ECOSYSTEM OVERVIEW

September Update

Stephani Zador
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Elizabeth Siddon
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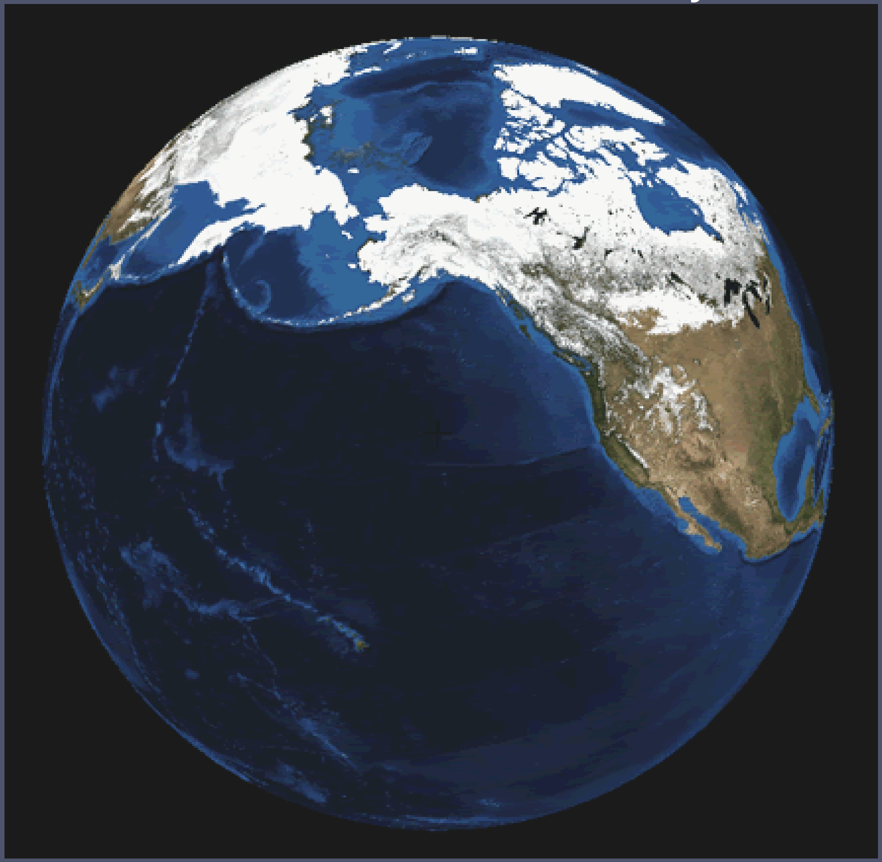
Groundfish Plan Team meeting
Sept 13, 2016

Status of Alaska’s Marine Ecosystems



OUTLINE “everything ecosystem”

1. Climate and Oceanography
2. Ecosystem Surveys
3. New Indicators
4. SPECs – species profiles and ecosystem considerations, sablefish example

