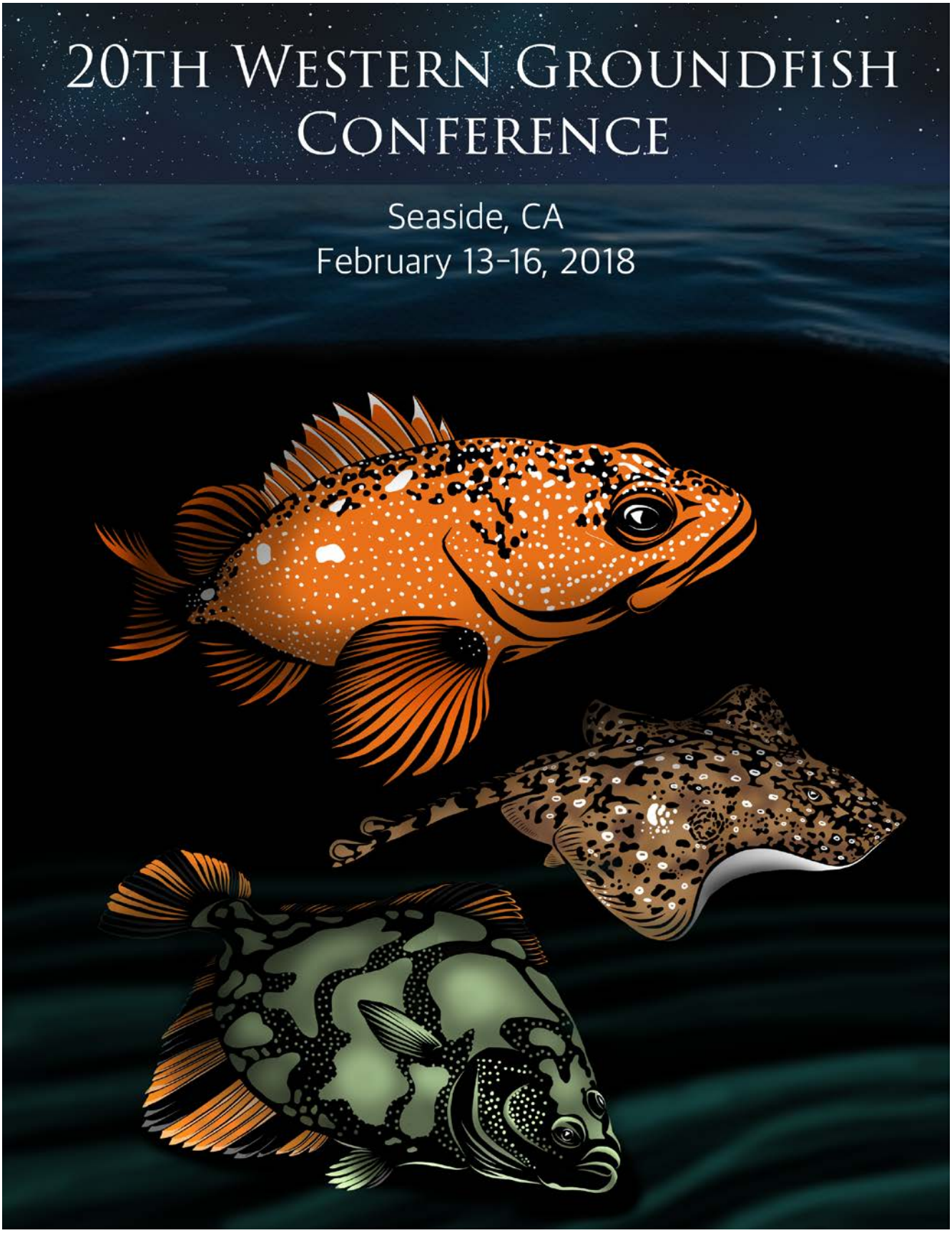
# 20th Western Groundfish Conference

Seaside, CA
February 13-16, 2018



# Schedule at a Glance

| Start time | Monday 2/12 | Tuesday 2/13 | Wednesday 2/14 | Thursday 2/15 | Friday 2/16 |
|---|---|---|---|---|---|
| 7:00 | | Registration | | | |
| 7:30 | | | | | |
| 8:00 | | | Registration | Registration | Registration |
| 8:30 | | Welcome and TSC Session | Oral presentations: Ecology | Oral presentations: Biology | Oral presentations: Management |
| 9:00 | | | | | |
| 9:30 | | | | | |
| 10:00 | | BREAK | BREAK | BREAK | BREAK |
| 10:30 | | Oral presentations: Bycatch | Oral presentations: Ecology | Oral presentations: Biology/Assessment | Oral presentations: Management |
| 11:00 | | | | | |
| 11:30 | | | | | |
| 12:00 | | Lunch | Lunch | Lunch | Meeting adjourns |
| 12:30 | | | | | |
| 13:00 | | | | | |
| 13:30 | | Oral presentations: Habitat | Oral presentations: Ecology/Biology | Oral presentations: Assessment/ Management | |
| 14:00 | | | | | |
| 14:30 | | | | | |
| 15:00 | | BREAK | BREAK | BREAK | |
| 15:30 | | Oral presentations: Habitat/Ecology | Oral presentations: Biology | Oral presentations: Management | |
| 16:00 | Registration and Networking<br>Embassy Suites Hotel Atrium | | | | |
| 16:30 | | | | | |
| 17:00 | | | | | |
| 17:30 | | Buses to Aquarium | | | |
| 18:00 | | | | | |
| 18:30 | | Monterey Bay Aquarium (hors d'oeuvres and dessert) | | | |
| 19:00 | | | Poster session, hotel ballroom (hors d'oeuvres) | Banquet, Auction, Keynote speaker | |
| 19:30 | | | | | |
| 20:00 | | | | | |
| 20:30 | | Buses return to hotel | | | |
| 21:00 | | | | | |
| 21:30 | | | | | |

The 2018 Organizing committee:

Lyall Bellquist, The Nature Conservancy
Mark Carr, University California Santa Cruz
Claude Dykstra, International Pacific Halibut Commission
John Field, NMFS/NOAA
Mary Gleason, The Nature Conservancy
Ed Henry, International Pacific Halibut Commission
Tom Laidig, NMFS/NOAA
Traci Larinto, California Dept. Fish & Wildlife
Milton Love, UC Santa Barbara
Leila Sievanen, California Ocean Science Trust
Susan Sogard, NMFS/NOAA
Rick Starr, MLML
Deb Wilson-Vandenberg, California Dept. Fish & Wildlife

# Networking Events

## Registration and Reception

Monday, Feb. 12, 4:00 – 8:00 p.m.

Registration and networking will take place in the atrium of the Embassy Suites hotel

## Evening at the Monterey Bay Aquarium

Tuesday, Feb. 13, 7:00 – 10:00 p.m.

Explore the wonderful exhibits of the Monterey Bay Aquarium while enjoying hors d'oeuvres, dessert, and live music by the Flypaper Blues. Beverages available at a no host cash bar. Buses will depart from the hotel beginning at 5:30 and continuing to 7:00. Aquarium doors will open to conference attendees WITH NAME TAGS at 7:00. Return buses to the hotel will begin leaving from the aquarium at 8:30 and continue until 10:15.

## Poster Session

Wednesday, Feb. 14, 7:00 – 10:00 p.m.

The poster session will be held in the hotel ballroom. Hors d'oeuvres will be served and all attendees will receive two free drink tickets.

## Banquet , Auction, and Keynote Speaker

Thursday, Feb. 15, 7:00 – 10:00 p.m.

The banquet will be held in the hotel ballroom. Dinner will be served and the silent auction concluded. Cash bar beginning at 7:00. Our keynote address will be presented by Margaret Spring, Vice President of Conservation & Science and Chief Conservation Officer of the Monterey Bay Aquarium.

**Margaret Spring, Monterey Bay Aquarium, Vice President of Conservation & Science and Chief Conservation Officer**

Margaret Spring directs the Monterey Bay Aquarium's conservation and science efforts, which include the aquarium's ocean policy initiatives, its respected Seafood Watch program, as well as conservation research programs involving sea otters, great white sharks, Pacific Bluefin tuna and other species. She brings to the task senior leadership experience with the National Oceanic and Atmospheric Administration, and as counsel to the Senate Committee on Commerce, Science, and Transportation, where she advised Congress on ocean issues and legislation. Her legislative work included enactment of the Oceans Act of 2000; the Oceans and Human Health Act; the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006; the Marine Debris Research, Prevention, and Reduction Act; and the Tsunami Warning and Education Act. She serves on the National Research Council's Ocean Studies Board, the California Ocean Science Trust Board of Trustees, the Monterey Bay Fisheries Trust Board of Trustees, the Environmental Law Institute Board of Directors, and the American Geophysical Union (AGU) Position Statement Task Force. She is a graduate of Duke University Law School and Dartmouth College.

## Monday, February 12, 2018

| Time | Event |
|---|---|
| 16:00-20:00 | 20th Western Groundfish Conference Registration and Reception |

## Tuesday, February 13, 2018

| Time | Event |
|---|---|
| **7:00** | Registration opens |
| **8:30** | Opening Remarks |

### Session 1: TSC Sponsored, Moderator: Dayv Lowry

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| **8:45** | **Dayv Lowry**<br>Introduction to TSC session: Ups and downs of descending device policy and science, and a summary of descending device regulations, outreach, and usage in Washington |
| **9:00** | **Dana Haggarty**<br>Use of recompression devices as a tool for managing rockfish barotrauma in British Columbia |
| **9:15** | **Lyall Bellquist**<br>Effectiveness of descending devices to mitigate the effects of barotrauma among rockfishes (*Sebastes spp.*) in the southern and central California recreational fisheries |
| **9:30** | **John Budrick**<br>Development of discard mortality rates for overfished rockfish reflecting the use of descending devices in the West Coast recreational groundfish fishery |
| **9:45** | **Lynn Mattes**<br>Descending devices: Incorporating the science into fisheries management |

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| **10:00** | **John Harms**<br>Development of a high-throughput approach for descending shelf rockfish |
| **10:15** | Coffee Break |

## Session 2: BYCATCH Moderator: Sabrina Beyer

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|---|---|
| **10:45** | **Joe Petersen**<br>Bycatch reduction in directed halibut fisheries with the Makah Tribe's traditional halibut hook |
| **11:00** | **Claude Dykstra**<br>Electronically monitoring release method as a proxy for Pacific halibut discard mortality rates in the directed Pacific halibut longline fishery |
| **11:15** | **Ian Stewart**<br>The one that got away (and lived): the challenge and importance of discard mortality rates for a robust commercial fish species |
| **11:30** | **Mark Lomeli**<br>Examining if artificial illumination can enhance Chinook salmon escapement out of a Pacific hake midwater trawl |
| **11:45** | **Noëlle Yochum**<br>Partnering technology with fish biology and behavior to reduce salmon bycatch |
| **12:00** | Lunch Break– 90 minutes |

## Session 3: HABITAT Moderator: Lyndsey Lefebvre

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|---|---|
| **13:30** | **Scott Marion**<br>Comparison of substrate-based groundfish density extrapolations with habitat suitability models for nearshore rocky reefs |
| **13:45** | **James Lindholm**<br>Quantification of habitat impacts under selected trawl modifications: a collaborative approach to pressing management questions |

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| **14:00** | **Gerald Hoff**<br>Skate nursery HAPC designation in the EBS: Continued studies |
| **14:15** | **Ian Kelmartin**<br>Better together: Using collaborative fisheries research and machine learning to create high resolution habitat suitability models for three nearshore reef-associated fishes in Northern California |
| **14:30** | **Lisa Lacko**<br>Mapping bottom substrate in Northern British Columbia (B.C.), Canada |
| **14:45** | **Matthew Baker**<br>Model of trawlable habitat using benthic terrain and oceanographic variables |
| **15:00** | Refreshment Break |
| **15:30** | **Sean Rooney**<br>Using species distribution models to describe deep-sea coral and sponge habitats on Oregon's continental shelf |
| **15:45** | **John Wallace**<br>Identifying Petrale spawning grounds and their utilization changes over time by using VAST on Winter Petrale fishery data |

## Session 4: ECOLOGY Moderator: Lyndsey Lefebvre

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|---|---|
| **16:00** | **Colin Jones**<br>Potential reserve effects of Cowcod Conservation Areas on shelf rockfish in the Southern California Bight |
| **16:15** | **Jay Staton**<br>Baseline characterization of nearshore rocky reef fishes found in northern California Marine Protected Areas |
| **16:30** | **Katherine Kaplan**<br>Setting a timeline of expected fished population responses to California's marine protected area network for adaptive management |

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| **16:45** | **Tom Calvanese**<br>Movement patterns of Pacific rockfishes in a temperate marine reserve |
| **19:00** | **Evening at the Monterey Bay Aquarium** |

## Wednesday, February 14, 2018

| Time | Event |
|---|---|
| **8:00** | Registration opens |
| **Session 4: ECOLOGY (cont.) Moderator: Melissa Head** | |
| **8:30** | **Yongwen Gao**<br>Climate driven regime shifts from stable isotopic records of otoliths of Pacific halibut |
| **8:45** | **Catarina Pien**<br>Changes in the elasmobranch assemblage in Elkhorn Slough, CA |
| **9:00** | **Cheryl Barnes**<br>A comparative assessment of resource use by Pacific Halibut and Arrowtooth Flounder throughout the Gulf of Alaska |
| **9:15** | **Brittany Schwartzkopf**<br>Juvenile rockfish diet analysis in three Oregon estuaries |
| **9:30** | **David Bryan (presenter Susanne McDermott)**<br>Fine-scale patchiness of Steller sea lion prey items in the Aleutian Islands and its influence on diet and foraging efficiency |
| **9:45** | **Douglas Duncan**<br>Patterns of predation on juvenile salmon by Pacific staghorn sculpin in estuaries near Juneau, Alaska |
| **10:00** | Coffee Break |

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| **10:30** | **Laura Solinger**<br>Developing spatially explicit stock assessment models to examine recruitment variability in Chilipepper Rockfish |
| **10:45** | **Jennifer Chiu**<br>Collection date as a factor explaining variability in Yellowtail Rockfish (*Sebastes flavidus*) diet along the central California coast |
| **11:00** | **Kirsten Simonsen**<br>Condition of walleye pollock (*Gadus chalcogrammus*) in relation to prey abundance |
| **11:15** | **Susanne McDermott**<br>Seasonal distribution and relative abundance of Steller Sea lion groundfish prey in the Aleutian Islands |
| **11:30** | **Alison Whitman**<br>Decadal change in juvenile groundfish community composition in an Oregon estuary |
| **11:45** | **Nick Tolimieri**<br>Oceanographic drivers of sablefish recruitment in the California Current |
| **12:00** | Lunch Break– 90 minutes |

## Session 4: ECOLOGY (cont.) Moderator: Aimee Keller

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|---|---|
| **13:30** | **Daniel Cooper**<br>Effects of larval advection and nursery area temperature on eastern Bering Sea northern rock sole recruitment |
| **13:45** | **Diana Baetscher**<br>Rockfish larvae replenish and connect marine reserves in central California |
| **14:00** | **Jodi Pirtle**<br>Dispersal, cross-shelf transport, and the delivery of larval Arrowtooth Flounder (*Atheresthes stomias*) to suitable nursery habitats in the Gulf of Alaska |

**14:15** **Mary Nishimoto**

The connectivity of offshore oil production platforms as sources of larvae recruiting to coastal shelf zones in the Southern California Bight

**14:30** **Eric Bjorkstedt**

Connections between currents, -clines, counts, and the coast: the importance of fronts for understanding early life history and recruitment of rockfishes.

## Session 5: BIOLOGY Moderator: Aimee Keller

**14:45** **Andrew Jasonowicz**

What goes up must come down: Diel vertical migration in the deepwater sablefish (*Anoplopoma fimbria*) revealed by pop-up satellite archival tags

**15:00** Refreshment Break

**15:30** **Ed Henry**

Pacific halibut sex ratio: 19 years of fishery-independent setline survey data

**15:45** **Sharon Wildes**

Big shark, small variation: sleeper shark (*Somniosus pacificus*) genetics. A work in progress

**16:00** **Laurel Lam**

Spatial demographic and life-history variation in lingcod (*Ophiodon elongatus*) along the U.S. West Coast

**16:15** **Josep Planas**

Identification of molecular growth signatures in skeletal muscle of juvenile Pacific halibut (*Hippoglossus stenolepis*) for monitoring growth patterns in the Pacific halibut population

**16:30** **Lyle Britt**

How can you take a picture of a rockfish without them knowing? Determining the spectral sensitivity and reflectance of S. California rockfishes

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| **17:00** | **Business meeting** |

## 19:00 Poster Session

# Thursday, February 15, 2018

| Time | Event |
|---|---|
| **8:00** | Registration opens |

## Session 5: BIOLOGY (cont.) Moderator: Rebecca Miller

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| **8:30** | **Aaron Baldwin**<br>Flea Market: The diversity and economic impact of sand fleas (Amphipoda: Lysianassoidea) in the Southeast Alaska sablefish fisheries |
| **8:45** | **Lauren Rogers**<br>Shifting spawn timing in Gulf of Alaska walleye pollock |
| **9:00** | **Lyndsey Lefebvre**<br>Back to basics: Why "basic" life-history data remains essential in an age of advanced population models |
| **9:15** | **Melissa Head**<br>Evaluating spatio-temporal reproductive variability in Pacific Hake (*Merluccius productus*) using a flexible asymptotic model to estimate maturity |
| **9:30** | **Sabrina Beyer**<br>More food, more young? Demonstrating variability in reproductive effort of Rosy Rockfish, *Sebastes rosaceus*, in relation to temperature and food availability |
| **9:45** | **Sandi Neidetcher**<br>Fecundity estimates for walleye pollock, *Gadus chalcogrammus*, during varying climate conditions |

**10:00** Coffee Break

**10:30** **Craig Kastelle**

Otolith stable oxygen isotopes used to reveal fish condition and fish age validation

## Session 6: ASSESSMENT Moderator: Rebecca Miller

**10:45** **David Sampson**

Transient behavior in population-level fishery selection-at-age

**11:00** **Kalei Shotwell**

Introducing a national framework for including stock-specific ecosystem and socio-economic considerations within next generation stock assessments

**11:15** **Beau Doherty**

Risk assessment framework for quantifying bottom fishing impacts on sensitive benthic habitats

**11:30** **Steven Rossi**

Linking decision-making for fisheries and sensitive benthic habitats using management strategy evaluation with spatial assessment models

**11:45** **Tien-Shui Tsou**

Challenges in the dockside sampling of species composition in changing groundfish fisheries

**12:00** Lunch Break– 90 minutes

## Session 6: ASSESSMENT (cont.) Moderator: Melissa Monk

**13:30** **Jonathan Heifetz**

Population characteristics of two sympatric species of rockfish in the Gulf of Alaska with implications for management

**13:45** **Joseph Bizzarro**

Addressing cryptic species issues in stock assessments as exemplified by Blue Rockfish (*Sebastes mystinus*) and Deacon Rockfish (*S. diaconus*)

## Session 7: MANAGEMENT Moderator: Melissa Monk

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| **14:00** | **Curt Whitmire**<br>What's the point? Comparing geospatial methods for representing fishing effort |
| **14:15** | **Laura Junge**<br>Spatiotemporal assessment of survey and commercial fishing effort relative to Pacific Cod (*Gadus macrocephalus*) habitat in the Aleutian Islands |
| **14:30** | **Peter Kuriyama**<br>Fleetwide responses to catch shares in the US West Coast Groundfish Fishery |
| **14:45** | **Rachel Zuercher**<br>Social-ecological coupling in the Central California commercial nearshore fishery |
| **15:00** | Refreshment Break |
| **15:30** | **Allan Hicks**<br>Fifty years of management strategy evaluation at the International Pacific Halibut Commission |
| **15:45** | **Chantel Wetzel**<br>Accounting for increased uncertainty in setting precautionary harvest limits from past assessments |
| **16:00** | **Josh Keaton**<br>What to do with a dead fish: The complexities of rockfish retention |
| **16:15** | **Kelly Andrews**<br>ESA-listed Puget Sound rockfish: how did we get here and how do we assess progress towards recovery planning goals? |
| **16:30** | **Lauren Yamane**<br>Using fisheries-independent data in marine reserves to quantify historical local fishing mortality rates |

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| **16:45** | **Kresimir Williams**<br>Moored stereo camera survey of rockfishes in untrawlable grounds |
| **19:00** | **BANQUET: Keynote Speaker Margaret Spring** |

## Friday, February 15, 2018

| Time | Event |
|---|---|
| **8:00** | Registration opens |
| **Session 7: MANAGEMENT (cont.) Moderator: Traci Larinto** | |
| **8:30** | **Steven Barbeaux**<br>Implementing an ecosystem approach to fisheries management: Gulf of Alaska Pacific cod (*Gadus macrocephalus*) |
| **8:45** | **Howard McElderry**<br>The future of fisheries monitoring |
| **9:00** | **Jessica Watson**<br>Refining long-term monitoring in a marine reserve by comparing relative abundance and length of reef fishes using simultaneous angling, underwater visual census, and video sampling |
| **9:15** | **Diana Watters**<br>A comparison of rockfish (*Sebastes*) length distributions from visual and trawl surveys off central California |
| **9:30** | **Robert Pacunski**<br>Using Species Distribution Modeling as a survey design tool for assessing Yelloweye Rockfish in the Southern Salish Sea |
| **9:45** | **Gregory Krutzikowsky**<br>Good things from rocky landings: A video lander study of a nearshore rocky reef area off the Oregon coast |
| **10:00** | Coffee Break |

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| **10:30** | **Kevin Stierhoff**<br>Comparing estimates of groundfish biomass, abundance, and diversity from different optical sampling methods in southern CA |
| **10:45** | **Sean Anderson**<br>A management-procedure framework for data-limited and data-moderate groundfish fisheries in British Columbia |
| **11:00** | **Nicholas Perkins**<br>Spatial point process models for visual survey data: a tool for abundance estimation and exploring sampling design |
| **11:15** | **Raymond Webster**<br>Improving the estimation of Pacific halibut density indices through spatio-temporal modelling of survey data |
| **11:30** | **Edward Dick**<br>Estimating fish abundance and biomass from underwater visual surveys: a model-based approach |
| **11:45** | **Stan Kotwicki**<br>Challenges and future directions for groundfish fisheries-independent surveys |
| **12:00** | Closing Remarks |

## Posters at a Glance

| Presenter | Title |
|---|---|

## BYCATCH

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|---|---|
| **Lyall Bellquist** | Reducing bycatch through a risk pool: a case study of the U.S. west coast groundfish fishery |
| **Caroline Mcknight** | Get hooked on descending! CDFW barotrauma education for recreational anglers |
| **Alayna Siddall** | Collaborative groundfish research supported by the Sportfishing Association of California: descending devices, Cowcod mortality estimates, and acoustic-optical surveys |

## HABITAT

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|---|---|
| **Aaron Chappell** | Using a towed video camera-sled to classify benthic habitat in Southern California Bight |
| **Beau Doherty** | Use of autonomous video and accelerometers to estimate bottom contact area of longline trap gear and presence-absence of sensitive benthic habitats |
| **Ned Laman** | Do light levels in the water column represent Atka mackerel habitat in the Aleutian Islands? |
| **Patrick Malecha** | Recruitment and response to damage of an Alaskan gorgonian coral |
| **Chris Rooper** | Are fish associations with corals and sponges more than an affinity to structure: evidence across two divergent ecosystems |
| **Samantha Simpson** | Recent groundfish habitat management activities from NOAA Fisheries Alaska Region, Habitat Conservation Division |
| **Diana Watters** | Mapping seafloor habitats using the Simrad ME70 sonar on NOAA ships |

## ECOLOGY

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| **Alexandra Avila** | Just going with the flow: how ocean currents influences the dispersal of larval rockfish (genus *Sebastes* spp.) from Marine Protected Areas in Oregon and Washington |
| **Keith Bosley** | Relating groundfish diversity and biomass to structure-forming invertebrates in the Northeast Pacific Ocean: an exploration of catch data from a fishery-independent trawl survey |
| **Rachel Brooks** | Examination of spatial differences in demography and life history of Canary Rockfish (*Sebastes pinniger*) along the U.S. West Coast |
| **Bonnie Brown** | Geographic and ontogenetic variation in the trophic ecology of lingcod (*Ophiodon elongatus*) along the U.S. West Coast |
| **Peter Frey** | Return of the dead zone; severe hypoxia observed off of Oregon and Washington during the 2017 West Coast Groundfish Bottom Trawl Survey |
| **Elizabeth Graham** | ENSO and market squid diet: are changes in the utilization of krill species important to their success? |
| **Aimee Keller** | Variation in size and catch of demersal fish species within the Southern California Bight in relation to the Cowcod Conservation Areas (2014 - 2016) |
| **Michael Prall** | A multivariate analysis of fish species assemblages across California's mid-depth (20-90 meters) rocky reefs from recent statewide remotely operated vehicle surveys |

## BIOLOGY

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| **Thomas Helser** | An innovative approach to ageing fish otoliths with near infra-red spectroscopy (NIRS) |
| **Morgan Arrington** | Standardizing the age reading protocol for longnose skate (*Raja rhina*) |
| **Brendan Connors** | Sablefish (*Anoplopoma fimbria*) on the move: 27 years of tagging in British Columbia |
| **Karson Coutre** | Temporal trends in vertical movement of Greenland turbot |

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| **Claude Dykstra** | Investigations into the use of natural tail markings to identify individual Pacific halibut (*Hippoglossus stenolepis*) |
| **Steven Eikenbary** | Effects of seawater pH and dissolved oxygen concentration on ventilation rates in *Sebastes* spp. |
| **Marisol Figueroa** | Influence of ocean acidification and dissolved oxygen availability on swimming speeds in larval gopher rockfish (*Sebastes carnatus*) |
| **Anna Holder** | An exploration of factors that relate to the occurrence of multiple brooding in rockfish (*Sebastes* spp.) |
| **Joseph Krieger** | Too hot, too cold, or just right? Temperature dependent growth and consumption of YOY Sablefish (*Anoplopoma fimbria*) |
| **Beth Matta** | Regional differences in age and growth of Pacific sand lance *Ammodytes personatus* within the Gulf of Alaska large marine ecosystem: Evidence for a latitudinal gradient |
| **Melissa Palmisciano** | Physiological resilience of juvenile copper (*Sebastes caurinus*) and gopher (*S. carnatus*) rockfish to projected upwelling conditions |
| **Josep Planas** | Assessment of reproductive development in female Pacific halibut (*Hippoglossus stenolepis*) |
| **Kristin Saksa** | Effects of projected upwelling conditions on Gopher rockfish (*Sebastes carnatus*) larval deformity and survival |
| **Vladlena Gertseva** | Spatial growth variability in marine fish: example from northeast Pacific groundfish |

## ASSESSMENT

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| **Jamie Fuller** | Liver to whole fish weight conversion: Improving historical catch data in stock assessments |
| **Tracee Geernaert** | Changing face of data collection - how technology has impacted surveys and the job of field biologist at the International Pacific Halibut Commission |
| **Stan Kotwicki** | A remotely-operated, towed acoustic system for observation of fish behavior in front of trawls |
| **Kelly Lawrence** | Developing nearshore fishery-independent survey for semi-pelagic rockfish species |

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| **Leif Rasmuson** | Comparison of nearshore and offshore Deacon Rockfish stock structure |
| **Kathryn Meyer** | California Halibut population status through 2016: assessment results and key uncertainties |
| **Andi Stephens** | Comparison of data-moderate approaches with the full age-structured assessments of Yellowtail Rockfish north and south of Cape Mendocino |

## MANAGEMENT

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|---|---|
| **Rose Dodgen** | Impacts on populations of rockfish species under changing depth regulations |
| **William Donaldson** | A processors guide to species identification in the Gulf of Alaska rockfish fishery |
| **Cassandra Donovan** | Otoliths, ovaries, and fin clips, oh my! Biological sampling by human observers |
| **Ryan Fields** | Survey like a BOSS: Development of new Benthic Observation Survey System to estimate rockfish densities along the West Coast |
| **Sheryl Flores** | Evaluation of an electronic sampling system for commercial port sampling: a pilot project |
| **Jamie Goen** | Scientific data collection programs at the International Pacific Halibut Commission |
| **Gerald Hoff** | The development of electronic data acquisition for fisheries independent groundfish surveys |
| **Elise Keppel** | A reproducible annual data-synopsis report for British Columbia groundfish species |
| **James Selleck** | NOAA rockfish recovery management and research in the Salish Sea, Washington |
| **Victor Simon** | HookLogger: An integrated and interactive three-station, portable, rugged data collection platform |
| **Maria Surry** | Visualizing and processing net mensuration and sensor data in GFBioField |

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| **Kathryn Temple** | Development of an alternative method for the biological sampling of catch using Sablefish heads |
| **Grant Waltz** | The California Collaborative Fisheries Research Program: implementation and expansion of a statewide marine protected area monitoring program |
| **James Williamson** | Testing the efficacy of using volunteer citizen scientists for fisheries video survey analysis |


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# Abstracts

Oral Presentation

**Anderson, Sean**, E. Keppel
Pacific Biological Station, Fisheries and Oceans Canada

# A management-procedure framework for data-limited and data-moderate groundfish fisheries in British Columbia

The Canadian Sustainable Fisheries Framework lays the foundation for an ecosystem-based and precautionary approach to fisheries management. Such an approach requires knowledge of the status of most fish stocks affected by a given fishery. However, Fisheries and Oceans Canada (DFO) in British Columbia lacks the capacity and informative data to produce age-structured stock assessments for many groundfish stocks and has yet to adopt assessment tools for most data-limited groundfish stocks. We aim to develop a management-procedure (MP) framework for data-limited and data-moderate groundfish stocks. While MP approaches have become increasingly common for data-rich stocks, their implementation for more data-limited stocks has been sparse to date. Compared to prescribing one estimation model per tier of available data, we expect the MP framework to be focused on achieving long-term performance objectives, to incorporate feedback between MPs and the underlying system, and to allow us to potentially take advantage of all available data for a given stock. Furthermore, we expect that this framework will allow DFO to provide scientific advice on more stocks, will develop a standardized and transparent assessment approach across stocks, will require less time to update advice between full re-assessments, and will build an understanding of the most important data needs and research priorities for reducing uncertainty in stock advice. We will discuss the process we are undergoing to develop the MP framework, how we envision the framework working using a case study, and the challenges and opportunities of implementing such a framework for data-limited and data-moderate groundfish stocks.

