

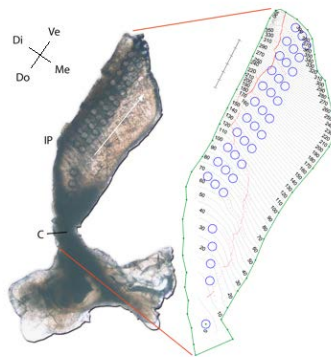
**NOAA
FISHERIES**

Southwest Fisheries
Science Center

Agenda Item I.1.b
Supplemental SWFSC Presentation 1
September 2019

NMFS Report SWFSC Activities Highly Migratory Species

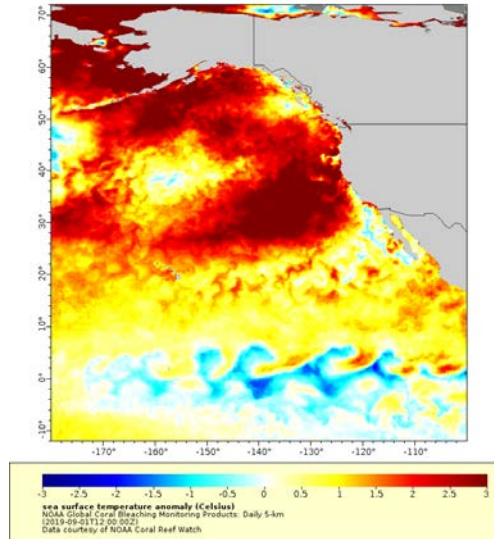
Kristen Koch
Director, Southwest Fisheries Science Center



NOAA FISHERIES

Presentation Outline

- Emerging Marine Heat Wave in North Pacific
- HMS Research Updates
 - Swordfish Foraging Ecology
 - Bluefin
 - Recreational size sampling
 - Life History
 - Opah
 - CPUE analyses
 - Life History
 - Sexual dimorphism
 - Albacore:
 - Life History
 - Habitat modeling
- ISC/IATTC Stock Assessments and Activities
- Workshops/Outreach



The emerging Marine Heat Wave of 2019

from NOAA West Watch Webinar

Toby Garfield*

SWFSC

10 September, 2019

* Multiple contributors: Chris Harvey, Nate Mantua, Andy Leising, Mike Jacox, Eric Bjorkstedt, Greg Williams, Brian Wells, John Field, Kym Jacobson, Dale Robinson, Elliott Hazen, Tom Good, Dean Roemmich, Alex Tardy, Michael Milstein and more



Marine Heatwave Update, September 2019

The NE Pacific has been experiencing a new Marine Heatwave (MHW) since mid-June 2019, with similarities to “The Blob” of 2013-2016

What defines a Marine Heatwave (MHW)?

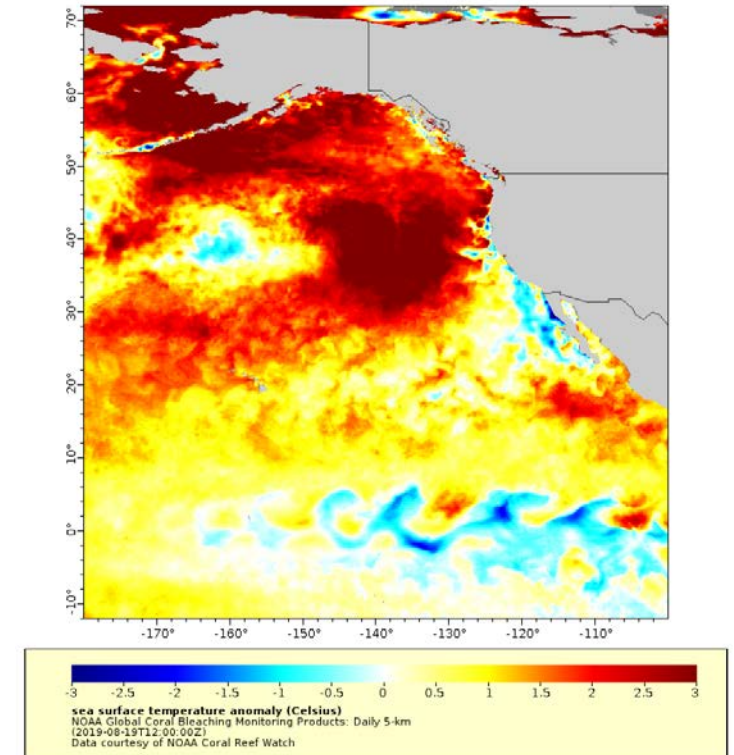
Hobday et al. (2018): Any parcel of water with a Sea Surface Temperature (SST) > 90% of the climatological mean for > 5 days

- Taken from the land-based definition for heatwaves, yet lacks the terrestrial concept of a “region”, e.g. just because its warm at my house for 5 days does not mean my state is experiencing a heatwave

Leising (CCIEA 2019) proposed: Contiguous region > 500,000 km² in area, normalized SST anomaly > 95% of the data, and lasting > 6 days

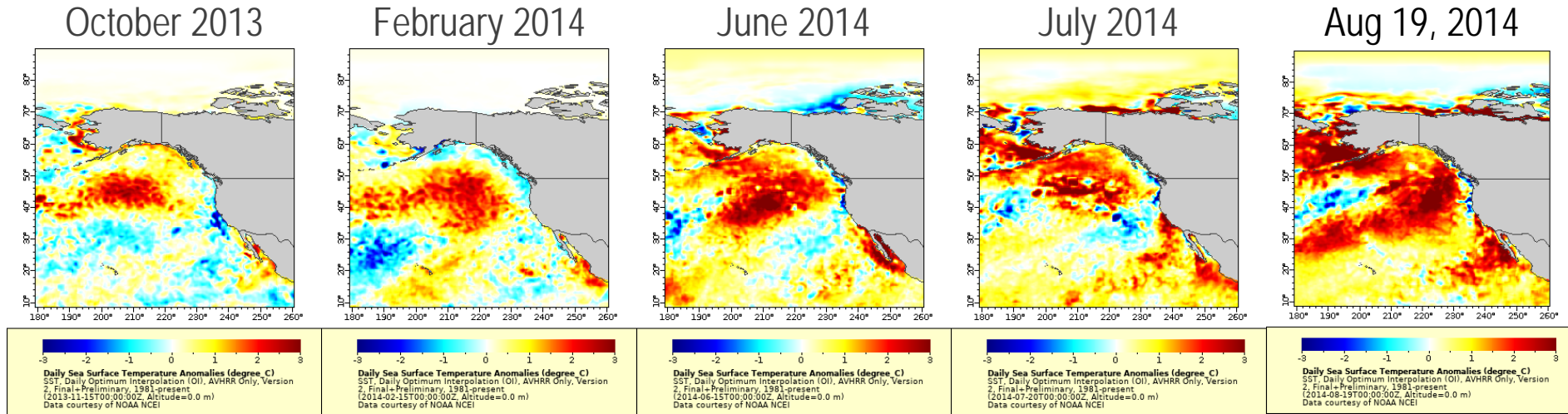
- Adjustments are proposed to account for advection of features, natural oceanic temporal scales of variability, adds a “regional” spatial component, allows for tracking individual features, and selects only the top 5% of SSTa data.

