



Salish Sea Science Roundtable



Land Acknowledgement

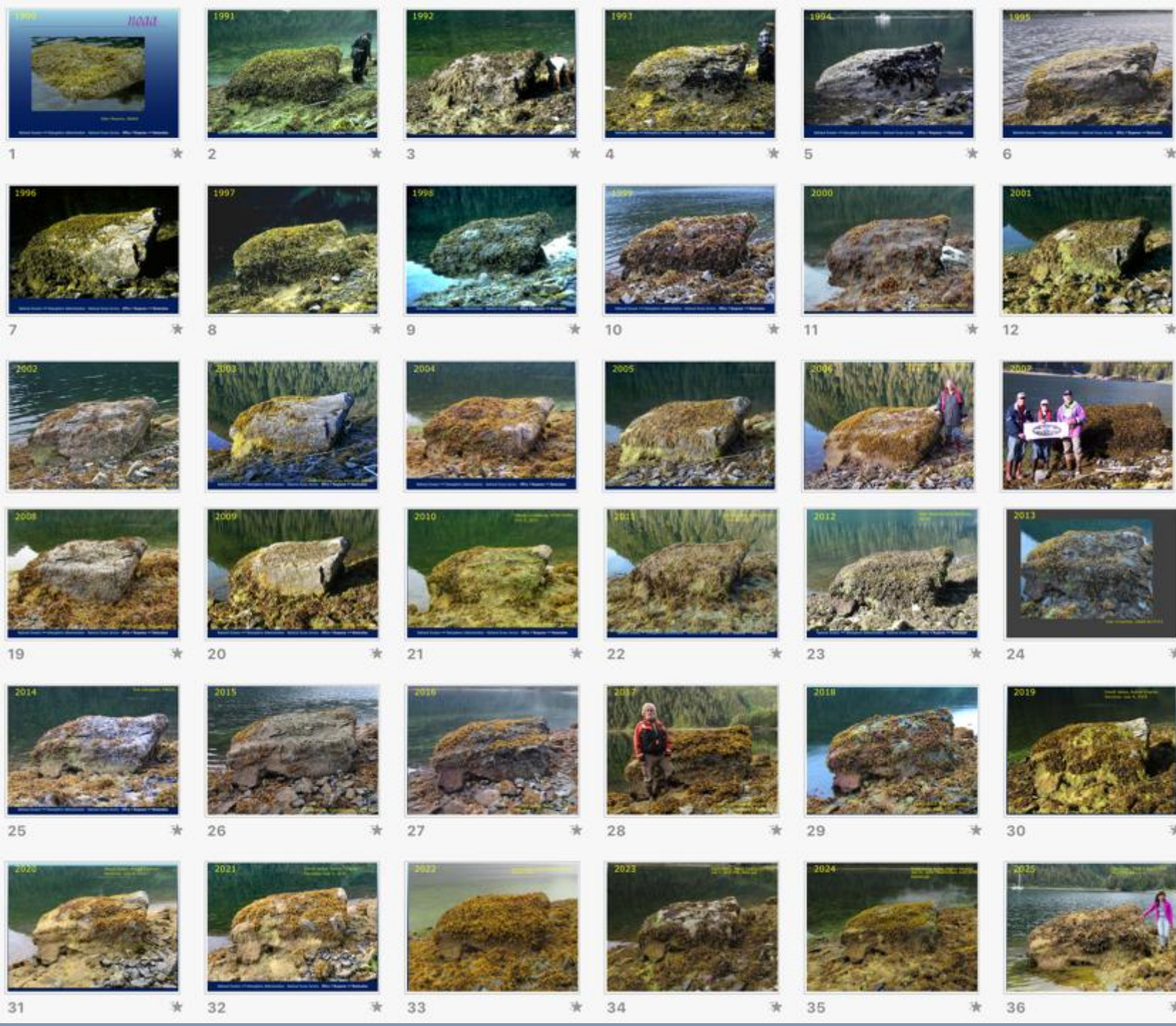
The UW Tacoma community acknowledges that we learn, teach, work and live on the ancestral land of the Coast Salish people. In particular, our campus is situated on traditional lands of the Puyallup Tribe of Indians. We recognize that this is a difficult and painful history, and we understand we must play an active role in remembering, not just what happened to Indigenous communities; post settlement, but also the rich history that existed long before colonization. This land acknowledgement is one small act in an ongoing process of honoring the past while working together with local Tribes to build a more inclusive and thoughtful community.

Thirty-seven Years of Repeated Photography following the Exxon Valdez Oil Spill in Prince William Sound

Alan Mearns¹
Gary Shigenaka¹
And
Valerie Chu²

¹NOAA Retired

²Washington Department of Ecology



Exxon Valdez oil spill

- 11 M gallons of crude oil
- 3,000 sq. miles covered
- 1,300 miles of coastline fouled
- Thousands of animals perished





(Volumes shown mainly in million barrels (Mbbbl) and sometimes converted estimates.)

Rank	Spill / Incident	Year	Location	Approx. Volume Released
1	Persian Gulf War Oil Spill	1991	Persian Gulf	~6–8 Mbbbl (≈380–520 million gallons)
2	Deepwater Horizon (Macondo well)	2010	Gulf of Mexico	~4.9 Mbbbl (≈134 million gallons) <small>Encyclopedia... +1</small>
3	Ixtoc I well blowout	1979	Bay of Campeche, Mexico	~3.0–3.5 Mbbbl
4	Atlantic Empress tanker collision	1979	Caribbean Sea (Trinidad & Tobago)	~2.1–2.4 Mbbbl
5	Fergana Valley / Mingbulak spill	1992	Uzbekistan (partially marine drainage)	~2.0+ Mbbbl
6	ABT Summer tanker explosion	1991	Off Angola	~1.9 Mbbbl
7	Castillo de Bellver tanker fire	1983	South Africa	~1.8 Mbbbl
8	Amoco Cadiz grounding	1978	Brittany, France	~1.6 Mbbbl <small>Encyclopedia Brit...</small>
9	Nowruz oil field spill	1983	Persian Gulf	~1.6 Mbbbl
10	Kolva River pipeline spill	1994	Russia (Arctic watershed)	~0.8–1.0 Mbbbl
11	MT Haven tanker explosion	1991	Italy (Mediterranean)	~0.9 Mbbbl
12	Odyssey tanker sinking	1988	North Atlantic	~0.9 Mbbbl
13	Torrey Canyon grounding	1967	UK / English Channel	~0.86 Mbbbl
14	Sea Star tanker collision	1972	Gulf of Oman	~0.8 Mbbbl
15	Urquiola tanker grounding	1976	Spain	~0.7 Mbbbl
16	Independenta tanker collision	1979	Bosporus, Turkey	~0.7 Mbbbl
17	Braer tanker grounding	1993	Shetland Islands, UK	~0.6 Mbbbl
18	Aegean Sea tanker grounding	1992	Spain	~0.5 Mbbbl
19	Exxon Valdez tanker grounding	1989	Alaska, USA	~0.26 Mbbbl (≈11 million gallons) <small>NOAA</small>
20	Prestige tanker sinking	2002	Spain / Bay of Biscay	~0.5 Mbbbl

The cleanup

Exxon paid: ~\$3.8 B

Exxon employees, federal responders, and 11,000+ Alaska residents:

- Skimmed oil from the water surface
- Sprayed oil dispersant
- Washed oiled beaches with high-pressure hot water
- Rescued and cleaned trapped animals



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Photo: Erich Gundlach

Studying untreated sites

In addition to control sites, purposely left some oiled areas untreated to study the cleanup effects



