

# Update on Untrawlable Survey Research in RACE

Research Goals – long term

- 1) Map untrawlable regions within the survey area
- 2) Estimate rockfish abundance in untrawlable areas

## Objective for FY19

Design a GOA-wide index survey for rockfish species in untrawlable habitat that can be run in parallel to the current trawl and longline surveys and provide data on trends and size structure for stock assessors.

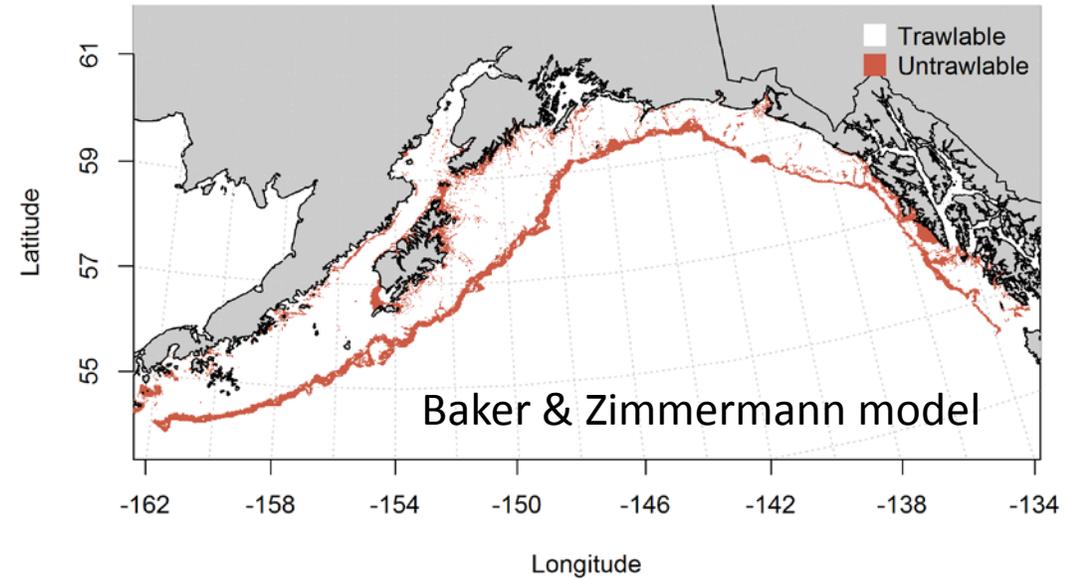
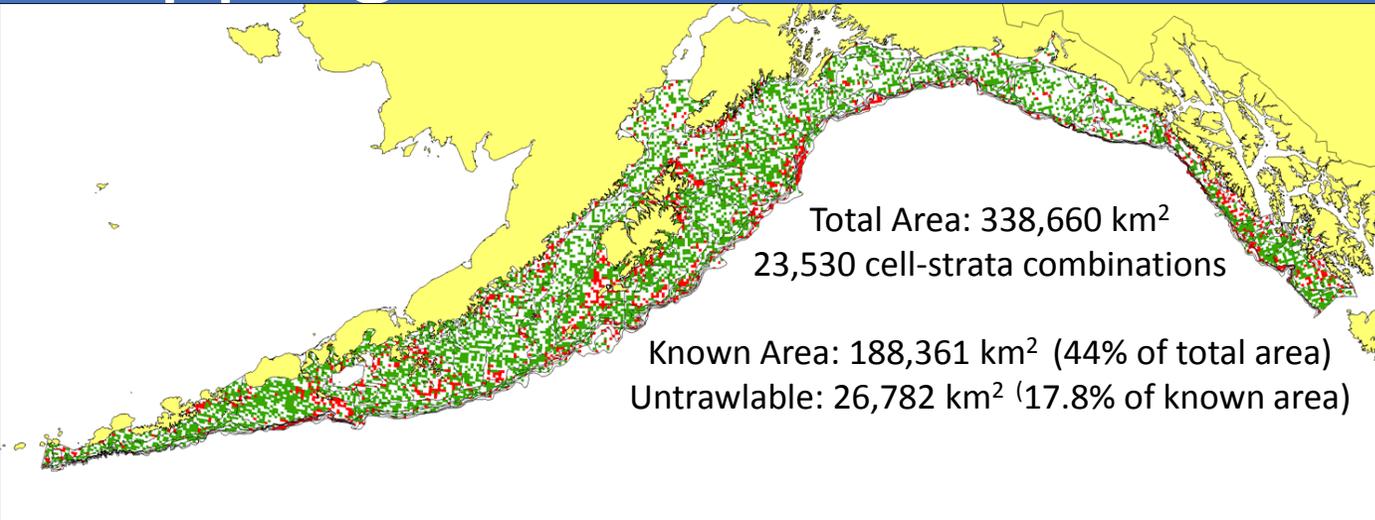
How big is the problem (how much untrawlable area is there)?

**What have we done so far?**

**Untrawlable Habitat Strategic Initiative results**

What works/doesn't work?

# How Big Is The Problem? Mapping Untrawlable Areas



## Ongoing Projects

Trawlability grid (Palsson, Von Szalay)

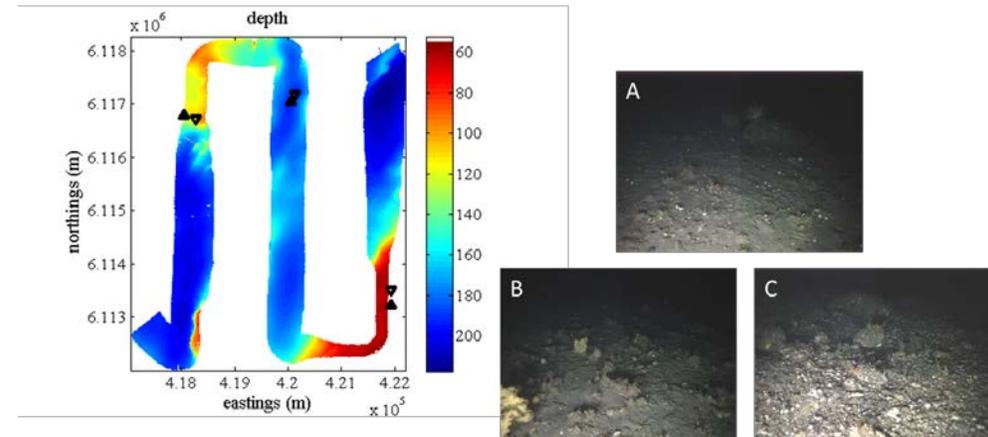
Modeling – Smooth Sheets (Baker, Zimmermann)

Modeling – ES60 (Von Szalay, Jorgensen)

Modeling – ME70 (Stienessen, Pirtle)

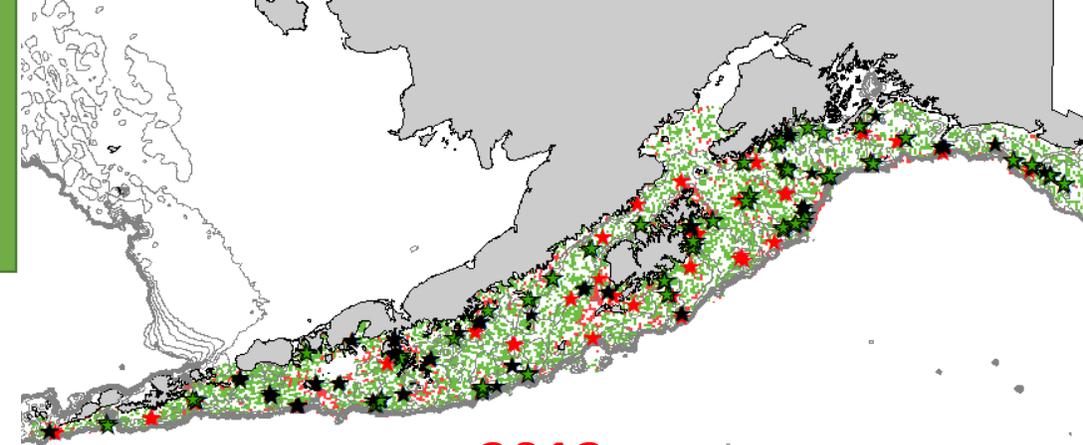
Mapping – Multibeam (McConnaughey)

## Stienessen & Pirtle



# What have we done so far? Acoustic-Optic Surveys (2009-2017)

- Pilot project on Snakehead bank in 2009 to determine feasibility
- Opportunistic surveys of BT “Trawlable” and “Untrawlable” grids using acoustics (splitbeam and multibeam) and lowered stereo cameras
- Assess substrate type/trawlability and rockfish ID/abundance
- Conducted during summer GOA walleye pollock AT survey
- Primarily nighttime operations