Oral Presentation

**Andrews, Kelly**[1], Jason M. Cope[1], Krista Nichols[1], Nick Tolimieri[1], Dan Tonnes[2], Dayv Lowry[3], Robert Pacunski[3]
[1]NOAA Northwest Fisheries Science Center
[2]NOAA West Coast Region
[3]Washington Department of Fish and Wildlife

## ESA-listed Puget Sound rockfish: how did we get here and how do we assess progress towards recovery planning goals?

In Puget Sound, WA, rockfish abundance declined significantly over the last 50+ years as a result of fishing pressure, life-history characteristics and the isolated geography of Puget Sound. In 2010, three species of rockfish were listed under the Endangered Species Act (ESA): yelloweye rockfish, canary rockfish and bocaccio. Due to a general lack of data specific to these three species, data from other rockfish species were used to support the listings. Since the listings, targeted research and recovery planning has begun to address major data gaps for these three species. First, cooperative research with the recreational fishing community has revealed that yelloweye rockfish are genetically distinct from coastal populations, whereas canary rockfish are not distinct - which has led to canary rockfish being delisted, the first delisting of a marine fish. Second, an ROV survey has been designed specifically to provide a path forward to estimate changes in abundance in Puget Sound. Third, the Rockfish Recovery Plan for yelloweye rockfish and bocaccio has been published. This plan provides, and we have begun to address, a list of research activities related to environmental conditions and human activities that might constrain rockfish recovery. Two ongoing studies examine whether specific environmental covariates (e.g., dissolved oxygen) alter the movement and foraging behavior of yelloweye rockfish and whether rockfish bycatch can be reduced in the recreational lingcod fishery by using specific bait types. Finally, we will discuss the criteria to be used for delisting these species under the ESA, including statistical methods and operational challenges.

Poster Presentation

**Arrington, Morgan**[1], T. Essington[1], T. Helser[2], B. Matta[2], C. Gburski[2], V. Gertseva[3], O. Ormseth[2], J. King[4]

[1]University of Washington

[2]NOAA Alaska Fisheries Science Center

[3] NOAA Northwest Fisheries Science Center

[4] Fisheries and Oceans Canada

# Standardizing the age reading protocol for longnose skate (*Raja rhina*)

Longnose skate (*Raja rhina*) occur along most of the North American Pacific coast. While there is not currently a directed fishery for skates, they are commonly caught and retained as bycatch in the groundfish fishery. The ability to accurately estimate their abundance is important because their long life span and low fecundity make skates more vulnerable to overfishing. Despite this species' continuous range, it is managed in three separate regions: U.S. West Coast, British Columbia, and Gulf of Alaska. Each region currently has different age determination protocols which may lead to biases in age estimates. With collaboration between these three federal agencies, this study aims to standardize aging protocols based on validated age reading criteria. In doing so, spatial and temporal variability in growth may be also be explored. The results from this study will increase available age data and improve the understanding of longnose skate life history parameters as well as potentially improve the precision of abundance estimates.

Poster Presentation

**Avila, Alexandra**, Scott Heppell
Oregon State University

## Just going with the flow: how ocean currents influences the dispersal of larval rockfish (genus *Sebastes* spp.) from Marine Protected Areas in Oregon and Washington

How fish larvae get from where they are born to where they settle and grow is a perplexing yet important question in fisheries management and marine reserve design. My research examines how ocean currents, particularly nearshore currents and upwelling, affect dispersal of larval rockfish (genus *Sebastes*), which support an economically important nearshore groundfish fishery in the northeast Pacific. My research will take place in the Marine Reserves and Marine Protected Areas (MPAs) along the Oregon Coast, and in Olympic Coast National Marine Sanctuary in Washington. I aim to determine how larval transport affects populations, genetic diversity and connectivity among marine reserves, and whether there is a detectable spillover effect from reserves into non-reserve areas. I will also develop oceanography-based larval dispersal models to inform fisheries management and marine reserves design. This project will enhance our ability to conserve coastal resources, and hopefully improve the marine reserve design process.

Oral Presentation

**Baetscher, Diana**[1,2], E.C. Anderson[2], M.H. Carr[1], D.P. Malone[1], E.T. Saarman[1], J.C. Garza[2]

[1]University of California, Santa Cruz

[2] NOAA Southwest Fisheries Science Center,

## Rockfish larvae replenish and connect marine reserves in central California

Nearshore marine species with pelagic larvae typically exhibit very little population structure in current-driven ecosystems, suggesting long distance dispersal and high gene flow. Because of this, quantifying dispersal of marine fishes is challenging, but remains a compelling goal, particularly for fisheries management and design of marine protected areas (MPAs). For species with sedentary adults, genetic parentage analysis can identify dispersal events: the distance between parents and settled offspring is the dispersal distance. Large sample sizes and intensive sampling are critical for increasing the likelihood of detecting parent-offspring matches, yet necessitate an efficient genotyping method to reduce cost without sacrificing accuracy. In this study, we genotyped over 6000 kelp rockfish (*Sebastes atrovirens*) sampled from Monterey and Carmel bays along roughly 25 km of coastline with a newly developed, efficient genotyping method that uses sequences from a set of 96 genomic regions. Using these genetic markers, we identified five parent-offspring pairs with high confidence. All five matches indicate juvenile fish born inside MPAs, three of which dispersed to nearby MPAs, while two dispersed to areas outside MPAs. Additionally, we identified 32 full-sibling matches, which occurred throughout the sampling area, including one pair of adult siblings located less than 1 km apart. Although the number of dispersal events detected is small, this study provides direct evidence for larvae produced within MPAs that are exported both to neighboring MPAs and unprotected areas

Oral Presentation

**Baker, Matthew**[1], Wayne Palsson[2], Mark Zimmermann[2], Christopher Rooper[2], David Somerton[2]
[1]North Pacific Research Board
[2]NOAA Alaska Fisheries Science Center

# Model of trawlable habitat using benthic terrain and oceanographic variables

Bottom trawl surveys provide fishery-independent data on relative abundance and life history parameters for a wide range of marine taxa. Survey data are used to assess species abundance and distribution, biological interactions, and ecosystem structure and to manage marine resources. Not all bottom types or oceanographic conditions accommodate this survey method. We applied digitized coverages of National Ocean Service hydrographic smooth sheets and seafloor bottom trawl events to evaluate physical attributes associated with habitat suitable to bottom trawl surveys. Random forest methods were used to evaluate the relative influence of benthic terrain and oceanographic predictors. We examined the marginal importance and quantified the response gradient of each predictor and determined threshold breakpoint values for each predictor variable. These thresholds were used to develop predictive maps in the Gulf of Alaska. Untrawlable habitat was associated with increased complexity in terrain (variance in depth, bathymetric position index), roughness (rugosity, ruggedness), slope and surface curvature, substrate, and the interaction of current speed and aspect. Maps suggest different variables constrain the probability a successful trawl in the nearshore, inshore shelf, offshore shelf, and continental slope. These maps and derived habitat layers may also be used to better understand the relative availability of various species and habitat types to bottom trawl surveys, evaluate bias in assessment indices and ecosystem metrics derived from survey data, and advance habitat-specific biomass estimates.

**Baldwin, Aaron**
Alaska Department of Fish and Game, Division of Commercial Fisheries

## Flea Market: The diversity and economic impact of sand fleas (Amphipoda: Lysianassoidea) in the Southeast Alaska sablefish fisheries.

Lysianassoid amphipods, commonly called sand fleas, are a diverse group of benthic crustaceans. Members of this group are predominately scavengers and predators of larger fish and invertebrates. Aggregations of sand fleas can skeletonize a hooked or trapped fish in hours. Shortened gear soak times reduce the amount of damage but fish may still be marked with lesions known as flea bites that affect the marketability of the fish. These amphipods will also consume bait and may greatly reduce fishing success. Samples of lysianassoids were collected during the 2015 and 2017 Alaska Department of Fish and Game Chatham Strait sablefish mark/tag surveys in southeastern Alaska. The sand fleas were identified to species and tallied. To estimate the cost to the fishing industry in unsalable sablefish due to sand flea depredation, survey data was used to reasonably apportion the percentage of discards due specifically to sand fleas and that value was applied to discards in the commercial fishery. Sablefish that are landed with flea bites but are still salvageable may incur a cost as the processor will typically pay less for these fish as damaged portions of the fish need to be discarded. Processor pricing and grading information from the last five years of the Chatham Strait sablefish fishery were used to estimate the annual loss to the fleet due this price reduction. Survey and commercial data in Chatham Strait was then used to find hot spots, areas with a persistent high density of sand fleas.

Oral Presentation

**Barbeaux, Steven**, Kirstin Holsman, Stephani Zador
NOAA's Alaska Fisheries Science Center

## Implementing an ecosystem approach to fisheries management: Gulf of Alaska Pacific cod (*Gadus macrocephalus*)

From 2015 to 2017 there was a 71% decline in the surveyed abundance of the Gulf of Alaska (GOA) Pacific cod (*Gadus macrocephalus*) stock. The GOA Pacific cod fishery supports a $103 million dollar fishery, 29% of the total groundfish harvest in the GOA. The decline in GOA Pacific cod abundance followed an unprecedented anomalously warm period in the North Pacific and GOA between 2014 and 2017. Multiple sources of evidence including fish condition in the fishery and surveys, bioenergetics, and concurrent mortality events documented in other marine animals suggest the decline was a direct result of increased metabolic demand and a decrease in available forage during this warm period. Methods were developed and implemented in the 2017 assessment cycle for this stock that incorporate the use of temperature indices to drive key parameters in single species age-structured assessment models developed in Stock Synthesis. We will present the ecological evidence accumulated to support the hypothesis of higher natural mortality in the GOA Pacific cod population during the anomalously warm period, evidence supporting temperature dependent catchability for a longline survey used in the assessment, and the use of these relationships to develop climate-enhanced Stock Synthesis models. We will also present the results from these assessment models, including the model selected by the North Pacific Fisheries Management Council (NPFMC) to manage this species in 2018.

Oral Presentation

**Barnes, Cheryl**[1], Anne H. Beaudreau[1], Mary E. Hunsicker[2], Lorenzo Ciannelli[3]
[1]College of Fisheries and Ocean Sciences (University of Alaska Fairbanks)
[2] NOAA Northwest Fisheries Science Center
[3]College of Earth, Ocean, and Atmospheric Sciences (Oregon State University)

# A comparative assessment of resource use by Pacific halibut and arrowtooth flounder throughout the Gulf of Alaska

Pacific Halibut (PH, *Hippoglossus stenolepis*) have supported culturally and economically important fisheries throughout the Gulf of Alaska for over a century. However, recent decreases in mean size-at-age have generated concerns among those who depend upon and manage the resource. Among the prevailing hypotheses for reduced size-at-age is intensified competition with Arrowtooth Flounder (ATF, *Atheresthes stomias*), a voracious predator that has exhibited nearly five-fold increases in biomass over the past 60 years. With an exponentially growing population, ATF are thought to competitively exclude PH from preferred habitat and/or prey, resulting in decreased growth rates. As a first step toward assessing the potential for competition between PH and ATF, we used food habits and bottom trawl survey data provided by the Alaska Fisheries Science Center (NOAA; 1990 to 2013) to quantify spatial and dietary overlap at various scales. Specifically, we utilized generalized additive models (GAMs) to quantify species-specific probabilities of occurrence and biomass per unit effort (BPUE) as a function of year, location, depth, temperature, and competitor biomass. Biomass predictions were then used to calculate spatial overlap across a uniform grid. Estimates of dietary overlap were calculated across the same uniform grid system using Schoener's similarity index. The degree of resource partitioning (employed as a proxy for competition) was evaluated based on linear relationships between spatial and dietary overlap. This study represents an initial evaluation of the hypothesis that competition with ATF is responsible for decreased PH size-at-age. It also identifies broad-scale environmental and ecological conditions that may limit productivity of PH.

Oral Presentation

**Bellquist, Lyall**[1], S. Beyer[2], J. Hyde[2], N. Wegner[2]
[1]The Nature Conservancy
[2]NOAA Southwest Fisheries Science Center

# Effectiveness of descending devices to mitigate the effects of barotrauma among rockfishes (*Sebastes* spp.) in the southern and central California recreational fisheries

To mitigate for the effects of barotrauma, the recreational fishing community pro-actively developed several types of descending devices to assist unwanted or protected fish back to the bottom for release. Resulting decreases in post-release mortality in some cases have led to revised estimates of total fishing mortality, but the effectiveness of the different device types has not been quantified. We conducted 24 Commercial Passenger Fishing Vessel charters at eleven sites in central and southern California, and invited volunteer recreational anglers aboard the charters to use the devices and respond to a survey of their device preferences. While there were significant differences between device types, all were effective for releasing rockfishes at depth. Initial post-release mortality (defined as all mortality events observable from the vessel while fishing) across all devices was relatively low (7.5%) in capture depths less than 100m, but increased significantly (16.4%) at capture depths beyond 100m. This is likely due to our 50m release depth, which suggests that rockfishes may need to be released at least half-way to the original depth of capture for the device to serve its intended purpose. Anglers showed a clear preference for one specific device type, the SeaQualizer, throughout California. This device produced low release error rates and low initial post-release mortality of rockfishes aboard the charters, so angler preference did coincide with device effectiveness. Collaborating with the recreational fishing community was an important aspect to this study, providing more robust results and fostering working relationships for future research projects.

Poster Presentation

**Bellquist, Lyall**[1], K. Kauer[1], M. Gleason[1], J. Sullivan[2], A. Rubinstein[3], D. Oberhoff[4], L. Damrosch[5], M. Norvell[5], M. Bell[5]

[1]The Nature Conservancy
[2]J. Sullivan Law Office
[3]Morro Bay Community Quota Fund
[4]Half Moon Bay Seafood Marketing Association
[5]Fort Bragg Groundfish Association

# Reducing bycatch through a risk pool: a case study of the U.S. west coast groundfish fishery

Rights-based fisheries (e.g., Individual Fishing Quota systems) and voluntary collective fisheries agreements (e.g., fishing quota risk pools) can incentivize fishermen to reduce fishing impacts, enhance stock health, and thereby improve economic outcomes. A fisheries risk pool is a type of voluntary collective agreement to pool individual fishing quotas and reduce the financial risk of catching overfished species. However, forming and implementing risk pools requires durable contracts, operational capacity and funding, and the ability to track, monitor, and enforce agreed-upon catches and fishing practices. We describe the development, performance, and ancillary benefits of a bycatch quota risk pool, known as the California Groundfish Collective, in the U.S. West Coast groundfish trawl IFQ fishery from 2011-2015. Initial investment in the risk pool by a conservation non-governmental organization (NGO) provided capacity and quota to cover transaction costs and incentivize transition to a cooperative model implemented across 5 ports, 15 commercial vessels, and over 48,000 $km^2$ of fishing grounds off California. Risk pool members used spatial fishing plans and information-sharing technology to reduce bycatch of overfished species relative to the general fleet. The risk pool and non-risk pool fleets produced overall overfished species quota utilization rates of 15.8% and 47.7%, and bycatch ratios of 0.006 and 0.009, respectively. Risk pool members were also able to use their spatial fishing data to inform a seafood sustainability rating and propose areas for Essential Fish Habitat protection. They also used their quota to support collaborative research on overfished species, and their collective membership to advocate for policy.

Oral Presentation

**Beyer, Sabrina[1],** T. Hogan[2], S.M. Sogard[3]
[1]University of California, Santa Cruz
[2]University of Miami
[3] NOAA Southwest Fisheries Science Center

## More food, more young? Demonstrating variability in reproductive effort of Rosy Rockfish, *Sebastes rosaceus*, in relation to temperature and food availability

It is well known that abiotic and biotic factors, such as temperature and ocean primary productivity affect growth in marine fishes; what is less known is how these factors affect reproductive effort. Here, we use Rosy Rockfish, *Sebastes rosaceus*, as a model species to test the effects of temperature and food availability on female energetic reserves, fecundity, larval quality and plasticity in the number of annual broods. Captive females fed a high ration diet had higher brood fecundity and produced a greater number of annual broods in comparison with females fed an intermediate or low ration diet. Warmer water temperatures did not affect fecundity, but shortened the interval of time between brood releases, suggesting that eggs and larvae develop more quickly at warmer temperatures. Larval length was positively correlated with maternal size and larvae were thinner in warmer water treatments. Maternal body condition of captive females, measured by the Fulton's K index (body weight * length$^{-3}$), was within the range observed for wild females in Central California. These findings suggest that declines in body condition during years of poor ocean feeding conditions, such as El Niño, are likely to reduce reproductive output in wild populations. This is of concern to fisheries management, as climate models for the California Current predict an increase in the frequency and intensity of warm water, low productivity climate events that could result in declines in reproductive output and greater variability in annual recruitment of rockfishes important to both commercial and recreational fisheries.

Oral Presentation

**Bizzarro, Joseph J.**[1,2], Elizabeth A. Gilbert-Horvath[2], E.J. Dick[2], Aaron M. Berger[3], Katie Schmidt[4], Don Pearson[2], Christine Petersen[5], Lisa A. Kautzi[6], Rebecca R. Miller[1, 2], John C. Field[2], and John Carlos Garza[2]
[1]University of California, Santa Cruz
[2]Southwest Fisheries Science Center
[3]Northwest Fisheries Science Center
[4]NOAA West Coast Region
[5]Bonneville Power Administration, Portland, OR
[6]Oregon Department of Fish and Wildlife

## Addressing cryptic species issues in stock assessments as exemplified by Blue Rockfish (*Sebastes mystinus*) and Deacon Rockfish (*S. diaconus*)

The discovery of cryptic species expands our understanding of biodiversity and provides avenues for further study but also presents significant management challenges, as exemplified in the 2017 stock assessment of the Blue and Deacon Rockfish stock complex. Genetic analyses recently demonstrated that the nominal Blue Rockfish, *Sebastes mystinus*, is actually a cryptic species pair that included Deacon Rockfish, *S. diaconus*. We utilized a variety of approaches to estimate and compare species-specific characteristics of the spatial distribution and life history traits of Blue and Deacon Rockfishes. Genetic assignment of modern fin tissues and historic otoliths to species facilitated subsequent analyses. Deacon Rockfish comprised the majority of individuals sampled between Half Moon Bay and Oregon and were uncommon in southern California. Blue Rockfish were more common from Monterey Bay to southern California. Overall, Deacon Rockfish females grew to larger sizes at slower growth rates than Blue Rockfish females but male growth parameters were similar by comparison. Within species, Deacon Rockfish reached larger sizes at slower growth rates in California. Blue Rockfish reached larger sizes at faster growth rates in Oregon, whereas those south of Point Conception grew larger at faster rates than those in northern California. The multidisciplinary nature of this study and the techniques and protocols we established may provide a model for future stock assessment work on cryptic species.

Oral Presentation

**Bjorkstedt, Eric**
NOAA Southwest Fisheries Science Center and Humboldt State University

## Connections between currents, -clines, counts, and the coast: the importance of fronts for understanding early life history and recruitment of rockfishes.

Hydrographic fronts have shown to influence the ecology of marine systems by enhancing productivity, often in conjunction with elevated biomass density, and structuring transport of plankton. In the coastal upwelling system of the California Current, fronts have the characteristics of being dynamic, mobile structures, yet also exhibiting broadly consistent structure in their spatial distribution. Published studies have shown correlations between the prevalence of fronts and indices of larval supply to benthic populations that support a hypothesis that fronts play a significant role in structuring the distribution and transport of planktonic or micronektonic early life history stages of coastal species. As a step towards better connecting spatial patterns along the coast to ocean dynamics, I review and analyze data from several field surveys to examine how fronts (and related hydrographic structure) influence the distribution of planktonic life history stages of rockfish ranging early larval through pelagic juvenile stages. These results support the hypothesized connection between fronts and population structure, provide a basis for understanding the implications of discrepancies in spatial overlap of sampling grids and hydrographic structure for abundance indices derived from survey observations, and highlight the need for targeted sampling to better address questions about the role fronts play in the ecology of early life history stages.

Poster Presentation

**Bosley, Keith,** Katelyn Bosley, Curt Whitmire, and Aimee Keller
NOAA Northwest Fisheries Science Center

## Relating groundfish diversity and biomass to structure-forming invertebrates in the Northeast Pacific Ocean: an exploration of catch data from a fishery-independent trawl survey

We investigated the associations between structure-forming invertebrates (SFIs: corals, sea pens and sponges) and demersal fish using bottom trawl survey data from the Northwest Fisheries Science Center's bottom trawl survey (2003-2015). General linear models (GLMs) showed that average species richness was slightly lower and finfish biomass slightly higher in hauls with no SFIs. Generalized additive models (GAMs) indicated a weak, non-linear relationship between species richness and sponge density (<1% of deviance explained). Slightly higher finfish biomass occurred in hauls with few or no sea pens or sponges. We used multivariate analyses to examine relationships between fish community structure, SFI densities, and environmental parameters (depth, latitude and bottom temperature). No strong correlations occurred between community structure and SFI densities, but bottom temperature and depth were the primary drivers of community composition. However, indicator species analysis, based on three SFI levels (high, low and none), showed various species-specific associations. Depending on species, flatfishes exhibited relationships with high and low densities of corals and sea pens or the absence of sponges. Thornyheads and some rockfishes were associated with high sponge densities but low or zero coral and sea pen densities. Sablefish exhibited opposite trends. These results provide information about broad-scale associations between SFIs and demersal fish that may be useful for developing studies specifically focused on the function of SFIs as essential fish habitat and the role they may play in the life-histories of groundfishes.

Oral Presentation

**Britt, Lyle**[1], and Ellis R. Loew[2]
[1]NOAA Alaska Fisheries Science Center
[2]Cornell University

## How can you take a picture of a rockfish without them knowing? Determining the spectral sensitivity and reflectance of S. California rockfishes

To aid in the development of underwater camera and lighting systems for assessment of deep water (>200m) demersal rockfish populations using drop cameras, ROV's, and other submersible platforms, two questions were addressed: (1) what is the spectral sensitivity of the species to be identified and (2) what are the spectral properties of the targets that the camera must be able to identify (in this case, rockfish body coloration patterns) from the background? Microspectrophotometry (MSP) and spectral reflectance techniques were used to describe the visual system of rockfishes and to model body coloration and patterning under different lighting options. Results outlining the visual system and spectral reflectance signature of 18 different species of rockfish collected in Southern California will be presented.

Poster Presentation

**Brooks, Rachel**[1], Scott Hamilton[1], Jameal Samhouri[2], and Sue Sogard[3]
[1]Moss Landing Marine Laboratories
[2]NOAA Northwest Fisheries Science Center
[3]NOAA Southwest Fisheries Science Center

# Examination of spatial differences in demography and life history of Canary Rockfish (*Sebastes pinniger*) along the U.S. West Coast

Differences in environmental conditions, habitat and fishing pressure across a species geographic range can cause variability in a species' life history, demography and abundance. This spatial variation in life history information can often be associated with environmental gradients in temperature and productivity, in conjunction with anthropogenic stressors such as overharvesting. Although most fish populations exhibit spatial variability in life history and demography, most stock assessment models neglect to account for these differences and assume life history information and demographic rates are invariant across broad regions. As a result, stocks are managed across broad geographic areas with catch limits and other regulations applying equally in all areas. This can potentially lead to the over or under-utilization of a species, which can have dire consequences for fisheries management. In this study, Canary Rockfish (*Sebastes pinniger*) were collected from 10 different ports across 4 geographically distinct regions (Washington to Central California) in collaboration with volunteer anglers. We evaluated regional differences in Canary Rockfish size structure, and size at 50% maturity for each region. Preliminary results show a latitudinal cline in total length (cm), and size at 50% maturity, where Canary Rockfish in northern waters grow larger and mature at larger sizes than Canary Rockfish in southern waters. Comparing sexes, males were found to mature at slightly larger sizes for all regions except Oregon. Overall, preliminary results suggest life history and demographic traits of Canary Rockfish stocks vary latitudinally across their range. Explicitly incorporating this spatial variability into stock assessments may help improve management.

Poster Presentation

**Brown, Bonnie**[1], L. Lam[1], E. Doyle[2], R. Starr[1], J. Samhouri[3], and S. Hamilton[1]

[1]Moss Landing Marine Laboratories

[2]California State University, Monterey Bay

[3] NOAA Northwest Fisheries Science Center

# Geographic and ontogenetic variation in the trophic ecology of Lingcod (*Ophiodon elongatus*) along the U.S. West Coast

Understanding predator-prey relationships is important both ecologically and for management purposes. One way to understand these relationships is to quantify a predator's diet. Lingcod (*Ophiodon elongatus*) are top marine predators in rocky-reef environments along the U.S. West Coast. Previous studies have shown that Lingcod are generalists. As such, they consume a wide variety of prey including cephalopods, teleost fishes, small sharks, and even other Lingcod. In this study, we conducted charter fishing operations along the U.S. West Coast in 2016 and 2017, spending >35 days at sea. With the help of >300 volunteer anglers, we obtained Lingcod stomachs from areas 12-162 m deep near 16 different ports. We will present differences in prey taxa, prey-specific abundances by number and weight (%PN, %PW), frequency of occurrence (%O), and prey-specific index of relative importance (%PSIRI) among Pacific Fishery Management Council management areas. This information will be used to understand the spatial, temporal, and ontogenetic variation in Lingcod diet, and determine if there are differences in these factors between male and female Lingcod.

Oral Presentation

**Bryan, David**[1,2], Susanne McDermott[1], Chris Rooper[1], Mike Levine[1], Tom Gelatt[3], and Brian Fadely[3]
[1]NOAA Alaska Fisheries Science Center, Resource Assessment and Conservation Engineering Division
[2]Pacific States Marine Fisheries Commission
[3]NOAA Alaska Fisheries Science Center, Marine Mammal Laboratory

# Fine-scale patchiness of Steller sea lion prey items in the Aleutian Islands and its influence on diet and foraging efficiency

The spatial distribution and density of prey items helps define the foraging efficiency of Steller sea lions (*Eumetopias jubatus*). From the perspective of a Steller sea lion, the availability of prey items can generally be regarded at two spatial scales: 1) a coarse scale (1-10 $km^2$), which dictates how far and where an individual needs to travel to find abundant prey items, and 2) a fine scale (1-100 $m^2$), which influences the success of an individual dive. Most research has focused on the distribution and density of prey at a coarse scale as this represents the scale at which most fish data has historically been collected. In this study we use data from 280 towed stereo camera hauls to provide fine scale information on fish densities in the Aleutian Islands during summer. Several methods are explored to quantify the patchiness of Steller sea lion prey items from towed camera data. Preliminary results suggest fish that are more commonly observed in SSL diets, such as Atka mackerel (*Pleurogrammus monopterygius*) and rockfish species (*Sebastes* sp.), are those with higher patchiness values (i.e. less likely to be randomly distributed). We examined species-specific patchiness of fish with respect to depth, bottom type, and distances from shore, rookeries, and passes. This will lay the groundwork towards creating a predictive model of fine-scale patchiness of Steller sea lion prey items.

Oral Presentation

**Budrick, John**
California Department of Fish and Wildlife

## Development of discard mortality rates for overfished rockfish reflecting the use of descending devices in the West Coast recreational groundfish fishery

Minimizing discard mortality is a priority in the Magnusson-Stevens Act under National Standard 9 and has implications for recreational fishing opportunity. Many rockfish suffer barotrauma when brought up from depth and releasing them properly using descending devices has been shown to increase survival. In 2011 the Pacific Fishery Management Council (PFMC) tasked their Groundfish Management Team with developing discard mortality rates reflecting the use of descending devices to account for their use when estimating mortality of cowcod, canary and yelloweye rockfish, which are species of importance to west coast recreational fisheries. Data from cage and acoustic tagging studies were combined in a hierarchical Bayesian model providing proxy estimates of mortality reflecting the use of descending devices. The 90% upper confidence estimate of mortality were approved by the PFMC for use in estimating discard mortality in depths to 100 fathoms (fm). The resulting mortality rates reflect an approximately 50% mortality rate in depths greater than 30 fm as compared to 100% for release at the surface. The Washington, Oregon and California Fish and Wildlife agencies now apply the resulting mortality rates to these species using the proportion of fish released with a descending device from routine creel survey programs. Outreach and education programs in all three states also inform anglers of the benefits of their use in releasing rockfish. The reduction in mortality is reflected in catch estimates and the reduction in discard mortality accommodates additional fishing opportunity and facilitates the rebuilding of overfished stocks.

