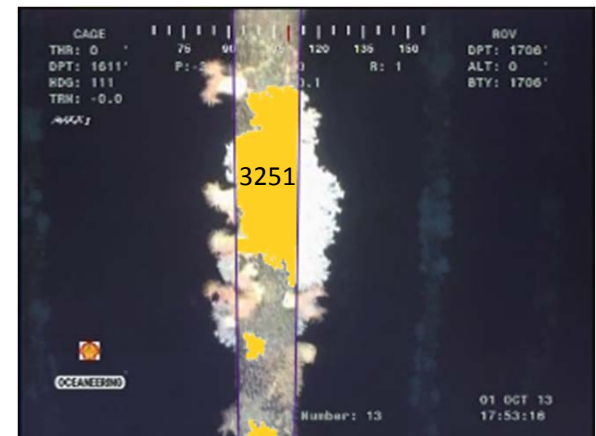
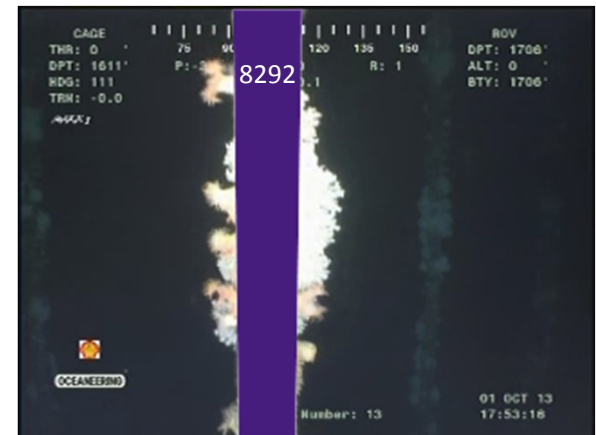
Methods

- Shell provided access to their video inspection archive
- Selected videos from a period when inspections took place within a short period of time
- 14 production risers inspected from October 1-8, 2013
- Colony abundance
 - Frame grab for each colony with unique filename: MC807A_yyyy_mm_dd_hh_mn_sc_depth_##.png
 - Filenames read into Matlab, depth parsed out
 - Histogram of abundances at 10 m intervals
 - Mean abundance per 10m interval estimated by averaging over all 14 risers



Methods

- Percent cover: frame grabs at 10m intervals
- Edge of riser delineated
- Area of riser (pixels) and *Lophelia* measured in Photoshop
 - In example: $3251/8292 \times 100 = 39.2\%$
- Data entered into Matlab and averaged over all 14 risers



Temperature and Salinity Climatology

- Climatological hydrography from NOAA¹
- Dataset has 0.1° resolution and the cell closest to Mars was used as an approximation of the hydrographic profiles at that rig
- Each monthly profile of salinity and temperature was smoothed with a Lowess filter in Matlab to remove occasional spikes in the data
- Vertical profiles spanning the range of temperature and salinity within each 10m depth bin were estimated by using minimum and maximum values from the smoothed monthly data

¹National Oceanographic Data Center's Gulf of Mexico Regional Climatology data repository