Image from August 19, 2019

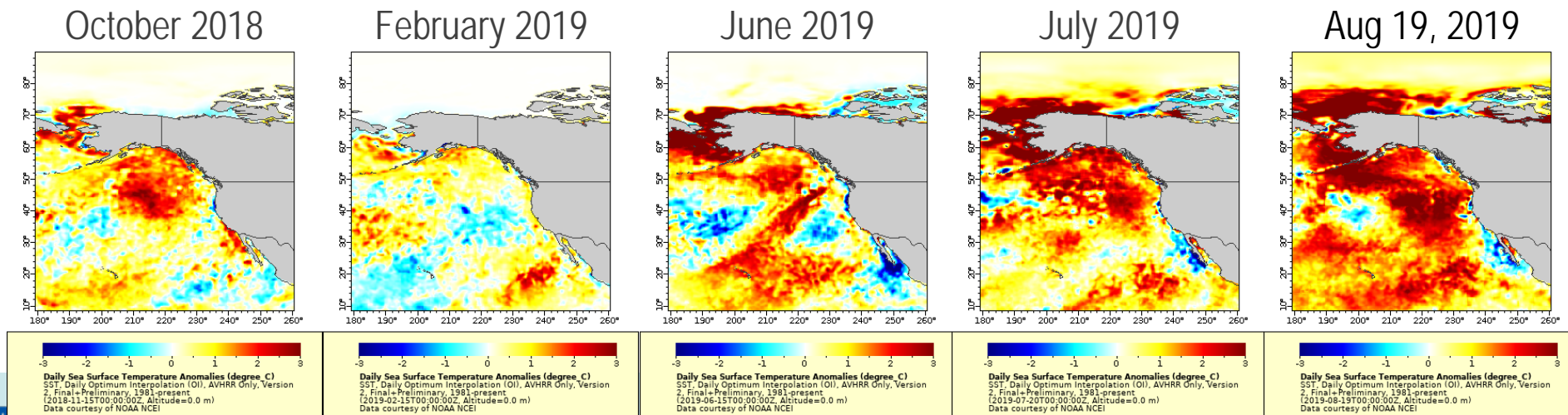


Current MHW vs. "The Blob": SST anomalies

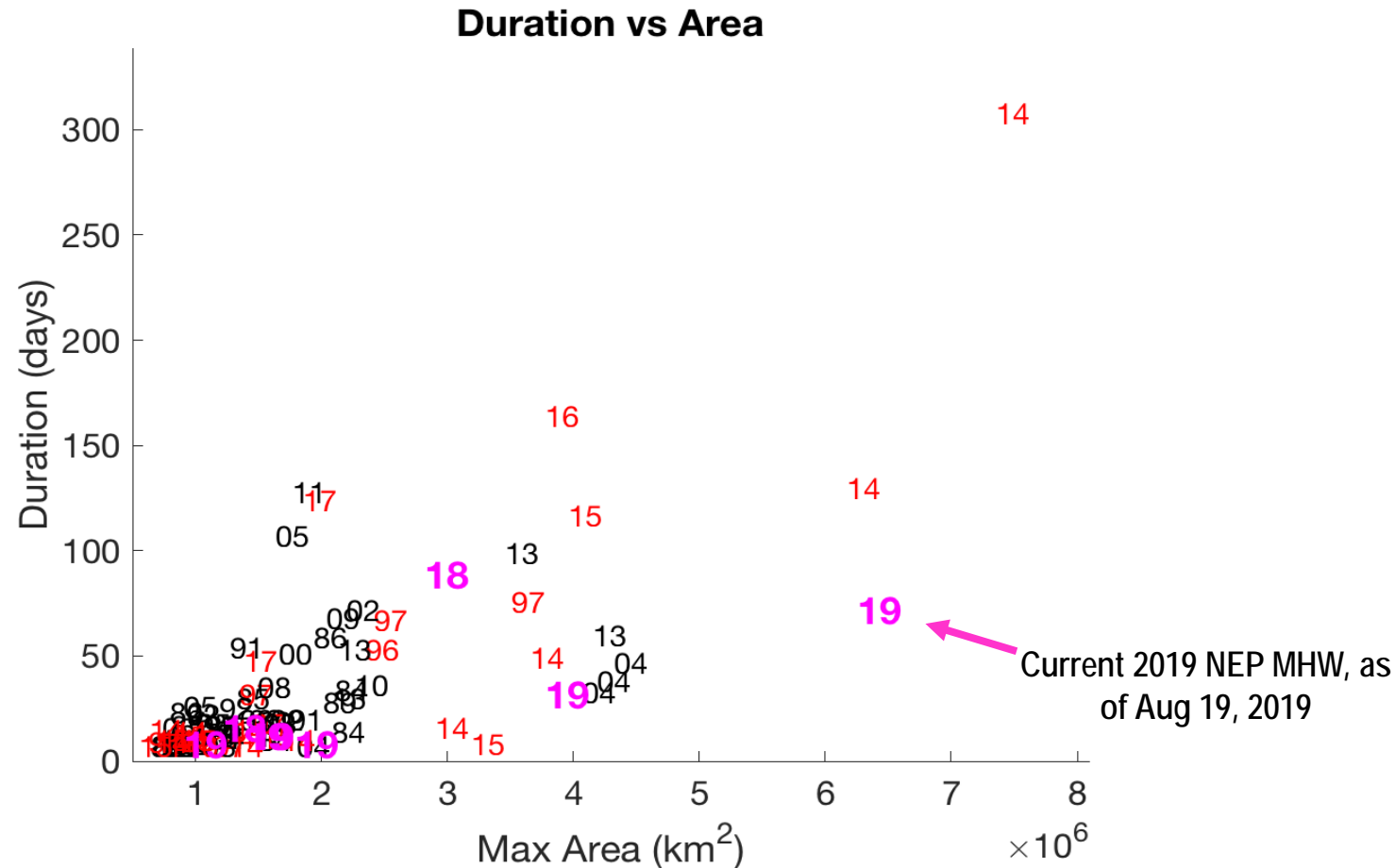
The Blob



Current MHW



This is the second-largest MHW on record for the NE Pacific
(although it's still only a few months old)



(Numbers indicate year in which each MHW began. Recent events in pink; "BLOB" years of 2014-2016 and the El Niño of 97 are in red)



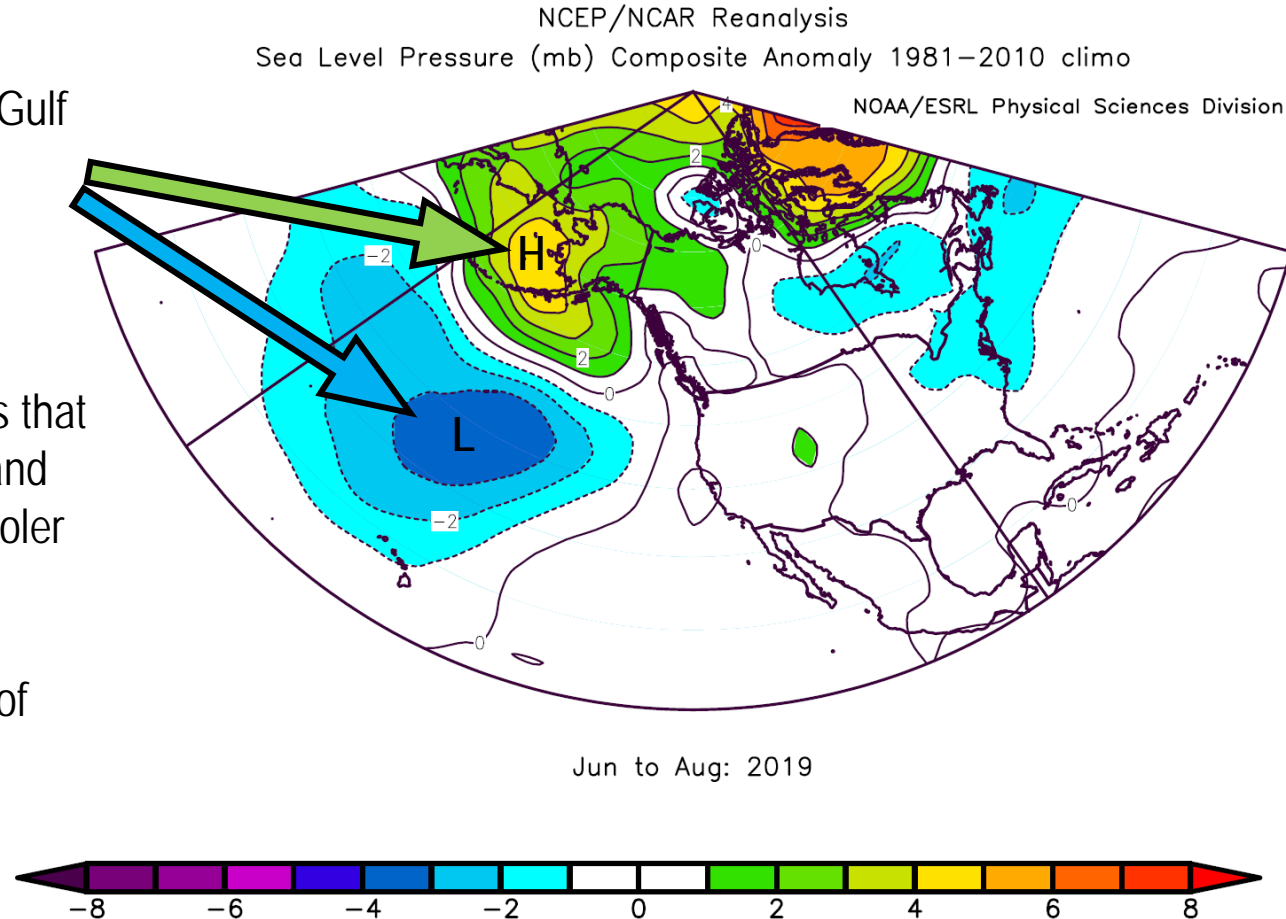
NOAA FISHERIES

Cause: persistent atmospheric pressure anomalies

Persistent **high pressure** over Gulf of Alaska, **low pressure** in NE Pacific in summer of 2019