Bert and Ernie boulders

SITE LOCATIONS

● Unoiled Control ○ Oiled Set Aside ○ Oiled & Cleaned

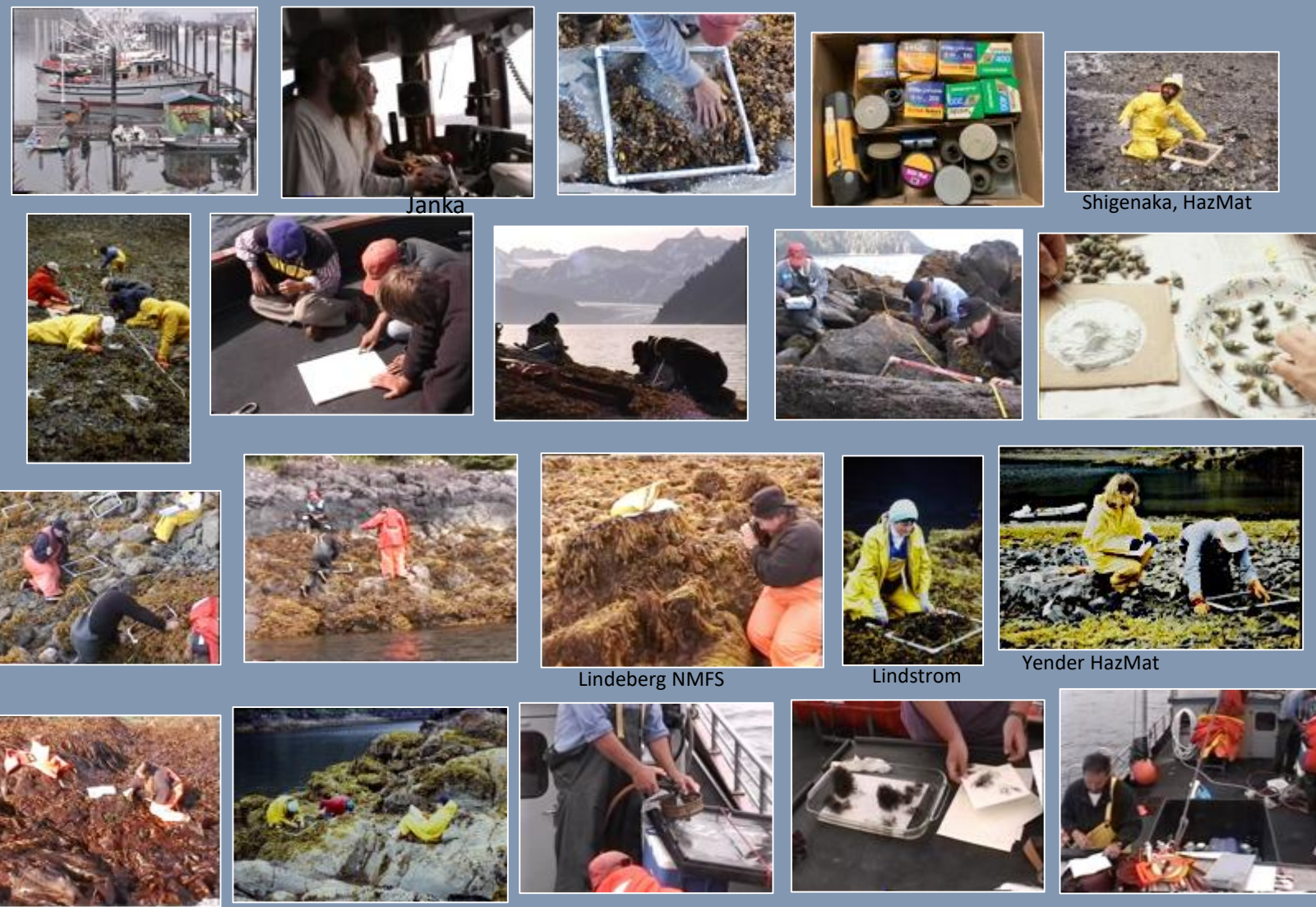


1990 -2000 HazMat Longterm Monitoring Program



17 Cruises, 49 participants, 21 sites

How fast was ecological recovery? How did the cleanup affect recovery?



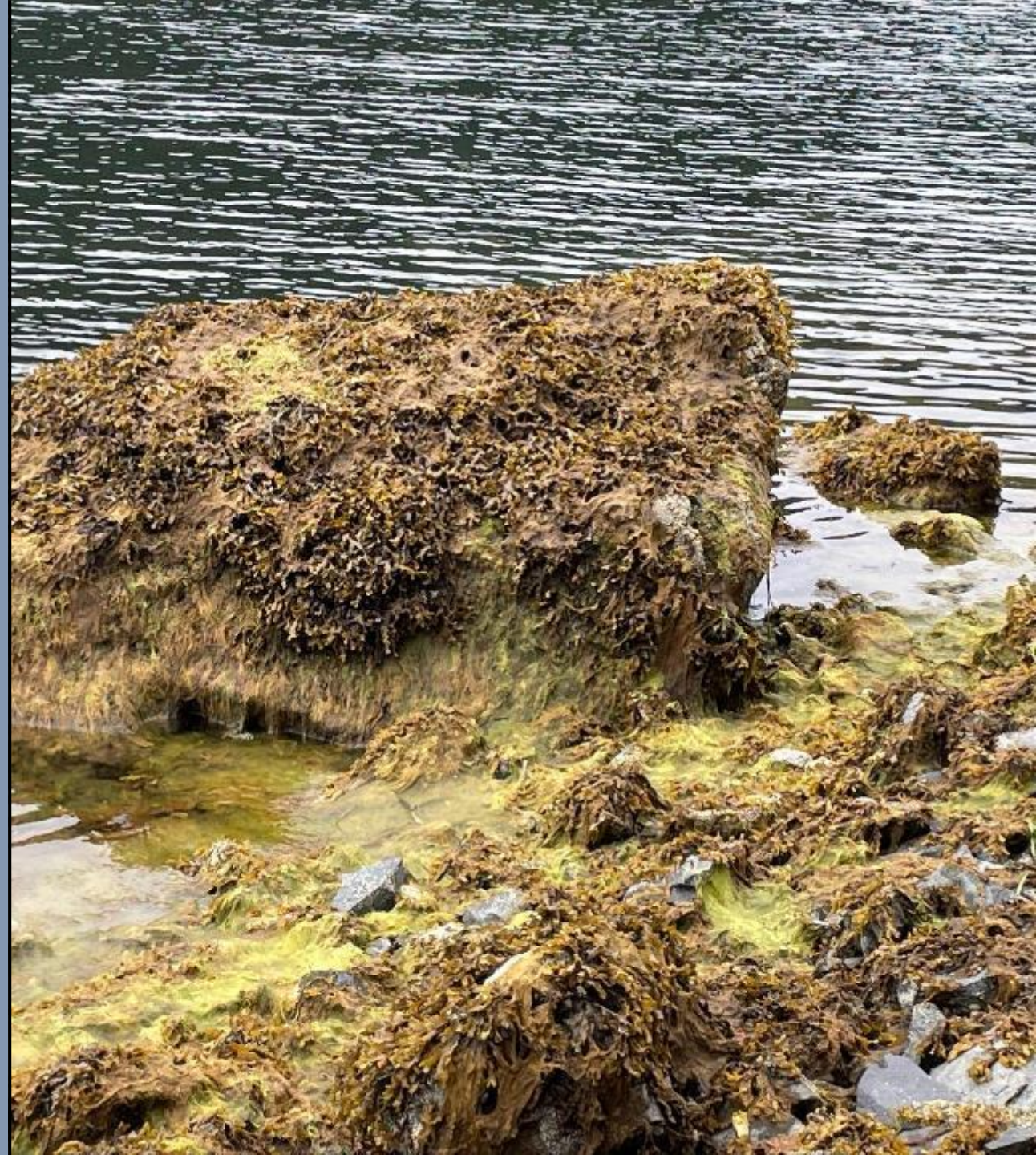
15 NOAA Tech Memos, dozens of papers, posters, conference proceedings

When is a shoreline ecosystem recovered?

