



Country Update
United States and Canada
Laura Rogers-Bennett

4 Abalone Aquaculture Farms in United States



THE CULTURED ABALONE FARM
Santa Barbara, California



Monterey Abalone Company

American Abalone Farms

Grow and sell California Red Abalone

In 2018 the US abalone sold 1,882,000 abalone
(339,00 pounds) worth \$6,432,000 USD

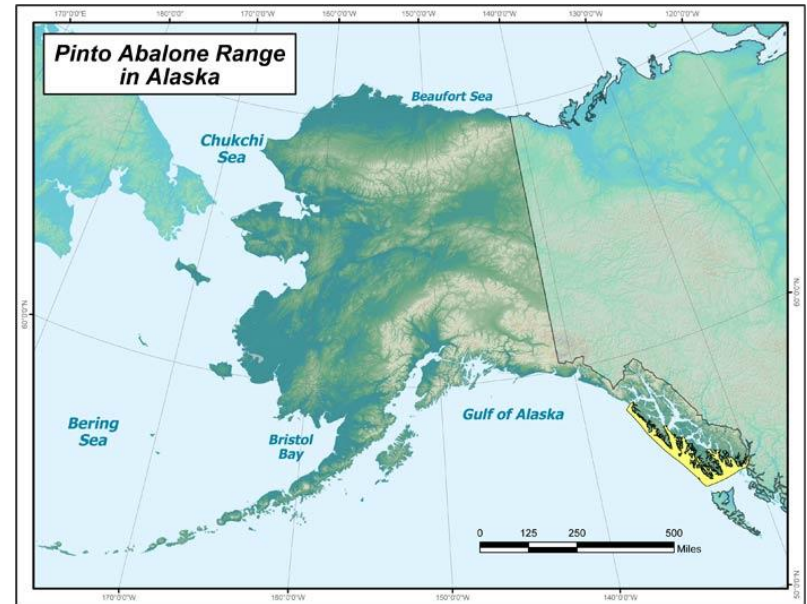


Hawaii Farm Sells Japanese Ezo Abalone

No abalone Farms in Canada

United States and Canada

- All fisheries are closed (except personal and subsistence fishing in SE Alaska)
- Abalone Facing Climate Change/ Multiple threats
- Abalone Restoration Includes
 - Restoration Aquaculture
 - Active stocking and translocation
 - Sea urchin control
 - Kelp restoration



Alaska, United States

Northern (Pinto) Abalone

H. kamtschatkana

Commercial fishery: Closed 1996

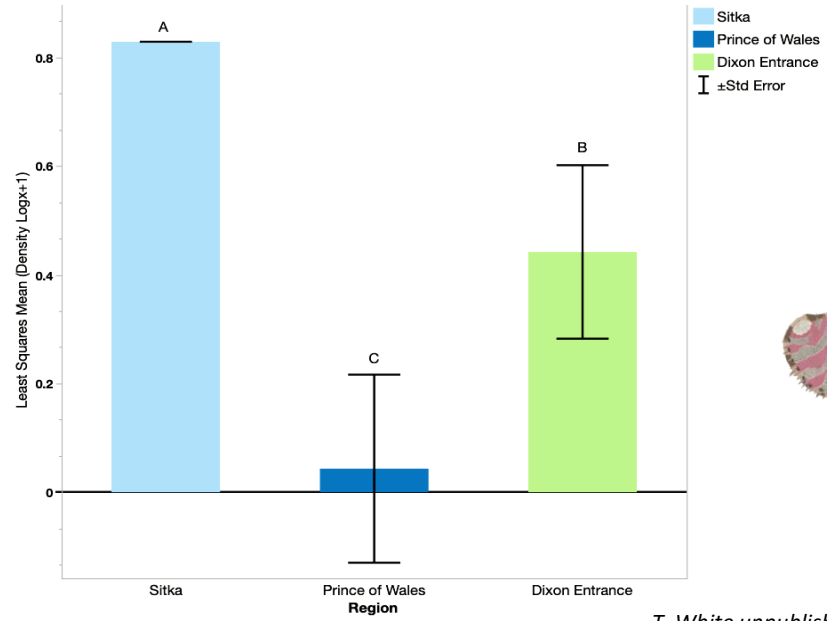
Personal and subsistence fishery: Ongoing

Bag Limit: 5 per day, Minimum legal size: 3.5 inches

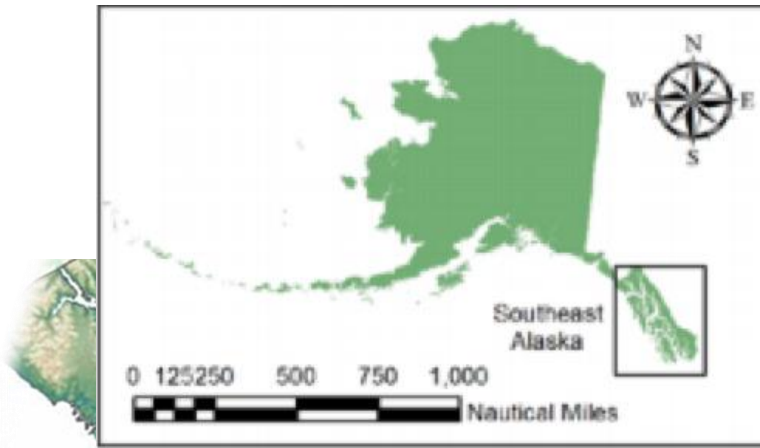
US: Species of Concern, IUCN: Endangered

Pinto Abalone Densities in areas of SE Alaska (northernmost range limit)

1) There are significant regional differences in populations that are managed the same (e.g., overall densities)



T. White unpublished data



Character Illustrations: Sienna Reid (Xoodzi)

Populations across regions of Southeast have distinctly different population threats.