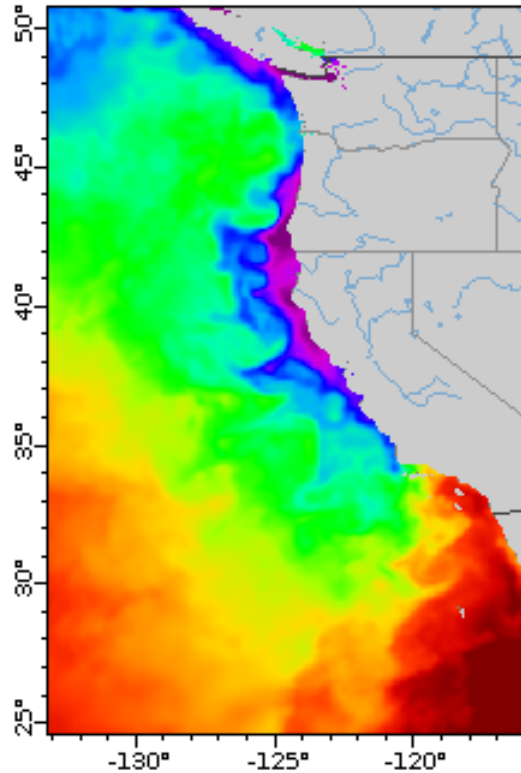
This combination has reduced winds over last several months that would otherwise extract heat and mix the surface waters with cooler waters below

Consequence: rapid warming of surface waters in NE Pacific



Satellite images of sea surface temperatures (SST) indicate serious coastal compression of cooler upwelling habitat:

Sept 2, 2012 "cool period"

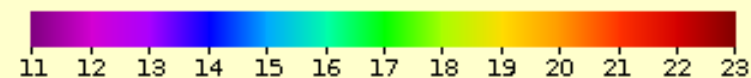
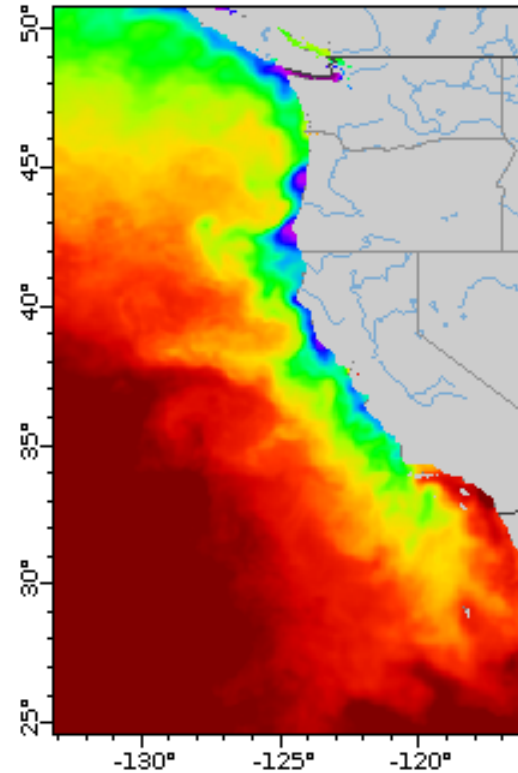


sea surface temperature (Celsius)

NOAA Global Coral Bleaching Monitoring Products: Daily 5-km
(2012-09-02T12:00:00Z)

Data courtesy of NOAA Coral Reef Watch

Sept 2, 2019 "MHW"



sea surface temperature (Celsius)

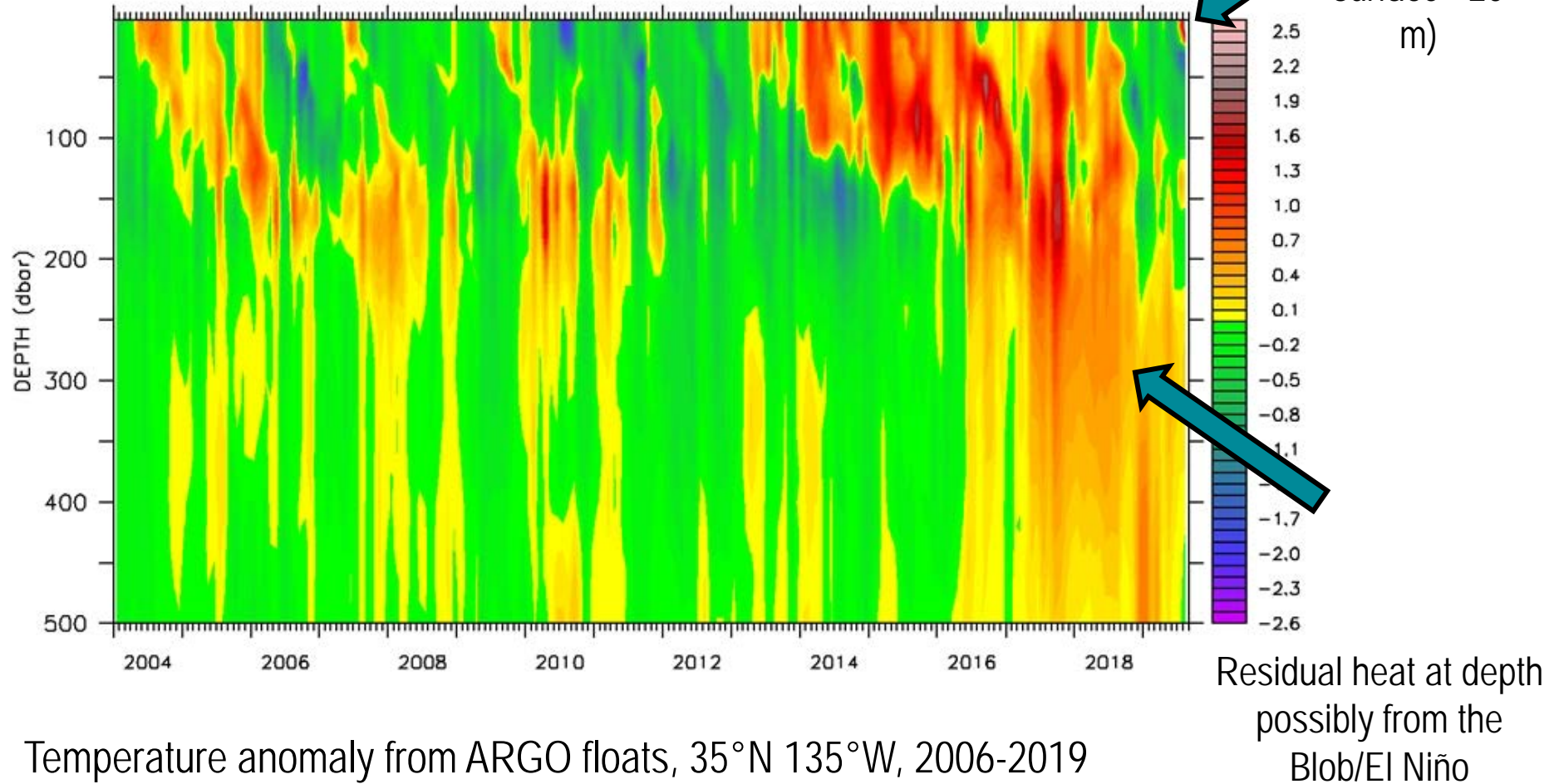
NOAA Global Coral Bleaching Monitoring Products: Daily 5-km
(2019-09-02T12:00:00Z)

Data courtesy of NOAA Coral Reef Watch

Water temperature at depth

LONGITUDE : 135W
LATITUDE : 35N

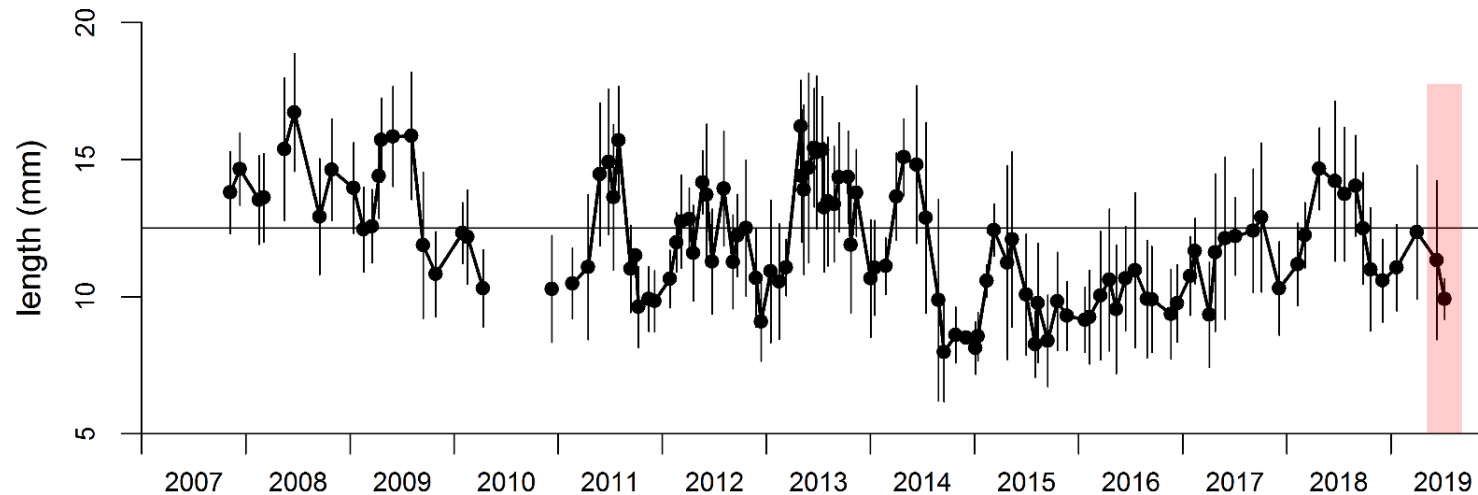
09-SEP-2019 11:38:41



Temperature anomaly from ARGO floats, 35°N 135°W, 2006-2019

Ecosystem responses?