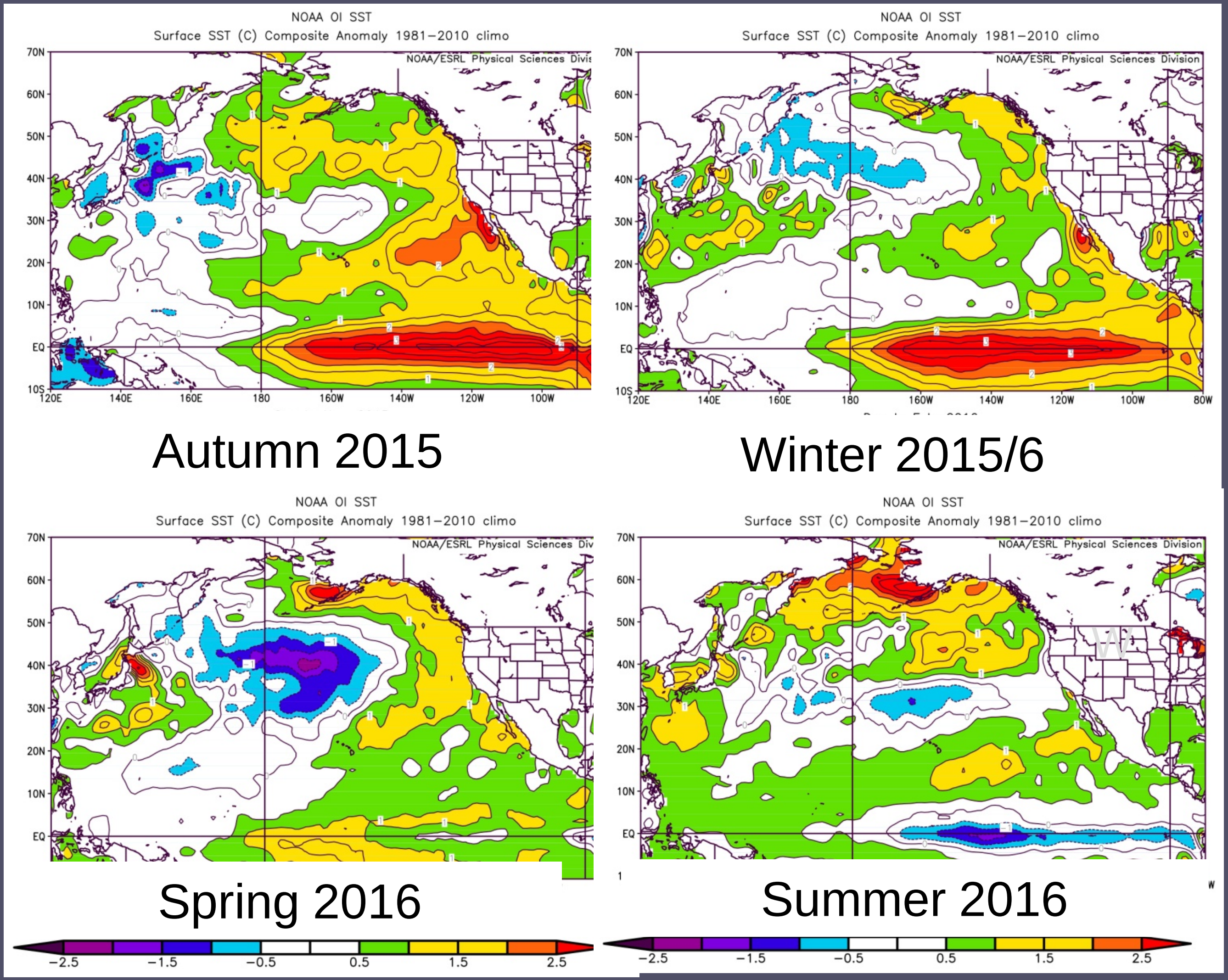
PHYSICAL CONDITIONS

Climate and oceanography

Sea Surface Temperature Anomalies (Bond)