**2013**

**36 grids surveyed**

- **18 trawlable, 11 untrawlable**

63 Lowered Stereo Camera deployments

**2015**

**45 grids surveyed**

- **18 trawlable, 19 untrawlable**

89 Lowered Stereo camera deployments

**2017**

**29 grids surveyed**

- **16 trawlable, 13 untrawlable**

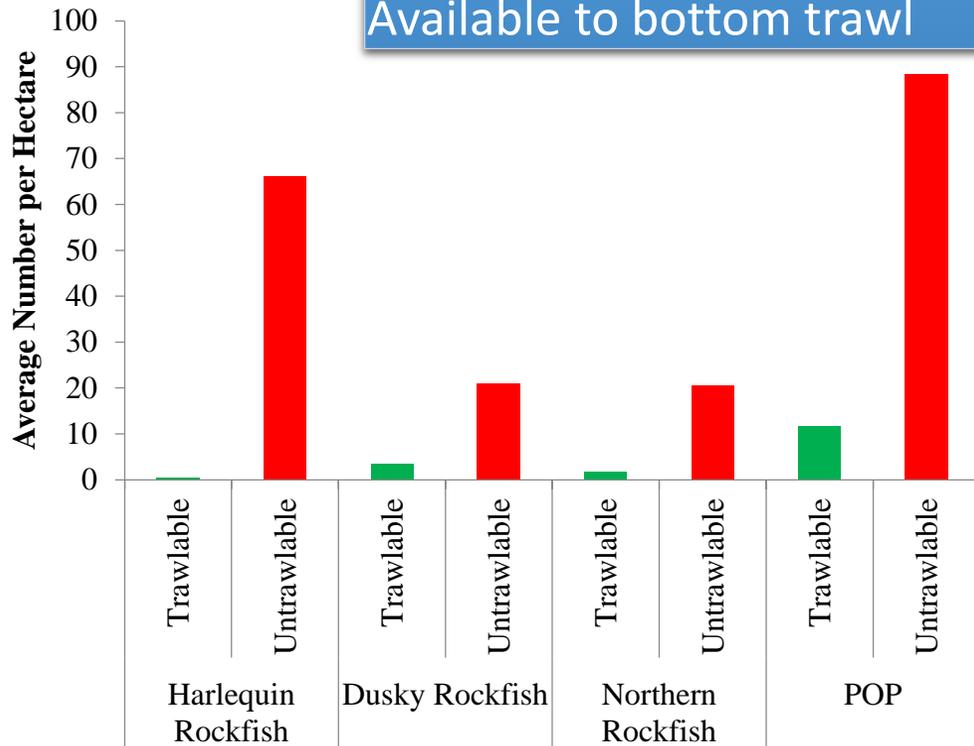
88 Lowered Stereo camera deployments

# Availability to bottom trawl survey

# What have we done so far?

## Q Estimation (HAIP Project – 2013 & 2015)

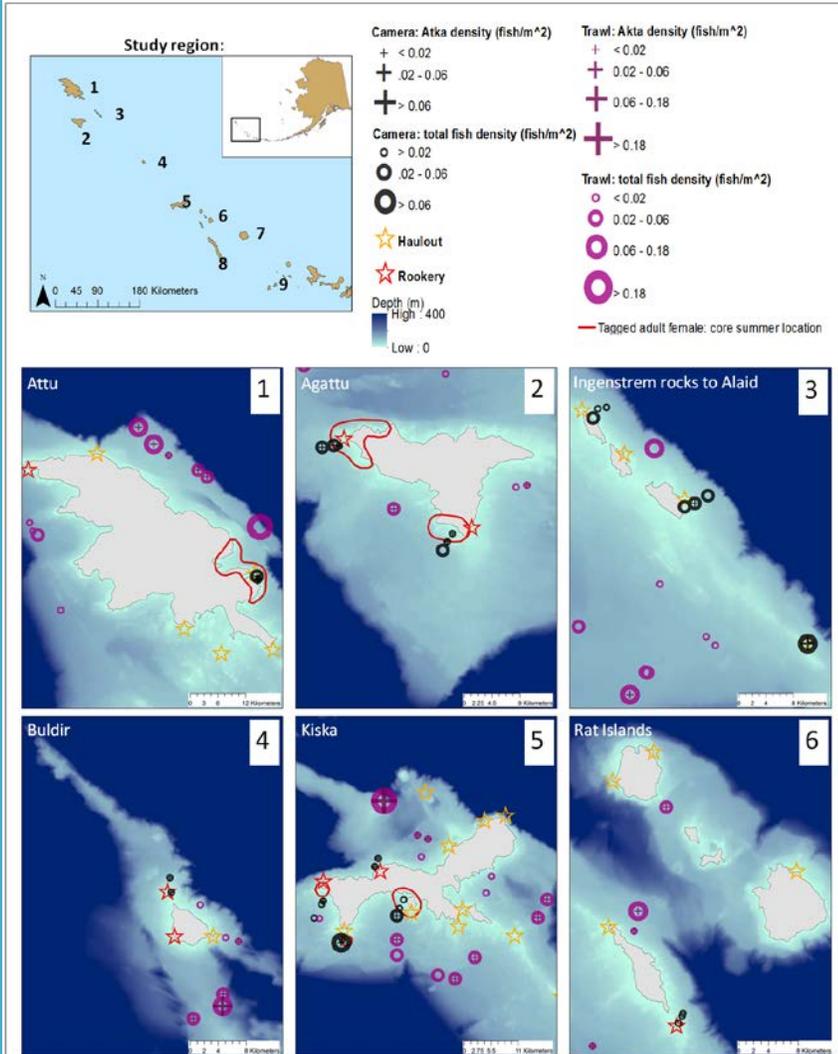
Species	Harlequin RF	Dusky RF	Northern RF	POP
Trawlable Density (#/ha)	0.45	3.46	1.74	11.57
Untrawlable Density (#/ha)	66.15	21.05	20.63	88.36
Available to bottom trawl	6.0%	40.7%	37.3%	52.0%



- Based on trawlability as determined from camera images
- Indication of the availability of select species to the bottom trawl