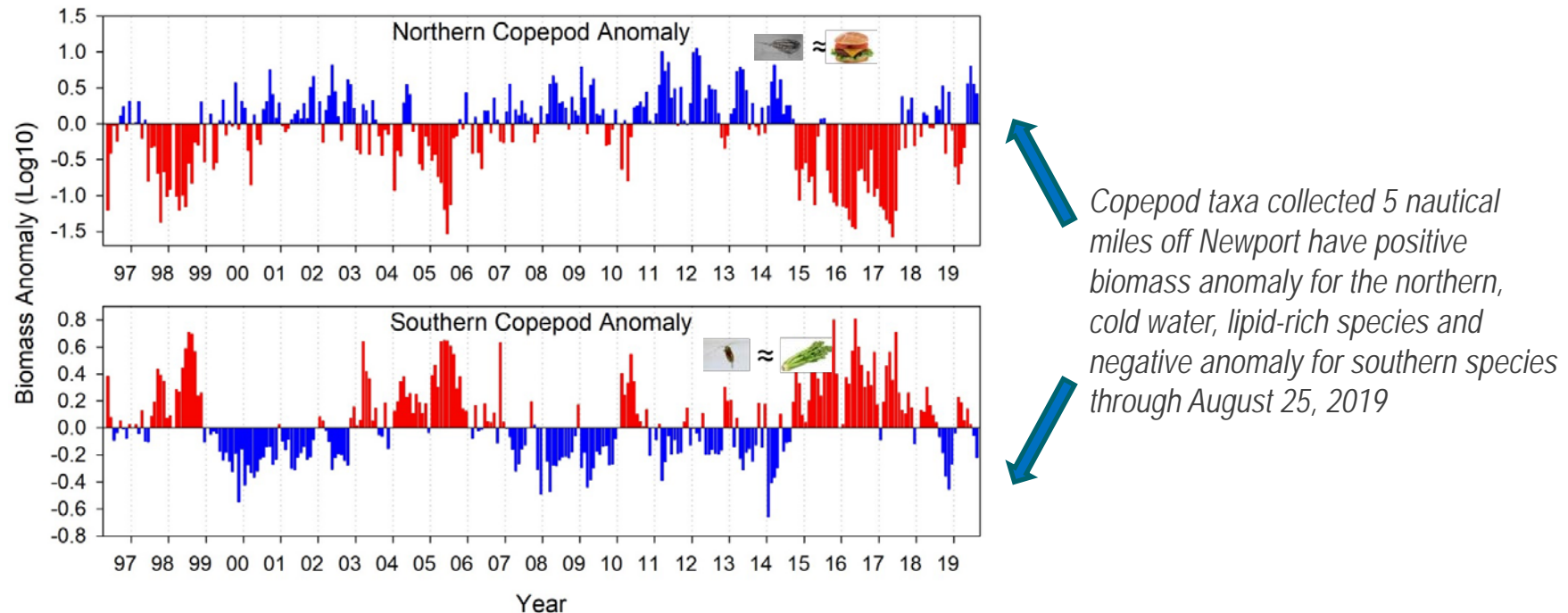
- Albacore much closer to shore in northern California Current
- Harmful algal blooms have recently closed shellfish fishing on Washington outer coast
- Krill off Trinidad Head, CA are smaller than normal...



...although that is also related to unusually warm coastal conditions last winter

Ecosystem responses?

- However, cool-water, lipid-rich northern copepods (“cheeseburger” copepods) still dominate off of Newport, OR, where water temperature remains normal for now



- Salmon returns this year most likely influenced by conditions prior to 2019 MHW (though ocean fisheries have likely been influenced by this year's warmth)
- Generally, it's too early to assign cause-and-effect impacts to MHW at this point, but its size, intensity and proximity are concerning

Next steps

- **NOAA and partners will continue to closely monitor conditions**
 - Physical conditions and characteristics of MHW
 - Physics, chemistry and plankton off Newport every 2 weeks
 - Physics, chemistry and plankton off Trinidad Head every 4 weeks
 - Physics, chemistry and plankton from regional cruises (e.g. CalCOFI, cps, etc)
 - Overwinter growth and survival of CA sea lion pups at San Miguel Island
 - Partners in states will monitor domoic acid and other HAB-related indicators
 - Coastwide network of partners will monitor bird strandings on beaches
- **Some key questions in upcoming months:**
 - Will pressure patterns change & break up the MHW before it has major impacts?
 - Will the MHW come ashore when upwelling subsides in the fall?
 - Will major HABs occur in the spring when upwelling resumes?
- **We will provide further updates to the PFMC in November, in the IEA report in March 2020, through NOAA websites, and as needed**



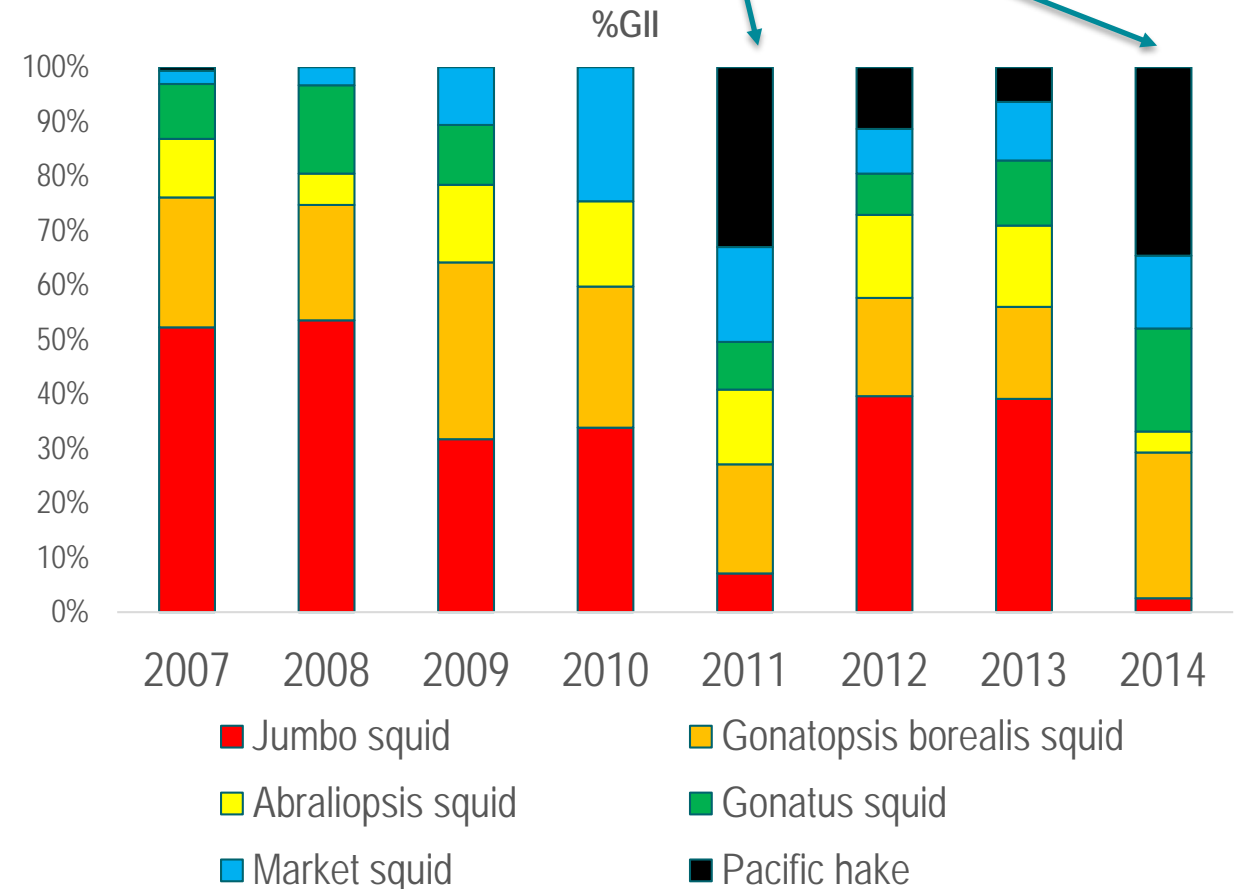
Swordfish Foraging Ecology

292 stomachs w/ food - 60 prey taxa – years 2007-2014

Prey Species	N	F	GII
Jumbo squid, <i>Dosidicus gigas</i>	1061	173	76.64
Boreopacific gonate squid, <i>Gonatopsis borealis</i>	884	182	52.35
<i>Abraliopsis</i> sp. (squid)	464	117	28.25
<i>Gonatus</i> spp. (squid)	299	110	25.08
Market squid, <i>Doryteuthis opalescens</i>	538	88	23.66
Pacific hake, <i>Merluccius productus</i>	331	49	21.81