When the system returns to within the *range of natural variability*

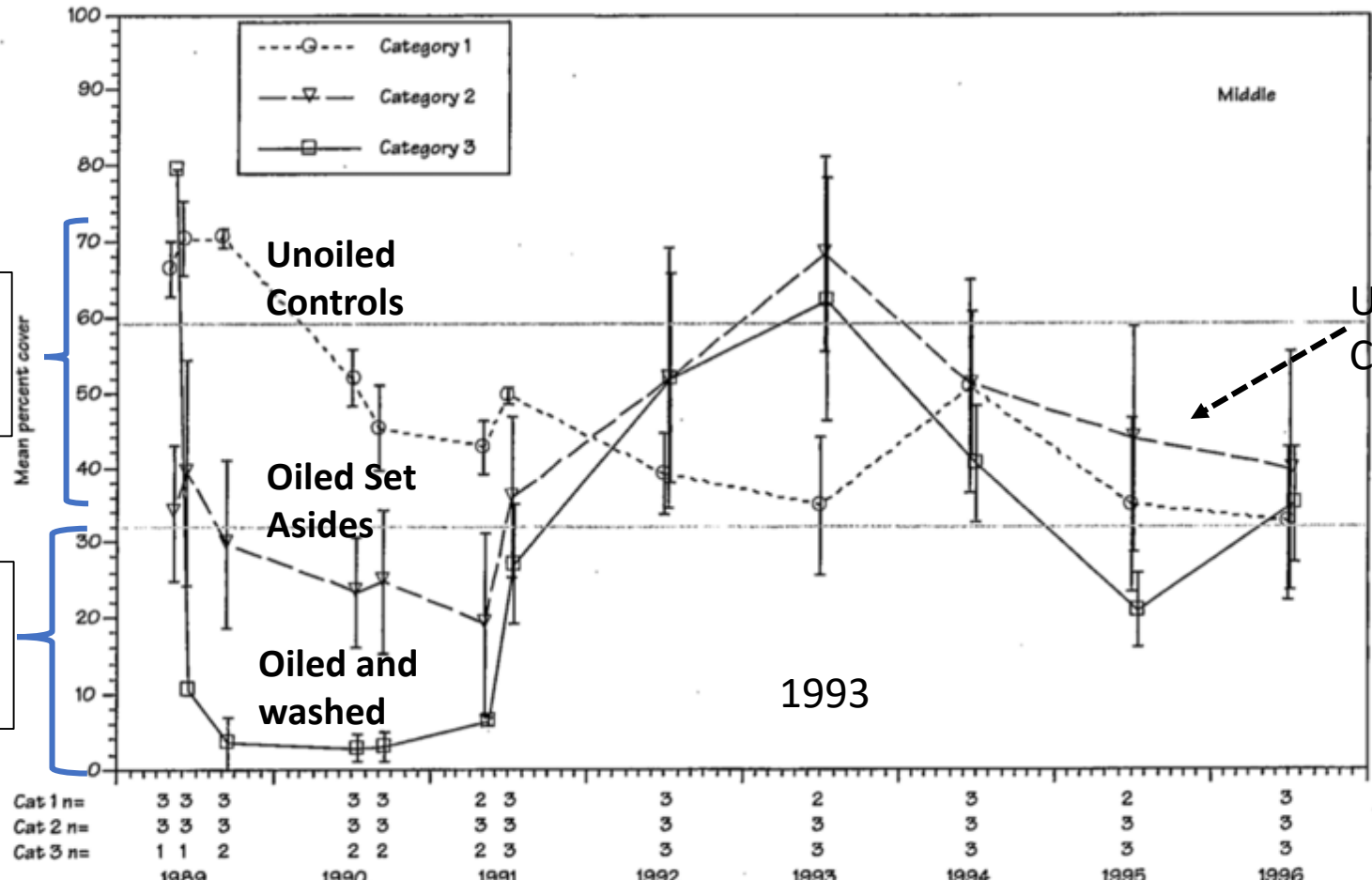
So you have to **measure variability**

Long-term repeated photography can help



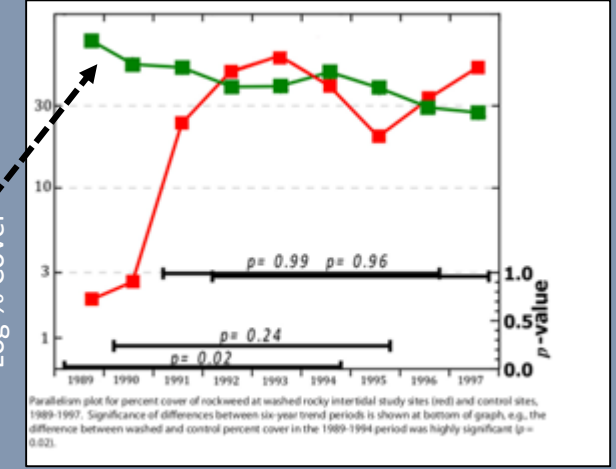
HazMat Longterm Monitoring Results 1989-1996

Mid-Intertidal Rockweed % Cover 1989-1996



Range of natural variability

Range of Injury and recovery



*“The magnitude and scope of the abrupt repopulation events provided compelling evidence that intertidal populations had **materially recovered by 1993.**”*
Shigenaka, 2014

But...was 10 years long enough to understand the complete range of natural variability ?

Impacts → Recovering → Recovered →

Figure 2-6. Mean percent cover (± 1 SE) of *Fucus* from middle rocky stations, by category, 1989-96.

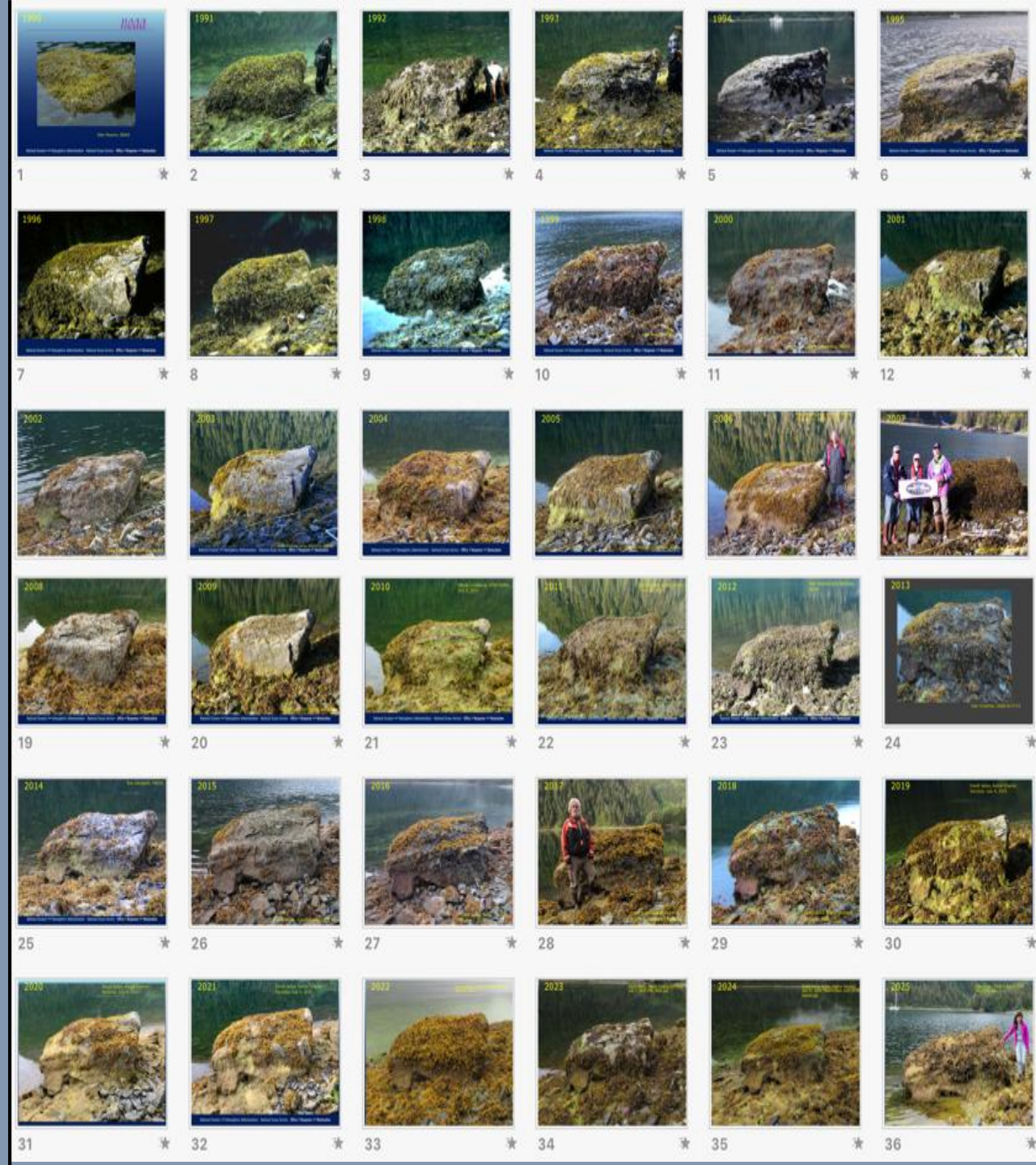
Long-term repeated photography

Visually compelling and inspiring

Can be done by citizens - even scientists!

