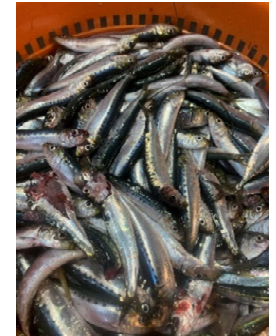
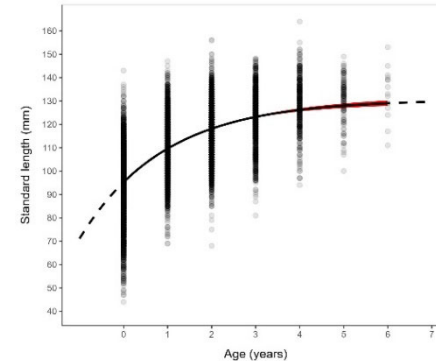


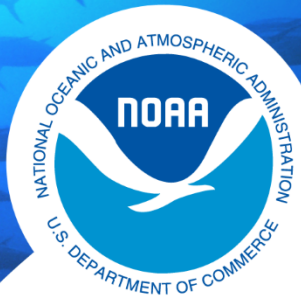
**NOAA**  
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# Southwest Fisheries Science Center Coastal Pelagic Species Research Update



## ***Presenter***

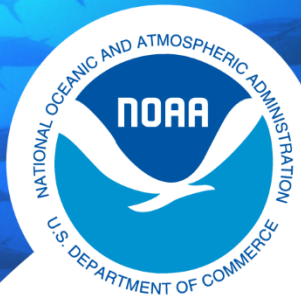
*Annie Yau, Fisheries Resources Division Director*



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## Outline

- CPS Assessment Schedule
- Upcoming CPS Meetings
- Survey Updates
- Life History Activities
- Ongoing Climate-Related Projects



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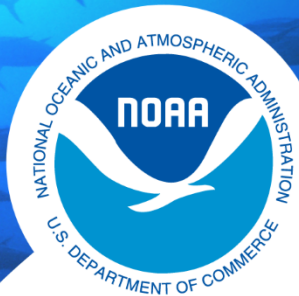
## CPS Assessment Schedule

Pacific Mackerel Benchmark (May 2023)

Sardine Northern Subpopulation

- Stock Structure workshop (Nov 2022)
- Methods Review (as needed) (Feb 2023)
- Benchmark Assessment (March 2024)

# Upcoming CPS meetings



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## **Pacific Sardine Stock Structure Workshop (SWFSC hosting)**

- Nov 15-17, 2022 @ SWFSC La Jolla
- Virtual and in-person options
- Contact [annie.yau@noaa.gov](mailto:annie.yau@noaa.gov)

## **CalCOFI conference**

- December 5-7, 2022 @ Scripps Institution of Oceanography, UCSD
- Virtual and in-person options
- Contact [esatterthwaite@ucsd.edu](mailto:esatterthwaite@ucsd.edu)

## **Trinational Sardine and Small Pelagics Forum**

- Thursday, December 8, 2022
- Virtual only
- Contact [Stephanie.Flores@noaa.gov](mailto:Stephanie.Flores@noaa.gov)

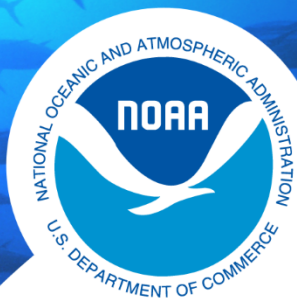
## **Pacific Sardine Methods Review (as needed; PFMC hosting)**

- Feb 21-23, 2023 @ SWFSC La Jolla

## **Pacific Mackerel STAR panel**

- May 2-4, 2023 @ SWFSC La Jolla





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### *Lasker*

Lost half DAS; No Leg 1

*Carranza* surveyed Baja

*Lisa Marie* & *Saildrones*  
off WA, OR and N. CA

Difficulty catching Jack  
Mackerel, deep schools,  
and CPS in clear water.

*Long Beach Carnage*  
Bodega Bay to San Diego

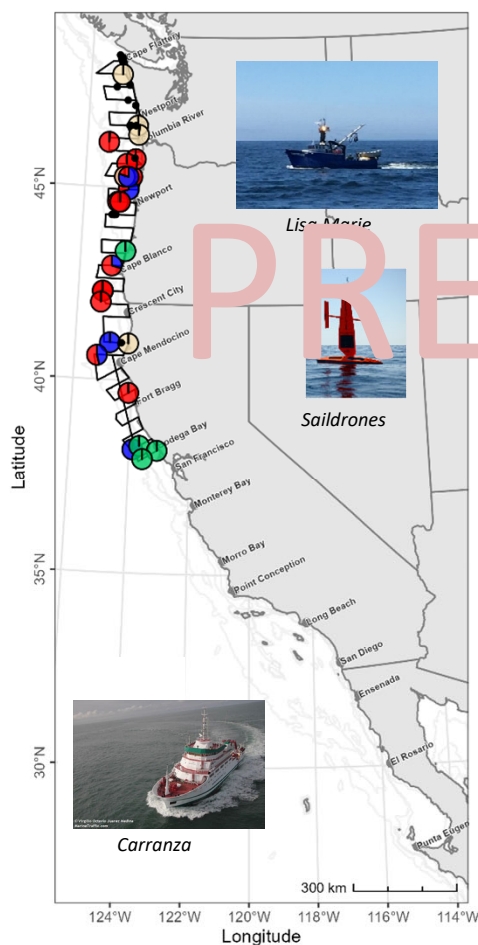
Sardine nearshore in  
southern stock habitat