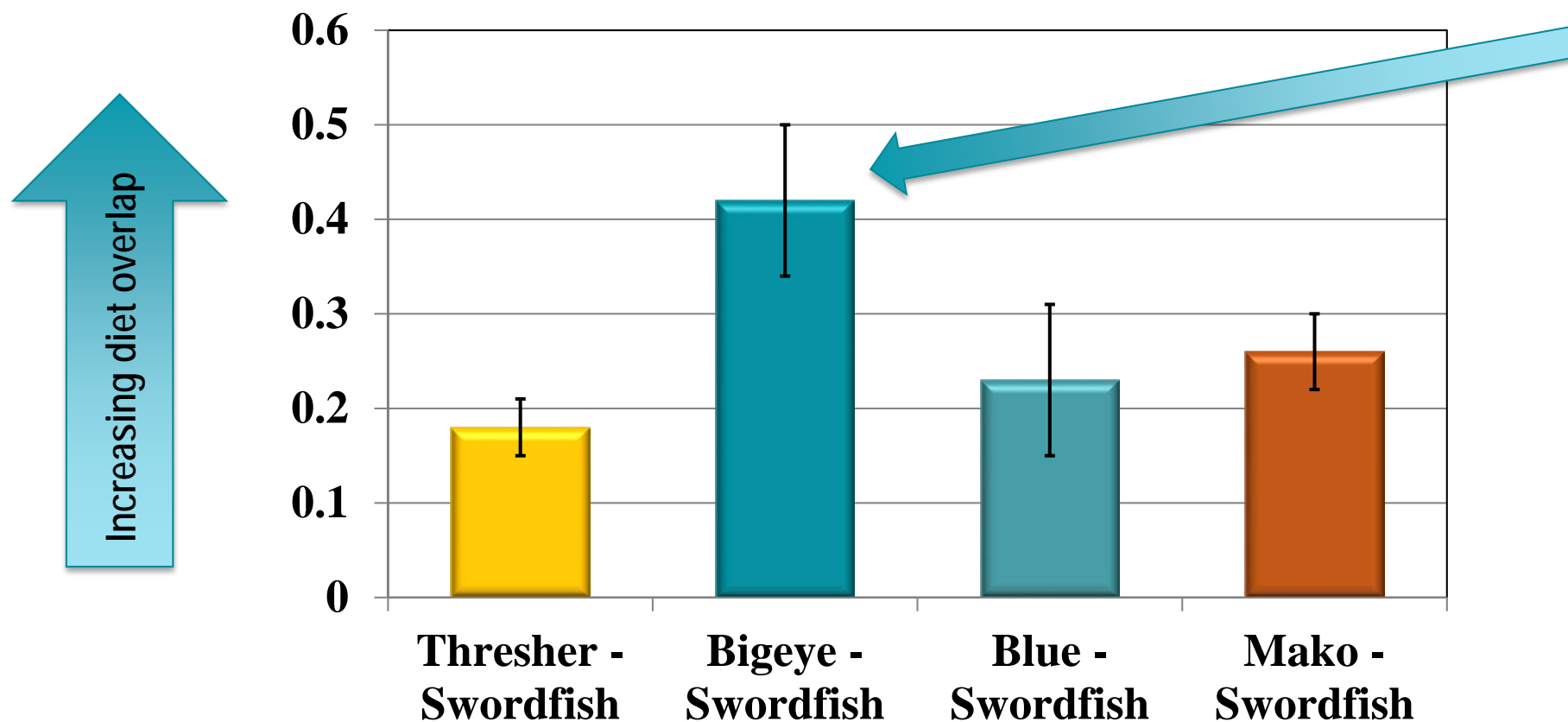
N = Individual prey items
F= Number of stomachs
GII = Rank of prey importance

Jumbo squid ranked low in the diet in 2011 and 2014 substituted by Pacific hake



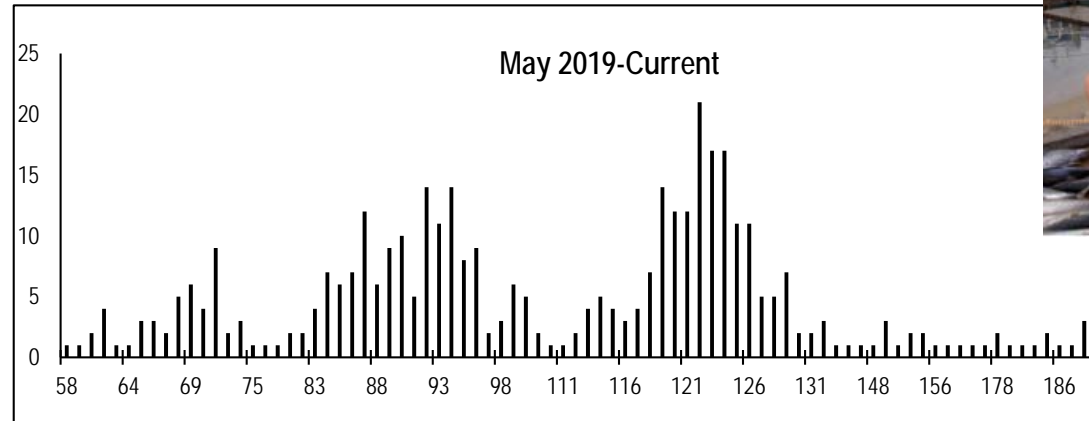
Preti 2019: preliminary data

Niche overlap: Sharks vs Swordfish

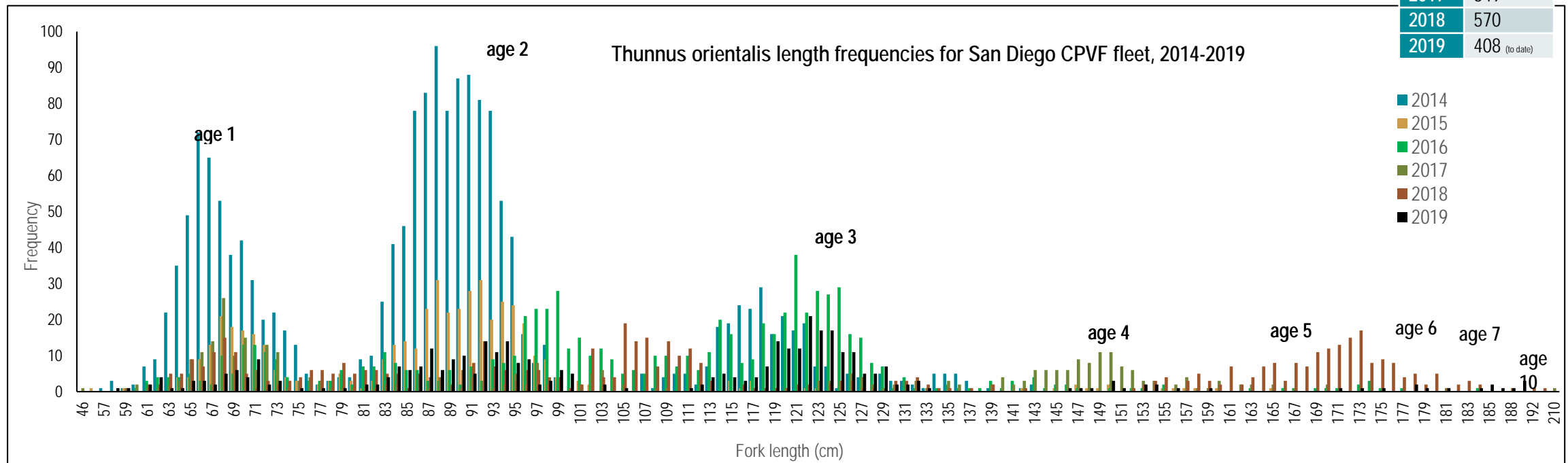


Swordfish are most similar to bigeye threshers sharks. Helps explain bycatch in deep-set buoy gear fishery. Post-release mortality of bigeye threshers very low.