Oral Presentation

**Calvanese, Tom**[1], Jessica Watson[2], Scott Heppell[1], and Brittany Huntington[2]
[1]Oregon State University
[2]Oregon Department of Fish & Wildlife

# Movement patterns of Pacific rockfishes in a temperate marine reserve

The effects of marine protected areas (MPAs) on adult fish populations depend on the degree of protection provided, which is partly a function of MPA size and the spatial extent of fish movements. The Redfish Rocks Marine Reserve, located on the south coast of Oregon near Port Orford, went into effect on January 1, 2012. One of the intended effects of this reserve was to provide protection for Pacific rockfishes targeted in the local commercial fishery. The boundaries of the RRMR were informed by the experience of local fishermen, but without explicit knowledge of the movement patterns of fishes that inhabit the reserve. We conducted a 17-month acoustic telemetry study to document the movement patterns of 20 individuals (6-7 each) of China Rockfish (*Sebastes nebulosus*), Quillback Rockfish (*S. maliger*), and Copper Rockfish (*S. caurinus*) at Redfish Rocks. Objectives were to (1) estimate residence times, (2) estimate home range size, (3) identify significant hotspots, and (4) analyze the relationship between movement patterns and habitat attributes. Mean home range for individuals of all species was 0.609 ± 0.109 $km^2$, and ranged between 0.196 and 2.15 $km^2$. We found no significant difference in estimated home range area among species using single factor ANOVA ($p = 0.08$). Our results demonstrated that this small (6.78 $km^2$) no-take marine reserve provides refuge for a portion of the local population of these demersal residential fishes, due to those species' high site fidelity in this patch of high relief rocky reef habitat within the Redfish Rocks Marine Reserve.

Poster Presentation

**Chappell, Aaron**[1], Colin Jones[2], John Harms[1], Jim Benante[2], and Curt Whitmire[1]
[1]NOAA Northwest Fisheries Science Center
[2]Pacific States Marine Fisheries Commission

# Using a towed video camera-sled to classify benthic habitat in Southern California Bight

The Northwest Fisheries Science Center's Southern California Shelf Rockfish Hook and Line Survey samples hard bottom habitats within the Southern California Bight via rod and reel gear to provide management information for multiple demersal rockfishes (*Sebastes* sp.). The survey, initiated in 2004, consists of 201 fixed stations sampled annually from Pt. Arguello (34.6$^{o}$N) to the Mexican border (32.1$^{o}$N) at depths of 37 – 229 m. We analyzed 8,260 benthic habitat observations collected during 90 dives representing 70 unique sites via deployment of a towed video camera-sled. Benthic habitat observations were categorized both by major strata (primary, ≥ 50% of the field of view; secondary habitat ≥ 20% of the next most abundant habitat; and all other habitats in the field of view), and by eight substrata categories: mud, sand, pebble, cobble, boulder, continuous flat rock, diagonal rock ridge and vertical rock-pinnacle top. When compared with existing NOAA Essential Fish Habitat (EFH) maps, we found significantly different habitat classification values, especially of hard substrates. Available EFH maps contain varying degrees of resolution, or use algorithms to predict benthic habitat composition, which likely reduces classification accuracy. Our analysis of camera-sled tows showed 47% hard bottom habitats and 53% soft bottom habitats. EFH designations in the same areas of our camera-sled tows comprised 27% hard bottom substrates, and 73% soft bottom substrates, with both values differing significantly from the corresponding camera-sled observation data. Our findings indicate hard-bottom habitat features, especially smaller reefs, may not adequately be resolved within some available habitat maps.

Oral Presentation

**Chiu, Jennifer,** and Rick Starr
Moss Landing Marine Laboratories

## Collection date as a factor explaining variability in Yellowtail Rockfish (*Sebastes flavidus*) diet along the central California coast

Yellowtail Rockfish (*Sebastes flavidus*) are opportunistic, semi-pelagic predators, an important part of the U.S. west coast commercial groundfish fishery, and abundant along the central California coast. Current information about Yellowtail Rockfish diets is more than 20 years old and primarily originates from studies in Oregon and Washington. In this presentation, I will describe and compare the diet of Yellowtail Rockfish collected from three locations along the central California coast (Half Moon Bay, Farallon Islands and Cordell Bank) over two years, and discuss significant factors driving the variability in Yellowtail Rockfish diets. The emergence of collection date as a key variable verifies that Yellowtail Rockfish are opportunistic feeders, and suggests the diet of this species is dependent upon time, space, and oceanographic conditions.

Poster Presentation

**Brendan Connors**[1], Lisa Lacko[2], Schon Acheson[2], A. Rob Kronlund[2] and Chris Acheson[3]
[1]Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC
[2]Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC
[3]Canadian Sablefish Association, Richmond, BC

# Sablefish (*Anoplopoma fimbria*) on the move: 27 years of tagging in British Columbia

Sablefish (*Anoplopoma fimbria*), also called Black Cod, are a long lived and commercially-valuable deep water species. In British Columbia (BC), Sablefish are caught principally by trap and longline in the integrated groundfish fishery. Beginning in the 1970s, the Department of Fisheries and Oceans Canada (DFO) initiated Sablefish tagging studies in BC, primarily to estimate tag retention and movement. Since 1991 the DFO has partnered with the Canadian Sablefish Association (CSA; a fishing industry association) to generate an annual time series of tag release-recovery data. In total over 380,000 tags have been released since 1991 primarily on annual fishery-independent research surveys conducted in offshore waters and inlets in BC, as well as a limited number of releases at offshore seamounts. To date, there have been ~ 73,000 Canadian tags recovered from the western Bering Sea all the way to Baja, California. Many tagged Sablefish released in BC are recovered in BC, both in inlets and along the continental slope in waters deeper than 180 m. Some tags have also been recovered on seamounts located within Canada's EEZ. For example, there have been almost 200, mostly male, tagged Sablefish recovered at the SGaan Kinghlas-Bowie Seamount, some having travelled from as far as 800 km away. In this poster we present emerging patterns from the 27 year dataset which highlights a successful collaboration between DFO and the fishing industry (CSA). We discuss our findings in light of previous investigations into Sablefish movement ecology and identify avenues for future analyses and research.

Oral Presentation

**Cooper, Daniel,** L. Rogers, and T. Wilderbuer
NOAA Alaska Fisheries Science Center

## Effects of larval advection and nursery area temperature on eastern Bering Sea northern rock sole recruitment

Difficulties exist in estimating northern rock sole recruitment at young ages since they do not appear in survey catches until age 3 and not in large numbers in age sampling until age 4 or 5. Past research efforts found that on-shelf springtime winds, which favor larval transport from spawning to nursery areas, and warm nursery area temperatures are positively correlated with rock sole recruitment. In this study, we create an index of nursery area temperature and combine it with a wind index through regression modeling to better understand their effect on estimated recruitment variability, and attempt to provide improved recruitment estimates for recent year classes. Multiple models were created using wind and temperature indices from 1982 to present, as well as a Ricker spawning biomass term. We compare model performance using AIC, as well as a leave-one-year-out analysis, and a one-step-ahead forecast method. The best performing models included both the wind and temperature indices, but not spawning biomass. Several models provided better recruitment estimates than the overall time series recruitment average, indicating the models could improve recruitment forecasting for recent year classes. The best performing model assumes a nursery area temperature threshold, with only the coldest temperatures negatively impacting recruitment. Other available regional temperature indices did not correlate with recruitment in previous studies, and were poorly correlated with the nursery area temperature index in this study, demonstrating the importance of using local indices. We will also discuss how multiple spawning and nursery areas complicate recruitment prediction efforts using environmental indicators.

Poster Presentation

**Coutré, Karson**[1,2], and C. Cunningham[2]
[1]ERT, Inc.
[2]NOAA Alaska Fisheries Science Center

# Temporal trends in vertical movement of Greenland turbot

Greenland turbot (also called Greenland halibut) are a cold water flatfish species with a circumpolar distribution. In the North Pacific Ocean they are found in highest densities in the Bering Sea and Aleutian Islands where they are commercially exploited. We analyzed temporal changes in adult Greenland turbot vertical movement encountered in the Bering Sea using archival tag data. Archival tag detections from 12 Greenland turbot spanned from 2003-2014 with mean depths for individual fish from 450 – 725 meters and mean temperatures from 3.2-3.7° C. The average distance between fish release and recapture location was 64 nautical miles with a maximum of 306 nautical miles with all releases and recaptures occurring near or on the shelf break. All of the tagged fish that were at liberty for 1+ years (n=8) had temporal differences in depth and vertical movement with an overall trend of shallower depths in the summer, suggesting movement on or towards the shelf. In winter months there were more occurrences of deep dives, for example one fish traveled from depths of 850 - 1500 meters within 15 hours. The range of temperatures experienced increases as depth decreases and there is evidence that some tagged turbot are on the continental shelf experiencing cold pool conditions in the summer months.

Oral Presentation

**Dick, Edward**[1], Michael Prall[2], Kevin Stierhoff[3], and Mary Yoklavich[1]

[1]NOAA Southwest Fisheries Science Center, Fisheries Ecology Division

[2]Statewide MPA Management Project, California Department of Fish and Wildlife

[3] NOAA Southwest Fisheries Science Center, Fisheries Resources Division

# Estimating fish abundance and biomass from underwater visual surveys: a model-based approach

Visual surveys of fish populations are often considered as an alternative to traditional fisheries surveys (e.g. trawl) due to their ability to sample in high-relief habitat, estimate fish density and size in situ, avoid mortality of low biomass stocks, and inform species-habitat associations. However, data from visual surveys often have characteristics that call into question inferences based on asymptotic properties of traditional (design-based) estimators of abundance, biomass, or both. These characteristics include small sample sizes, discrete observations, skewed distributions, and a high proportion of zero observations. Design-based estimators are also limited in their ability to deal with common logistical issues such as missing strata, or consideration of covariates that were not included in the survey design. We evaluate a simple, model-based approach to abundance and biomass estimation using visual survey data, and illustrate advantages of the model-based approach. Design-based estimates of density and biomass and associated uncertainty are compared to model-based estimates using maximum likelihood, parametric bootstrap, and Bayesian posterior distributions.

Poster Presentation

**Dodgen, Rose**
California Polytechnic State University

## Impacts on populations of rockfish species under changing depth regulations

Groundfish (including rockfish, cabezon, and greenling) are an ecologically, socially, and economically important recreational and commercial fishery along the central coast of California. In 2002, the National Marine Fisheries Service established the Rockfish Conservation Area (RCA), which defined a maximum fishing depth in central California between 20 – 40 fathoms. At the start of the 2017 recreational Rockfish season, the maximum fishing depth was relaxed to 50 fathoms for the first time since the RCA was established. On October 16, 2017 the maximum depth was set back to 40 fathoms as the catch of overfished Yelloweye rockfish (*Sebastes ruberimmus*) from the west coast approached the total federal harvest guideline. Cal Poly has been collecting on-board observer data from commercial passenger fishing vessels (CPFV) in San Luis Obispo County (SLO), California annually since 2003. Here we used on-board observer data from CPFV trips in SLO County during 2017 to examine catch composition when regulations allowed fishers to access deeper depths. Specifically, we compared the catch composition at 40 fathoms and 50 fathoms to elucidate whether certain species, such as Yelloweye rockfish, were more frequently encountered in the CPFV fleet at 50 fathoms relative to 40 fathoms. This information may help to inform resource managers and fishers about potential impacts from future depth changes. Expanding our knowledge of species composition by depth for varying populations will help inform management strategies for future seasons that will help fishers maintain their economic viability while also protecting the sustainability of the groundfish community in California.

Oral Presentation

**Doherty, Beau**[1], Steven Rossi[2], and Sean P. Cox[2]
[1]Landmark Fisheries Research
[2]Simon Fraser University

# Risk assessment framework for quantifying bottom fishing impacts on sensitive benthic habitats

Sensitive benthic habitats commonly occur in important fishing areas, but are vulnerable to damage from bottom contact fishing gear. To maintain access to fishing grounds, fisheries must demonstrate that risks to seafloor ecosystems are low and conservation objectives can be achieved in the presence of fishing. Despite increasing requirements to manage fishing gear interactions with habitats there are few quantitative approaches for assessing risks from bottom-contact fishing, largely due to a lack of information on the location of sensitive benthic habitats, the long-term damage caused from different bottom-contact fishing gears, and the potential for recovery. We developed a risk assessment framework for quantifying damage and recovery of deep-sea coral habitats over 30-years of bottom-longline trap fishing that: (1) uses presence-absence models to predict coral habitat distribution in fishing areas, (2) estimates historical bottom contact from Sablefish (*Anoplopoma fimbria*) longline trap fishing gear, and (3) estimates coral fishing mortality and recovery using a spatial population model for Gorgonian (Alcyonacea) corals. Our assessment of Gorgonian corals in the SGaan Kinghlas – Bowie Seamount (SK-B) Marine Protected Area estimated that biomass is currently at 71.7 (90% CI =70.6-73.2%) of unfished levels within the fishable area of the seamount (3% of the MPA), which is above levels that would trigger conservation actions under most fisheries policies (i.e. 20-40% B0). Our quantitative risk assessment approach provides valuable information for ecosystem-based fisheries management that can be used to investigate different management measures designed to reduce fishing risks to sensitive benthic habitats while minimizing economic losses from closing fishing areas.

Poster Presentation

**Doherty, Beau**[1], Sean P. Cox[2], Samuel D. N. Johnson[2], and Kristina Castle[3]
[1]Landmark Fisheries Research
[2]Simon Fraser University
[3]Fisheries and Oceans Canada

# Use of autonomous video and accelerometers to estimate bottom contact area of longline trap gear and presence-absence of sensitive benthic habitats

Bottom longline hook and trap fishing gear can potentially damage sensitive benthic habitats (SBHs) in the ocean; however, the large-scale risks to these habitats are poorly understood because of the difficulties in mapping SBHs and in measuring the bottom-contact area of longline gear. In this poster, we will describe a collaborative academic–industry–government approach to obtaining direct presence–absence data for SBHs and quantifying bottom-contact
of commercial longline trap fishing gear for Sablefish (*Anoplopoma fimbria*) using a novel deepwater trap-camera and motion-sensing system designed for deployment during regular fishing operations. We obtained in-situ presence–absence observations of cold-water corals (Alcyonacea, Antipatharia, Pennatulacea, Stylasteridae) and sponges (Hexactinellida, Demospongiae) at 92 locations during commercial fishing trips at the SGaan Kinghlas – Bowie Seamount (SK-B) Marine Protected Area and at 233 locations during British Columbia coastwide Sablefish surveys from 2013-2016. We developed a movement classification algorithm based on video, accelerometer and depth sensor data, which we used to estimate mean drag distances of 310 m (95% CI= 238-383 m) for the middle trap during gear retrieval. The effective trap contact area with SBHs depends on the height distribution of corals and sponges and mean estimates for small, medium and large Gorgonian (Alcyonacea) coral groups at SK-B ranged from 155-357 m2 for a standard Sablefish trap. Our successful collaboration demonstrates how research partnerships with commercial fisheries have potential for massive improvements in the quantity and quality of data needed for conducting quantitative risk assessment for SBHs over large spatial and temporal scales.

Poster Presentation

**Donaldson, William**
NOAA Alaska Region

## A processors guide to species identification in the Gulf of Alaska rockfish fishery

This document provides seafood industry workers, specifically with the Gulf of Alaska Rockfish fishery, an easy to use species identification guide. Each species is depicted with key characters defined in English, Tagalog and Spanish that can be used to identify the species.

Poster Presentation

**Donovan, Cassandra**
Pacific States Marine Fisheries Commission

## Otoliths, ovaries, and fin clips, oh my! Biological sampling by human observers

Resource managers and stock assessors rely on location-specific data about fish populations to assess their health and maintain sustainable harvest levels. While electronic monitoring aids in capturing discard amounts, the biological data observers have been collecting for decades are vital data. Age data, genetic information, capture location of coded-wire-tagged salmon, maturities, lengths, and gender ratios are all valuable inputs into understanding the status of a species' population. Plant monitors are able to collect biological data from full retention shoreside vessels but the ability to link haul-specific location to biological data is lost. The Northwest Fisheries Science Center's At-Sea Hake Observer Program (A-SHOP) oversees the deployment of fisheries observers on catcher-processors and motherships participating in the at-sea Pacific hake fishery. Hake is processed and frozen onboard, while bycatch species are generally discarded after being sampled by a fisheries observer. The only way to obtain biological specimens, such as otoliths or fin clips, from both hake and bycatch species, is by deploying human observers on these vessels. Observer-collected data from the at-sea hake fishery feeds into stock assessments for a number of federally managed species. The need for human observers to collect location-specific data about fish populations will continue as long as the fishery continues.

Oral Presentation

**Duncan, Douglas,** Anne Beaudreau
University of Alaska Fairbanks, College of Fisheries and Ocean Sciences

## Patterns of predation on juvenile salmon by Pacific staghorn sculpin in estuaries near Juneau, Alaska

Pacific staghorn sculpins (*Leptocottus armatus*) are generalist benthic predators common to nearshore habitats along the west coast of North America. In Southeast Alaska, staghorn sculpins can occur in high densities in estuaries during the same time period as juvenile salmon are leaving freshwater streams and hatcheries. This overlap of predators and potential prey raises the question of whether staghorn sculpins could be an important source of mortality for juvenile salmon. To investigate this, we sought to: 1) quantify the diet compositions of Pacific staghorn sculpins in estuarine environments; 2) evaluate size-based relationships between staghorn sculpins and their salmon prey; and 3) assess differences in consumption of juvenile salmon by staghorn sculpins among sites that vary in proximity to hatchery releases. We deployed beach seines at 4 estuaries near Juneau, Alaska from April to September (2016 and 2017). A subset of captured staghorn sculpins were retained for stomach content analysis (n=940; 92-329 mm TL). We found that smaller individuals primarily consumed benthic invertebrates such as amphipods, isopods, and polychaete worms. The proportion of fish consumed increased with sculpin length and varied by site. Common prey fish included juvenile salmon (*Oncorhynchus* spp.), Pacific sand lance (*Ammodytes hexapterus*), and various flatfishes (Pleuronectiformes spp.). Gastric evacuation rate experiments indicated that staghorn sculpins take approximately 72 hours to fully digest a salmon smolt. Combining our diet data and gastric evacuation results in a field-based consumption model will ultimately help us understand the potential magnitude of staghorn sculpin predation on juvenile salmon at our sites.

Oral Presentation

Dykstra, Claude, Timothy Loher, Ian J. Stewart, Allan C. Hicks, and Josep V. Planas
International Pacific Halibut Commission

## Electronically monitoring release method as a proxy for Pacific halibut discard mortality rates in the directed Pacific halibut longline fishery

Regulations require that all sublegal size Pacific halibut in the directed fishery be returned to the sea with minimal injury. Accurate understanding of the types and relative levels of injuries and stresses that Pacific halibut are exposed to during the capture and discarding process can be instrumental in helping better estimate the probability of resultant mortality. Discard mortality rates (DMRs) in the Pacific halibut longline fishery are currently estimated from vitality data obtained on observed trips. The small vessel (<57') longline fleet in Alaska is currently developing electronic monitoring (EM) capabilities, but determining vitality codes requires handling of the animal, something that cannot be achieved with cameras. EM provides information on Pacific halibut hook release techniques (careful shake, gangion cut, hook stripper), however the suite of injuries incurred by each hook release technique is unknown. In the fall of 2017, we conducted a field study to begin developing injury profiles for different hook release techniques with associated physiological condition measures, which could then be used to calculate DMRs on vessels carrying EM systems rather than observers. Physiological parameters collected included condition status at capture (round weight, fat reserves) and post-handling stress levels (blood stress hormones). Additionally, we tagged and released 79 Pacific halibut with accelerometer pop-up archival transmitting tags to assess near term (96 days) survival, and 1,048 fish with wire tags to investigate longer term survival. Results of this study will be used to further refine the estimation of DMRs by hook release method. Preliminary results will be presented.

Poster Presentation

**Dykstra, Claude**
International Pacific Halibut Commission

## Investigations into the use of natural tail markings to identify individual Pacific halibut (*Hippoglossus stenolepis*)

New interest is arising in the use of natural tags, marks or patterns indigenous to specific species, and unique to individuals. Pacific halibut (*Hippoglossus stenolepis*) have natural patterning on both sides of the body and a pilot study was conducted by the International Pacific Halibut Commission (IPHC) to explore the extent of uniqueness that can be ascertained for an individual within a population with the use of pattern recognition software. Analysis of photographic images of the blind side and colored side of Pacific halibut tails were performed using pattern recognition software. The blind-side was determined to be the better side of the halibut for unique tail pattern differentiation, and the software tested was able to correctly identify individuals 88% of the time on fresh animals, dropping to 67% when matching a fresh animal to its offload image. Sex, pattern type, fork length were evaluated as methods to improve the accuracy of the matches. Initial results demonstrated that Pacific halibut tails have unique enough patterning to allow for computer-assisted recognition software to track individuals. Further study is needed to refine techniques, and to verify permanence of the markings during animal growth.

Poster Presentation

**Eikenbary, Steven**[1], Kashef, N.S.[2,3], Palmisciano, M.[4], Stafford, D.M.[2,3], Saksa, K.V.[4], Sogard, S.M.[3], Logan, C.A.[1] and Hamilton, S.L.[4]

[1]California State University, Monterey Bay

[2]University of California, Santa Cruz

[3]NOAA Southwest Fisheries Science Center, Fisheries Ecology Division

[4]Moss Landing Marine Laboratories

# Effects of seawater pH and dissolved oxygen concentration on ventilation rates in *Sebastes* spp.

Effects of climate change on marine ecosystems include a decrease in pH and a decrease in the availability of dissolved oxygen (DO) in some regions due to changes in ocean circulation. To better understand the effects of ocean acidification and reduced oxygen availability on the physiology of juvenile rockfishes (*Sebastes* spp), their ventilation rates were examined after exposure to different environmental conditions. Young-of-the-year gopher (*S. carnatus*), blue (*S. mystinus*), and copper (*S. caurinus*) rockfishes were subjected to the following treatments for 8-20 weeks prior to ventilation trials: 4.0 mg/L DO, 7.5 pH, 4.0 mg/L DO and 7.5 pH and a control treatment (~8.0 pH & 8.4 mg/L DO). Ten fish per species per treatment were recorded with video cameras in flow through channels restricting their movement, in treatment water at 12°C to estimate ventilation rates. Gill beats per minute were counted at 3 time point replicates per fish after a two-hour acclimation period. Mean ventilation rates were compared among treatment levels for each species. This study is one of the first to investigate effects of decreased pH and DO simultaneously on rockfish physiology and will provide valuable information regarding if combined stressors act synergistically or antagonistically to influence ventilation rates.

Poster Presentation

**Fields, Ryan**[1], Richard Starr[1], Mary Gleason[2], Chad Kecy[3], Francois Cazenave[3], Eric Martin[3], Kent Headley[3], Craig Okuda[3], Rick Botman[4], and Dirk Rosen[4]
[1]Moss Landing Marine Laboratories
[2]The Nature Conservancy
[3]Monterey Bay Aquarium Research Institute
[4]Marine Applied Research and Exploration

## Survey like a BOSS: Development of new Benthic Observation Survey System to estimate rockfish densities along the West Coast

Many species of groundfishes along the West Coast are associated with high-relief, rocky reef habitats that are intrinsically difficult to survey. Video landers outfitted with stereo cameras are increasingly being used to survey fishes around the world because they are relatively low cost and can be rapidly deployed over large survey areas. Furthermore, stereo photogrammetry allows accurate and precise estimation of densities and size distributions of fishes. Between 2013 and 2015, we developed a rotating stereo video lander with Marine Applied Research and Exploration (MARE) and conducted >1000 surveys along the central California coastline. Although a success, this initial lander design had several operational constraints that limited the speed at which surveys could be conducted. We are now working with the Monterey Bay Aquarium Research Institute (MBARI) to overcome those limitations and develop a new stereo-video drop camera (Benthic Observation Survey System (BOSS)). The BOSS will have 8 paired-stereo cameras that provide circular video coverage around the lander. A load-bearing fiber optic umbilical will allow for rapid deployment and for HD quality footage to be recorded. A two-camera prototype of the BOSS was successfully deployed at the Footprint SMR in the Channel Islands during a NMFS research cruise. Preliminary video analysis suggests that fishes do not greatly react to the lander's presence over the course of 10 minute surveys. Future tests with this tool will help us understand the viability of this form factor to collect robust data in high-relief rocky reef environments.

Poster Presentation

**Figueroa, Marisol[1],** N.S. Kashef[2,3], D.M. Stafford[2,3], K.V. Saksa[4], M. Palmisciano[4], S.M. Sogard[3], C.A. Logan[1], G. Bernardi[2] and S.L. Hamilton[4]
[1]California State University, Monterey Bay
[2]University of California, Santa Cruz
[3]NOAA Southwest Fisheries Science Center, Fisheries Ecology Division
[4]Moss Landing Marine Laboratories

# Influence of ocean acidification and dissolved oxygen availability on swimming speeds in larval gopher rockfish (*Sebastes carnatus*)

Climate change is altering ocean environments resulting in reduction of seawater pH and dissolved oxygen (DO) levels in upwelling zones. Little is known about the influence of these environmental changes on larval behavior in temperate reef fishes. Our research objective is to better understand how pH and DO affect activity levels in early life stage rockfishes (*Sebastes* spp.). Adult gopher rockfish (*Sebastes carnatus*) were placed into aquaria into the following treatment levels: 7.5 pH, 4 mg/L DO, both 7. 5 pH and 4 mg/L DO and a control treatment of ~8.0 pH and 8.4 mg/L DO throughout gestation. At parturition, video of larval activity was obtained using a GoPro camera mounted above the fish tank. Video footage was processed using Image Pro Premier software to measure larval speed and distance traveled. Analysis of variance was used to examine statistical differences in activity levels among treatments. Gestation in and exposure to reduced pH and dissolved oxygen, both independently and combined, resulted in reduced undisturbed larval swimming speeds and swimming range. Data from this study will be valuable in broadening our understanding of impacts of environmental change on rockfish early life history.

Poster Presentation

**Flores, Sheryl**[1], Robert Ireland[1], Alison Whitman[1], Justin Ainsworth[1], and Daniel Erickson[2]
[1]Oregon Department of Fish & Wildlife
[2]Contractor with Ocean Associates, Inc., for NMFS, West Coast Region

# Evaluation of an electronic sampling system for commercial port sampling: a pilot project

Data collection tools for recording biological data from commercial groundfish landings have largely remained unchanged in Oregon since the 1980s. Currently, groundfish port sampling includes recording data on paper and then transcribing the data to a web-based database. The goal of this pilot project was to test the utility of an electronic port sampling system on a small-scale before moving forward with a long term commitment of staff time and resources needed to enhance or replace the current data-recording procedure. From 2016 to early 2017, we tested an electronic sampling system comprised of an Android tablet, Big Fin Scientific software application, Big Fin Scientific electronic fish measuring board, a Bluetooth serial adapter for our existing scale, and headset. All the electronic data were imported into our existing SQL Server sampling database. The project evaluated efficiency, precision, accuracy, and flexibility between the two systems. Results indicated there was no significant difference in sampling times between the systems for field collection, but there was a significant time savings for the data transfer to the main database. Although the electronic system was found to be precise, the results for accuracy were confounded by many sampling elements and sample sizes were too limited to be conclusive. Flexibility in the field was better with the current paper system. In conclusion, our commercial groundfish sampling program believes that an electronic sampling system is worth pursuing, but will continue testing new options.

Poster Presentation

**Frey, Peter,** A. Keller, and V. Simon
NOAA Northwest Fisheries Science Center

## Return of the dead zone; severe hypoxia observed off of Oregon and Washington during the 2017 West Coast Groundfish Bottom Trawl Survey

Seasonal hypoxia has been observed in near-bottom waters of the Oregon continental shelf since 2002 (Keller et al., 2010). Potentially linked to shifts in climate and upwelling, the severity of these hypoxic events has varied considerably over time. In 2017, the West Coast Groundfish Bottom Trawl Survey (WCGBTS) encountered severe hypoxia in shelf tows with depths ranging from 62 to 160 m off the coasts of Oregon and Washington. Near-bottom dissolved oxygen levels as low as 0.10 ml $l^{-1}$ correlated strongly with reductions in catch size and species richness. Large quantities of decomposing Dungeness crabs encountered in other areas suggested that these hypoxic conditions may have been widespread and resulted in local die-offs of benthic invertebrates. We examine the extent and intensity of near-bottom hypoxia observed in 2017, analyze catches of groundfish and invertebrates from oxygen-poor locations, and explore environmental factors that may have contributed to the severity of this phenomenon in 2017.

Poster Presentation

**Fuller, Jamie** and T. Tsou
Washington Department of Fish and Wildlife

## Liver to whole fish weight conversion: improving historical catch data in stock assessments

In the mid-1900's there was a high demand for fish livers for the production of vitamin A along with the use of liver oil for lighting and lubrication. During this liver fishery the most valued livers were from the spiny dogfish due to their high oil and vitamin A content. Later, livers from other groundfish species such as lingcod, flatfish, and rockfish were utilized for their oils. Several groundfish species in Washington were landed as livers only on commercial groundfish fish receiving tickets but there are no accurate conversions to whole fish weights for these landings. Our goal is to determine the conversion for landed liver weights to whole fish weights to improve catch estimates for stock assessments. Liver weights and whole fish weights were collected and analyzed from various size ranges of spiny dogfish, lingcod, and a variety of different species of rockfish and flatfish.

Oral Presentation

**Gao, Yongwen,** and Russell Svec
Makah Fisheries Management

# Climate driven regime shifts from stable isotopic records of otoliths of Pacific halibut

The regimes concept, or regime shift hypothesis, is an important advance in fisheries management. Large-scale fluctuations in Pacific salmon production and in zooplankton biomass have been linked to ocean climate and decadal-scale ecosystem changes in the North Pacific. In this study we report stable isotopic records of otoliths of Pacific halibut (*Hippoglossus stenolepis*) and their connection with climate driven regime shifts from Makah's usual and accustomed (U&A) fishing areas. The long-term otolith collections (four intervals from 1991, 2002, 2012, and 2017 fishing season), which cover the past 48 years in the same fishing area along the Washington coast, provide valuable information on climate regime shifts. The d18O values of Pacific halibut otoliths of this study ranged from -0.74 to +3.21 ‰, whereas the d13C values of the same samples ranged from -3.64 to +0.26 ‰. As previously reported, the isotopic composition of mature halibut (ages 8-12) indicated that the 1977 regime shift had a warming impact; while the 1990 regime shift may have a bottom seawater temperature decrease of about 2$^{o}$C. More regime shift events are being determined in this dataset. The connection between stable isotope variation in otoliths and the climate regime shifts is thus potentially useful in studying the population dynamics of Pacific halibut stocks, and decadal-scale (e.g., the last 40-50 years) ocean environmental changes.

