Using triggered cameras to determine fish behavior in rocky, untrawlable areas

Kresimir Williams, Chris Rooper, Mike Levine, Alex De Robertis

RACE Division, Alaska Fisheries Science Center, National Marine Fisheries Service, Seattle, Washington Kresimir.Williams@noaa.gov

Background

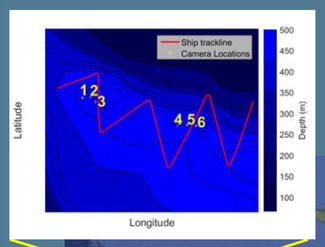
In Alaska, rockfish assessments rely on abundance indices derived from bottom trawl surveys. Because rockfishes tend to inhabit rocky, rugose, and thus untrawlable areas, bottom trawl indices of rockfish abundance can be biased and imprecise. Optical-acoustic surveys for semi-pelagic species hold promise for producing abundance indices from these untrawlable areas, but the response of rockfish to optical samplers and survey vessels must be accounted for. Acoustic measurements are limited by the inability to see fish near the bottom, and the proportion of fishes that are detectable by an echosounder is poorly known. Thus, observing rockfishes in a relatively undisturbed condition as we can get is useful to interpret fish behavior and distribution with regard to optical-acoustic surveys.

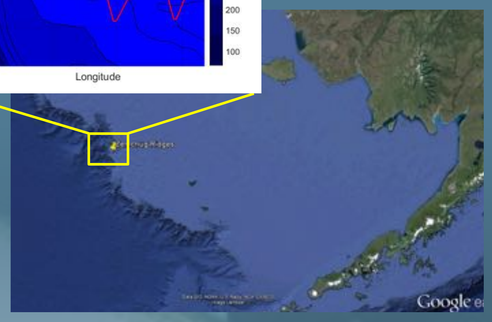
Objectives

- Conduct multiple, 12-hr. deployments of motion-triggered cameras in a rocky reef during day and night
- Observe density and vertical distributions of fishes thought a diel cycle.
- Determine what proportion of fish of different species cannot be sampled by acoustics because they are near or on-bottom.

Study Area

- Zhemchug Ridges , Eastern Bering Sea, July 2014





- Zhemchug ridges contain high densities of rockfishes occupying medium to high relief habitat. Acoustic data was collected during a nighttime and daytime pass along a trackline shown in the figure above aboard the NOAA ship Oscar Dyson. Six triggered cameras were lowered into position in two clusters in the middle of the ridge and left to collect data for 12 hours.

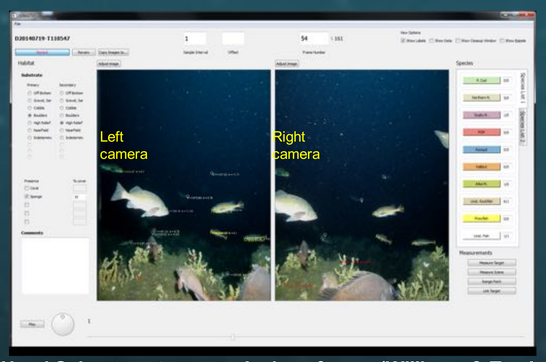
Methods

Triggered camera systems

- Cameras were designed to take a picture when animals are present. After image is taken system waits 5 minutes before checking for fish presence

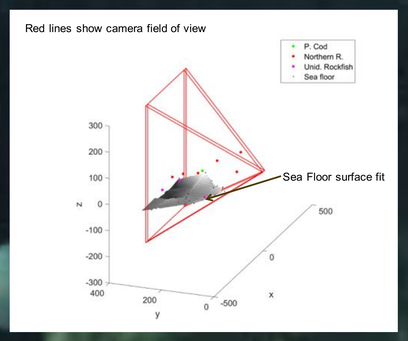
- Low cost consumer grade stereo cameras
- Red strobe (trigger evaluation) and white strobe (image collection) arrays
- Standard Dungeness crab commercial rig (line, buoy, pot puller)
- Sacrificial deployment base

Image processing

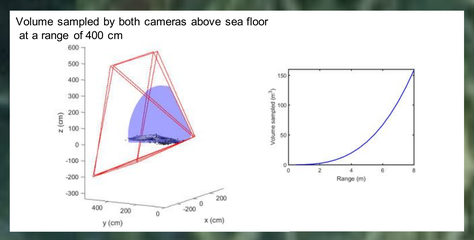


- Used Sebastes stereo analysis software (Williams & Towler)
- Fish identified, measured, and counted in each image pair

Stereo data analysis



- Height off the seafloor was determined by projecting a 3-D bottom profile onto the image

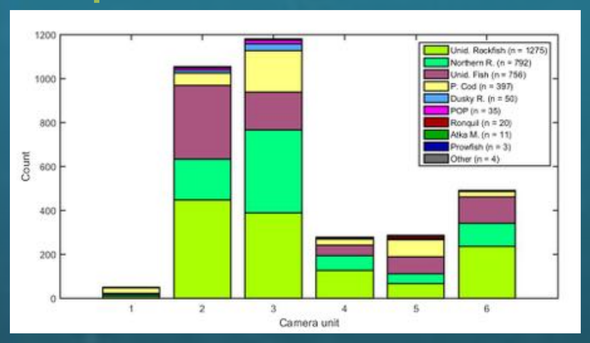


- Volumetric estimates of density for each species required estimating joint stereoscopic imaging volume above seafloor as a function of range and height off bottom