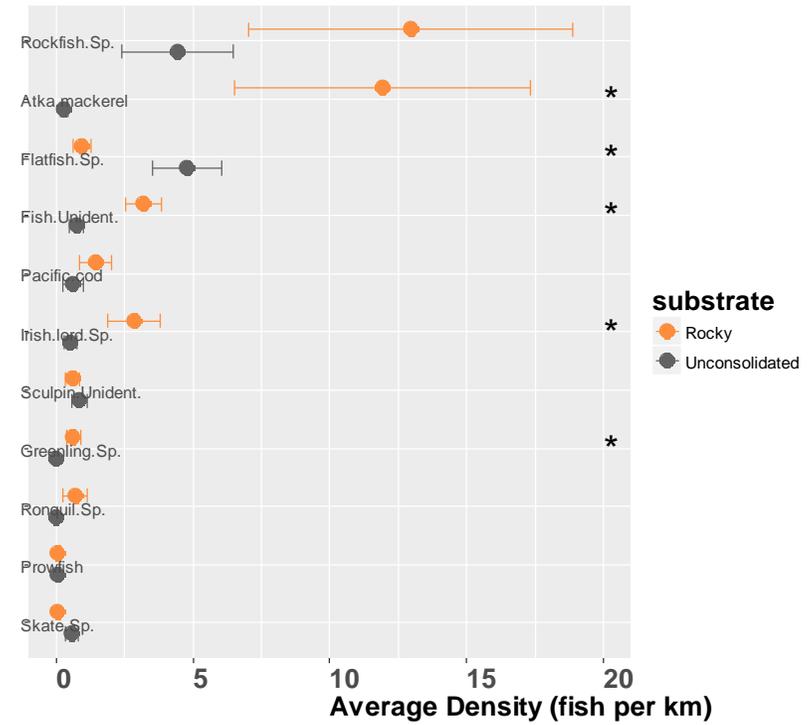
# Preliminary Analysis

## Comparison of Density Estimates: Camera System and Trawl Survey

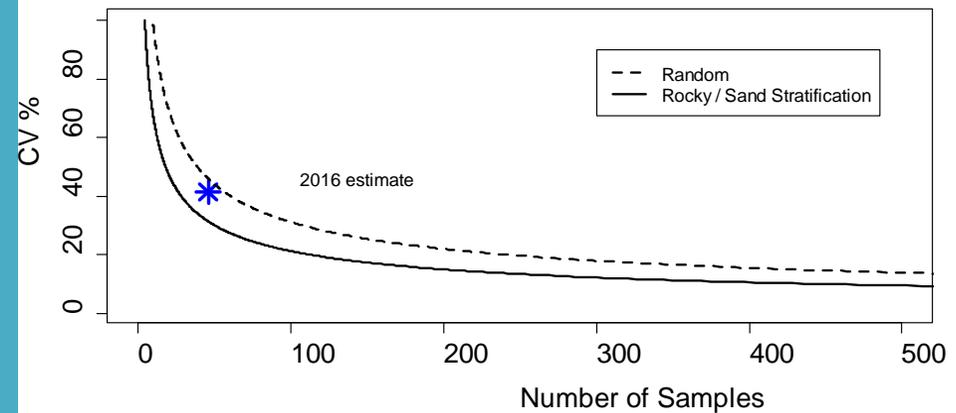


## Density Estimates by Habitat Type

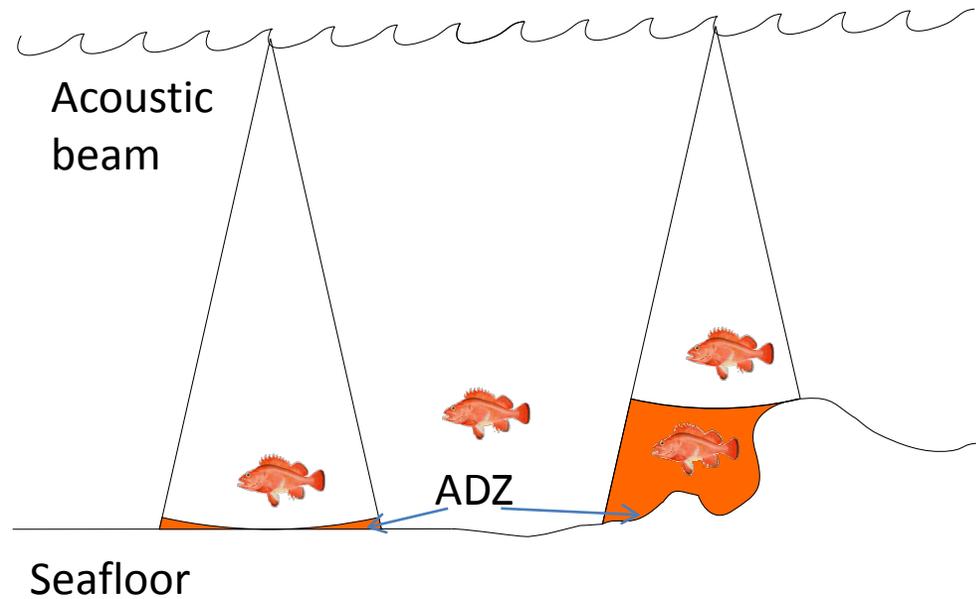
Average Fish Density (□ SE) per km



## Sample size Estimates for Atka Mackerel



# Assessing fish distribution in the Acoustic Dead Zone (ADZ)



Problem is much greater in high relief and sloping seafloor conditions

Size of the ADZ currently cannot be estimated from the acoustics

Fish distribution within the ADZ is unknown

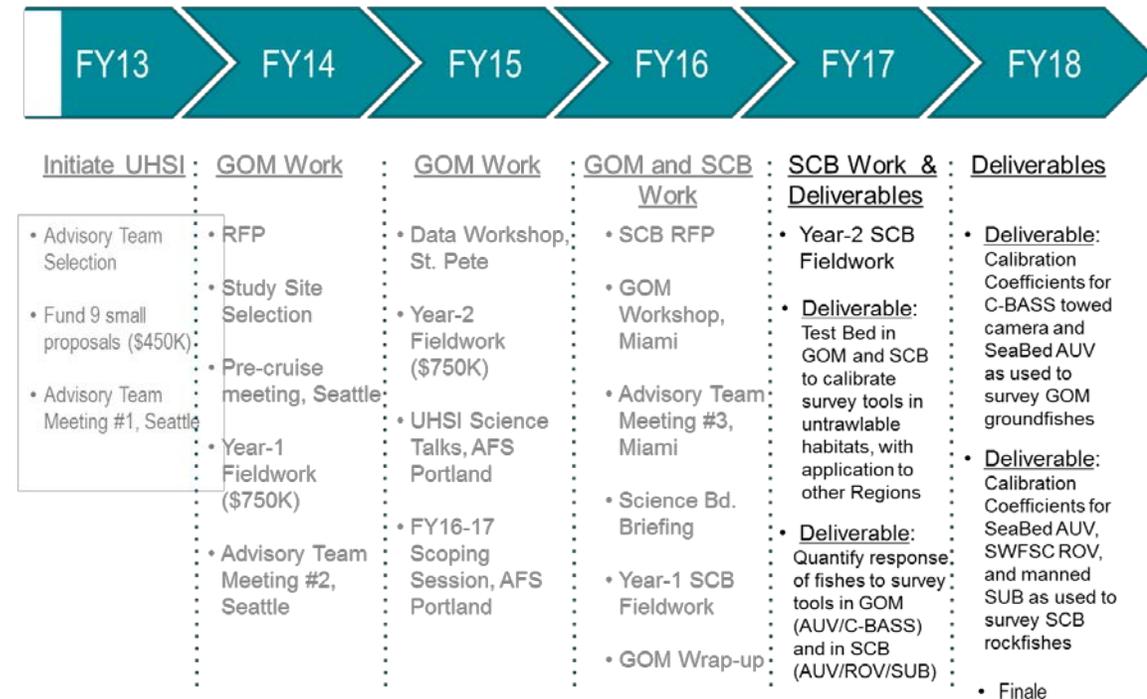
Theoretical ADZ can be estimated for a flat smooth seafloor

# Gear Efficiency/Behavior

# Untrawlable Habitat Strategic Initiative

1. Assess the behavior of fish to the introduction of novel gears in the environment.
2. Estimate the change in local density attributed to a transiting vehicle.
3. Estimate the sampling efficiency and survey capabilities of each vehicle.
4. Calculate platform and species specific sighting functions.
5. Evaluate the effectiveness of the test-bed method of experimentation.
6. Vehicle and sampling recommendations

## UHSI Roadmap and Deliverables



# UHSI Year-1 Southern California Bight Test Bed Experiment

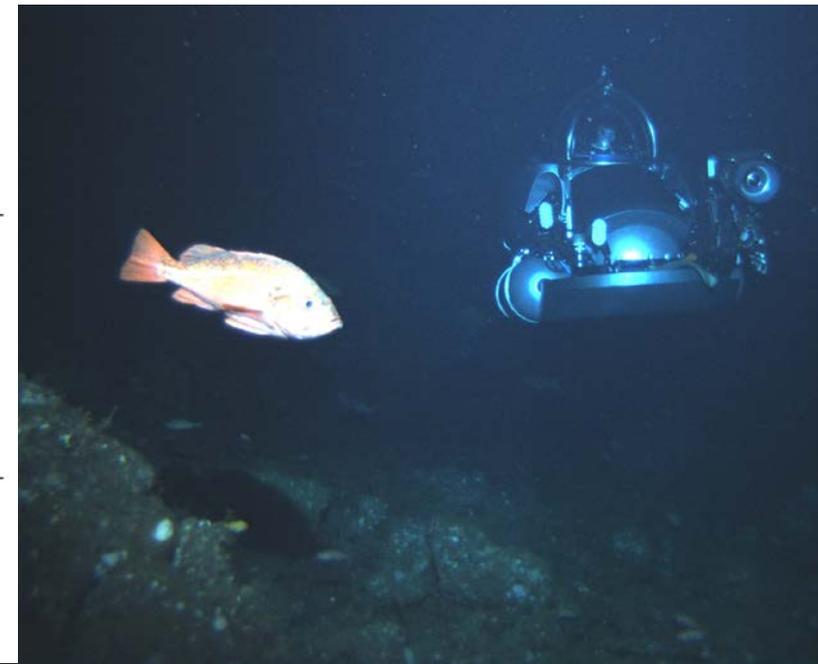
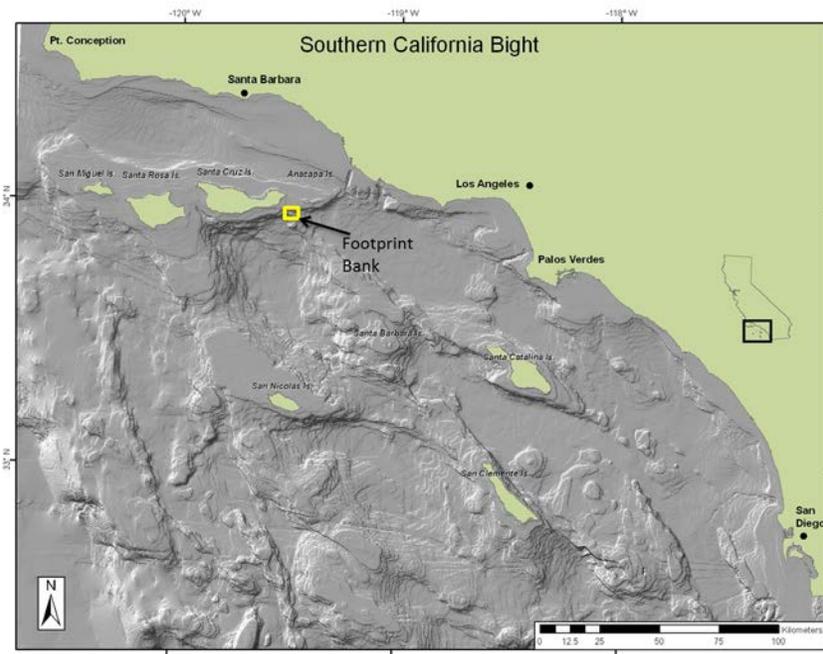
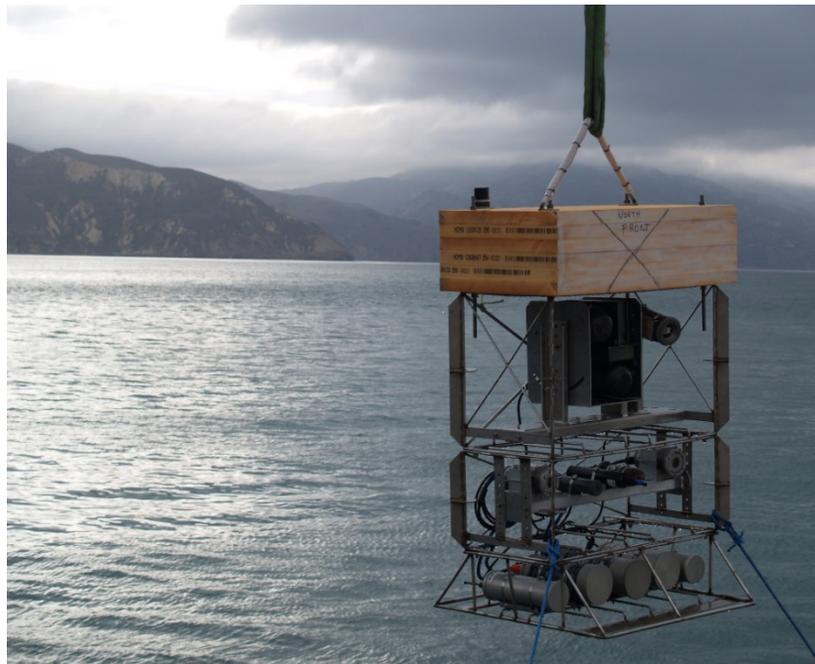
Coordinators: Clarke, Wakefield, Yoklavich