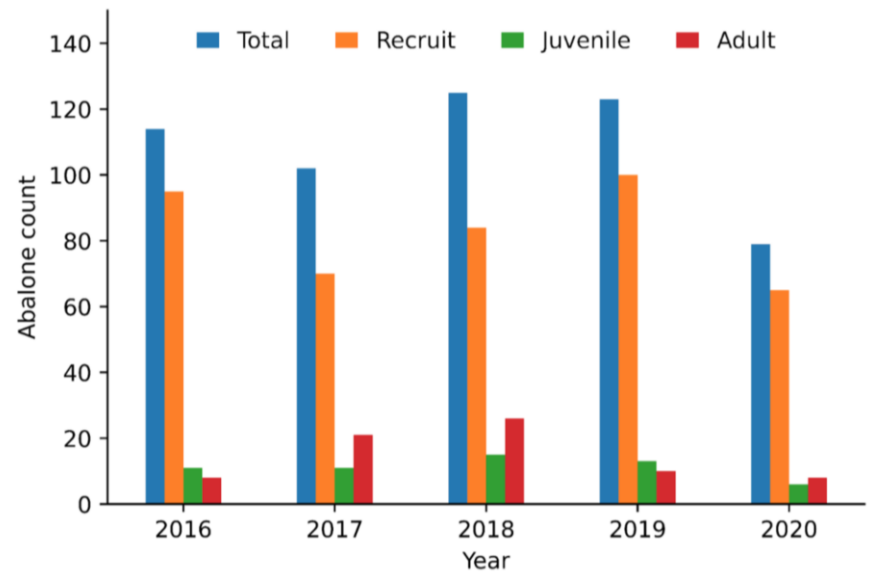
Large biotic factors: sea otters, human harvest, prior intensive commercial fishery landings, and sea otter hunting

Taylor White UCSC



Counts of “recruits” at Index site Baby Abalone Recruitment Traps (BARTs)

Similar to Abalone Recruitment Modules (ARMs) used in Canada (DeFreitas 2003), Washington (Bouma et al. 2012) and BARTs in California (Rogers-Bennett 2007)



NOTE: not all years included, abalone size count (not density), and “recruits” are Identified as >20mm, Juvenile 20 – 40mm

Graph from research by Aimee Wang
(prior UCSC Science Internship (abalone project), current MIT undergraduate)

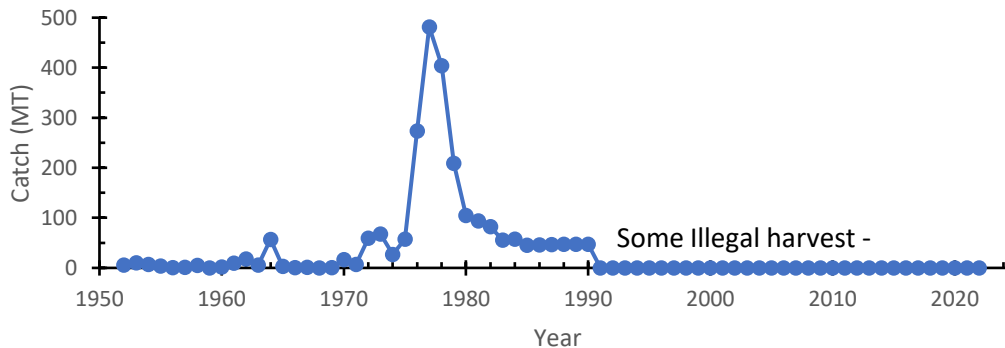
Taylor White Talk Tues 224a @15:00



Northern abalone (*Haliotis kamtschatkana*) in Canada

- No commercial, recreational, or First Nations harvest of Northern abalone permitted in BC since 1990.
- The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed Northern abalone as Threatened in 1999 and Endangered in 2009. Status usually assessed every 10 years and Northern abalone is scheduled for re-assessment in 2023.
- Listed as *Species at Risk Act* as Threatened in 2003 and Endangered in 2011.
- Threats are poaching and low recruitment.

Catch history in Canada





Northern abalone (*Haliotis kamtschatkana*) in Canada

Department of Fisheries and Oceans (DFO) Science Program:

- Monitoring density of Northern abalone at index sites since 1978. Index site is surveyed on a 5-year rotational basis. Some with First Nations
- Started seeing an increase in density of juveniles in 2006 in Northern British Columbia, sixteen years after full coastwide closure to harvest.
- Sea star wasting disease started in 2013 and spread coastwide by 2015.
- Sea Otters Expanding along Pacific coast of Canada is expanding.
- No abalone hatcheries or aquaculture in British Columbia since 2010.





2023 Update on Northern abalone (*Haliotis kamtschatkana*) in Canada

Monitoring, research and restoration work by First Nations:

- DFO has funded over 30 projects 2013 – 2021. Projects led by First Nations with DFO support.
 - E.g. Kitasoo stewardship program
- Haida Fisheries Program has 132 recruitment modules at 33 sites in Haida Gwaii between 2002-2006.
- First Nations and coastal communities also participate in enforcement of fisheries closures through local vessel patrols, Abalone Coastal Watch program, and other guardian programs. This work occurs both independently and in collaboration with DFO.

Erin Herder *Northern abalone Wednesday @ 14:45-14:30 (Room WA 224a).*





Canada



Fisheries and Oceans
Canada



Hakai
Science on the Coastal Margin



UNIVERSITY
OF OREGON



Dr. Lynn Lee

photo: Ryan Miller/millermarine.ca

Canada



HAIDA NATION

Pinto Abalone Restoration Work in Washington State, USA



Washington Abalone Recovery Program

WDFW + Puget Sound Restoration Fund + many collaborators
working together to restore State Endangered Pinto abalone (*Haliotis kamtschatkana*)

- Overharvest led to **97%** decline of statewide population: **Rec Fishery Closed in 1994 closed 30 years**
- Release of **hatchery raised abalone** restoration strategy since 2009
- Currently **27** outplant sites with, **2/3** of these sites successful
 - Our best site “Omaha” has solid aggregation of **181 hatchery pintos** from 6 outplants between 2009 - 2020



Washington Abalone Recovery Program Restoration Aquaculture

NOAA Manchester Research Station

PSRF's Ken Chew Center for Shellfish Research & Restoration

"Where the magic happens"

- **300 m²** hatchery/nursery buildings hold **110** abalone culture tanks
- Microalgae greenhouse & Kelp Lab
- Ocean acidification research system
- **Local & Range-wide Pinto abalone genetics studies** recently completed
- Produced and released over **11,000 hatchery-raised juvenile abalone** with **38 unique families** in 2021



Washington Abalone Recovery Program

[LEARN MORE!](#)

Comparing survival of hatchery-reared pinto abalone **released in mixed-age cohorts** in Washington State

Katie Sowul

Tuesday 2:30pm

Resource Productivity & Enhancement
WA224b

Population genomics of wild and hatchery-raised pinto abalone

Jay Dimond, Ph.D.