Taps into local knowledge

Permanent record



What critters are we watching?

Rockweed

Fucus distichus



Rockweed submerged
Jan Kocian photo

Mussels

Mytilus trossulus



Oyster catcher

John Tarpley, June 15, 2007



Low tide



Sun star

David Janka, Aug. 1, 2016

Barnacles

cirripedia

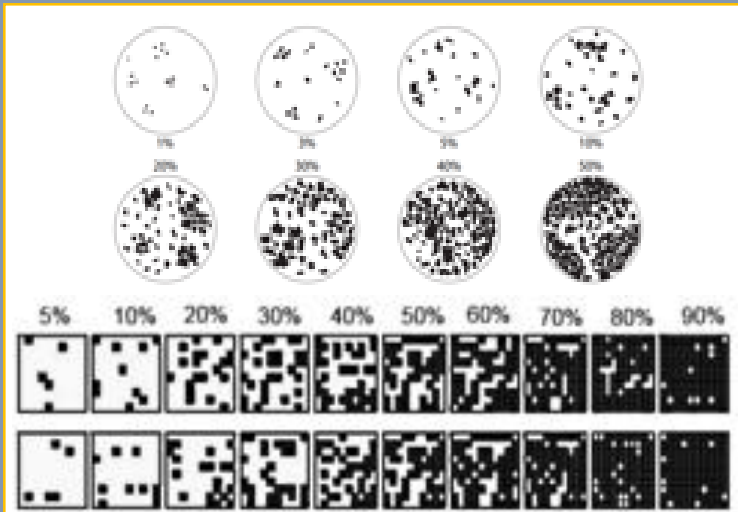


Whelk

Rockweed, mussels and barnacles are foundational species creating habitat & food for dozens of others

Percent cover estimation

Volunteers follow methods and Photosite Guide to capture daylight images at summer, low, or minus tides. Photos are then standardized, analyzed, and stored in several databases.



ERD Shoreline Guide and
Percent Cover Guides



1991
Rockweed 90 %
Mussels 0 %



1994
Rockweed 5%
Mussels 50%

“Mearns’ Rock”: ONE of nine long-term photo monitoring sites



July 1991

Photographers 2000 - 2025

noaa



John Whitney, NOAA AK SSC



David Janka, Auklet Charters



Scott Pegau, OSRI



Mandy Lindeberg, NOAA Fisheries



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Rob Campbell, PWSSC



Kate McLaughlin, Chenega



Brian Robinson, USGS



Pamela Eiting, Eshamy Bay



Valerie Chu, WADOE



Dan Crowther, PWSSC



Gary Shigenaka, NOAA ERD



Angie Doroff, Kasitsna Bay NERR



Brenda Ballachey, USGS



Jon Houghton, PENTEC

NOT SHOWN
Allan Fukuyama
Barbara Lydon

Oscillations at Mearns Rock: What is "Normal"?



1990

1994

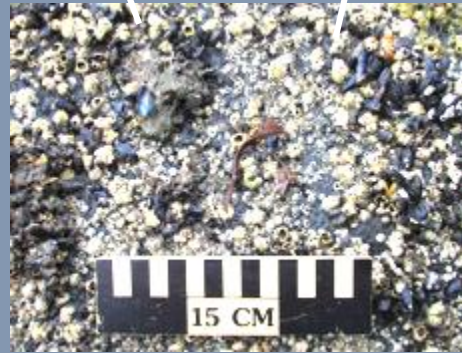
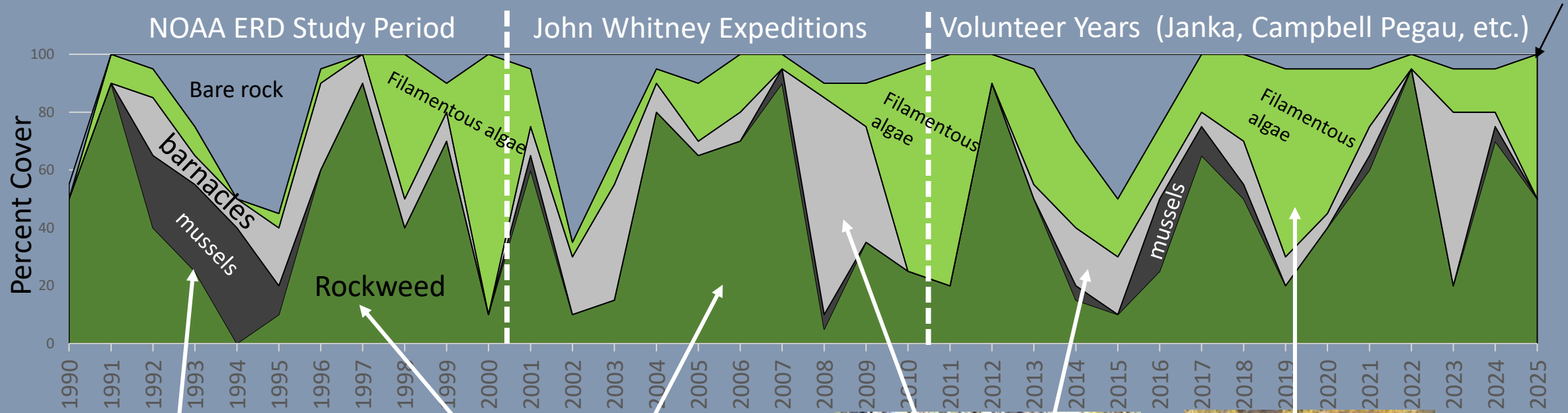
2007

2014

2022

2025

Valerie Chu



Mearns Rock Summary Year 36

Rockweed abundance ranged from less than 5 to over 90 % cover

There were 7 “oscillations” with heavy cover in 1991, 1996-99, 2004-2007, 2012, 2017, 2022 and 2024

There appeared to be increasing episodes of heavy filamentous algal cover.

Mussels colonized the rock during 1992-1995 with a second episode of moderate cover in 2016-2017.

Sea stars were first observed on and at the base of the rock during later years

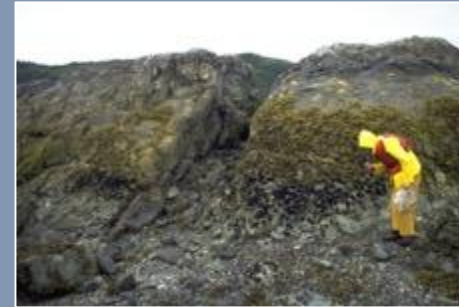
The Other Sites

Bert

Ernie



Mussel Madness on
Two Boulders,
Shelter Bay. 34 years



NW Bay Rocky Islet:
Variations on Split
Rock. 27 years



The Controls: Eshamy
and Crab. 24 years



2020 Wipe Out at
Herring Set Aside.



Climb to recovery?
Splayed Rocks,
Mussel Beach
33 Years



There's more, but not
enough time here!



2010



2011

Shelter Bay Boulders Bert and Ernie 1990-2025

Mussel Madness”

Cover of adult
mussels peaked in
1993, 2003, 2010,
2019.

Adult mussels absent in
1997, 2005, 2011,
2016, 2025.

Four inter-annual
oscillations of mussel
cover appeared
synchronous across 4
sites.