## Objective:

To understand the effects of optical and acoustic survey vehicles on the behavior of rockfish species living on or near untrawlable (rocky) deep habitats

## Challenges to Rockfish Surveys in Untrawlable Habitats

- Offshore deep water (100-150 m)
- Dark (requires artificial lighting)
- Diverse rocky habitats with patchy spatial distributions
- Diverse assemblage of species, many resembling one another

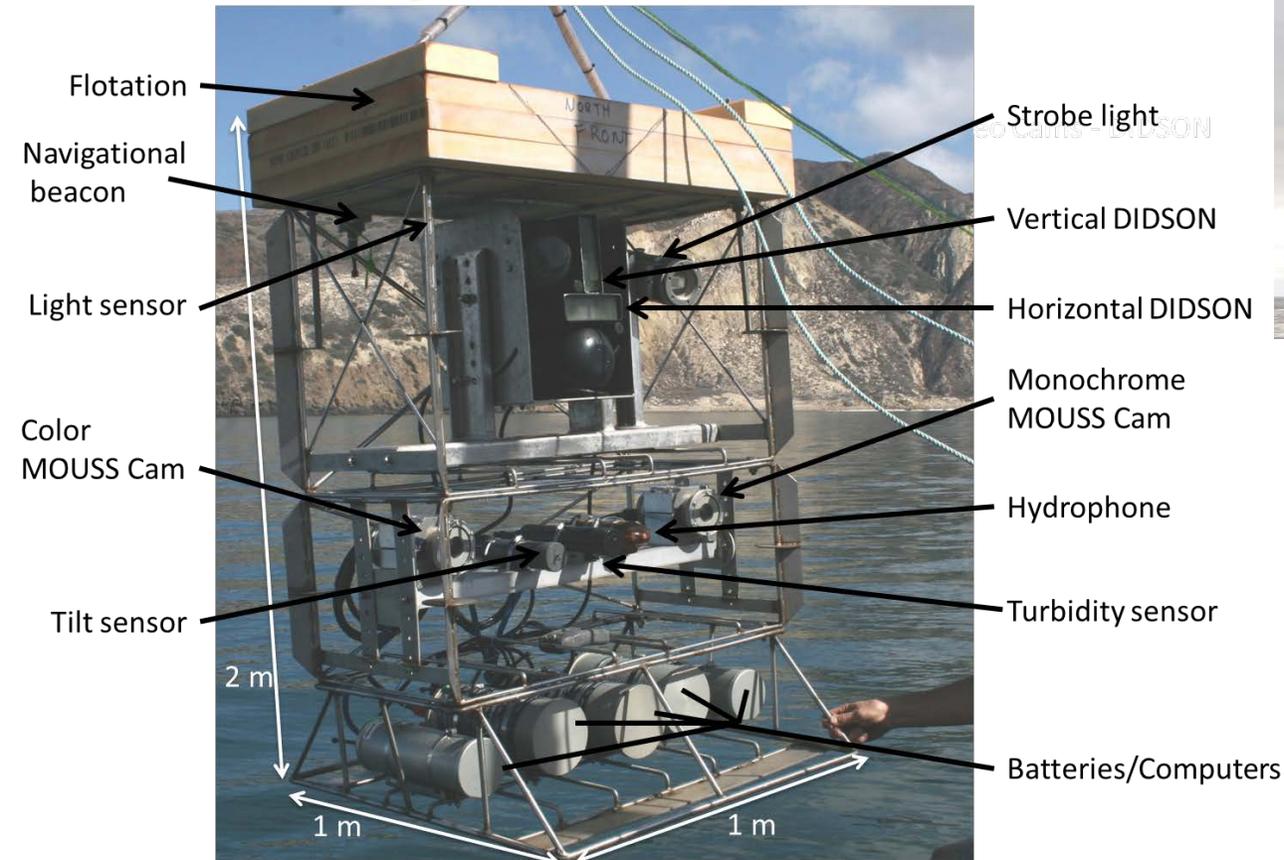


# Approach to Quantify Rockfish Reactions to Mobile Survey Gear

October 19-30, 2016: Deploy visual and acoustic cameras on fixed surveillance platforms on top of Bank

- Researchers from SWFSC, NWFSC, SEFSC, AFSC, UCSB
- Use of NOAA R/V *Lasker* and contracted R/V *Velero IV*
- Monitor fish reactions to movement/noise/light associated with mobile survey tools
  - Metric is change in fish behavior and abundance before, during, after passage by mobile tool

## Surveillance Systems: MOUSS-DIDSON Platforms

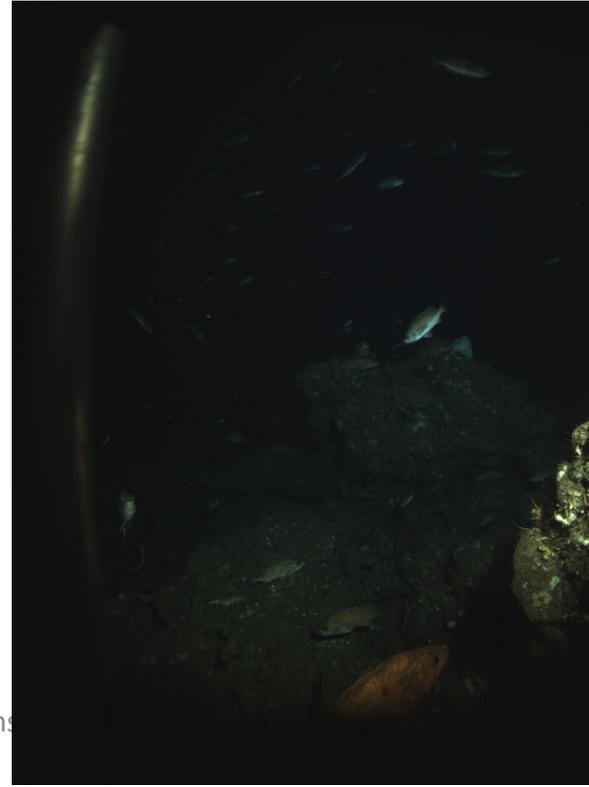
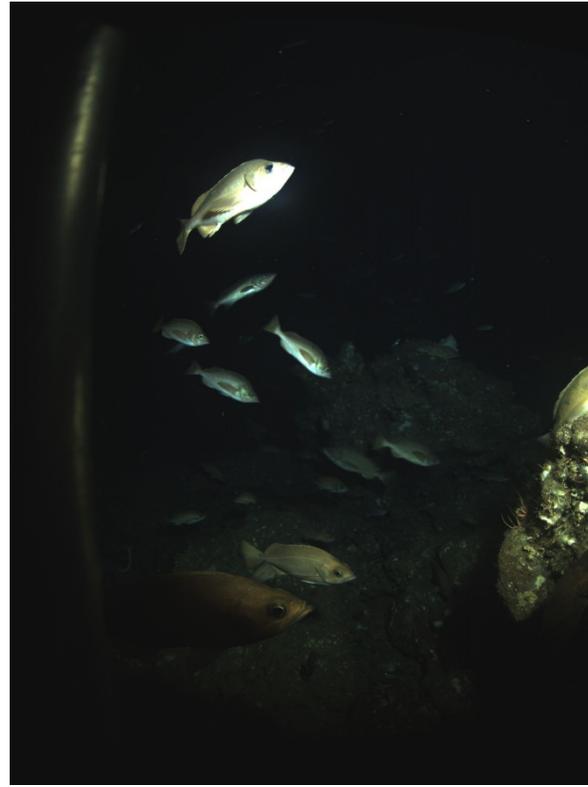
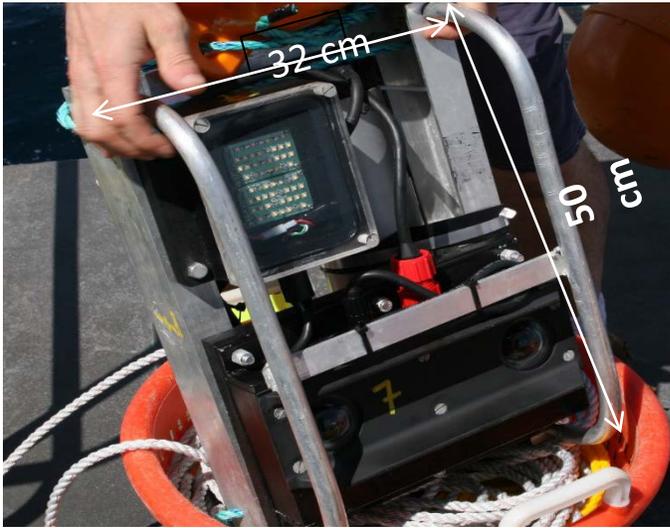
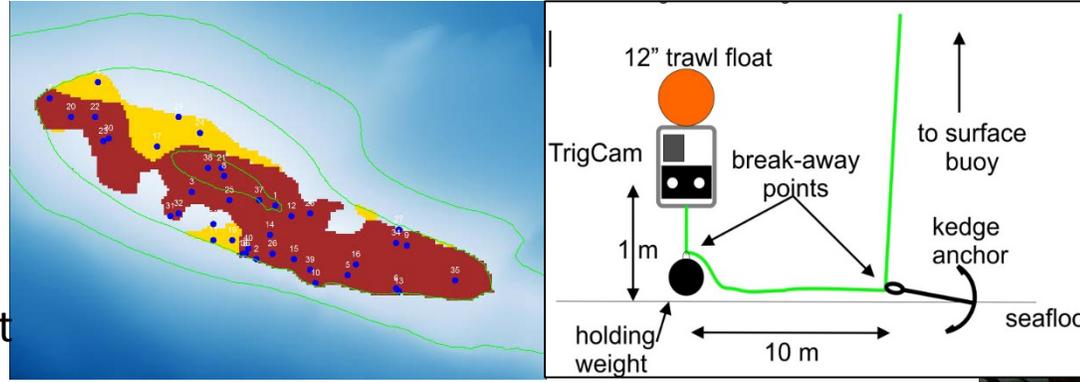


