Use Analysis Process Update

Washington Coastal Marine Advisory Council Meeting

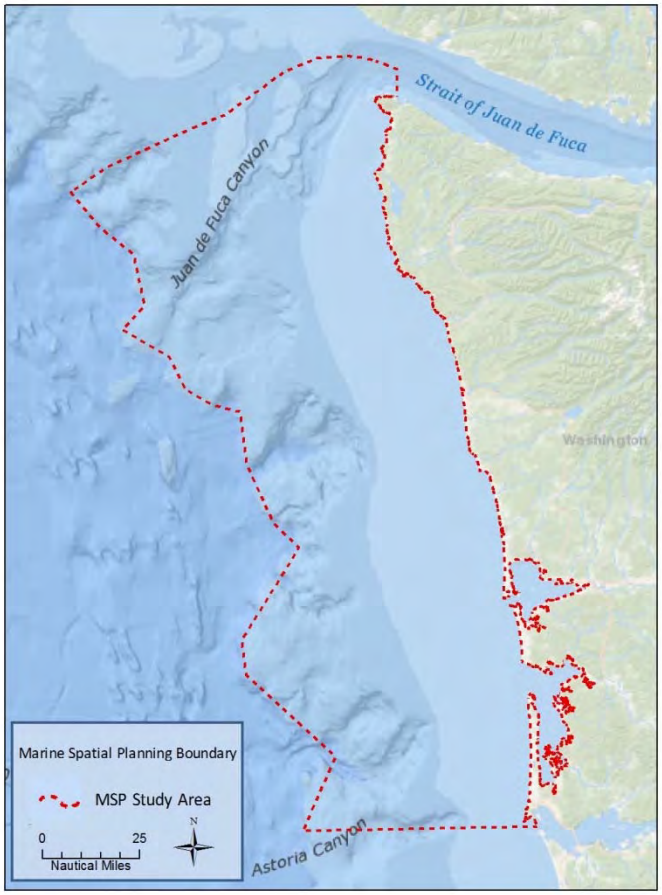
September 23, 2015

Port of Grays Harbor

Outline

1. Outline of MSP & Use Analysis project
2. Methods/Approach
3. Existing Use Mapping Progress
4. Next steps
5. Discussion

Scope of MSP



The study area is 700 fathoms offshore and includes federal waters and estuaries.

INTENT:
Address location of potential new marine uses.

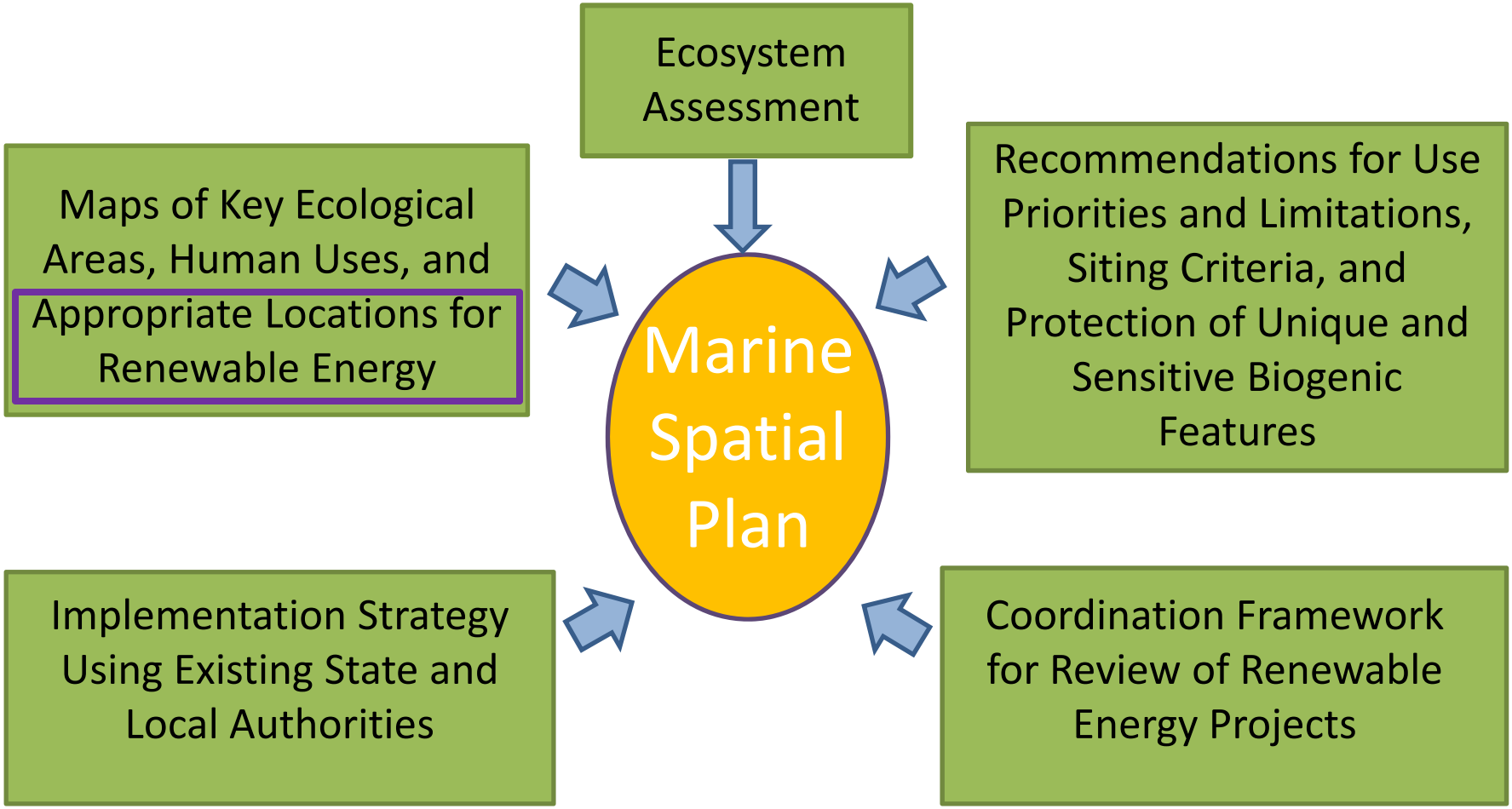
PLAN GOALS/OBJECTIVES:

- Protect existing uses
- Protect cultural uses/resources
- Preserve environment
- Integrate decision-making
- Provide new economic opportunities

NON-REGULATORY PLAN

MSP Context

The marine management plan must include but not be limited to…



RCW 43.372.040(6)

(6) The marine management plan must include but not be limited to:

. . .

(c) A series of maps that, at a minimum, summarize available data on: The key ecological aspects of the marine ecosystem, including physical and biological characteristics, as well as areas that are environmentally sensitive or contain unique or sensitive species or biological communities that must be conserved and warrant protective measures; human uses of marine waters, particularly areas with high value for fishing, shellfish aquaculture, recreation, and maritime commerce; and appropriate locations with high potential for renewable energy production with minimal potential for conflicts with other existing uses or sensitive environments;

-RCW 43.372.040

Use Analysis Process

Final Products:

1. Maps that provides general sense of where higher levels of conflict *may* occur with new uses

2. Recommendations for planning regarding new uses (space use)

Use Analysis Approach

1. Produce conflict maps for existing uses by sector:
   - Intensity of uses
   - Sum of uses
2. Overlay all sector conflict maps to produce map of all existing uses
   - Intensity of uses
   - Sum of uses
3. Overlay renewable energy maps for comparison
4. Develop recommendations

Process To Date

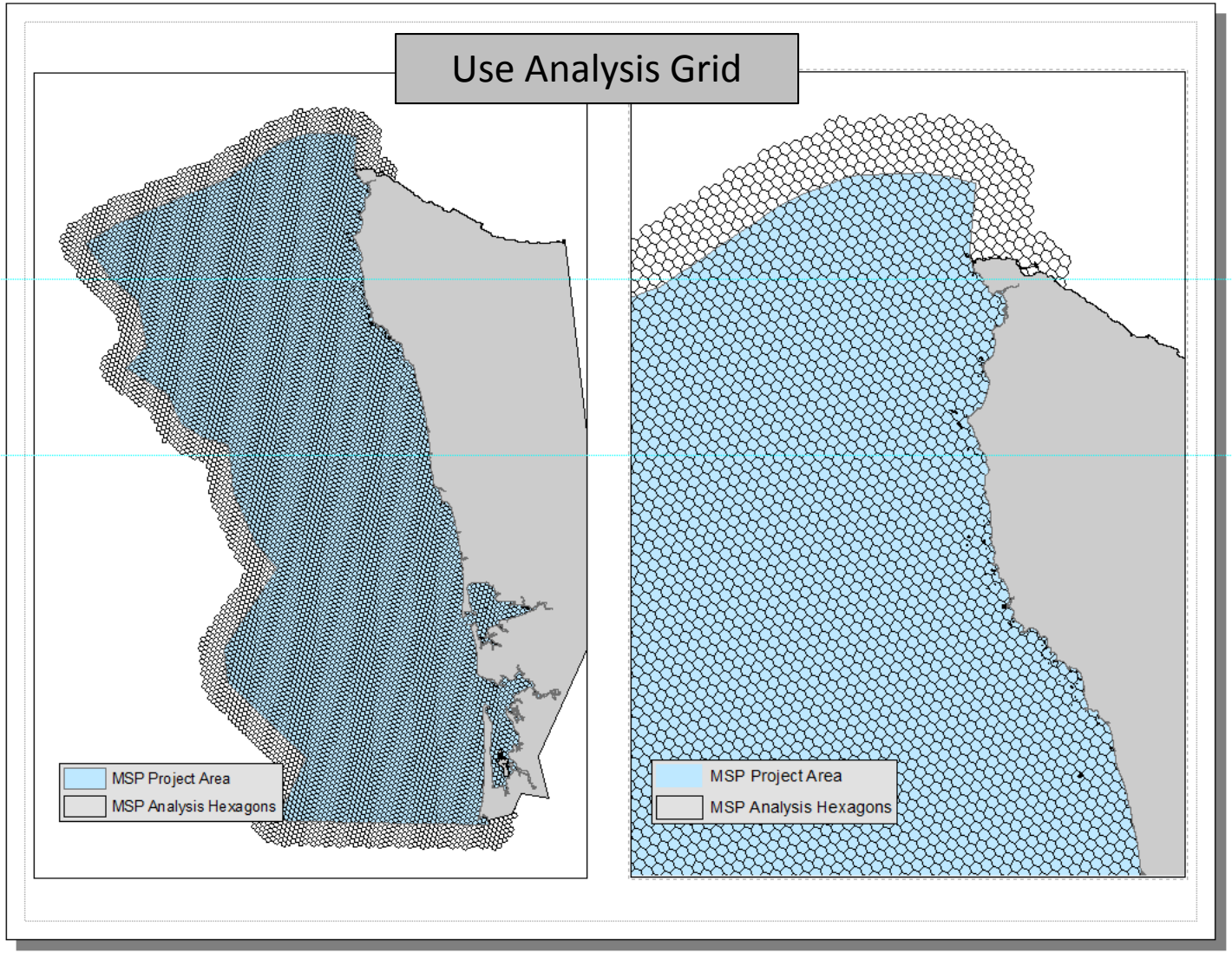
- Briefings to WCMAC on concept and process
- Meetings with marine use sectors regarding conflicts (*mostly completed*)
- GIS work (*ongoing*)

Existing Use Scoring Criteria

- Use intensity data, where available.
- Convert data to footprints of where the use occurs (or not) for “sum of uses” maps.

- Retain conflict coding for existing use data layers within attributes of data, where available:
  - High, Medium, Low, None

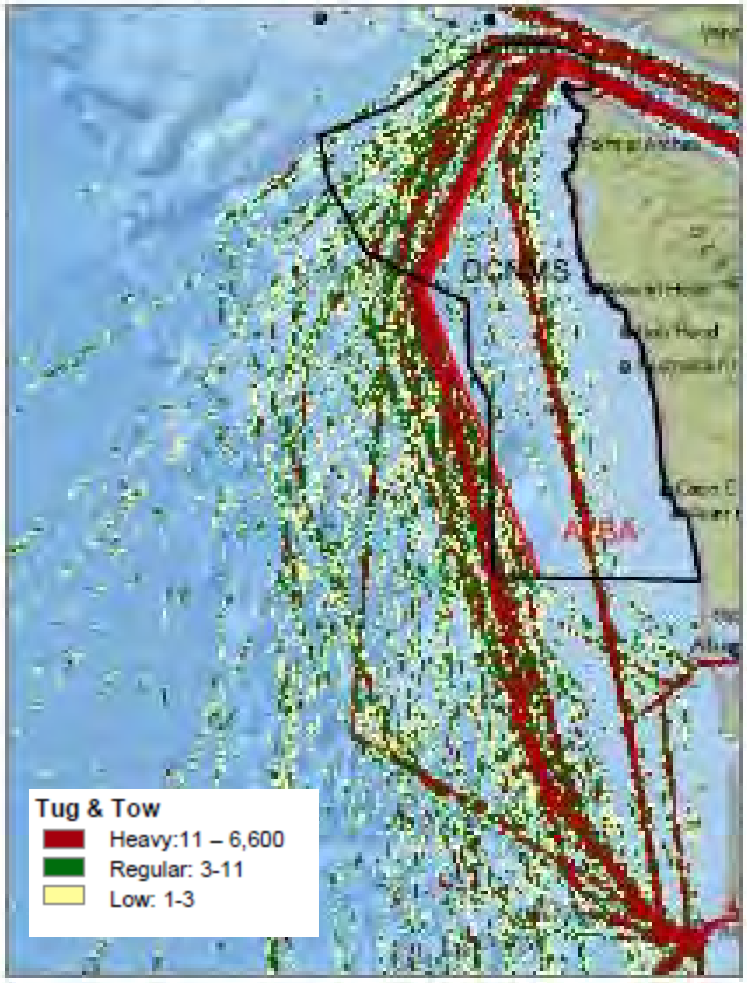
Analysis Unit = 1 Sq Mile Hexagons



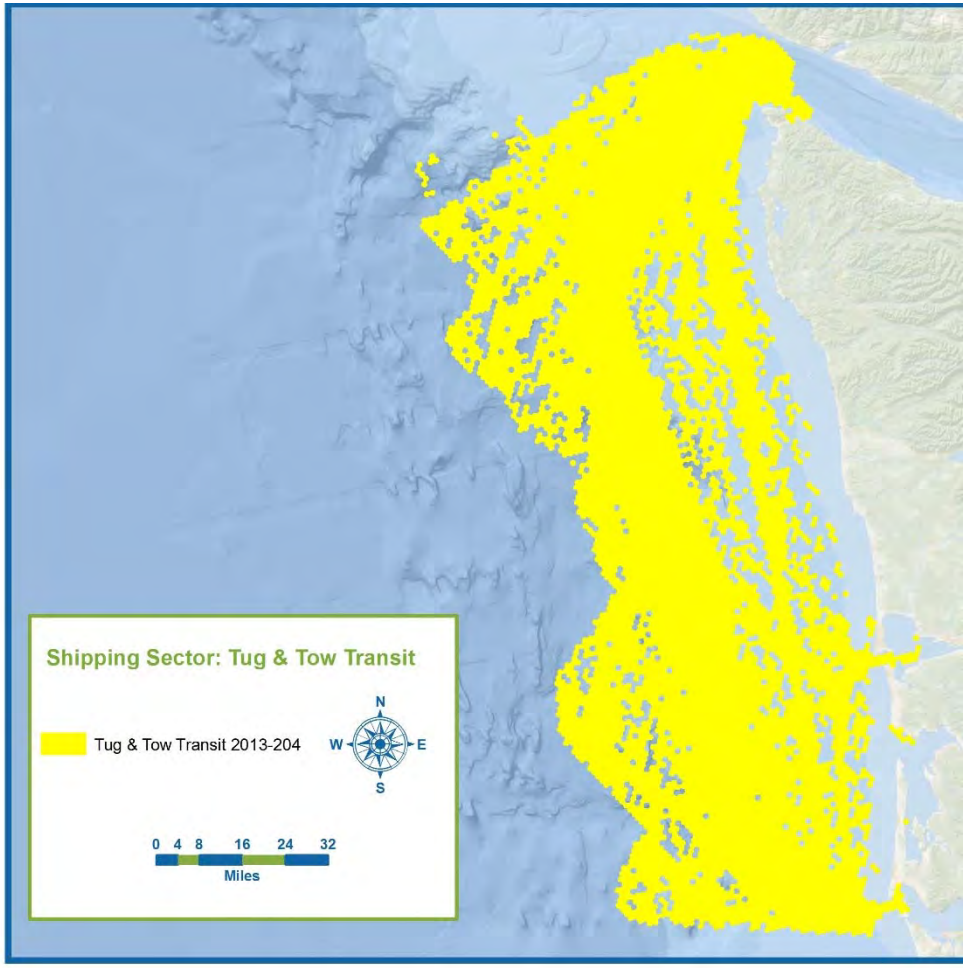
There are 8,272 hexagon cells in the grid within the boundaries of the planning area.