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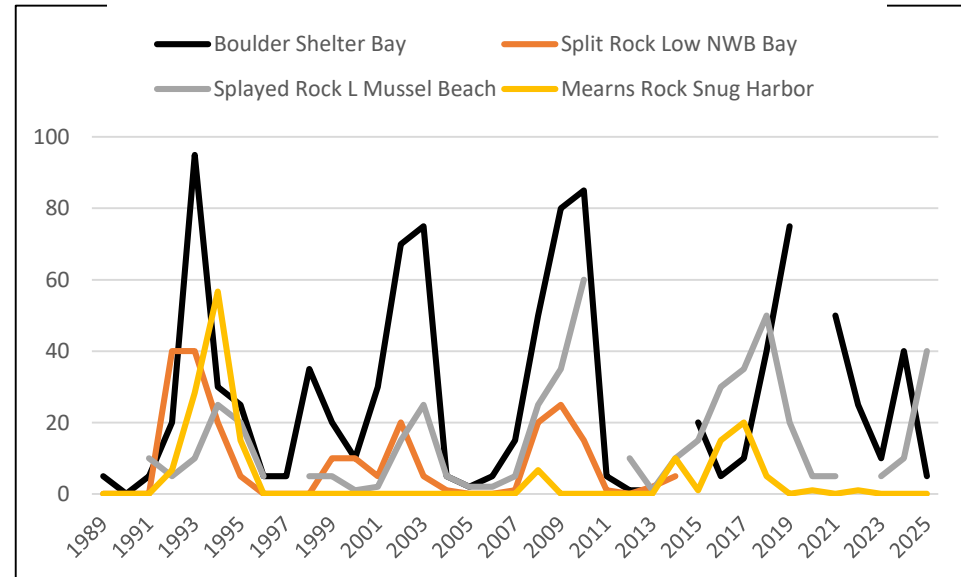


32



33

Mussel Cover at Four Sites 1990-2025

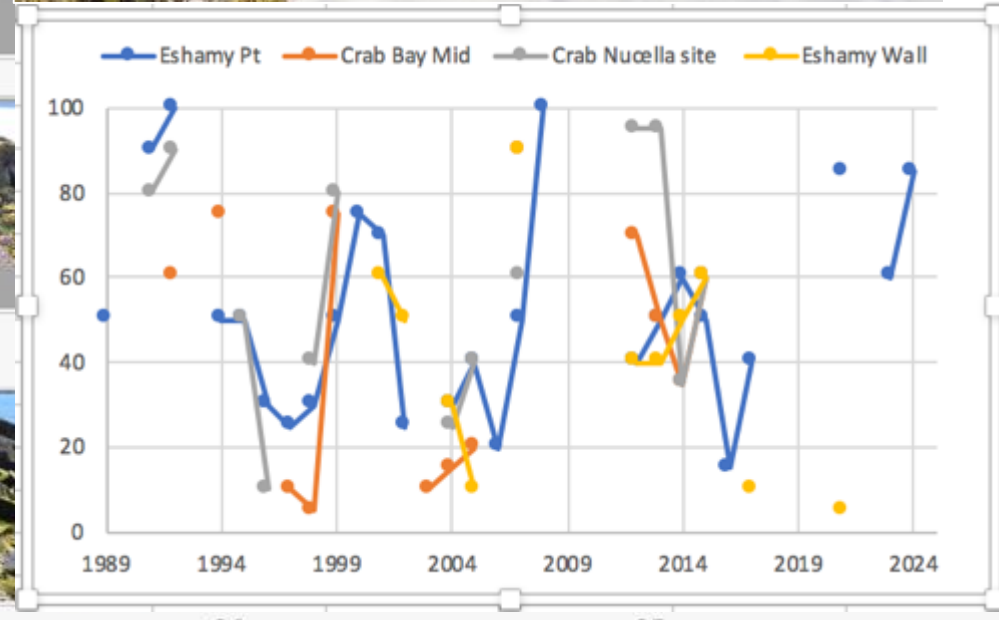


Control Sites Eshamy Point

(broken timeseries)

Two control sites, four photo points.

Rockweed cover heavy in 1991-92, 1999-2000, 2008, 2012-2013, 2024.



1

6

16

17

18

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22

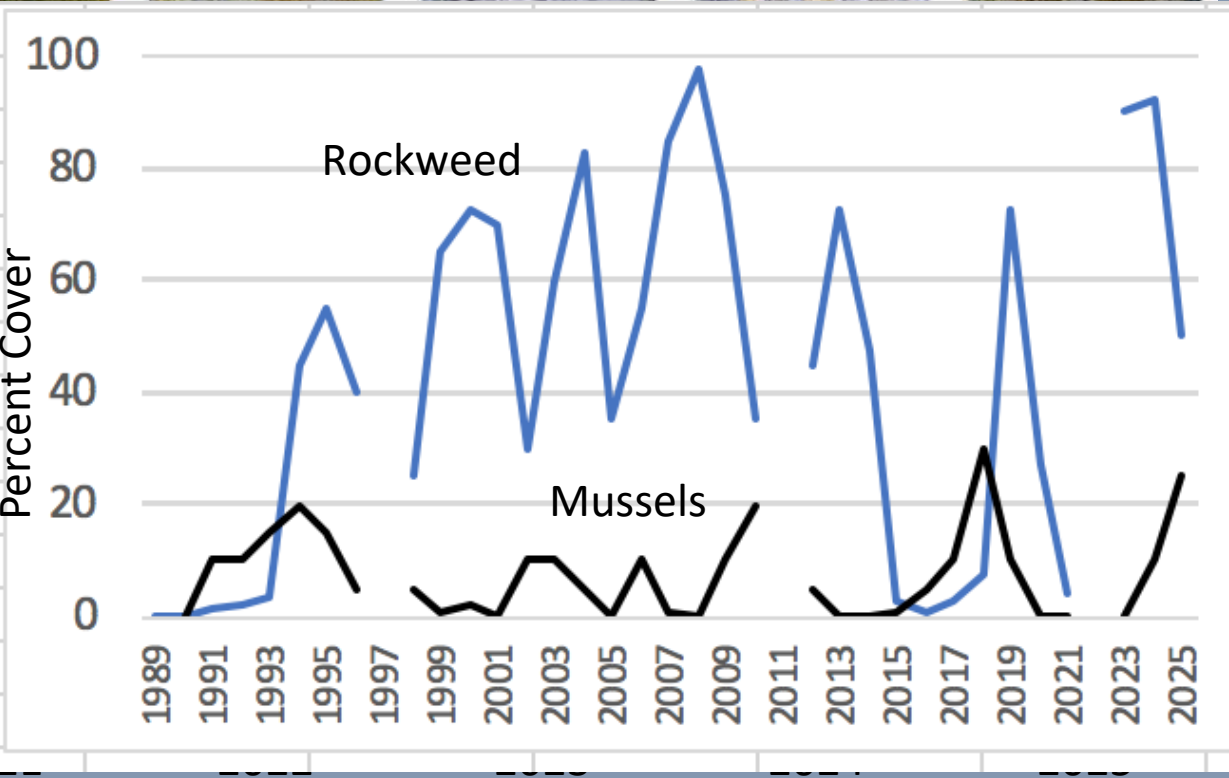
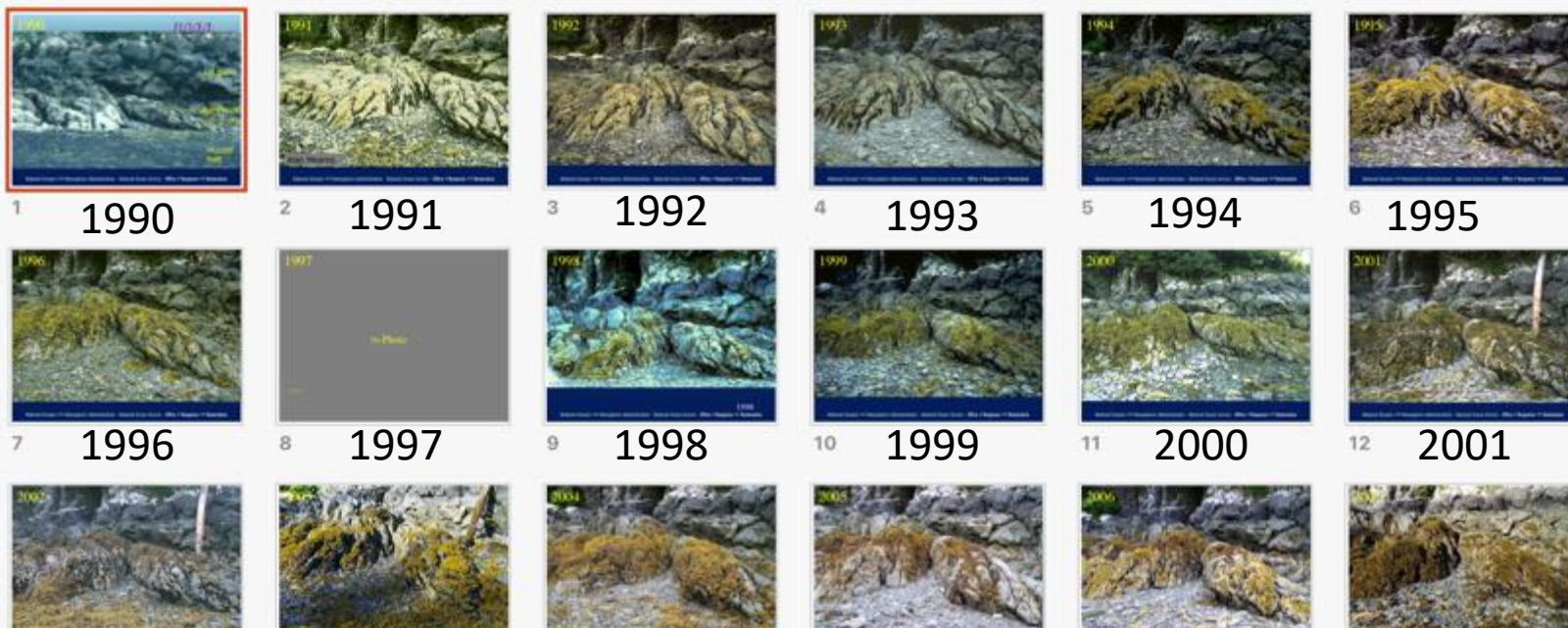
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Mussel Beach 1989-2025