Poster Presentation

**Gasper, Jason**[1], Jennifer Mondragon[1], Brian Lieb[2], Cathy Tide[1], Jacob VanBaalen[3]
[1]NOAA Alaska Fisheries Science Center, Sustainable Fisheries Division
[2]NOAA Alaska Fisheries Science Center, Information Services Division
[3]Wostmann & Associates, Inc.

## Accounting of Federal fisheries catch off Alaska: So many things are possible just as long as you don't know they're impossible (Norton Juster)

Catch and economic information from fisheries off Alaska are critical for the management and conservation of marine resources. The National Marine Fisheries Service, Alaska Regional Office, relies on complex data architecture to integrate a large volume of near real time information across multiple agencies to meet its data needs. For example, in 2016 the Alaska Region Catch Accounting System processed 1.84 million fishery-related transactions; this accounts for nearly all federal fishery catch data off Alaska. Sources of information in the database system include landings, at-sea processing information, at-sea observations, vessel monitoring systems, electronic monitoring, vessel-specific permit information, and systems that process this information to generate estimates of discards, fees on landings, spatial effort and catch apportionment models, and other useful information for managers and scientists. Several recent enhancements have greatly improved both the efficiency of the system, provided a robust data and coding architecture, and allowed analysts to explore changes in estimation in parallel to production. Our paper provides a simple overview of the system architecture, including a brief discussion of a new analytical test and simulation capability using R-Cran in an Oracle production environment, the data feeds and processes, and a broad overview of major data users.

Poster Presentation

**Geernaert, Tracee,** Eric Soderlund, and Aaron Ranta
International Pacific Halibut Commission

## Changing face of data collection - how technology has impacted surveys and the job of field biologist at the International Pacific Halibut Commission

The International Pacific Halibut Commission (IPHC) fishery-independent setline survey (FISS) is a large-scale comprehensive annual survey that covers Pacific halibut *(Hippoglossus stenolepis*) grounds from the Bering Sea to California. The survey comprises over 1,300 sampling locations and is one of the largest annual fisheries surveys in the world. The massive amount of data generated represents an important data source for the current year's Pacific halibut stock assessment. The size, age, and sex composition data collected is essential to the assessment and is used to monitor changes in biomass, growth, and mortality in adult and sub-adult components of the Pacific halibut population. In 2017, after 93 years of collecting Pacific halibut data, we left pencil and paper behind and launched coastwide electronic data recording via ruggedized electronic tablets. We were successful in collecting data electronically on 99% of the sets. Thanks to real-time data validation, the overall data quality was improved and common data transcription errors in set location and handwriting issues were greatly reduced. The electronic tablets improved data quality, timeliness of data availability to our end users and liberated our staff for other duties. The impact of electronic data recording on the change of protocols, adoption and adjusting data collection in the field, training, support, hardware, and finally data delivery to the end users will be discussed.

Poster Presentation

**Gertseva, Vladlena[1],** Sean Matson[2], and Jason Cope[1]
[1]NOAA Northwest Fisheries Science Center
[2]NOAA West Coast Region

## Spatial growth variability in marine fish: example from northeast Pacific groundfish

Life history parameters of marine fishes vary in space and time, often in response to multiple factors. Understanding this variability is vital to ensure sustainability of marine resources and ecosystem services provided by the ocean. We examined spatial variability in growth for a number of groundfish species in the northeast Pacific Ocean to identify shared spatial patterns and hypothesize about common mechanisms behind them. Growth parameters were estimated in different areas over the latitudinal range of the species and multiple hypotheses were tested as to whether growth parameters differ in all the areas, at specific area breaks or exhibit a latitudinal cline. Clear differences in spatial growth variability emerged among the species examined. Shelf species exhibited the highest growth rate between Cape Blanco and Cape Mendocino, which may in part be attributed to area-specific upwelling patterns in the California Current ecosystem, when nutrient rich deep water are brought to the surface southward of Cape Blanco and are uniquely distributed throughout this area, providing favorable conditions for primary productivity. Slope species showed a cline in asymptotic size (Linf), with Linf increasing from south to north. This cline, previously attributed to fishery removals, also fits a specific case of the widely described Bergmann's rule, and we explore specific potential ecological mechanisms behind this relationship.

Poster Presentation

**Goen, Jamie**
International Pacific Halibut Commission

# Scientific data collection programs at the International Pacific Halibut Commission

The International Pacific Halibut Commission (IPHC) has an extensive data collection program for Pacific halibut (*Hippoglossus stenolepis*) from both fishery-dependent and fishery-independent sources. Fishery-dependent sources include not only information from fish landing receipts and domestic agency monitoring programs in the U.S. and Canada, but also from vessel logbooks and from biological data collected by IPHC staff located in major ports where Pacific halibut are landed. Fishery-independent sources include IPHC's extensive fishery-independent setline survey (FISS), other IPHC research projects, and the National Marine Fisheries Service's trawl surveys. IPHC's data collection programs offer great opportunities for collaboration and mutually beneficial research. For example, IPHC's FISS operates annually between May and September using 10-15 chartered Pacific halibut longline vessels in waters off of Alaska, British Columbia, and the U.S. West Coast covering approximately 1,300 stations in a 10 nmile by 10 nmile square grid. Every year in the fall, the IPHC solicits interest in collaborating on additional specialized data collection projects to be conducted during the next year's IPHC FISS. In addition to Pacific halibut, data can be collected on many other species and on environmental conditions. We will present past collaborative projects with domestic and state agencies, academia, and other organizations resulting in the collection of data on several shark species, rockfish, Pacific cod, and seabirds.

Poster Presentation

**Graham, Elizabeth[1],** Steven Y. Litvin[1], Aaron B Carlisle[2,3], John C. Field[4], Emmanis Dorval[4], and Bruce Finnney[5]
[1]Monterey Bay Aquarium Research Institute
[2]Stanford University
[3]University of Delaware
[4]NOAA Southwest Fisheries Science Center
[5]Idaho State University

# ENSO and market squid diet: are changes in the utilization of krill species important to their success?

In the California Current Ecosystem (CCE) the distribution, abundance and growth of market squid (*Doryteuthis opalescens*), an important commercial fishery species, is thought to be largely driven by El Nino Southern Oscillation (ENSO) cycles. Although ENSO cycles are strongly correlated with squid abundance and distribution within the CCE, the factors that may drive the observed boom and bust population dynamics have yet to be fully understood. Field studies suggest that there is a positive correlation between the abundance of juvenile market squid and the coastal euphausiid *Thysanoessa spinifera*. Using stable isotope analysis, we evaluated the extent that squid in high abundance years (such as 2013) are more dependent on coastal food webs and trophic pathways, relative to lower productivity years (such as 2015) in which they are likely to be more reliant on offshore resources (e.g., *Euphausia pacifica*). These results complement ongoing NOAA efforts examining market squid distribution, abundance, growth and trophic ecology (stomach contents). Together these studies provide insight into the mechanisms by which ENSO driven changes in productivity drive market squid abundance, distribution and population dynamics.

Oral Presentation

**Haggarty, Dana,** and Greg Workman
Pacific Biological Station, Fisheries and Oceans Canada

## Use of recompression devices as a tool for managing rockfish barotrauma in British Columbia

Pacific rockfishes suffer high rates of barotrauma when they are brought to the surface due to their closed gas bladder. Although many jurisdictions recommend the use of descending devices that return a fish with barotrauma to depth, little research their use and the survival of recompressed fishes has been done in BC. Policy in BC on descending devices has yet to be developed; however, the recreational sector is interested in using them to conserve rockfishes. In order to inform management in BC, we reviewed the literature on the responses of barotrauma in rockfishes and the ability of recompression devices to decrease mortality of released fish in the short and long-term; synthesized results for species found in BC; and characterized research gaps and uncertainty. Rockfish species are found to show a remarkable resiliency in their ability to recover from barotrauma and to survive after recompression. However, the effects of barotrauma and the survival rates are complex in this diverse genus of fishes and a number of uncertainties remain. Although recompression certainly increases the survival rates of discarded fishes, keeping what you catch and moving fishing locations to avoid further capture or ceasing to fish once limits have been reached remains a more precautious recommendation. Incorporating the voluntary or mandatory use of descending devices in the management of recreational rockfish fisheries will require careful consideration because considerable uncertainty about their implementation and their effectiveness to mitigate rockfish mortality remains.

Oral Presentation

**Harms, John**[1], Jim Benante[2], Colin Jones[2], Victor Simon[1], Aaron Chappell[3], and Joe Villareal[4]
[1]NOAA Northwest Fisheries Science Center, Seattle, WA
[2]Pacific States Marine Fisheries Commission, Seattle, WA
[3]NOAA Northwest Fisheries Science Center, Newport, OR
[4]Mirage Sportfishing, Oxnard, CA

## Development of a high-throughput approach for descending shelf rockfish

Since 2004, the Northwest Fisheries Science Center's (NWFSC) Hook and Line Survey has monitored a network of fixed sites throughout the Southern California Bight to provide data to support stock assessments for shelf rockfish populations in the region's untrawlable habitats. When no-take marine reserves within the Channel Islands National Marine Sanctuary (CINMS) were expanded in 2007-2008 to encompass existing survey sites, NWFSC and CINMS staff discussed ways to continue sampling these locations to maintain the data time series while minimizing impacts to the reserves' living resources. In 2016, survey protocols were modified so captured individuals are descended after expedited collection of biological data. To reduce potential mortality to captured specimens, we needed to minimize the amount of time fish spent out of the water by descending fish more rapidly than is feasible using traditional descending methods. We developed a downrigger approach using a recreational crab pot puller to lower a downline and cannonball weight most of the way to the seafloor. After basic data are collected, fish are attached to a SeaQualizer™ Recompression Device affixed to a customized bracket which is then clipped onto the downline and dropped into the water. Fish are released when the bracket assembly reaches the depth setting selected on the SeaQualizer™. All descended fish are tagged prior to release to provide a secondary measure of abundance and to provide information about fish movement and potential post-release mortality. We discuss our approach in detail and share some of the lessons we learned in developing and implementing this approach.

Oral Presentation

**Head, Melissa,** Ian G. Taylor, and Jason M. Cope
NOAA Northwest Fisheries Science Center

## Evaluating spatio-temporal reproductive variability in Pacific Hake (*Merluccius productus*) using a flexible asymptotic model to estimate maturity

Over the last decade, fisheries managers increasingly identified a need for up-to-date, coast wide reproductive information on groundfishes along the west coast. Many management models used out of date maturity studies that were localized and often from unreliable macroscopic maturity estimates. In response to this, the NWFSC FRAM's division instituted a reproductive biology program in 2009 using two sampling platforms. We sampled Pacific hake ovaries from the West Coast Groundfish Trawl Survey in 2009 and 2012 - 2017. In 2012, we expanded the sampling platform to capture better spatio-temporal patterns. This included sampling from the Fisheries Engineering Acoustics and Technology (FEAT) summer survey, the at-sea hake observer program in the spring and fall months, and finally the FEAT winter survey in 2016 – 2017. From 2009 – 2016, we histologically assessed 2544 hake maturity samples. These coast wide collections allowed us to explore biogeographic relationships North and South of Pt. Conception, CA (34.44°N) within varying temporal patterns. Overall length and age at 50% (L50, A50) maturity were estimated at 33.4 cm and 2.3 years. However, L50 results north and south of Pt. Conception varied substantially, with corresponding L50 estimates of 35.0 and 26.2 cm. In addition, to the varying spatial relationships, we found temporal trends in their reproductive cycle; including time of spawning, shift in spawning locality, and interannual variability in the rate of skipped spawning. To account for skip spawning we estimated length at maturity using a spline model that incorporates the fraction of adult sexually mature skip spawners into a flexible asymptote.

Oral Presentation

**Heifetz, Jonathan, K**alei Shotwell, Sharon Wildes, Dana Hanselman, and Charles Hutchinson
NOAA Alaska Fisheries Science Center, Auke Bay Laboratories

## Population characteristics of two sympatric species of rockfish in the Gulf of Alaska with implications for management

Rougheye and blackspotted rockfish are notoriously difficult to distinguish from each other in the field. Genetically verified misidentification rates have been high and variable ranging from 13 to 23% in the 2009-2015 trawl surveys. Although blackspotted rockfish has a deeper distribution than rougheye rockfish, both species often occur together in the same survey hauls and presumably fishery catches. The two species are managed together as a complex with a complex wide catch quota. Blackspotted rockfish can be considered the weaker stock because they are slower growing, mature at a later age, and have a lower natural mortality rate than rougheye rockfish. Although the complex is lightly exploited, the differences in population characteristic between the two species suggests that blackspotted rockfish is likely more vulnerable to fishing pressure. Recent advances using otolith morphology and growth characteristics to distinguish the two species has enabled the historical reconstruction of species composition in the fishery and survey. We conduct a sensitivity analysis to examine risks to the weaker stock and conclude that under current fishing practices there is a low probability of overfishing the weaker stock. Thus we consider current management specifications for this non-targeted complex to be sufficiently precautionary. Given the high and variable misidentification rates of the two species in surveys, we recommend that genetic sampling be conducted as part of the routine sampling protocol. This will enable direct monitoring of long term population trends.

Poster Presentation

**Helser, Thomas**, and Irina Benson
NOAA Alaska Fisheries Science Center

## An innovative approach to ageing fish otoliths with near infra-red spectroscopy (NIRS)

Fish ages are one of the most fundamental data elements of integrated stock assessments because they provide critical information on recruitment, growth, maturity, mortality and production which inform models and management advice. Despite the increase in demand for age data, the capacity to support the need has not increased. As such, we investigate an innovative technology to derive machine-based ages from near Infra-red spectroscopy (NIRS), which is a method of measuring light absorbance signatures in organic substances. After the initial calibration-validation procedure, scan and age estimation of ageing otoliths takes 30 seconds for walleye Pollock compared to approximately 5 minutes per specimen by a trained ageing expert, so efficiency can be increased 500% to 1000%. Based on a pilot study of EBS walleye Pollock from otoliths collected during the 2016-2017 survey years, we successfully replicated the ageing process using FT-NIR with equal or better precision than the traditional ageing process. While these results are extremely promising additional research is needed to evaluate the spatial and temporal variation in calibration models from different species (i.e., Pollock vs. Pacific cod), to evaluate quality control procedures (statistical metrics) in an operationalized ageing process, and quantify the cost-benefit of moving away from a traditional to machine-based ageing approach.

Oral Presentation

**Henry, Ed**
International Pacific Halibut Commission

## Pacific halibut sex ratio: 19 years of fishery-independent setline survey data

Since 1998, the International Pacific Halibut Commission (IPHC) has completed a consistent, standard grid for our fishery-independent setline survey (FISS) that spans from southern Oregon, north to Alaska, including British Columbia. As part of the FISS, seasonal fishery biologists routinely collect biological data on Pacific halibut (*Hippoglossus stenolepis*) that includes length, sex and maturity, evidence of prior hooking injury and severity, and otoliths for aging. Thus, historical trends in the ratio of male and female Pacific halibut can be analyzed across the coast, within large biological regions, smaller setline charter regions, and statistical areas. Also, these data can be coupled with length and age information to reveal interesting trends and changes over the past two decades. In 2016, the IPHC Regulatory Area 3B (western Gulf of Alaska) observed a 15% decrease in the percentage of females to male Pacific halibut from the previous year. Once analyzed more closely, a shift in sex ratio in the 2006 year class was discovered, with predominantly 9-year old females in 2015 to a predominance of 11-year old males in 2017. Also, stations along the western Aleutian Islands (IPHC Regulatory Area 4B) have consistently observed approximately 60% males as compared to females, which is in contrast to the coastwide average of 60% females to males. Since 1998, geographic differences in Pacific halibut sex ratios have been observed with important consequences for stock assessment, management, and understanding of this socio-economically important population.

Oral Presentation

**Hicks, Allan**
International Pacific Halibut Commission

## Fifty years of management strategy evaluation at the International Pacific Halibut Commission

The International Pacific Halibut Commission (IPHC) has a long history of Management Strategy Evaluation (MSE) and there are many lessons to be learned. Many notable fisheries scientists have contributed to this history, and stakeholders have been involved in various ways. From a 1968 report on simulating management strategies to the recent formation of an advisory body to the Commission, this paper explores the history of MSE at the IPHC as well as the benefits and challenges of involving stakeholders in the process. In 2013, the IPHC's Management Strategy Advisory Board (MSAB) was formed to oversee the MSE process and to advise IPHC staff on the development and evaluation of harvest policies. The MSAB formally meets biannually and includes representatives from commercial, sport, processing, Tribal/First Nations, and management sectors. Defining goals and objectives was a first step to developing performance metrics and specifying the models necessary for evaluation. Identifying management procedures to evaluate is currently ongoing, and approaches to present results to stakeholders is in development. Overall, a cooperative and successful environment has been created by educating stakeholders on the MSE process, explaining that it is a process and not a product, and defining how they and analysts fit into the process.

Oral Presentation

**Hoff, Gerald,** Rooper, C.N., Stevenson, D.E., Spies, I., and Orr, J.W.
NOAA Alaska Fisheries Science Center

## Skate nursery HAPC designation in the EBS: Continued studies

In January 2015 the North Pacific Management Council (NPFMC) designated eight skate nursery sites (six areas) as Habitat Areas of Particular Concern (HAPC) in the Bering Sea and Aleutian Island management area. During the designation process the NPFMC determined that skate nurseries in the EBS are rare and provide an important ecological function as discrete sites with unique abiotic features that serve as important spawning and embryonic development areas for skate species. Although the NPFMC did not take protective measures for skate nurseries at the time of designation, they did make it one of the Council's annual research priorities. In response to the Councils designation the National Marine Fisheries Service agreed to provide more information in the utility of the sites for reproduction and the relationships between habitat and their use as nurseries. As a result we embarked on a three year project to address some of the Councils questions/research priorities that developed during the HAPC designation. I will discuss the results of the research conducted on three aspects of skate nurseries; fishers encounters of skate eggs and their viability, skate nurseries as vectors for population structure, and modeling of habitats suitable for skate nursery sites. I will discuss completed and ongoing research in each of these areas.

Poster Presentation

**Hoff, Gerald,** Alison Vijgen, Heather Kenney, and Robert Lauth
NOAA Alaska Fisheries Science Center

## The development of electronic data acquisition for fisheries independent groundfish surveys

Programmers and scientists at the Alaska Fisheries Science Center have developed an innovative data collection system intended for use on fisheries independent groundfish surveys conducted each year in Alaskan waters. For more than 30 years traditional data recording on surveys has been on waterproof paper and hand entered to computers equipped with customized access programs. Recognizing the need to improve our efficiency and ability to real time error check, we embarked on developing a new data acquisition system for our groundfish surveys using Android operating systems with customizable applications for data acquisition, and off the shelf android tablets. The applications and data acquisition is controlled by either bar-codes, interaction with the touch screen, or voice technology in which data is entered through a Bluetooth headset and microphones with a customized android application recognizing voice commands. Since 2013 we have successfully collected lengths on crabs and fishes as well as biological data using our electronic data system. Our future goal is to collect our entire groundfish survey dataset using voice activated android applications with all tablets and applications interacting with a centralized database on each vessel. This methodology will afford us less data handling and real time data checking for a more streamlined error free data set.

Poster Presentation

**Holder, Anna[1],** and John C. Field[2]
[1]California State University, Monterey Bay
[2]NOAA Southwest Fisheries Science Center, Fisheries Ecology Division,

# An exploration of factors that relate to the occurrence of multiple brooding in rockfish (*Sebastes* spp.)

Despite the identification of multiple brooding in some rockfish species (*Sebastes* spp.) over 50 years ago, multiple brooding continues to be a complicated and poorly understood component of the reproductive biology of rockfishes. We sought to better understand the oceanographic factors that relate to the capacity of individual Sebastes species to produce multiple broods by evaluating how well this life history trait could be predicted by data that reflect the mean latitude, ocean temperature, dissolved oxygen levels, and mean length for each species. The data used were catch and associated physical oceanographic data from the Northwest Fisheries Science Center combined shelf/slope bottom trawl survey, commercial landings from the Pacific Fisheries Information Network (PacFIN), and a review of the literature regarding the ability of each species to produce (or not) multiple broods. We fit binomial generalized linear models to the probability of being described as a multiple brooder to 24 shelf rockfish species to determine whether and to what extent these factors influenced the probability of the species being a multiple brooding species. Preliminary results suggest that multiple brooding species are significantly more likely in lower latitudes and/or in warmer waters. Completion of this research will result in a more comprehensive understanding of the reproductive biology of shelf rockfish, could contribute to climate change vulnerability assessments, and should eventually lead to improvements in stock assessment models for rockfish populations.

Oral Presentation

**Jasonowicz, Andrew**[1], Frederick W. Goetz[2], and Steven B. Roberts[1]

[1]University of Washington, School of Aquatic and Fishery Sciences

[2]NOAA Northwest Fisheries Science Center, Environmental and Fisheries Sciences Division

# What goes up must come down: Diel vertical migration in the deepwater sablefish (*Anoplopoma fimbria*) revealed by pop-up satellite archival tags

The sablefish (*Anoplopoma fimbria*) is a long-lived species with wide distribution throughout the northern Pacific Ocean. While sablefish are considered a deepwater fish, diet analyses suggest that they undergo vertical migrations in the water column that could be related to prey movement and feeding. Popup satellite archival tags (PSAT) were used to observe the fine-scale depth selection behavior of sablefish tagged off the Washington coast during the summer months (Jun – Aug). Data from retrieved tags confirm that sablefish inhabit depths greater than 750 m. Wavelet analysis was used to identify periods of time that fish exhibited significant patterns of diel vertical migration that have not been characterized before in this species. This analysis revealed extensive daily vertical displacements averaging 254 m. During periods of vertical migration, fish ascended towards the surface at night and descended prior to daylight (i.e., diel vertical migration). Preliminary results from tagging fish over-winter suggests that diel vertical migratory behavior may occur in the fall and spring but not during the reproductive period (Dec - Jan). During summer months, sablefish generally inhabited temperatures of 5$^{o}$C but temperatures of 6-10$^{o}$C were experienced when fish were near the upper extent of their vertical range. Sablefish are opportunistic feeders with a large proportion of their diet being fish, euphausiids and cephalopods. Since these prey items also exhibit diel vertical migrations, it is likely that the vertical migratory behavior displayed by sablefish is in response to the movements or the location of their prey.

Oral Presentation

**Jones, Colin**[1], John Harms[2], Jim Benante[1], Aaron Chappell[3], John Wallace[2], and Aimee Keller[2]
[1]Pacific States Marine Fisheries Commission
[2]NOAA Northwest Fisheries Science Center, Seattle, WA
[3]NOAA Northwest Fisheries Science Center, Newport, OR

# Potential reserve effects of Cowcod Conservation Areas on shelf rockfish in the Southern California Bight

The Northwest Fisheries Science Center (NWFSC) annually conducts a fishery-independent hook and line survey to monitor groundfish associated with hard bottom habitats within the Southern California Bight (SCB). The survey was developed in 2003 and is a collaborative effort among Pacific States Marine Fisheries Commission, NWFSC, and southern California's sportfishing industry. The survey's historical sampling frame (2003-2013) consisted of 121 fixed sites and excluded two large Cowcod Conservation Areas (CCAs). The CCAs were implemented in 2001 to protect shelf habitat and fishery resources in areas where cowcod (*Sebastes levis*) are most abundant by prohibiting bottom fishing in depths greater than 37 meters. In 2014, at the request of the Pacific Fishery Management Council, the hook and line survey initiated sampling inside the CCAs, and currently monitors approximately 80 sites inside the two closures. Survey data results from 2014-2016, show a significantly higher total catch inside the CCAs versus outside. In addition, the mean number of species observed per site visit is greater inside the CCAs. With only four years of data inside the CCAs, the hook and line survey will continue to monitor these sites into the future and document other potential effects on shelf rockfish related to the CCAs. Sampling inside the CCAs will also allow for a more robust estimation of relative abundance for several important rockfish species in the SCB.

Oral Presentation

**Junge, Laura**, and B. Harris
Alaska Pacific University

## Spatiotemporal Assessment of Survey and Commercial Fishing Effort Relative to Pacific Cod (*Gadus macrocephalus*) Habitat in the Aleutian Islands

Pacific cod (*Gadus macrocephalus*) is a commercially targeted, demersal groundfish. In the Aleutian Islands (AI), off the southwest coast of Alaska, Pacific cod biomass is estimated based on data collected by a biennial government trawl survey conducted in the summer (June - August). However, the AI fishery is primarily prosecuted during the winter months with trawl, longline, and pot gears the latter two of which can fish in untrawlable habitats not sampled by the survey. We hope to highlight differences between habitats sampled through the fishery-independent survey and those targeted in the commercial fishery. We explored the overlap in survey and fishery observations with the predicted Pacific Cod Essential Fish Habitat (EFH) and produced sampling profiles of key environmental covariates (e.g. bathymetry and sediment) to better understand these mismatches. Preliminary results indicate that the between 11-21% of Pacific Cod seasonal EFH is sampled NOAA-NMFS trawl survey. By describing the underlying differences in the habitat sampled by the survey and the commercial fishery b space and time we aim to improve the state of understanding about Pacific cod habitat use, expose potential biases that may result from the current sampling methodology, and suggest alternative sampling approaches effective in other fisheries.

Oral Presentation

**Kaplan, Katherine[1,2]**, L. Yamane[1,2], W. White[3], M. Baskett[1], L. Botsford[1], and A. Hastings[1]
[1]University of California, Davis
[2]California Department of Fish and Wildlife
[3]Oregon State University

# Setting a timeline of expected fished population responses to California's marine protected area network for adaptive management

Adaptive management of California's marine protected area (MPA) network will require developing appropriate methods to evaluate whether monitoring data indicate the MPAs are performing as predicted. The first step is to determine expected population responses of fished species to implementation of MPAs. Modeling the expected responses for fished species to the MPA network, with a clear timeline for those expectations, can aid in the development a monitoring program designed to evaluate whether those expectations are met. Here we use open and closed deterministic population models to describe expected changes in abundance and biomass in response to MPAs for fished populations in California. We also include expected population responses with stochastic recruitment in comparison to deterministic population models. These expectations will help form the basis of a long-term monitoring program for the evaluation of the MPA network as part of the adaptive management process.

Oral Presentation

**Kastelle, Craig**, Thomas Helser, and Kali Williams
NOAA Alaska Fisheries Science Center

## Otolith stable oxygen isotopes used to reveal fish condition and fish age validation

Stable isotopes found in otoliths can be used to address a variety of environmental and fisheries management questions. This is especially useful in studying climate change, climate related effects on fish growth and health, and paleotemperature. In this study we used stable oxygen isotopes, in the form of δ18O, as an indicator of water temperature experienced by individual fish. First, we developed empirical fractionation curves of otolith δ18O in relation to water temperature using laboratory based studies on four North Pacific Gadid species: Artic cod (*Boreogadus saida*), saffron cod (*Eleginus gracilis*), walleye pollock (*Gadus chalcogrammus*), and Pacific cod (*Gadus macrocephalus*). We found statistically significant relationships, with up to $r^1 = 0.94$. We analyzed life-history seasonal cycles of microsampled otolith δ18O to validate the accuracy of ages estimated by counting otolith growth zones from wild caught Artic cod. Lastly, we used early-life-stage otolith δ18O, and its relationship to temperature, to consider late-life-stage fish condition in terms of body mass, fish length, and otolith mass.

Oral Presentation

**Keaton, Josh**, and Jason Gasper
NOAA Fisheries Alaska Region

## What to do with a dead fish: The complexities of rockfish retention

Rockfish species are commonly caught in commercial fisheries off Alaska. Most rockfish that are caught have near one-hundred percent mortality unless deep-water release techniques are used. In the commercial fisheries off Alaska, these techniques are rarely used. Therefore, discarded rockfish are considered dead and wasted. Rockfish have commercial value and methods to reduce waste of rockfish have been implemented in some federal and state fisheries. These methods commonly require full retention of all rockfish species that are incidentally caught. This allows for increased utilization, species identification, and more precise estimates of total catch. However these regulations are not consistent throughout the waters off Alaska. This has resulted in a mish-mash of conflicting regulations that are confusing to most commercial fishermen. In 2016 the North Pacific Fishery Management Council requested a discussion paper to identify the challenges and benefits of implementing full retention of all rockfish by fixed gear vessels. This paper will discuss these benefits, the challenges, and the future of utilizing rockfish that are incidentally caught.