Existing Use Mapping – Shipping: draft use maps

Intensity data: Tug and Tow

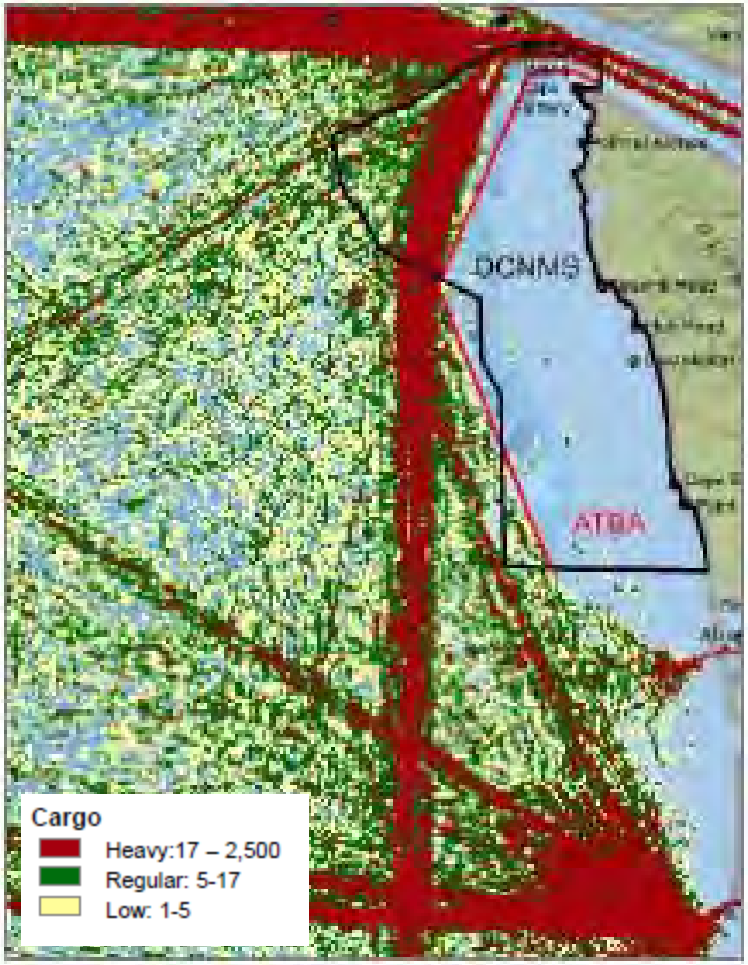


Sum of Use: Tug and Tow

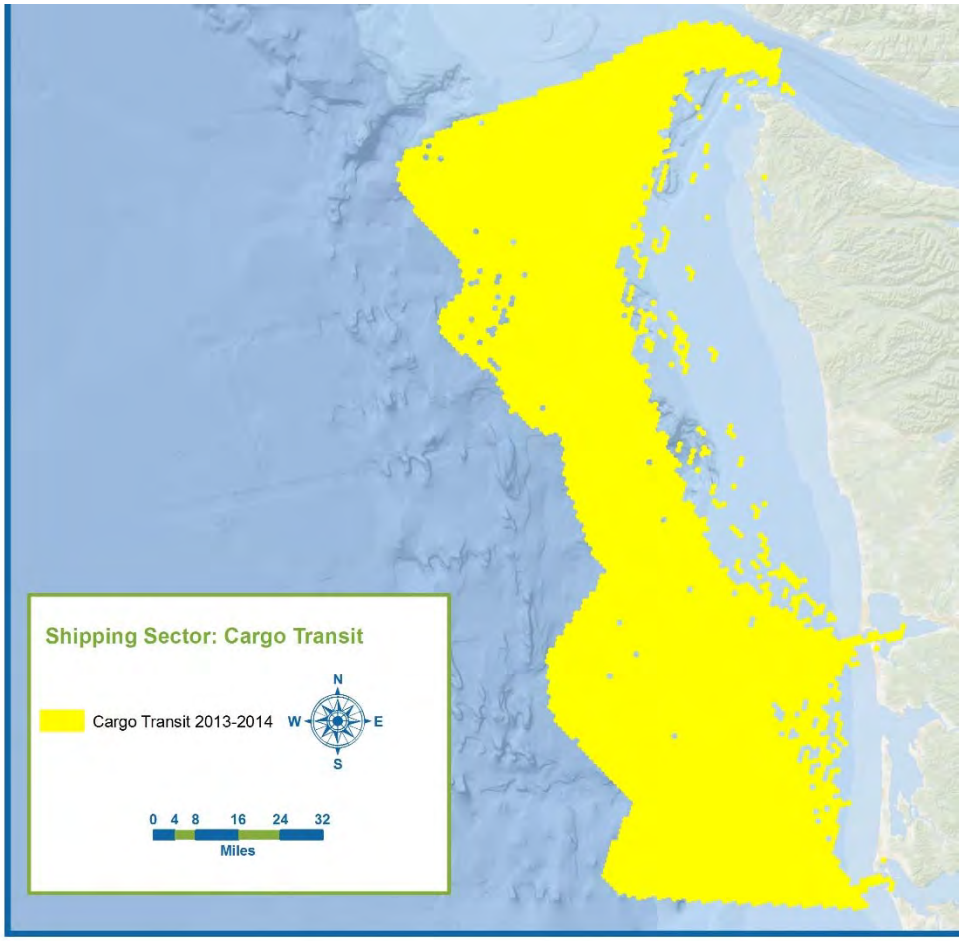


Existing Use Mapping – Shipping: draft use maps

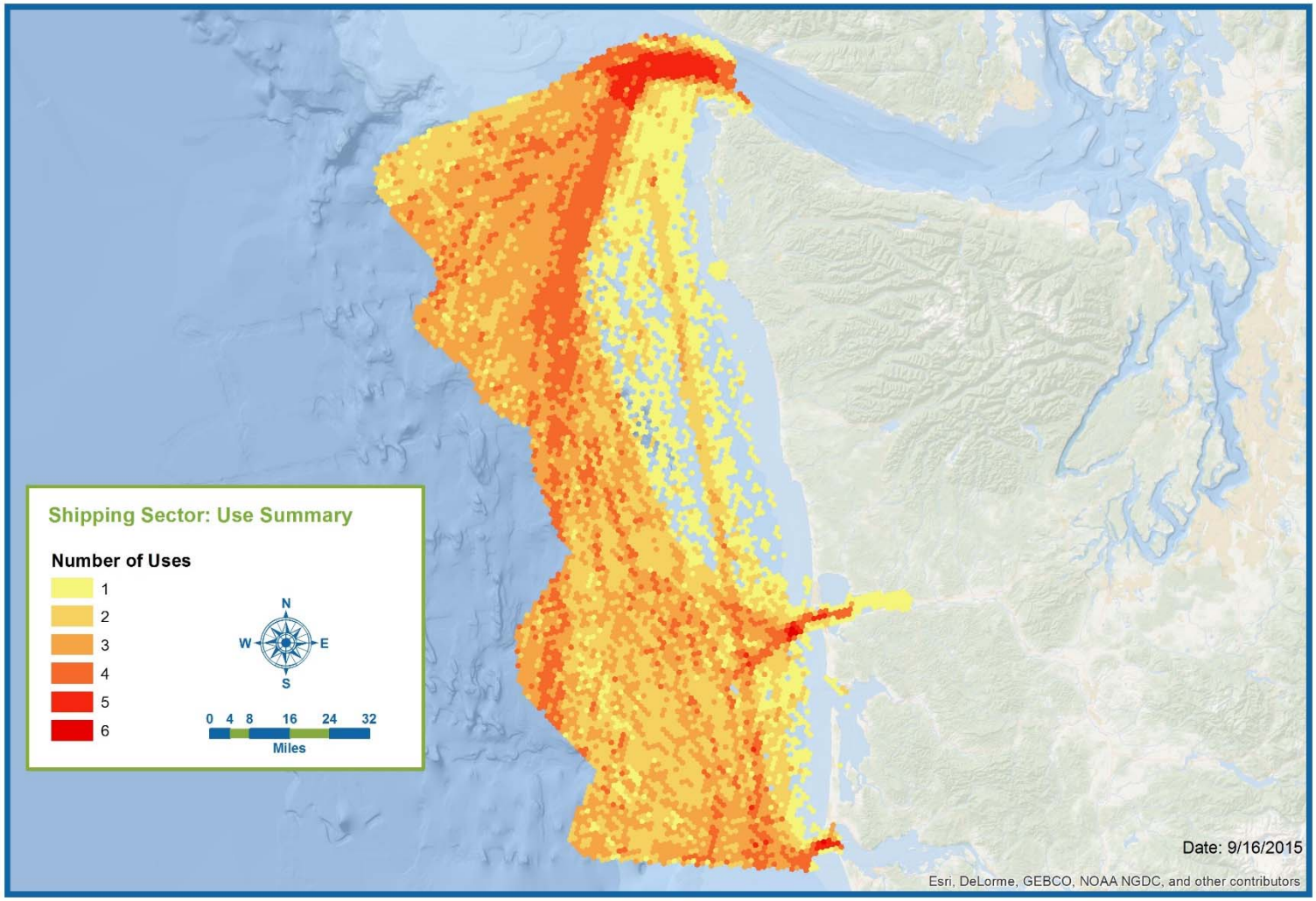
Intensity data: Cargo



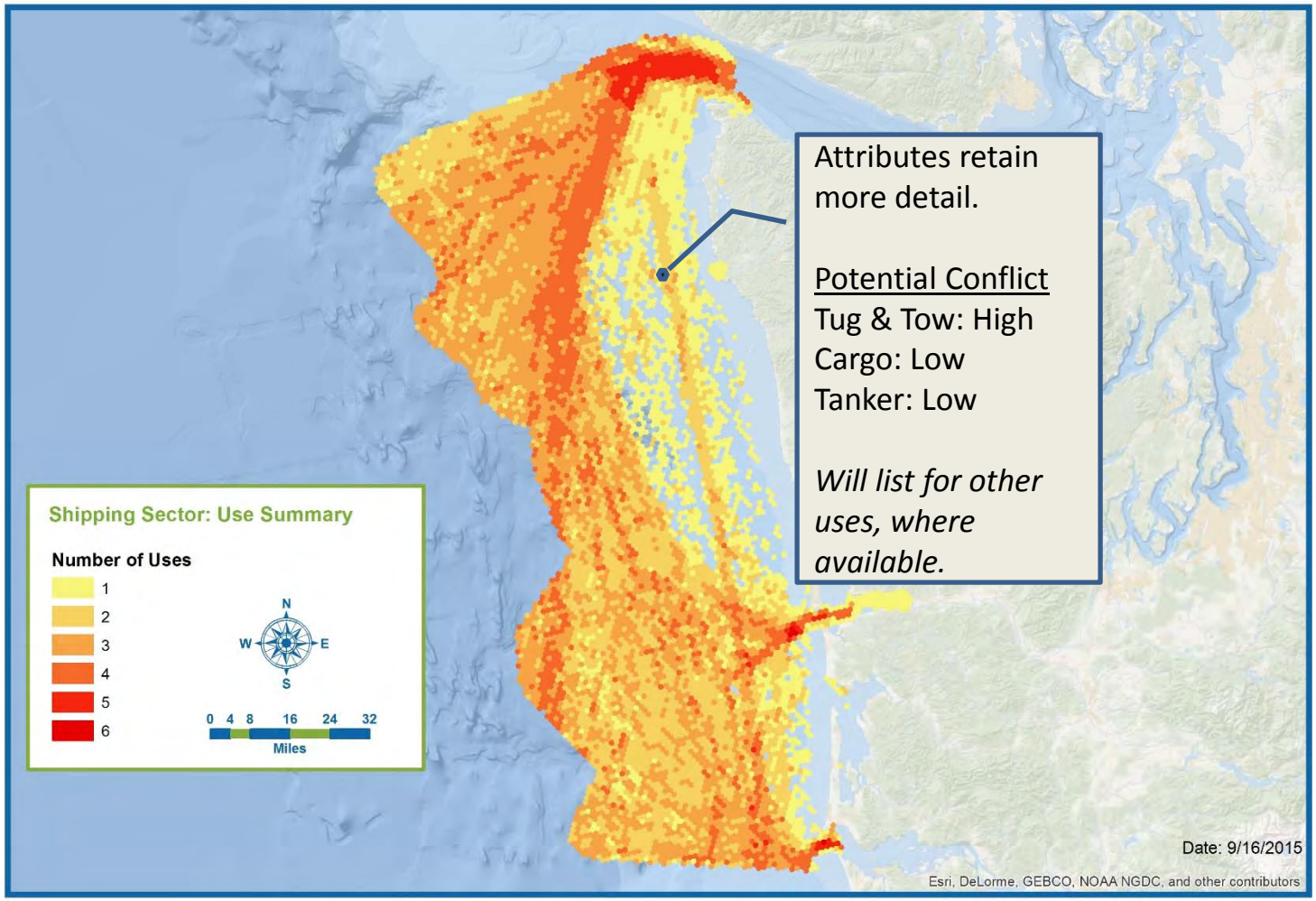
Sum of use: Cargo



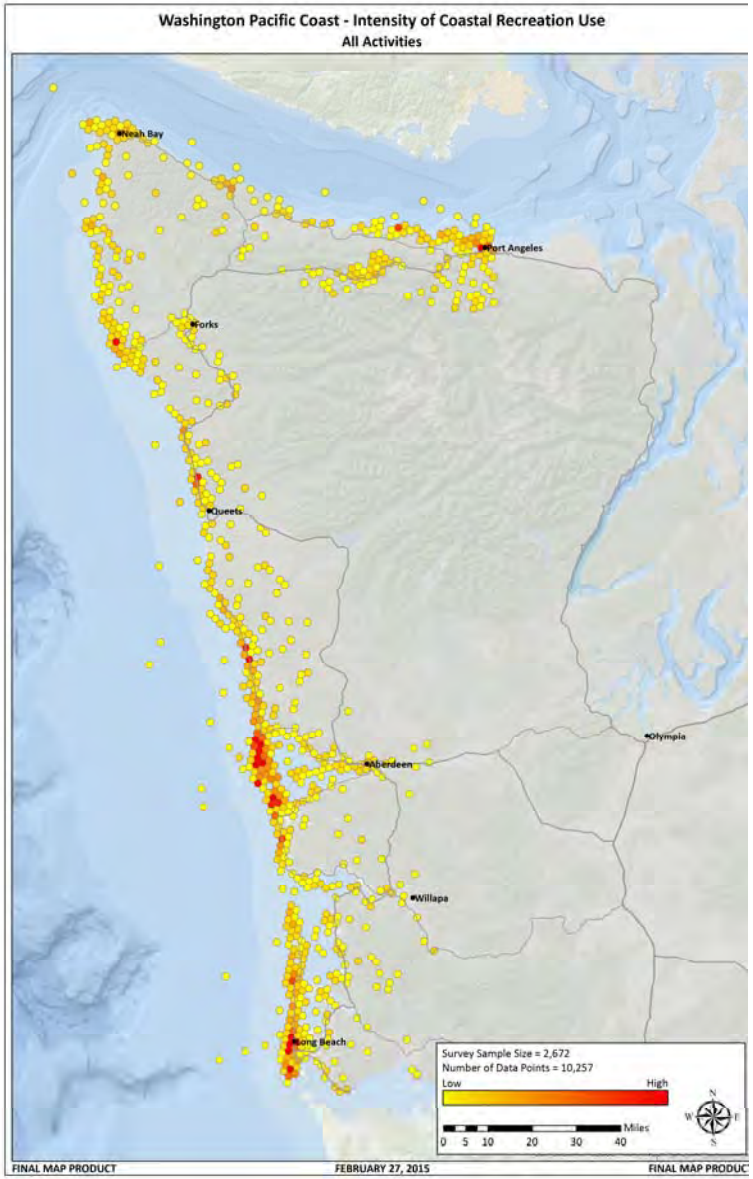
Shipping: Draft Sum of All



Shipping: Draft Sum of All

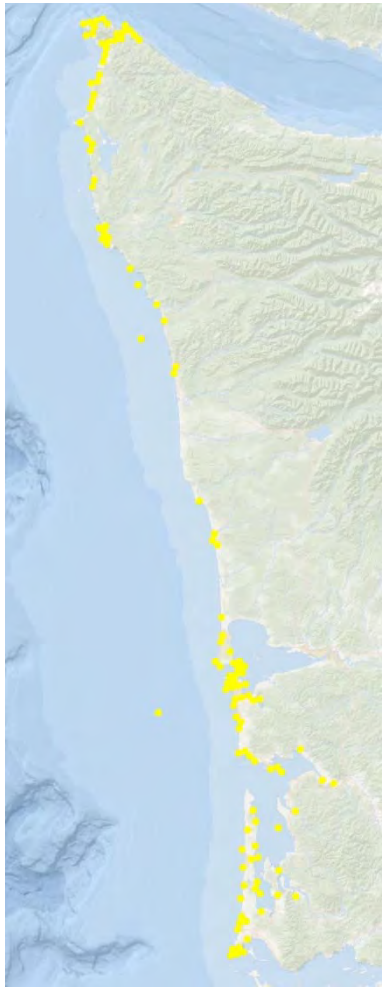


Recreation Study – Intensity data

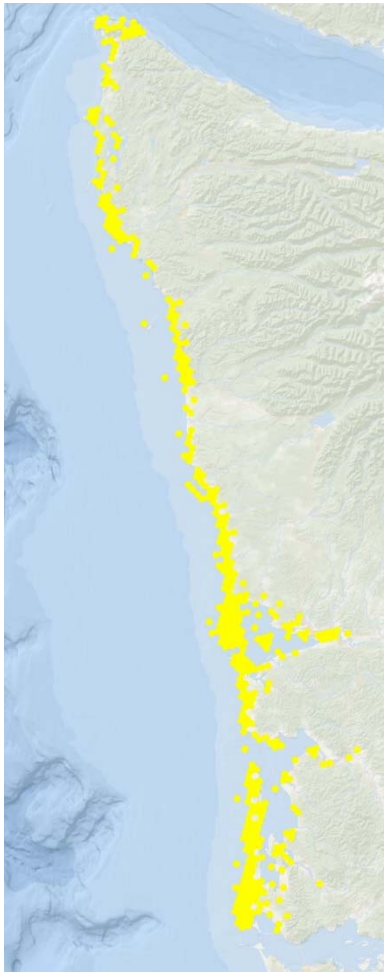


Recreation: Draft Use Maps

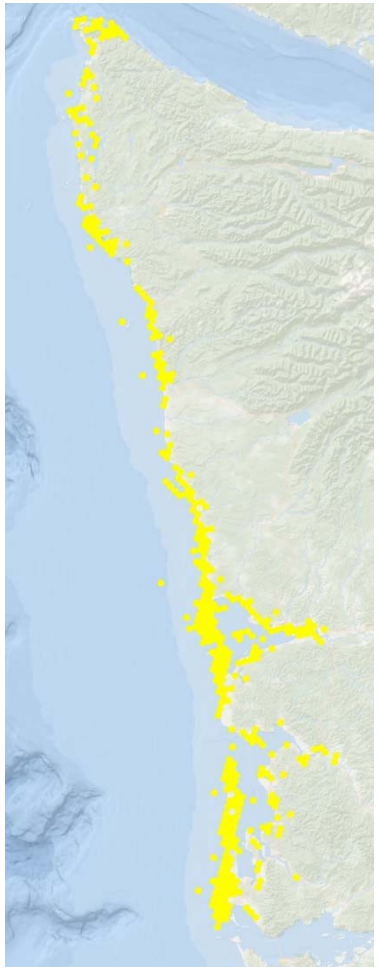
Sum of use: Surface-water



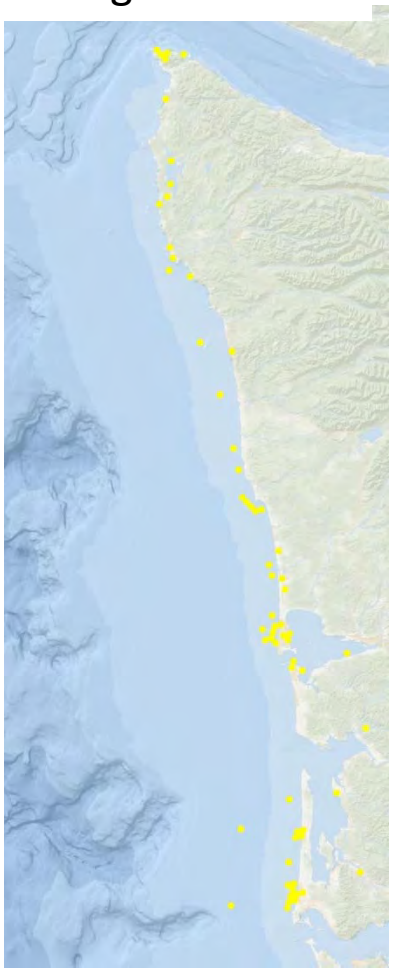
Sum of use: Shore-based



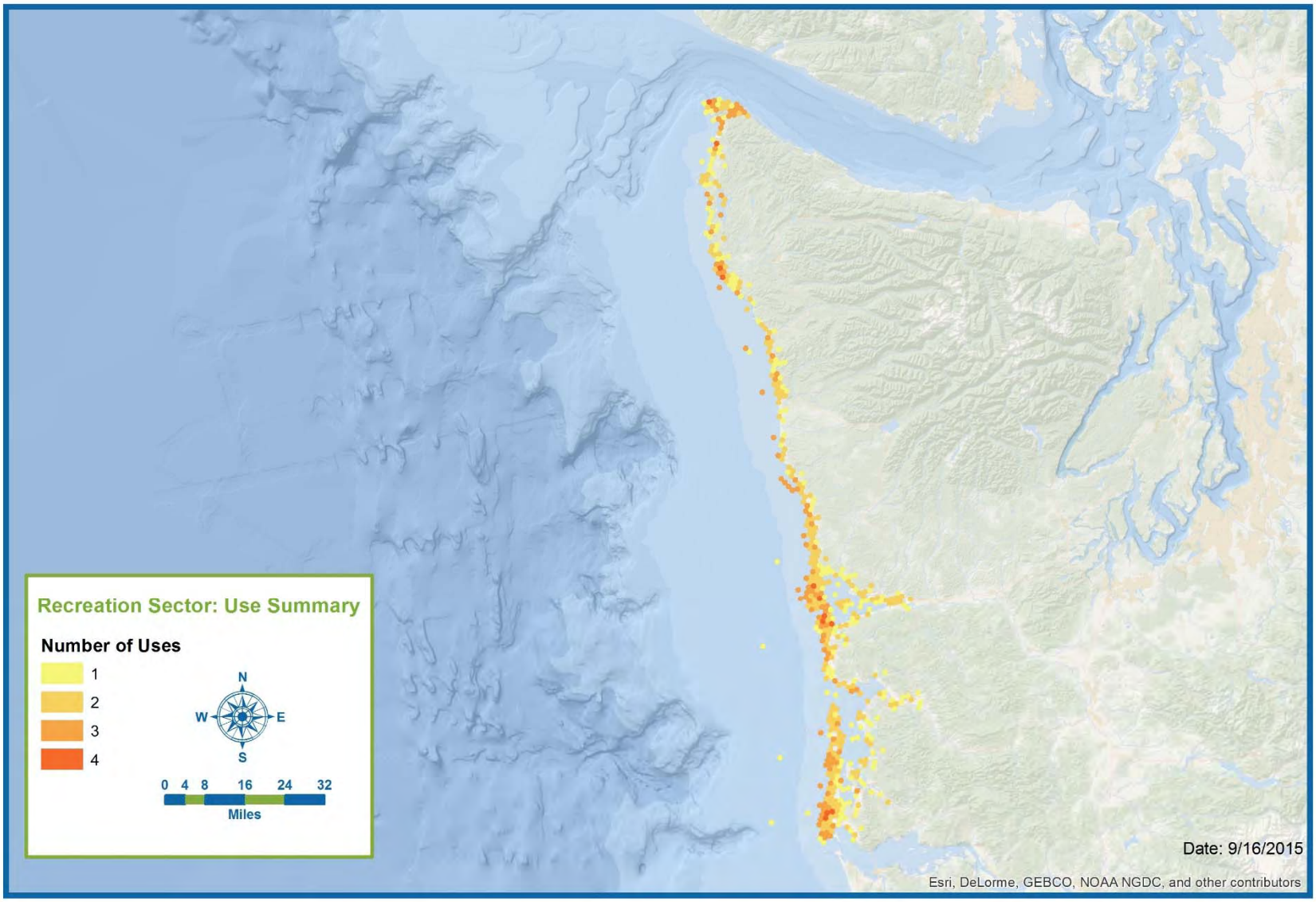
Sum of use: Wildlife Viewing



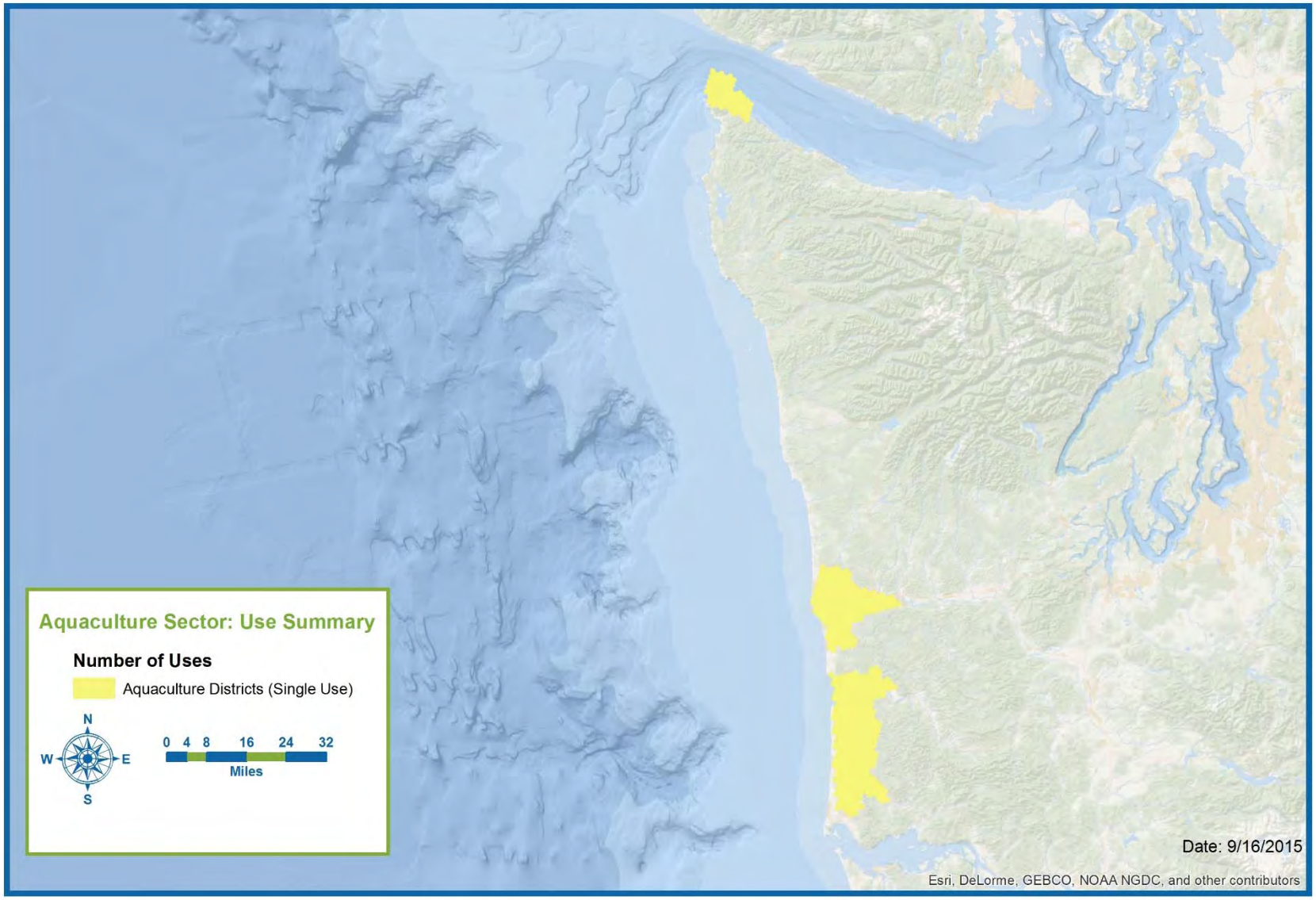
Sum of use: Diving



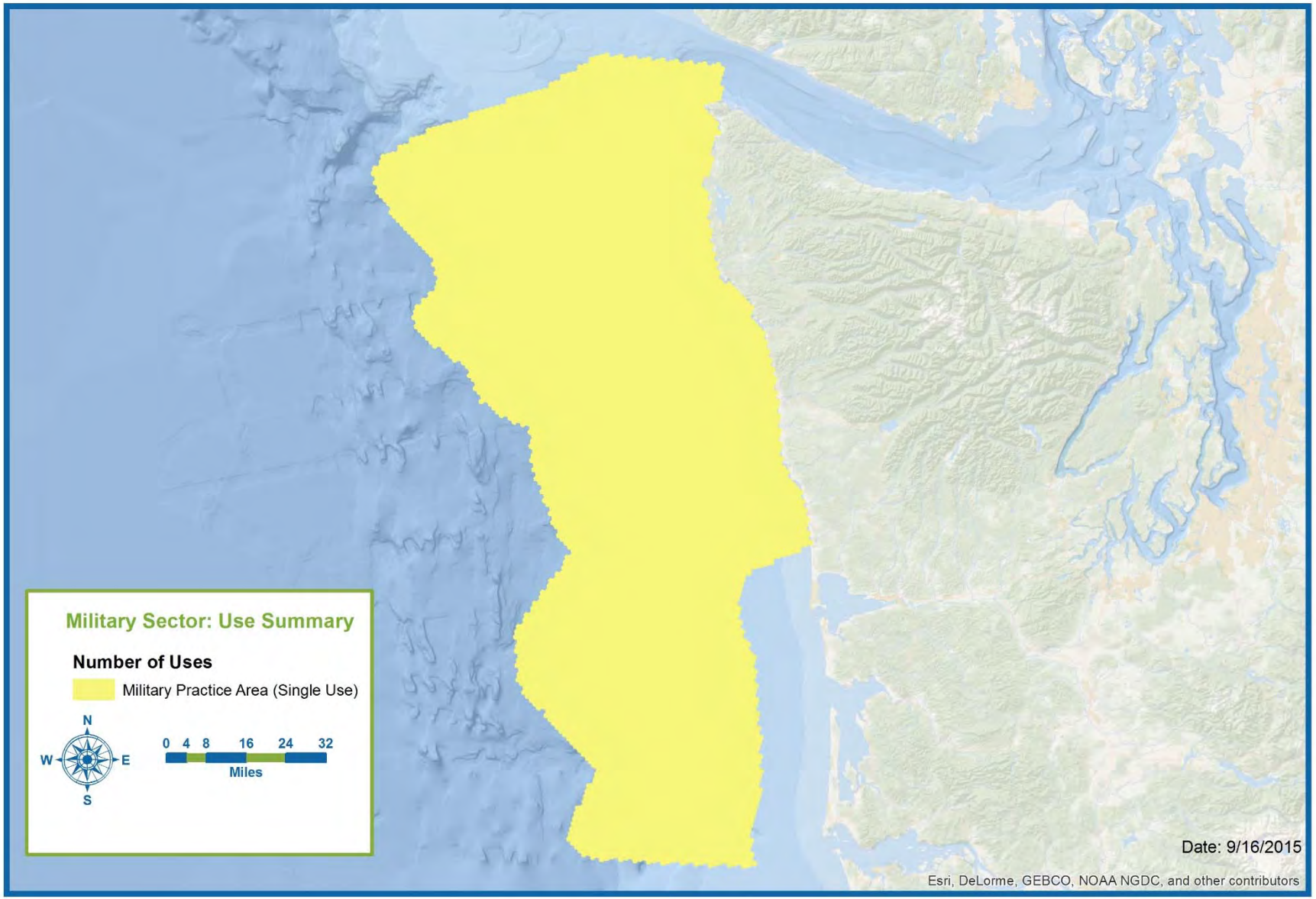
Recreation: draft Sum of All



Aquaculture: draft



Military: draft



Next Steps & Timeline

Summer	Sector input on intensity data & conflict
	GIS analysis
June 24	**WCMAC - describe general approach & discuss conflicts**
Sept. 23	**WCMAC review draft conflict maps, policy options**
Oct	Revise draft maps
Oct	WDFW fisheries maps workshop – WCMAC & others
Oct.	**Tribal policy & technical review**
Fall	GIS work & alternatives analysis
Dec.	**Tribal policy & technical review**
Dec. 9	**WCMAC review draft conflict maps, input on recommended actions & alternatives**
Winter	*Additional time for additional analysis and WCMAC recommendations/alternatives, if needed.*

Seabird and Marine Mammal Maps: Tools for Washington's Marine Spatial Plan

Charles Menza and Jeffery Leirness

Tim White, Arliss Winship, Brian Kinlan, Laura Kracker, Jeannette E. Zamon, Lisa Ballance, Elizabeth Becker, Karin Forney, Josh Adams, David Pereksta, Scott Pearson, John Pierce, Liam Antrim, Nancy Wright, Ed Bowlby, Rob Suryan, Jonathan Scordino, Jeff Laake, Brad Hanson, Jay Barlow, John Calambokidis, Annie Douglas, Steven Jeffries, Scott Benson, Jessica Redfern, Wayne Perryman.

Washington Coastal Marine Advisory Council
September 23, 2015

Outline of today's presentation

1. Background
2. Project overview
3. Challenges and solutions
4. Example products and uses
5. Timeline/next steps

National Centers for Coastal Ocean Science

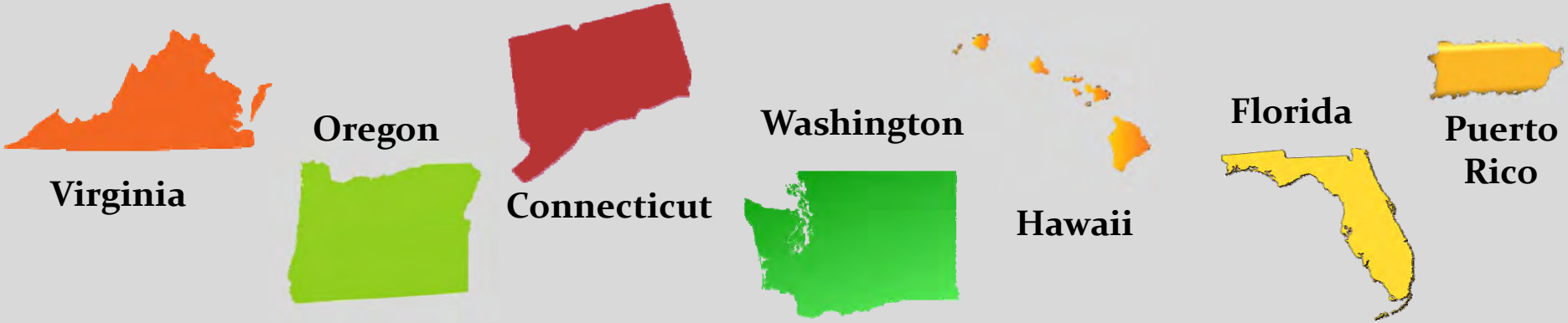
Ocean Planning

Seafloor mapping

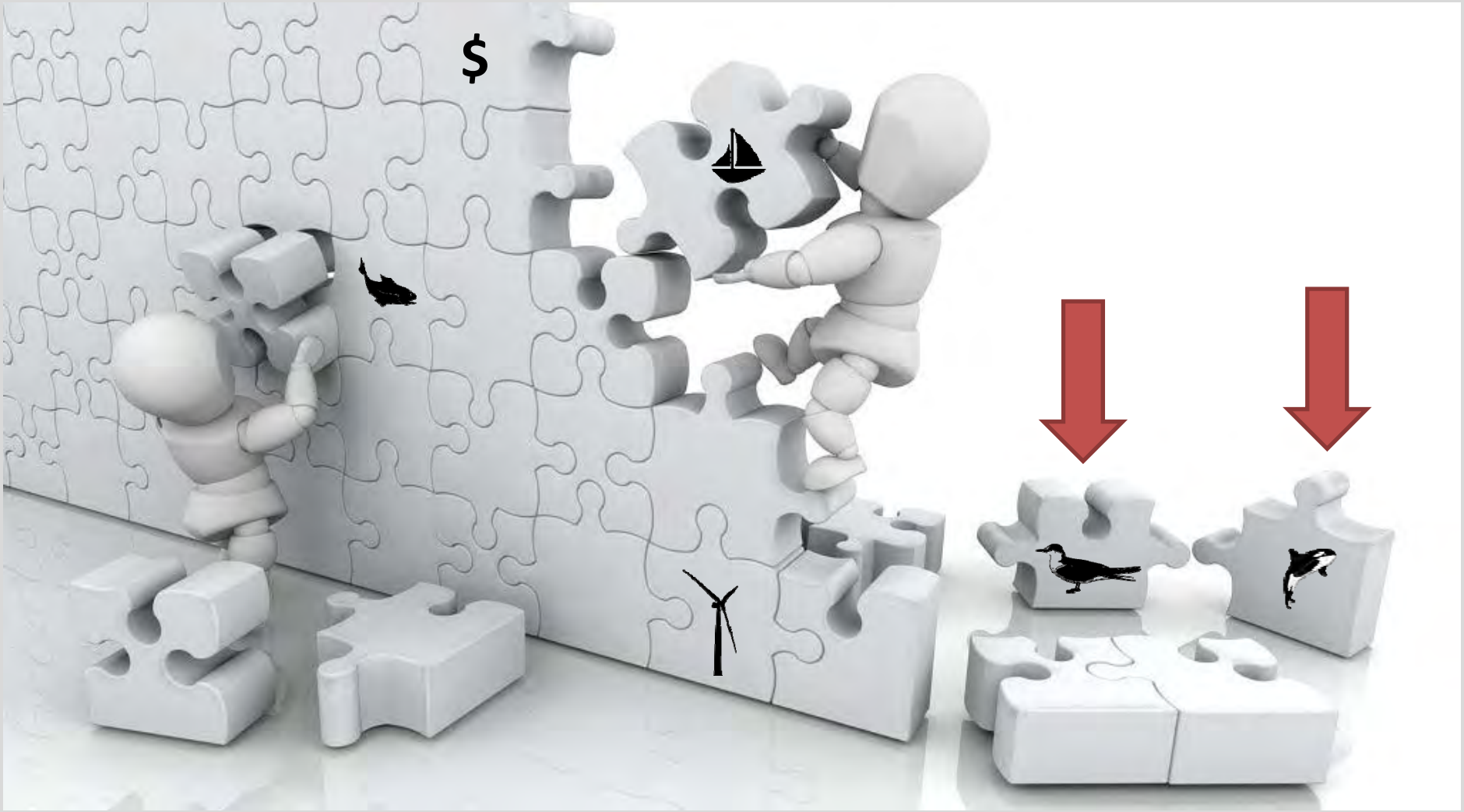
Predictive modeling of plants and animals

Mapping economic and cultural values

Integrated assessments



Support the larger state-led MSP project



Partners

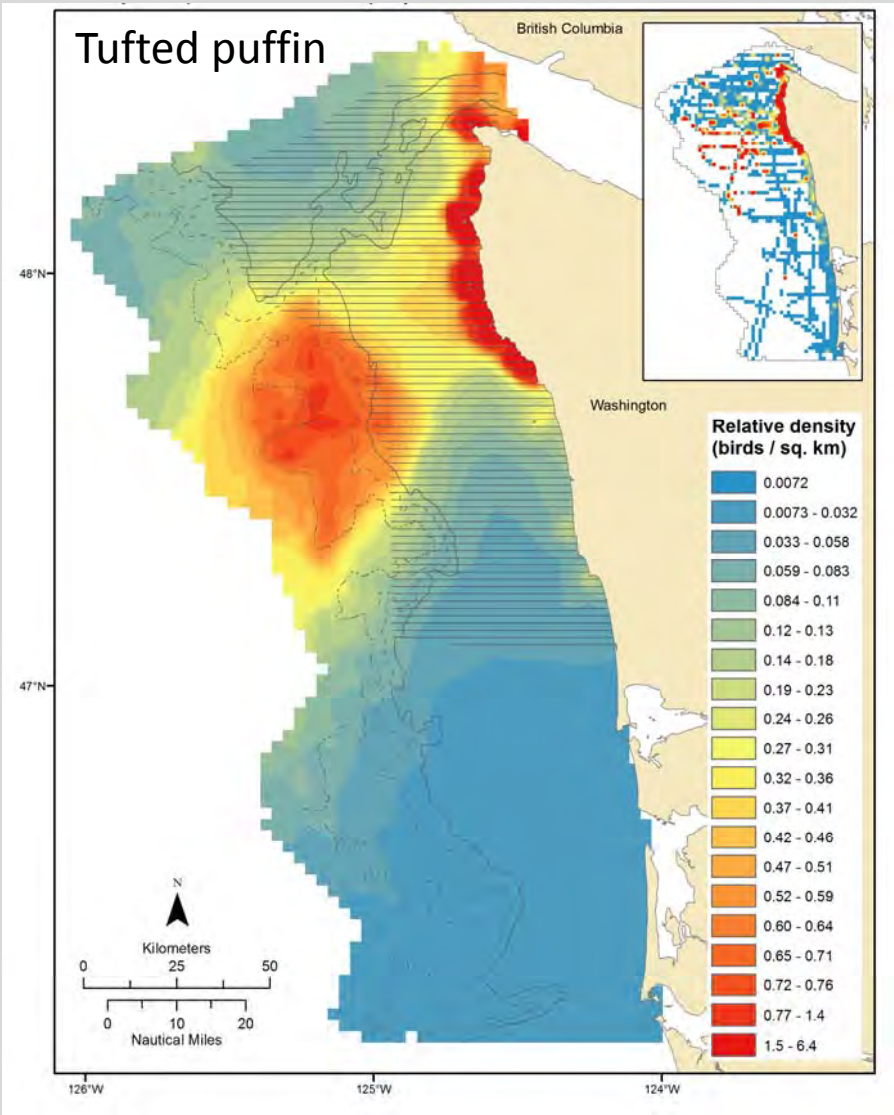
- Department of Ecology, State of Washington
- OSU Oregon State University
- BOEM Bureau of Ocean Energy Management
- Cascadia Research Collective — non-profit research and education since 1979
- NOAA Fisheries
- NCCOS
- Washington Department of Fish and Wildlife
- USGS — science for a changing world
- Washington State Department of Natural Resources
- National Oceanic & Atmospheric Administration National Marine Sanctuaries