ADCP Data

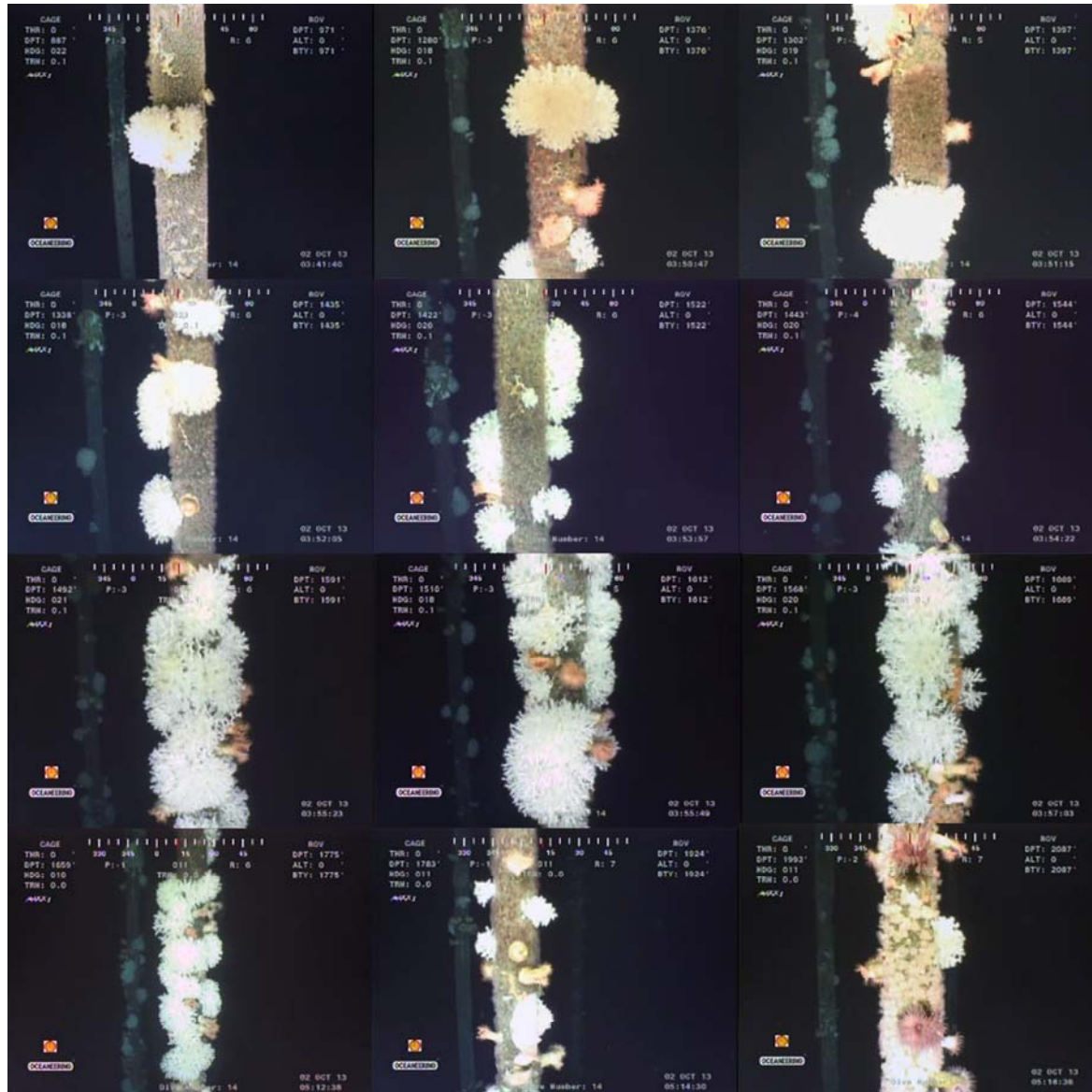
- Downloaded from NDBC station 42363 from National Data Buoy Center for 2005 – 2013
- Current velocities averaged for each year within the depth range encompassed by the ADCP
- Interpolated into a common depth interval (50:10:900m) in Matlab
- Averaged over years
- Direction of flow not considered in analysis
- **Aside: Why has the Oil and Gas ADCP data been removed from the NDBC website navigation???**