Poster Presentation

**Keller, Aimee**[1], John Harms[1], John Wallace[1], Jim Benante[2], Colin Jones[2] and Aaron Chappell[1]
[1]NOAA Northwest Fisheries Science Center
[2]Pacific States Marine Fisheries Commission

# Variation in size and catch of demersal fish species within the Southern California Bight in relation to the Cowcod Conservation Areas (2014 - 2016)

Since 2001, fishing was prohibited at depths greater than 36 m in two large (10878 $km^2$ and 260 $km^2$) Southern California Bight marine reserves known as the Cowcod Conservation Areas (CCAs). The Pacific Fishery Management Council established the CCAs in response to declining abundance of west coast rockfishes, particularly overfished cowcod. We investigated variations in catch rate, size, length frequency and percent of positive sites for 11 abundant groundfish species (bank, bocaccio, chilipepper, copper, cowcod, greenspotted, lingcod, olive, speckled, squarespot, starry), and the vermilion-sunset complex inside and outside the CCAs using data from the Southern California Hook and Line Survey, an annual fishery independent survey. From 2014 to 2016, the Hook and Line Survey sampled up to 75 fixed sites within the CCAs and 121 sites outside the restricted areas using rod and reel gear. Generalized Linear Models (GLMs) that included area, year, depth and distance from port revealed significantly greater catch ($P<0.05$) within the CCAs for eight of 11 species; two species (copper rockfishes and lingcod) and the vermilion-sunset complex were significantly more abundant outside the CCAs. Although more abundant within the CCAs, results for cowcod were not significant ($P=0.13$). We also observed significant differences ($P<0.05$) in length frequency distribution and mean size for nine species and the vermilion-sunset complex with larger fish present inside the CCAs. Length frequency and mean size of bank and starry rockfishes were not significantly different by area. The proportion of sites positive for individual species tended to be greater inside the CCAs for nine species, although significant differences occurred only for bank, bocaccio and starry rockfishes.

Oral Presentation

**Kelmartin, Ian**[1], J. Staton[1], T. Bean[1], T. Mulligan[1], and J. Tyburczy[2]
[1]Humboldt State University
[2]California Sea Grant

# Better together: Using collaborative fisheries research and machine learning to create high resolution habitat suitability models for three nearshore reef-associated fishes in Northern California

The habitat preferences of nearshore fishes along the Northern California coast remain poorly understood, a result of difficult-to-access habitat, relatively low fishing pressure compared to other regions of the state, and a lack of scientific infrastructure. This study used presence data gathered opportunistically from a collaborative hook and line survey, publicly available seafloor habitat data, and Maxent, an open source species distribution modeling software, to create habitat suitability models for Black Rockfish (*Sebastes melanops*), Canary Rockfish (*S. pinniger*), and Lingcod (*Ophidion elongatus*) off the coast of Cape Mendocino, Humboldt County, California. The three species were shown to occupy different environmental niches, driven by depth, habitat complexity, and proximity to reef edges. Techniques demonstrated in this work show that opportunistically gathered presence data, coupled with publically available data and open source software, can produce defensible habitat suitability models, which in turn could prove valuable in management of the complex suite of species pursued by sport and commercial fishers on the North Coast.

Poster Presentation

**Keppel, Elise**, and S. C. Anderson
Pacific Biological Station, Fisheries and Oceans Canada

# A reproducible annual data-synopsis report for British Columbia groundfish species

The combination of fishery dependent data, such as catch and effort, and fishery independent survey data, such as biomass indices and age compositions, forms the backbone of most fisheries stock assessments. For British Columbia groundfish fisheries, we collect vast quantities of such data with 100% at-sea observer coverage, 100% dockside monitoring of landings, and multiple trawl, trap, and hook-and-line surveys deployed annually. However, we lack the capacity to conduct formal stock assessments for most stocks annually, and therefore, much of this data is not regularly published or readily accessible. We are developing a reproducible report to give a snapshot of long-term and recent population and fishing trends and data availability for all British Columbia groundfish stocks of commercial and conservation interest. The report generation is fully automated — pulling data from databases, generating visualizations, and stitching the document together to facilitate annual publication. Our goals are: (1) to facilitate groundfish scientists and managers regularly reviewing trends in survey indices and stock composition to potentially flag stocks for prioritized assessment; (2) to generate standardized datasets and visualizations that will help assessment scientists develop operating models and select candidate management procedures as part of a planned management-procedure framework for data-limited groundfish stocks; and (3) to increase data transparency between Fisheries and Oceans Canada, the fishing industry, non-governmental organizations, and the public. We have developed an early version of the report and will be refining it based on consultation with other groundfish scientists, fisheries managers, industry representatives, and other interested parties.

Oral Presentation

**Kotwicki, Stan**[1], Jim Thorson[2], Robert Lauth[1], Wayne Palsson[1], Chris Rooper[1], and Michael Martin[1]
[1]NOAA Alaska Fisheries Science Center
[2]NOAA Northwest Fisheries Science Center

# Challenges and future directions for groundfish fisheries-independent surveys

The main goal of fisheries-independent surveys is to assess distributions and estimate indices of abundance of commercially important fish populations. These estimates are then directly used in fishery stock assessments and fisheries research to infer the status of stocks, ecosystem condition, and for forecasting. Because of their importance to management and fishery science, surveys are often required to follow strict standardized protocols to ensure survey data accuracy and consistency over time. However the consistency is often challenged by factors such as: varying catchability (due to varying sampling efficiency, vertical and spatial availability), reduction in survey effort (due to weather, vessel breakdowns, or budget constraints), developments of new survey technologies, new statistical analysis tools, new data requirements, species distribution shifts, etc. The need to address these challenges has been recognized, but the methods to address many of them have not been yet firmly established. We present an overview of major challenges faced by groundfish survey scientists in providing estimates of abundance and distribution for assessment and advice. We also provide an overview of existing methods which can be used to address some of the challenges. We show specific examples of deriving model-based abundance estimates by incorporating information about survey sampling efficiency and vertical availability. We show that spatio-temporal models can be used to address issues associated with spatial availability. Lastly we propose future research directions for survey and stock assessment scientists which have a potential to resolve some of present challenges.

Poster Presentation

**Kotwicki, Stan**, Liz Dawson, Alex De Robertis, and Kresimir Williams
NOAA Alaska Fisheries Science Center

## A remotely-operated, towed acoustic system for observation of fish behavior in front of trawls

Understanding fish behavioral response to approaching bottom trawls is important for fisheries research and commercial fishing. In commercial fishing, knowledge of fish behavior can be used to improve trawling efficiency for desirable species while avoiding bycatch. Fisheries surveys need this knowledge to understand sampling efficiency, selectivity, and availability of different species to the trawl. However, fish behavior in front of the trawl is difficult to observe. In the past, video cameras, and acoustic equipment were used to make these observations. However, video cameras have limited viewing range and require artificial lighting which can affect fish behavior. Acoustic equipment has a larger range, does not require artificial lighting, and is perceived as having no effect on fish behavior. However, the use of vessel or buoy -mounted acoustics to observe fish in front of the trawl is difficult. We designed a new acoustic observation system which can be towed behind a trawling vessel and remotely steered to access all the locations between the vessel and the trawl to observe fish abundance, distribution and behavior in front of the trawl. The remotely operated catamaran (ROC) is built on a catamaran platform and can be steered (side to side) using a towing winch and an electric motor. The ROC is currently scheduled to perform observations of walleye pollock behavior in front of the survey bottom trawl in the eastern Bering Sea (EBS) in summer 2018. These observations will provide data needed to estimate pollock vertical availability to the EBS bottom trawl survey.

Poster Presentation

**Krieger, Joseph**[1], Ashwin Sreenivasan[1], Anne H. Beaudreau[2], and Ron A. Heintz[1]
[1]NOAA Alaska Fisheries Science Center
[2]University of Alaska, Fairbanks

# Too hot, too cold, or just right? Temperature dependent growth and consumption of YOY Sablefish (*Anoplopoma fimbria*)

We are conducting a series of experiments to better understand how variable temperature and ration affect growth and energy allocation patterns of young-of-year (YOY) sablefish (*Anoplopoma fimbria*) in the Gulf of Alaska (GOA). Our goal is to assess how fall physiological condition of YOY sablefish translates to overwinter survival and subsequent year class success. To meet this goal we are conducting a series of controlled growth studies to understand how ration size, food quality and temperature influence growth and lipid energy allocation during feeding and energy loss rates during fasting. We began this work in 2016 when we fed YOY sablefish ad lib rations at 5, 8, 12, 16 and 20°C for three weeks followed by one week of fasting to assess how growth and metabolism relate to temperature. We found that growth was maximized at 15.3°C and metabolic rates were maximized at 12.0°C. However, fish fed ad lib rations probably do not represent trophic conditions of wild fish and may not fully capture the physiological response of sablefish to varying environmental conditions. An experiment underway is subjecting YOY sablefish to four temperature (7, 14, 18, 22°C) and three ration treatments (high, medium, low) for a growth period of 12 weeks. Physiological data (calorimetry, proximate composition, RNA/DNA ratios, length, mass) is being collected to determine how energy is allocated and prioritized (somatic growth vs. lipid storage) among tank treatments. Following this initial growth period, all fish will be starved for 12 weeks to mimic overwinter fasting. Information on growth, consumption rate, and respiration (derived from energy loss through fasting) will be used to outfit a Wisconsin type bioenergetics model. In addition, growth and physiological data obtained from the lab experiment will be used to generate a Dynamic Energy Budget (DEB) model capable of capturing the influence of variable environmental conditions on YOY sablefish physiology and survivorship. This DEB model will help inform managers by providing context to field observations of YOY sablefish, and provide a platform from which future population-level models may be integrated into existing fisheries management efforts in the GOA.

Oral Presentation

**Krutzikowsky, Gregory**
Oregon Department of Fish and Wildlife

## Good things from rocky landings: A video lander study of a nearshore rocky reef area off the Oregon coast

A video lander was used to survey an approximately 30.2 $km^2$ area of subtidal nearshore rocky reefs in the marine waters from Cape Foulweather to Alsea Bay Oregon. The focus of the work was on investigating the use of the video lander as a tool to characterize the fish community, habitat characteristics and the potential for a lander to provide density and abundance estimates for fish species. Sixteen fish species were observed, with the blue/deacon species complex being counted as one. The frequency at which species were observed varied from 53.1% of the 145 lander drops for kelp greenling to 0.7% for wolf-eel and tiger and yelloweye rockfish. Based on the sum of MaxN species counts, the maximum number visible in a single frame, ten species made up more than 99% of the fish identified to species with the remaining six species combined making up less than 1% of the total. We calculated density and abundance estimates for species observed and also compared the estimates for black rockfish, which had the highest density and abundance for the species observed, to abundance estimates derived from previous PIT tag work in the same area.

Oral Presentation

**Kuriyama, Peter**[1], T. A. Branch[1], D.S. Holland[2], and L. A. K. Barnett[2]
[1]University of Washington
[2]NOAA Northwest Fisheries Science Center

# Fleetwide responses to catch shares in the US West Coast Groundfish Fishery

Catch shares should result in declines in fleet size, while shifts in the spatial effort are difficult to predict. Catch shares were implemented in 2011 in the US West Coast Groundfish fishery. Individual quotas for the most overfished species can be as low as one fisher per year, and the risk of exceeding overfished species quotas is high. Due to this high risk, the spatial footprint of effort may be expected to contract and concentrate in areas with known species mixes. Additionally, communication and collaboration among fishers may increase. We measured shifts in fishing effort in each of the two years before and four years after catch share implementation, and fit random utility models to these data to measure port-specific behavioral changes. Fishing effort declined and concentrated in areas closer to the coast. Fine-scale individual vessel habits (within five kilometer radii), distance from port and the previous tow, and revenues were significant predictors of fishing locations ($p < 0.05$) in all ports in all years. There was also evidence that in Astoria and Newport, the two biggest ports, fishers were hesitant to fish in areas unfished recently by members of the fleet. Bycatch expectations, accounted for as the coast of purchasing quota for each species, did not affect location choices. Thus, somewhat to our surprise, fishing locations were better explained by habits, distance, and revenue, than by avoidance of costs associated with fishing in areas with the highest quota prices.

Oral Presentation

**Lacko, Lisa**[1], and Brent Seymour[2]
[1]Fisheries and Oceans Canada, Pacific Region
[2]Canadian Hydrographic Service

# Mapping bottom substrate in Northern British Columbia (B.C.), Canada

For many years, seafloor mapping techniques have employed the use of imagery data from multibeam echosounders. Methods of classifying acoustic data into bottom type maps have varied from skilled expert interpretation to unsupervised classification algorithms. In an effort to develop an automated, repeatable and quantitative method of seafloor classification, Random Forests (RF) machine-learning algorithm has been applied to acoustic data and video observations in Northern B.C. to produce classification maps and predicted probability surfaces. A RF is an ensemble approach that operates by constructing many regression or classification trees in which each tree predicts a value. The majority decision of all the trees in the forest is returned as the final categorical prediction. In the case of probability prediction, the mode of the trees in the forest is used. In addition to maps, RF returns an evaluation and assessment of the relative importance of the input variables that contribute to the final results. This study applied the RF model to over 4700 square kilometers of high resolution (5x5 m) multibeam bathymetry and backscatter data (collected by Canadian Hydrographic Service) in the Douglas Channel area and in the Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site. The results have obtained overall high prediction accuracy, AUC values and kappa coefficients. The RF model identified bathymetry as the most important predictor, followed closely by the variance derivative of backscatter. Results suggest that this method provides an objective and promising approach for predicting fine-scale seafloor bottom types.

Oral Presentation

**Lam, Laurel**[1], S. Hamilton[1], J. Samhouri[2], J. Cope[2], and B. Brown[1]
[1]Moss Landing Marine Laboratories
[2]NOAA Northwest Fisheries Science Center

# Spatial demographic and life-history variation in Lingcod (*Ophiodon elongatus*) along the U.S. West Coast

Fish populations are known to exhibit spatial variability in life history demography due to factors such as temperature, productivity, habitat, and fishing pressure. However, most stock assessment methods neglect to account for these differences and assume that life history traits are constant and unchanging across space and time. As a result, stocks are managed across broad geographic areas with catch quotas, size limits and other regulations applying equally in all places, running the risk of over-harvesting in one area while under-harvesting in another. In this study, Lingcod were collected throughout their U.S. range from 7 geographically distinct regions (Alaska to Southern California) in collaboration with volunteer anglers. We evaluated regional differences in Lingcod sizes and age structure, growth parameters, the timing at 50% maturity, and total mortality rates. Size structure, growth, and maturity rates were found to exhibit a latitudinal cline, where Lingcod in northern waters grew faster, larger, and matured at larger sizes than Lingcod in southern waters. Between sexes, females were found to grow slower, larger, and matured at larger sizes than males. There was no trend in total mortality. Overall, these findings demonstrate significant latitudinal and sex-based variability of life history traits and demography in Lingcod stocks. Implications for applying these findings to other groundfish species and stock assessment models will be discussed.

Poster Presentation

**Laman, Ned,** Chris Rooper, Lyle Britt, Stan Kotwicki, and Mark Zimmermann
NOAA Alaska Fisheries Science Center

## Do light levels in the water column represent Atka mackerel habitat in the Aleutian Islands?

Recent work describing essential fish habitat in the Aleutian Islands has shown that bottom depth, geographic location, and local slope were amongst the habitat covariates with the greatest leverage for predicting spatial distribution of adult Atka mackerel abundance. When selecting habitat covariates as a preliminary to that modeling effort, water column light measurements were considered and eliminated because they were intercorrelated with bottom depth. However, since Atka mackerel have many visually mediated behaviors related to mating, feeding, and diurnal vertical movements, we suspect that the availability of light in the water column could represent an important habitat consideration for this species. In the present study, we reconsider the prediction of Atka mackerel abundance across the Aleutian archipelago by including down-welling light data in the initial suite of habitat covariates that we subject to stepwise term selection while *a priori* eliminating other intercorrelated variables like bottom depth. By including on-bottom light levels when identifying the best-fitting generalized additive model formulation, we demonstrated that light levels influence spatial predictions of Atka mackerel abundance. This new formulation also provides a heuristic alternative to our previously published description of essential habitat for this species.

Poster Presentation

**Lawrence, Kelly**, L. Rasmuson, M. Blume, P. Rankin
Oregon Dept. of Fish and Wildlife

## Developing nearshore fishery-independent survey for semi-pelagic rockfish species

Currently, there are no synoptic fishery-independent surveys in Oregon's nearshore waters despite the economic importance of nearshore stocks. Our work aims to develop a survey of Oregon's semi-pelagic, schooling rockfish such as black and deacon rockfish (*Sebastes melanops* and *S. diaconus*). These species are generally found over rugose rocky reefs and occupy a larger depth range than their more benthic congeners. Hydroacoustic technologies are well developed for these types of species and habitats but require fisheries samples to be effective. Recent advances in underwater stereo cameras make them a viable tool to provide these data. However, most underwater camera platforms sit on the bottom substrate causing them to miss the majority of schooling rockfish. To address this data gap, we developed an anchored suspended stereo video camera system capable of being deployed at various depths off bottom. In order to obtain adequate stereo video footage for length measurements it was designed to remain upright and orient into the current. In addition to two forward looking stereo cameras, the platform has a downward looking camera to provide fish counts within the acoustic dead zone. The platform was outfitted with sensors to record depth, temperature, camera system tilt and optical back scattering. Tilt data can be used to improve hydroacoustic biomass estimates, and scattering data allows us to quantify fish detectability. Initial findings indicate that the combination of acoustic data and a stereo visual survey tool is an effective method for determining species composition and abundance of semi-pelagic species in Oregon's rocky reefs.

Oral Presentation

**Lefebvre, Lyndsey**[1,2], and John C. Field[2]

[1]Institute of Marine Science, University of California, Santa Cruz

[2]NOAA Southwest Fisheries Science Center, Fisheries Ecology Division

## Back to basics: Why basic life-history data remains essential in an age of advanced population models

The collection of basic life-history data, pertaining to areas such as population age-structure, growth rates, age or size at maturity, and reproductive potential, remain essential to informing accurate population stock assessments. While data pertaining to age and growth tend to be routinely collected and analyzed in order to continually update stock assessment parameters for managed species, parameters pertaining to reproduction, when available, tend to rely on individual studies and/or decades old data which often lack a thorough understanding of the reproductive strategy of a species. Herein we present examples of how either updating parameters or thoroughly examining the reproductive biology of a species can reveal population-level shifts in age or size at maturity (with an example based on Pacific sanddab, *Citharichthys sordidus*); inform estimates of maturity (based on an example with Blackgill rockfish, *Sebastes melanostomus*); provide more robust estimates of fecundity and reproductive complexity (an example with Petrale sole, *Eopsetta jordani*); and provide improved, more realistic estimates of reproductive output by accounting for multiple brooding in rockfish (based on an example with the multiple brooding Chilipepper rockfish, *S. goodei*). We discuss the relevance of these matters relative to accurate characterizations of population ecology as well as to properly informing stock assessments.

Oral Presentation

**Lindholm, James**[1], L. Lemon[1], J. Smith[1], and H. McGonigal[2]
[1]Institute for Applied Marine Ecology, California State University, Monterey Bay
[2]Fathom Consulting

## Quantification of habitat impacts under selected trawl modifications: a collaborative approach to pressing management questions

Bottom trawling has been shown to impact the seafloor, and associated biological communities, around the world. Considerably less is known about the nature of those impacts to the structural attributes of fish habitat, particularly in the unconsolidated sediments of the continental shelf. We quantified the relative impacts of traditional bottom trawl gear and modified trawl gear on the seafloor habitats that form an important component of Essential Fish Habitat (EFH) for many groundfish species on California's continental shelf. We collaborated with commercial fishermen and an NGO to conduct experimental trawling along the 140 m isobaths in an area off Santa Cruz (central coast of California). A remotely operated vehicle (ROV) was used to collect continuous video within two plots –one trawled by traditional gear and one trawled by the modified gear – before and after multiple trawl passes. Results indicate that both gear types produced statistically significant reductions in the numbers of biogenic mounds and depressions in the study plots, with the impact of the traditional bottom trawl exceeding that of the modified trawl for all metrics. Further, the total fuel consumed varied significantly between trawl types, again with the traditional trawl exceeding that of the modified trawl. In the context of on-going efforts to understand and manage fishing impacts, the results of our study suggest that modifications to bottom trawls that focus on minimizing bottom contact can provide the fishing community and managers with a credible option for limiting impacts to the seafloor.

Oral Presentation

**Lomeli, Mark**[1], and W. Waldo Wakefield[2]
[1]Pacific States Marine Fisheries Commission
[2]NOAA Northwest Fisheries Science Center

## Examining if artificial illumination can enhance Chinook salmon escapement out a Pacific hake midwater trawl

Bycatch of Chinook salmon, a prohibited species that currently has nine Endangered Species Act (ESA) listed Evolutionary Significant Units, is an issue affecting the Pacific hake fishery. Thus, developing or enhancing techniques that minimize Chinook salmon bycatch would have a positive impact in the Pacific hake fishery and support management priorities to protect ESA listed salmon. Recent research by Lomeli and Wakefield (2016) in the Pacific hake fishery has demonstrated the ability to attract Chinook salmon towards and out specific escape windows of a bycatch reduction device (BRD) using artificial illumination (LED lights). The data also suggested that illumination could be used to enhance their escapement overall. The initial study used video camera systems to observe Chinook salmon behavior and escapement. Building off prior findings, in 2017, we specifically tested if artificial illumination can enhance the overall escapement of Chinook salmon by comparing their escapement rates out a BRD between tows conducted with and without the use of artificial illumination. A recapture net was designed and incorporated into the trawl to quantify fish escapement out the BRD. Project results and future research directions will be discussed.

Oral Presentation

**Lowry, Dayv**
Washington Department of Fish and Wildlife

## Introduction to TSC session: Ups and downs of descending device policy and science, and a summary of descending device regulations, outreach, and usage in Washington

The Canada-US Groundfish Committee consists of representatives from state and federal government agencies that manage natural resources and fisheries from Alaska to California. The Technical Subcommittee (TSC) was formed in 1959 to: 1) exchange groundfish stock status information among partners; 2) promote cooperative research to support sound management; 3) review the technical merit of existing management and conservation strategies; and 4) communicate recommendations and documentation to policy makers. In addition to meeting annually, since its creation the TSC has organized workshops that include academic and non-governmental partners to address shared challenges and concerns that span multiple jurisdictions. With declines of numerous rockfish stocks along the West Coast in recent decades, a plethora of conservative management approaches have developed. Facing closed areas, reduced bag limits, and in some cases complete harvest prohibitions in recreational fisheries, managers and anglers alike have eagerly sought tools and strategies to reduce fishery impacts. When brought rapidly to the surface by anglers, rockfish often experience barotrauma that can lead to direct and indirect mortality. One area of recent conservation focus along the coast has been on the use of descending devices as a promising tool to minimize post-release mortality. In this session recent research and policy actions pertinent to the efficacy and use of descending device along the west coast will be presented by diverse scientists and managers. The session starts with a review of descending device regulations, outreach efforts, and usage in Washington waters, where devices are now required for all targeted groundfish fisheries.

Poster Presentation

**Malecha, Patrick[1],** Kalei Shotwell[1], and Erika Ammann[2]
[1]NOAA Alaska Fisheries Science Center, Auke Bay Laboratories
[2]NOAA Alaska Region, Habitat Conservation Division, NMFS Restoration Center

# Recruitment and response to damage of an Alaskan gorgonian coral

Coldwater corals are particularly sensitive to disturbance and their recovery is likely protracted because they are long-lived, grow slowly, and are believed to have low rates of reproduction. Recruitment and recovery data for coldwater corals are extremely limited. This information is key to understanding long-term effects of anthropogenic disturbances such as, commercial fishing, on the population dynamics of this important benthic habitat. A multi-year study was initiated in Kelp Bay, Southeast Alaska, where hundreds of colonies of the coldwater gorgonian coral *Calcigorgia spiculifera* are concentrated at depths (17-25 m) easily accessible to scuba divers. The objective of the research was to simultaneously observe: 1) coral recruitment, and 2) coral growth and recovery from damage. Recruitment was investigated by observing settlement of coral planulae onto natural rock tiles. Coral growth and recovery was examined by observing the response of coral colonies to damage treatments designed to mimic trawl disturbances. Although we observed a minimal amount of recruitment over the five years of the study, these observations may be the first documented coldwater coral recruitment events known in Alaska. Survival varied among treatment groups (63%-100%) and growth and recovery of damaged coral tissues showed a wide range of responses among treatments. The body plan of *C. spiculifera* is similar to many other gorgonian corals commonly found throughout the North Pacific Ocean. Therefore, sensitivity to disturbance, rate of recovery, and recruitment are likely to be similar. Thus results from this research could be applied broadly in habitat assessments on less accessible corals.

Oral Presentation

**Marion, Scott,** and Jessica Moye
Oregon Department of Fish and Wildlife

# Comparison of substrate-based groundfish density extrapolations with habitat suitability models for nearshore rocky reefs

Nearshore rocky reef systems along the Oregon coast support diverse and abundant groundfish stocks, but the difficulty of generating density estimates contributes to uncertainty about scale in stock assessments. The Oregon Department of Fish and Wildlife conducts remotely operated vehicle (ROV) video surveys which provide fishery-independent data on the abundance and distribution of fish in these untrawlable habitats. These data were used in conjunction with seafloor mapping data (variable resolution multibeam bathymetry and geologic substrate classification) to explore multiple methods of generating regional fish abundance estimates. We utilized three approaches for these estimates: 1) density extrapolations across generalized areas of hard substrate, 2) density extrapolations across substrate-specific geologic areas, and 3) generalized additive models (GAMs) using environmental predictor variables derived from bathymetry data to estimate abundance according to suitable habitat. We compared these three approaches using an ROV survey conducted at Redfish Rocks Marine Reserve in 2010. The consistency and generality of the models were then assessed with data from a second survey of Redfish Rocks in 2016, and from a different study site in 2017. Comparison of the model-based estimates of abundance with estimates created from the area-based and substrate-based density extrapolations illustrates the broad range in abundance estimates potentially resulting from different assumptions about species' use of particular habitats. Results provide insight into species-specific spatial distributions and habitat associations, and inform the selection of methods for extrapolating survey data to larger scale abundance estimates.

Poster Presentation

**Matta, Beth**[1], and Matthew Baker[2]
[1]NOAA Alaska Fisheries Science Center
[2]North Pacific Research Board & University of Washington

# Regional differences in age and growth of Pacific sand lance *Ammodytes personatus* within the Gulf of Alaska large marine ecosystem: Evidence for a latitudinal gradient

Pacific sand lance (*Ammodytes personatus*) are an important component of the forage base for many species of marine birds, mammals and fishes. Despite this, very little is known regarding basic life history parameters for this species. Biological information on age, growth, reproduction, and mortality is particularly lacking for sand lance in the Salish Sea, an inland sea that encompasses the San Juan Archipelago. Here, we present information on age and growth of sand lance from this region, and then contrast it with a previous study based in Cook Inlet, Alaska. These two regions comprise the latitudinal extremes of the Gulf of Alaska large marine ecosystem, defined largely by circulation of large oceanic currents including the Alaska Coastal Current, which extends from northern Washington State through coastal British Columbia and Alaska to Unimak Pass. We found dramatic differences in growth of sand lance between the two regions, with San Juan Island fish being much smaller-at-age than fish in Alaska. We interpret these results with respect to regional temperature differences, which we hypothesize impacts the period of winter dormancy employed by this species as a strategy to cope with resource limitation.

Oral Presentation

**Mattes, Lynn**
Oregon Department of Fish and Wildlife

## Descending Devices: Incorporating the Science into Fisheries Management

Non-retention of US West Coast rockfish species in fisheries, due to overfishing status or harvest caps, has led to increasing use of descending devices in recreational fisheries for fish which cannot overcome the capture effects of an overinflated swimbladder, and may not be able to descend to depth without assistance. Researchers have produced a significant body of work on the effects of barotrauma, and the use of descending devices to release back to depth and recompress captured rockfish species. Fisheries managers have been tasked with incorporating that research into management analyses to more accurately account for discard mortality when anglers use descending devices. To complete this task, species-specific mortality rates which incorporate the use of descending devices had to be developed, and then approved by the Pacific Fishery Management Council. Once rates were approved, the states could proceed to: (1) incorporate into tracking and management of fisheries, the estimations of discard mortality when descending devices are used, and (2) conduct public outreach on the importance of using descending devices. This talk will describe this process, using yelloweye rockfish (*Sebastes ruberrimus*) and canary rockfish (*Sebastes pinniger*) in Oregon recreational fisheries as an example.

Oral Presentation

**McDermott, Susanne**[1] , Kimberly Rand[1], Mike Levine[2], David Bryan[2], and Jim Ianelli[1]
[1]NOAA Alaska Fisheries Science Center
[2]Pacific States Marine Fisheries Commission

# Seasonal distribution and relative abundance of Steller Sea lion groundfish prey in the Aleutian Islands

Groundfish stocks in Alaska are managed at large scales (i.e., 100's of km); however, important ecological interactions, such as predation, spawning and habitat selection occur on local scales (i.e., 10's of km). Furthermore, commercial fishing is an activity with potential for localized effects. In 1997, the Aleutian Island's western stock of the Steller sea lion (*Eumetopias jubatus*) population was declared endangered. One of the hypotheses for their decline was competition between the commercial groundfish fishery and Steller sea lions for prey. In order to better understand the effects of fishing on a local scale we assessed Steller sea lion prey distribution around rookeries and haulouts in the western and eastern Aleutian Islands during the fall and winter. The focus was primarily the dominant prey, Atka mackerel (*Pleurogrammus monopterygius*); We conducted a large scale tagging study to estimate local abundances and movement and exploitation rates of Atka mackerel near Steller sea lion rookeries and haulouts in areas of commercial fishing activities at scales relevant to sea lion foraging (i.e., 10's of km). We also examined prey distribution patters and relative abundance of northern rockfish (*Sebastes policspinis*), Pacific cod (*Gadus macrocephalus*, Pacific Ocean perch (*Sebastes alutus*) and walleye pollock (*Theragra chalcogramma*). We related fish distribution and relative abundance to several metrics such as distance to rookeries and haulouts and environmental variables such as depth and temperature. We compared results from the western Aleutian Islands, where sea lion populations continue to decline, to a location in the eastern Aleutian Islands, where sea lion populations have been stable. Atka mackerel showed some movement at smaller scales but no significant movement between management areas. Total abundance, average size, and CPUE of Atka mackerel was lower in the western Aleutians, whereas relative abundance of Northern rockfish was higher. The results of these studies contribute to an improved understanding of interactions between sea lions and groundfish and the commercial fishery.