Objectives

SPECIES LIST

gray whale
humpback whale
Dall's porpoise
harbor porpoise
Steller sea lion
harbor seal

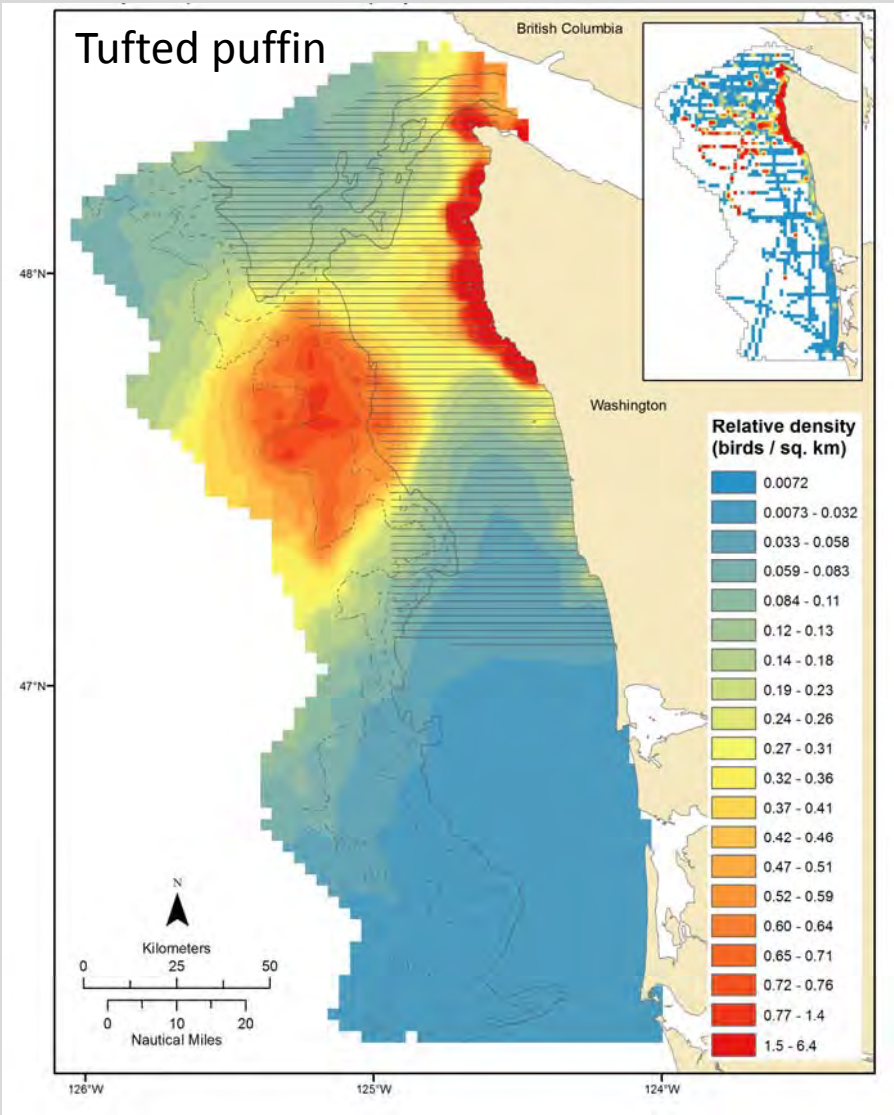
Northern fulmar
Marbled murrelet
Tufted puffin
Common murre
Sooty shearwater
Northern fulmar
Black-footed albatross



Objectives

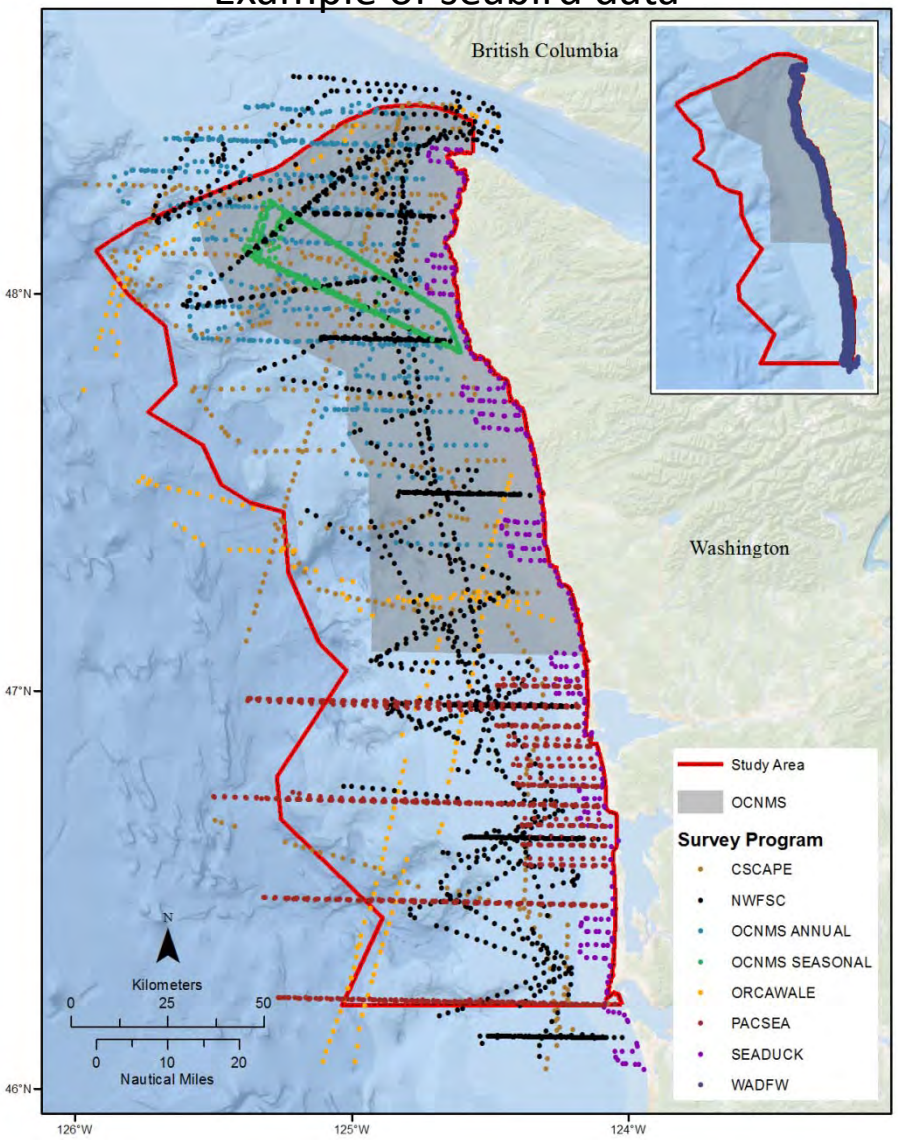
How do we…

- Plan **long-term fixed location projects** in context of **dynamic ecosystem**?
- Derive **high-resolution, gap-free maps** from scattered, incomplete, and spatially non-random survey data?
- Assess **uncertainty** of predictions?
- Turn maps, models & uncertainty assessment into **decision-making tools**?



Survey data sets

Example of seabird data



Seabirds

- **NWFSC** - Northern California Current Seabird Surveys
- **Sea Duck Joint Venture & WDFW** – Winter seaduck survey

Marine mammals

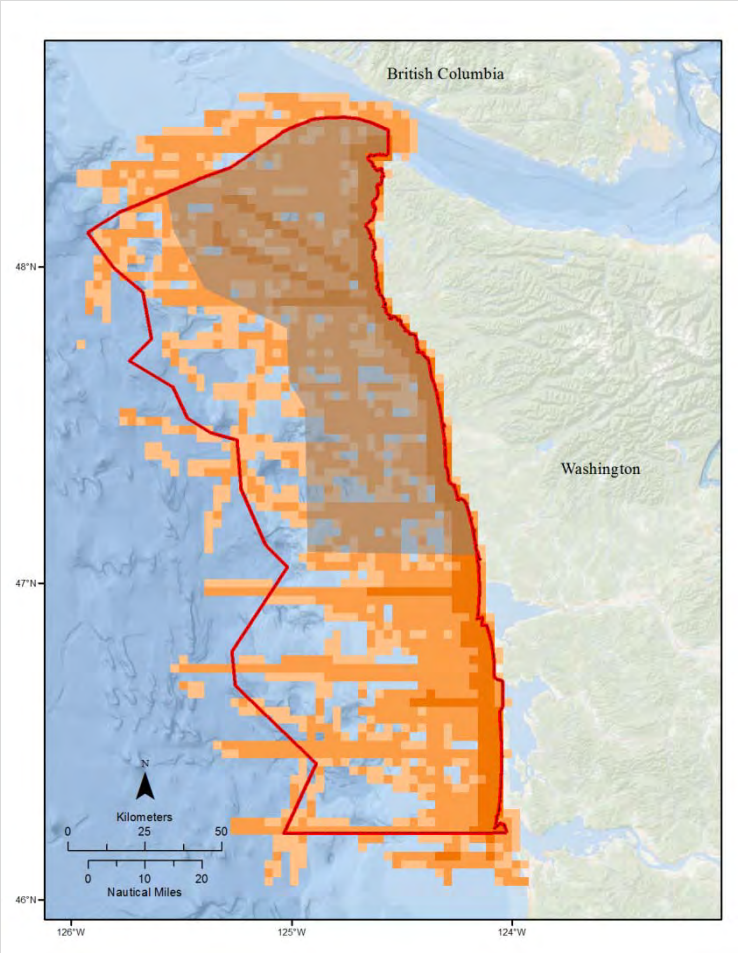
- **Cascadia & WDFW**– large whale surveys
- **WA & OR state** - cetacean surveys
- **SWFSC** – leatherback turtle surveys
- **NWFSC** - Southern Resident Killer Whale surveys

Both

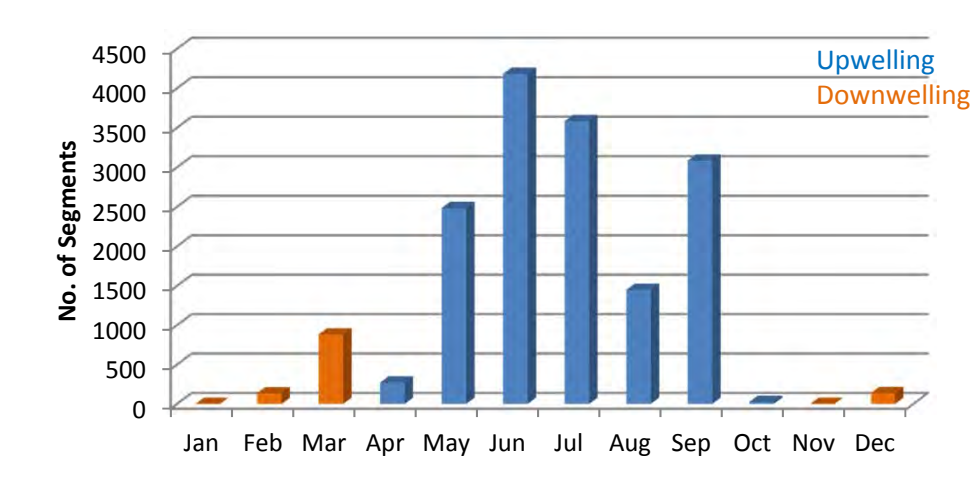
- **OCNMS & Cascadia** - Sanctuary surveys
- **SWFSC** – ORCAWALE and CSCAPE
- **BOEM & USGS** - PaCSEA
- **USFS, USFWS, WDFW** - Northwest Forest Plan Marbled Murrelet Effectiveness Monitoring Program

Challenges of using survey data

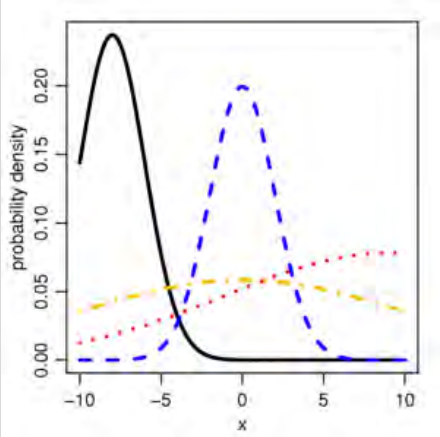
Spatial gaps



Temporal gaps

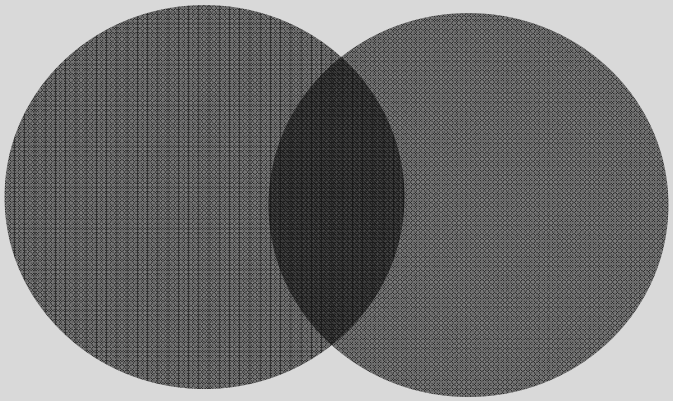


Mobile organisms



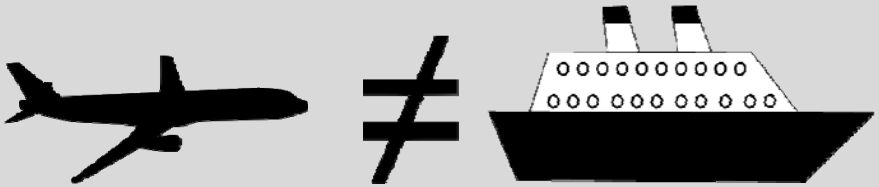
Challenges of combining survey data

Uneven survey effort



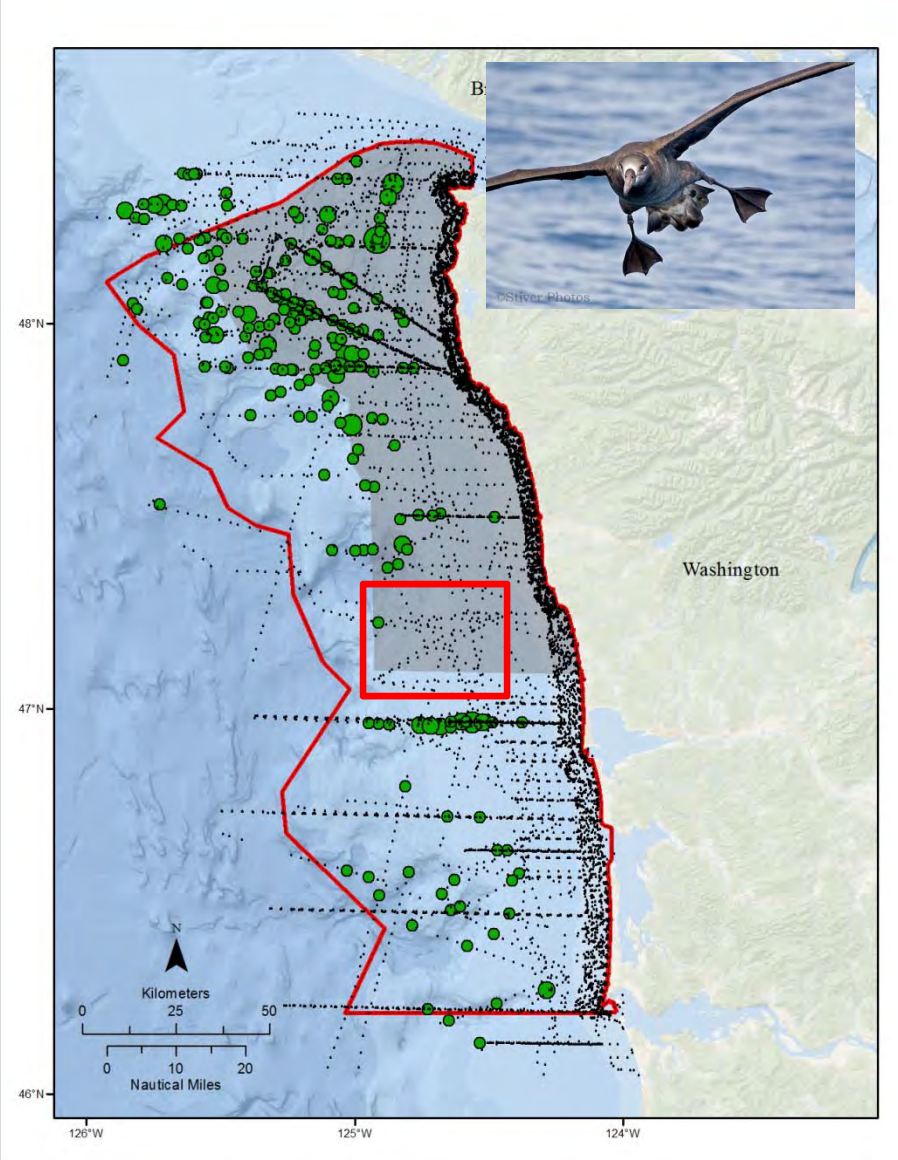
Effort is integrated into model as an offset

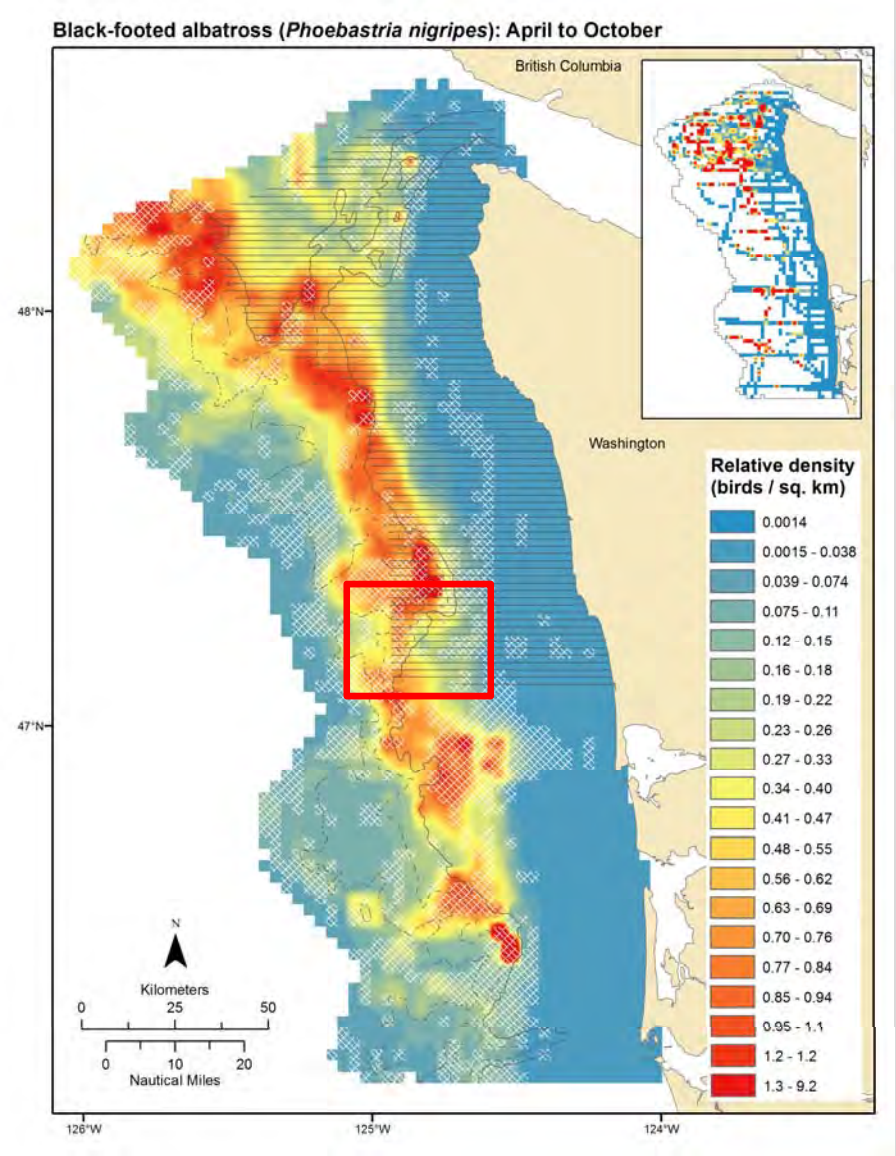
Methodological differences



Survey platform type must be treated as a non-random explanatory variable

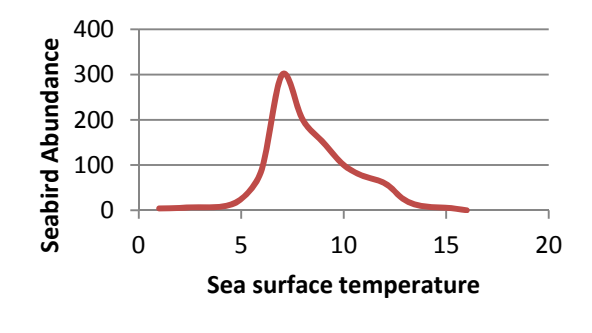
Species distribution models solve many of our challenges



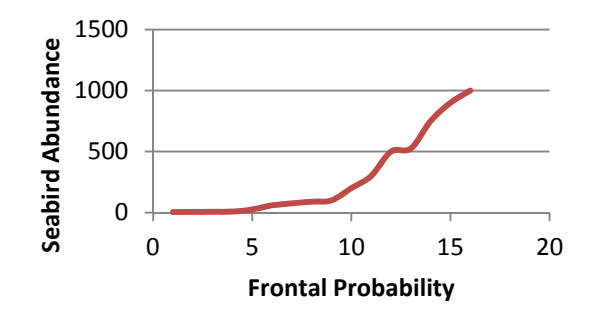


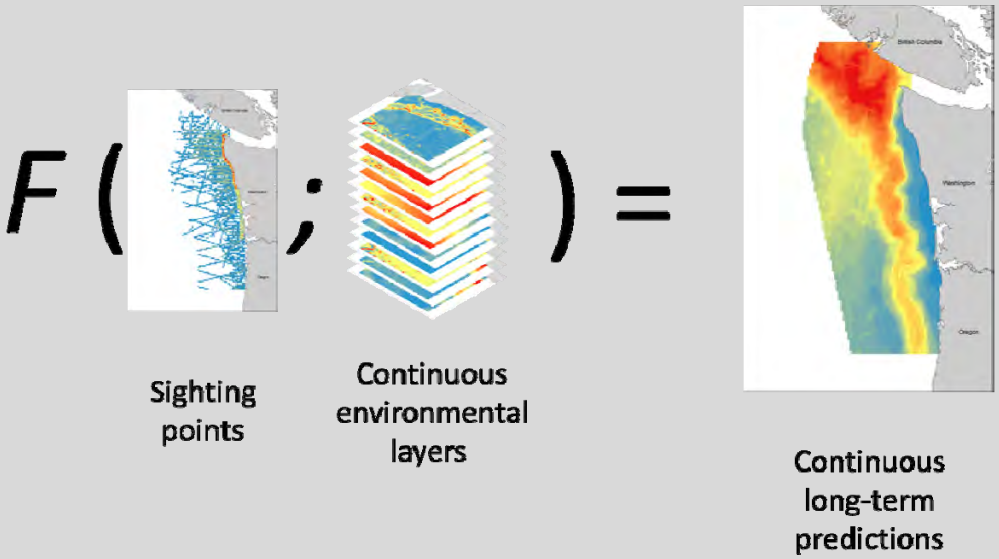
Basic modeling approach

Seabirds and temperature



Seabirds and ocean fronts

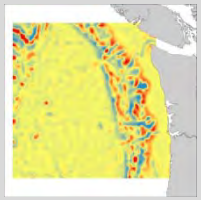




Environmental data

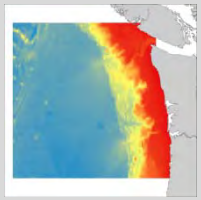
Stationary:

Bathymetric position index

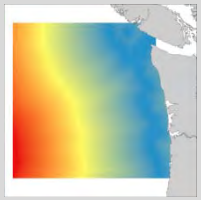


3 & 20 km resolutions

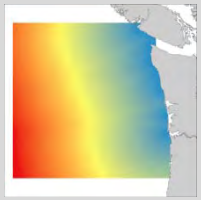
Bathymetry



Distance to 200 m isobath

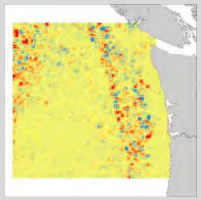


Distance to colony site

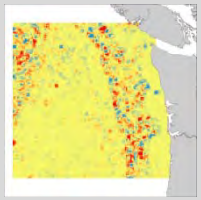


+ FCPI

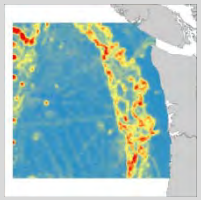
Planform curvature



Profile curvature

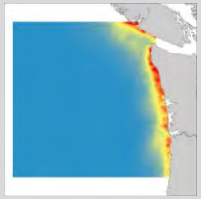


Slope

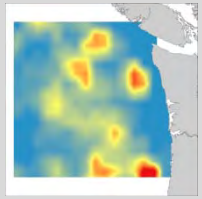


Dynamic:

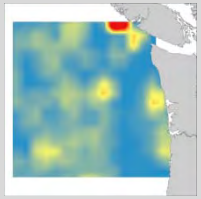
Chlorophyll *a*



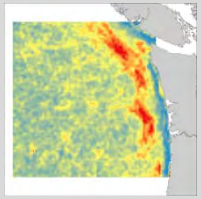
Eddy prob. (anticyclonic)



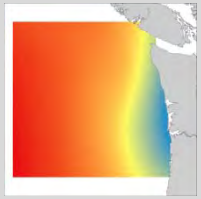
Eddy prob. (cyclonic)



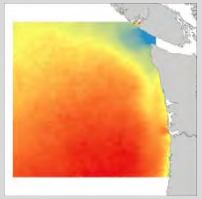
Frontal prob.



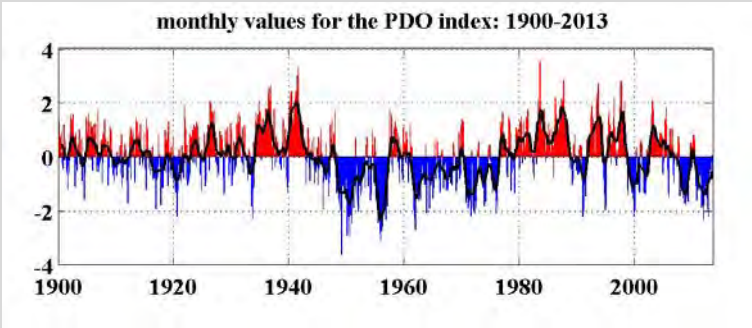
Salinity



Sea surface temp.