Anchovy S. of Bodega  
Bay

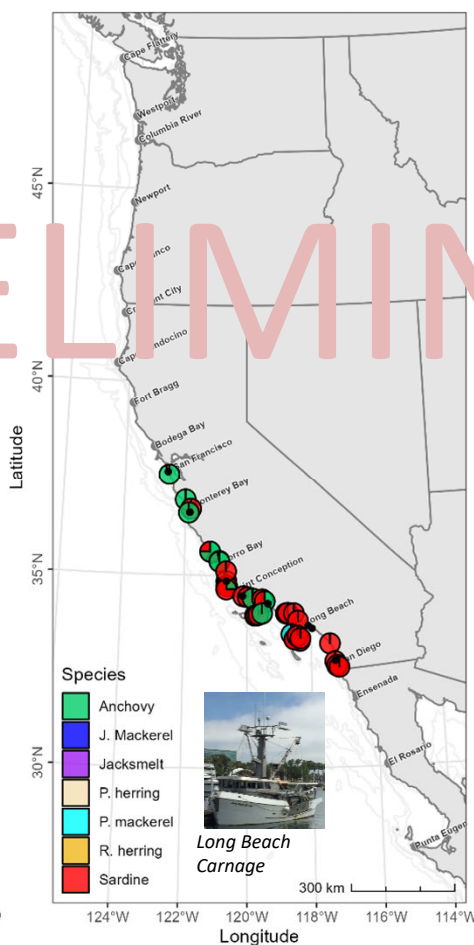
# Survey Updates

## CPS Survey Summer 2022

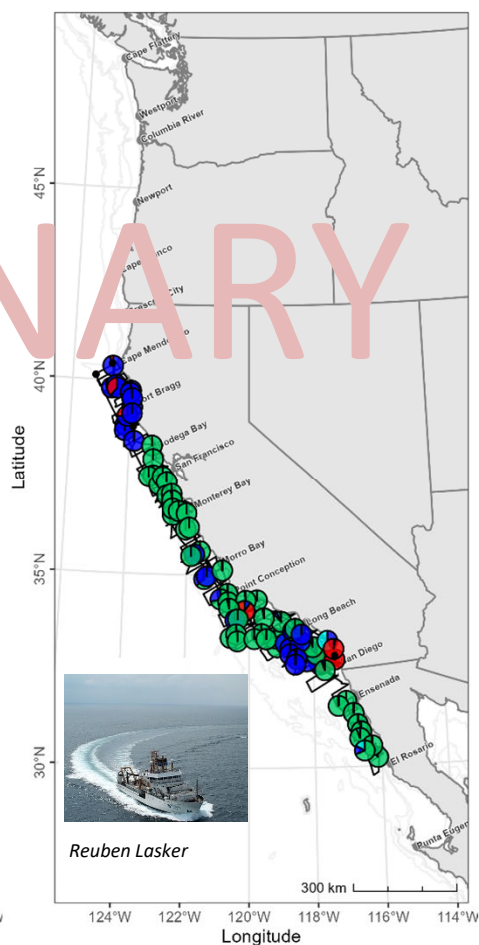
Leg 1



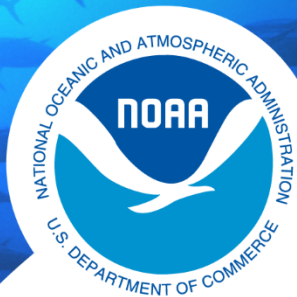
Legs 2 and 3



Legs 2, 3 and 4



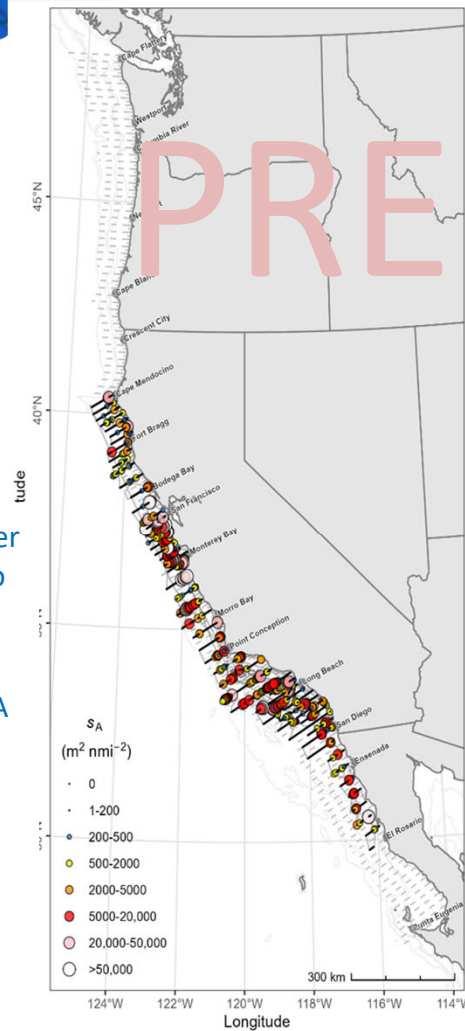
# Summer 2022 Lasker



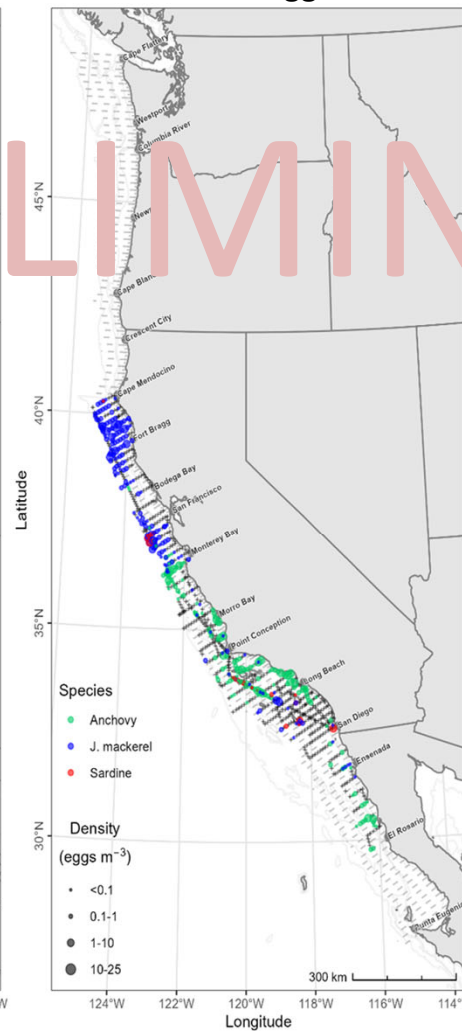
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- Mostly anchovy backscatter San Francisco to San Diego
- Anchovy spawning Monterey Bay to Oceanside, and off Baja CA
- Jack Mackerel spawning north of Monterey Bay
- Jack Mackerel west of Channel Islands
- Sardine nearshore in Southern California Bight

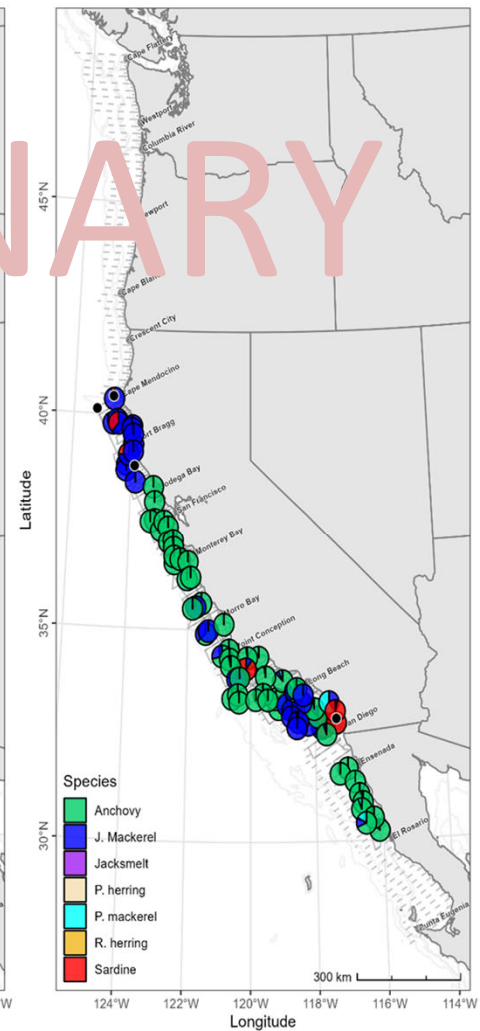
CPS Backscatter



CPS Eggs



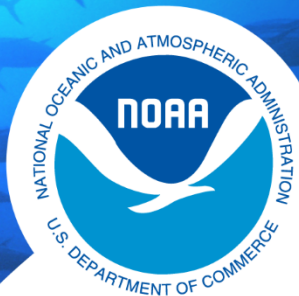
CPS Catch



Year	Survey Region	DAS	Transit (nm)	Transects	Transects (nm)	Trawls	UCTD	CTD	Bongos	CUFES
2022	Mendocino to Punta Baja	44 (82 allotted)	5452	65	2483	89	89	8	11	850
2021	Cape Flattery to El Rosario	68 (86 allotted)	8722	84	4000	127	199	0	35	1200