Oral Presentation

**McElderry, Howard**, and M. J. Pria
Archipelago Marine Research Ltd.

# The future of fisheries monitoring

Today's modern commercial fisheries are data hungry, challenged to satisfy the information requirements of management, science, market, business operations and social license. These needs are met in a variety of ways but independent monitoring is the gold standard for comprehensive and verifiable fisheries-dependent data. Available monitoring methods include observer programs and, more recently, electronic monitoring (EM). These tools are employed in various ways, each having a unique suite of strengths, limitations, operational needs, and costs. As well, and often ignored, fisheries governance needs to be tailored to, and evolve with, the monitoring approach considered. In practice, independent monitoring, as currently conducted, is limited in scope. Total commercial fleet coverage nationwide in Canada and the US is less than 10% and is far less in other developed nations. Globally, many fisheries are not monitored and those that are have low sample rates. While full or even partial monitoring may not be required in many instances, the list is long of fisheries with inadequate levels, given their information requirements. Despite the need, increased coverage is often impractical for multiple reasons, cost being the most significant. EM may offer savings over observer programs, which perhaps may increase as technology advances, yet independent monitoring will continue to be too costly for many fisheries. The mismatch between information aspirations and monitoring capacity is not solved by simply increasing funding. Foundational changes to governance, engagement, individualized responsibility, accountability and societal expectations will also be necessary to support the rich information needs of sustainable, well-managed fisheries.

Poster Presentation

**Mcknight, Caroline,** Oliviya Wyse, and Melanie Parker
California Department of Fish and Wildlife

## Get hooked on descending! CDFW barotrauma education for recreational anglers

Over the last decade, the California Department of Fish and Wildlife has been educating recreational anglers on the importance of releasing rockfish (*Sebastes* spp.). In 2007, CDFW developed a flyer in partnership with CA Sea Grant that describes barotrauma and techniques for minimizing injuries, which has been distributed at various outreach and education events across the state. In 2016, CDFW expanded its outreach efforts to include other media platforms to continue educating recreational anglers about barotrauma and the importance of using of a descending device to recompress rockfish. CDFW embarked on gathering underwater video to demonstrate how recompression can return a rockfish with significant external pressure injuries back to a functional swimming state. CDFW also launched a new website that contains instructional videos on rigging descending devices, benefits of using descending devices, and references to scientifically peer-reviewed literature on barotrauma and survivability in rockfish species.

Poster Presentation

**Meyer, Kathryn**
California Department of Fish and Wildlife

# California Halibut population status through 2016: assessment results and key uncertainties

California Halibut (*Paralichthys californicus*) have supported commercial and recreational fisheries along the coast of California since the 1880s, yet our understanding of the population status has only recently improved. In 2010, the first formal assessment was conducted on two separate populations along the coast of California using data beginning in 1971 (Maunder et al 2011). The separation of halibut into two populations, one north and one south of Point Arguello (Santa Barbara County), was motivated by tagging data which suggests that movement is somewhat limited by this oceanographic break. The decision to model separate populations was further supported by different exploitation and management histories within each region. Each population was evaluated using an age structured, two-sex model in Stock Synthesis fit to standardized catch-per-unit effort (CPUE) based indices of abundance from the commercial passenger fishing vessel fleet. The northern model was also fit to a CPUE-based index of abundance from the trawl fleet. I provide an update to the previous assessment with data through 2016 using the same basic modeling framework, but with several changes to reflect improvements in our understanding of the species biology and with a more objective approach to standardizing the CPUE-based indices. Model results are presented along with sensitivity analyses of the biological parameters, the CPUE indices, and the method of assigning catch to each sector. The results are followed by a discussion of the underlying assumptions of the modeling framework, in particular population structure along the California coast and across the U.S.-Mexico border.

Oral Presentation

**Neidetcher, Sandi**
NOAA Alaska Fisheries Science Center

# Fecundity estimates for walleye pollock, *Gadus chalcogrammus*, during varying climate conditions

Atresia, or oocyte resorption, may occur to remove abnormal or damaged oocytes or as a means of adjust resource allocation toward reproduction as in down-regulation. High levels of atresia may result from anomalous water temperatures during late stage oocyte development and spawning, or may result indirectly from limited nutrient intake if temperature conditions limit prey availability. Because female spawning biomass is used as a proxy for reproductive output in stock analysis of walleye pollock, (*Gadus chalcogrammus*) understanding the processes associated with atresia are important for stock assessments. For this work we analyzed fecundity data and the occurrence of atresia in pollock in the Bering Sea and Gulf of Alaska over a 20 year time period. We found both interannual and regional variability in fecundity over the duration of the time series and increased levels of atresia during years of unusually warm water temperatures in the Gulf of Alaska.

Oral Presentation

**Nishimoto, Mary**[1], R.D. Simons[2], and M. Love[1]
[1]Marine Science Institute, University of California, Santa Barbara
[2]Earth Research Institute, University of California, Santa Barbara

# The connectivity of offshore oil production platforms as sources of larvae recruiting to coastal shelf zones in the Southern California Bight

We quantified the connectivity of offshore larval source localities to coastal shelf zone regions in the Southern California Bight (SCB) by employing a Lagrangian particle tracking method driven by three-dimensional circulation simulations from a Regional Ocean Modeling system (ROMS). A diverse assemblage of adult reef fishes occurs at offshore oil production platforms, and many of the species persist and potentially reproduce at these artificial reef structures. At each of three offshore oil production platforms, particles were released every 3 hours for 12 years (1996-2007) from vertical intervals of 0.25 meters from 1 to 80 meters below the surface, the depth range of the planktonic larvae of most rocky reef dwelling fishes that occur at the platforms in the SCB. The passive transport trajectories of all the particles released were tracked for 30 days and transformed into long-term seasonal averages of two-dimensional Lagrangian probability density functions (PDFs) in the SCB for each platform. Findings will be presented which show that the expected larval dispersal patterns are dependent upon the location of the platform and the seasonality of particle releases, i.e., spawning. The PDFs for a platform are associated with complex coastal bathymetry of the region and distinctive circulation patterns. Given the location-dependence of larval dispersal, an evaluation of the options of either removing a platform or leaving part of it in place, should include estimates of the platform habitat's connectivity to natural coastal habitat and its contribution as a source of recruitment.

Oral Presentation

**Pacunski, Robert**[1], D. Lowry[1], C. Rooper[2], D. Tonnes[2], and J. Pirtle[3]
[1]Washington Departmentof Fish and Wildlife
[2]NOAA West Coast Region
[3]NOAA Alaska Fisheries Science Center

## Using species distribution modeling as a survey design tool for assessing Yelloweye Rockfish in the southern Salish Sea

Yelloweye rockfish in the Puget Sound/Georgia Basin were listed as Threatened under the Endangered Species Act in 2010 and recovery planning requires an estimate of population size near the time of listing to evaluate recovery trajectories and promulgate effective management strategies. Due to the species affinity for patchily distributed, complex habitats (e.g., rock piles) within the geographic range of the Distinct Population Segment (DPS), a habitat-stratified survey would be preferred in order to maximize detection probability and produce statistically valid abundance estimates. However, the lack of accurate habitat data within the DPS necessitated an alternative design approach. Over the past decade, species distribution models (SDMs) have been widely used to predict habitat suitability and/or probability of occurrence, especially for rare species with limited survey data. In 2015-16, the WDFW and NOAA used a Maximum Entropy (MaxEnt) SDM to design and conduct a remotely operated vehicle survey for Yelloweye Rockfish in Puget Sound that produced an acceptably precise population estimate. This result, and a post hoc exercise showing that a systematic survey design would require at least a 5-fold increase in sampling effort to achieve similar results, validated our use of a MaxEnt SDM as a practical survey design tool for assessing a data-poor population. Until ground-truthed habitat maps become available, fish location data collected in recent surveys and on-going studies will be used to update the SDM and design future surveys that will allow the WDFW to provide timely assessments of listed rockfish, as called for in the recovery plan.

Poster Presentation

**Palmisciano, Melissa**[1], N. S. Kashef[2,3], D. M. Stafford[2,3], K. V. Saksa[1], S. M. Sogard[2], C. A. Logan[4], and S. L. Hamilton[1]

[1]Moss Landing Marine Laboratories

[2]NOAA Southwest Fisheries Science Center, Fisheries Ecology Division

[3]University of California, Santa Cruz

[4]California State University, Monterey Bay

# Physiological resilience of juvenile copper (*Sebastes caurinus*) and gopher (*S. carnatus*) rockfish to projecting upwelling conditions

In the California Current ecosystem, spring upwelling transports deep $CO_2$-rich, low dissolved oxygen (DO) water onto the coastal shelf. Global climate change is expected to increase the frequency and severity of upwelling events, while triggering large-scale changes in ocean chemistry such as intensifying ocean acidification (OA) and deoxygenation. Due to the timing and location of settlement, nearshore-recruiting juvenile rockfish species such as Copper (*Sebastes caurinus*) and Gopher (*S. carnatus*) Rockfish may be particularly vulnerable to elevated $pCO_2$ and hypoxia. To determine how future projected upwelling conditions will impact rockfish fitness, we exposed juveniles to a periodic extreme upwelling treatment (a recurring cycle of 8 days of 7.3 pH, 2.0 mg/L DO, followed by 8 days of recovery at ambient conditions), two static reduced pH/DO treatments (extreme at 7.3 pH, 2.0 mg/L DO and moderate at 7.5 pH, 4.0 mg/L DO), and a static ambient treatment (~8.0 pH, ~8.0 mg/L DO). We compared critical swimming performance (Ucrit) and capacity for aerobic activity (aerobic scope) among treatments and before and after exposure in the fluctuating upwelling-relaxation treatment. Fish in the extreme static and fluctuating upwelling treatments showed significantly reduced swimming performance and depressed aerobic scope. During the relaxation phase of the cycle, swimming performance and aerobic scope for juveniles in the fluctuating treatment were equal to those of control fish, suggesting full recovery from physiological impairment. This study will help elucidate the species-specific physiological resilience of rockfishes to OA and hypoxia at a critical life history stage.

Oral Presentation

**Perkins, Nicholas**[1,2], Avishek Chakraborty[3], Michael Prall[2], and Steven Morgan[1]
[1]University of California, Davis
[2]California Department of Fish and Wildlife
[3]University of Arkansas

# Spatial point process models for visual survey data: a tool for abundance estimation and exploring sampling design

Visual survey methods such as ROVs are increasingly being used for abundance estimation of nearshore groundfish species. Large spatial areas can be surveyed and the location of individual fish recorded with high precision. These methods have been extensively utilized in monitoring California's MPA network beyond SCUBA depths providing opportunity to inform nearshore species management. The majority of California's nearshore rocky reefs, have now been mapped with multibeam sonar providing a rich source of habitat and bathymetry derived variables with which to relate the distribution of fish. Previous research has shown that models utilizing data from visual surveys and bathymetry derived variables can provide predictive maps of species distributions and estimates of abundance. However, previous work has not accounted for spatial autocorrelation, which may be significant in these data sets. We explore spatial point process models for estimating abundance of nearshore groundfish species. These models use the geolocated positions of observed fish by a ROV in combination with environmental covariates whilst explicitly accounting for spatial autocorrelation. We argue that such models have advantages over non-spatial models as incorporating spatial dependence allows improved predictive performance at unsampled locations, providing more accurate estimates of abundance and associated uncertainty. Moreover, they can capture the effect of any spatially varying environmental factor that is not adequately represented by the available pool of covariates. We also show how these models can be used as a framework for exploring sampling design to determine the sampling required for precise estimates and to detect change.

Oral Presentation

**Petersen, Joe**, and Jonathan Scordino
Makah Tribe

# Bycatch reduction in directed halibut fisheries with the Makah Tribe's traditional halibut hook

The mortality of non-target fish species caught during recreational and commercial Pacific halibut (*Hippoglossus stenolepis*; hereafter halibut) fisheries is a management concern that has led to the closure of fishing areas. Non-target fish that are hooked and released during halibut fisheries are often killed due to injuries received from the hook, barotrauma, or increased vulnerability to predators. The development of a hook that selectively catches halibut while minimizing catch of non-target species would improve the sustainability of the fishery. Ethnographic records state that the traditional halibut hook for the Makah Tribe (the čibu·d) was designed to selectively catch halibut. We tested the hypothesis that čibu·d are more selective than contemporarily fished circle hooks in longline and recreational fisheries. Results of our longline study showed that 13/0 circle hooks caught 9.6 times more halibut than a brass čibu·d but also landed 61 times more bycatch on a demersal longline. Our recreational fishing study showed paired 8/0 circle hooks caught 2.8 halibut for every halibut landed on a čibu·d but landed 26.3 times more bycatch. In 2017 we started a study to evaluate if design changes improved the performance of the čibu·d for catching halibut. Our preliminary results show an improvement of halibut catch efficiency but also that the new design caught more bycatch. Our research on improving catch rates of halibut on čibu·d while maintaining low bycatch ratios will continue this next spring with modifications to the material used to make the čibu·d.

Oral Presentation

**Pien, Catarina**[1], Joseph J. Bizzarro[2,3], and David A. Ebert[1]
[1]Pacific Shark Research Center, Moss Landing Marine Laboratories
[2]University of California, Santa Cruz
[3]NOAA Southwest Fisheries Science Center, Santa Cruz, CA

## Changes in the elasmobranch assemblage in Elkhorn Slough, CA

Elkhorn Slough is an estuarine embayment that drains directly into the Monterey Bay. Over the last few decades, the Slough has undergone several natural and anthropogenic changes, which have greatly altered the environment into becoming a more marine habitat, with higher current flow, tidal prism, and rates of erosion. Along with these physical changes, the biological composition of elasmobranchs has also changed over time. This study aims to characterize the elasmobranch species currently using Elkhorn Slough, and to understand which variables influence their presence, as well as their abundance. Between April 2015 and August 2016, longlines and gillnets were used to sample elasmobranchs. Specimens were measured, sexed, and their locations were recorded. Multivariate statistics were used to analyze the influence of oceanographic variables on the observed patterns in elasmobranch abundance, such as patterns of seasonal migration, and segregation of species at different life history stages. By using historical shark derby data, larger-scale oceanographic drivers were also assessed to examine their influence on the elasmobranch species assemblage over several decades. Attaining a better understanding of the current species assemblage, and the broader factors influencing these species will allow for better management of these important top predators and of Elkhorn Slough, especially as this dynamic estuary continues to evolve.

Oral Presentation

**Pirtle, Jodi**[1], Esther Goldstein[2], Janet Duffy-Anderson[3], Matt Wilson[3], William Stockhausen[3], Mark Zimmerman[3], and Calvin Mordy[4]
[1]NOAA Alaska Region
[2]National Academy of Sciences, National Research Council
[3]NOAA Alaska Fisheries Science Center
[4]Joint Institute for the Study of the Atmosphere and Ocean, University of Washington

# Dispersal, cross-shelf transport, and the delivery of larval Arrowtooth Flounder (*Atheresthes stomias*) to suitable nursery habitats in the Gulf of Alaska

Arrowtooth flounder (ATF: *Atheresthes stomias*), an ecologically important predator, spawns along the continental slope in water depths of ~400-500 meters, and after a pelagic larval duration of several months, late-stage larvae settle to juvenile nursery habitats in shallower water on the continental shelf. The successful transition between the pelagic larval stage and demersal juvenile stage is influenced by two major processes: 1) dispersal and along-shelf transport of larvae, and 2) cross-shelf transport from offshore pelagic habitats to high quality inshore nursery habitats. Here we utilize an individual-based biophysical model (IBM) paired with a juvenile nursery habitat model to determine the mechanisms that promote coupling between these processes to influence survival to recruitment during this critical early life history transition. IBM results suggest that inter-annual oceanographic variability influences larval along-shelf transport with implications for local retention, long distance dispersal, and regional connectivity. Submarine canyons along the continental slope are important conduits of shelf-ward transport for larvae. Eddies influence local retention and the geographic location of cross-shelf transport and the degree to which larvae are successfully transported from offshore pelagic habitats to inshore nursery habitats. These findings suggest that in the heterogeneous marine environment of the Gulf of Alaska, dispersal, transport, and offshore to inshore habitat connectivity are mediated by the interaction between persistent topographic features and transient oceanographic processes that ultimately affect survival and recruitment for these early life stages.

Oral Presentation

**Planas, Josep**[1], and Thomas P. Hurst[2]
[1]International Pacific Halibut Commission
[2]NOAA Alaska Fisheries Science Center

# Identification of molecular growth signatures in skeletal muscle of juvenile Pacific halibut (*Hippoglossus stenolepis*) for monitoring growth patterns in the Pacific halibut population

The International Pacific Halibut Commission has reported changes in the size-at-age (SAA) of Pacific halibut (*Hippoglossus stenolepis*) caught in the commercial fishery as well as in its own survey research for almost 100 years. However, our understanding of the potential causes for the long-term variability in SAA is still rather scarce. Although a number of factors could be contributing to this variability, recent analyses have suggested that temperature variation may have been a contributing factor to the observed changes in SAA in the Pacific halibut. Therefore, there is an urgent need to better understand the physiological effects of temperature on growth in this species. In order to address this issue, we have conducted studies investigating the transcriptomic effects of temperature on white skeletal muscle in juvenile Pacific halibut acclimated for 8 weeks to 2°C and 9°C. Acclimation at 2°C resulted in a significant reduction in the specific growth rate (SGR) of juvenile Pacific halibut when compared to fish acclimated at 9°C. At the end of this acclimation period, fish previously acclimated at 2°C were gradually brought up to 9°C and held at 9°C for 6 additional weeks. This resulted in a significant increase in SGR when compared to fish that were constantly held at 9°C. The transcriptomic responses of white skeletal muscle from fish experiencing temperature-induced growth suppression and growth compensation were analyzed by RNA sequencing (Illumina). The resulting molecular signatures of temperature-regulated growth will be useful to investigate potential changes in growth patterns in Pacific halibut.

Poster Presentation

**Planas, Josep**, Claude L. Dykstra, Tracee Geernaert, and Timothy Loher
International Pacific Halibut Commission

## Assessment of reproductive development in female Pacific halibut (*Hippoglossus stenolepis*)

Current maturity estimates in female Pacific halibut are derived from macroscopic visual criteria of the ovaries collected in the field. In order to improve maturity estimates and to provide updated estimates of maturity-at-age, the International Pacific Halibut Commission (IPHC) is conducting studies destined to improve our knowledge on reproductive development in female Pacific halibut. In an initial study, Pacific halibut females from three geographical locations throughout the distribution range of the species were collected during the summer, or non-spawning season, and during the winter, or spawning season. Histological examination of ovaries of winter- and summer-caught females evidenced differences in oocyte size distribution and predominant oocyte stages that appeared to be relatively consistent with females sexually maturing in the winter and with females undergoing vitellogenesis in the summer, as a prerequisite for spawning in the winter. Current studies are devoted to describe the entire annual reproductive cycle of the species and to study in detail morphological, histological, endocrine and functional changes in both female and male gonads. These studies will lead to a better understanding of the temporal and spatial progression of sexual maturation in Pacific halibut females, and to a better estimate of maturity for stock assessment purposes.

Poster Presentation

**Prall, Michael**[1], Nicholas Perkins[1,2], and Andrew Lauermann[3]
[1]California Department of Fish and Wildlife
[2]University of California, Davis
[3]Marine Applied Research and Exploration

# A multivariate analysis of fish species assemblages across California's mid-depth (20-90 meters) rocky reefs from recent statewide remotely operated vehicle surveys

Between 2014 and 2016 California Department of Fish and Wildlife and Marine Applied Research and Exploration completed a comprehensive visual survey of 148 rocky reef locations across California's jurisdictional waters using a Remotely Operated Vehicle. These surveys were spatially extensive, spanning from Crescent City (Del Norte County) to San Diego (San Diego County), and were conducted with a standardized protocol. Mean densities of fish species at 120 locations were calculated from replicate 500 meter long video swath transects with depths ranging between 20 – 90 meters. Multivariate PRIMER analysis was used to examine similarity of species assemblages across sites. SIMPROF analysis at the 0.1 significance level provided 21 distinct groupings of fish assemblages across the surveyed sites. These groupings are shown in a multidimensional scaling plot. A statewide map of these assemblage groupings shows that defined groups often fall within distinct geographical regions. A key displaying the species contributing the most to each grouping is provided. Additionally, the mean density of select fish species are presented across the study sites, giving a broad range of latitudinal gradients of densities across the state.

Poster Presentation

**Rasmuson, Leif**, P. Rankin, L. Kautzi, K. Lawrence, and M. Blume
Oregon Department of Fish and Wildlife

## Comparison of nearshore and offshore Deacon Rockfish stock structure

The newly described Deacon Rockfish (*Sebastes diaconus*) occurs in both the nearshore and deeper offshore waters of Oregon, and experiences distinctly different fishing pressures by area. Little is known about the differences between these two groups and the potential implications for fisheries management, as landings data are largely comprised of nearshore females. The goal of this project was to compare fish from both areas by collecting specimens monthly throughout a one-year period to evaluate differences in age, sexual maturity and gender distribution across all size classes. From December 2016 - November 2017, 888 Deacon Rockfish were collected, using hook and line, on central Oregon nearshore reefs and offshore at Stonewall Bank. We found that 63% of the fish captured in the nearshore and 67% in the offshore were females. Visual maturity methods (histology pending) indicate that 74% of the nearshore females were immature compared to 9% of the offshore. Males were less divergent with 77% of the nearshore being immature and 24% of the offshore being immature. Otoliths were aged and analyzed using otolith shape analysis. For both groups and sexes, the youngest fish were 0-1 yr. The mean (max) age for nearshore females was 4.3 (23) yrs versus 10.2 (32) yrs for offshore females. The mean (max) age for nearshore males was 3.8 (22) yrs versus 9.5 (26) yrs. Results of initial otolith shape analysis indicate that these two groups may be separate stocks. The implications for these findings for fisheries management are discussed.

Oral Presentation

**Rogers, Lauren,** and A. Dougherty
NOAA Alaska Fisheries Science Center

## Shifting spawn timing in Gulf of Alaska walleye pollock

The timing of spawning in marine fishes is key for delivering larval offspring to suitable habitats at a time when sufficient prey are available. While spawning time is relatively fixed in some species, others show flexibility depending on thermal conditions, as well as variation among individuals within a population. Such interannual and intrapopulation variation in spawn timing can have consequences for match or mismatch of first-feeding larvae with production of prey, and subsequent recruitment success. In this study, we use 30+ years of data from larval surveys to reconstruct timing of walleye pollock spawning in Shelikof Strait, the primary pollock spawning grounds in the Gulf of Alaska. We find evidence that the mean date of spawning has varied by three weeks over the last three decades. Most of the interannual variation in mean spawn date can be explained by mean age of the spawning stock and temperature during spawning, with an older spawning stock and warmer temperatures leading to early spawning. Variance in spawn timing also increased in warmer years and when the spawning stock was older, which has the potential to reduce recruitment variability through a portfolio effect (i.e. though a broader distribution of larval hatch dates). These results illustrate the potential interacting effects of changes in climate and demography on spawn timing and recruitment of marine fishes.

Oral Presentation

**Rooney, Sean[1,2],** B.N. Tissot[3], and C. Rooper[2]
[1]Washington State University
[2]NOAA Alaska Fisheries Science Center
[3]Humboldt State University

## Using species distribution models to describe deep-sea coral and sponge habitats on Oregon's continental shelf

Deep-sea coral and sponge (DSCS) are key components of marine ecosystems. They provide habitats for fish and invertebrate communities. Many DSCS are slow growing and long lived, making them vulnerable to impacts from bottom contact fishing gear. Management of vulnerable species such as DSCS requires an effective understanding of their distributions. The objective of this analysis was to construct models to predict the distribution of five sponge and one coral taxa on Heceta Bank, Oregon. Two statistical modeling approaches were utilized: maximum entropy (MaxEnt) and generalized additive modeling (GAMs). Models were constructed using observations from remotely operated vehicle (ROV) surveys, coupled with independent covariates derived from high resolution multi-beam bathymetry (10 m), satellite data, and oceanographic models. Model performance measures indicated that most MaxEnt and GAMs models achieved robust fits; but they did not clearly indicate a preferred modeling method across all conditions. The model results showed DSCS distributions were strongly influenced by bathymetric position index (BPI) and water depth, possibly indicative of reduced sedimentation or increased food-delivery processes related to moderate to high currents near the shelf break. The majority of high suitability DSCS habitats were also predicted to occur outside of the existing Heceta Bank Essential Fish Habitat (EFH) bottom trawl closure. The Pacific Fishery Management Council is currently conducting a review of essential fish habitat for federally managed groundfish species. The results of this study could help inform the current EFH review to more effectively locate and manage these species.

Poster Presentation

**Rooper, Chris,** P. Goddard, and R. Wilborn
NOAA Alaska Fisheries Science Center

## Are fish associations with corals and sponges more than an affinity to structure: evidence across two divergent ecosystems

The role of deep-sea coral and sponge communities as habitat for marine fishes has been widely deliberated. Almost all studies that have looked for associations between corals and sponges and fishes (especially rockfishes) have found significant relationships. However, rockfishes also thrive in areas largely devoid of corals and sponges. The objective of this study was to compare the association of fish species with deep-sea coral and sponges and other available benthic structure across different spatial scales in the eastern Bering Sea (EBS) and Aleutian Islands (AI). The two ecosystems were found to have much different abundances of corals and sponges (with the AI densities roughly 3 orders of magnitude higher than the EBS). At broad scales, the results showed that rockfish species and Pacific cod were significantly correlated to structured seafloors. At smaller scales (the scale of individual fish) only Pacific cod, northern rockfish and Pacific Ocean perch had significant associations with structure. We used stereo imagery to measure the distance between fish and structure, and found that the strength of associations (measured by distance to and overall affinity to structure) was weak for fish >40 cm. The size of the structure did not appear to matter to fish. We also found that rockfish preferred sponge to other structure, when all were available. These relationships were consistent across ecosystems, indicating that even though rockfish densities and coral and sponge abundance were very different between the EBS and AI, the ecological processes guiding habitat use by rockfish was consistent.

Oral Presentation

**Rossi, Steven**[1], Beau Doherty[2], and Sean Cox[1]
[1]Simon Fraser University
[2]Landmark Fisheries Research

# Linking decision-making for fisheries and sensitive benthic habitats using management strategy evaluation with spatial assessment models

Large-scale area closures are increasingly used to protect sensitive benthic habitats from bottom-contact fisheries, creating trade-offs between anticipated conservation benefits and economic fishing opportunities. Predicting conservation outcomes under different management procedures designed to protect habitat (e.g. area closures, effort controls, gear restrictions, bycatch limits, encounter protocols) is difficult due to uncertainties in assessing fishing risks to bottom habitats and fleet responses to new management measures. We linked an assessment of coral habitat in the SGaan Kinghlas – Bowie Seamount (SK-B) Marine Protected Area with a spatial population dynamics model for sablefish at SK-B in a management strategy evaluation framework. We projected coral and sablefish dynamics 30 years into the future under a variety of MPs (e.g., fixed or variable fishing effort, permanent area closures, monitoring and updating of area closures) and evaluated each using a suite of performance measures (e.g., catch, CPUE, sablefish biomass, coral biomass). Projections produced median coral biomass estimates ranging from 68-80% of unfished levels in the fishable SK-B area. All MPs had minimal impact on sablefish at SK-B, as catches were low relative to immigration from coastal stocks. This research demonstrates how habitat and fisheries stock assessments can be linked to evaluate whether conservation and fisheries objectives are likely to be achieved under different management decisions.

**Saksa, Kristin**[1], N.S Kashef[2,3], D.M. Stafford[2,3], M Palmisciano[1], S.M. Sogard[2], C.A. Logan[4], G. Bernardi[3], and S.L. Hamilton[1]

[1]Moss Landing Marine Laboratories

[2]NOAA Southwest Fisheries Science Center, Fisheries Ecology Division

[3]University of California, Santa Cruz

[4]California State University, Monterey Bay

# Effects of projected upwelling conditions on Gopher rockfish (*Sebastes carnatus*) larval deformity and survival

The California Current ecosystem is experiencing dramatic changes in ocean chemistry. Two threats to marine species in this ecosystem are ocean acidification (i.e., decreasing pH) and hypoxia (i.e., lower dissolved oxygen [DO] levels), which are exacerbated by changes in upwelling intensity and the shoaling of the oxygen minimum zone. Gopher rockfish (*Sebastes carnatus*) gestation and parturition season coincides with spring upwelling, making them vulnerable to low pH and low DO stressors. Replenishment of *S. carnatus* populations relies on larval survival through this sensitive and critical life stage in projected upwelling conditions. We tested how changes in ocean chemistry may impact *S. carnatus* embryo development and larval performance. We exposed gravid females to 4 treatments throughout gestation: 1) low pH (pH 7.5); 2) low DO (DO 4.0 mg/L); 3) a combined stressor (pH 7.5 x DO 4.0 mg/L); and 4) control (pH 8.0 x DO 8.0). At parturition, we quantified the proportion and type of larval deformities and found a non-significant trend of increased deformity in low DO and combined stressor treatments. Post-parturition, we seeded larvae into all 4 treatments to evaluate survivorship. Survival trials were performed by counting and removing larval mortalities daily until 50% mortality was reached. We found significantly decreased larval survival in the combined stressor maternal gestation treatment, however found no effect of the larval treatment on larval survival. Results from this research suggest that maternal *S. carnatus* exposure to stressors associated with climate change will result in decreased larval fitness.