Climate Variability:



MEI, NPGO, PDO, and upwelling index
+ 12 month lags

Modeling details

boosted generalized additive models

- Machine learning technique
- Iterative: fitting & variable selection at each step
- Flexible relationships and interactions (semi-parametric)
    - linear, random effects, splines, regression trees, …
- Zero-inflated likelihoods (Poisson & negative binomial)
- GAMLSS: generalized additive models for location, scale, and shape
    - e.g., allows modeling of zero, count, & shape parameters of ZINB separately

+ spatial (x, y) coordinates
+ Julian day
+ year
+ Beaufort sea state
+ transect ID (random effect)
+ survey ID (random effect)
+ platform (fixed effect; 3 levels)
+ segment length offset (km)

Modeling details

cross validation
(to prevent over-fitting)

boosted generalized additive models

- **Machine learning technique**
- **Iterative: fitting & variable selection at each step**
- **Flexible relationships and interactions (semi-parametric)**
    - **linear, random effects, splines, regression trees, …**
- **Zero-inflated likelihoods (Poisson & negative binomial)**
- **GAMLSS: generalized additive models for location, scale, and shape**
    - **e.g., allows modeling of zero, count, & shape parameters of ZINB separately**

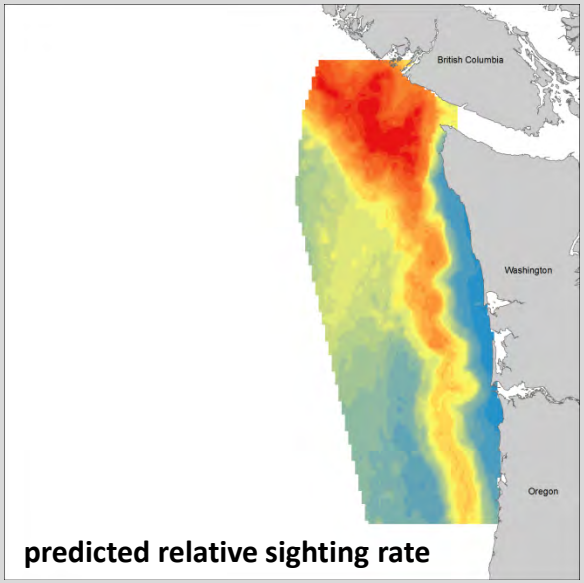
+ spatial (x, y) coordinates
+ Julian day
+ year
+ Beaufort sea state
+ transect ID (random effect)
+ survey ID (random effect)
+ platform (fixed effect; 3 levels)
+ segment length offset (km)

Modeling details

cross validation
(to prevent over-fitting)

boosted generalized additive models

bootstrapped



predicted relative sighting rate

- Machine learning technique
- Iterative: fitting & variable selection at each step
- Flexible relationships and interactions (semi-parametric)
    - linear, random effects, splines, regression trees, …
- Zero-inflated likelihoods (Poisson & negative binomial)
- GAMLSS: generalized additive models for location, scale, and shape
    - e.g., allows modeling of zero, count, & shape parameters of ZINB separately

+ spatial (x, y) coordinates
+ Julian day
+ year
+ Beaufort sea state
+ transect ID (random effect)
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+ platform (fixed effect; 3 levels)
+ segment length offset (km)

gray whale (first draft)

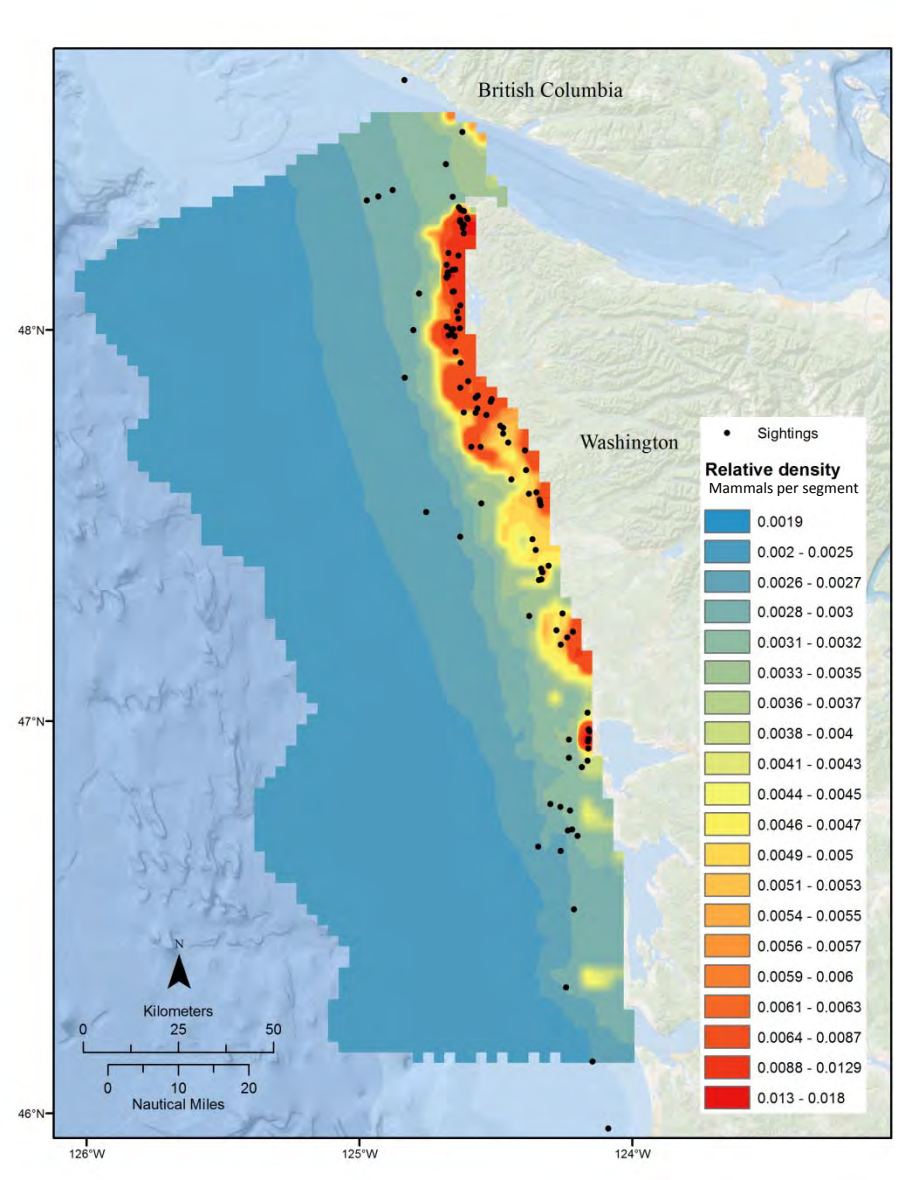
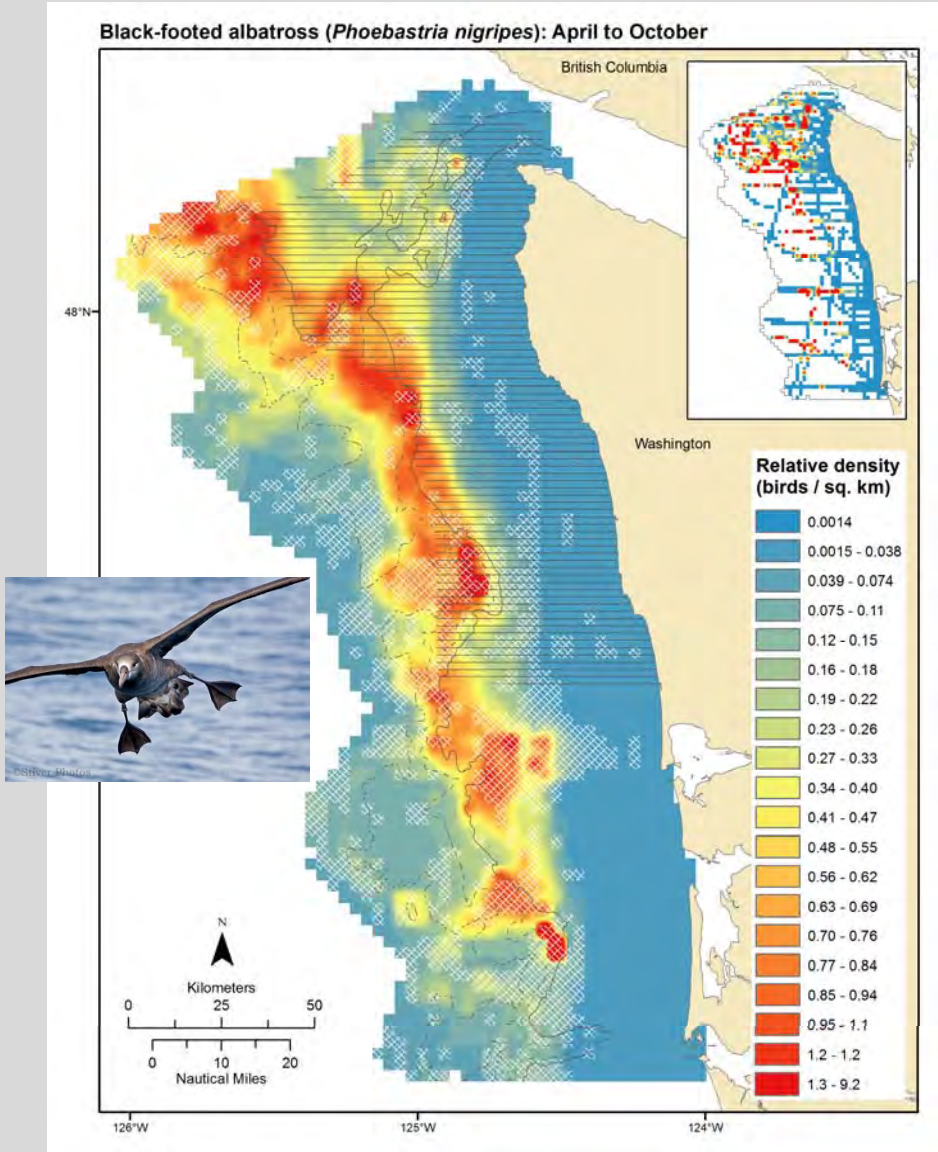
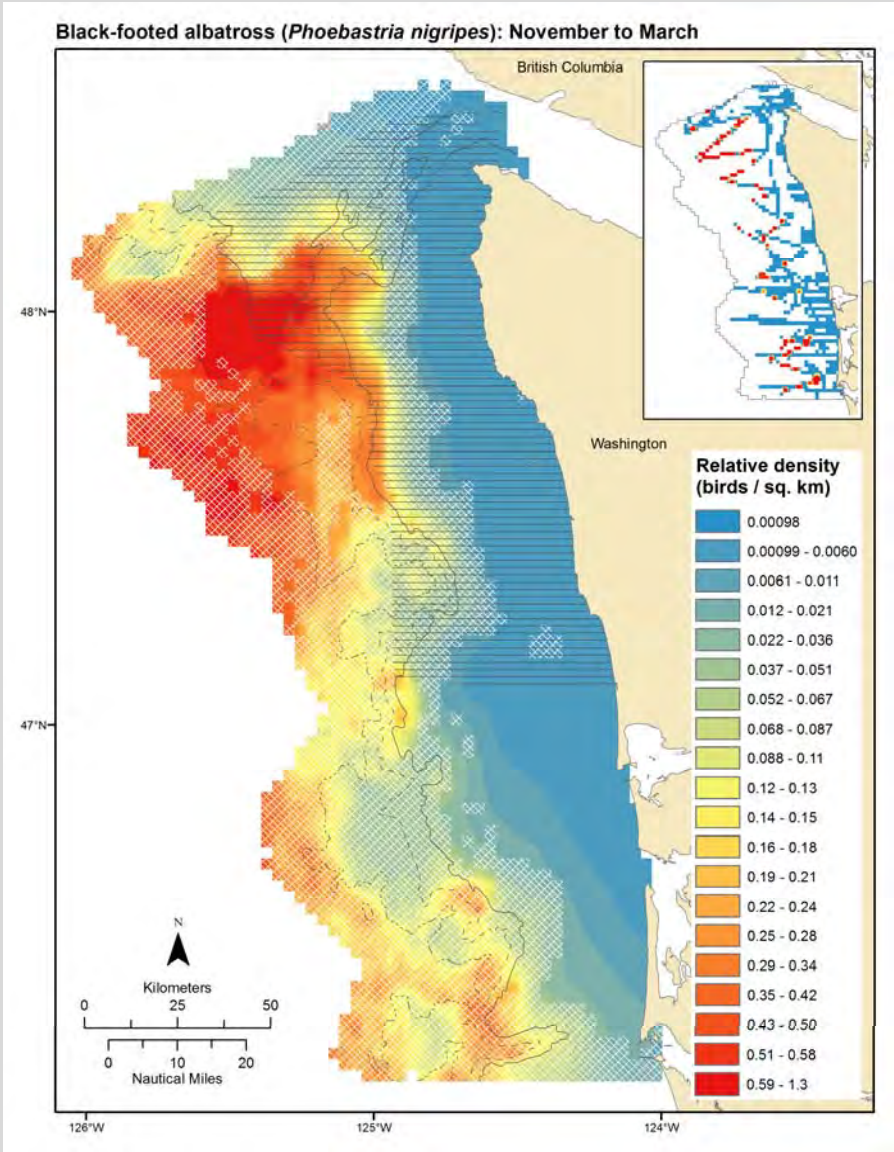


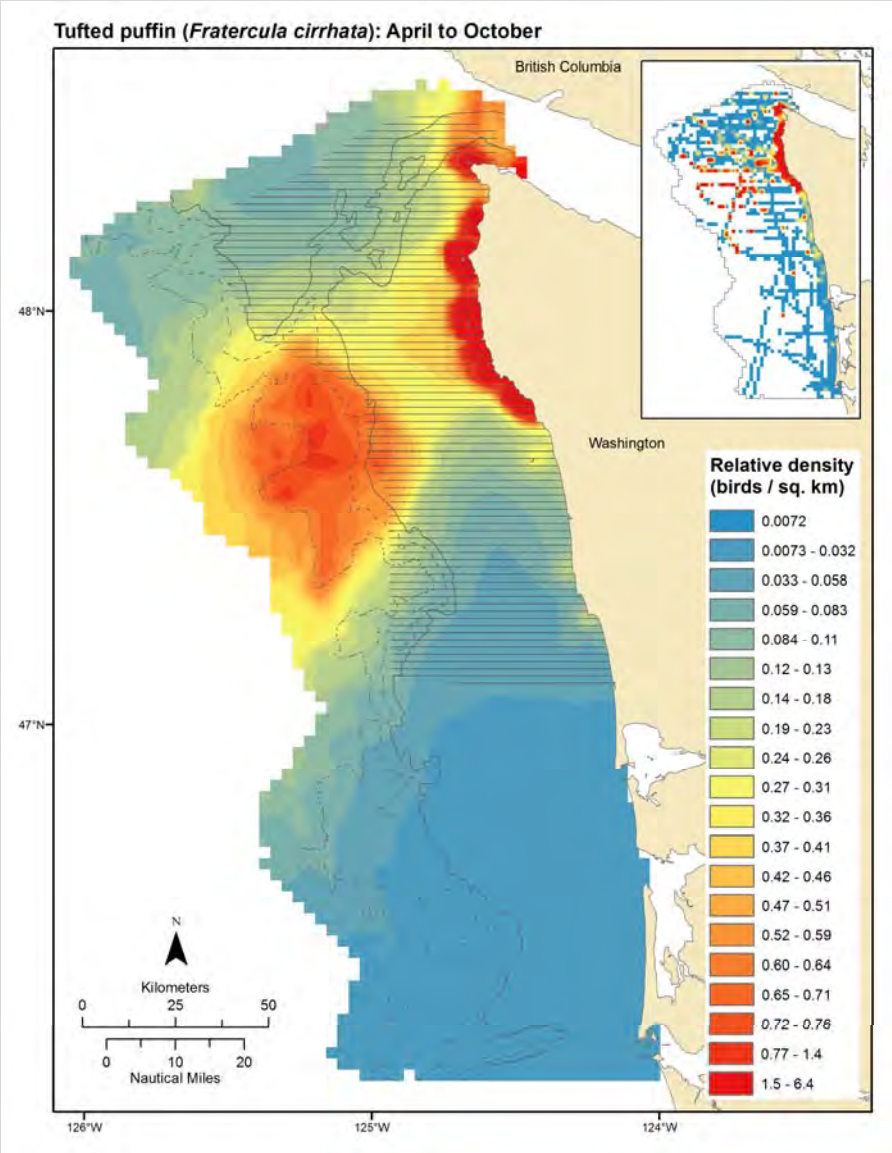
Photo: D. Weller

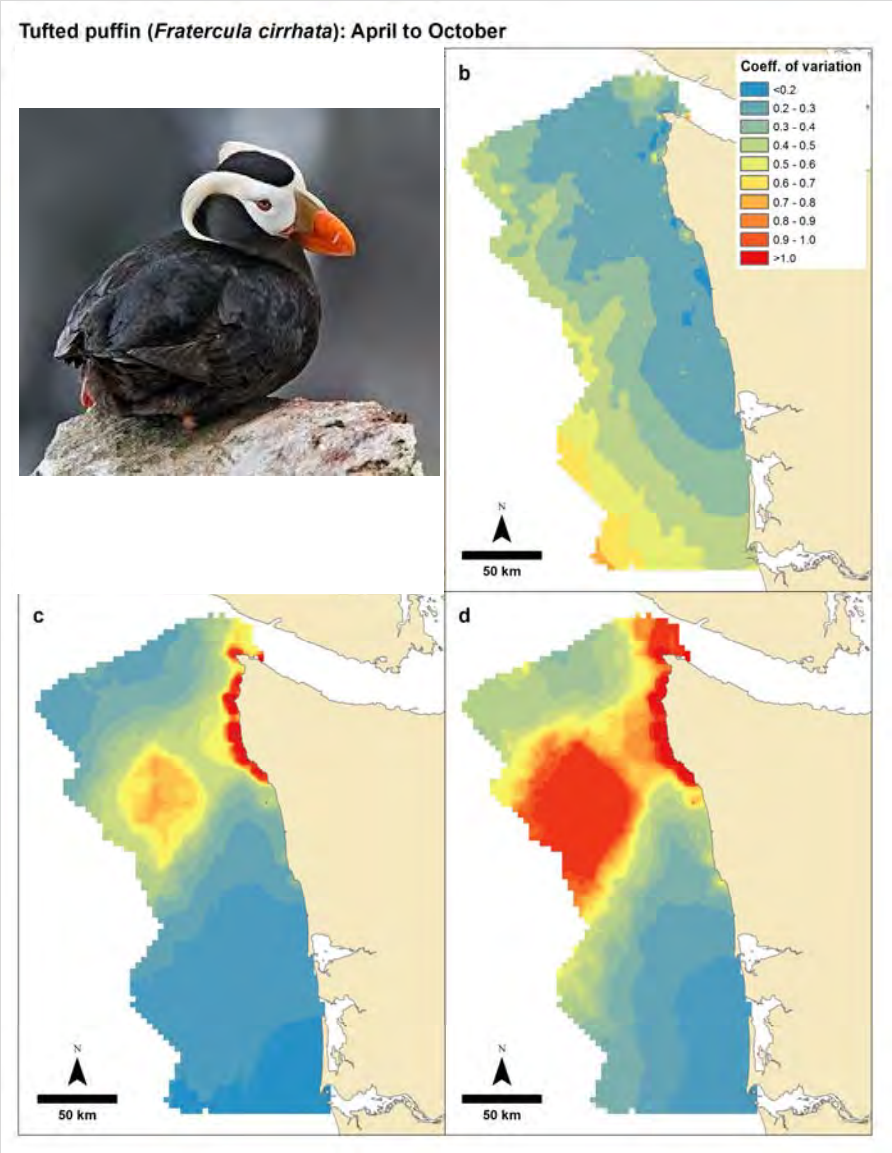
Black-footed albatross





Tufted puffin





Example of model performance outputs

Model performance metrics

Species code	Season	No. segments	No. individuals	AUC Occupancy	AUC Non-zero	Rank R (non-zero)	Median absolute error Fit	Median absolute error Cross-val
tupu	summer	1,738	11,777	0.92	0.75	0.60	21.6%	23.5%
mamu	summer	1,625	5,604	0.92	0.76	0.62	37.7%	32.4%
comu	summer	6,533	293,713	0.91	0.84	0.70	20.1%	27.1%
comu	winter	405	6,516	0.91	0.82	0.69	19.6%	23.9%
bfal	summer	421	3,008	0.96	0.70	0.41	12.1%	11.9%
bfal	winter	87	162	0.97	0.78	0.46	37.0%	37.4%
nofu	summer	463	2,916	0.97	0.75	0.57	15.9%	15.8%
pfsh	summer	611	3,977	0.96	0.65	0.39	22.1%	19.5%
sosh	summer	2,586	249,380	0.91	0.72	0.49	8.3%	8.3%

Marginal plots to assess biases

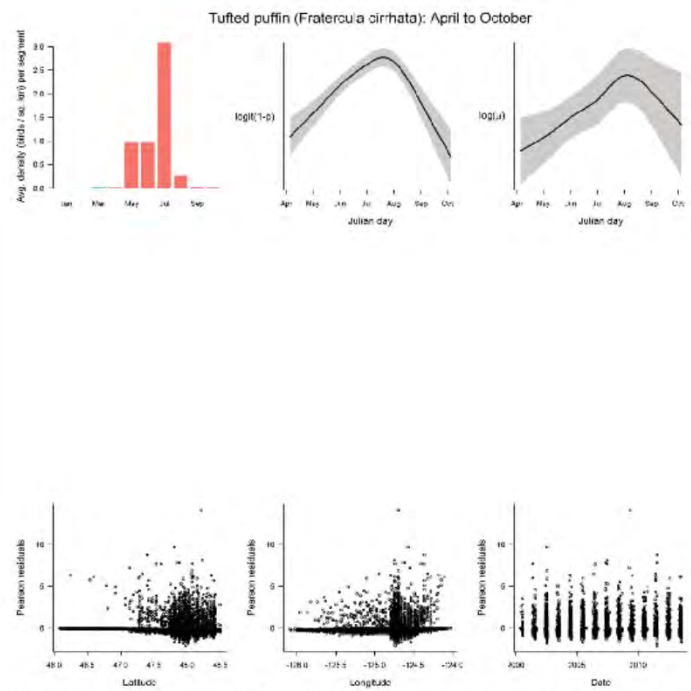


Figure D2: Marginal and residual plots for Tufted Puffin (*Fratercula cirrhata*) during the months of April to October.

Collaboration and expert review

Project phases with reviews

Data inventory → Species and model → Phase I maps → Phase II maps → Report

NOAA FISHERIES

WASHINGTON STATE DEPARTMENT OF Natural Resources

DEPARTMENT OF ECOLOGY State of Washington

Cascadia Research Collective
non-profit research and education since 1979

BOEM
Bureau of Ocean Energy Management

Washington Department of FISH and WILDLIFE

National Oceanic & Atmospheric Administration
NATIONAL MARINE SANCTUARIES

USGS
science for a changing world

Four take home messages

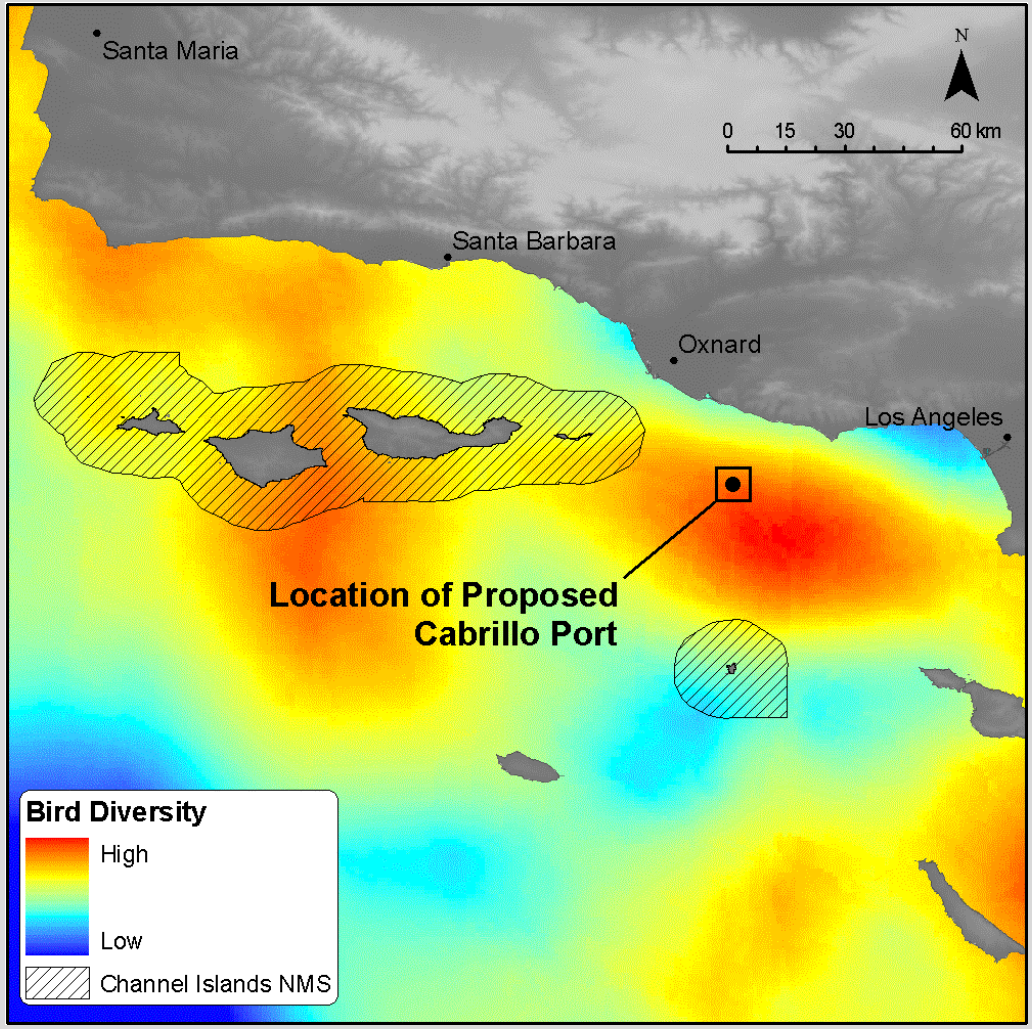
1. The most comprehensive synthesis of seabird and marine mammal at-sea survey data in AOI

2. Data, methods and outputs extensively reviewed and model diagnostics show good to excellent performance

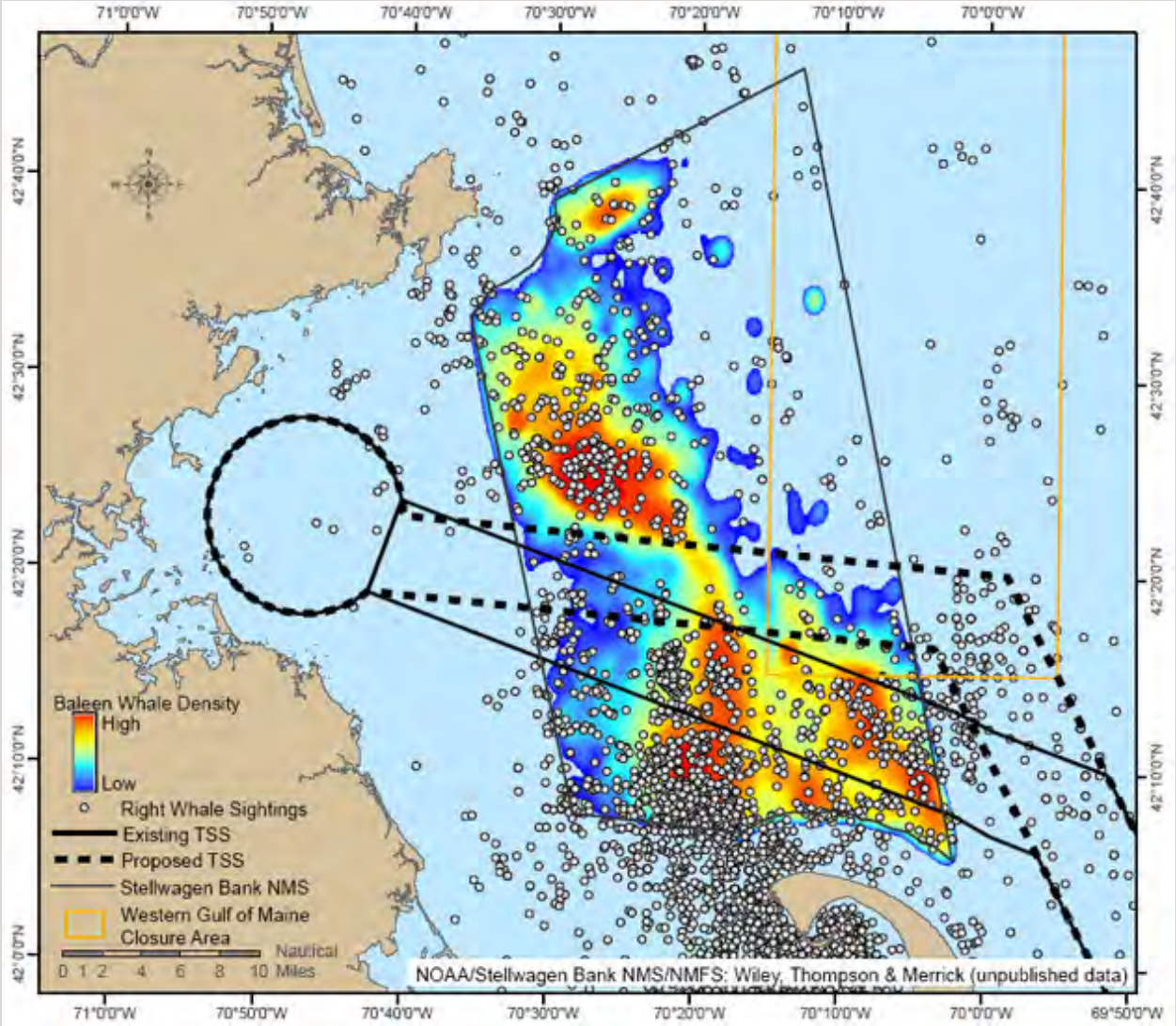
3. Useful to plan long-term fixed location projects
   - Predictions do not give estimates of absolute abundance

4. Maps are imperfect
   - Additional data needed for site-specific assessments

Cursory risk assessment



Shipping lane amendments

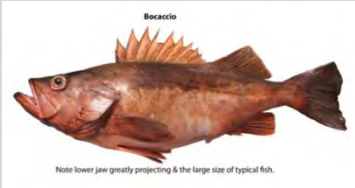


Identification of ecologically important areas

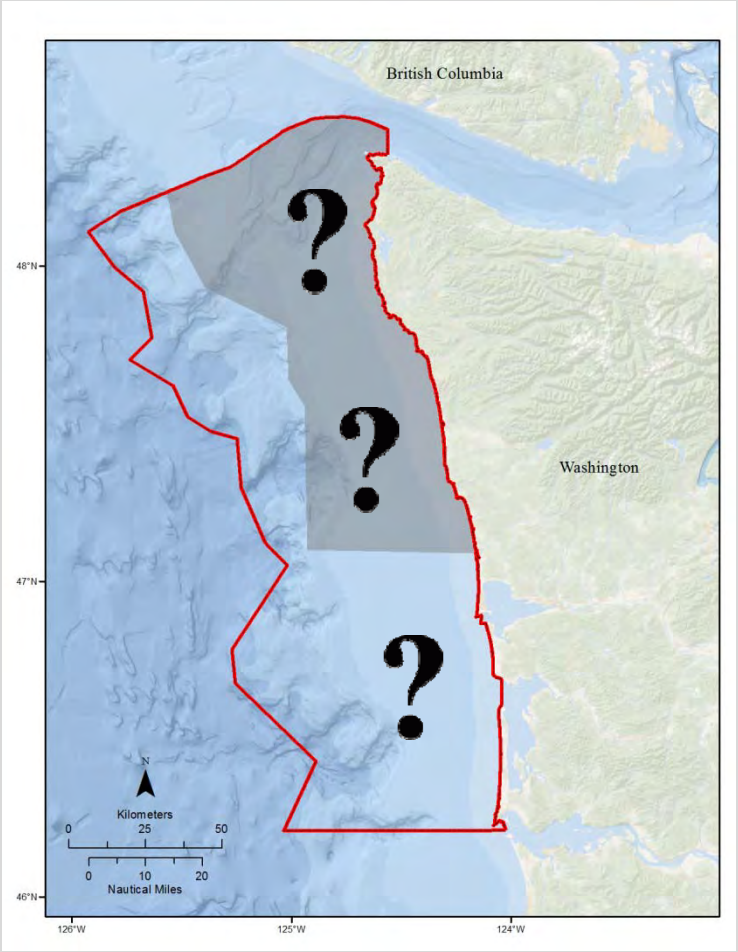
kelp

seabirds

fish



mammals



WDFW's Project Update Feb 25, 2015 WCMAC Meeting

What is next?

