Integrated Spatial Data Modeling Tools for auto-classification and delineation of species-specific habitat maps from high-resolution, digital hydrographic data

Authors: E. Summers-Morris[1], P. Iampietro[1], R. Kvitek[1]

[1] California State University, Monterey Bay, Seafloor Mapping Lab

Abstract

We used high-resolution multibeam bathymetry, together with precisely geolocated (± 5m) ROV observations of fish distribution, to produce species-specific and genus-specific habitat suitability models for eight rockfish (*Sebastes*) species in the Del Monte shale beds of Monterey Bay, California. A high-resolution (2m) digital elevation model (DEM) was generated and used to produce derived habitat characteristic layers using repeatable, non-subjective algorithmic methods. These data layers, together with the positions and counts of observed species were then used to create predictive models of habitat suitability. Factors evaluated for incorporation in the models included depth, slope, rugosity, and TPI at various scales. Statistical and empirical testing revealed that distance to a TPI_{50} "peak" was the most effective predictor of fish location. Thus, distance to TPI_{50} peak was used as a simple indicator of habitat suitability for all species. An average of 80% of all *Sebastes* were found within optimal habitat as defined by this simple model (Model 1). By incorporating depth, a refined suitability model (Model 4) was created for five species. Both models were used to produce stock estimates for all species and for all *Sebastes*, based on observed densities of rockfish within the ROV survey area and total area of habitat suitability classes in the overall shale bed study area.

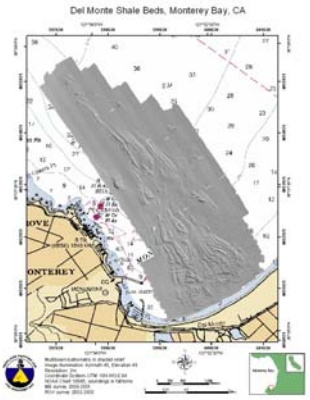
Methods

- Multibeam bathymetric data with 2m resolution used to generate ROV survey and derivative grids: slope, rugosity, Topographic Position Index (TPI)
- ROV survey transects run perpendicular to the strike of the shale reef
- Evaluation of fish distribution and abundance data from ROV survey to generate habitat suitability models using ArcGIS.

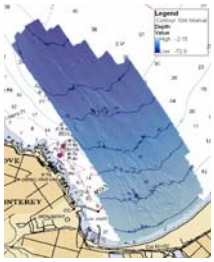
R/V MacGinitie fitted with Reson 8101 Seabat multibeam sonar

Hyball ROV with digital video recorder

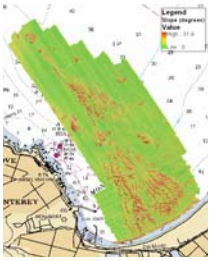
Study site



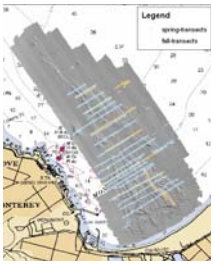
Depth



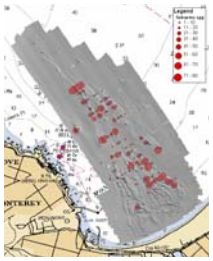
Slope



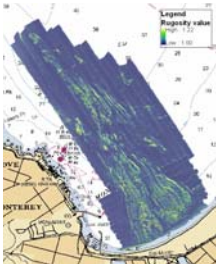
ROV Survey Transects



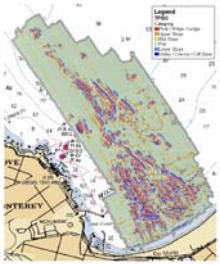
Sebastes spp. distribution



Rugosity



Topographic Position Index$_{50}$ (TPI_{50})



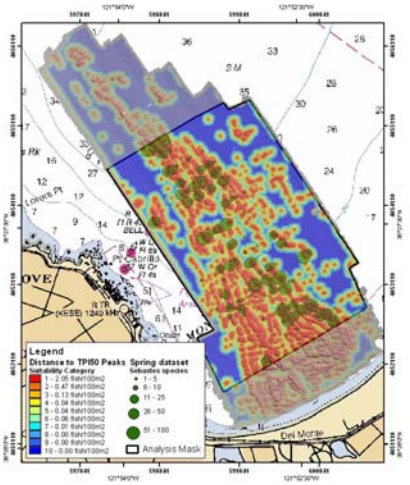
Results

Analysis of ROV survey data relative to the four factors analyzed (depth, slope, rugosity and TPI) suggested that proximity to features classified as "peaks" by a 50m scale Topographic Position Index analysis (TPI_{50}) seemed to be the most significant factor affecting rockfish distribution. Habitat suitability Model 1, representing distance to TPI_{50} peaks was generated and reclassified into 10 categories at 10m intervals, with category 1 representing 0-10m to a peak (including peak features) and the last category (10) representing ≥90m distance to a peak. "Most suitable" habitat was considered to be 0-10m to a peak (category 1). Habitat suitability Model 4 - Deep incorporated species-specific depth preference and distance to: TPI_{50} peaks, rugosity, and slope, which further refined the model. Model 1 captured 80% of all *Sebastes,* and Model 4 - Deep captured 69% of *Sebastes serranoides/S. flavidus.*

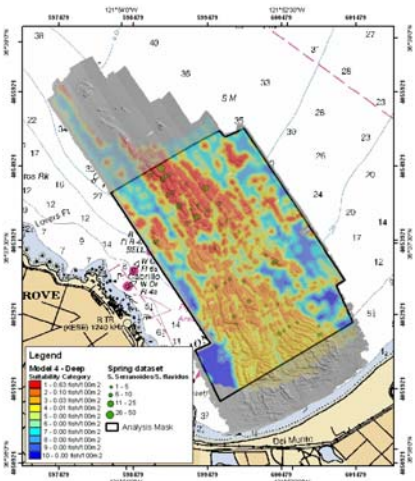
Conclusions

- The methods and models developed for this project are geared to assess *Sebastes* species on the shale beds of Monterey Bay, CA, and appear to be an accurate predictive model of distribution and abundance.
- With these habitat suitability models, we can accurately predict type of habitat within which approximately 80% of *Sebastes* spp. fishes in the shale beds will be found.
- The use of multibeam bathymetry to generate habitat suitability models has potential to be to be an effective tool in predicting *Sebastes* species distribution and abundance.
- This project has shown that using repeatable algorithmic terrain analysis techniques, products can be derived from high-resolution multibeam DEMs that can be used to develop cost-effective, non-subjective, scaleable habitat suitability models.

Habitat Suitability Model 1:
Distance to TPI_{50} Peaks



Model 4 - Deep:
Distance to Optimal: TPI_{50} Peaks + Slope + Rugosity + Depth



References

Kvitek, R, P Iampietro, E Summers-Morris. 2003. NOAA Technical Report: Integrated Spatial Data Modeling Tools for auto-classification and delineation of species-specific habitat maps from high-resolution, digital hydrographic data.
http://seafloor.csumb.edu/publications/Kvitek_NA17OC2586_Rpt.pdf

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