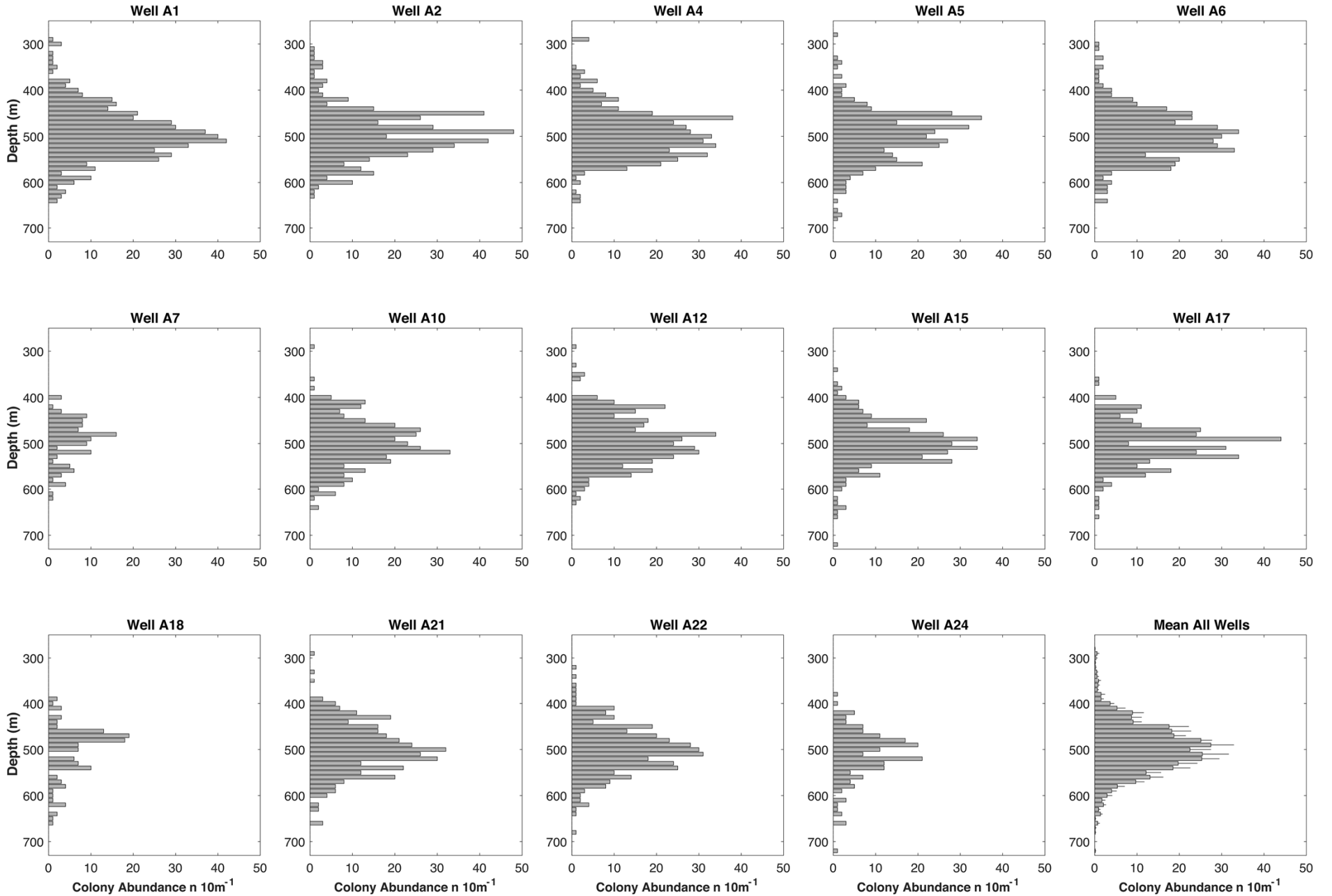
Predictive Model

- General additive model (GAM)
- $Y = \beta_0 + f_\alpha(D) + f_\gamma(T \cdot V) + \varepsilon$
 - Y is the **Abundance of *Lophelia* spp.**
 - B_0 is the **Model Intercept**
 - D is the **Depth (m)**
 - T is the **Minimum Temperature (°C)**
 - V is the **Mean Velocity (m/s)**
 - ε is the **Error Term**
 - f_α is the smooth term for D estimated by Residual Maximum Likelihood (REML)
 - f_γ is the tensor product smooths and interaction of T and V estimated by REML