Aleutians cooled to normal

Increased anomaly in EBS and W GOA



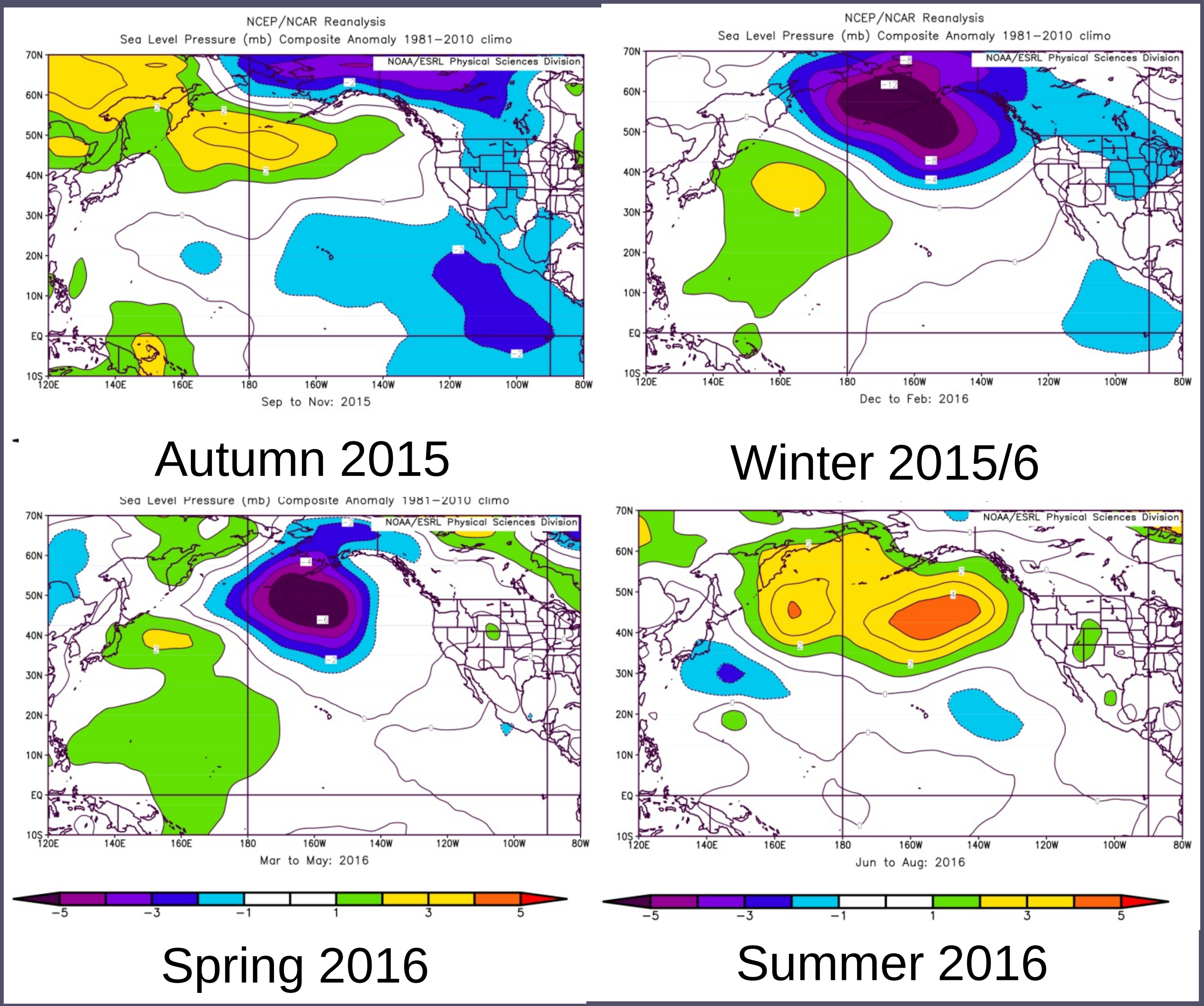
>3ºC pos anomaly in EBS

Development of La Niña?

From NOAA's Optimum Interpolation SST analysis

Sea Level Pressure Anomalies (Bond)