2019	Cape Scott to San Diego	77 (77 allotted)	5970	140	7390	163	266	17	19	1836
2018	Cape Scott to San Diego	80 (80 allotted)	TBD	127	6104	169	239	59	55	1848

Plots: Kevin Stierhoff





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- Faster catch processing
- Improved data-entry accuracy
- Graphical user interface by Ed Weber

## Electronic Fish-Measuring Board



Anchovy



Kelsey James, Kamran Walsh, Andrew Thompson, Ed Weber

Haul: 22

Species: 161828 N. Anchovy ▾

Length Type: FL ▾

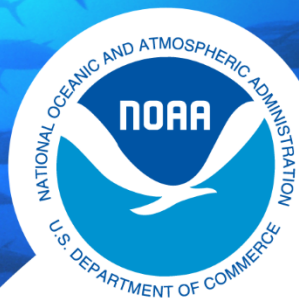
Start Measurements Stop Measurements

Fish #	Length (mm)	Weight (g)
1	125	21.5
2	124	17.5
3	120	18.5
4	121	18
5	122	17.5
6	123	20
7	126	20.5
8	118	15.5
9	122	18
10	146	28

Add Record Delete Record

Photos: Scott Mau, Emily Gardner

# CalCOFI Surveys



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## Enhanced CalCOFI

- October 12-19, 2022

Collaborative effort between NOS  
Channel Islands National Marine  
Sanctuary, CDFW, SIO, and SWFSC.