Seabirds

Data inventory	Species and model	Phase I maps	Phase II maps	Report and data
June 2013	Dec 2014	Mar 2015	May 2015	June 2015

Marine mammals

Data inventory	Species and model	Phase I maps	Phase II maps	Report and data
Mar 2015	Dec 2014	Aug 2015	Oct 2015	Feb 2016

Reports and data are available at:
http://www.msp.wa.gov/msp-projects/
http://coastalscience.noaa.gov/projects/detail?key=167

Questions

Ecological indicators for Washington State's outer coastal waters

Kelly S. Andrews and Chris J. Harvey

NOAA Northwest Fisheries Science Center, Seattle

Jill M. Coyle

Frank Orth & Associates, Seattle

***Funding and support from the Washington Dept. of Natural Resources, Dept. of Ecology and WA Sea Grant**

Why do we need ecological indicators?

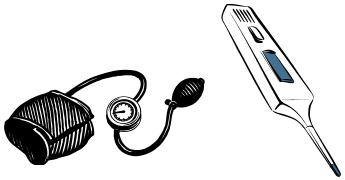
- **In very general terms, we (scientists, managers, the public) care about *attributes* of ecosystems.**
  - **But "attributes" are hard to measure!**

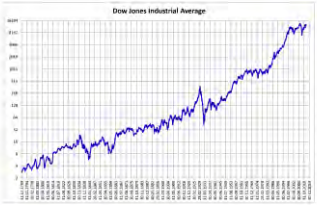
- **Mandate! Washington Marine Spatial Planning legislation (2010) requires development of indicators to:**
  - Assess "the *health* and trends of the ocean ecosystem."
  - Detect changes in components of the ecosystem that we care about.

What is an ecological indicator?

- **Empirically tractable metrics that reflect the status or trend in ecosystem attributes**
  - Status: where are we now?
  - Trend: where are we going?

- **Examples of indicators in other fields:**
  - Human Health: Blood pressure, Body temperature
  - Economics: Unemployment rate, Housing starts
  - World Health: Infant mortality rate, Immunization (%)
  - Public Safety: Homicide rate, Traffic accidents per capita
  - Education: Adult literacy rate, Expenditures as %GDP

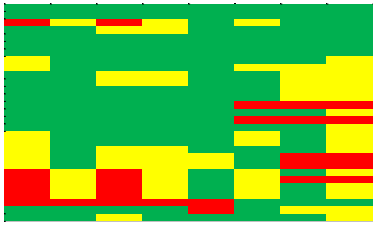




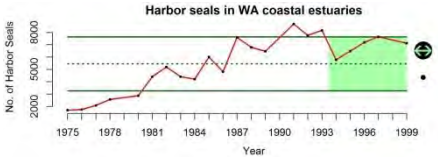
Assessing the “health” of WA coastal ecosystems

1. Develop conceptual models of the key physical, ecological and human activities in habitats of the outer Washington coast.

2. Evaluate and select a portfolio of indicators for the key components of the conceptual models.



3. Quantify the status and trends of these indicators.



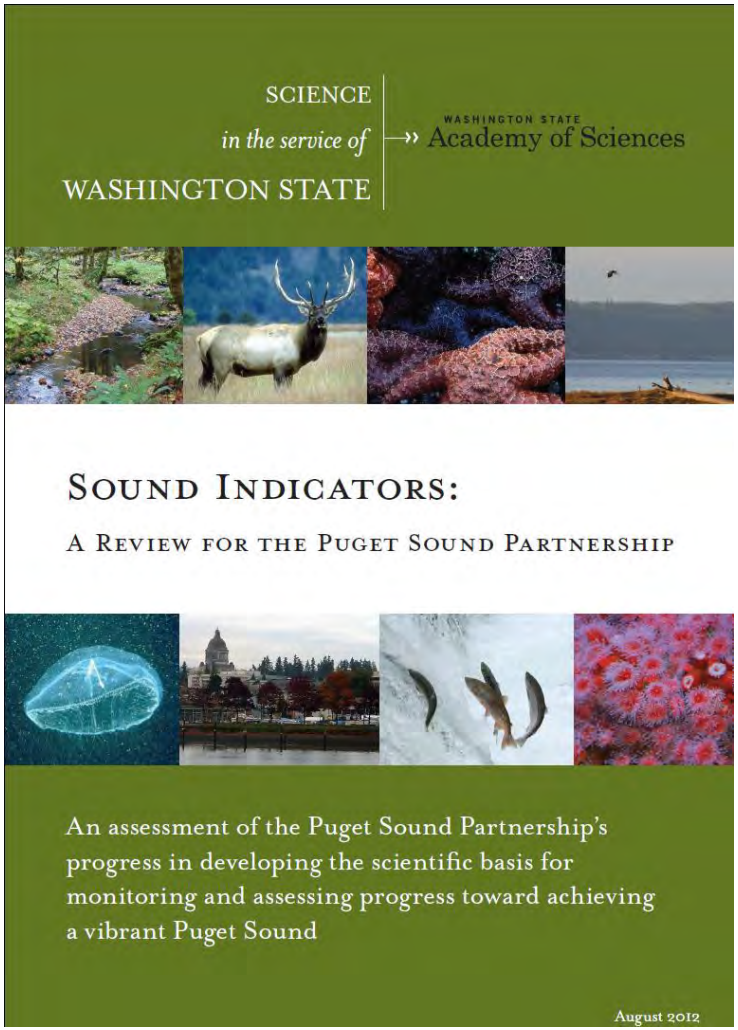
Washington Academy of Sciences report on development of ecosystem indicators by the Puget Sound Partnership

(Orians et al. 2012)

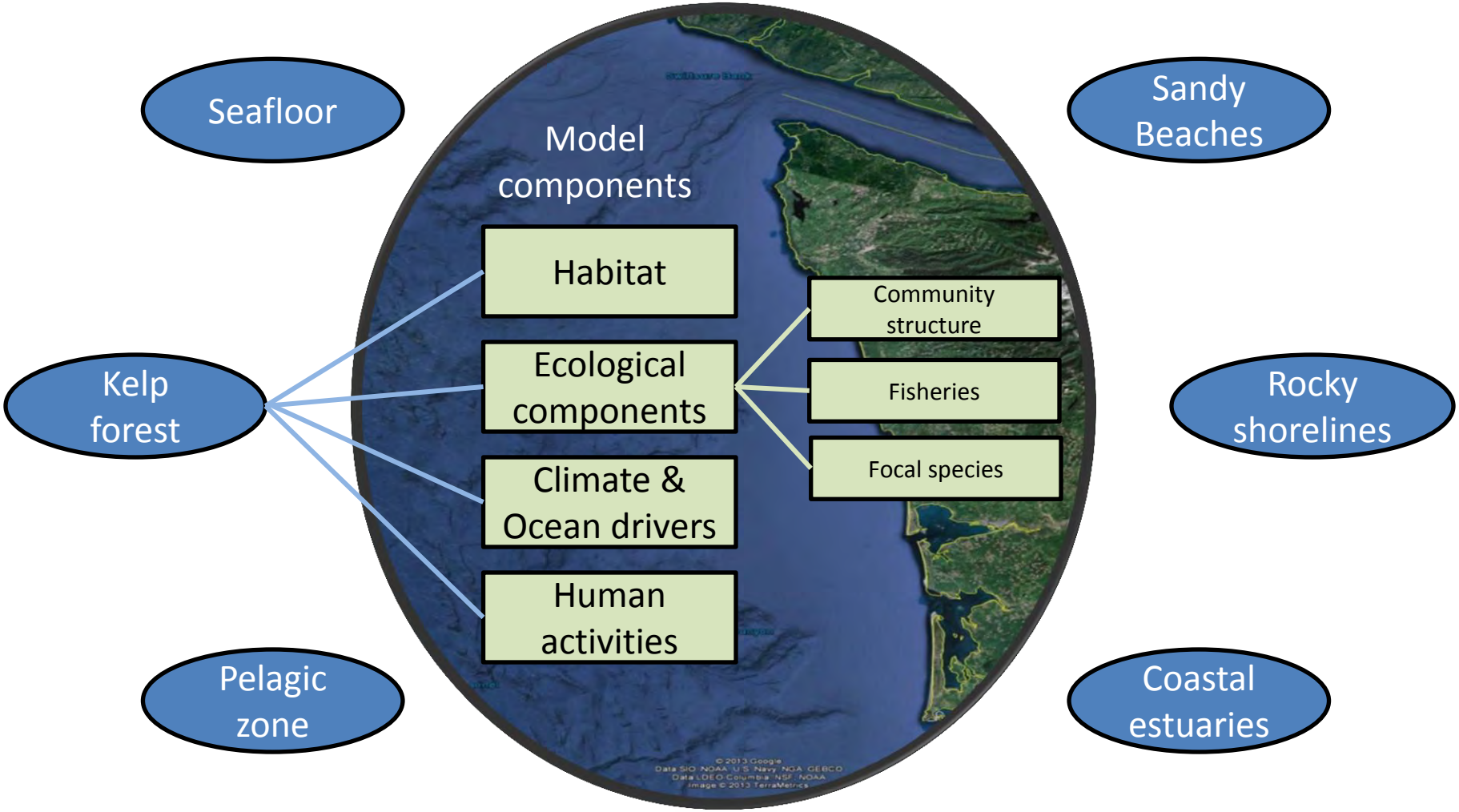
- Reviewed the process for selecting indicators by the Partnership.

- Part of that process included the same indicator screening protocol we are using for this work.

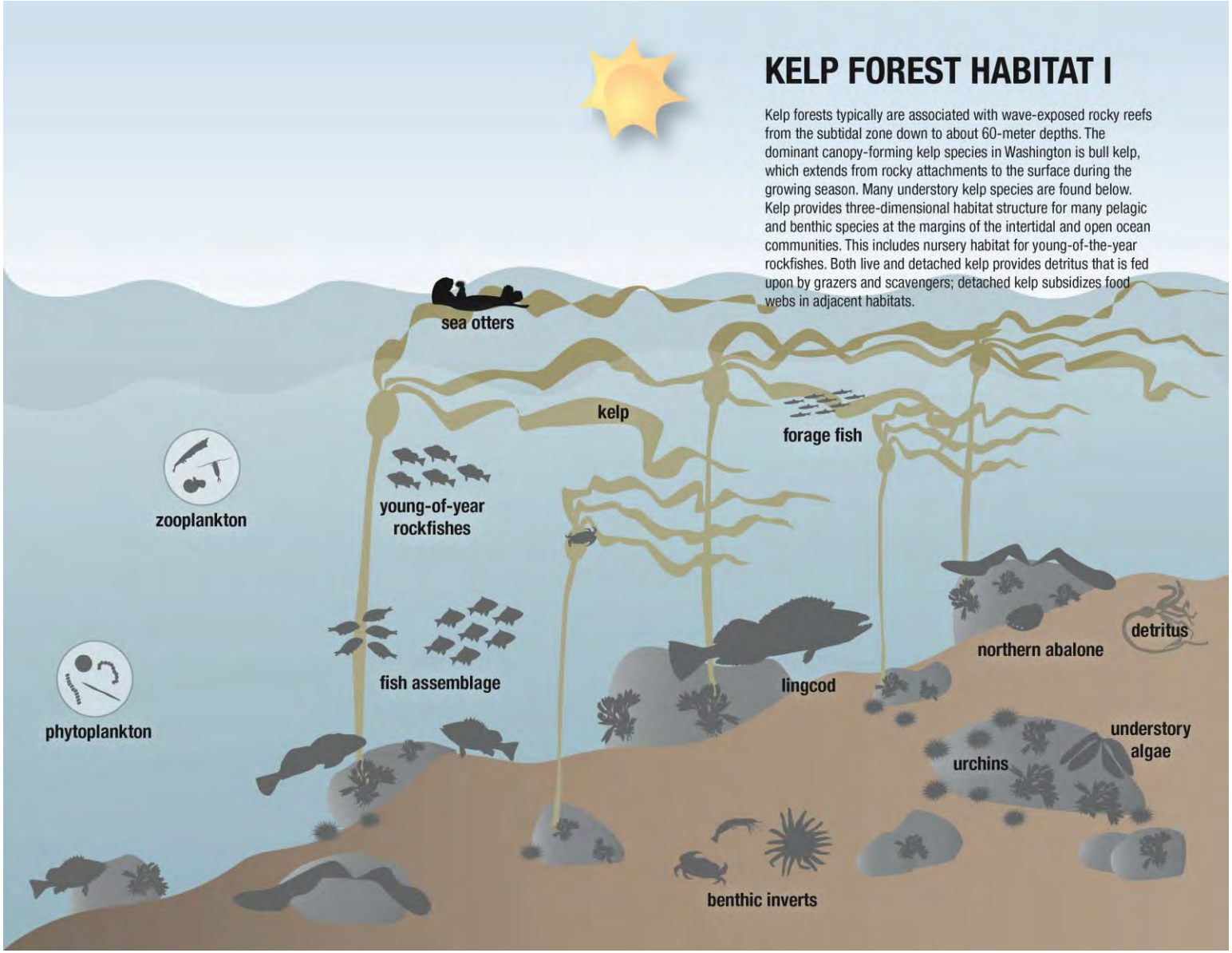
*"…**it is paramount to begin with a conceptual model** of the ecosystem being evaluated, and to use this understanding to guide the selection of indicators that represent the important attributes of the system."*



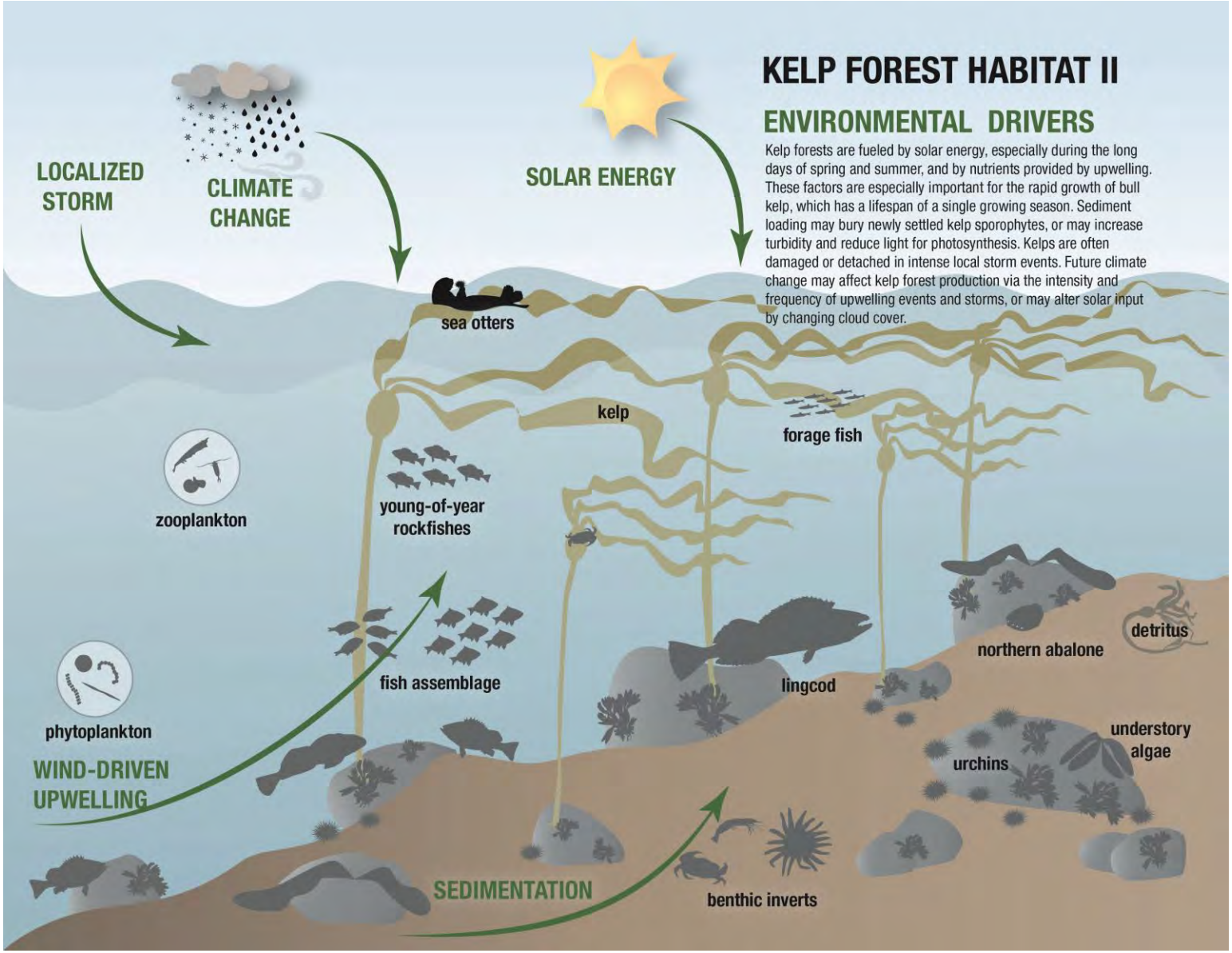
Conceptual framework for selecting ecological indicators



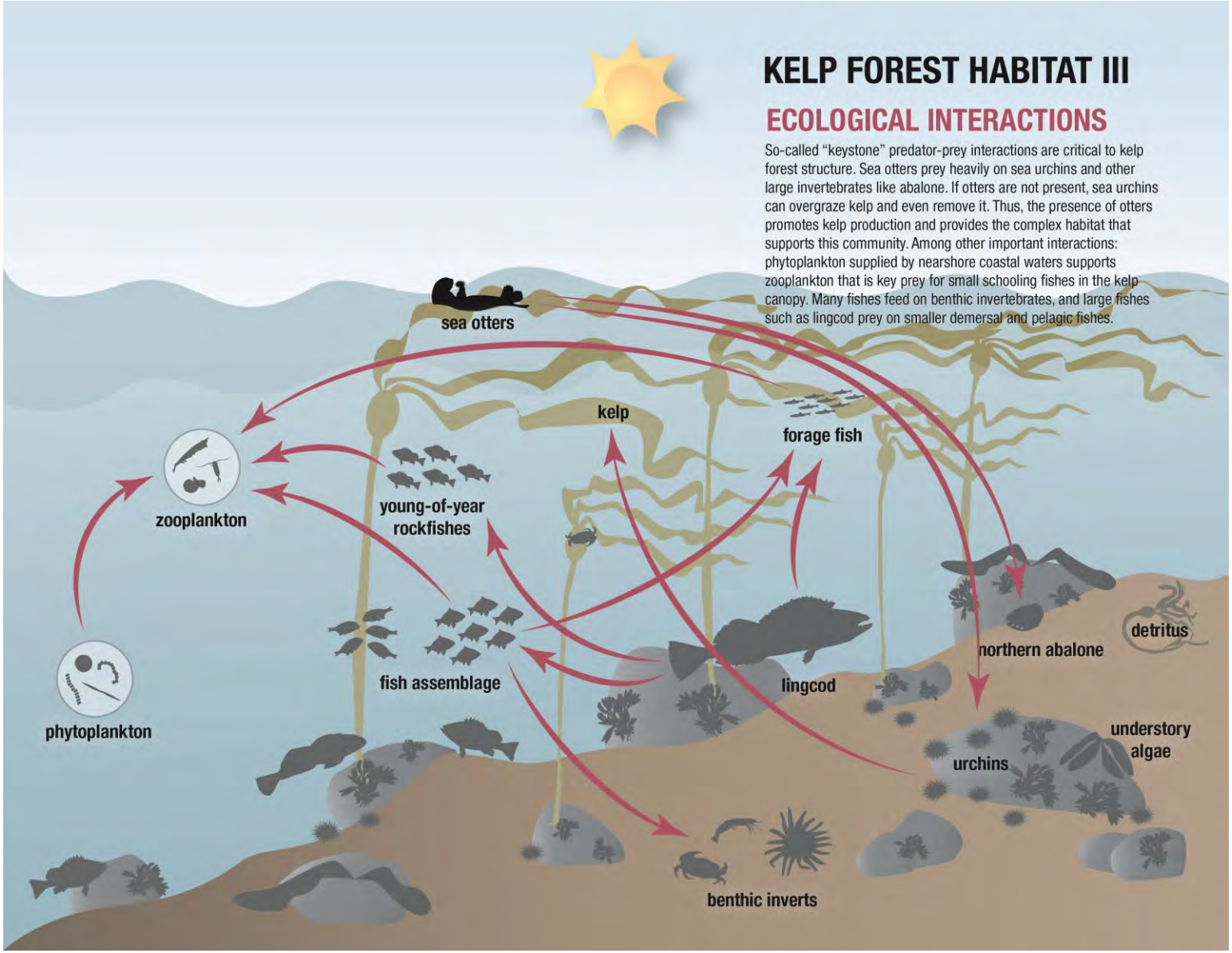
Conceptual models



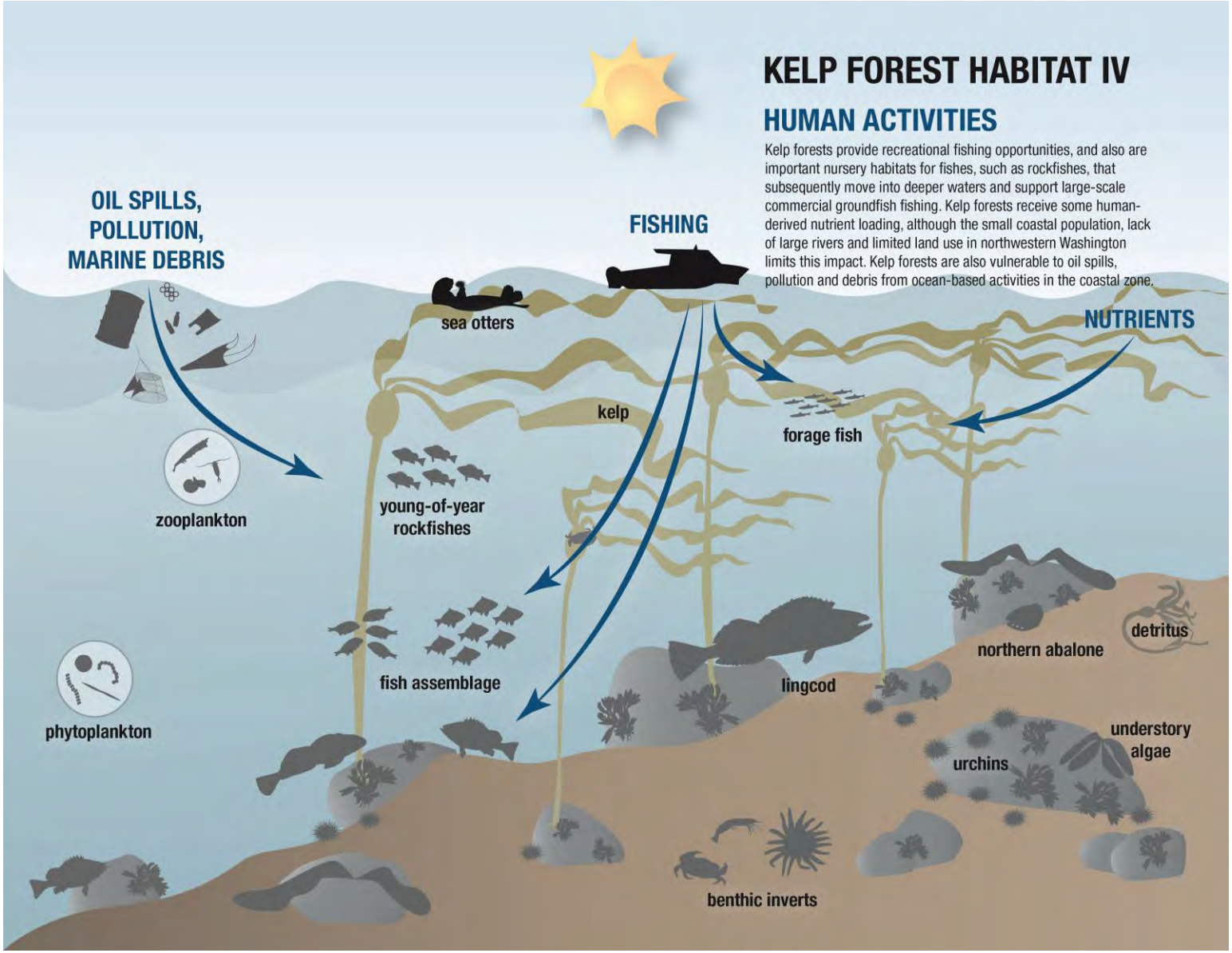
Conceptual models



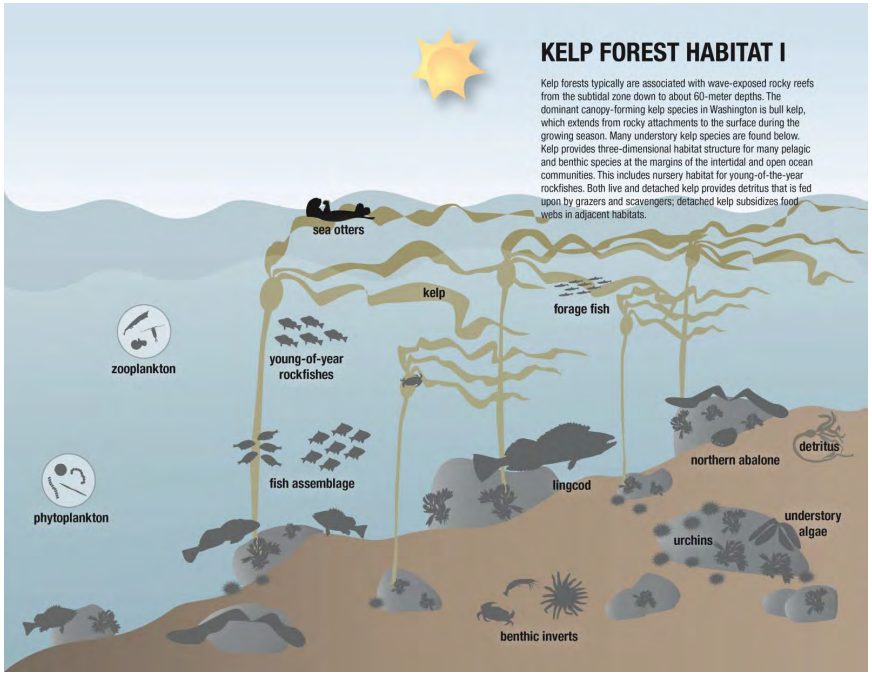
Conceptual models

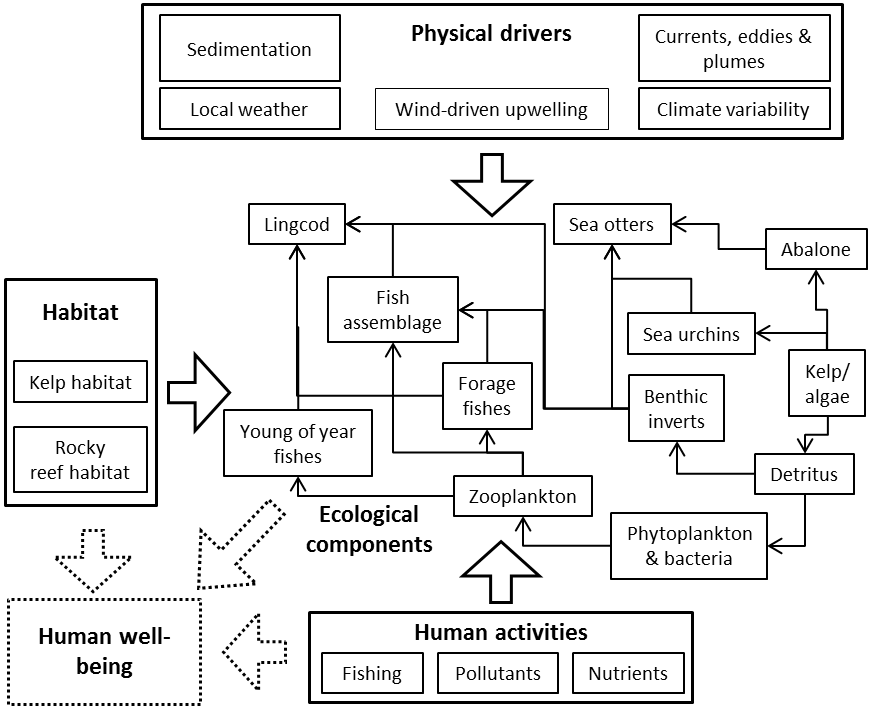


Conceptual models



All “illustrative” conceptual models have “analytical” counterparts



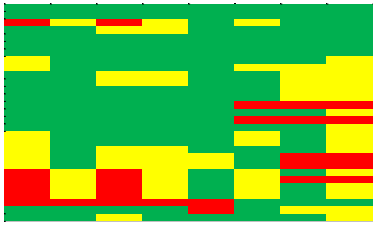


Each box should have at least one indicator associated with it!