Bluefin: Recreational Catch Size Sampling



Year	N=
2014	1,732
2015	492
2016	775
2017	349
2018	570
2019	408 (to date)



NOAA FISHERIES

NOAA: unpublished data

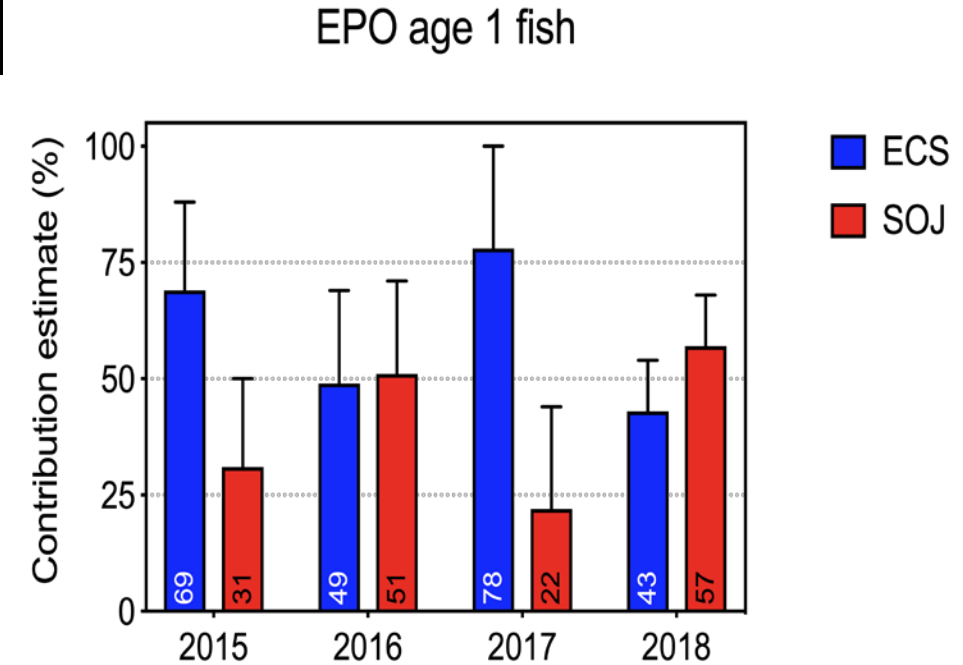
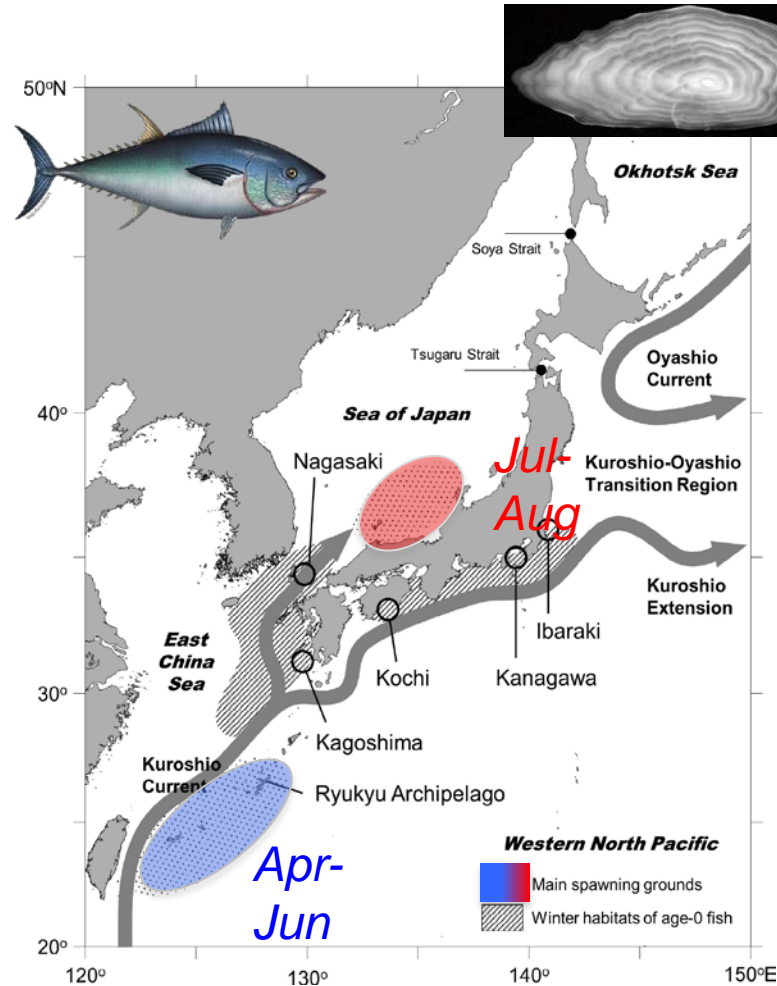
Bluefin: Otolith Microchemistry

Natal Origin of fish in the EPO

Using otolith microchemistry we have determined, for the first time, the natal origin of fish in the California Current. The relative proportion varies across years.

Next steps:

- 1) expand analyses across years.
- 2) sample age 2 fish in the EPO.
- 3) sample juveniles in the WPO.
- 4) Two MS in preparation.



40 age 1 Bluefin/year
Mixed stock analysis
HISEA (Millar 1990)

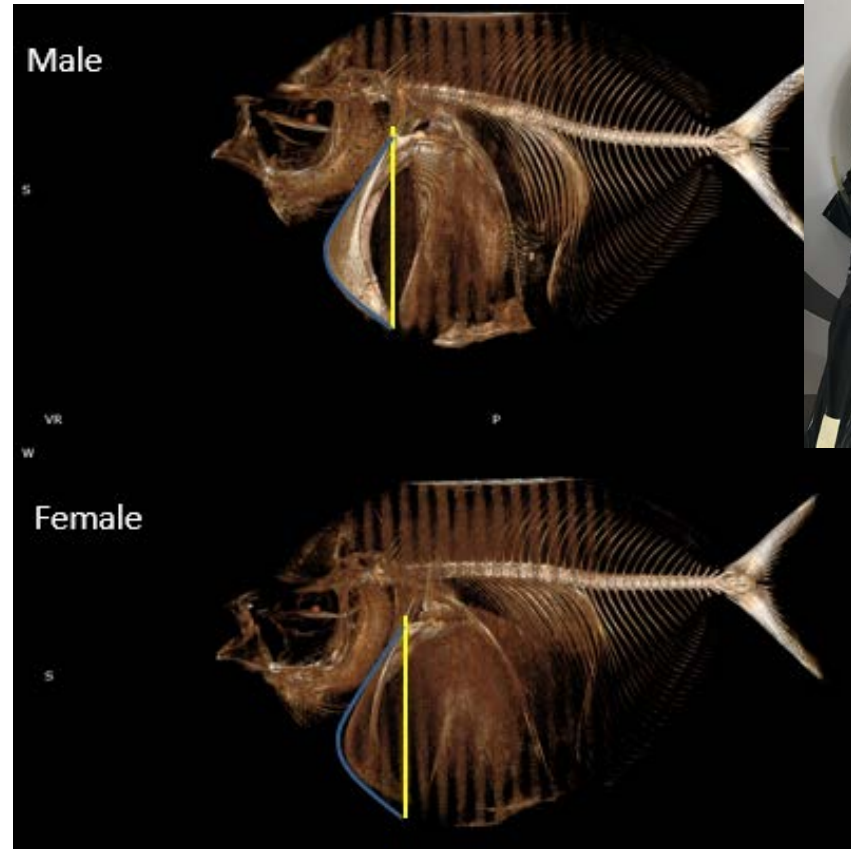
Opah

Life history/ Fisheries

- DGN CPUE analyses: CPUE increasing (*Walker and Teo in prep*)
- Hard parts: otoliths show some promise for aging.
- Sexual dimorphism: unusual in pelagic fish
 - Males have a deeper pectoral girdle and additional connective tissue
 - Functional significance not yet known

Next Steps:

- 1) Compare hard parts for age and growth
- 2) Continue habitat modeling
- 3) Increase sample size/ sexual dimorphism



Opah

Genetic Results

- Genetic analyses: $n > 900$ individuals
- All coastal fish are small eye opah
- 67% offshore fish also small eye
- Relative proportion changes seasonally