Oral Presentation

**Sampson, David**
Oregon State University, Hatfield Marine Science Center

## Transient behavior in population-level fishery selection-at-age

Although stock assessment models generally assume that age- or size-classes of fish differ in their vulnerability to fishing, assessment models usually assume that fish and fishing are spatially uniform. Previous work has shown that under equilibrium conditions (constant annual recruitment and time-invariant age-specific mortality) spatial structure in a stock can result in dome-shaped population-level fishery selection-at-age, even though the same asymptotic gear-level fishery selection operates across all spatial regions. This presentation examines the transient behavior of population-level selection coefficients, which are easily derived from the numbers-at-age matrix typically produced by an age-structured stock assessment. A simplified set of survival equations (three distinct spatial regions; the same asymptotic selection curve in each region; natural mortality constant by age and time) are used to show that the overall population-selectivity has surprisingly complicated behavior, with between-year and between-age variations that can be sharply discontinuous. Ad hoc explorations indicate some of the important drivers of this phenomenon. The implications for stock assessment modeling are discussed.

Oral Presentation

**Schwartzkopf, Brittany,** and Scott. A. Heppell
Department of Fisheries and Wildlife, Oregon State University

## Juvenile rockfish diet analysis in three Oregon estuaries

Multiple species of rockfish (*Sebastes* spp.) utilize Oregon estuaries during their early life. This utilization gives rise to the hypothesis that these estuaries function as nursery habitat for rockfishes, playing a significant role in rockfish settlement and recruitment and therefore are important for population productivity. Juvenile rockfishes were collected at three Oregon estuaries (Alsea, Nehalem, Yaquina) once to twice per month from July 2015 to October 2017. A fin clip from each individual was sent to NOAA's Southwest Fisheries Science Center for genetic analysis to confirm species identification. A total of 995 juvenile rockfishes were collected from Alsea (n=83), Nehalem (n=111), and Yaquina (n=801), comprised of 11 different species. The catch was dominated by Black Rockfish (n=791), followed by Copper (n=88), and Quillback Rockfishes (n=76). For Black Rockfish, abundances varied across years and estuaries, with the highest abundances observed in Yaquina and in June and July 2016. Juvenile Black Rockfish utilized the estuaries during the entire year, as total length generally increased throughout each year. For Black Rockfish, stable isotope values and diet differed between Yaquina and Alsea and Yaquina and Nehalem for Black Rockfish. A total of 70 prey items were observed in the diet, with the highest prey species diversity found for Black Rockfish in Yaquina Bay. The results will aid in understanding why juveniles may be present in estuaries and if certain estuaries and habitats are important for the early life history of these species.

Poster Presentation

**Selleck, James,** and Dan Tonnes
NOAA West Coast Region, Protected Resources Division

## NOAA rockfish recovery management and research in the Salish Sea, Washington

This talk discusses the recently finalized NOAA recovery plan for ESA-listed yelloweye rockfish (*Sebastes ruberrimus*) and Bocaccio (*S. paucispinus*) in the Puget Sound/Georgia Basin, with an emphasis on important research and outreach efforts. The recovery plan outlines federal and state management actions and research programs to fill data gaps and develop monitoring programs to assess conservation and survival of the species. These actions include outreach and education, involvement with citizen scientists to inform rockfish distribution and abundance estimates, research and adaptive management to investigate the effects from fisheries barotrauma, critical habitat conservation and recovery, and funding opportunities for rockfish conservation. Specific conservation goals for nearshore and benthic habitat improvements include supporting the conservation and recovery of kelp. Kelp, especially bull kelp (*Nereocystis luetkeana*), is of particular importance as habitat for Young-of-Year (YOY) and juvenile rockfish. A cooperative monitoring and research plan on recovering kelp habitats at index sites is currently ongoing, and a variety of rockfish outreach products (informational posters, citizen science dive pamphlets, online videos, public signage, and books) are now available.

Oral Presentation

**Shotwell, Kalei**[1], K. Blackhart[2], C. Cunningham[1], D. Hanselman[1], M. Doyle[1], B. Fissel[1], P. Lynch[1], S. Zador[1], P. Spencer[1], and K. Aydin[3]
[1] NOAA Alaska Fisheries Science Centers
[2]NMFS Headquarters
[3]University of Washington

# Introducing a national framework for including stock-specific ecosystem and socio-economic considerations within next generation stock assessments

Ecosystem-based science is an important component of effective marine conservation and resource management; however, the proverbial gap remains between conducting ecosystem research and integrating with stock assessments. A main issue involves the general lack of a consistent approach to deciding when to incorporate ecosystem and socio-economic information into a stock assessment and how to test the reliability of this information for identifying future change. Our current national system needs an efficient testing ground and communication tool in order to effectively merge the ecosystem and stock assessment disciplines. We developed a new standardized framework for operationalizing the integration of ecosystem and socioeconomic factors within the NOAA Fisheries' stock assessment system. We use Alaska groundfish as a case study and data collected from a large variety of national initiatives was first synthesized for all stocks. A four-step process was then used to generate a set of standardized products that culminate in a focused, succinct, and meaningful communication of potential drivers on a given stock. We combine a priority-based data gap analysis with qualitative network models and a Bayesian model selection process to test potential indicators on data-limited to data-rich stocks. The resulting ecosystem and socio-economic profile (ESP) report is effectively a synthesis of ecosystem and socioeconomic factors that can be distilled into several different formats to communicate with the scientific community, stakeholders, and the public. The standardized process/product framework allows for comparison across stocks and provides the necessary building blocks to move toward an ecosystem-based approach to fisheries management.

Poster Presentation

**Siddall, Alayna**[1], Nick Wegner[2], Lyall Bellquist[3], and David A. Demer[2]
[1]Sportfishing Association of California
[2]NOAA Southwest Fisheries Science Center
[3]The Nature Conservancy

# Collaborative groundfish research supported by the Sportfishing Association of California: descending devices, Cowcod mortality estimates, and acoustic-optical surveys

Founded in 1972, the Sportfishing Association of California (SAC) is a non-profit organization that represents the Commercial Passenger Fishing Vessel (CPFV) fleet in California. SAC has developed several impactful collaborations with state and federal fisheries managers to help fill data gaps that are critical for the effective management of local fisheries. Since 2010, SAC has worked closely with NOAA to mitigate the effects of rockfish barotrauma by distributing fish descending devices and training to every CPFV in the fleet. SAC also collaborated with NOAA on research projects to assess: 1) post-release survival of protected adult rockfishes at offshore banks; 2) post-release survival of sub-adult cowcod in nearshore areas; and 3) effectiveness of (and angler preference for) different descending device types. Post-release survival estimates of sub-adult and adult cowcod using acoustic telemetry data (depth, acceleration, and horizontal movement) range from 60-80% during multiple monitoring periods from 2012-2017. SAC vessels supported NOAA in the development and use of the Collaborative Optical-Acoustic Survey Technique (COAST) to characterize: 1) the acoustical spectral signatures for different rockfish species; 2) site fidelity and diel behaviors of rockfishes; and 3) temporal variability of mixed species assemblages. COAST surveys from 2003-2009 generated estimates of the species-specific distributions and abundances of rockfishes and their seabed habitats throughout the Southern California Bight. This broad range of support for collaborative research illustrates that SAC plays an important role in informing cooperative fisheries science and management.

Poster Presentation

**Simon, Victor**[1], Todd Hay[1], Jim Benante[2], Colin Jones[2], Aaron Chappell[3], and John Harms[1]
[1]NOAA Northwest Fisheries Science Center, Seattle, WA
[2]Pacific States Marine Fisheries Commission, Seattle WA
[3]NOAA Northwest Fisheries Science Center, Newport, OR

# HookLogger: An integrated and interactive three-station, portable, rugged data collection platform

Since 2004, the Northwest Fisheries Science Center (NWFSC) has annually monitored an array of fixed sampling sites over high relief habitat using rod and reel gear in the Southern California Bight. Pencil and paper forms had been used for capturing all back deck information such as catch, effort, and biological sampling details. These hard to read forms were transcribed into approximately 150,000 unique data fields and manually entered into a relational database in the offseason. In 2017 a portable, rugged, wireless, integrated and interactive data collection platform was deployed. The new three-station system is named HookLogger and it utilizes windows tablets, barcode label printers, barcode scanners, and motion compensated digital scales to input data over TCP/IP using virtual comports. The tablets communicate with a centralized SQLite database located at the primary event logging Galley-station. The benefits of this digital data collection capability include faster and streamlined field data collection, on-entry data validations, and the elimination of approximately 320 hours of post-season data entry.

Oral Presentation

**Simonsen, Kirsten,** Patrick Ressler, and Christopher Rooper
NMFS Alaska Fisheries Science Center

# Condition of walleye pollock (*Gadus chalcogrammus*) in relation to prey abundance

Euphausiids (or krill) are a key prey item for many species of fish, including walleye pollock (*Gadus chalcogrammus*) in the Gulf of Alaska (GOA). As such, the availability of euphausiid prey may influence fish condition and growth. We constructed a time series of acoustic backscatter (sA) from euphausiids (proportional to abundance) using acoustic trawl survey data collected during surveys from 2003 to 2015. We assessed the condition of pollock specimens collected from both acoustic trawl and bottom trawl surveys during the same time period. A 'condition index' was determined by finding residuals from a length-weight relationship fitted to all pollock specimens collected during both surveys over five sampling years (e.g., positive residuals for a given length indicate better condition). These condition indices were averaged for each trawl haul during each survey year in three different regions where euphausiid abundance data were available (Shelikof Strait, Barnabas Trough, and Chiniak Trough), then modeled using generalized additive models (GAM) as a function of euphausiid abundance. Preliminary results indicate that higher abundance of euphausiids (sA greater than 50 $m^2*nmi^{-2}$) is associated with improved condition in pollock in the GOA. This relationship was stronger in Barnabas and Chiniak Troughs ($r^2$= 0.49) than it was in Shelikof Strait, and was also stronger for pollock collected in the acoustic trawl surveys ($r^2$= 0.33) than those collected in bottom trawl surveys. These results provide evidence that pollock condition may be affected by prey availability.

Poster Presentation

**Simpson, Samantha,** Matthew Eagleton
NOAA Alaska Region, Habitat Conservation Division

# Recent groundfish habitat management activities from NOAA Fisheries Alaska Region, Habitat Conservation Division

Biologists from NOAA Fisheries Alaska Region, Habitat Conservation Division (HCD) provide a comprehensive overview of management and related activities conducted since the 2016 Western Groundfish Conference. HCD works in coordination with industries, stakeholder groups, government agencies, and private citizens to avoid, minimize, or offset the adverse effects of human activities on Essential Fish Habitat (EFH) and living marine resources in Alaska. This work includes conducting and/or reviewing environmental analyses for a large variety of activities, such as: commercial fishing, coastal development, large transportation, and energy projects. HCD regularly coordinates with the Alaska Fisheries Science Center (AFSC), North Pacific Fishery Management Council (NPFMC), academia, other agencies, and NOAA Headquarters and line offices to identify technically and economically feasible alternatives, and offers realistic recommendations for the conservation of valuable living marine resources. Specific activities discussed in this poster include recent completion of an EFH 5-year review, a coordinated EFH Research Science Plan, a Non-Fishing Activities Report (includes Ocean Acidification and Climate Considerations), participation at the National EFH Summit, coordinated efforts for an Alaskan-specific Habitat Assessment Prioritization Report.

Oral Presentation

**Solinger, Laura**[1], Eric Bjorkstedt[1,2], John Field[2], Andre Buchheister[1], and Mark Henderson[1,3]
[1]Department of Fisheries Biology, Humboldt State University
[2]NOAA Southwest Fisheries Science Center
[3]US Geological Survey, California Cooperative Fish and Wildlife Research Unit

# Developing spatially explicit stock assessment models to examine recruitment variability in Chilipepper Rockfish

Unresolved spatial variability in growth and recruitment contributes to uncertainty in assessments of groundfish stocks, and potentially confounds efforts to elucidate biological responses to variability in oceanographic conditions. Recruitment is expected to be particularly sensitive to environmental variability in many groundfish stocks. We are using spatially discrete assessments of Chilipepper Rockfish (*Sebastes goodei*) along the California coast to examine spatial and temporal variability in recruitment, with the intent of testing hypotheses that link coherent recruitment patterns to large-scale climate variability and provide insight into how regional oceanographic structure might contribute to spatial variability in recruitment along the coast. Our approach extends the work of Field and Ralston (2005, CJFAS) through 2015 to span stock rebuilding and several oceanographic events suspected to influence recruitment in west coast rockfishes. Available data from fisheries landings and fisheries-independent surveys are parsed among several port-complexes along the California coast, and Stock Synthesis 3 is used to develop region-specific assessments from which estimates of local recruitment variability are extracted. The structure of regional assessment models is informed by the most recent stock assessment, with adaptations designed to account for challenges arising in partitioning the available data among regions. Preliminary results confirm that recruitment along the California coast continued to exhibit a high degree of synchrony since 1999, but suggest the existence of variability among regions that might be related to corresponding structure in ocean dynamics.

Oral Presentation

**Staton, Jay**[1], I. Kelmartin[1], J. Tyburczy[2], W. Bean[1], and T. Mulligan[1]
[1]Humboldt State University
[2]California Sea Grant

# Baseline characterization of nearshore rocky reef fishes found in northern California Marine Protected Areas

The nearshore rocky reef habitat along California's North Coast supports a diverse assemblage of ecologically, economically, and culturally important fishes. In December 2012, a network of Marine Protected Areas (MPAs) was established in Northern California with the goal of protecting these species. Our study utilized collaborative hook and line fishing methods, while employing local charter fishing vessels, to establish a baseline of rocky reef fishes associated with four MPAs and four unprotected reference sites. These baseline data were then used to inform generalized additive models (GAMs) to explore potential drivers of relative abundance, size, and diversity of fishes. Understanding what factors drive initial conditions in paired sites will allow managers to track fluctuations in fish communities associated with rocky reefs, and properly attribute changes to MPA effects over time. This is especially important in the Pyramid Point and Sea Lion Gulch MPAs, where total CPUE and species richness were significantly different from their associated reference sites. These differences are likely a function of different levels of historical fishing pressure between MPAs and reference sites. Distance from port, a proxy for historical fishing pressure, and depth, were the most important predictors of fish catch per unit effort and diversity in the North Coast MPA Region. Continued monitoring of MPAs in the North Coast region will be critical in the evaluation of MPA effects and provide much needed fishery-independent data that can be used to improve management strategies in this area.

Poster Presentation

**Stephens, Andi**
NOAA Northwest Fisheries Science Center, Fisheries Resource Analysis and Monitoring

# Comparison of data-moderate approaches with the full age-structured assessments of Yellowtail Rockfish north and south of Cape Mendocino

The 2017 Yellowtail Rockfish assessment was the first benchmark assessment for the northern stock (N of 40° 10') since 2005, and the first attempt at a full age-structured assessment for the southern stock. The northern assessment was adopted for use in management advice by the Pacific Fisheries Management Council, however the southern model was not robust enough to provide management advice, partially due to a lack of recent age data. In 2013, data-moderate assessments (based upon simplified assumptions, and using population index data, but not length or age composition information) were prepared for both the northern and southern stocks, however the Stock Assessment Review panel was unable to evaluate the southern model due to time constraints. The panel chose to focus on the northern stock, since data for the southern model were sparse. I revisit those data-moderate assessments, updating the data and comparing the results with the 2013 analyses and 2017 full assessments, modeling the data with both Depletion-Based Stock Reduction Analysis (DB-SRA), and a Simple Stock Synthesis (SSS) approach.

Oral Presentation

**Stewart, Ian**[1], and Bruce M. Leaman[2]
[1]International Pacific Halibut Commission
[2]International Pacific Halibut Commission (Ret.)

# The one that got away (and lived): the challenge and importance of discard mortality rates for a robust commercial fish species

Capture and discard (or loss) represents a major source of global fisheries mortality. However, many species are sufficiently robust to survive the capture process, suggesting that full retention is not the only feasible solution to address the aggregate mortality on stocks, especially in cases where unmarketable fish are handled or the individuals captured are well below the optimum size for maximizing yield. Discard mortality rates are notoriously difficult to estimate with a broad suite of potentially important contributing factors, some operating on time and spatial scales impractical for most scientific studies. We use the case of Pacific halibut, with a recent total catch of nearly twice the retained harvest, to illustrate these challenges. Summarizing a range of historical studies conducted over the last 50 years, we identify several key pieces of information that could improve the estimation of all Pacific halibut mortality due to fishing practices. We further suggest some general conclusions for prioritizing key parameters and identifying successful experimental methods to most accurately estimate discard mortality rates.

Oral Presentation

**Stierhoff, Kevin**[1], Mary M. Yoklavich[1], M. Elizabeth Clarke[2], Jeff Anderson[2], Erica Fruh[2], Thomas E. Laidig[1], Milton S. Love[3], Abigail Powell[2], and Diana Watters[1]

[1]NOAA Southwest Fisheries Science Center

[2]NOAA Northwest Fisheries Science Center

[3]University of California, Santa Barbara

# Comparing estimates of groundfish biomass, abundance, and diversity from different optical sampling methods in southern CA

Many managed groundfish stocks on the U.S. west coast inhabit high-relief rocky areas that are inaccessible to traditional net-based survey methods (e.g., swept-area benthic trawls). Several species, such as cowcod (*Sebastes levis*) and yelloweye rockfish (*S. ruberrimus*), are strongly associated with these untrawlable habitats, have populations at various levels of depletion, and occupy habitats that have incurred substantial impacts from mobile fishing gear. Because much of the continental shelf and upper slope are closed to fishing for these species, alternative methods are required to monitor fishes living in untrawlable habitats. Several types of visual tools are used by NMFS to survey fishes in these areas; however, comparisons of population estimates are often not possible due to differences in sampling design and tool capabilities. To evaluate resultant data from these tools, contemporary underwater surveys of demersal fishes and their seabed habitats were conducted on two rocky seamounts off southern CA using an autonomous underwater vehicle (AUV), remotely operated vehicle (ROV), and human-occupied submarine (SUB). Stratified-random visual transect sampling was conducted using each vehicle to produce estimates of biomass and abundance by depth and site. Population estimates (and their precision) of rockfishes, lingcod, and hake will be compared and the potential causes of observed differences will be discussed.

Poster Presentation

**Surry, Maria,** and Norm Olsen
Fisheries and Oceans Canada (DFO)

## Visualizing and processing net mensuration and sensor data in GFBioField

GFBioField is a data acquisition system designed for the at-sea collection of groundfish research survey data. It runs on Windows platforms using a Microsoft Access 2007 project to provide user interfaces and business logic, with a SQL Server 2016 database running on a Windows 10 platform as the back-end. SQL Server 2016 is the first version of SQL Server with integrated R services, which allows for the integration of R scripts directly into traditional SQL code. Groundfish trawl surveys deploy a suite of net mensuration and oceanographic sensors with each fishing event. Following each survey, data collected at sea are archived in a corporate Oracle database called GFBio. Previously, the sensor data were stored as simple text files while at sea, and then processed by staff in the months following each survey. Post-survey processing consisted of visualizing and trimming the sensor data files to the relevant fishing portion of each event and removing spurious values and noise. After processing the cleaned data were manually loaded into GFBio. The latest version of GFBioField utilizes the integrated R functionality of SQL Server 2016 to allow at-sea visualizing and processing of the net mensuration and sensor data directly within the field database, reducing the amount of post-survey processing required, and allowing a seamless upload to GFBio following the survey. In addition, the new version allows live viewing of the net mensuration data from within the bridge log screen while fishing is ongoing, enhancing the operator's ability to diagnose fishing performance and fishing event usability in real-time.

Poster Presentation

**Temple, Kathryn,** A. R. Kronlund, K. Castle, J. Supernault, and M. Wyeth
Fisheries and Oceans Canada

# Development of an alternative method for the biological sampling of catch using Sablefish heads

Stock assessment of Sablefish in British Columbia requires information on individual fish size, age, and sex in the commercial fisheries. Since product is landed J-cut, these data are currently obtained from a voluntary catch sampling program where samples are randomly selected from longline trap or hook gear and are returned whole to port. A tag-release recovery program used to estimate gear selectivity is also in place, and relies on voluntary return of tagged Sablefish from all gear types. We are investigating the potential for obtaining biological information using only Sablefish heads. This requires: 1. Demonstrating that head measurements can be used to reliably predict fork length for both sexes; 2. Developing an at-sea sampling program where fishermen segregate returned heads by sex; 3. Developing an audit program of sex determination accuracy using genetic methods; 4.Revising shore-side sampling of Sablefish to collect head measurements, genetic tissue, and otoliths. Our preliminary results show a strong relationship between head dimensions (eye diameter, inter-orbital distance, snout length, upper jaw length, and post-orbital to pre-operculum distance) and fork length, with correlation coefficients ranging from 0.938 for eye diameter to 0.976 for snout length. A pilot project was also initiated to test the feasibility for commercial vessels to assess sex and return heads for biological sampling, and development of a genetic test to determine gender. Successful application of this research may result in increased participation in the voluntary catch sampling and tagging programs and improve biological data from all commercial gear types that intercept Sablefish.

Oral Presentation

**Tolimieri, Nick**[1], M. Haltuch[1], Q. Lee[2], M. Jacox[3], and S. Bograd[3]

[1]NOAA Northwest Fisheries Science Center

[2]University of Washington

[3]NOAA Southwest Fisheries Science Center

## Oceanographic drivers of sablefish recruitment in the California Current

Oceanographic processes and ecological interactions can strongly influence recruitment success in marine fishes. Here, we develop an environmental index of sablefish recruitment with the goal of elucidating recruitment-environment relationships and informing stock assessment. We start with a conceptual life-history model for sablefish *Anoplopoma fimbria* on the US west coast to generate stage- and spatio-temporally-specific hypotheses regarding the oceanographic and biological variables likely influencing sablefish recruitment. Our model includes seven stages from pre-spawn female condition through benthic recruitment (age-0 fish) for the northern portion of the west coast U.S. sablefish stock (40-50°N). We then fit linear models and use model comparison to select predictors. We use residuals from the stock-recruitment relationship in the 2015 sablefish assessment as the dependent variable (thus removing the effect of spawning stock biomass). Predictor variables were drawn primarily from ROMS model outputs for the California Current Ecosystem. We also include indices of prey and predator abundance and freshwater input. Five variables explained 57% of the variation in recruitment not accounted for by the stock-recruitment relationship in the sablefish assessment. Recruitment deviations were positively correlated with (1) colder conditions during the spawner preconditioning period, (2) warmer water temperatures during the egg stage, (3) stronger cross shelf transport to near-shore nursery habitats during the egg stage, (4) stronger long-shore transport to the north during the yolk-sack stage, and (5) cold surface water temperatures during the larval stage. This result suggests that multiple mechanisms likely affect sablefish recruitment at different points in their life history.

Oral Presentation

**Tsou, Tien-Shui**[1], J.M. Cope[2], K. Privitera-Johnson[3], and J. Fuller[1]
[1]Washington Department of Fish and Wildlife
[2]NOAA Northwest Fisheries Science Center
[3]University of Washington

# Challenges in the dockside sampling of species composition in changing groundfish fisheries

Groundfish species composition sampling is a key activity for collecting information to prorate multispecies market category landings into single species landings that ultimately inform catch estimates. The treatment of species compositions is difficult, though, because sampling designs, protocols, and data processing algorithms vary among the agencies and through time. This presentation will focus on current issues associated with sampling commercial groundfish landed in Washington State. We will discuss the mismatches between our current sampling design and fishing practices, and the impacts of these mismatches on single species catch estimates.

Oral Presentation

**Wallace, John,** and Melissa Haltuch
NOAA Northwest Fisheries Science Center

# Identifying Petrale Sole spawning grounds and their utilization changes over time by using VAST on Winter Petrale Sole fishery data

A spatio-temporal analysis (VAST) of Winter Petrale sole Fishery logbook data was used to define Petrale sole spawning grounds (static over time) and their utilization changes over time based on the proportion of the stock occupying each spawning ground by year. The logbook data was filtered for realistic tow location and depth and the centroid of reported logbook blocks were used when necessary. All recorded depths were compared to GIS calculated depths based on the location logged for the start of the tow and a cutoff was established. This work is part of a larger effort to develop a conceptual life-history model for Petrale sole that will be tested with a biophysical individual-based model (IBM) driven by a regional oceanic modeling system (ROMS).

Poster Presentation

**Waltz, Grant**[1], L. Bellquist[2], J. Caselle[3], J. Chiu[4], C. Dibble[5], R. Fields[4], C. Honeyman[3], I. Kelmartin[6], E. Mason[7], S. Morgan[8], J. Mulligan[6], E. Satterthwaite[8], B. Semmens[7], R. Starr[5], J. Staton[6], J. Tyburczy[9], and D.E. Wendt[1]

[1]Center for Coastal Marine Sciences, California Polytechnic University, San Luis Obispo
[2]Scripps Institution of Oceanography University of California, San Diego
[3]Marine Science Institute University of California, Santa Barbara
[4]Moss Landing Marine Laboratories
[5]Department of Environmental Science and Policy, University of California, Davis
[6]Department of Fisheries Biology, Humboldt State University
[7]Scripps Institution of Oceanography, University of California, San Diego,
[8]Department of Environmental Science and Policy, University of California, Davis
[9]California Sea Grant

# The California Collaborative Fisheries Research Program: implementation and expansion of a statewide marine protected area monitoring program

The State of California mandated, through the Marine Life Protection Act, a statewide network of marine protected areas (MPAs) along the coast of California in 1999. The State legislation included a mandate for monitoring the performance of the MPA network. The California Collaborative Fisheries Research Program (CCFRP) was designed by a consortium of academic scientists, resource managers, commercial and recreational fishers, and local stakeholders to monitor the performance of the MPAs. The study design utilized local fisher knowledge and standardized hook and line methods to monitor MPAs. The first suite of MPAs was established along the central coast of California in 2007 and primarily regulated extractive activities. CCFRP was initially implemented by Moss Landing Marine Laboratories and Cal Poly, SLO in 2007 along the central coast of California. In 2017, CCFRP expanded to include all of the MPA network regions: North, North Central, Central, and South. CCFRP now includes six academic institutions monitoring 14 MPAs across the entire State MPA network. To date, CCFRP has caught and released a total of 108,190 fishes from more than 35 species. These data have been and will continue to be distributed to State and federal resource managers. In addition to the biological data CCFRP has collected, CCFRP science crews have interacted with commercial and recreational fishers from all of these regions, building a strong working relationship between scientists and local stakeholders.

Oral Presentation

**Watson, Jessica,** and Brittany Huntington
Oregon Department of Fish and Wildlife

## Refining long-term monitoring in a marine reserve by comparing relative abundance and length of reef fishes using simultaneous angling, underwater visual census, and video sampling

Robust marine reserve assessment hinges on managers knowing the biases of the sampling methods employed. In this study, concurrent surveys using hook and line (angling), remote underwater video (RUV), and diver underwater visual censuses (UVC) were compared to identify biases and optimize future long-term monitoring within a temperate, nearshore marine reserve. Surveys were performed at the same spatial and temporal locations to directly compare: 1) detection, 2) multivariate community composition, and 3) size structure of temperate reef fishes among methods. We also evaluated sampling efficiency (i.e. statistical power, sample sizes, and costs) to detect change. The least abundant and diverse fish assemblage was observed by UVC, likely due to the depth constraints of divers and fish avoidance behaviors. RUV observed greater fish abundances than UVC – yet these abundances were highly variable. Hook selectivity resulted in larger individuals sampled using hook and line compared to UVC. However, the shape of the length-frequency distributions for many species did not differ between methods. This suggests data could be integrated with a correction factor. UVC and hook and line approaches were considerably more cost-effective and time-efficient than RUV. Based on the results of this pilot study we suggest that a combination of diver UVC and hook and line techniques offer the most efficient sampling approach. We encourage other management programs to take a similar approach to evaluating the strengths and limitations of their monitoring efforts when establishing long-term monitoring.

Oral Presentation

**Watters, Diana,** and E.J. Dick
NOAA Southwest Fisheries Science Center

# A comparison of rockfish (*Sebastes*) length distributions from visual and trawl surveys off central California

Data from the West Coast Bottom Trawl Survey and visual surveys conducted with a human-occupied submersible in nearby untrawlable areas were used to compare length distributions for greenspotted rockfish (*Sebastes chlorostictus*), greenstriped rockfish (*S. elongatus*), canary rockfish (*S. pinniger*), and vermilion rockfish (*S. miniatus*) off central California. For all 4 species, a broader range of sizes and greater proportion of small fish were present in the visual survey data than the trawl survey data. Length distributions were significantly different ($p<0.01$) for the 4 species when comparing all visual and trawl lengths, and were significantly different for greenspotted, greenstriped, and canary rockfish when comparing visual lengths on untrawlable and trawlable habitats and visual and trawl lengths on trawlable habitat. Length-dependent trawl selectivity curves from recent stock assessments were evaluated relative to the length distribution data for greenspotted, greenstriped, and canary rockfish. Although limited in spatial and temporal extent compared to that of stock assessments, our results suggest that the major difference between trawl and visual survey size compositions may be a reduced frequency of smaller individuals in the trawl survey. The estimated selectivity curves in the greenspotted rockfish and greenstriped rockfish assessments appear to account for this difference, but the selectivity curve in the canary rockfish assessment does not. Similar comparisons between visual and trawl-surveyed rockfish lengths from other regions of the west coast could help address spatial variability in trawl survey selectivity, and can further inform the trawl selectivity functions used in stock assessments for rockfishes.