NWFS/PIFSC SeaBED AUV

DeepWorker Manned Submersible

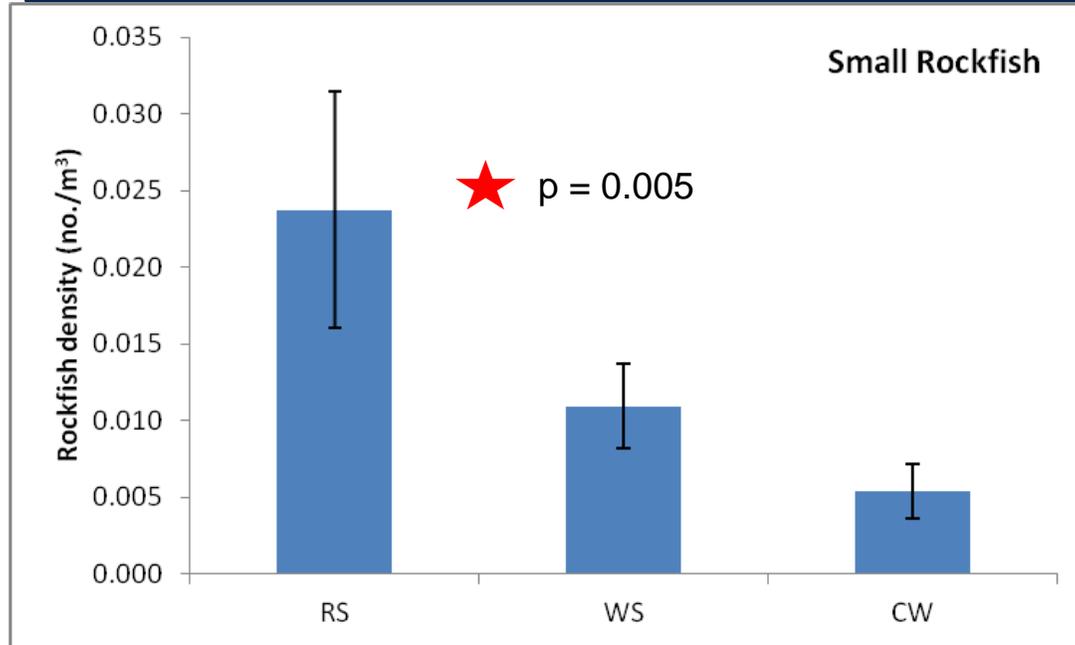
# Footprint bank density estimation – Williams/Rooper

Nine cameras were built  
Deployments at 26 of 40 randomly selected sites  
Depths from 96-150 m  
3.5 days of at sea time  
Habitats from Cobble to High Relief Bedrock  
Soak times from 3 to 17 hours including overnight  
Many rockfish were observed

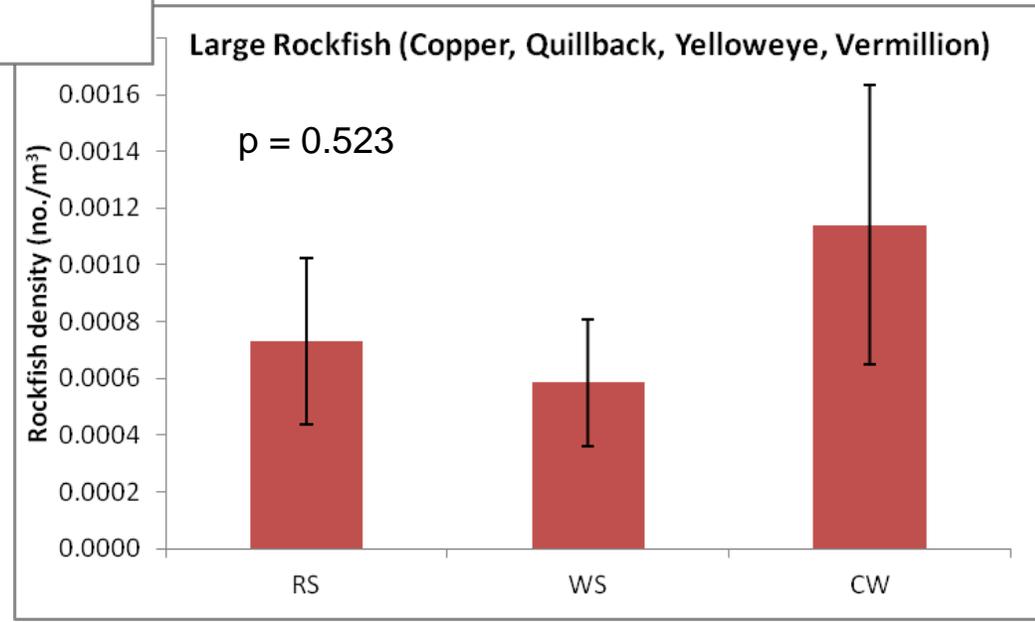
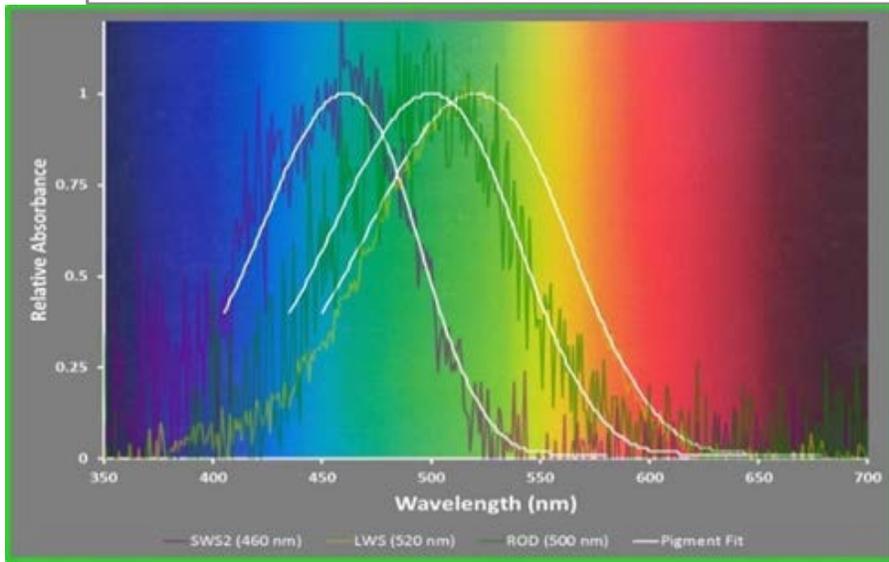