"Splayed Rocks" Photo point



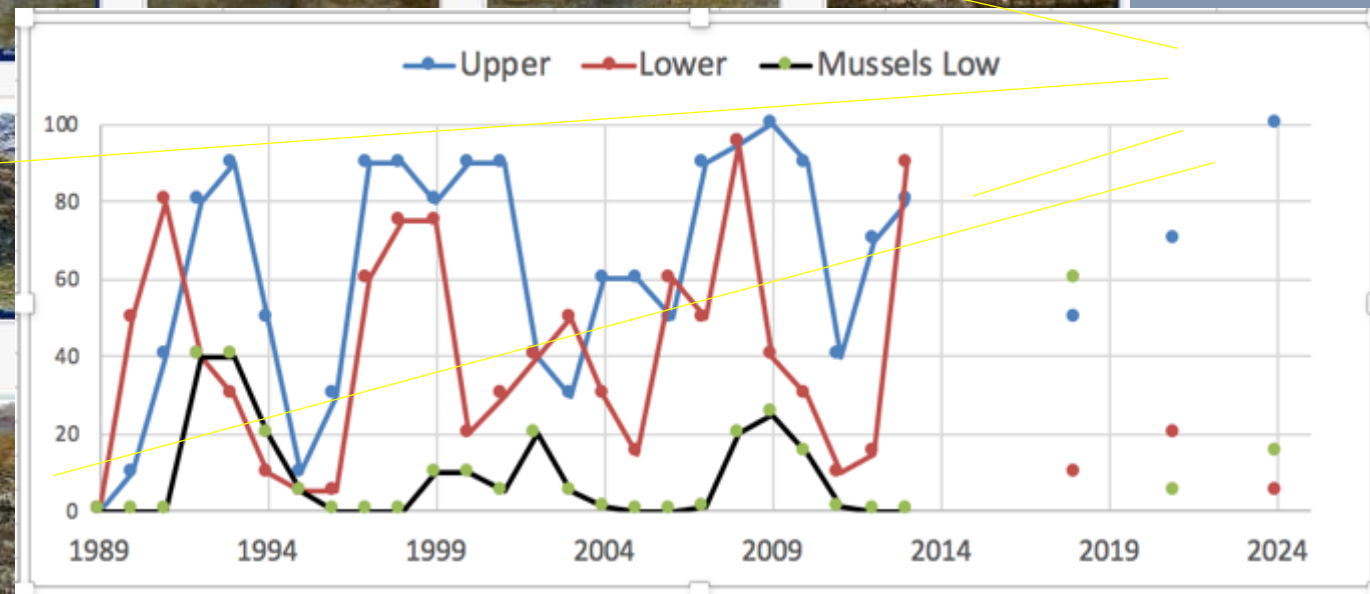
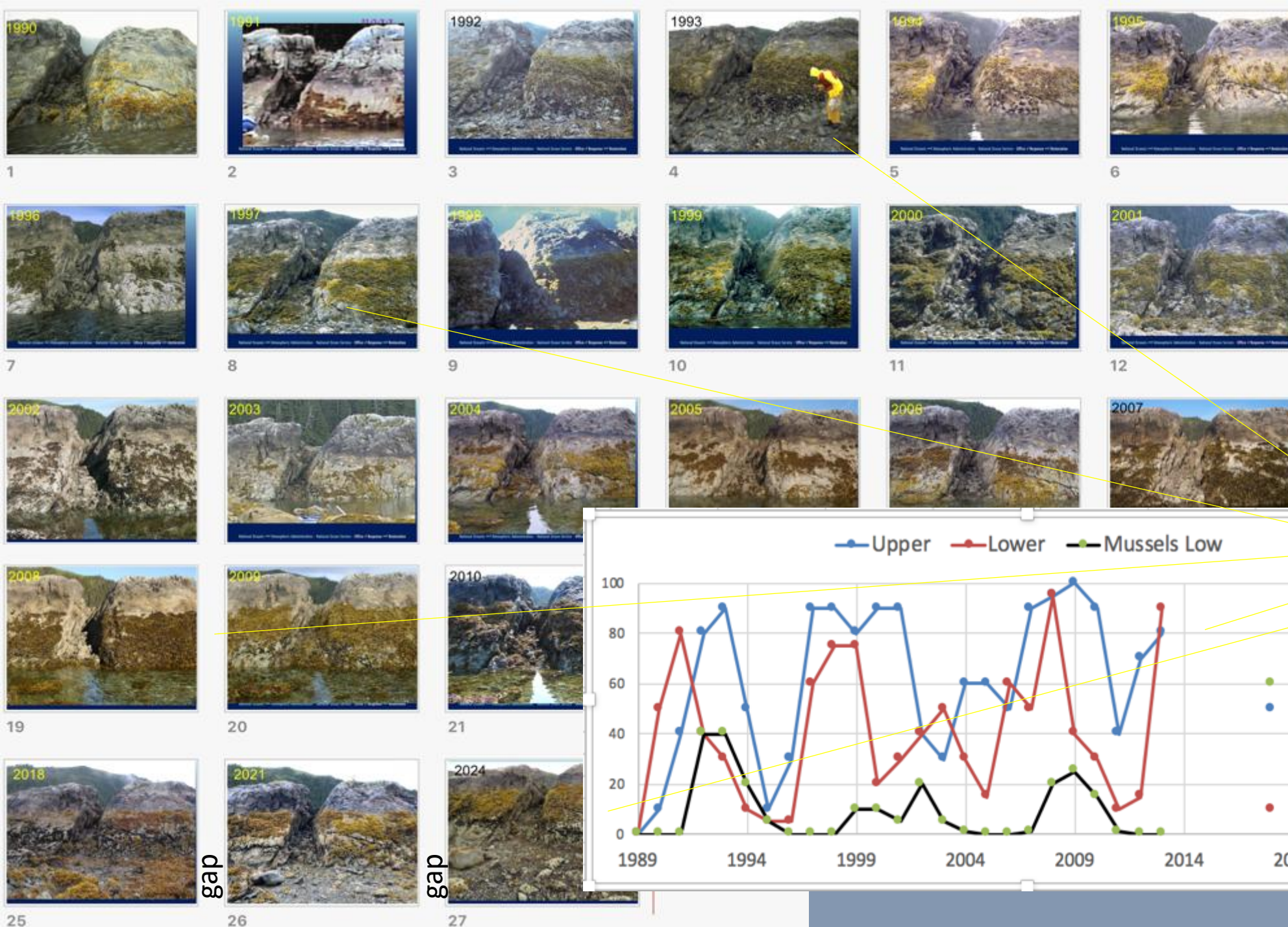
Oiled intertidal bedrock rises in background above gravel tombolo and mussel bed. June 22, 1989, J. Houghton. Bedrock subjected to high-pressure hot water wash, spring 1989. 7 oscillations in rockweed cover, 4 to 7 years apart.