Poster Presentation

**Watters, Diana**[1], Jodi Pirtle[2], Laura Kracker[3], and Mary Yoklavich[1]
[1]NOAA Southwest Fisheries Science Center
[2]NOAA Alaska Region
[3]National Ocean Service, National Centers for Coastal Ocean Science

# Mapping seafloor habitats using the Simrad ME70 sonar on NOAA ships

High resolution seafloor maps support better management of groundfishes that associate with complex rocky habitats, by improving survey efficiency and the accuracy of population estimates, and delineating critical habitats for protection. In 2016 and 2017, Untrawlable Habitat Strategic Initiative field research cruises were leveraged to include nighttime seafloor mapping operations at the Northern Channel Islands. NOAA Ships Reuben Lasker and Bell M. Shimada are equipped with Simrad ME70 multibeam echosounder systems, which we used to acquire high-resolution bathymetry and seafloor scattering strength (backscatter) data at depths 30-500 meters. A total of 312 $km^2$ of seafloor was mapped over 22 nights. This work contributes toward Southern California Seafloor Mapping Initiative efforts in collaboration with Channel Islands National Marine Sanctuary. From this information we will be able to distinguish various substrata such as high-relief rock and soft sediment.

Oral Presentation

**Webster, Raymond**
International Pacific Halibut Commission

# Improving the estimation of Pacific halibut density indices through spatio-temporal modelling of survey data

Data from the International Pacific Halibut Commission's (IPHC) annual fishery-independent setline survey are used for estimating indices of density and monitoring changes in the stock distribution of Pacific halibut (*Hippoglossus stenolepis*) over time. In 2016 the IPHC started using spatio-temporal modelling of CPUE data from the survey to estimate indices of density. By accounting for spatial and temporal dependence in the data, this modelling approach has improved the estimation of density and its uncertainty, has provided more accurate predictions in regions not observed annually, and has allowed years with incomplete survey coverage to be included in the time-series without relying on ad-hoc adjustment scalars. Additionally, spatio-temporal modelling has made estimating stock distribution more transparent, and has permitted estimates of uncertainty for stock distribution to be easily determined. We demonstrate the use of this approach by presenting results from models of Pacific halibut CPUE data from the IPHC's survey off the United States West Coast. The models' usefulness in further understanding relationships between CPUE and environmental variables is illustrated by exploring models that include bottom temperature and dissolved oxygen as covariates.

Oral Presentation

**Wetzel, Chantel,** and Owen Hamel
NOAA Northwest Fisheries Science Center

## Accounting for increased uncertainty in setting precautionary harvest limits from past assessments

Estimates of current spawning output derived from stock assessments are uncertain. Management has adopted approaches to account for this uncertainty when setting harvest limits that will avoid overfishing for West Coast groundfish stocks, as mandated by the MSA. Currently, the Overfishing Limit (OFL), derived from the stock assessment and management proxies, is reduced by the uncertainty surrounding the estimated final year spawning output as a proxy for the OFL uncertainty when setting the Acceptable Biological Catch (ABC) for subsequent years. However, uncertainty increases during the projection period of a stock beyond the final assessment year due to the increasing period over which true population dynamics may differ from the expected values (e.g., annual recruitment) for the modeled stock. While the current adjustment for uncertainty may be appropriate for the years immediately following an assessment, subsequent future ABCs should account for the uncertainty in projected spawning output. We evaluate alternative approaches to determine the increase in uncertainty over a forecasted period. The first approach looks at the uncertainty presented in the alternative states of nature from the Decision Table presented in an assessment, which capture major axes of uncertainty within the assessment. The second approach uses MCMC sampling to generate a distribution for future possible trajectories based upon parameter uncertainty given removals for West Coast groundfish stock assessments. We will show the potential implications of setting ABCs when this additional source of uncertainty is considered, concluding with a discussion advantages and disadvantages of each approach and potential ways forward.

Oral Presentation

**Whitman, Alison**[1], Brittany Schwartzkopf[2], Amy J. Lindsley[3], and Dr. Scott Heppell[2]
[1]Oregon Department of Fish and Wildlife
[2]Oregon State University, Department of Fisheries and Wildlife
[3]Alaska Department of Fish and Game

# Decadal change in juvenile groundfish community composition in an Oregon estuary

Along the West coast, estuarine habitats can serve as an extension of the nearshore environment, and long-term monitoring of juvenile groundfish communities in estuaries may provide hints as to the importance of these habitats to groundfish populations. An analysis of a decade's worth of community composition data from Yaquina Bay on the central Oregon coast. Demersal traps sampled juvenile fishes at multiple sites in both anthropogenic structure and eelgrass habitats over seven years (2008 -2017). Preliminary results reveal changes in the juvenile groundfish community composition and significant differences in species richness and diversity. Species richness and biodiversity is shown to change temporally on both an intra-annual and inter-annual scale. Biodiversity in the different habitat types (structure and eelgrass) within the bay was also significantly different, after taking into account temporal variation. However, species evenness does not change dramatically, indicating that the dominant juvenile fish species present in the bay are relatively consistent over time and space. Understanding how and when fish communities utilize habitat during their early life history will be essential for evaluating changes to estuarine habitats and their potential contributions to nearshore fish populations.

Oral Presentation

**Whitmire, Curt**[1], Alice Thomas-Smyth[2], Kayleigh Somers[1], Waldo Wakefield[1], John Stadler[3], and Allison Bailey[4]
[1]NOAA Northwest Fisheries Science Center
[2]NOAA Southwest Fisheries Science Center
[3]NOAA West Coast Region
[4]Sound GIS

# What's the point? Comparing geospatial methods for representing fishing effort

The integration of data from global positioning satellite (GPS) and vessel monitoring systems (VMS) has improved our understanding of where fishing occurs and how fleets respond to spatial management. Compared to logbook data that typically includes only start and end points of fishing events, VMS data more accurately represents the actual path of fishing by increasing the number of fixes along a tow or set. Despite this improvement, using VMS data involves significant processing time, particularly when analyzing over broad spatial and temporal scales. To understand how different spatial representations of fishing events affect summaries of effort across space, we examined three representations of bottom trawl effort in and around proposed conservation areas. The representations we analyzed were: 1) VMS track lines composed of several points, 2) lines connecting tow start and end points, and 3) single points representing tow start points. We explored whether increasing the number of fixes improves our understanding of fishing effort in and around these areas, and at what costs to staff time and computer resources. The results of our analyses are intended to help others determine what level of detail best suits their specific needs to summarize effort and catch data

Oral Presentation

**Williams, Kresimir,** C. Rooper, R. Towler, P. Goddard, and R. Wilborn
NOAA Alaska Fisheries Science Center

## Moored stereo camera survey of rockfishes in untrawlable grounds

Stationary underwater stereo-camera systems are increasingly used for assessing fish abundance, especially in areas that cannot be sampled using more traditional methods such as trawls. Recent reductions in size and cost of machine vision cameras and other electronics have allowed for the development of a new class of stereo-camera systems. We describe a new method using multiple moored stereo-camera systems to collect time-lapse images every 30 s over 22-24 hr time periods, using short duration strobe light pulses. Eight camera units were repeatedly deployed for 24 h periods during 11 days on an offshore bank in the Channel Island National Marine Sanctuary. The camera units were deployed without surface floats, and instead released a tethered float via a remote command from the surface vessel to recover the camera packages. Stereo images were used to estimate fish abundance, length composition, habitat association, and distance above the sea floor. Stereo-calibration information was used to estimate camera viewing volumes, which were combined with the fish distance data to estimate absolute volumetric density. The relationship between fish density and range from the cameras was examined using a new modeling technique. Ten species of rockfish were observed, with four occurring in high densities during the day. The ability of these unobtrusive, moored camera systems to collect time-lapse imagery over long periods can provide new insights into marine ecosystems and thus serve as an important and innovative approach for sampling untrawlable habitats.

Poster Presentation

**Williamson, James**
Moss Landing Marine Laboratories

## Testing the efficacy of using volunteer citizen scientists for fisheries video survey analysis

Camera systems are being increasingly employed to collect visual data for MPA and stock assessment monitoring. One of the major difficulties of working with visual fish survey data is the time required for analysis. Collected footage requires hours of detailed analysis, typically performed by trained researchers, to extract relevant information on fish counts and species identification. To test the efficacy of using crowdsourcing as a means of expediting the analysis process, I provided groups of volunteers with video collected using a rotating stereo video lander and trained them counting and identifying observed fish species. Utilizing a modified MaxN, volunteer results were then compared to analyses of the same videos using identical protocols performed by members of the Fisheries and Conservation Biology Lab at Moss Landing Marine Laboratories (MLML). By comparing volunteer results to the results of expert analysis of MLML lab members I hope to determine the potential of utilizing volunteer effort to provide accurate abundances from visual survey data. The emergence of cloud-based video hosting and citizen-outreach websites such as Zooniverse (www.zooniverse.org) and the ability to reach a broad collection of citizen scientists makes the utilization of volunteer effort an intriguing prospect for future visual survey experiments.

Oral Presentation

**Yamane, Lauren[1,2]**, K. Kaplan[1,2], L.W. Botsford[1], M.L. Baskett[1], A. Hastings[1], and J.W. White[3]
[1]University of California, Davis
[2]California Department of Fish and Wildlife
[3]Oregon State University

# Using fisheries-independent data in marine reserves to quantify historical local fishing mortality rates

Fishing mortality rates are critical parameters for assessing stock status and are needed to understand how population size structure for harvested species should fill-in at sites where marine reserves are now in place. Fishing mortality is often calculated at regional scales, but not accounting for spatial heterogeneity in these values can lead to inaccurate estimates of biomass and yield. A recently developed tool, the state-space integral projection model, provides a method for using fisheries-independent diver survey data to estimate historical, spatially-explicit fishing mortality rates (i.e., local F's), both inside and outside current marine reserves. Before this tool can be broadly applied, however, a greater understanding is needed of the model's performance for different species and available time series. Here we describe the model and results quantifying the model's precision and accuracy to estimate these local F values. We use a number of nearshore rockfish and groundfish species associated with California's network of marine protected areas as examples. Such local, historical fishing mortality rates can provide information that is useful for informing both fisheries assessments and the management of marine reserves.

Oral Presentation

**Yochum, Noëlle,** and Scott McEntire
NOAA Alaska Fisheries Science Center

## Partnering technology with fish biology and behavior to reduce salmon bycatch

Incidental catch of Pacific salmon (*Oncorhynchus* spp.) has been a significant driver in the management of the commercial walleye pollock (*Gadus chalcogrammus*) fishery in the Bering Sea and Aleutian Islands. Since 2003, members of the fishing and conservation engineering communities have worked to develop and improve upon bycatch reduction devices that permit salmon to escape out of the trawl after capture and before entering the codend (an 'excluder'). Some fishermen have added artificial light around the escapement portal with the expectation that it attracts or guides salmon towards the 'exit'. To evaluate the efficacy of artificial lights for this application, we are conducting a two-year research program consisting of behavioral studies on salmon both in the trawl and in a controlled environment. Details of the research and results from year one will be presented, along with information about our related, ongoing efforts to observe fish behavior in the absence of visible, artificial light illumination. To avoid influencing behavior with the use of camera lights, we have relied on extreme low light cameras and infrared camera systems. It is assumed that most species of fish cannot see in the infrared spectrum given there is little to no infrared in their environment, except at a very narrow margin of shallow surface waters due to the absorption of infrared by water. Imaging underwater in the infrared spectrum poses significant challenges due to this absorption. We will discuss our ongoing efforts to mitigate these challenges through technology development and evaluation.

Oral Presentation

**Zuercher, Rachel**[1], and Carrie Pomeroy[1,2]
[1]University of California, Santa Cruz
[2]California Sea Grant, University of California, San Diego

# Social-ecological coupling in the Central California commercial nearshore fishery

Small-scale fisheries play a pivotal role in many coastal communities, but are vulnerable to environmental and socioeconomic changes. Disturbances such as oceanographic shifts and management actions can have major impacts on fish populations and fishing communities alike. However, our understanding of the interactions between social and environmental factors that influence fishery outcomes is incomplete. Using the California Nearshore Fishery as a case study, I explore social-ecological coupling, focusing on feedbacks among biophysical dynamics, human behavior, markets and governance. Over the last 20 years, management changes in the nearshore fishery (including the establishment of a limited entry program that significantly reduced fishery participation), shifts in markets, and changes in interacting fisheries have affected nearshore fishery dynamics. We use commercial fishery "fish ticket" data collected by the California Department of Fish and Wildlife, and information collected from semi-structured interviews with nearshore fishermen and fish buyers in central California to quantify changes in the fishery and explore potential causal factors. We assess changes in the spatial distribution of fishing, fishing portfolios of nearshore participants, catch composition, and fishing operations and practices, including effort allocation within and between the nearshore fishery and interacting fisheries. The work highlights ways that social, economic and biophysical factors interact to influence ecosystem services and fishery dynamics, and provides insight to inform continued implementation of California's Nearshore FMP.

Attendees contact list


Chris Acheson
Canadian Sablefish Association
caheson@canadiansablefish.com

Kate Achilles
Southwest Fisheries Science Center
Kate.Achilles@noaa.gov

Justin Ainsworth
Oregon Department of Fish and Wildlife
justin.c.ainsworth@state.or.us

Sean Anderson
Department of Fisheries and Oceans Canada
sean.anderson@dfo-mpo.gc.ca

Kelly Andrews
Northwest Fisheries Science Center
kelly.andrews@noaa.gov

Morgan Arrington
University of Washington
marringt@uw.edu

Seth Atkinson
Natural Resources Defense Council
satkinson@nrdc.org

Alexandra Avila
Oregon Department of Fish and Wildlife
alexandra.avila@oregonstate.edu

Diana Baetscher
UC Santa Cruz
dbaetsch@ucsc.edu

Matthew Baker
North Pacific Research Board
Matthew.Baker@nprb.org

Aaron Baldwin
Alaska Department of Fish and Game
aaron.baldwin@alaska.gov

Kenneth Baltz
Southwest Fisheries Science Center
ken.baltz@noaa.gov

Steven Barbeaux
Alaska Fisheries Science Center
steve.barbeaux@noaa.gov

Cheryl Barnes
University of Alaska Fairbanks
cheryl.barnes@alaska.edu

Lyall Bellquist
The Nature Conservancy
Lyall.Bellquist@tnc.org

Sabrina Beyer
UC Santa Cruz
sbeyer@ucsc.edu

Joseph Bizzarro
UC Santa Cruz and SWFSC
joe.bizzarro@noaa.gov

Eric Bjorkstedt
SWFSC and Humboldt State University
eric.bjorkstedt@noaa.gov

Keith Bosley
Northwest Fisheries Science Center
keith.bosley@noaa.gov

Andre Boustany
Monterey Bay Aquarium
aboustany@mbayaq.org

Sheila Bowman
Monterey Bay Aquarium
sbowman@mbayaq.org

Lyle Britt
Alaska Fisheries Science Center
lyle.britt@noaa.gov

Rachel Brooks
Moss Landing Marine Laboratories
rbrooks@mlml.calstate.edu

Bonnie Brown
Moss Landing Marine Laboratories
bbrown@mlml.calstate.edu

John Budrick
California Department of Fish and Wildlife
John.Budrick@wildlife.ca.gov

Jennifer Cahalan
Alaska Fisheries Science Center
jcahalan@psmfc.org

Tom Calvanese
Oregon State University
Tom.Calvanese@oregonstate.edu

Mark Carr
UC Santa Cruz
mhcarr@ucsc.edu

Kristina Castle
Department of Fisheries and Oceans Canada
kristina.castle@dfo-mpo.gc.ca

Jen Chiu
Moss Landing Marine Laboratories
jchiu@mlml.calstate.edu

Kathleen P Cieri
Moss Landing Marine Laboratories
kcieri@mlml.calstate.edu

Brendan Connors
Department of Fisheries and Oceans Canada
Brendan.Connors@dfo-mpo.gc.ca

Daniel Cooper
Alaska Fisheries Science Center
dan.cooper@noaa.gov

Justin Cordova
Moss Landing Marine Laboratories
jcordova@mlml.calstate.edu

Karson Coutre
Earth Resources Technology
karson.coutre@noaa.gov

David Demer
Southwest Fisheries Science Center
david.demer@noaa.gov

Christopher Dewees
Dewees Nature Designs
cmdewees@cal.net

Edward Dick
Southwest Fisheries Science Center
edward.dick@noaa.gov

Rose Dodgen
Cal Poly
rdodgen@calpoly.edu

Beau Doherty
Landmark Fisheries Research
bdoherty@landmarkfisheries.com

William Donaldson
NOAA Fisheries Alaska Region
william.donaldson@noaa.gov

Cassandra Donovan
Pacific States Marine Fisheries Commission
cassandra.donovan@noaa.gov

Robert Dooley
Marine Resource Education Program
redooley@aol.com

Joseph Drummondo
Fisher
jnozicka1@peoplepc.com

Doug Duncan
University of Alaska Fairbanks
dhduncan@alaska.edu

Claude Dykstra
International Pacific Halibut Commission
claude@iphc.int

Matthew Eagleton
NOAA Habitat Conservation
matthew.eagleton@noaa.gov

Steven Eikenbary
CSU Monterey Bay
seikenbary@csumb.edu

Kristen Elsmore
UC Davis
keelsmore@ucdavis.edu

John Field
Southwest Fisheries Science Center
John.Field@noaa.gov

Ryan Fields
Moss Landing Marine Laboratories
rfields@mlml.calstate.edu

Marisol Figueroa
CSU Monterey Bay
marfigueroa@csumb.edu

Sheryl Flores
Oregon Department of Fish and Wildlife
sheryl.m.flores@state.or.us

Omi Fontaine
Department of Fisheries and Oceans Canada
dana.haggarty@dfo-mpo.gc.ca

Bob Fraumeni
Finest At Sea
rghf@fasseafood.com

Peter Frey
Northwest Fisheries Science Center
peter.frey@noaa.gov

Jamie Fuller
Washington Department of Fish and Wildlife
jamie.fuller@dfw.wa.gov

Yongwen Gao
Makah Fisheries Management
gaoy@olypen.com

John Carlos Garza
Southwest Fisheries Science Center
carlos.garza@noaa.gov

John Gauvin
Alaska Seafood Cooperative
gauvin@seanet.com

Tracee Geernaert
International Pacific Halibut Commission
tracee@iphc.int

Vladlena Gertseva
Northwest Fisheries Science Center
vladlena.gertseva@noaa.gov

Mary Gleason
The Nature Conservancy
mgleason@tnc.org

Jamie Goen
International Pacific Halibut Commission
jamie@iphc.int

Jonathan Gonzalez
Pacific Seafood
jgonzalez@pacseafood.com

Martin Gonzalez
Fish Enthusiast
cmcknightgonzalez@yahoo.com

Elizabeth Graham
Monterey Bay Aquarium Research Institute
elgraham@csumb.edu

Joanna Grebel
California Department of Fish and Wildlife
Joanna.Grebel@wildlife.ca.gov

Nicholas Grunloh
Southwest Fisheries Science Center
nick.grunloh@noaa.gov

Dana Haggarty
Department of Fisheries and Oceans Canada
Dana.Haggarty@dfo-mpo.gc.ca

Keith Hanson
Southwest Fisheries Science Center
keith.d.hanson@noaa.gov

John Harms
Northwest Fisheries Science Center
john.harms@noaa.gov

Xi He
Southwest Fisheries Science Center
xi.he@noaa.gov

Melissa Head
Northwest Fisheries Science Center
melissa.head@noaa.gov

Jon Heifetz
Alaska Fisheries Science Center
jon.heifetz@noaa.gov

Ed Henry
International Pacific Halibut Commission
ed@iphc.int

Allan Hicks
International Pacific Halibut Commission
allan@iphc.int

Gerald Hoff
Alaska Fisheries Science Center
jerry.hoff@noaa.gov

Anna Holder
CSU Monterey Bay
aholder@csumb.edu

Ily Iglesias
Southwest Fisheries Science Center
ilysa.iglesias@noaa.gov

Andy Jasonowicz
University of Washington
andyj1@uw.edu

Colin Jones
Pacific States Marine Fisheries Commission
cjones@psmfc.org

Laura Junge
Alaska Pacific University
ljunge@alaskapacific.edu

Katherine Kaplan
UC Davis and CDFW
kakaplan@ucdavis.edu

Neosha Kashef
Southwest Fisheries Science Center
neosha.kashef@noaa.gov

Craig Kastelle
Alaska Fisheries Science Center
craig.kastelle@noaa.gov

Josh Keaton
NOAA Fisheries Alaska Region
josh.keaton@noaa.gov

Aimee Keller
Northwest Fisheries Science Center
aimee.keller@noaa.gov

Ian Kelmartin
Humboldt State University
idk16@humboldt.edu

Elise Keppel
Department of Fisheries and Oceans Canada
elise.keppel@dfo-mpo.gc.ca

Bruce Koike
Little Pond Nature Prints
koike.bruce@gmail.com

Rosamaria Kosaka
Southwest Fisheries Science Center
rosemary.kosaka@noaa.gov

Stan Kotwicki
Alaska Fisheries Science Center
stan.kotwicki@noaa.gov

Joseph Krieger
Alaska Fisheries Science Center
joseph.krieger@noaa.gov

Gregory Krutzikowsky
Oregon Department of Fish and Wildlife
greg.krutzikowsky@state.or.us

Peter Kuriyama
University of Washington
ptrkrym@uw.edu

Lisa Lacko
Department of Fisheries and Oceans Canada
Lisa.Lacko@dfo-mpo.gc.ca

Tom Laidig
Southwest Fisheries Science Center
tom.laidig@noaa.gov

Laurel Lam
Moss Landing Marine Laboratories
llam@mlml.calstate.edu

Edward Laman
Alaska Fisheries Science Center
Ned.Laman@noaa.gov

Ned Laman
Alaska Fisheries Science Center
ned.laman@noaa.gov

Traci Larinto
California Department of Fish and Wildlife
Traci.Larinto@wildlife.ca.gov

Andrew Lauermann
Marine Applied Research and Exploration
andy@maregroup.org

Kelly Lawrence
Oregon Department of Fish and Wildlife
kelly.a.lawrence@state.or.us

Lyndsey Lefebvre
UC Santa Cruz and SWFSC
Lyndsey.lefebvre@noaa.gov

James Lindholm
CSU Monterey Bay
jlindholm@csumb.edu

Mark Lomeli
Pacific States Marine Fisheries Commission
mlomeli@psmfc.org

Milton Love
UC Santa Barbara
love@lifesci.ucsb.edu

Heidi Lovig
Marine Applied Research and Exploration
heidi@maregroup.org

Dayv Lowry
Washington Department of Fish and Wildlife
dayv.lowry@dfw.wa.gov

Pat Malecha
Alaska Fisheries Science Center
Pat.Malecha@noaa.gov

Tim Maricich
F/V Donna Kathleen
tmaricich@gmail.com

Donna Maricich
F/V Donna Kathleen
donnamaricich@yahoo.com

Scott Marion
Oregon Department of Fish and Wildlife
scott.r.marion@state.or.us

Jacek Maselko
Alaska Fisheries Science Center
Jacek.Maselko@noaa.gov

Beth Matta
Alaska Fisheries Science Center
beth.matta@noaa.gov

Lynn Mattes
Oregon Department of Fish and Wildlife
lynn.mattes@state.or.us

Susanne McDermott
Alaska Fisheries Science Center
susanne.mcdermott@noaa.gov

Howard McElderry
Archipelago Marine Research
howardM@archipelago.ca

Caroline Mcknight
California Department of Fish and Wildlife
caroline.mcknight@wildlife.ca.gov

Jon McVeigh
Northwest Fisheries Science Center
jon.mcveigh@noaa.gov

Kathryn Meyer
Department of Fisheries and Oceans Canada
kathryn.meyer@wildlife.ca.gov

Rebecca Miller
Southwest Fisheries Science Center
rebecca.miller@noaa.gov

Jacklyn Mohay
Moss Landing Marine Laboratories
jmohay@mlml.calstate.edu

Melissa Monk
Southwest Fisheries Science Center
melissa.monk@noaa.gov

Mark Morales
UC Santa Cruz
mamamora@ucsc.edu

Melissa Nehmens
Moss Landing Marine Laboratories
mnehmens@mlml.calstate.edu

Sandi Neidetcher
Alaska Fisheries Science Center
sandi.neidetcher@noaa.gov

Mary Nishimoto
UC Santa Barbara
mary.nishimoto@lifesci.ucsb.edu

Alexander Norton
Monterey Bay Aquarium
anorton@mbayaq.org

Giuseppe Nozicka
Fisher
jnozicka1@peoplepc.com

Ladislav Nozicka
Fisher
jnozicka1@peoplepc.com

Jiri Nozicka
Fisher
jnozicka1@peoplepc.com

Elizabeth Nozicka
Fisher
jnozicka1@peoplepc.com

Billie Nozicka
Fisher
jnozicka1@peoplepc.com

John Olson
Alaska Pacific University
jvolson@alaskapacific.edu

Bob Pacunski
Washington Department of Fish and Wildlife
robert.pacunski@dfw.wa.gov

Melissa Palmisciano
Moss Landing Marine Laboratories
mpalmisciano@mlml.calstate.edu

Billie Pennisi
Fisher
jnozicka1@peoplepc.com

Nicholas Perkins
UC Davis and CDFW
nrperkins@ucdavis.edu

Joseph Petersen
Makah Tribe
joe.petersen@makah.com

Brad Pettinger
Oregon Trawl Commission
bpettinger@ortrawl.net

Catarina Pien
Moss Landing Marine Laboratories
cpien@mlml.calstate.edu

Jodi Pirtle
Alaska Fisheries Science Center
jodi.pirtle@noaa.gov

Josep Planas
International Pacific Halibut Commission
josep@iphc.int

Michael Prall
California Department of Fish and Wildlife
michael.prall@wildlife.ca.gov

Roy Qi
UC Santa Cruz
rqi@ucsc.edu

Leif Rasmuson
Oregon Department of Fish and Wildlife
leif.k.rasmuson@state.or.us

Lauren Rogers
Alaska Fisheries Science Center
lauren.rogers@noaa.gov

Sean Rooney
Alaska Fisheries Science Center
sean.rooney@noaa.gov

Chris Rooper
Alaska Fisheries Science Center
chris.rooper@noaa.gov

Craig Rose
FishNext Research
fishnextresearch@gmail.com

Dirk Rosen
Marine Applied Research and Exploration
dirk@maregroup.org

Steven Rossi
Simon Fraser University
spr1@sfu.ca

Kristin Saksa
Moss Landing Marine Laboratories
ksaksa@mlml.calstate.edu

Keith Sakuma
Southwest Fisheries Science Center
keith.sakuma@noaa.gov

David Sampson
Oregon State University
David.Sampson@oregonstate.edu

Brittany Schwartzkopf
Oregon State University
brittany.schwartzkopf@oregonstate.edu

Jamey Selleck
NOAA Fisheries West Coast Region
James.Selleck@noaa.gov

Kalei Shotwell
Alaska Fisheries Science Center
Kalei.Shotwell@noaa.gov

Alayna Siddall
Sportfishing Association of California
alayna.siddallsac@gmail.com

Victor Simon
Northwest Fisheries Science Center
victor.simon@noaa.gov

Kirsten Simonsen
Alaska Fisheries Science Center
kirsten.simonsen@noaa.gov

Samantha Simpson
NOAA Habitat Conservation
samantha.simpson@noaa.gov

Susan Sogard
Southwest Fisheries Science Center
susan.sogard@noaa.gov

Laura Solinger
Humboldt State University
lks290@humboldt.edu

David Stafford
Southwest Fisheries Science Center
david.stafford@noaa.gov

Rick Starr
Moss Landing Marine Laboratories
Starr@mlml.calstate.edu

Jay Staton
Humboldt State University
jms1860@humboldt.edu

Andi Stephens
Northwest Fisheries Science Center
andi.stephens@noaa.gov

Ian Stewart
International Pacific Halibut Commission
ian@iphc.int

Kevin Stierhoff
Southwest Fisheries Science Center
kevin.stierhoff@noaa.gov

Maria Surry
Department of Fisheries and Oceans Canada
maria.surry@dfo-mpo.gc.ca

Kathryn Temple
Department of Fisheries and Oceans Canada
kathryn.temple@dfo-mpo.gc.ca

Nick Tolimieri
Northwest Fisheries Science Center
nick.tolimieri@noaa.gov

Vivian Ton
Moss Landing Marine Laboratories
vton@mlml.calstate.edu

Theresa Tsou
Washington Department of Fish and Wildlife
tsoutt@dfw.wa.gov

John Wallace
Northwest Fisheries Science Center
John.Wallace@noaa.gov

Grant Waltz
Cal Poly
gwaltz@calpoly.edu

Jessica Watson
Oregon Department of Fish and Wildlife
jessica.l.watson@state.or.us

Diana Watters
Southwest Fisheries Science Center
Diana.watters@noaa.gov

Ray Webster
International Pacific Halibut Commission
ray@iphc.int

Joe Welsh
Monterey Bay Aquarium
jwelsh@mbayaq.org

Chantel Wetzel
Northwest Fisheries Science Center
Chantel.Wetzel@noaa.gov

Phillip Weyland
Washington Department of Fish and Wildlife
phillip.weyland@dfw.wa.gov

Alison Whitman
Oregon Department of Fish and Wildlife
alison.d.whitman@state.or.us

Curt Whitmire
Northwest Fisheries Science Center
curt.whitmire@noaa.gov

Sharon Wildes
Alaska Fisheries Science Center
sharon.wildes@noaa.gov

Kresimir Williams
Alaska Fisheries Science Center
kresimir.williams@noaa.gov

Jimmy Williamson
Moss Landing Marine Laboratories
jwilliamson@mlml.calstate.edu

Ellen Willis-Norton
UC Santa Cruz
ewillisn@ucsc.edu

Chris Wilson
Satlink
clw@satlink.es

Oliviya Wyse
California Department of Fish and Wildlife
oliviya.wyse@wildlife.ca.gov

Lauren Yamane
UC Davis
layamane@ucdavis.edu

Noelle Yochum
Alaska Fisheries Science Center
noelle.yochum@noaa.gov

Rachel Zuercher
UC Santa Cruz
rzuerche@ucsc.edu