Wednesday 11:45am

Genetics & Genome
WA224a

Can **settlement on coralline algae** ameliorate negative effects of **ocean acidification and temperature** increase on pinto abalone early life stages?

Eileen Bates

Wednesday 12:30pm

Biology & Physiology
WA224b

Recovering Pinto abalone: Use of conservation aquaculture to give Washington State's largest rocky-reef grazing snail a population boost

Josh Bouma

Wednesday 3:00pm

Restoration Ecology & Biodiversity
WA224a



-  Pinto
-  Flat
-  Red
-  Black
-  Green
-  Pink
-  White

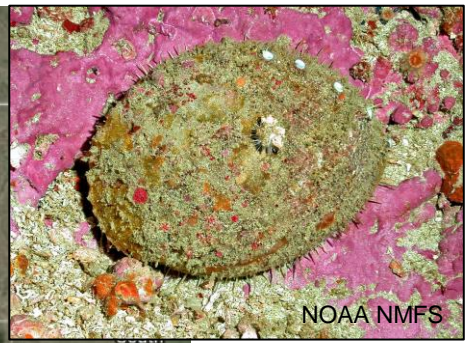
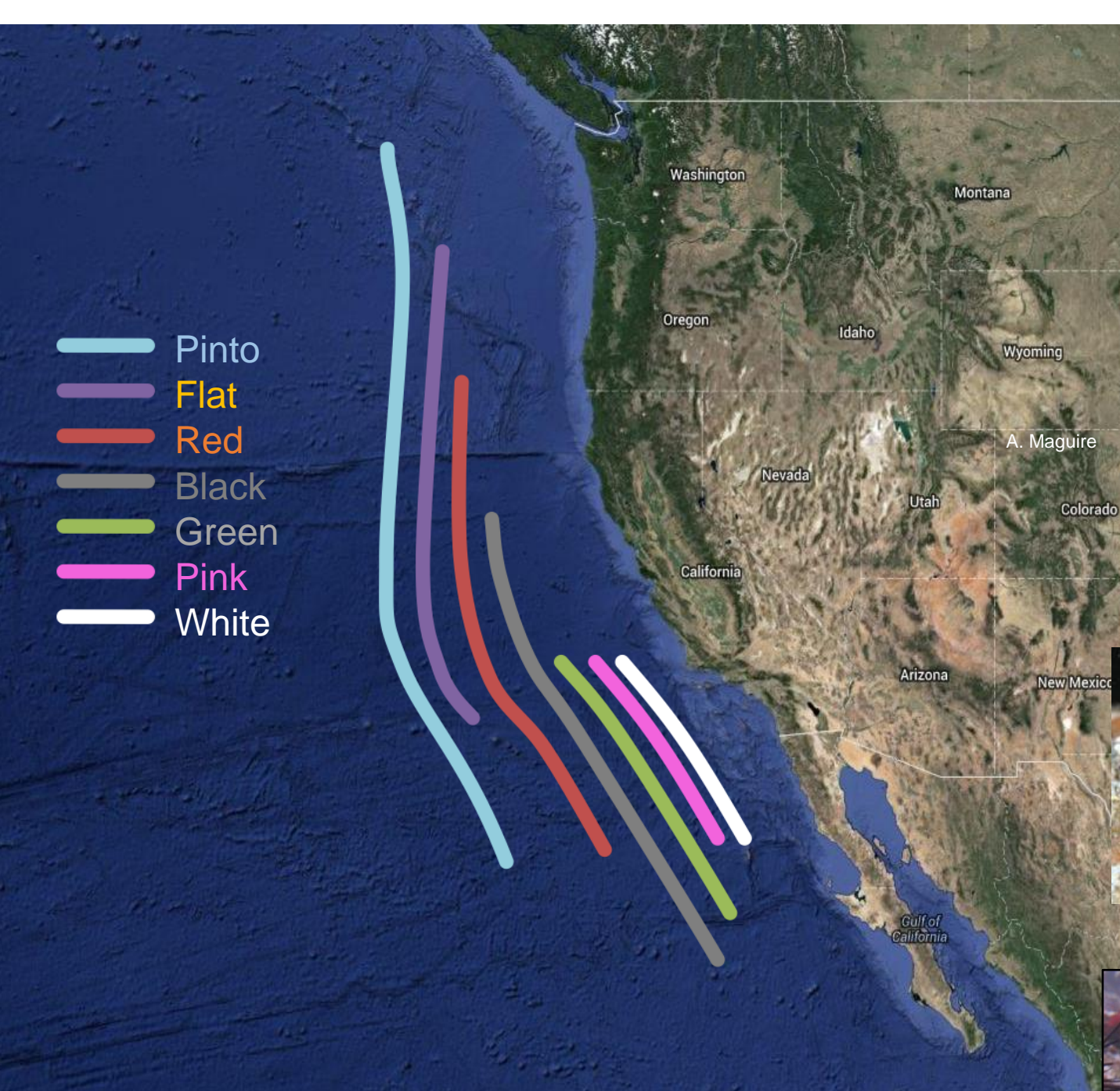
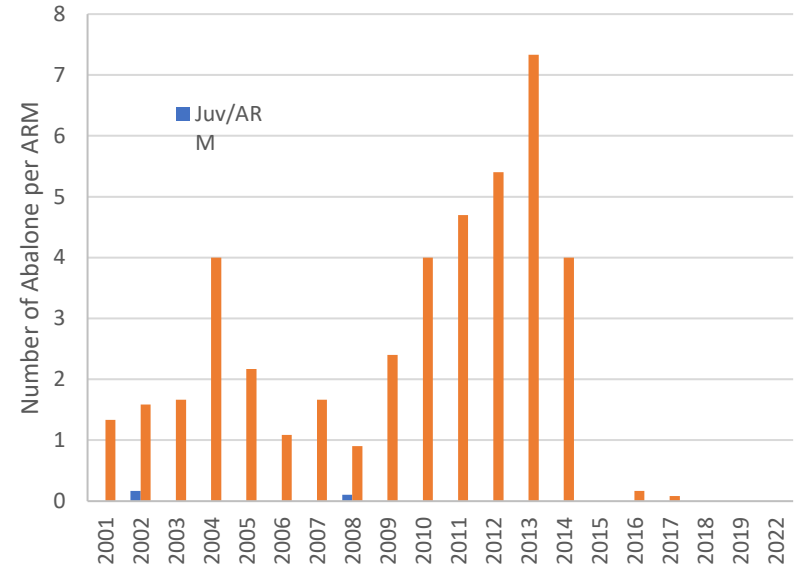