Next Step: Examine temporal and spatial patterns

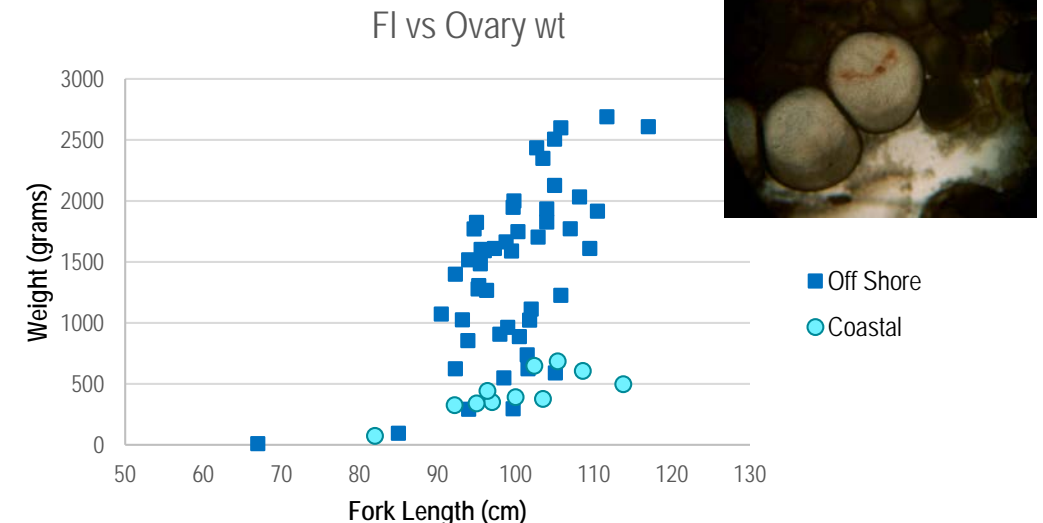
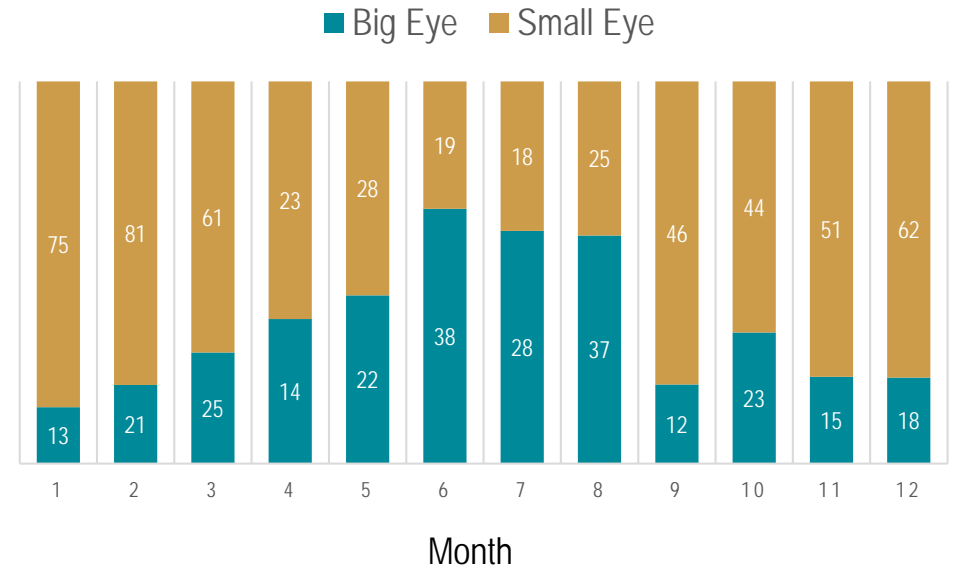
Reproductive Biology

- First documentation of spawning in the North Pacific
- California fish not spawning
- Age at first reproduction likely >90 cm FL

Next Steps:

- 1) Expand sample collection across size classes.
- 2) Examine gonad histology to fine-tune estimate of age at first reproduction.

RELATIVE COMPOSITION OFFSHORE



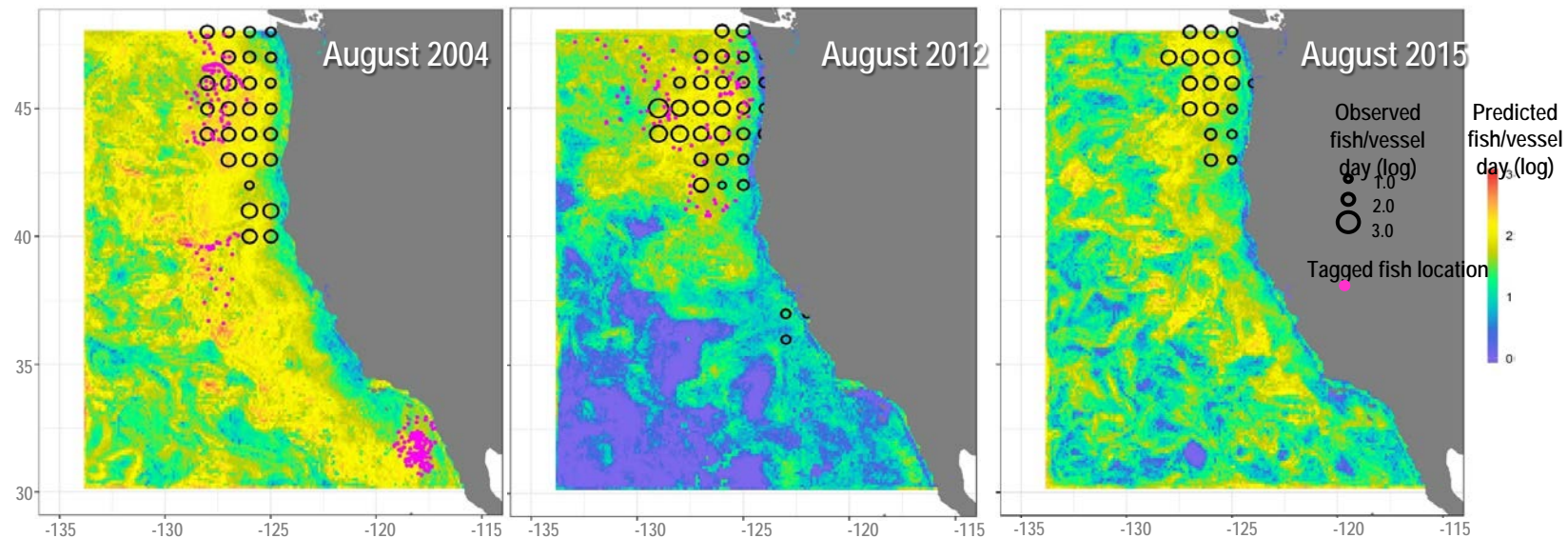
Albacore



Life history

- Stomachs: NRC post-doc (C. Nickels) focusing on analyses
- Age and growth: expanded sampling to regional/ sex specific curves

Habitat modeling: MS published (Muhling et al., 2019)



Next steps:

1. Incorporate multi-year SWFSC diet studies into models (O. Snodgrass and C. Nickels)
2. Examine importance of migration behavior vs. local conditions for determining interannual availability
3. Consider potential climate change impacts ("Future Seas" project: <https://future-seas.com/>)



HMS Stock Assessments – ISC

2018-2019

- WCNPO Striped Marlin – Benchmark Assessment – Relative to MSY-based reference points; stock is overfished and experiencing overfishing.

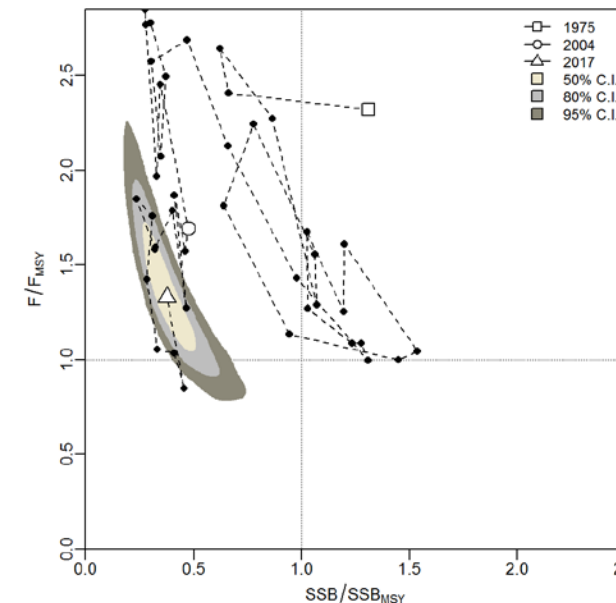
2019-2020

- North Pacific Albacore Tuna (Benchmark)
- Pacific Bluefin Tuna (Benchmark)
- North Pacific Blue Shark (Pending WG review of workplan)

2020-2021

- Pacific Blue Marlin (Benchmark)

Striped Marlin Kobe Plot



Other ISC Tasks

- Management Strategy Evaluations (MSE)
 - North Pacific Albacore Tuna MSE Workshop – Late 2020 to early 2021 – Location TBD but likely in USA
 - Pacific Bluefin Tuna – process discussed at Joint NC/IATTC WG meeting in Sep 2019 – Portland, OR
- Pacific Bluefin Tuna Catch Projections
 - Projections to determine if the catch of PBF in 2020 may be increased were reviewed by JWG in Portland.
 - JWG also requested ISC evaluate additional harvest scenarios, several of which involve 50-50 split.