## Fall CalCOFI (R/V Sally Ride)

- Nov 5-20, 2022

## Winter CalCOFI (R/V Lasker)

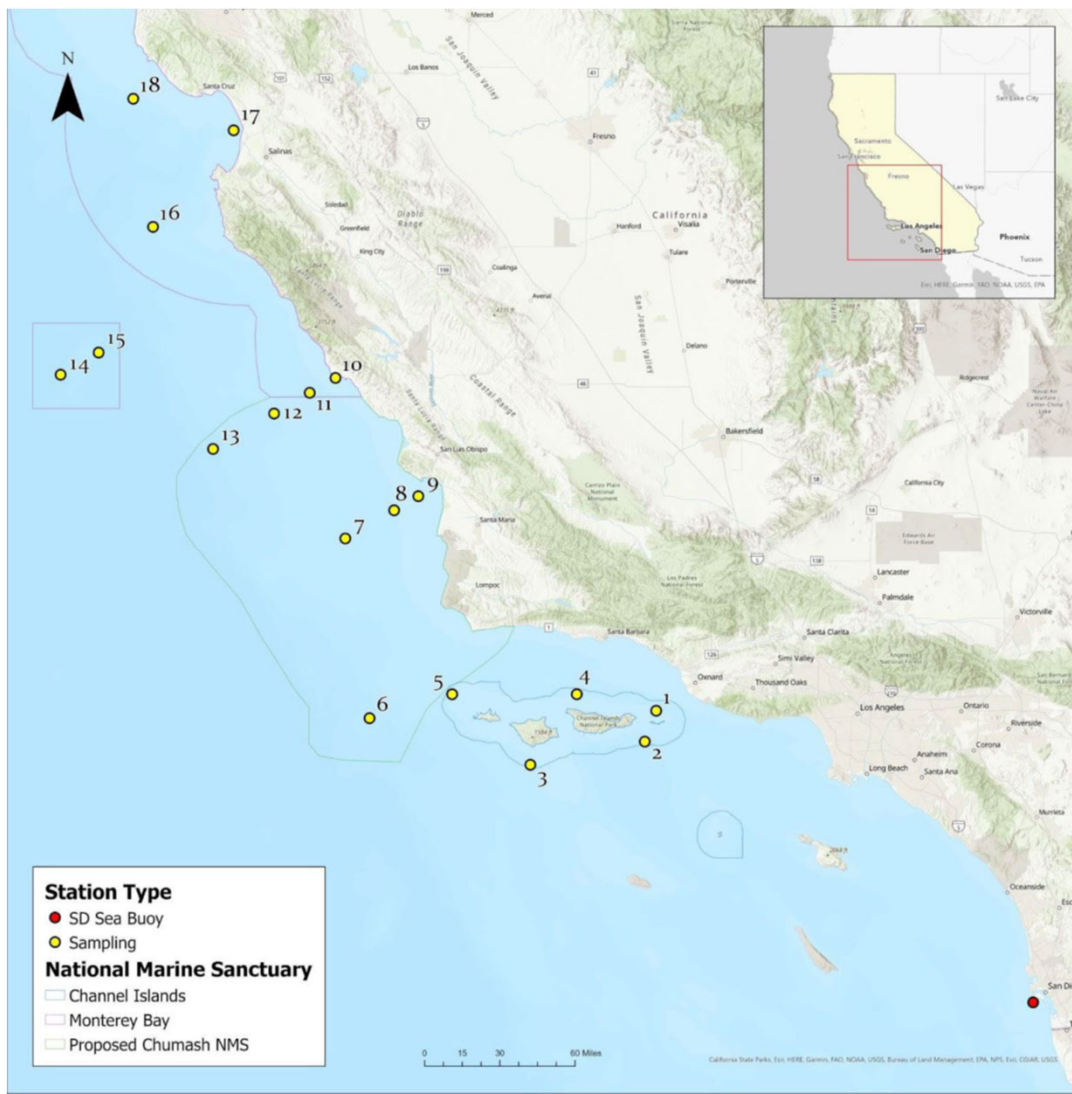
- January 6-26, 2023

## Spring CalCOFI (R/V Shimada)

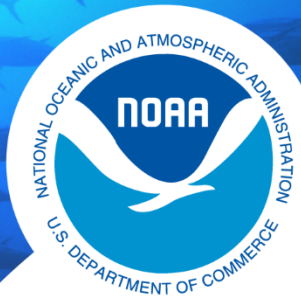
- March 27-April 4, 2023

## Summer CalCOFI (SIO hosted)

- July 2023, dates TBD





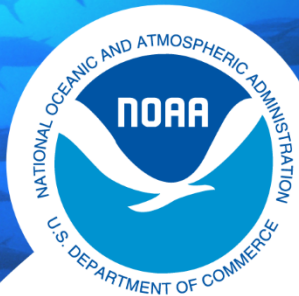


## West Coast Pelagic Surveys Re-envisioning

By 2025 and beyond, NMFS is attempting to integrate NWFSC and SWFSC west coast surveys of hake and coastal pelagic species.

- An integrated survey seeks to optimize resources and improve the data collected for stock assessments, management strategy evaluations, and ecosystem research and modeling.
- Internal planning meetings between NWFSC and SWFSC continue.
- Planning for a 2025 fully integrated survey, with incremental progress between now and then.





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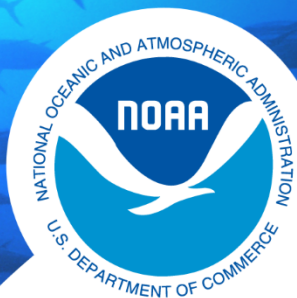
# Life History Updates

## CPS Ageing Efforts

- Streamlined biosampling protocols on CPS surveys to maximize efficiency and collection of otolith samples across all length and age classes.
- Aged backlog of otolith samples (2012 – current) to have age data for all CPS through 2021.
- Maximized consistency and accuracy of age estimates for CPS in collaboration with CDFW through:
  - Completion of trainings for ageing all CPS
  - Refined ageing protocols

Plan to have up to date ageing data for CPS assessments moving forward.