Photo O. Poindexter

Flat Abalone
Number per Recruit Module



California and S. Oregon, United States

Flat Abalone

H. walallensis

Incidental Take fishery: Closed in 2000: Previous commercial fishery in Oregon

US: Species of Concern: Narrow Geographic distribution

IUCN Listed as critically endangered

* In Danger of Extinction

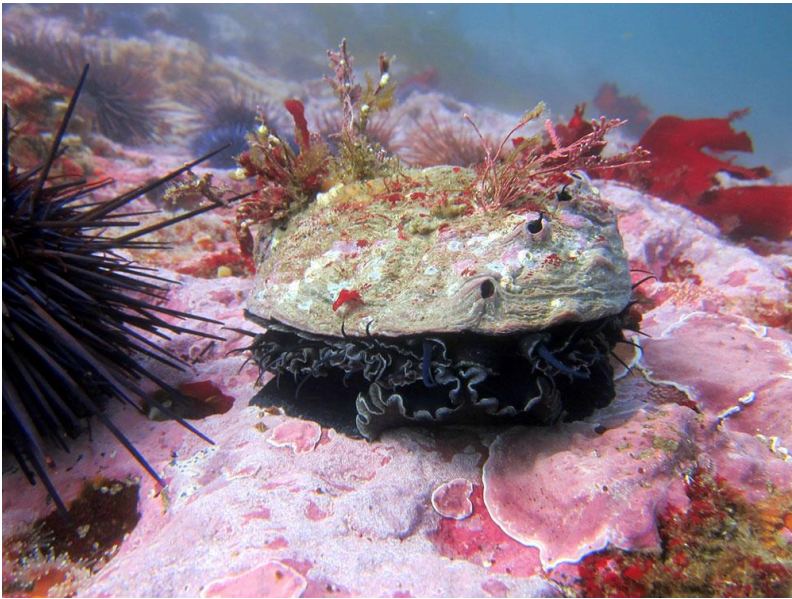


Photo: Athena Maguire



California and S. Oregon, United States

Red Abalone

H. rufescens

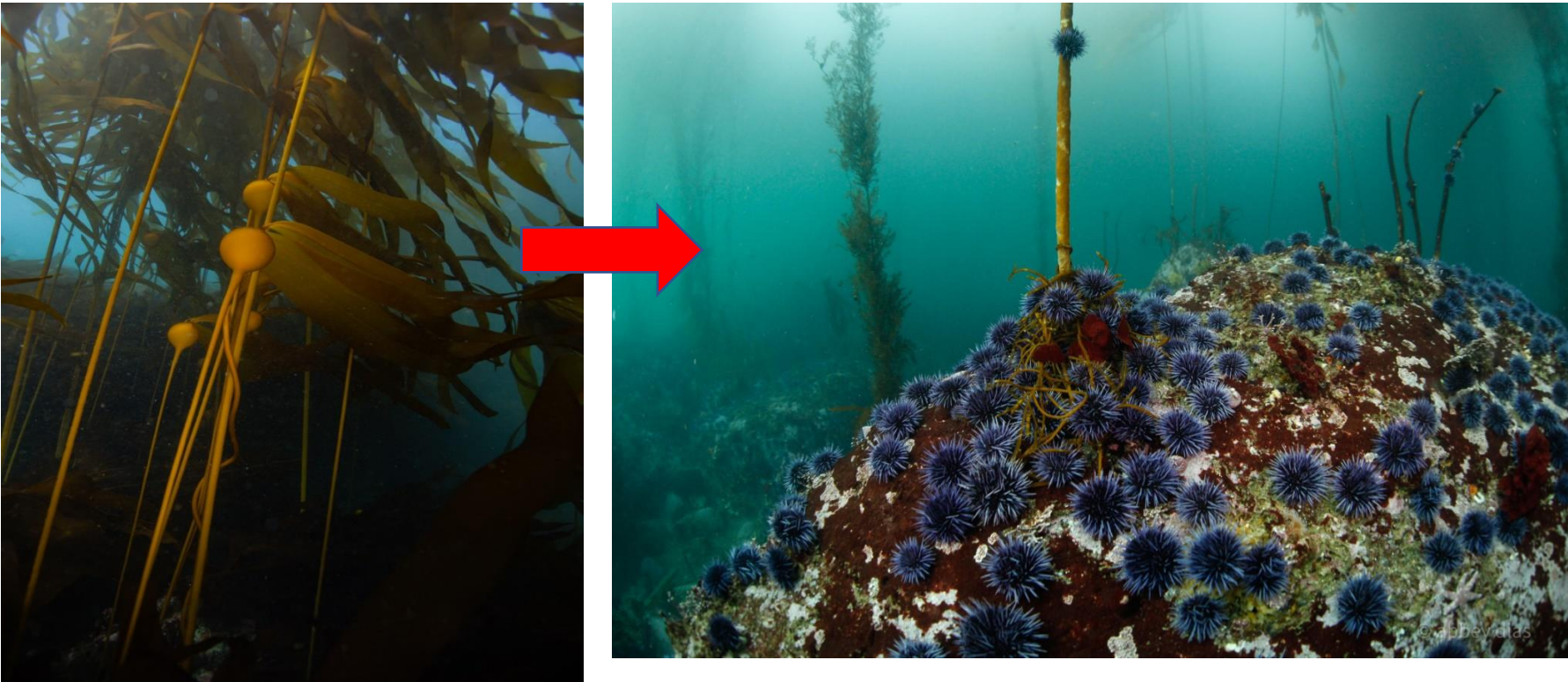
Commercial fishery: Closed 1996

Recreational fishery closed 2018

Not listed in the US: IUCN Critically Endangered

Kelp Forest To Sea Urchin Barrens

(Rogers-Bennett and Catton 2019 Sci. Reports)



Photos: Abbey Dias

Ecosystem Shift From Kelp to Urchin

(Rogers-Bennett and Catton 2019)