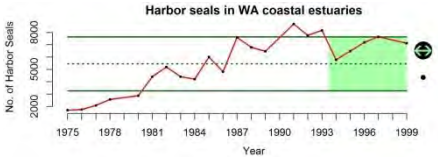
Assessing the “health” of WA coastal ecosystems

1. Develop conceptual models of the key physical, ecological and human activities in habitats of the outer Washington coast.

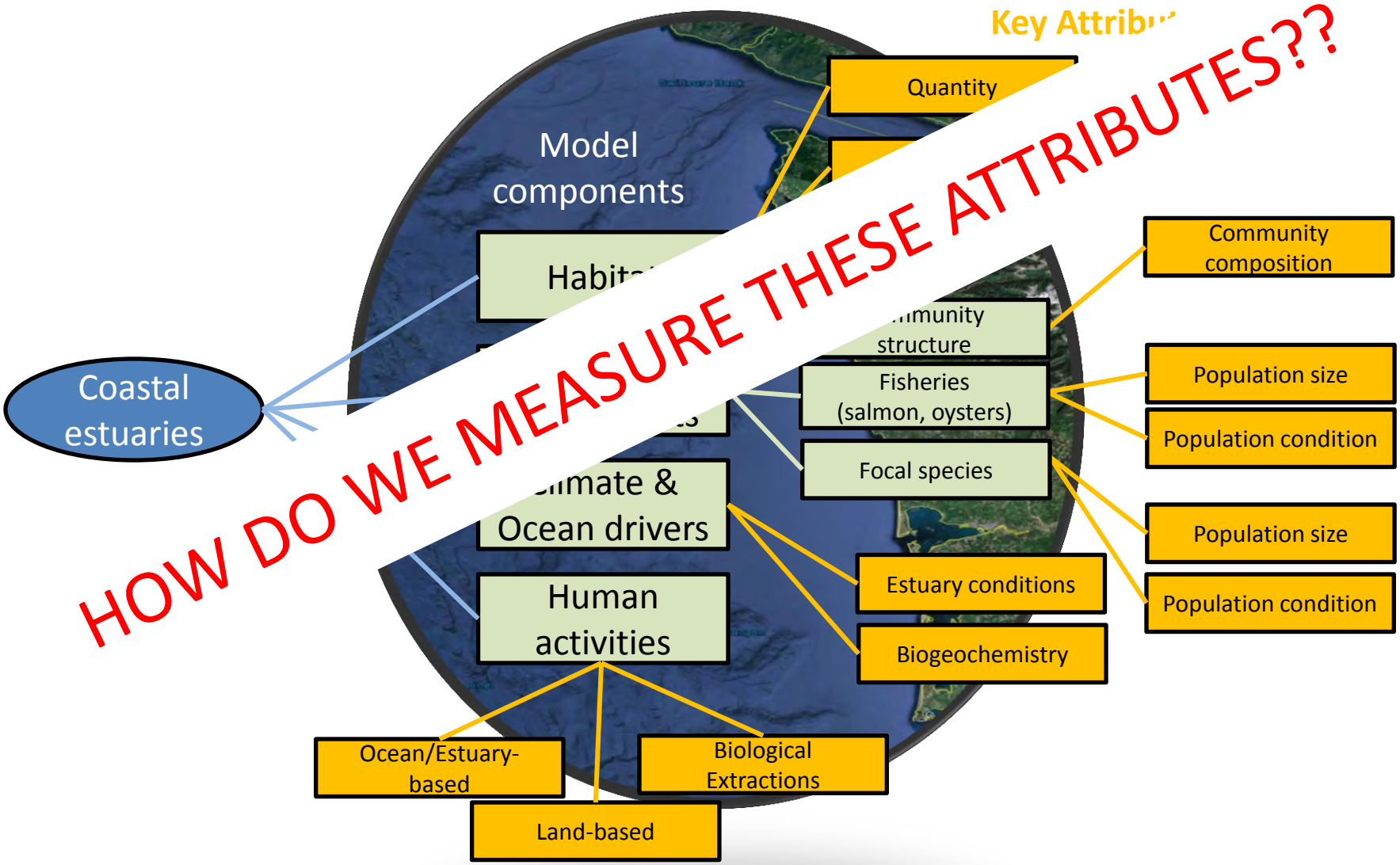
2. Evaluate and select a portfolio of indicators for the key components of the conceptual models.



3. Quantify the status and trends of these indicators.

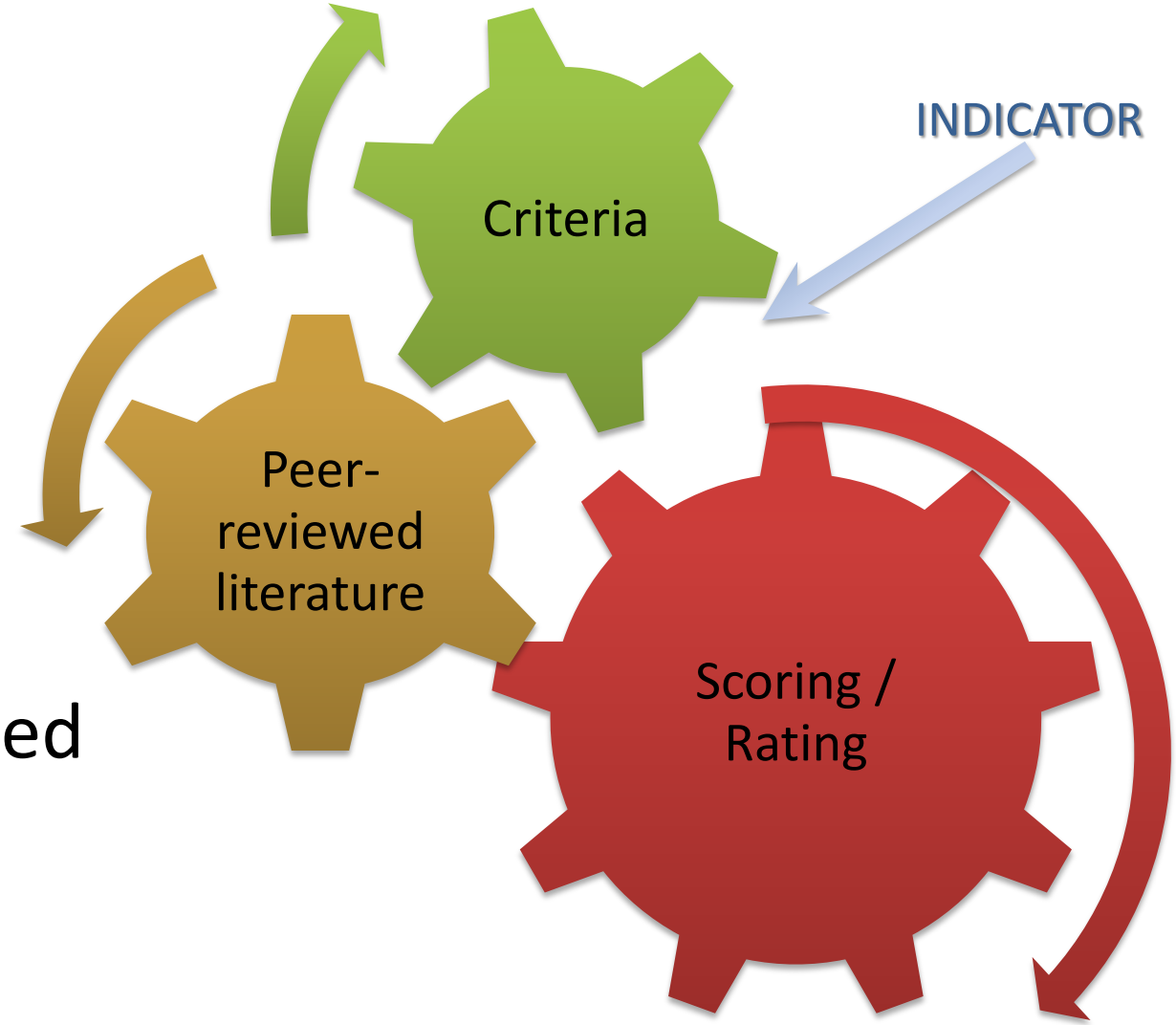


Indicator Evaluation Process



Indicator Evaluation Process

- Transparent
- Repeatable
- Scientifically Defensible
- Readily Updated



Step 1: Identify Indicators

Compile a list of potential indicators that could be used to measure key attributes of each model component.

Examples of potential indicators:

- **Ecological components**
  - **Fisheries taxa (salmon)**
    - **Population size**
      - Natural spawning escapement
      - Juvenile abundance
      - Ocean abundance
      - Commercial landings

    - **Population condition**
      - Smolt-to-adult survival
      - Juvenile growth rates
      - Age structure of population
      - Genetic diversity of population

- **Human activities**
  - **Estuary-based**
    - **Shellfish aquaculture**

      - WA production
      - Acres farmed
      - Licenses permitted
    - **Commercial shipping**

      - # of vessel trips
      - Port volume
      - Volume of water disturbed

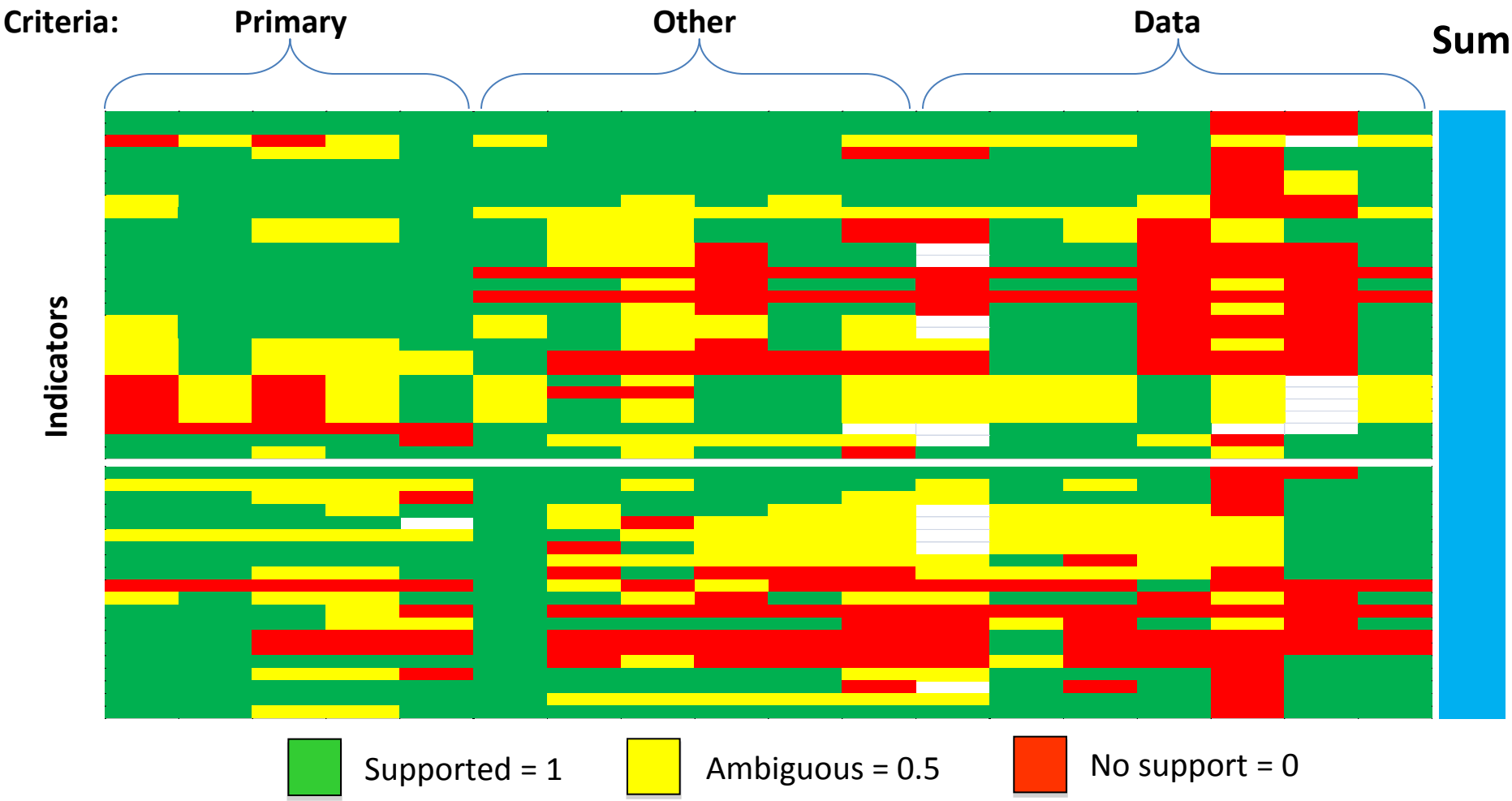
Step 2: Screen with criteria

Indicator Evaluation Criteria (Kershner et al. 2011)

Primary considerations (5)	Other considerations (5)	Data considerations (7)
• Theoretically sound • Relevant to management concerns • Responds to changes in attributes • Responds to changes in management • Linkable to targets	• Understood by the public • History of reporting • Cost-effective • Anticipatory • Compatible (regional, national, international)	• Concrete and numerical • Historical data • Simple • Broad spatial coverage • Continuous time series • Spatial & temporal variation understood • Signal-to-noise ratio

Indicators “rated” for each criterion based on information in peer-reviewed literature

Step 3: Literature-based scoring



Step 4: Criteria weighting

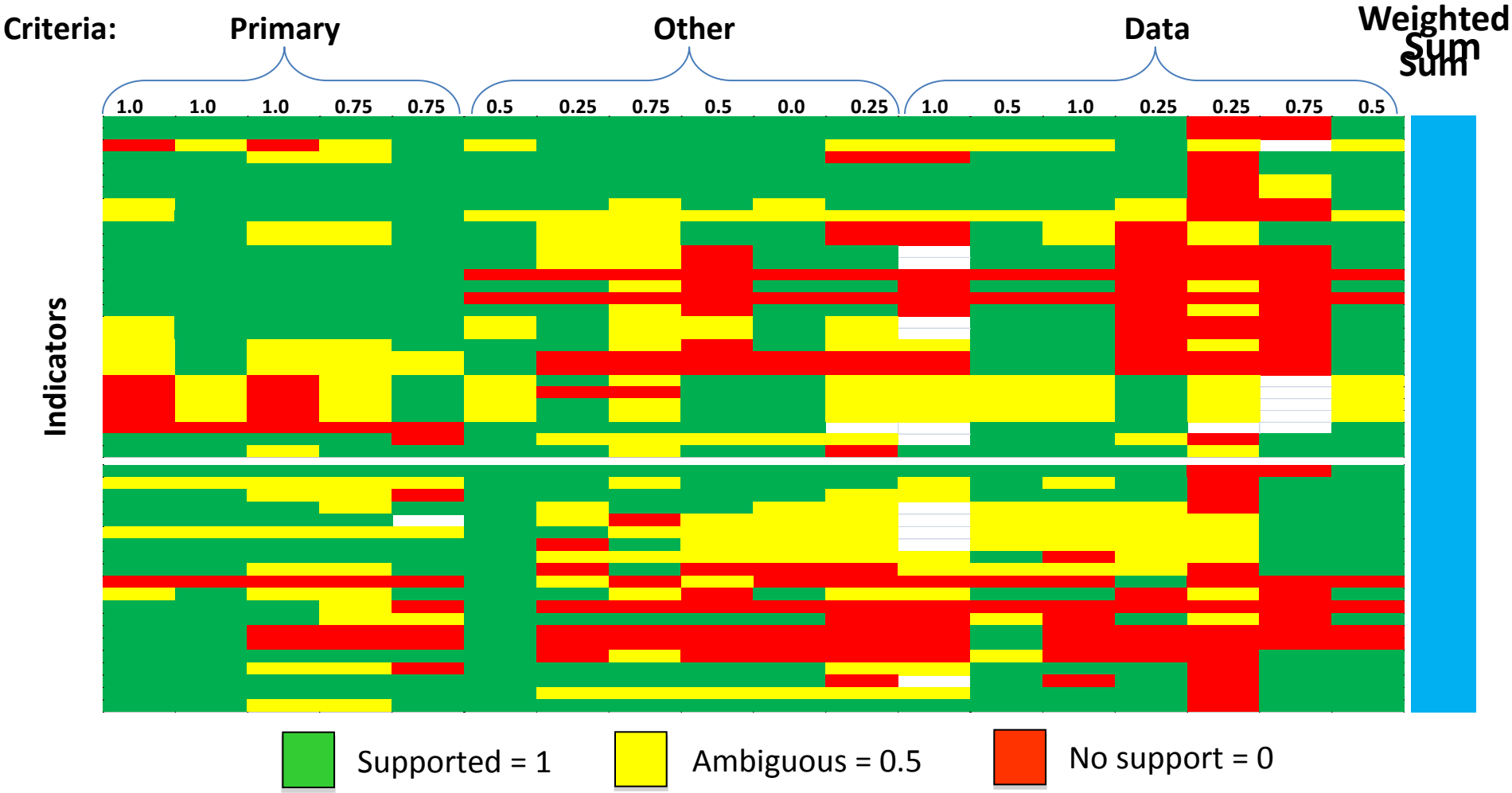
- Not all criteria are equally important.
- Polled 35 scientists, managers, and stakeholders from Washington State.
- Experts ranked each of the 17 criteria from 0 (“not important”) to 1 (“highly important”).

Theoretically sound?	Spatial and temporal variation understood?	Easily understood by public?
1	0.75	0.5

Etc. …

Step 4: Criteria weighting

*Use Primary and Other as first screen, then bring in Data considerations.



Final tables for each habitat (ex.: Sandy beaches)

Component	Attribute	Indicator	Time period of available data
Physical drivers			
Climatic	Water temperature	Sea surface temperature	2000 – 2014
		Pacific Decadal Oscillation	1900 – 2015
	El Niño events	Multivariate El Niño Index	1950 – 2015
		Northern Oscillation Index	1948 – 2014
	Source waters	North Pacific Gyre Oscillation index	1950 – 2015
		Northern copepod anomaly	1996 – 2015
Oceanographic	Upwelling	Upwelling index	1967 – 2014
		Spring transition index	1967 – 2015
	Sediment deposition	Columbia River plume volume	1999 – 2014
		Maximum wave height	2004 – 2014
	Wave energy	Wind speeds	1984 – 2014
		Maximum wave height	2004 – 2014
Habitat			
Physical Habitat	Quantity	Beach slope	2004 – 2015†
		Sediment size composition	2004 – 2015†
	Quality	Water temperature	2000 – 2014
		Sediment quality index	NA
Ecological components			
Phytoplankton	Population size	Aggregate abundance	NA†
	Population condition	Diatoms : Dinoflagellates ratio	NA†
Crustaceans	Population size	Aggregate abundance	2004 – 2015†
	Population condition	Not evaluated	NA
Infaunal predators	Population size	Aggregate abundance	2004 – 2015†
	Population condition	Not evaluated	NA
Razor clams	Population size	Density	1997 – 2014
	Population condition	Recruitment	1997 – 2014
		Condition index	1994 – 2015
Surf zone fish assemblage	Population size	Population abundance	NA
	Population condition	Recruitment	NA
Seabirds & shorebirds	Population size	Population abundance	NA
	Population condition	Reproductive output	NA
Terrestrial mammals	Population size	Aggregate abundance	NA
	Population condition	Reproductive output	NA
Ecosystem health	Biodiversity	Simpson's diversity	NA
		Species richness	NA
	Trophic structure	Mean trophic level	NA
		Kelp wrack density	NA
Human activities			
Biological extractions	Fishing	Razor clam landings	1976 – 2014

Assessing the "health" of WA coastal ecosystems for marine spatial planning

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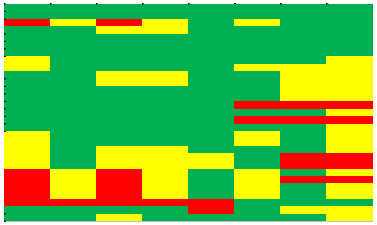
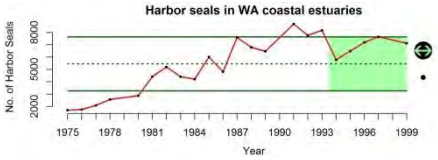
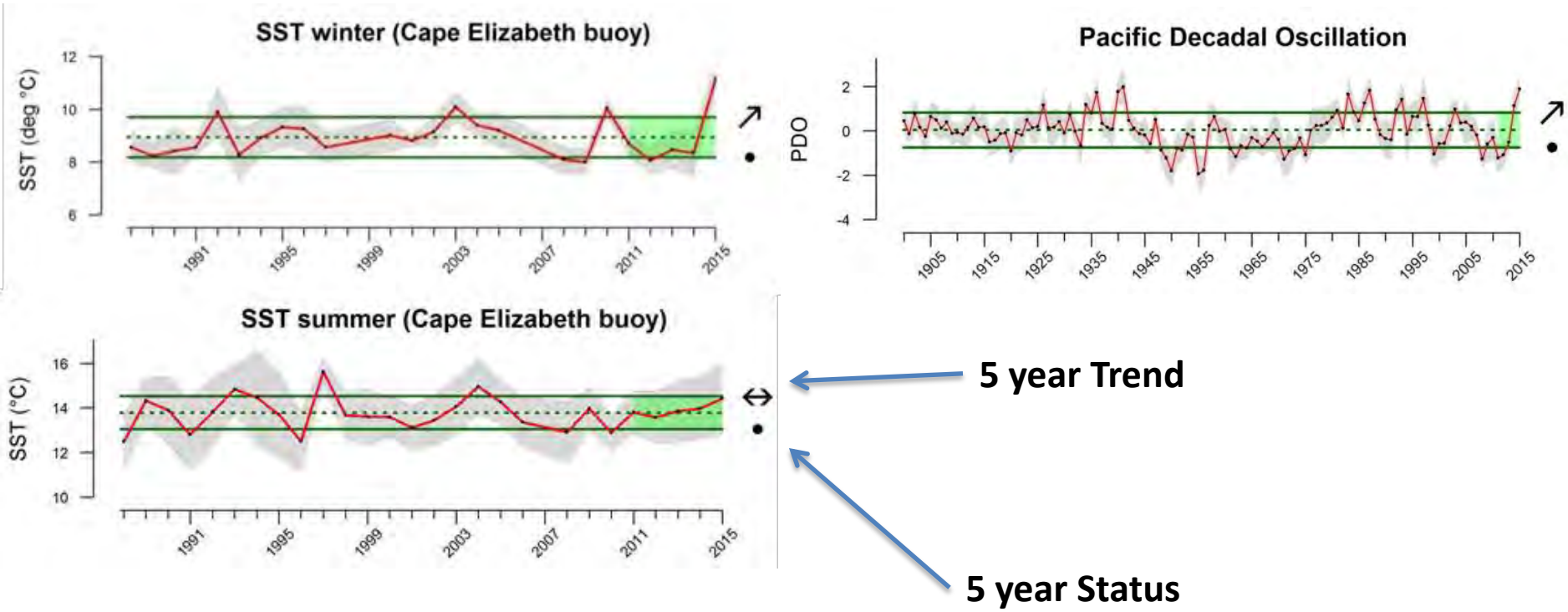


3. Quantify the status and trends of these indicators.



Two ways to track status and trends

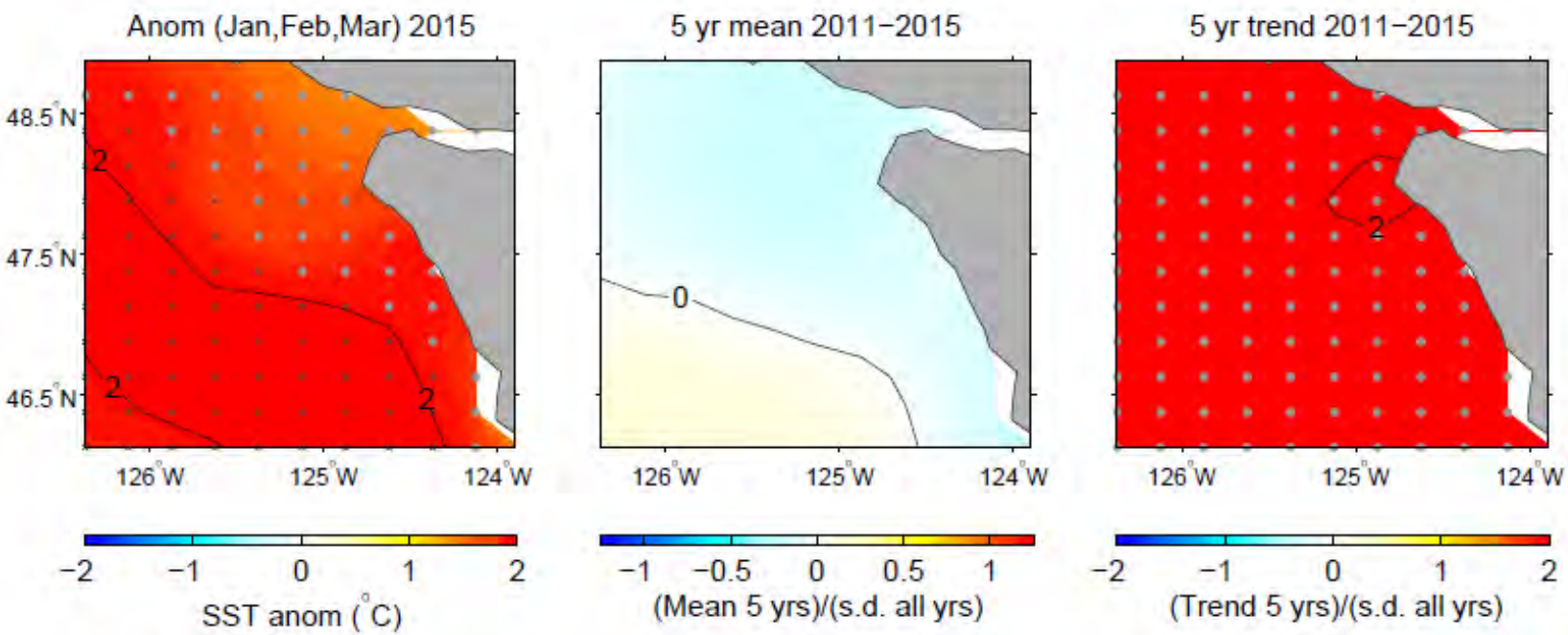
1. Temporally



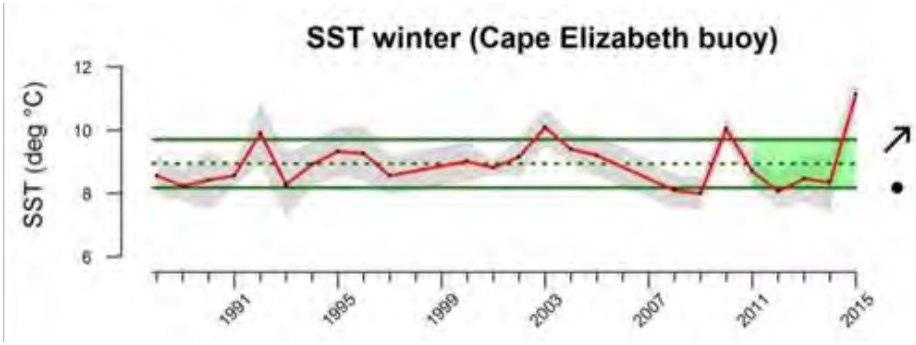
Two ways to track status and trends

2. Spatiotemporally

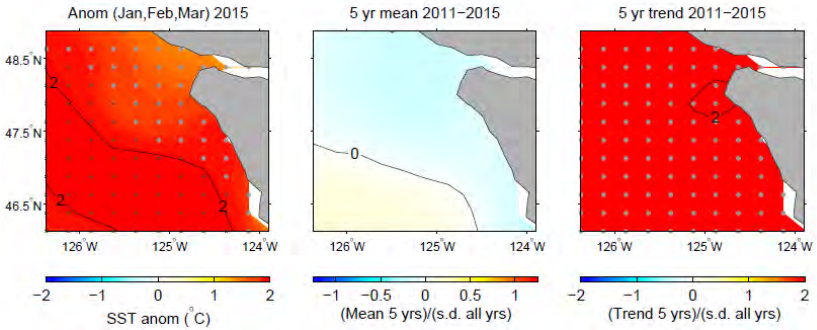
Current year anomaly | **5 year Status** | **5 year Trend**



Two ways to track status and trends



vs.