Pattern implies anomalous westerly winds and upwelling in GOA



Lowest low since 1949

Warm wind to E GOA

Suppressed storminess

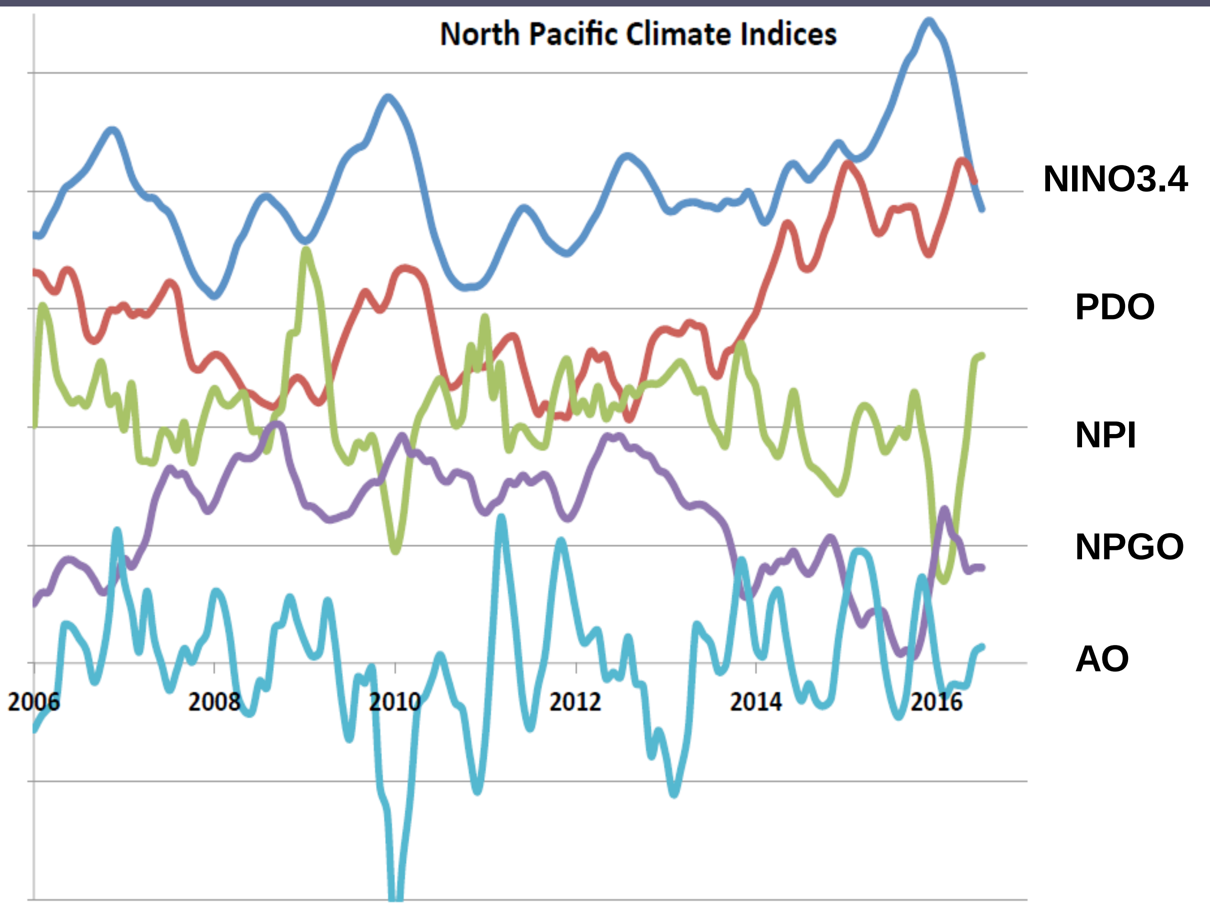
Little mixing, hence warm surface temp

From the NCEP/NCAR Reanalysis project

Climate Indices

(Bond)

North Pacific atmosphere-ocean climate system “highly perturbed”



ENSO declining

PDO has been positive; did not track with recent El Niño

NPI implies deep Aleutian Low; contributed to EBS warmth

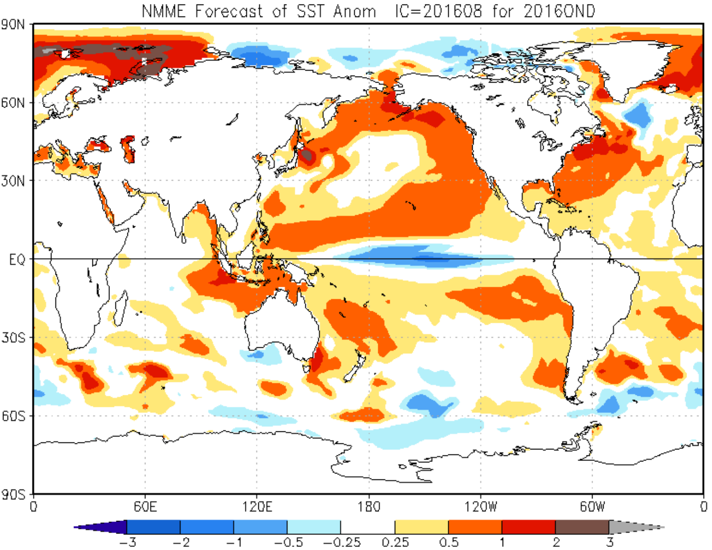
NPGO relates to chemical and biological properties in GOA and CalCOFI area. Negative→ reduced flows in Alaska and CA currents