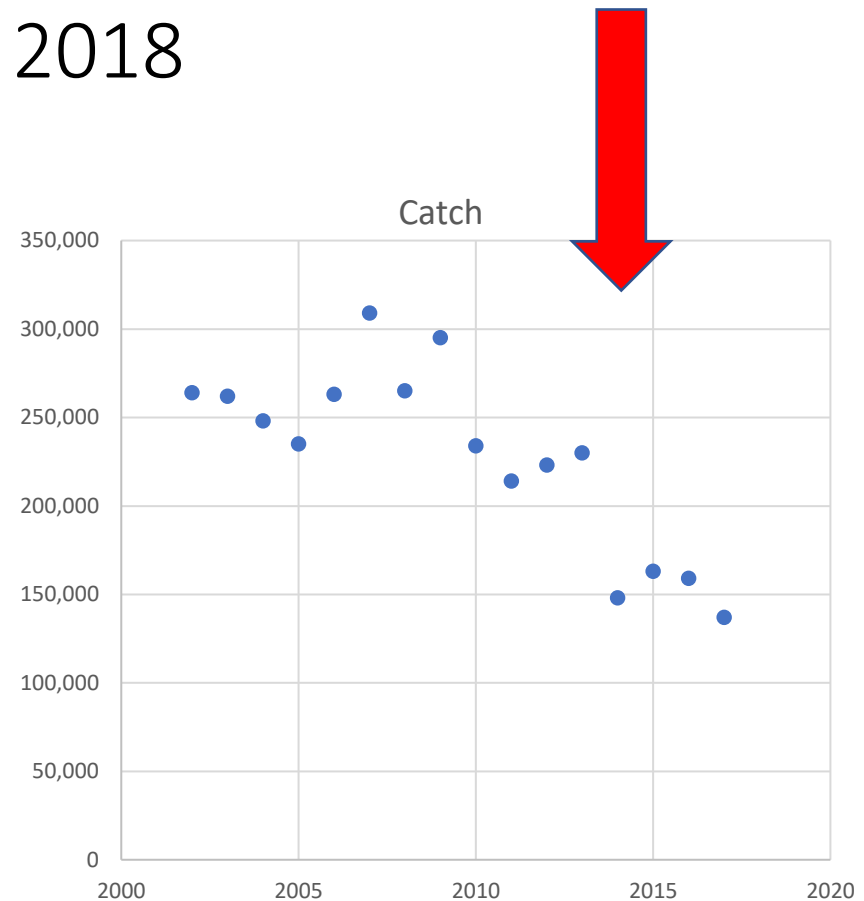
North Coast Recreational Red Abalone Fishery: Culturally and economically significant fishery

- 30,000 – 40,000 participants
- Red abalone only
- Free diving only
- 7 months of fishing
- 7" minimum size limit
- Report card + Annual catch limit
- 3 abalone / day (possession and catch limit)
- **Average 260,000 abalone /year**
- **683,800 pounds = 330mton**



Once Iconic North Coast Recreational Red Abalone Fishery: Closed in 2018

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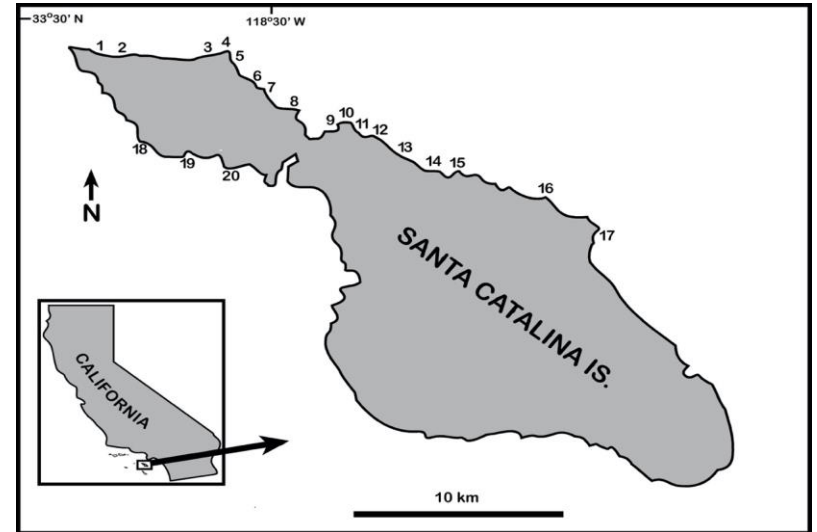


Red Abalone impacted by warm water and loss of kelp on San Miguel Island, Southern California





Photo. NOAA Fisheries



Southern California, United States

Green Abalone

H. fulgens

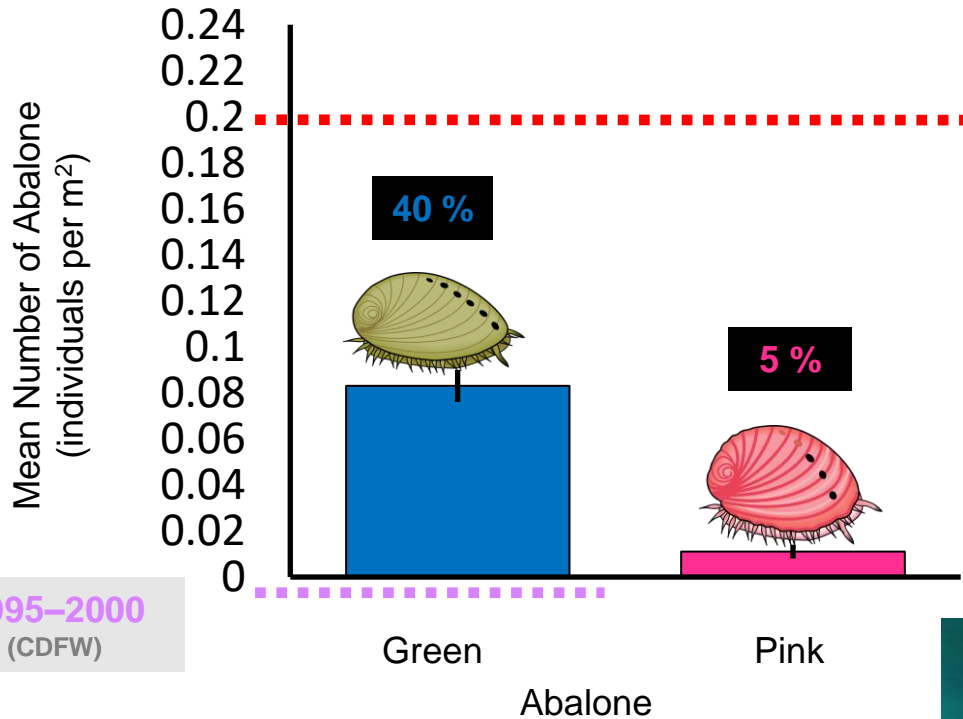
Commercial fishery: Closed 1996

United States: Species of Concern

IUCN: Critically Endangered

Green and Pink Abalone at Catalina (Alexis Estrada CSUN)