Split Rock 1990-2024

Northwest Bay Rocky Islet
Elanor Island
1990-2024 with gaps

Heavily Oiled
and pressure
washed in
1989

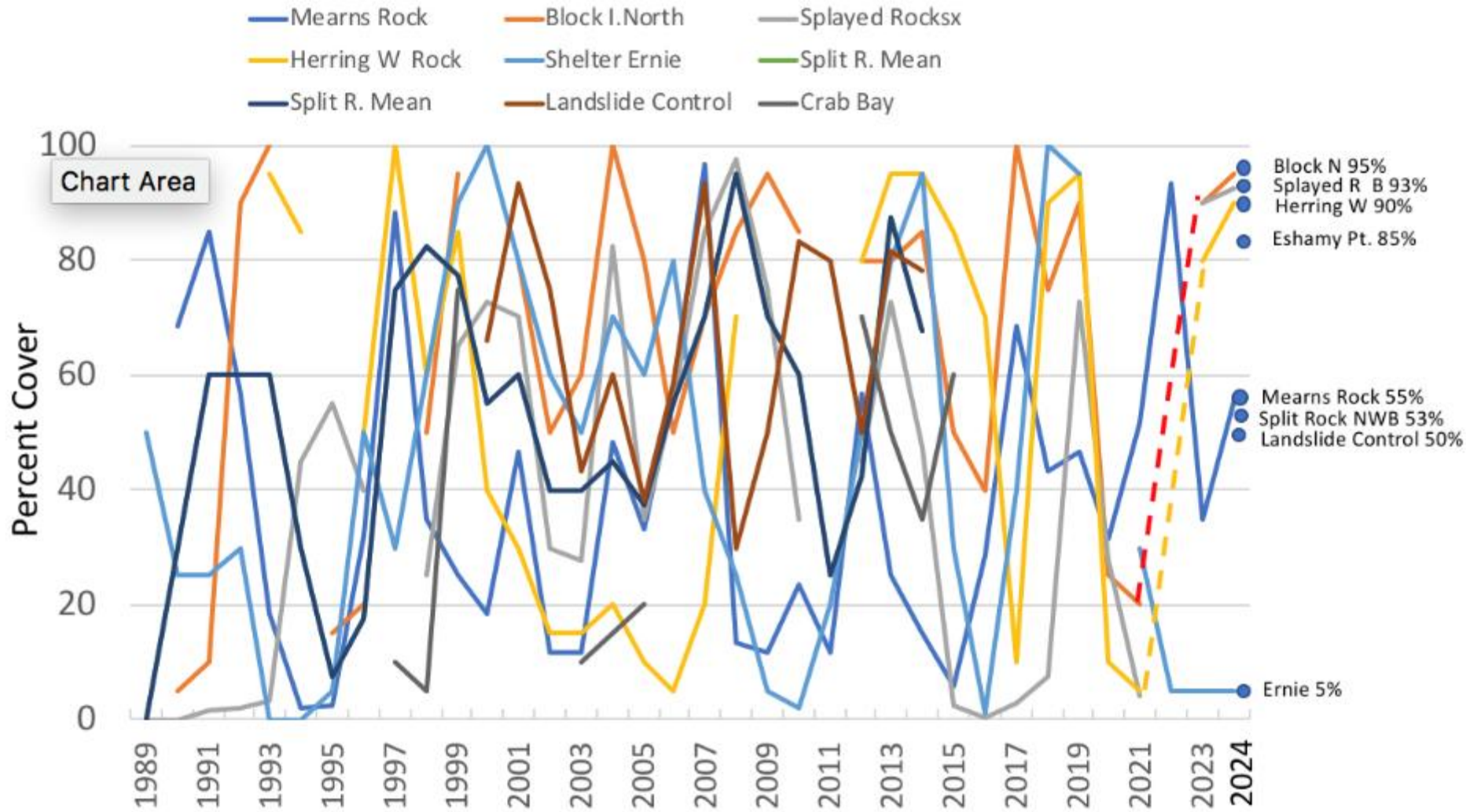
Heavy Rockweed cover
1993,



on mussel
-94, 2018,

Long-Term Monitoring Results by Site

Variability of Rockweed Cover 1990-2024



Block Island- Oiled and cleaned with high pressure washing

Herring W- Oiled but not cleaned

Eshamy Bay- Not oiled (control)

Mearns Rock- Oiled but not cleaned

Landslide- Not oiled (control)

Ernie- Oiled and cleaned with high pressure washing

Credit: Mearns et al. 2025

Variability makes it difficult to determine when rockweed “recovers”.

Rethinking Recovery: Science Beyond “Before and After”

Ecosystems are
dynamic, and
even without
catastrophe,
change is
inevitable

There is no
simplistic
narrative of
“before and
after”

Always
complexity and
uncertainty

Nonlinear

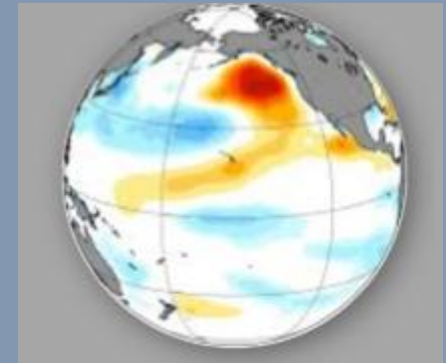
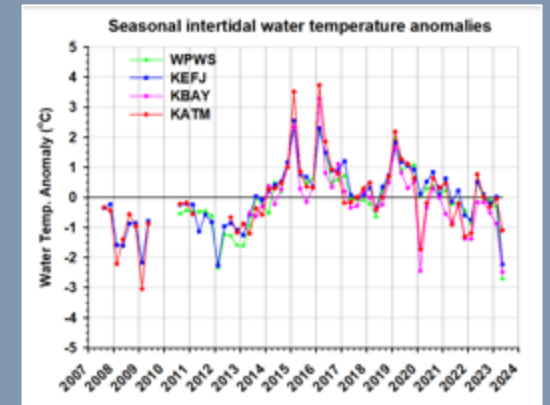
Why the variability?

We don't address causes! Only provide images that make it easy to see variability.

To learn more we must go to publications by the USGS Gulf Watch Alaska Nearshore Program, 2007-present, eg:

Decline of Rockweed and other algae, and increased cover of mussels, was associated with the 2014-2018 Marine Heat Wave in Gulf Alaska (Weitzman et al 2021).

Bodkin et al. 2018 found synchrony in adult mussel populations. So did we.