- **VASTLY** more often than not, our status & trends plots are temporal (left).
- As much as anything, that's an issue of the way monitoring is currently done.
- MSP approach likely will require more focus on spatiotemporal data, but the indicators themselves are (we hope) robust.
- Washington State should be able to use both approaches.

Some highlights

Credit: Cheryl Morgan

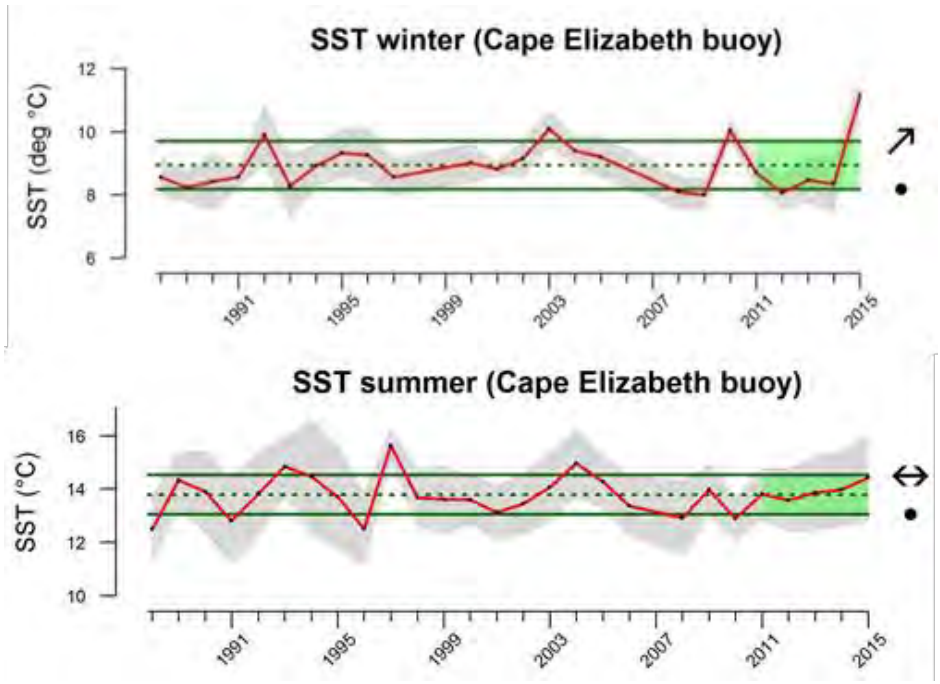
Credit: Daniel Ayres

Credit: Daniel Ayres

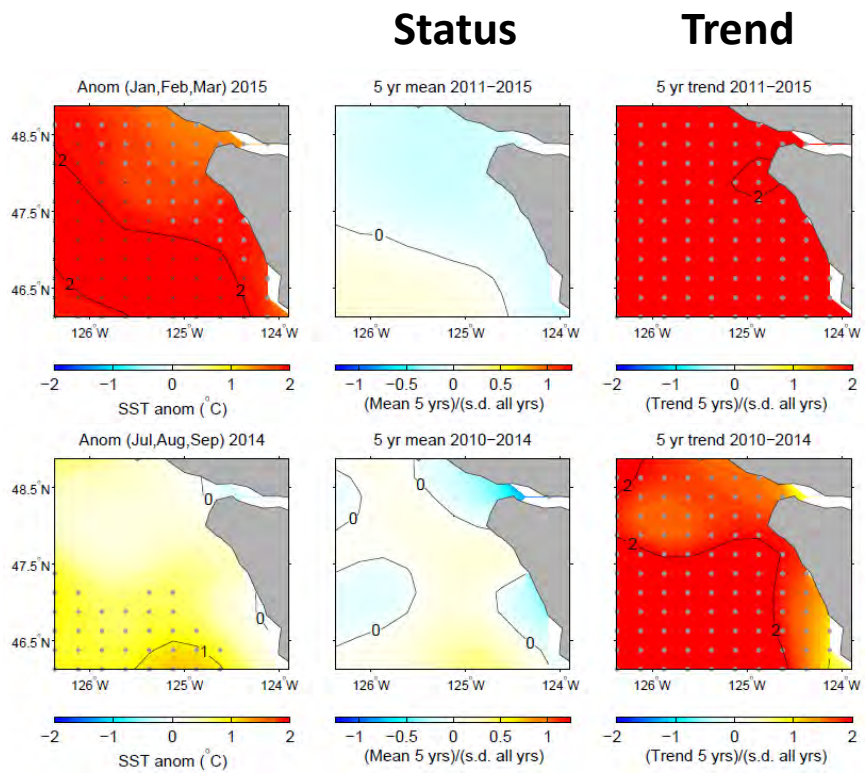
Credit: Cheryl Morgan

Some status & trends highlights: pelagic

- **Sea surface temperature = highly ranked indicator of climate drivers & habitat quality**
  - **It's been getting warmer**



*Data from NOAA's National Data Buoy Center (NDBC)



*Data from NOAA's CoastWatch West Coast Regional Node

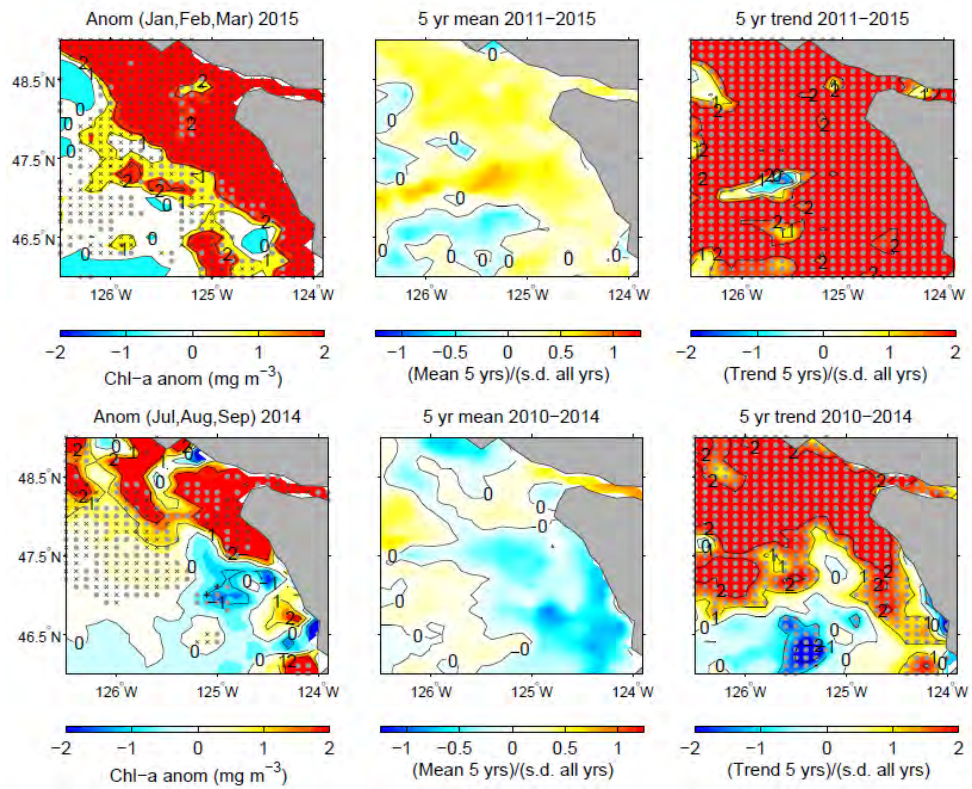
Some status & trends highlights: pelagic

- **Key indicators of ecosystem health: <u>chlorophyll a</u> and abundance of northern copepods**
  - **A transition may be occurring…**

Status **Trend**

Winter 2015

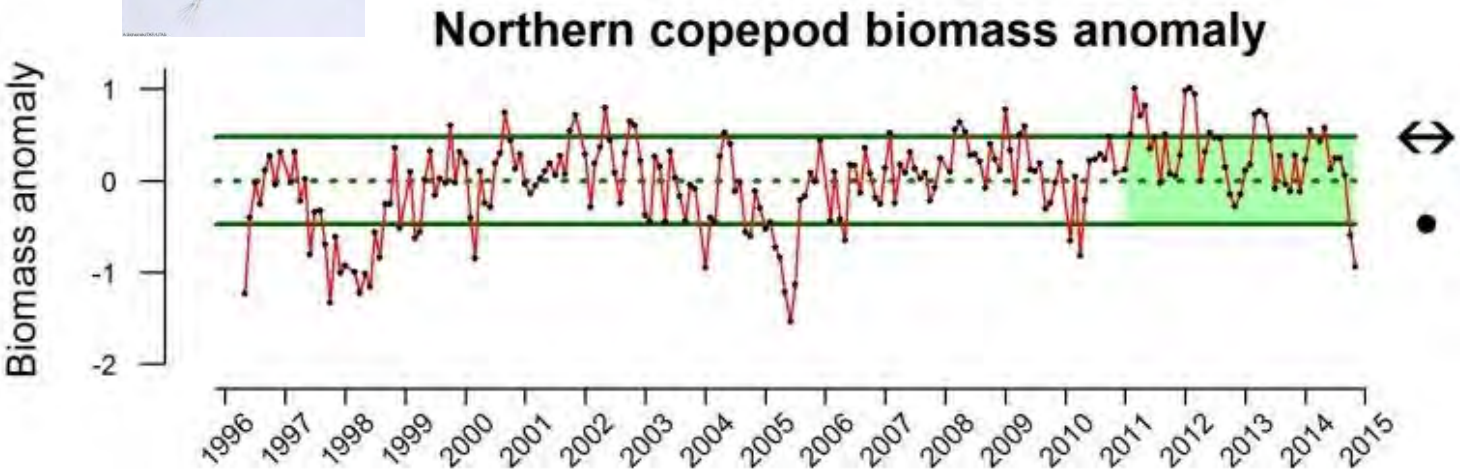
Summer 2014



*Data from NOAA's CoastWatch West Coast Regional Node

Some status & trends highlights: pelagic

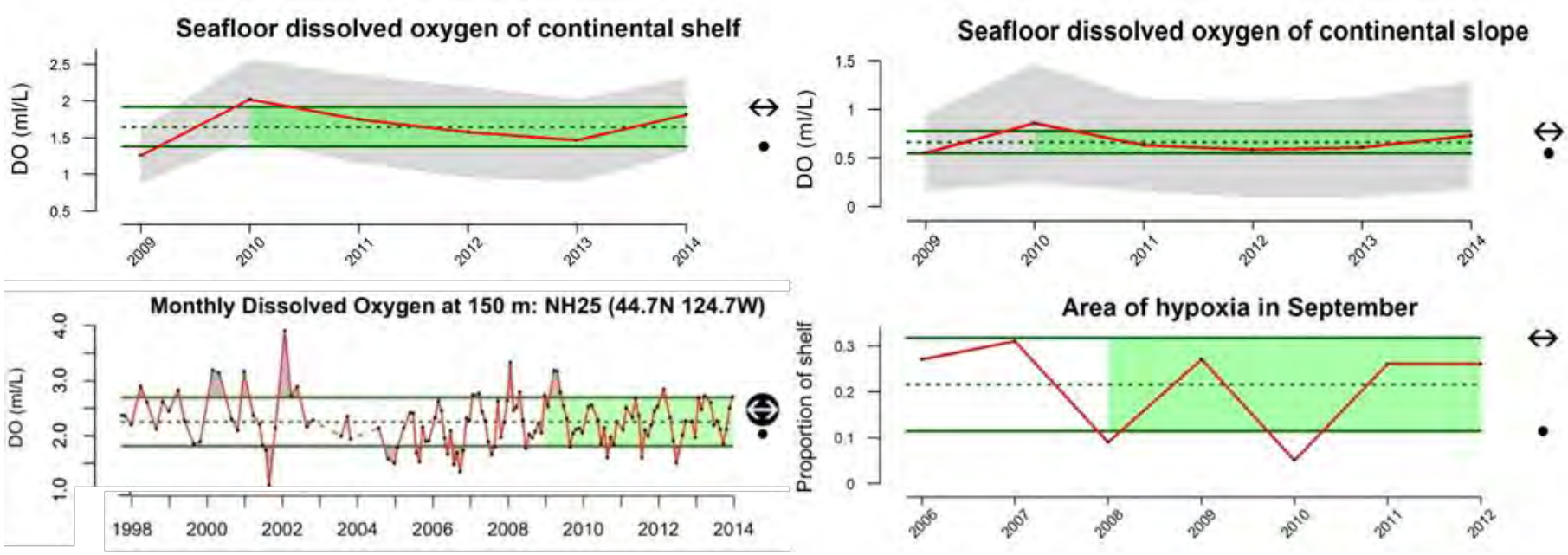
- **Key indicators of ecosystem health: chlorophyll a and <u>abundance of northern copepods</u>**
  - **A transition may be occurring…**



*Data from Bill Peterson, NWFSC

Some status & trends highlights: seafloor

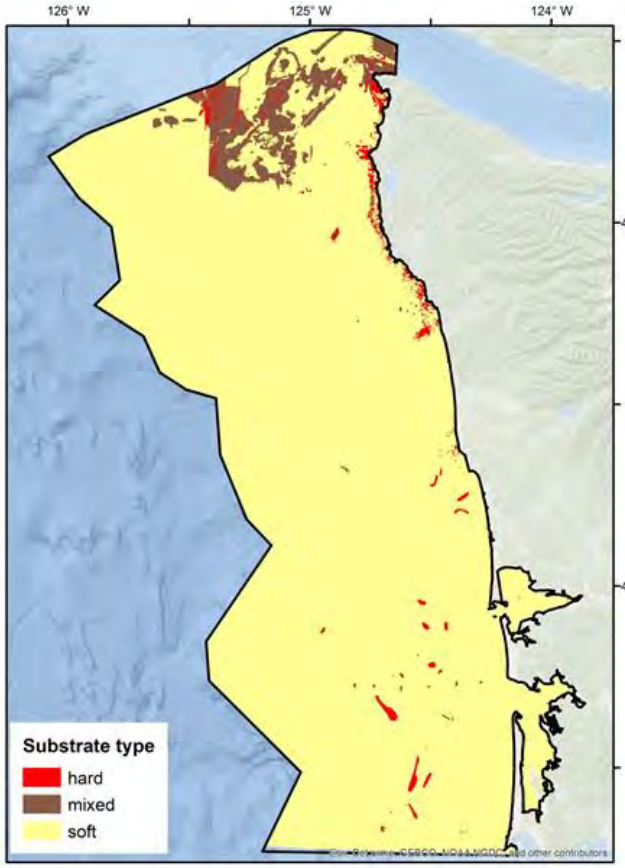
- **Dissolved oxygen = highly ranked indicator of oceanographic drivers & habitat quality**
  - **No real surprises here, I don't think, though many of these time series are short and not terribly spatially refined yet.**

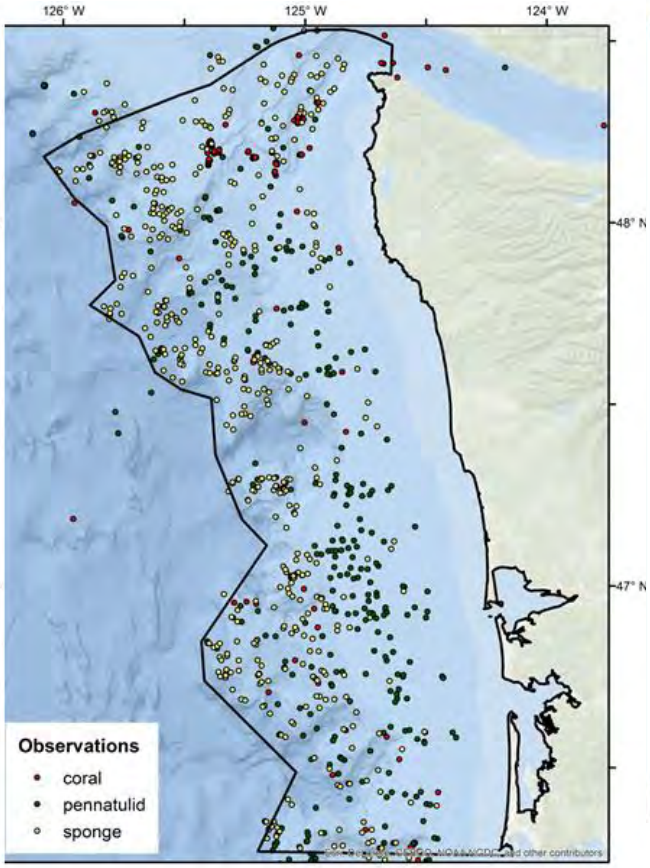


*Data from NWFSC

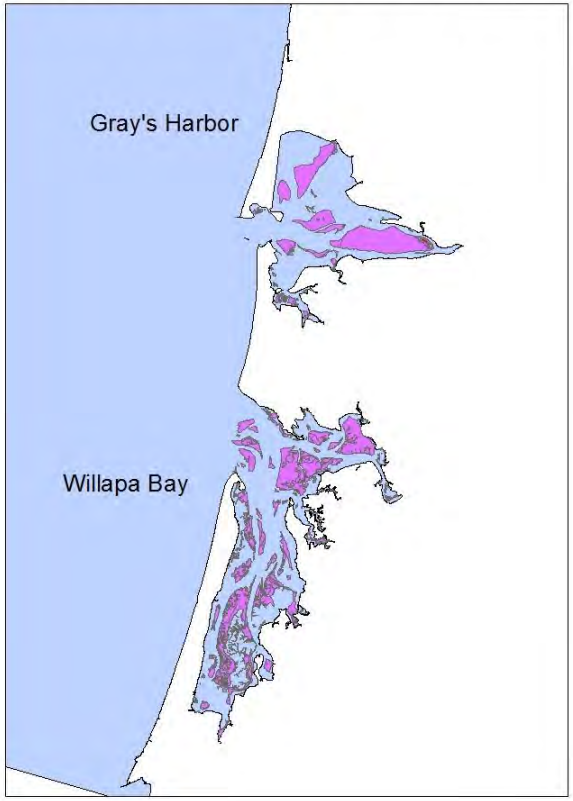
Some status & trends highlights: seafloor

- **Substrate and biogenic habitats rated highly for habitat quantity**
  - **We mainly have a snapshot, from EFH work, but it's a start and WA State is moving towards filling data gaps.**



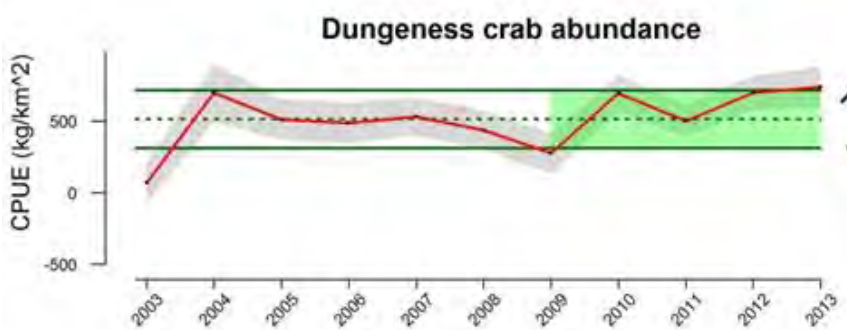


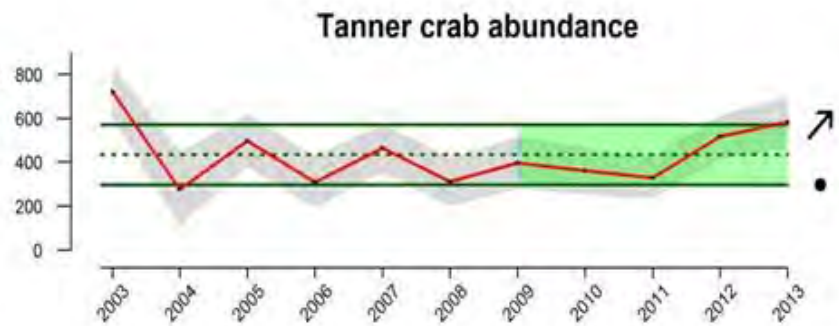
Estuarine & Marine wetland in MSP area

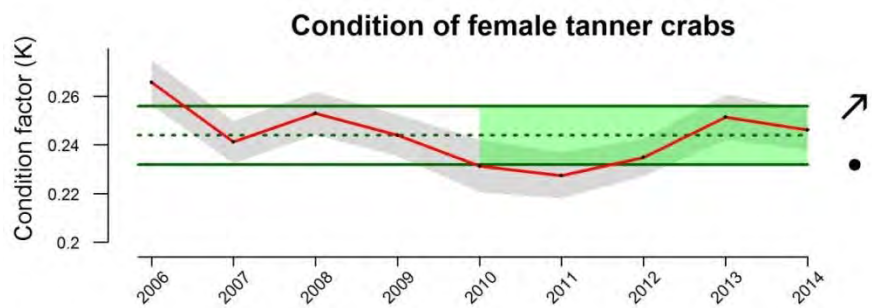


Some status & trends highlights: seafloor

- **Crustacean CPUE = highly ranked for population size**
- **Tanner crab female condition factor = highly ranked for population condition.**
  - **Time series are short, so interpret with caution; trends have been stable or increasing in WAMSP region**



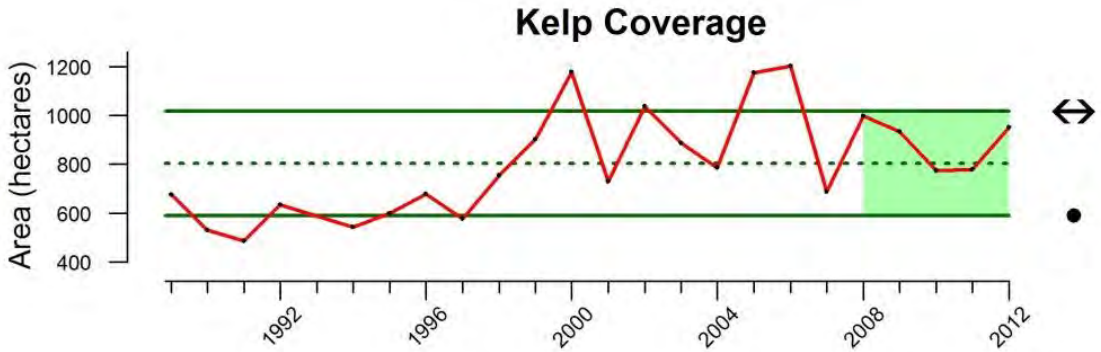




*Data from NWFSC

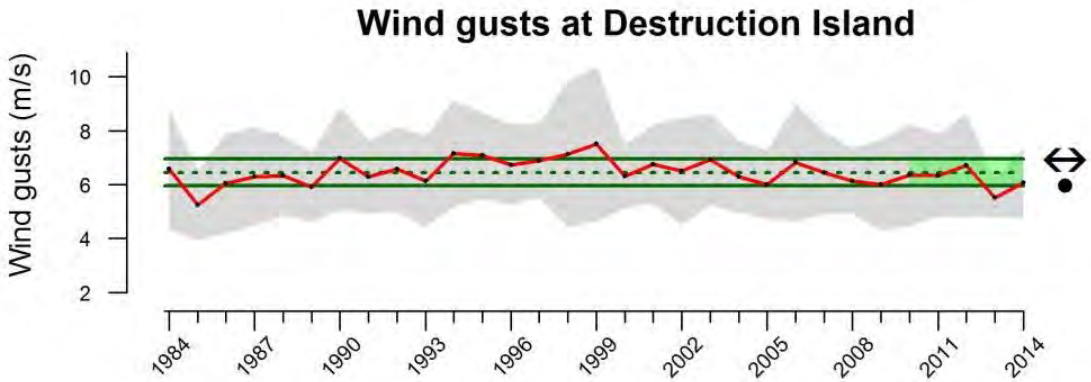
Some status & trends highlights: kelp forests

- **Kelp coverage = highly ranked indicator of habitat quantity**
  - **Kelp cover in WAMSP waters was highly variable from 2000-2008, but appears more stable over the last five years**



*Data from WA DNR

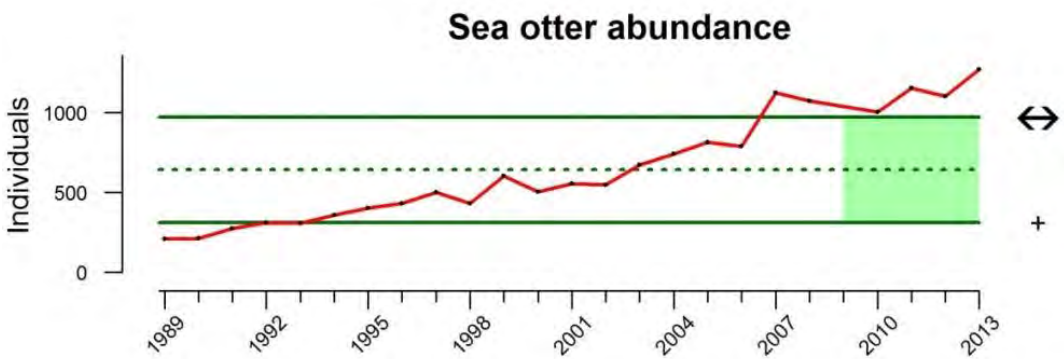
- **Wind gusts = highly ranked indicator of local weather drivers**
  - **Long-term trend is relatively stable; may need to refine this indicator**

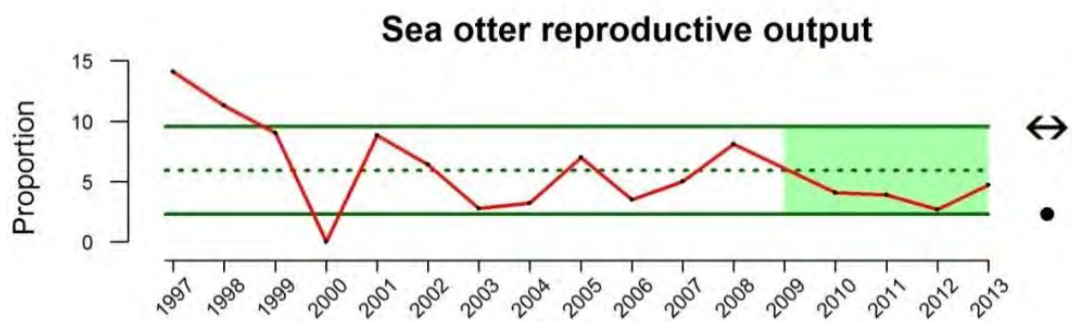


*Data from NOAA NDBC

Some status & trends highlights: kelp forests

- **Sea otter abundance and reproductive output = highly ranked indicators of population size and condition**
  - **Abundance stable and at (recent) historic peak**
  - **Reproductive output stable but below (recent) historic peak**