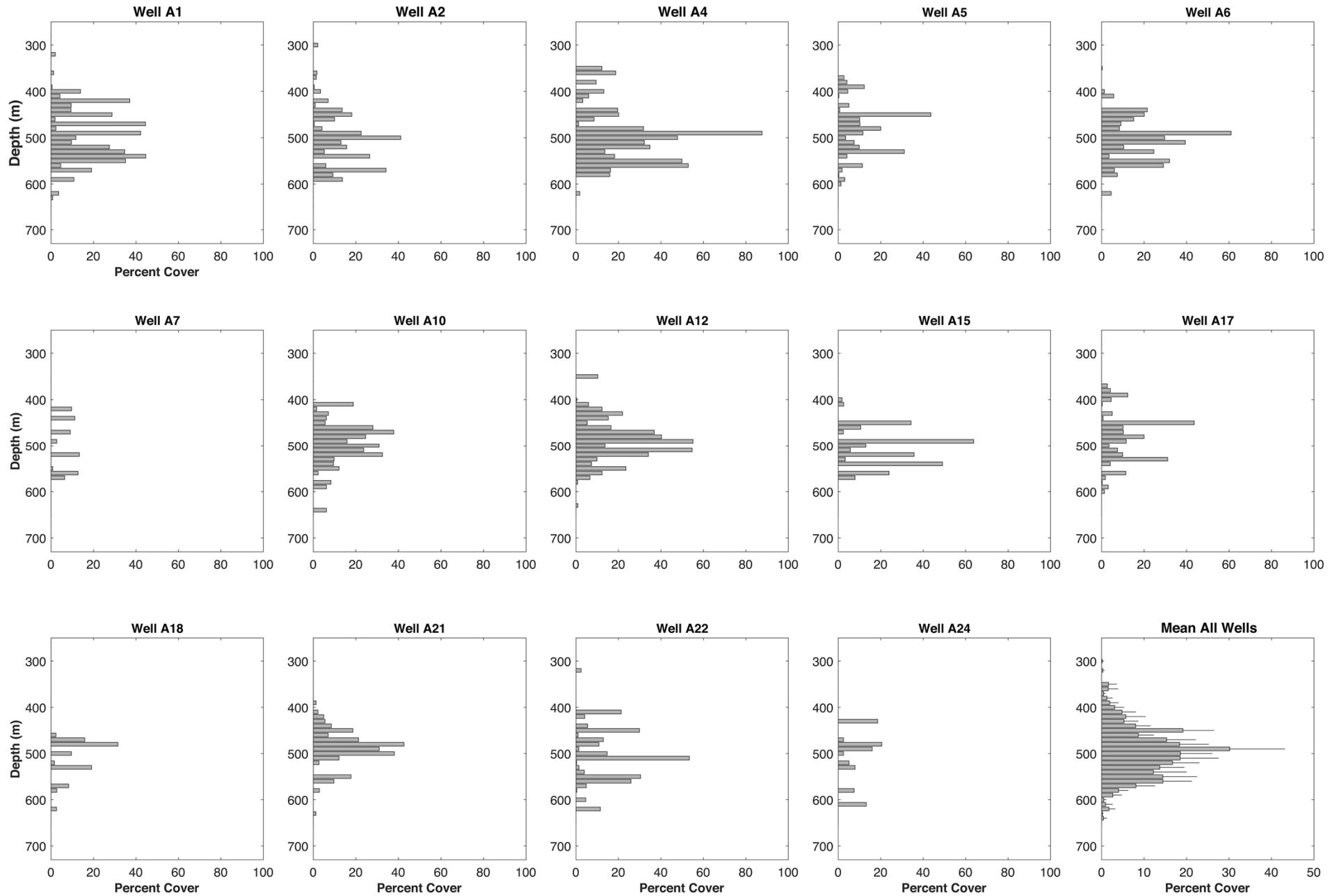
Results: Colony Abundance



Results: Colony Abundance



Results: Percent Cover



Results: Climatology and Current Velocity