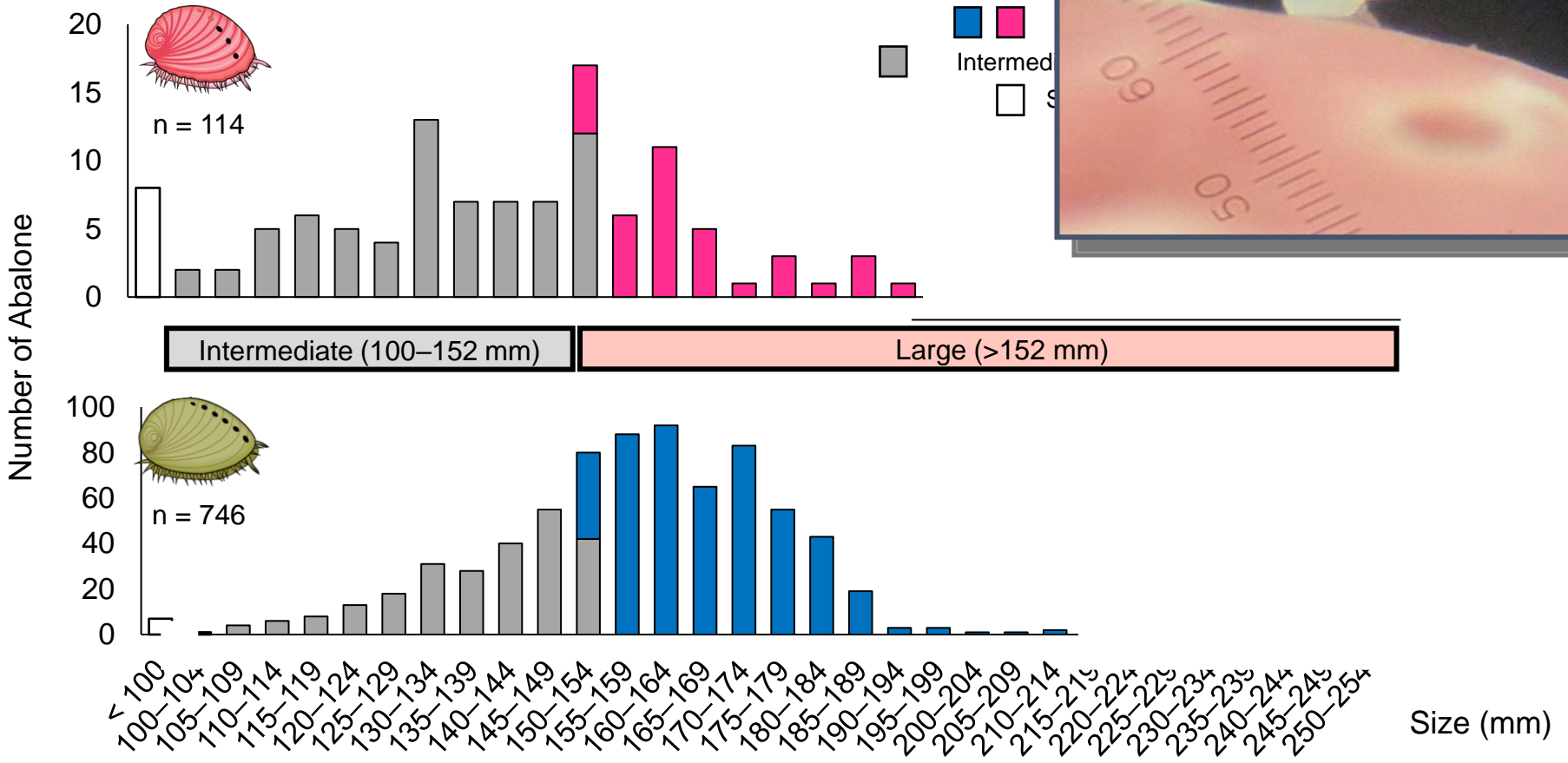
Abalone Density at Santa Catalina Island



DENSITY CRITERION
2000 abalone per hectare



Broad Size Distributions at Santa Catalina Island



(Alexis Estrada CSUN)



Photo. NOAA Fisheries

Southern California, United States

Pink Abalone

H. corrugata

Commercial fishery: Closed 1996

United States: Species of Concern

IUCN: Critically Endangered

Translocation Study (Taniguchi et al. 2013)

- High survival after tagging and monitoring
- Minimal movement first week; increased one week after tagging
- Pink abalone persisted where greens were more mobile





Photo D. Witting NOAA Fisheries



Photo J. Steinbeck

Central/Southern California, US

Black Abalone

H. cracherodii

Commercial fishery: Closed 1996 suffered from disease WS

United States: Endangered

IUCN: Critically Endangered

Status Update

- 2009: ESA Endangered
- 2011: Critical habitat designation
- 2020: Recovery Plan and Implementation Team
- Coordinator
Susan.Wang@noaa.gov

Recovery Goals

Restore black abalone by:

- Increasing abundance, productivity, spatial structure, and diversity to **support long-term survival, viability, and resilience to threats.**
- Addressing the effects of **past, ongoing, and emerging threats.**
- **Criteria:** Geographic range occupied, habitat-based density, recruitment, size structure, and population trend.