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## Summary of Age and Maturity Data

### **Pacific Sardine**

3,694 otoliths from 2016 to 2021 plus re-reads

### **Northern Anchovy**

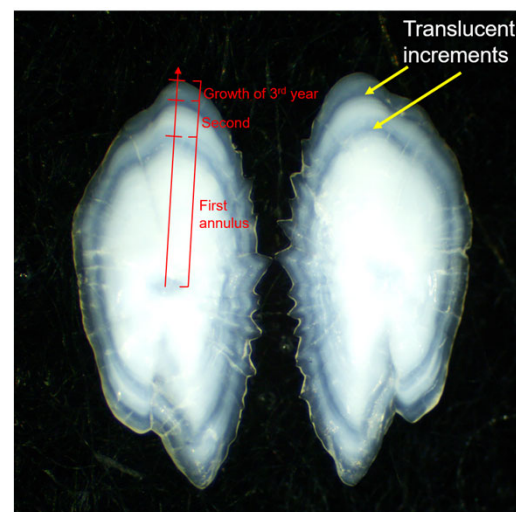
6,182 otoliths from 2014 to 2021 plus re-reads

1,418 gonad samples from 2012 to 2021

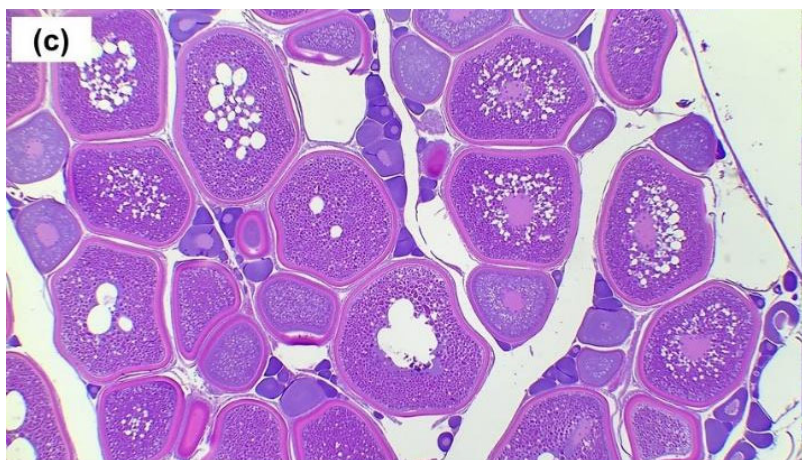
### **Pacific Mackerel**

2,665 otoliths from 2012-2021 plus re-reads

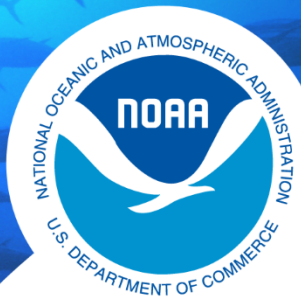
912 gonad samples from 2010 to 2021



*Northern Anchovy otoliths*



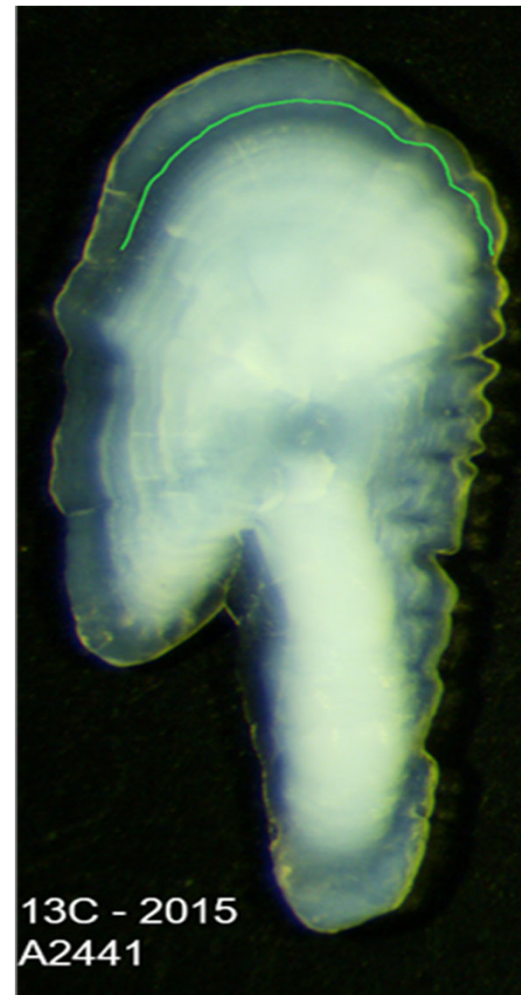
*Cross-section of an ovary from a spawning capable, female Pacific Mackerel*



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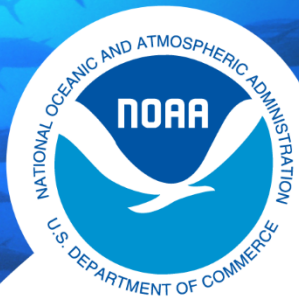
## CPS Age Validation Efforts

- Pacific Sardine, Northern Anchovy, and Pacific Mackerel marked with a fluorescent marker (oxytetracycline; OTC) and raised in captivity for 12 months.
- Pacific Sardine held in captivity for 12 months deposited an annulus, indicating that counts of annuli reflect fish ages in years.
- Northern Anchovy and Pacific Mackerel data still being analyzed.



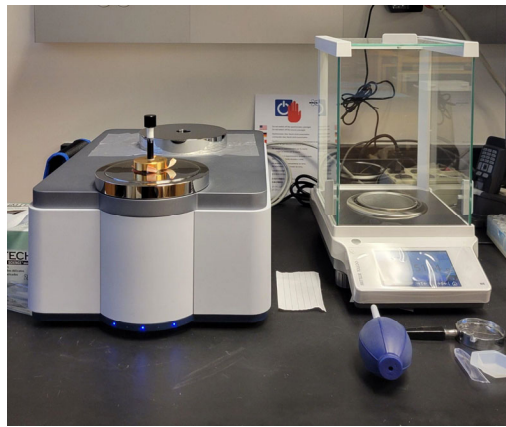
*Image of a Pacific Sardine otolith marked with OTC (green line) and held in captivity for 12 months.*