AO measures strength of polar vortex. Positive = low pressure over Arctic, high over Pacific (45º). Variable signal last winter

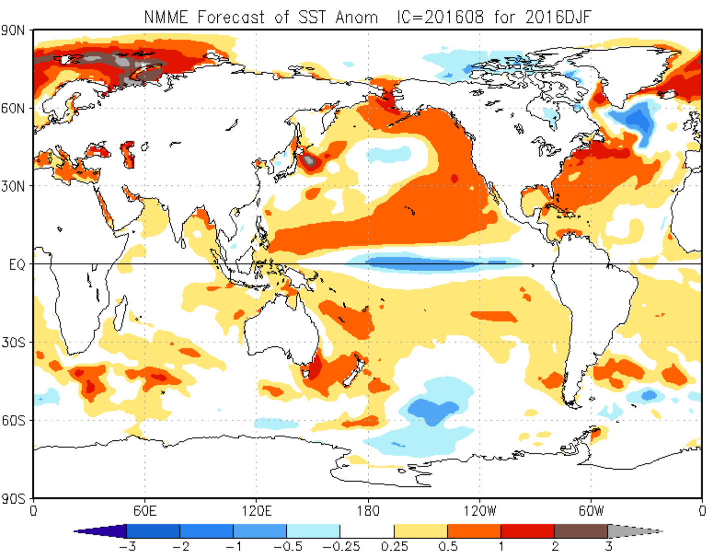
Seasonal Projections from the National Multi-Model Ensemble (NMME)

(Bond)