HMS Stock Assessments - IATTC

2020

- Bigeye Tuna (Benchmark with updates thereafter)
- Yellowfin Tuna (Benchmark with updates thereafter)
- Skipjack Tuna (Indicators annually until 2023)
- Silky Shark (Indicators annually until 2023)

2021

- Bigeye Tuna, Pacific-wide (Exploratory)
- Swordfish, South EPO (Benchmark)

2022

- South Pacific Albacore Tuna (Benchmark)

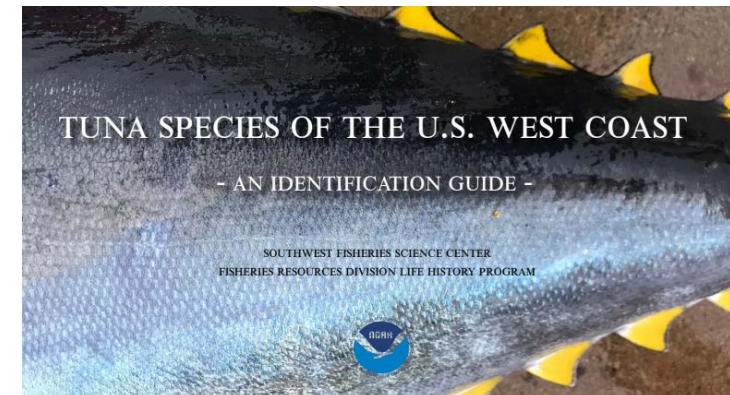
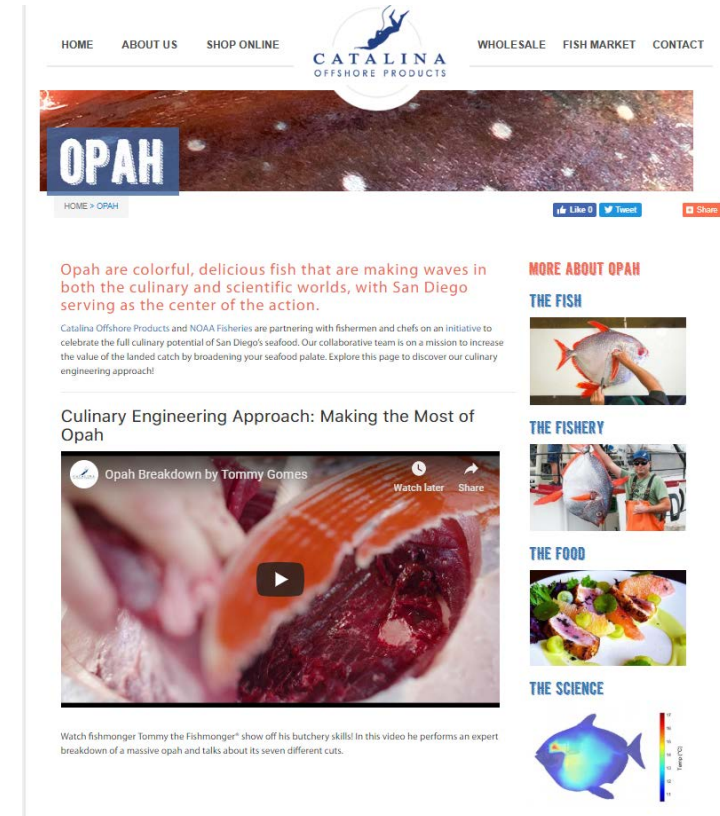
Workshops-Meetings

- North Pacific Marine Science Organization (PICES) 2019 Annual Meeting – Oct. 16-27, 2019, Victoria, Canada
 - Topic Session 11 - Incorporating ecosystem variability and climate change into fisheries management: Progress and challenges for EBFM in the 21st century
- Center for the Advancement of Population Assessment Methodology (CAPAM)
 - Next Generation Stock Assessment Models – Nov 4-8, 2019, Wellington, NZ
 - Natural Mortality: Theory, Estimation, and Application – Mar 23-27, 2020, NWFSC

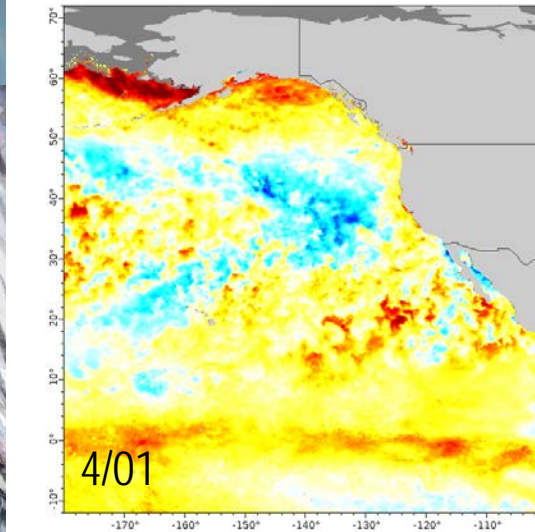
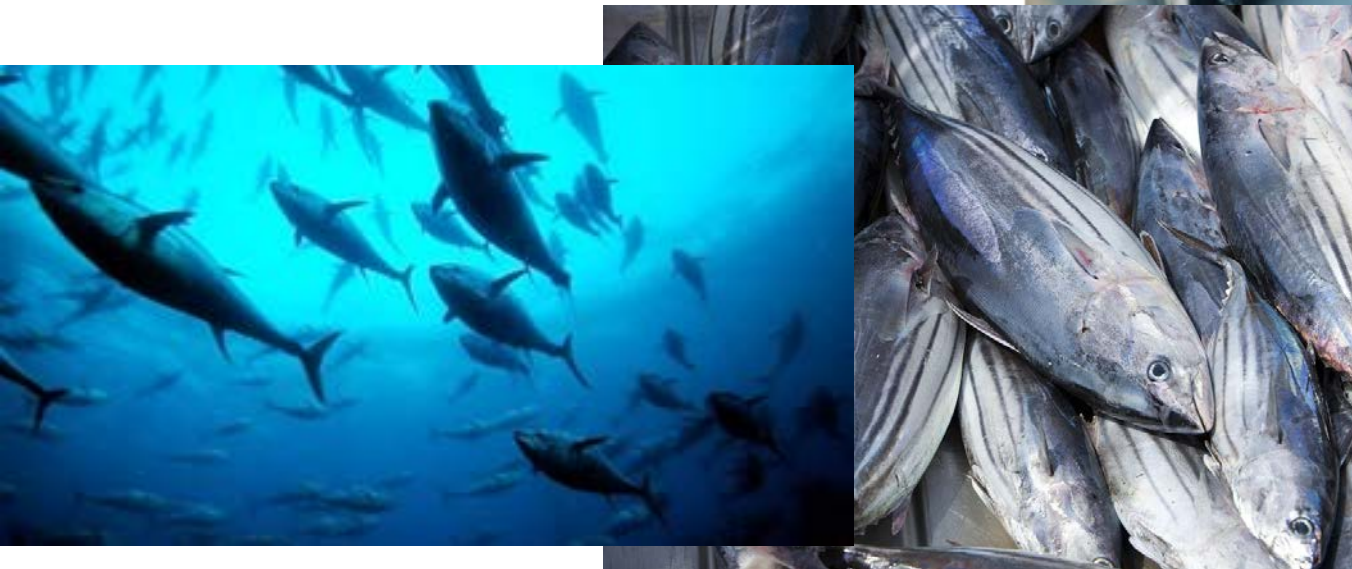


Outreach

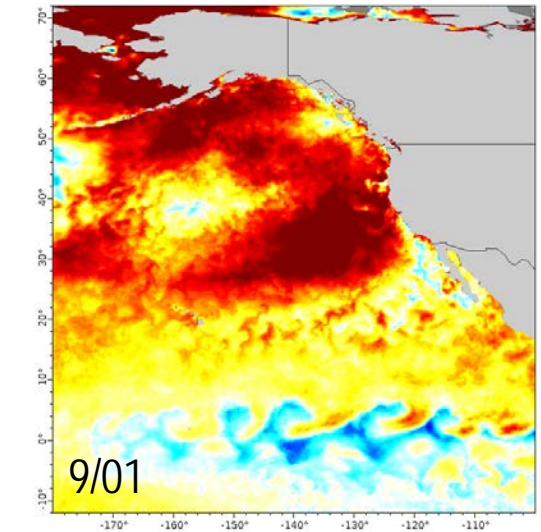
- Website hosted by Catalina Offshore Products on SK project to increase value and reduce waste in CA fisheries through culinary engineering. <http://catalinaop.com/opah/>
- Final SK project event September 24th.
- Tuna Species of the U.S. West Coast – An Identification Guide
 - Pacific Ocean management overview
 - Species-specific biology and ecology



Thank You Questions?



sea surface temperature anomaly (Celsius)
NOAA Global Coral Bleaching Monitoring Products: Daily 5-km
(2019-04-01T12:00:00Z)
Data courtesy of NOAA Coral Reef Watch



sea surface temperature anomaly (Celsius)
NOAA Global Coral Bleaching Monitoring Products: Daily 5-km
(2019-09-01T12:00:00Z)
Data courtesy of NOAA Coral Reef Watch



NOAA FISHERIES