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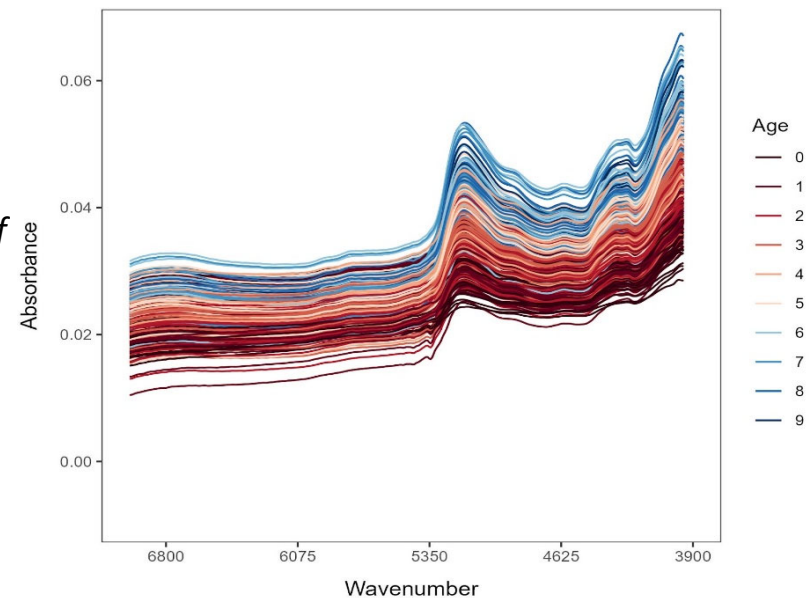
## CPS Automated Ageing Efforts

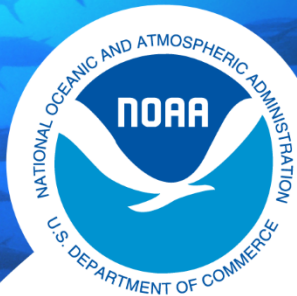


*FT-NIRS  
machine  
(Tango)*

- Scanning otoliths using Fourier Transform Near-Infrared Spectroscopy (FT-NIRS) to determine if this method would allow for rapid and automated ageing of CPS.
- Scanned > 2,500 otoliths of Pacific Sardine; hundreds of otoliths for Northern Anchovy and Pacific Mackerel
- Samples provided by CDFW, DOF Canada, and WDFW

*Raw spectra of scans of  
Pacific Sardine otoliths  
colored by age*





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# Climate-related Projects on CPS

## A New Research Project on CPS

**“Impact of climate and ecosystem change on the California Current forage complex and the fishing communities and predators it sustains”**

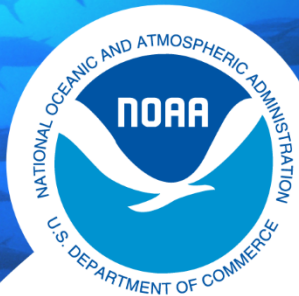
*Three year project funded by NOAA Climate Program Office's Coastal and Ocean Climate Applications (COCA) Fisheries and Climate Program*

Collaboration between SWFSC, NWFSC, UCSC, and CSIRO

3 postdocs have been hired –

- Felipe Quezada Escalona (economist)
- Pierre-Yves Hervann (ecosystem modeler)
- Robert Wildermuth (population dynamics modeler)





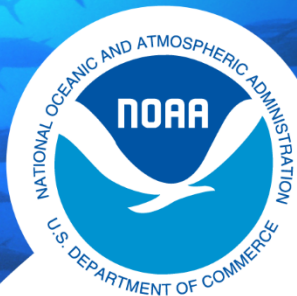
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Project follows on the **Future Seas Project** which investigated downscaled climate projections in the CA current and impacts on regional fisheries including sardine.

*Project aims:*

- 1) assess the **effects of long-term climate change** on the forage fish assemblage of the CC and on the predators and fishing communities it sustains,
- 2) develop a **climate-informed ecosystem management strategy evaluation** (MSE) to assess performance of current and alternative CPS management strategies under a changing climate, shifting forage species composition, and varying predator populations.