# Results: Rockfish Density

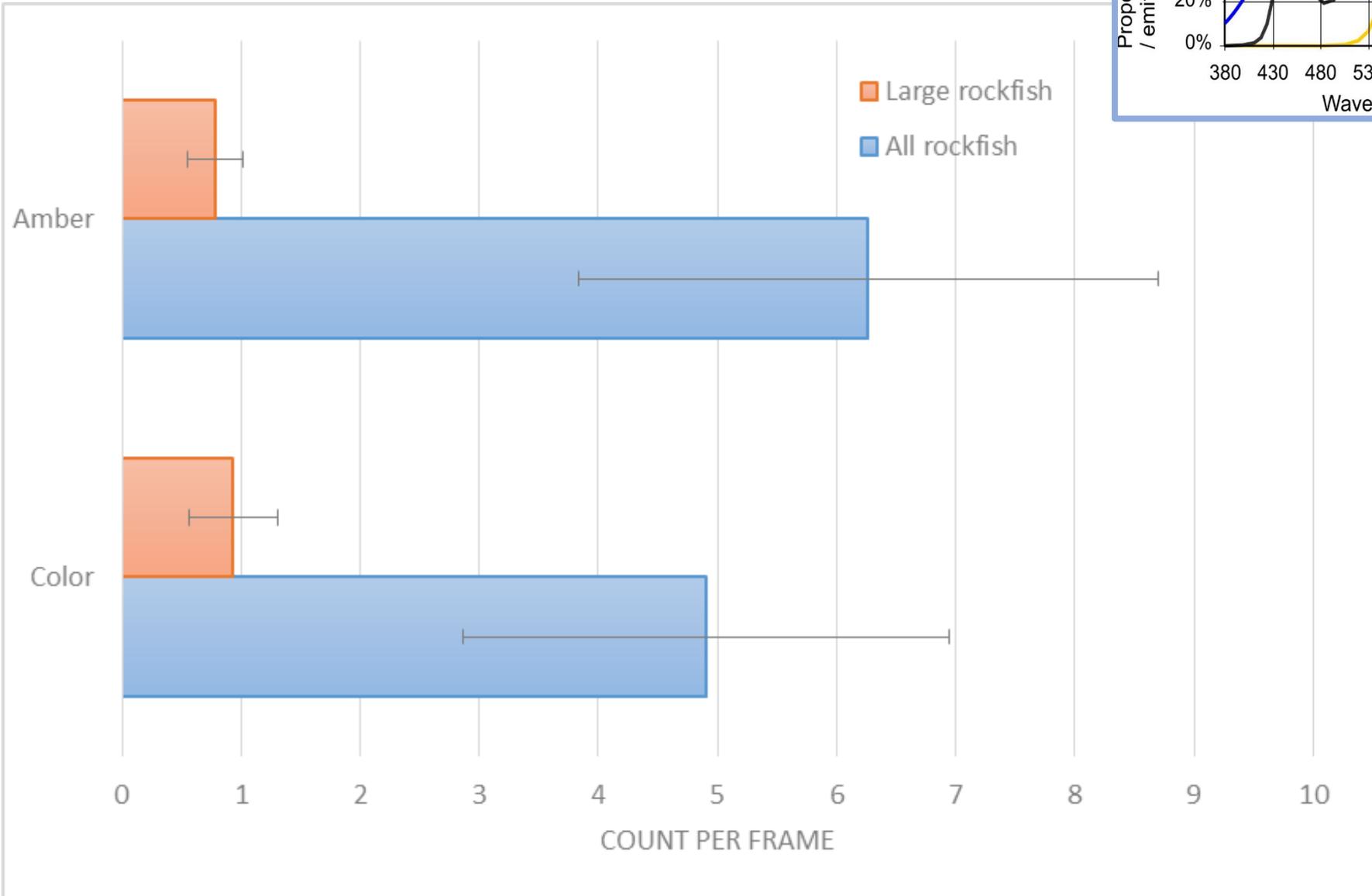
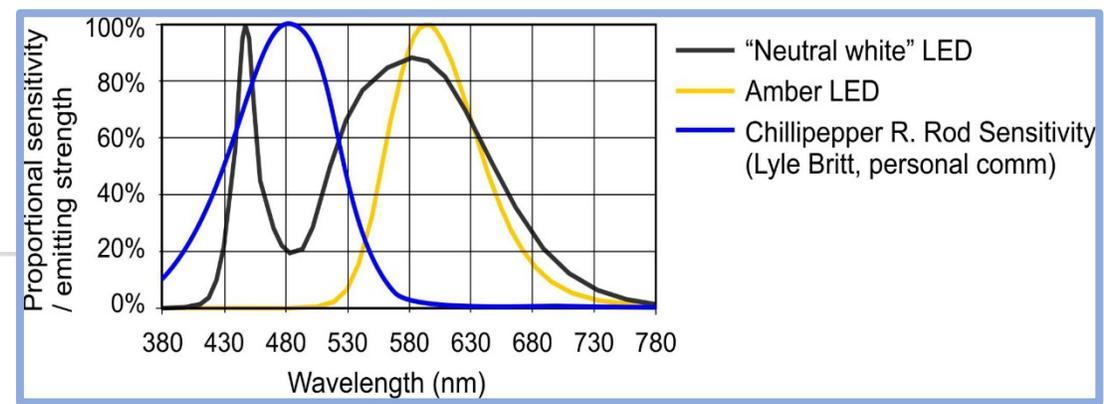
Treatments = Red strobe (RS), white strobe (WS), constant white (CW)



Post-hoc  
RS & WS > CW



# Lighting comparisons



- Differences not significant
- Probably a bit larger FOV with mono cameras/amber lights
- Need to correct for habitat type and possibly time of day
- Tending towards white

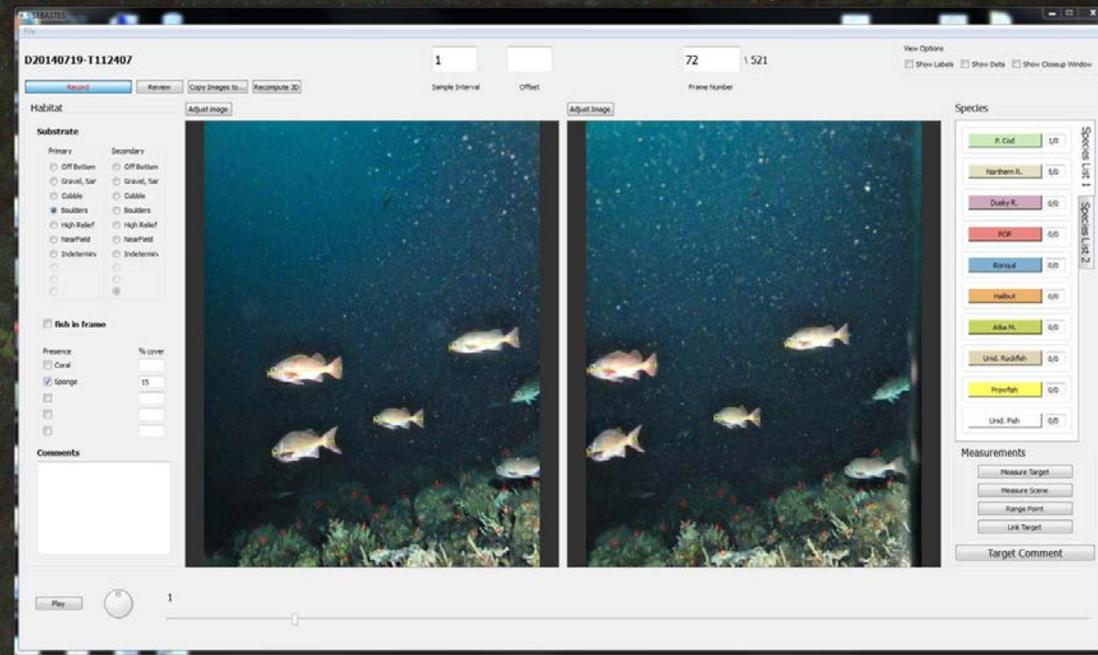
# Survey design/analysis methods

# Untrawlable habitat surveying methods

- Stationary cameras
- Volumetric density estimation
- Automated image processing

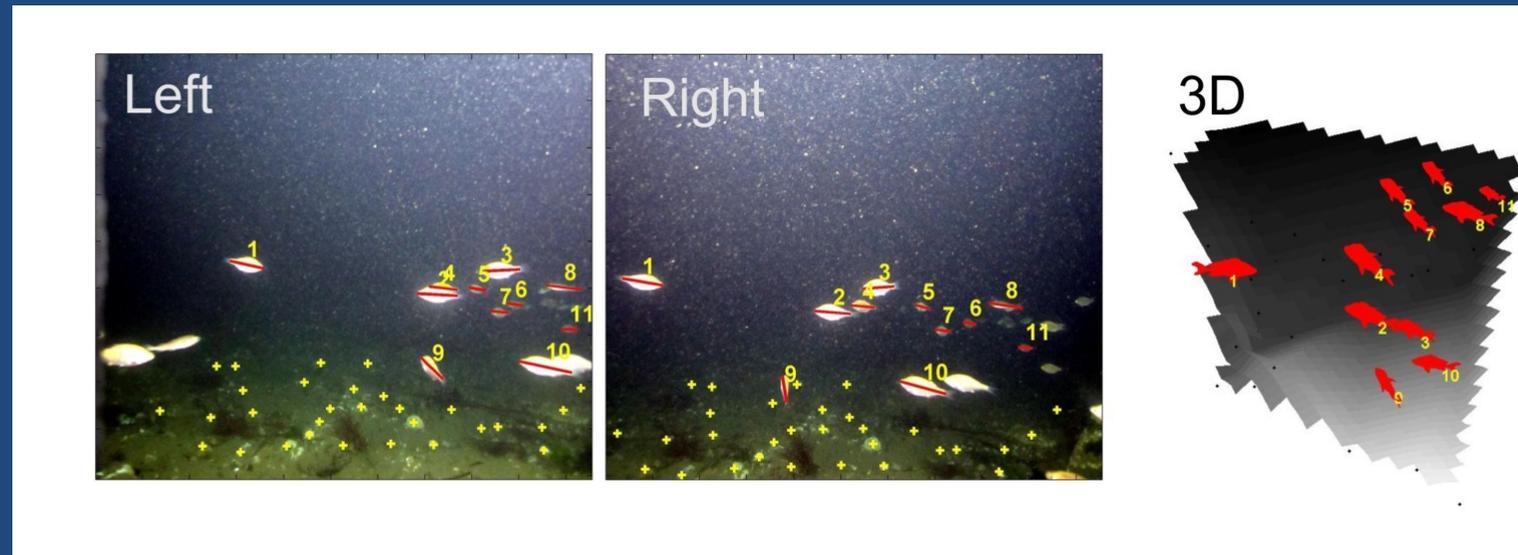
Stereo data analysis – SEBASTES software