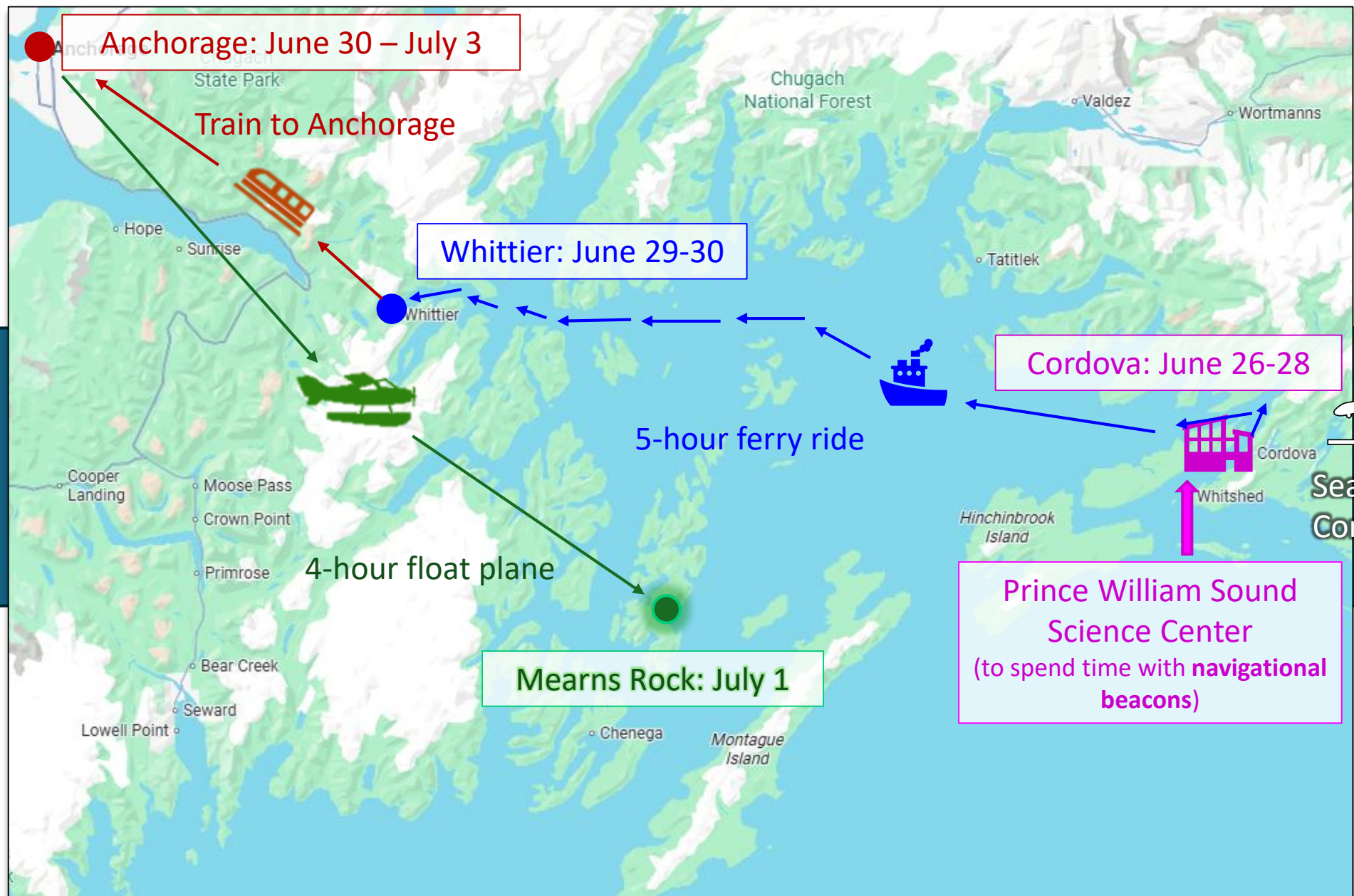


Mearns Rock: A Pilgrimage of Purpose

- A powerful symbol of resilience
- Deep connection to Alan
- Generational knowledge transfer



Travel Itinerary



SeaTac to Cordova

Seeking Expert Guidance

- **Navigational Beacons:**
 - **Scott Pegau:** Freshly retired from the Prince William Sound Science Center Oil Spill Recovery Institute
 - **David Janka:** A retired local charter boat captain with intimate knowledge of the waters and years of photographing Mearns Rock.
- Their insights became invaluable in navigating the complexities.



Reaching the Rock: A Breathtaking Experience

- A long journey: Flight, ferry, train, and float plane
- Prince William Sound's legendary tides and unpredictable weather proved formidable
- A testament to Alaska's wild beauty

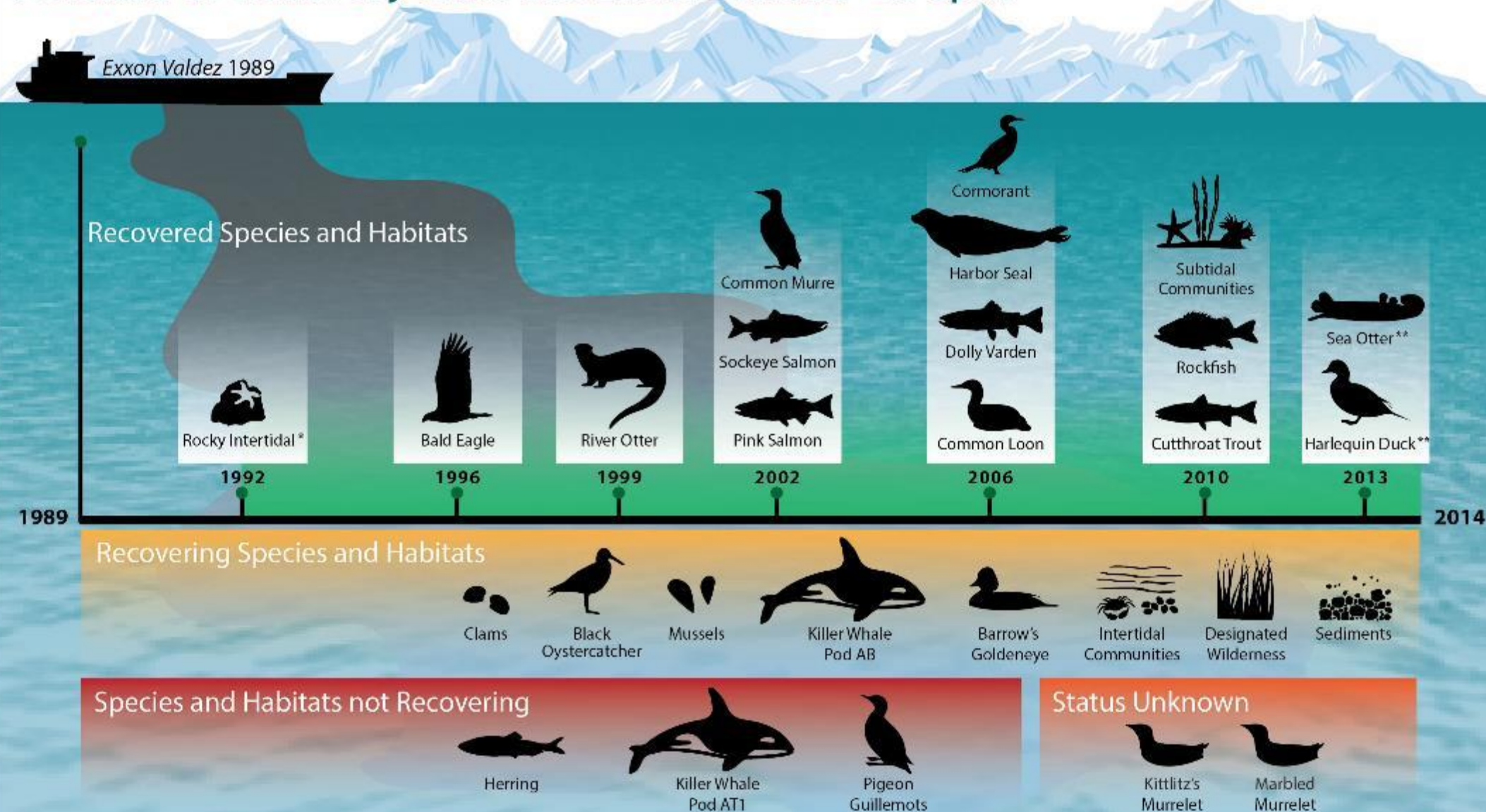


25 YEARS LATER

The tanker *Exxon Valdez* spilled almost 11 million gallons of oil into Alaska's Prince William Sound on March 24, 1989, injuring 28 types of animals, plants, and marine habitats. How long has it taken them to recover from this spill? Twenty-five years later, which ones have not yet recovered?

Here is a timeline showing when natural resources were declared officially "recovered," though actual recovery could have occurred earlier than this official designation from the Exxon Valdez Oil Spill Trustee Council.

Timeline of Recovery from the *Exxon Valdez* Oil Spill



* Data from NOAA

** Data from USGS

Data were taken from the Exxon Valdez Oil Spill Trustee Council's 2010 Update on Injured Resources and Services (www.evostc.state.ak.us), U.S. Geological Survey, and National Oceanic and Atmospheric Administration's Office of Response and Restoration. This infographic was produced by the National Oceanic and Atmospheric Administration. Credit: response.restoration.noaa.gov



Passing Down Knowledge: Inspiring Generations

Contributions to science/policy in
the Salish Sea and beyond:

- Biomonitoring
- OPA90



Mearns Rock #2 Edmonds Jetty



- Even when the path is slippery, tides are against you, and the future seems foggy, **we must not give up**

Acknowledgements

Photo Contributors

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Scott Pegau Barbara Lydon
Rob Campbell Tim Lydon
Dean Dale Valerie Chu
Jeff Lankford Dan Crowther
Gary Shigenaka Angie Doroff
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Jon Houghton Valerie Chu
Dennis Lees Ruth Yender
Allan Fukuyama Michael Wheeler
John Tarpley Laura McDuffie
James Bodkin

Field Assistance and Collaboration

John Coombs
Whittier Flotilla
USCG
David Goldstein
NWS
Jacqui Michel
John Bauer (ADEC)
Sarah Allan
Rebecca Hoff

For Authorizations, Travel, Financial and Technical Support:

Bob Pavia
David Kennedy
Debbie Payton
Jerry Galt
Scott Lundgren
David Wesley
Mark Dix
Donna L. Roberts
Thelma Mendenhall
Nickie Scillo
Lance Davey