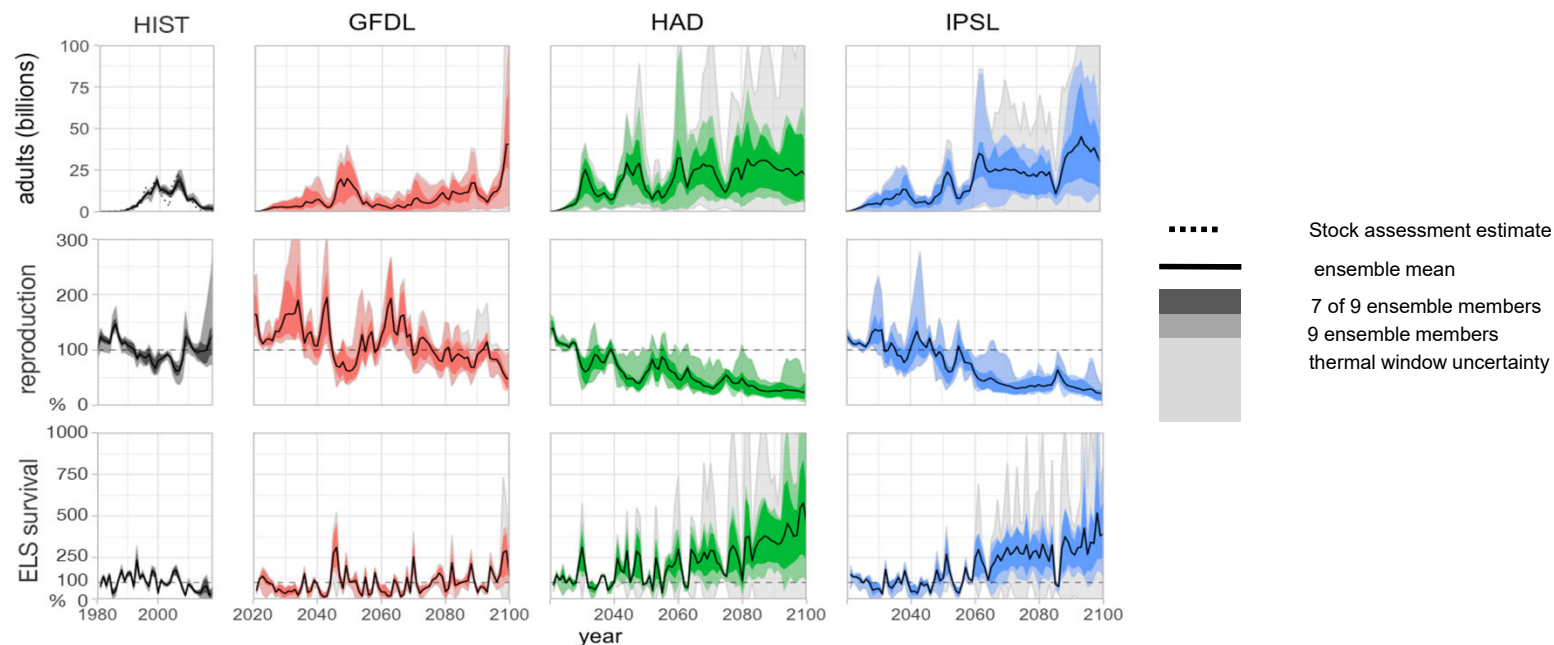
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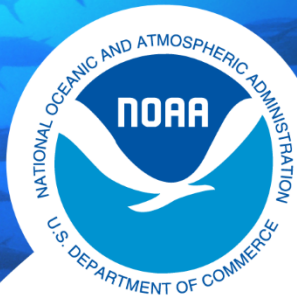
## Ongoing research projects on CPS

***“Population projections of Pacific sardine driven by ocean warming and changing food availability in the California Current”***

*Koenigstein et al. (2022) ICES Journal of Marine science*

- Age-structured sardine population model with mechanistic model structure based on biological processes affected by environmental drivers
- Recent sardine decline preceded by low food availability
- Projections of future sardine biomass differ by climate model
- Uncertainty associated with response of sardine to temperatures outside historical period



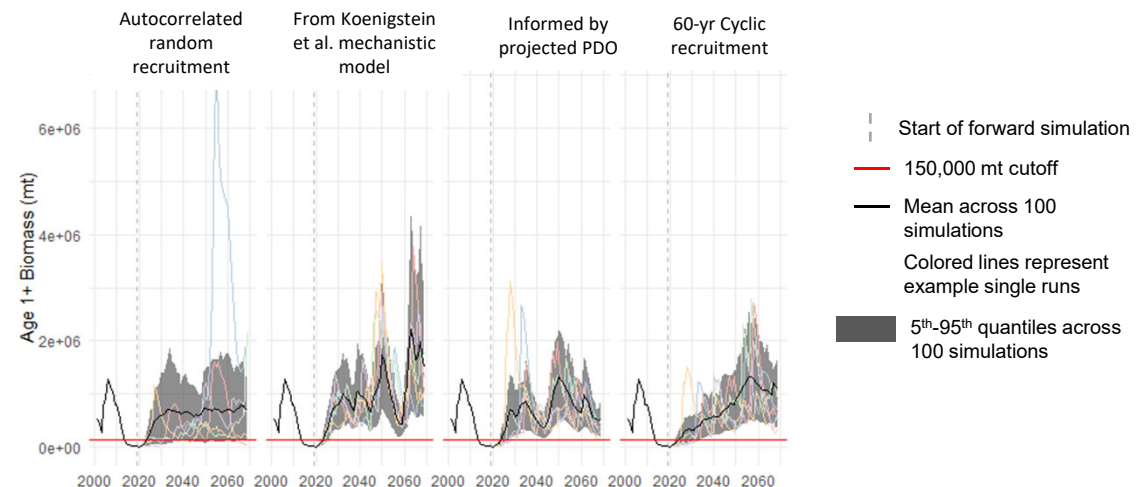


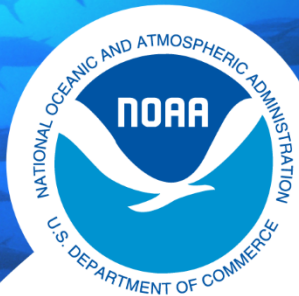
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## Ongoing Research Projects on CPS

*“Evaluating robustness of harvest control rules for sardine to climate driven recruitment variability”*

- Wildermuth et al. paper in prep
- MSE simulates sardine dynamics under different climate driven recruitment scenarios and harvest strategies