- Fish counts by species
- Habitat assessment
- Accurate length measurements
- Fish position/orientation



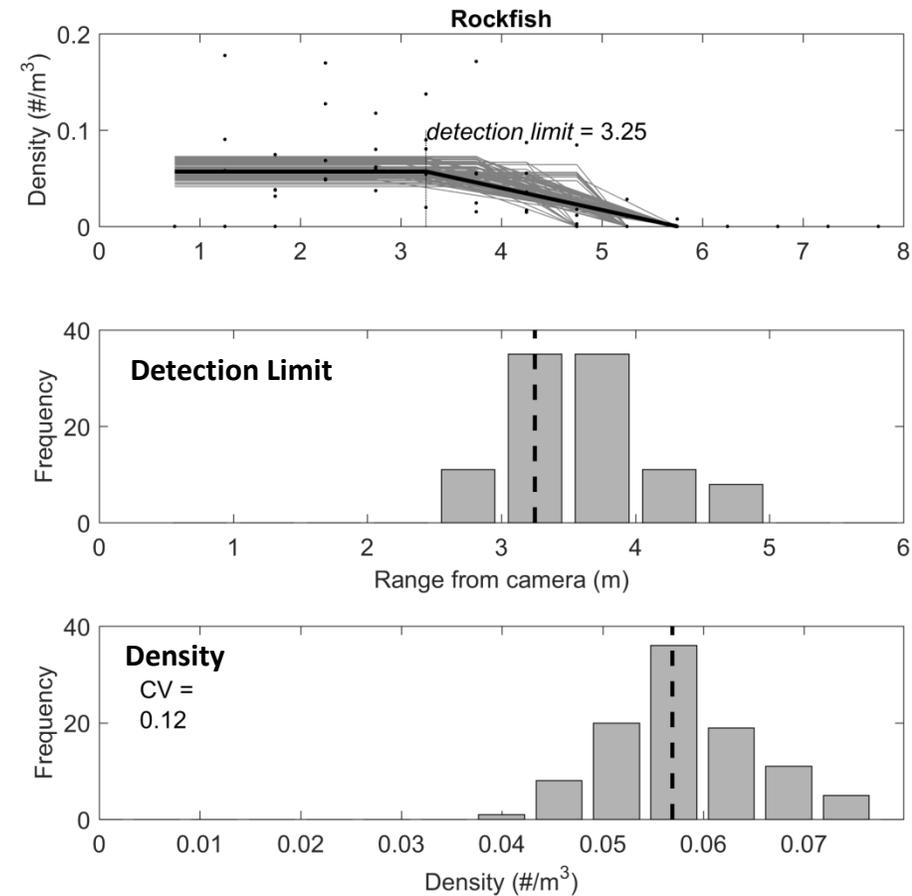
## Volumetric density estimation from stereo cameras

- Reconstruct 3D positions of fish and seafloor from stereo image analysis
- Estimate joint-camera imaging volume that is "above ground"
- Estimate fish range-detection loss function



# Volumetric density estimation from stereo cameras

- Compute density by range using previous approach
- Estimating the “detection limit” where density starts to drop off
- Intercept is “true” density
- Variance estimate by bootstrap



# DPM fish detection for video with tracking (SWFSC)



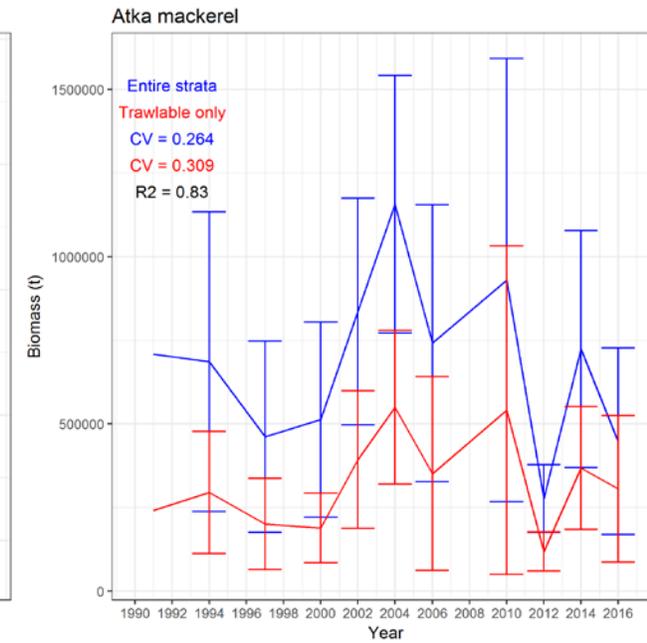
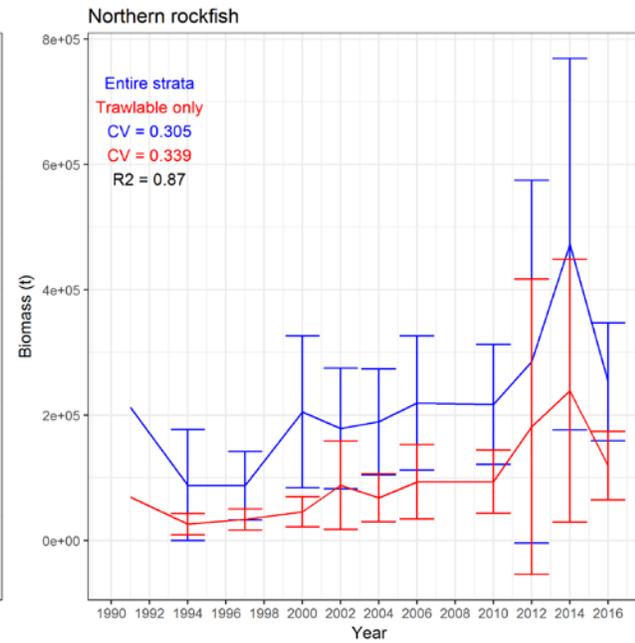
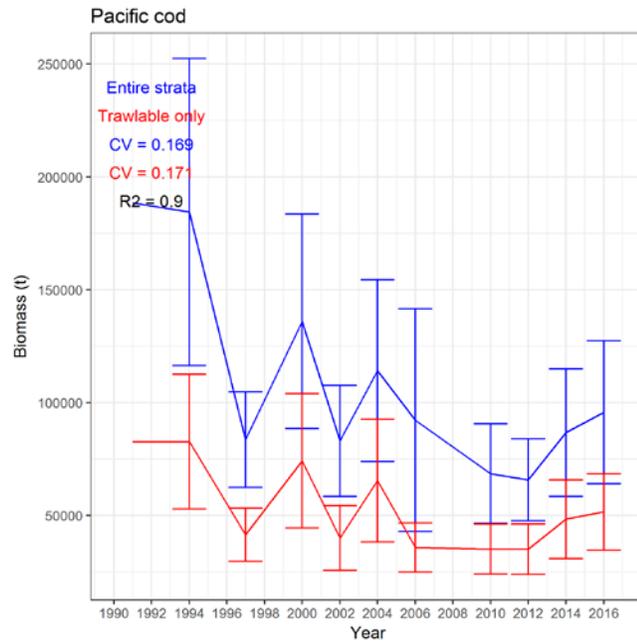
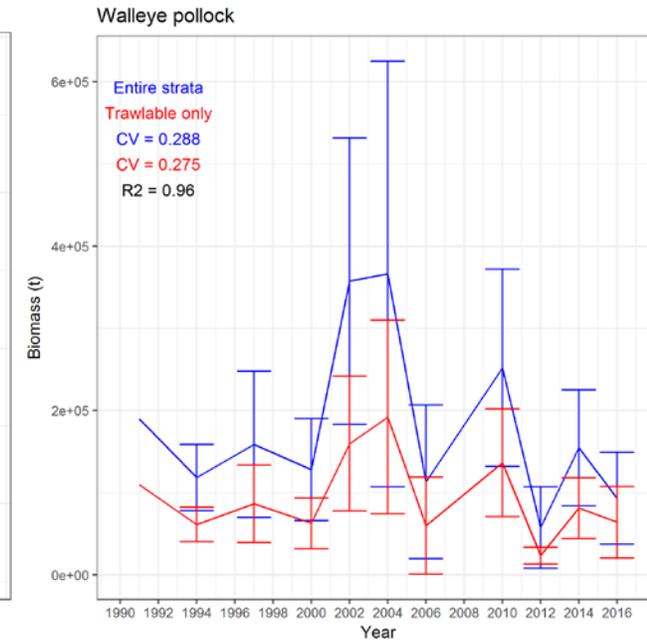
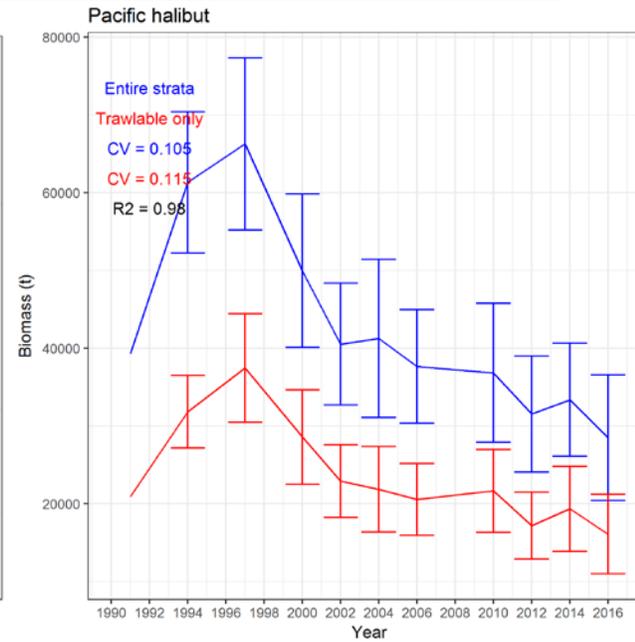
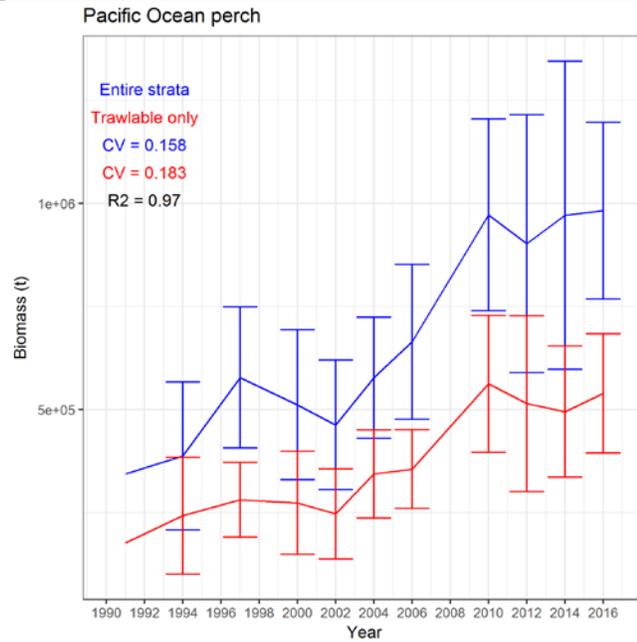
# Automated image processing