2016 Oct-Nov-Dec

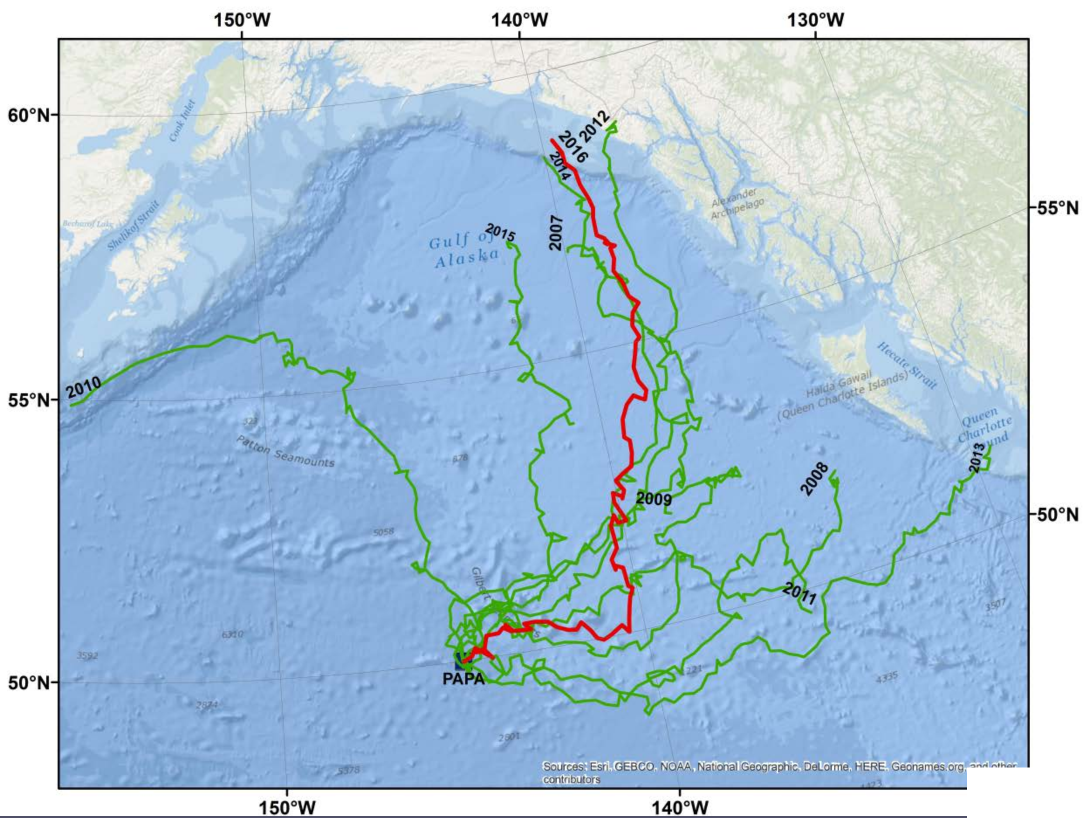


2016 Dec-Jan-Feb



- SST projections
- NMME is average of 6 models
- Continuation of warm
- Strongest positive anomalies in EBS and GOA
- Maintenance of positive PDO conditions with La Niña could reflect extra heat in system

Ocean Surface Currents – PAPA Trajectory Index (Stockhausen and Ingraham)

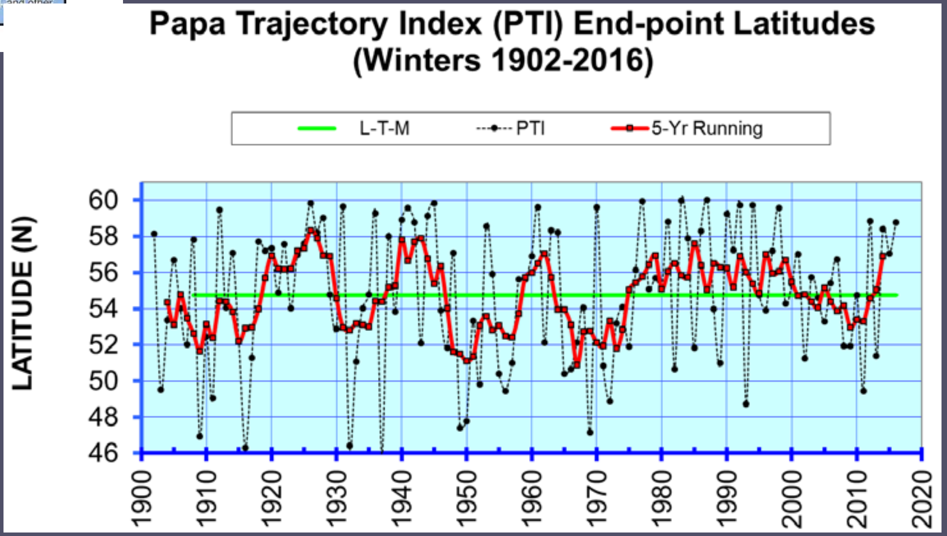


Simulated surface drifter released from Ocean Station PAPA Dec 1 90 days

2015/6 trajectory: similar to past 2 years (S wind anomalies -> “Blob”)

N-ward shift in “boundary” between sub-arctic and sub-tropical species; absence of open ocean LT organisms in SE AK