Results

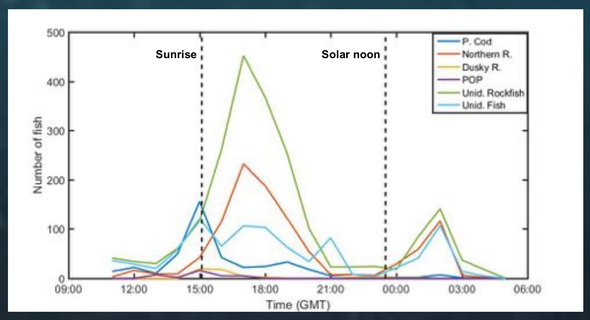
758 image frames analyzed, resulting in 4283 targets, 713 of which were measured

Fish species observed



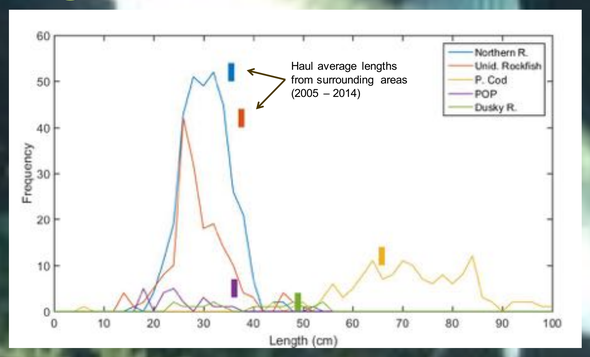
- Most numerous category was unidentified Rockfishes (Fish were identifiable to about 2.5 m from the camera)
- Of identifiable fish, Northern Rockfish and Cod were the most numerous
- The majority of observations came from two units (# 2 and 3) indicating uneven fish distribution on the ridge

Diurnal pattern



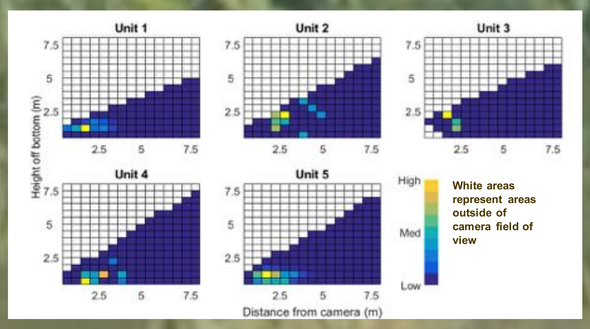
- Three activity modes were detected, at sunrise, early-midmorning, and early afternoon.
- Fish composition changed throughout out the day, overall maximum density was observed 2.5 hours after sunrise.

Length of rockfish and cod



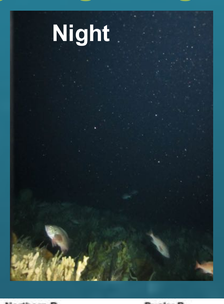
- Mean fish sizes in images were smaller than trawl data from surrounding areas for all species except Cod

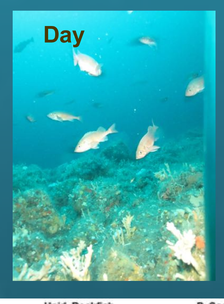
Fish density relative to camera location

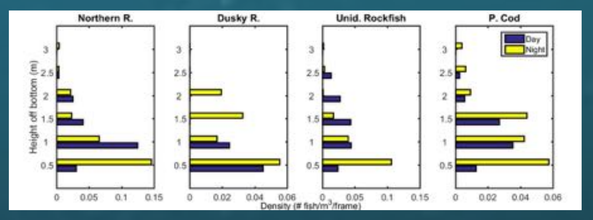


- Example analysis for Northern Rockfish shows diversity of distributions observed at different cameras/stations
- Fish detected out to a range of 4.5 m

Day v. night height above the seafloor

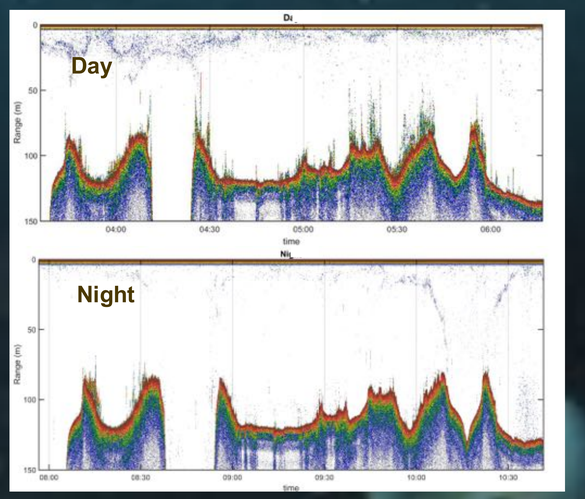






- Most fish were observed within 1 m of the sea floor
- Increase in daytime height off bottom for Northern and unidentified R. and with opposite pattern for Dusky R. and Cod
- Very few fish seen above 3 m

Acoustic Data



- Fish backscatter appears to be much stronger and higher off the seafloor during the day.

Conclusions

- Triggered stationary stereo cameras provide a range of information on fish behavior and distribution despite small sampling volumes
- Fish exhibited strong species-specific diel patterns in density
- Highest densities of fish observed are likely within the acoustic "dead zone"
- The scale of vertical fish migration seen in acoustic data was not as apparent in image based density estimates
- Peaks in camera fish density may line up with minimum acoustic density – multiple acoustic passes would be required to confirm

Acknowledgements

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