- Great potential for solving analysis “bottleneck”
- Trade-offs in accuracy and efficiency
- Accuracy is a moving target with continual improvements
- Will always require humans in the loop



# Accounting for UT areas in the AI survey

- Not much change in trend (estimates highly correlated)
- CV's slightly larger for trawlable only
- Estimates for most species about ½ of current (~53% Untrawlable)



# What have we done so far?

## Sample Size Estimation for DropCam Survey

- ~ 440 to 2500 transects depending on the target species/area

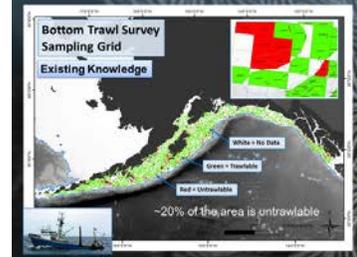
# Methodology for a camera-based survey of demersal shelf rockfish in the Gulf of Alaska

Chris Rooper, Kresimir Williams, Darin Jones, Matt Baker, Chris Wilson  
RACE Division, Alaska Fisheries Science Center, Seattle Washington



### Abstract

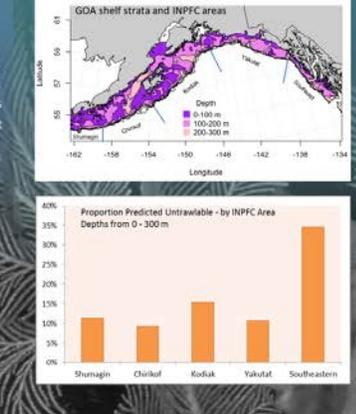
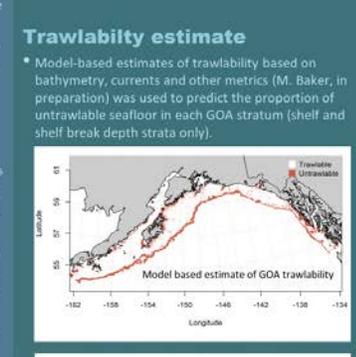
The abundance of some demersal rockfish species in the Gulf of Alaska is not well estimated by the current bottom trawl survey because they inhabit areas that are too rough or rocky for bottom trawls to operate. These species include yelloweye rockfish and other demersal shelf rockfish species that contribute to valuable fisheries. Alternative methodologies to estimate abundance for these species are needed, particularly because of conservation concerns for these assemblages in the central and western Gulf of Alaska. We evaluated existing information on the extent of untrawlable areas in the Gulf of Alaska and variance associated with visual surveys of rockfish from Alaska ecosystems to develop a plan for a gulf-wide survey of demersal shelf rockfishes. Sample size were estimated for each species to attain a coefficient of variation of 0.30. Estimates were also determined for number of vessel days needed to obtain the visual survey data and process images. The survey would use existing stereo-camera methods to obtain species identification, area-swept densities and length measurements. These data would complement existing bottom trawl survey data on age and growth. Important complementary information included acoustic estimates of abundance for semi-pelagic species, as well as habitat associations and other behavioral information.



**Acknowledgements**  
The authors would like to gratefully Jodi Pirtle for the use of her map figure.

### Background

- The AFSC has been developing methods to conduct surveys of untrawlable areas for rockfishes since 2005
- Recently, underwater camera surveys have been completed in the western and central Gulf of Alaska, the eastern Bering Sea and the Aleutian Islands
- Although not necessarily designed for this purpose, these surveys can provide regional estimates of rockfish densities in untrawlable areas
- Concurrently, efforts have been made to develop predictive maps of untrawlable areas for the Gulf of Alaska
- Combining these data provides estimates of the sample size needed to estimate abundance of rockfishes (with a CV of 0.30) for the Gulf of Alaska

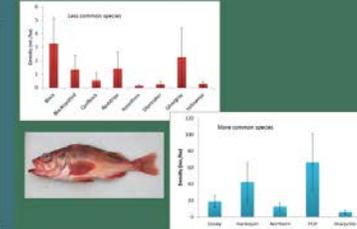


### Survey data

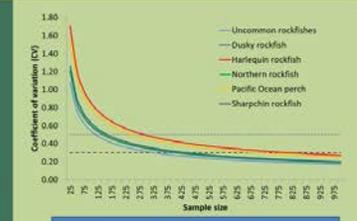
- The data were from the 2013 and 2015 GOA Untrawlable Rockfish project (see presentation by Jones et al. - Friday 11:45 AM).
- Data from 91 drop camera stations in central and western GOA untrawlable habitat were used to estimate densities of rockfish by species.

### Sample size required

- Sample sizes by species were estimated using Sampling (Thompson 1992) and a desired CV = 0.3.
- Samples consisted of 15 minutes of on-bottom time, using the stereo camera, drifting at ~ 1 knot (covering about 1200 m<sup>2</sup>).

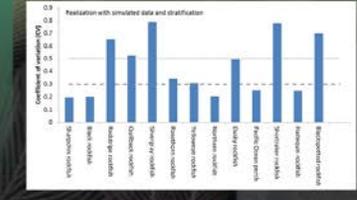


- A few common species dominated the stereo camera surveys (similar to trawl survey catches)



A sample size of ~440 would achieve a CV of ~0.30 for 3 of 5 common rockfishes and the uncommon rockfishes as a group

Species	Sample size to achieve CV = 0.30	Sample size to achieve CV = 0.50
Dusky rockfish	397	143
Harlequin rockfish	810	292
Northern rockfish	411	148
Pacific Ocean perch	692	250
Sharpchin rockfish	441	159
Uncommon rockfish	326	117
Black rockfish	893	322
Blackspotted rockfish	1577	568
Quillback rockfish	2676	964
Redstripe rockfish	1944	700
Rosehorn rockfish	2676	964
Shortraker rockfish	2676	964
Silvergray rockfish	2475	891
Yelloweye rockfish	1434	516



Item	Camera survey	Existing Trawl Survey
Sample size	460	825
Days at sea	40	205
At-sea personnel	4	72
Analysis days	-42	30
Total cost	\$511K	~1,000K

### Conclusions

- Stereo camera survey for rockfishes in the GOA is feasible for untrawlable area
- Stratification will be useful in reducing CV's further (with possible sample size reduction)
- More data from are needed to better assess uncommon species, which are typically found deeper and in SE Alaska (SE Alaska and Yakutat regions)

# Summary Research in Trawl Survey(?) Parlance

## Acoustic-optic assessment

- Zhemchug
- Snakehead
- GOA AT Surveys (2013-2017)
- Footprint Bank study - UHSI

## Availability to trawl survey

- Snakehead
- Q estimation project
- Aleutians SSL project
- Diel behavior studies

## Gear efficiency/Behavior

- Puget sound RF lighting project
- Vision project
- UHSI vehicle response
- Dead zone projects
- Footprint study

## Survey Design/Analysis

- Image processing automation
- Sample size estimates
- Q estimation project
- Volumetric density estimation
- Aleutian untrawlable area effect study

## Conclusion

We know something about a lot of these things

# What are we proposing for survey Topics for Friday Discussion

- Acoustic-optic methods
- Towed camera transects
- Complemented by TrigCam experiments to get at some of the remaining questions

## What we need to decide

- Ideally random placement of stations/transects/acoustics into untrawlable areas – is this feasible
- Sample design (stratified random only untrawlable or both)
- Others?