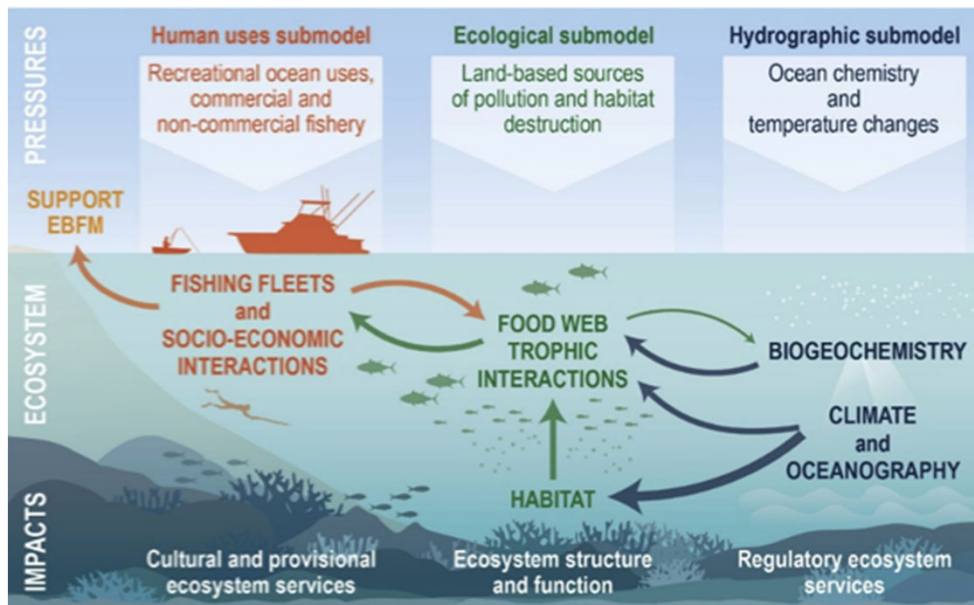


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## Ongoing Research Projects on CPS

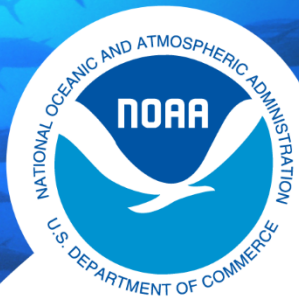
***“Investigating impacts of climate change and CPS management on connected species and fisheries (e.g. protected species and HMS)”***

- Ongoing development of Atlantis ecosystem model in collaboration with NWFSC to be used in climate-informed ecosystem MSE
- Assess impact of shifting forage fish distributions on predator dynamics (Hervann et al., in prep)



<https://research.csiro.au/atlantis/>  
H.R. Pethybridge et al. 2019; E.A. Fulton et al. 2011



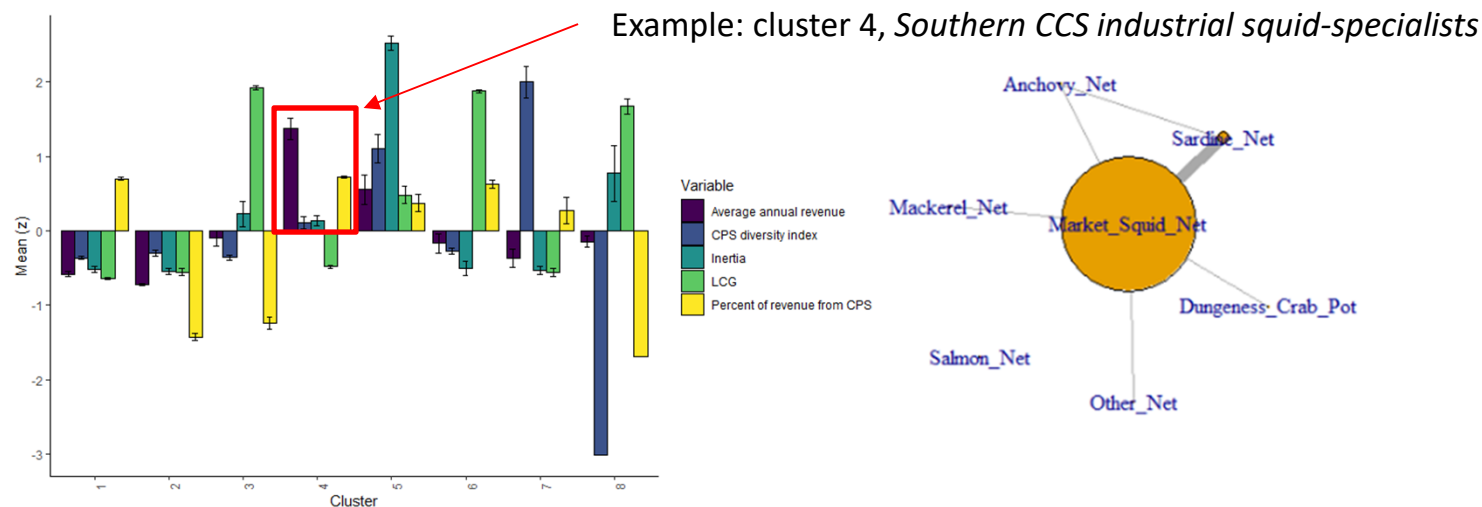


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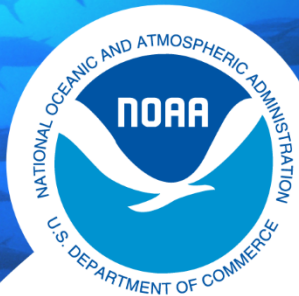
## Ongoing Research Projects on CPS

*“Assessing impacts of climate change on CPS fishery participants and their portfolio”*

- Developed CPS (squid, sardine anchovy) economic model to assess how changes in CPS distribution and regulations affect CPS landings by port area (Quezada et al., in prep)
- Analysis takes into account heterogeneous responses of CPS fishery participants by first defining clusters of CPS vessels with similar behavior (Quezada et al., in prep)







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- The project will update Council periodically via NMFS CPS council updates and presentations to relevant Council bodies
- Late November meeting with stakeholders to
  - Engage stakeholders in the CPS fishery to identify perceived climate-driven challenges in the fishery
  - Engage stakeholders in the CPS fishery to help us better understand the fleet dynamics and fisheries operations to improve socio-economic models used in the project
  - Engage stakeholders in the CPS fishery to help us identify relevant performance metrics for the climate-informed, ecosystem management strategy evaluation



A photograph of a person silhouetted on a balcony, looking out at a sunset over the ocean. The sun is low on the horizon, creating a bright orange glow and a long, shimmering reflection on the water. The sky transitions from a deep orange near the horizon to a pale blue at the top. The balcony is on the left, with a railing visible. The overall mood is contemplative and serene.

# Questions?