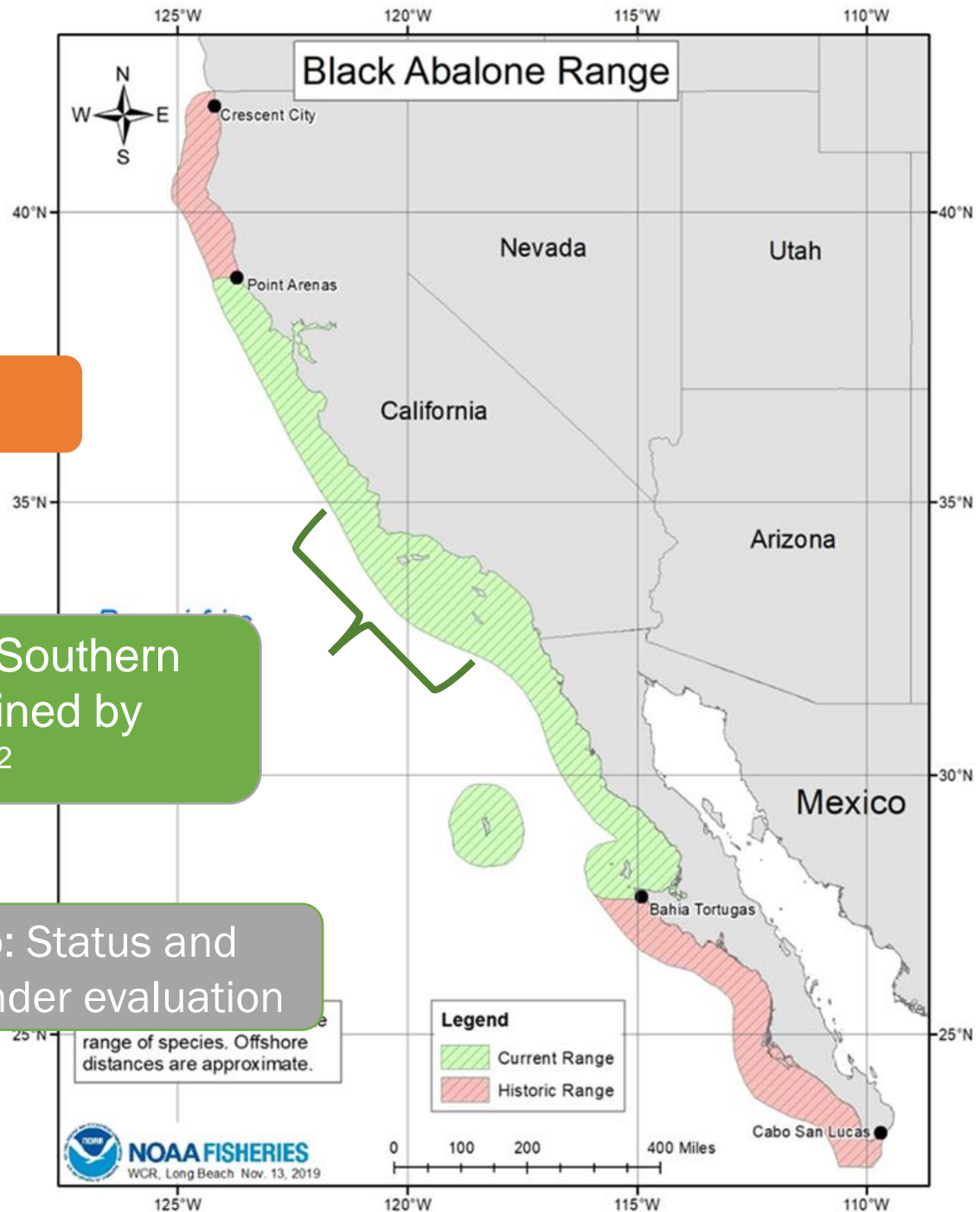


Status

Central CA: Healthy

South-central and Southern CA: Densities declined by >80%, to <1 per m²

Mexico: Status and trends under evaluation



Recovery Activities

- Continue long-term monitoring throughout the species range
- Rescue and relocation in response to emergency climate events: Wildfires and fire scars
 - See **talk on March 1 Wendy Bragg** (Session: Resource Threats) - Post-fire debris flows: a newly realized threat to endangered black abalone and the rocky intertidal zone in California, USA
- Pilot transplanting studies to restore populations



Photo credits: Steve Lonhart, MBNMS



Photos Athena Maguire

Southern California, United States

White Abalone

H. sorenseni

Commercial fishery: Closed 1996

United States: Endangered

IUCN: Critically Endangered



White Abalone Restoration Aquaculture Update- Alyssa Frederick UC Davis



Kristin Aquilino UC Davis

Saving a species, saving ourselves:
The importance of community- and
relationship-building in species
restoration

Keynote Tues Feb 28 @ 9:00

Alyssa Frederick UC Davis

Tools for saving a species:
Using ecophysiology to improve
endangered white abalone production

Wed Mar 1 @ 14:00 Rm WA224a

Bodega Marine Lab spawning Feb. 2023

Abalone Restoration Update-Southern California



Monitoring of wild abalone habitat, genetics, & movement

Witting et al. Feb. 28 @ 14:15

Rm WA224b

Restoring the iconic white abalone to the kelp forests of southern California

Neuman et al. -Mar. 1 @15:30

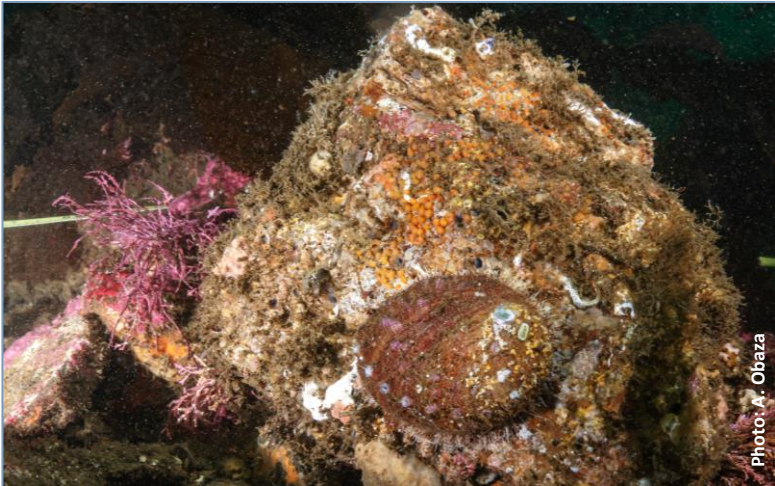
Rm WA224a

Time lapse cameras monitor community response to outplanting and module performance

Obaza et al. poster.