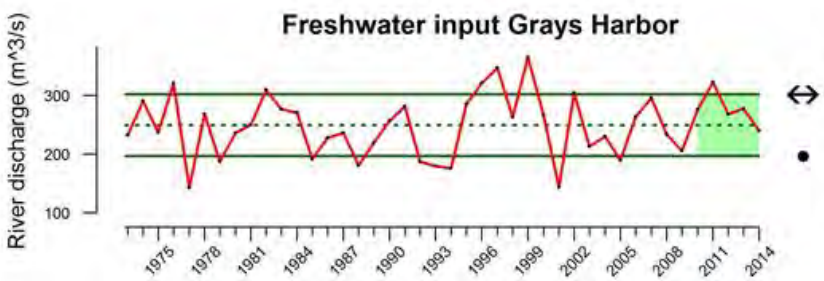


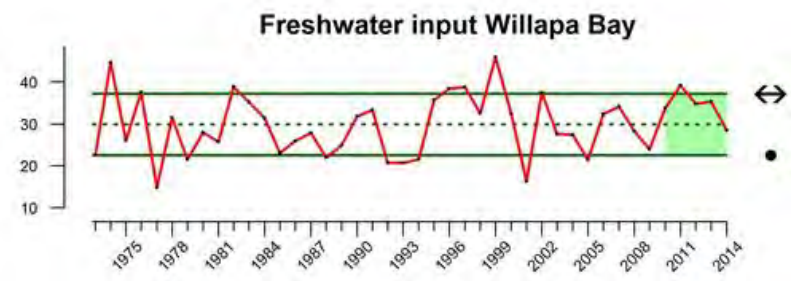


*Data from WDFW

Some status & trends highlights: estuaries

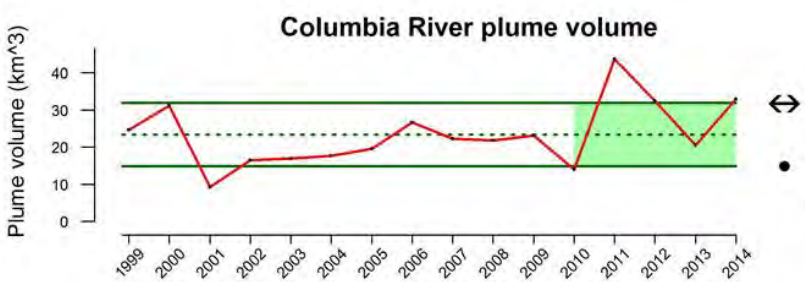
- **River discharge = highly rated indicator of freshwater input**
  - **Highly variable; addition of 2015 data likely to result in decreasing trends**

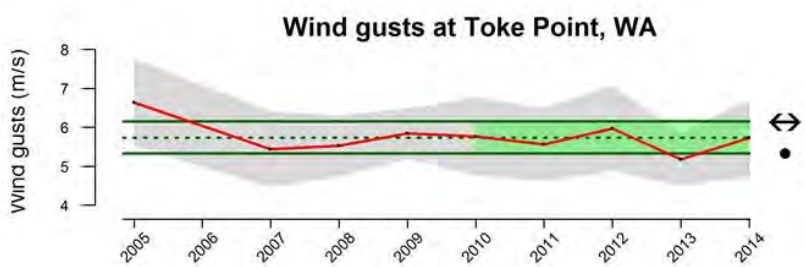




*Data from USGS

- **Columbia River plume and wind gusts = highly rated indicator of sediment dynamics**
  - **Plume has varied over last five years; Wind gusts stable over long periods of time.**



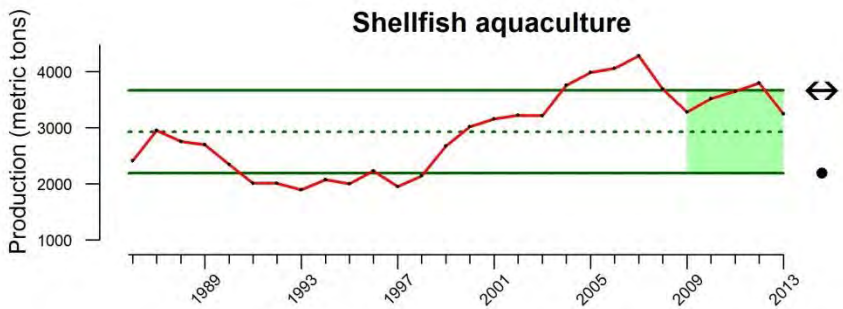


*Data from Center for Coastal Margin Observation and Prediction Center

*Data from NOAA NDBC

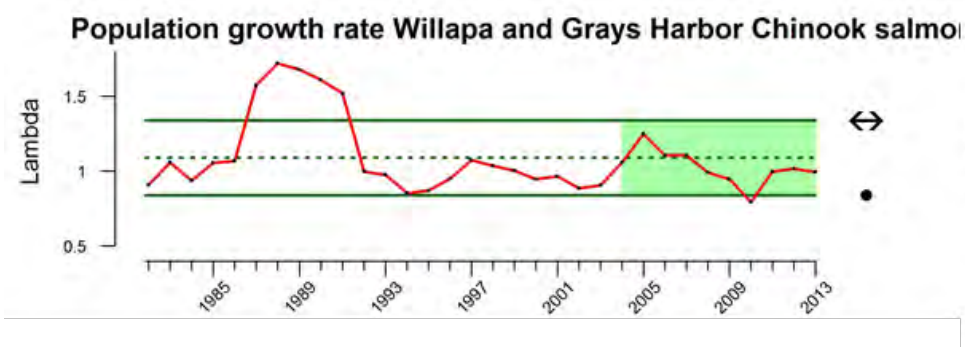
Some status & trends highlights: estuaries

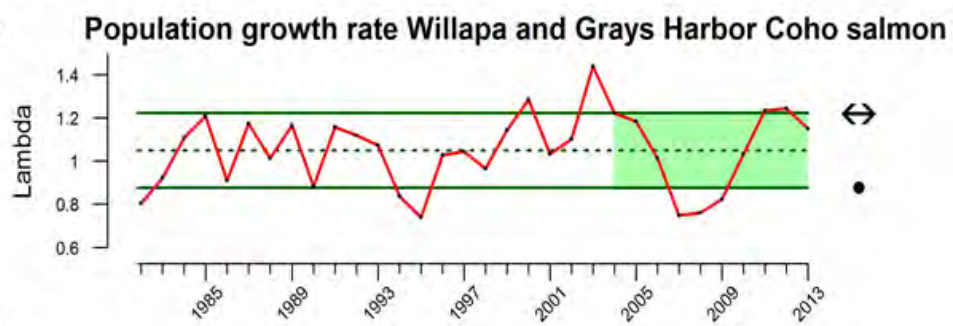
- **Shellfish aquaculture = highly rated indicator of biological extractions**
  - **Increased from 1997 to 2007, but relatively stable recently.**



*Data from WDFW

- **Population growth rate = highly ranked indicator of population condition for estuary salmon stocks**
  - **Willapa and Grays Harbor Chinook stable over last twenty years; Coho have varied widely.**

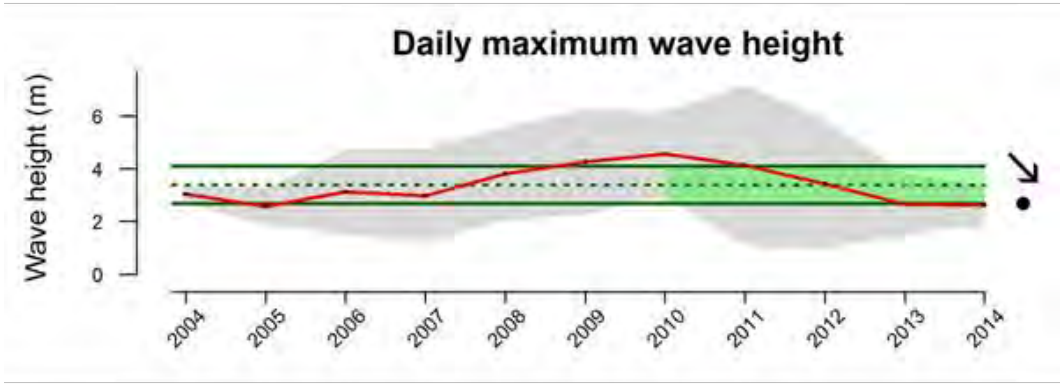




*Data from Pacific Fisheries Management Council

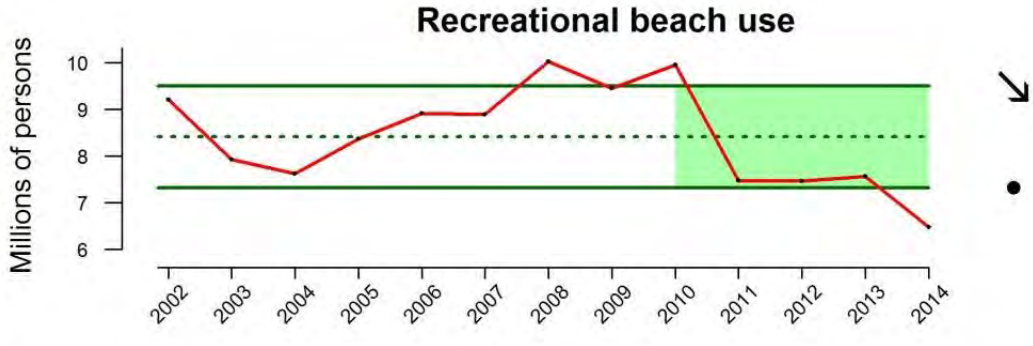
Some status & trends highlights: rocky shores

- **Wave height = highly rated indicator of local weather drivers**
  - **Daily maximum wave height trending down over last 5 years**



*Data from NOAA NDBC

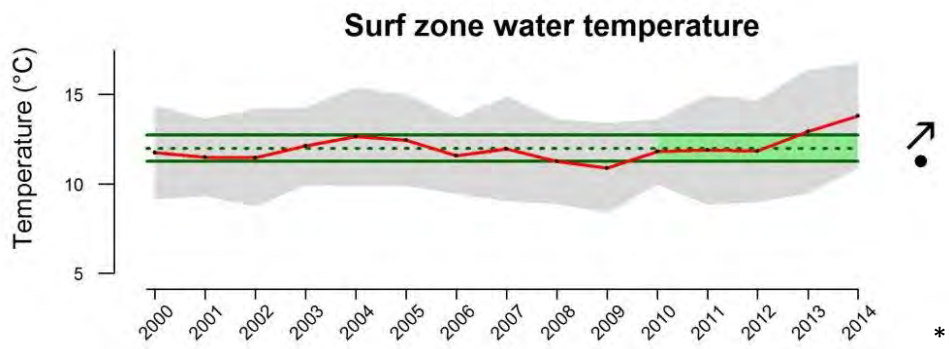
- **Beach attendance = highly rated indicator of habitat modification due to trampling**
  - **Beach attendance trending down over last 5 years**



*Data from WA Dept Parks and Recreation

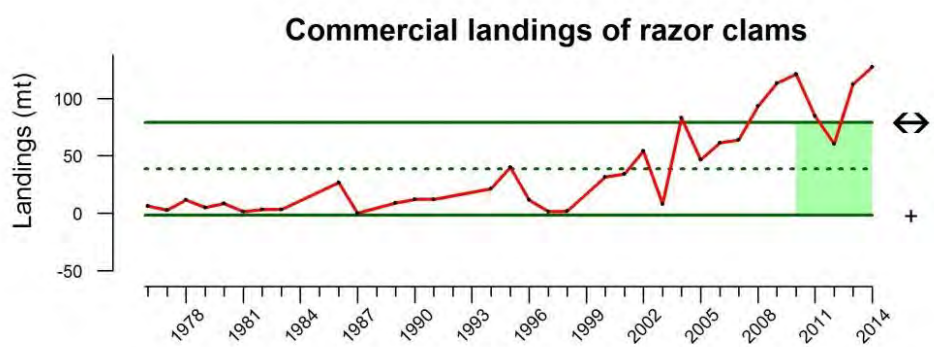
Some status & trends highlights: sandy beaches

- **Surf zone temperature = highly rated indicator of habitat quality**
  - **Temperature increasing over last five years**



*Data from WDFW

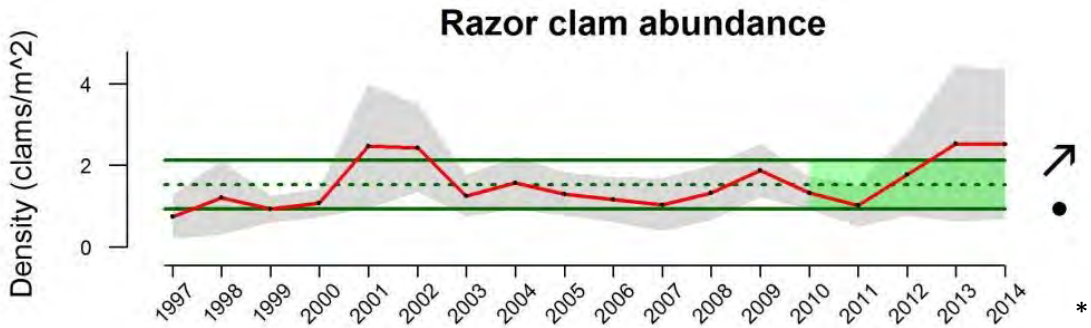
- **Landings of razor clams = highly rated indicator of biological extractions**
  - **Highly variable but above historic averages over the last five years**



*Data from WDFW

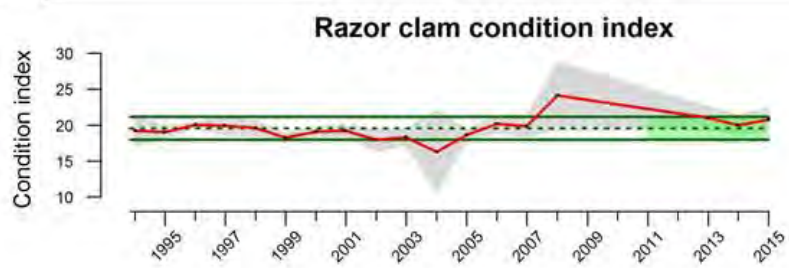
Some status & trends highlights: sandy beaches

- **Razor clam density = highly rated indicator of population size for razor clams**
  - **Density increasing over last five years**



*Data from WDFW

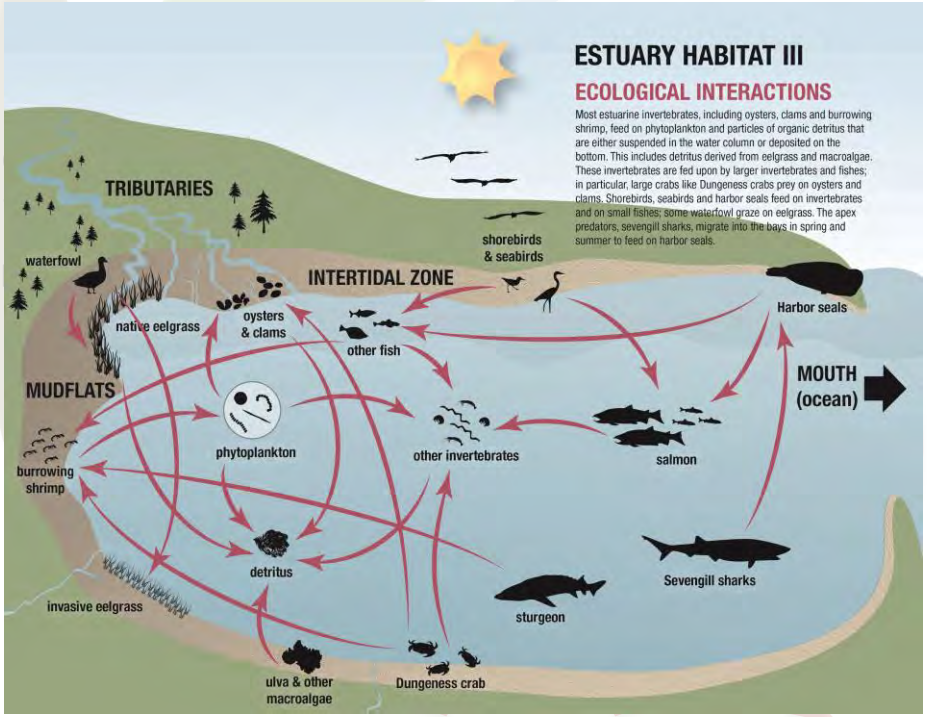
- **Recruitment and condition index = highly rated indicators of population condition**
  - **Recruitment has been variable but within historic averages, while condition index is lower than peak condition in 2008, but near the top of historic averages over the last five years**



*Data from WDFW

Summary

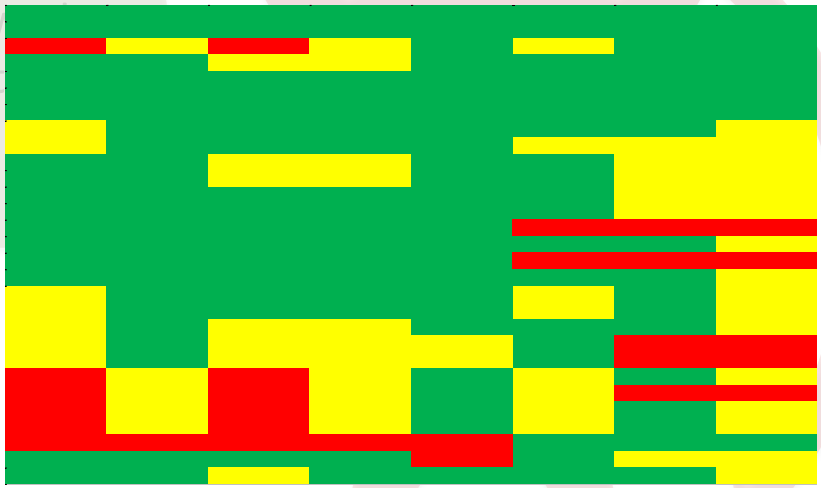
- Indicator development in support of MSP goals has been a linked, multi-step process
  - Developing conceptual models



All model images by Su Kim, NWFSC

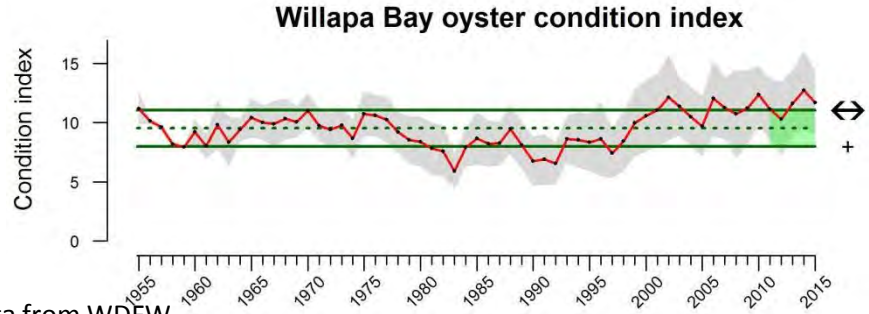
Summary

- Indicator development in support of MSP goals has been a linked, multi-step process
  - Developing conceptual models
  - Developing indicators linked to those models
    - Selection
    - Screening criteria
    - Weighting

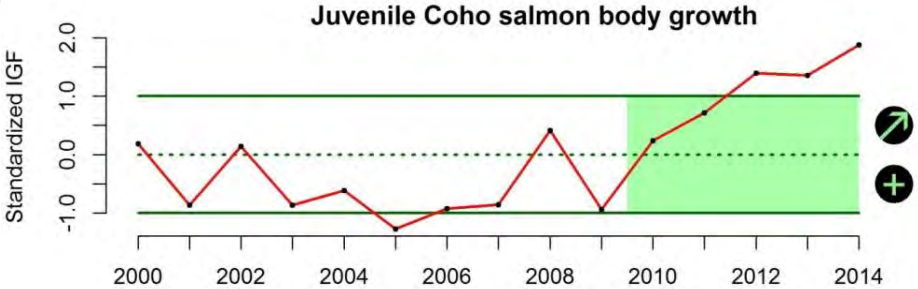


Summary

- Indicator development in support of MSP goals has been a linked, multi-step process
  - Developing conceptual models
  - Developing indicators linked to those models
    - Selection
    - Screening criteria
    - Weighting
  - Finding time series data for highly rated indicators



*Data from WDFW



*Data from NWFSC

Summary

- Indicator development in sup
  goals has been a linked. r
  - Developing concept
  - Developing ind e models
    - Selectio
    - So
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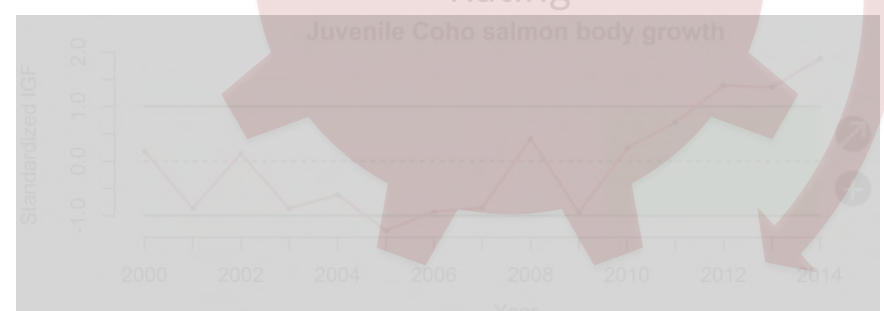
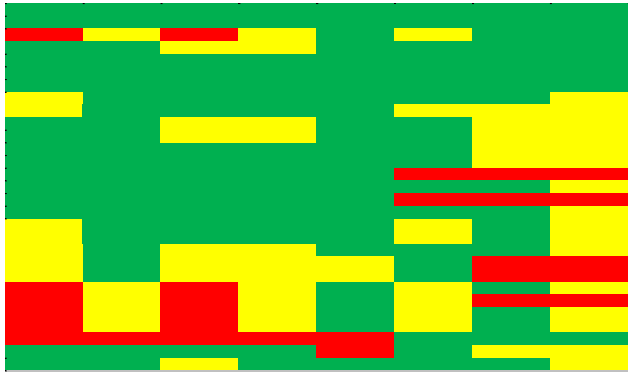
      terature
  - es data for highly rated indicators

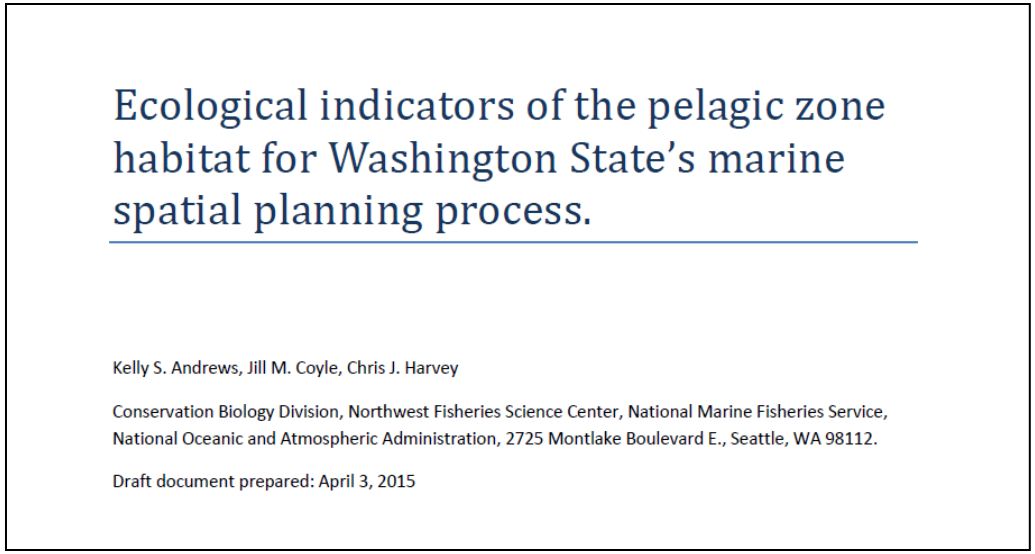
Key product: sets of robust indicators that can be used to assess "health" of Washington MSP habitats.



Next steps…

- Immediate
  - Cleaning up evaluation spreadsheets which show the scoring for all indicators.
  - Completing detailed appendices describing the evaluations and selection of indicators for each habitat.





Ecological indicators of the pelagic zone habitat for Washington State's marine spatial planning process.

Kelly S. Andrews, Jill M. Coyle, Chris J. Harvey

Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Boulevard E., Seattle, WA 98112.

Draft document prepared: April 3, 2015

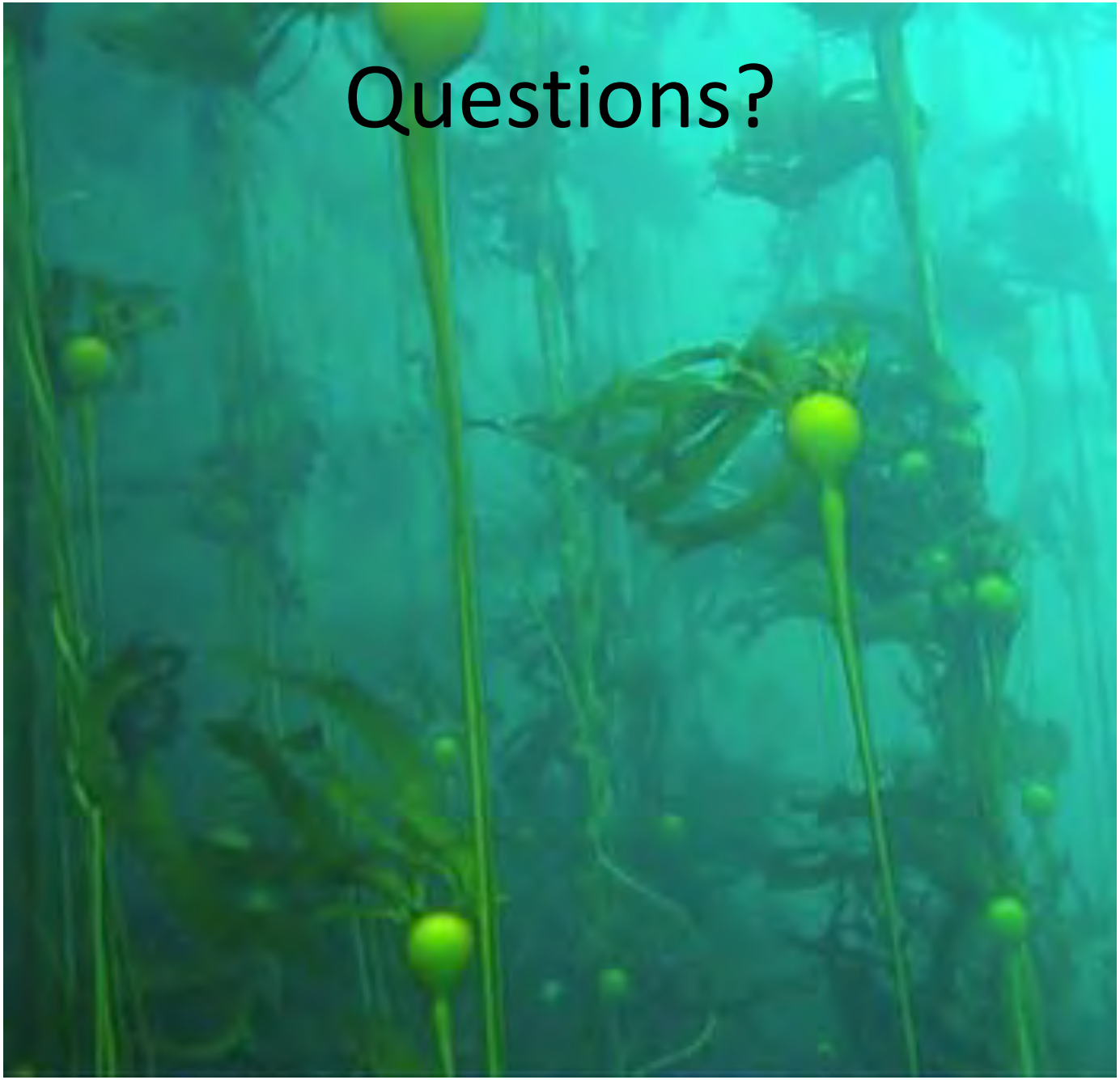
Next steps…

- How do we use these selected indicators?
  - Work with WA MSP Team to scope out which indicators are most relevant to their plan.
    - Indicators affected by specific permitting activities?
    - Indicators affected by specific environmental conditions?

Next steps…

- How do we use these selected indicators?
  - Work with WA MSP Team to scope out which indicators are most relevant to their plan.
    - Indicators affected by specific permitting activities?
    - Indicators affected by specific environmental conditions?
  - Work with WA MSP Team to develop methods to identify relationships between indicators and drivers/pressures
    - How do we know when a permitted activity is causing changes in an indicator?
    - How do we know when an environmental condition is causing changes in an indicator?

Reminder…

- This is only one-half of the coupled socio-ecological ecosystem…
  - Human well-being indicators
    - Melissa Poe (Washington SeaGrant)
  - Economic indicators
    - Kevin Decker (Washington SeaGrant)

Questions?