Integrated database development to share high quality

data **Boch et al. poster.**



Thank you and thanks to contributors

- Katie Sowul
- Melissa Neuman
- Susan Wang
- Erin Herder
- Alexis Estrada
- Lynn Lee
- Alyssa Frederick
- Taylor White
- Cynthia Catton

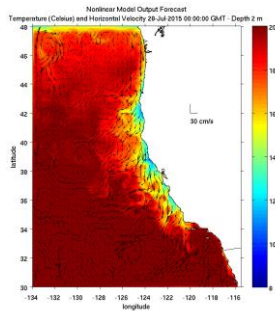


20 Year Abalone Monitoring Program

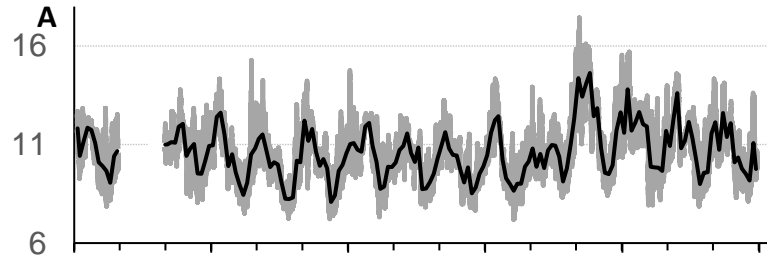


- 10 Sites
 - Sonoma (5)
 - Mendocino (5)
- key fished sites
- 48% of the catch comes from these sites
- Early warning for declines in the fishery

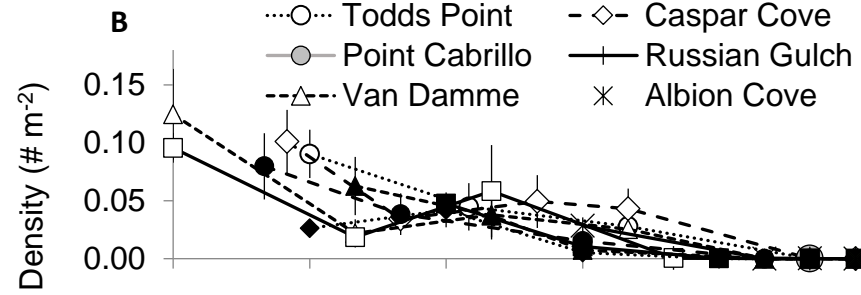
MHW



Temperature (C)



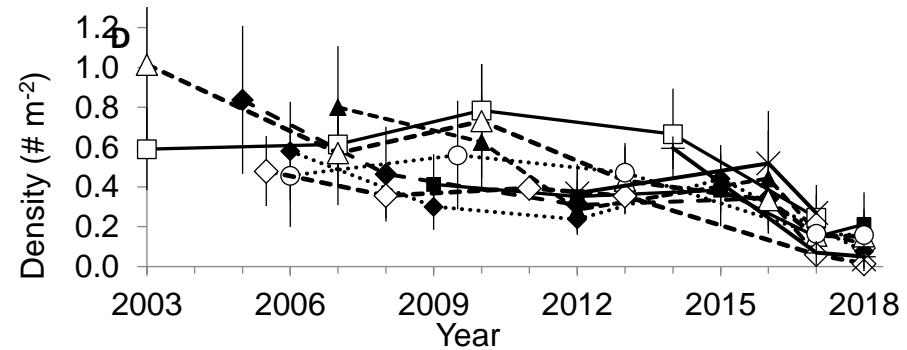
SSWD



Urchin
Barrens



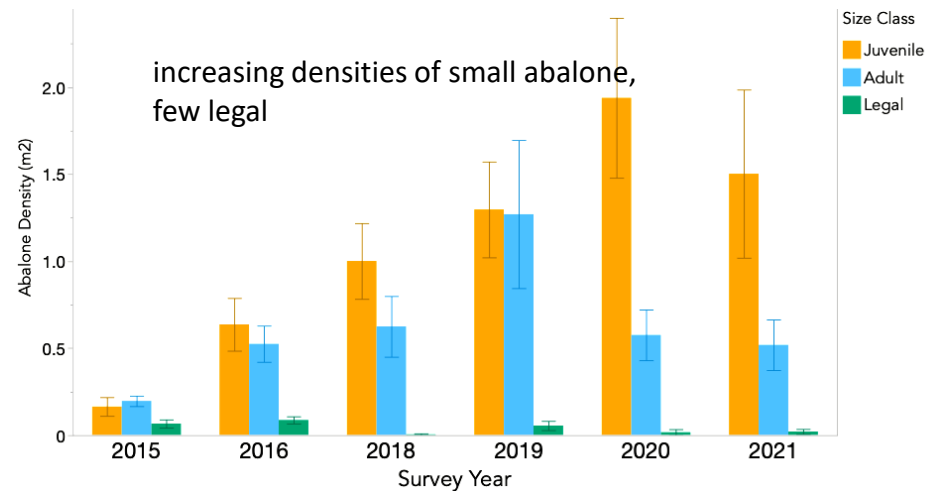
Mass
Abalone
Mortality



Sitka – Northern Abalone

Index Density Transect (densities by size class*)

*Juvenile is <41mm in this – increasing densities of small abalone, few legal size abalone



T. White unpublished data

Washington Abalone Recovery Program

NOAA Manchester Research Station

PSRF's Ken Chew Center for Shellfish Research & Restoration

"Where the magic happens"



Oriana Poindexter



Gemina Garland-Lewis

Pinto abalone hatchery production 2019 – 2022:

Spawn Year	Eggs Produced	Larval survival	Larvae produced	Percent larvae set	Larvae set	Target settlement density	Tanks set	Distinct M x F crosses
2019	9.48M	42%	4.02M	52%	2.09M	30,000	73	28
2020	6.95M	39%	2.71M	59%	1.61M	25,000	70	28
2021	8.01M	46%	3.68M	38%	1.40M	15,000	96	27
2022	6.00M	30%	1.80M	71%	1.27M	15,000	96	20
Average:	7.61M	39.25%	3.05M	55%	1.53M	21,250	84	26