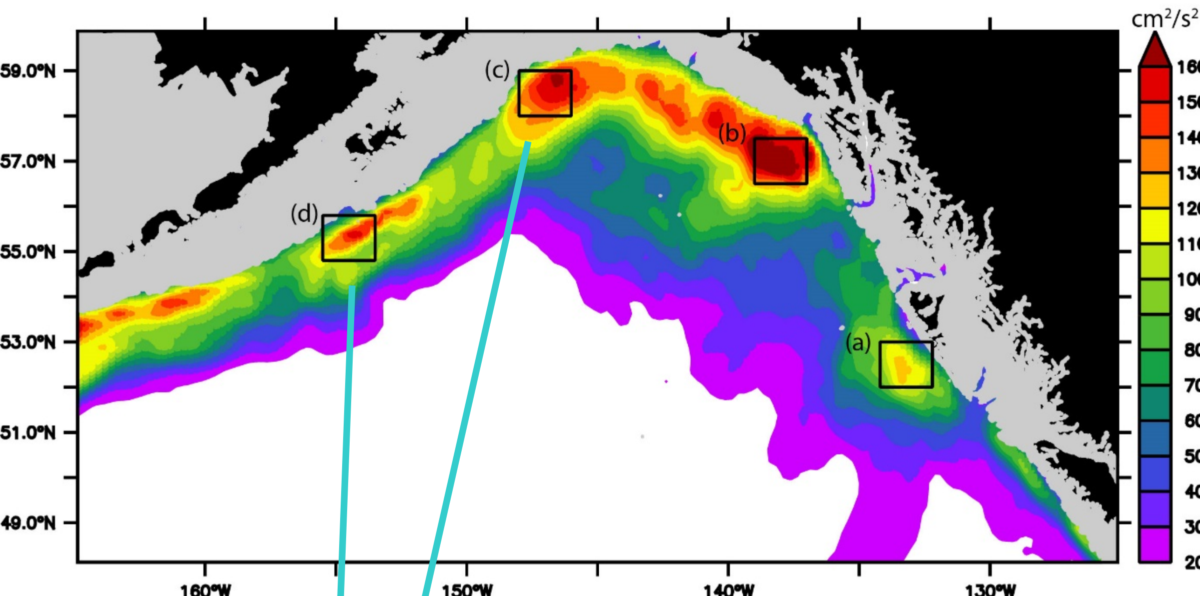
- Changed little from last 2 years - rare
- Recent period of mostly southerly flow is shortest in time-series
- Does **not** indicate return to surface drift conditions similar to <1977 regime shift

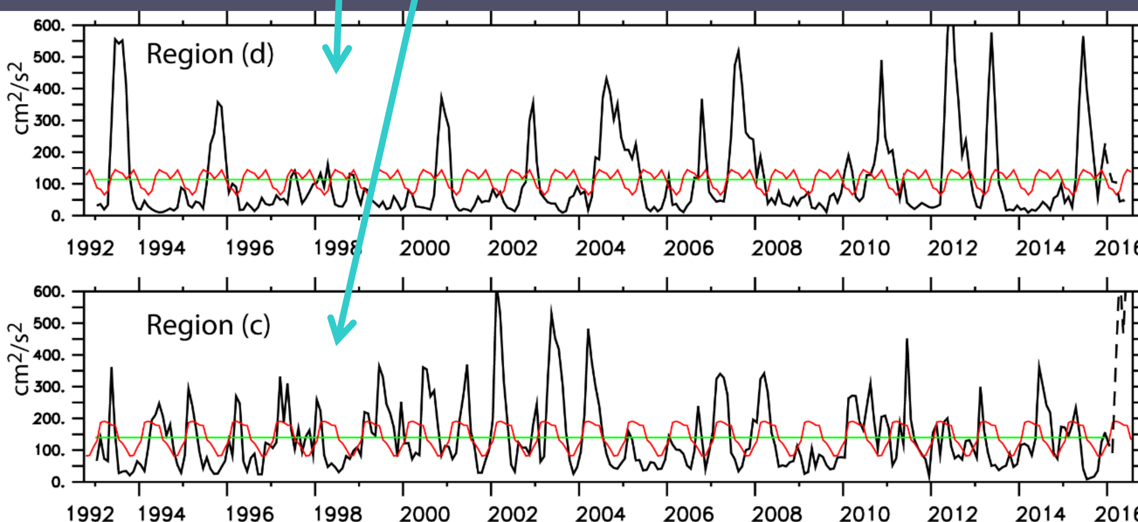


Eddies in the Gulf of Alaska

(Ladd)

Average Eddy Kinetic Energy Oct 1993 - 2014





Seasonal cycles:

(c) High EKE in spring

(d) High EKE in fall

(c) → strong eddy started in Yakutat, Jan 2016; enhanced cross-shelf exchange

(d)→ Currently weak, after recent strong ones in 2012, 2013, 2015

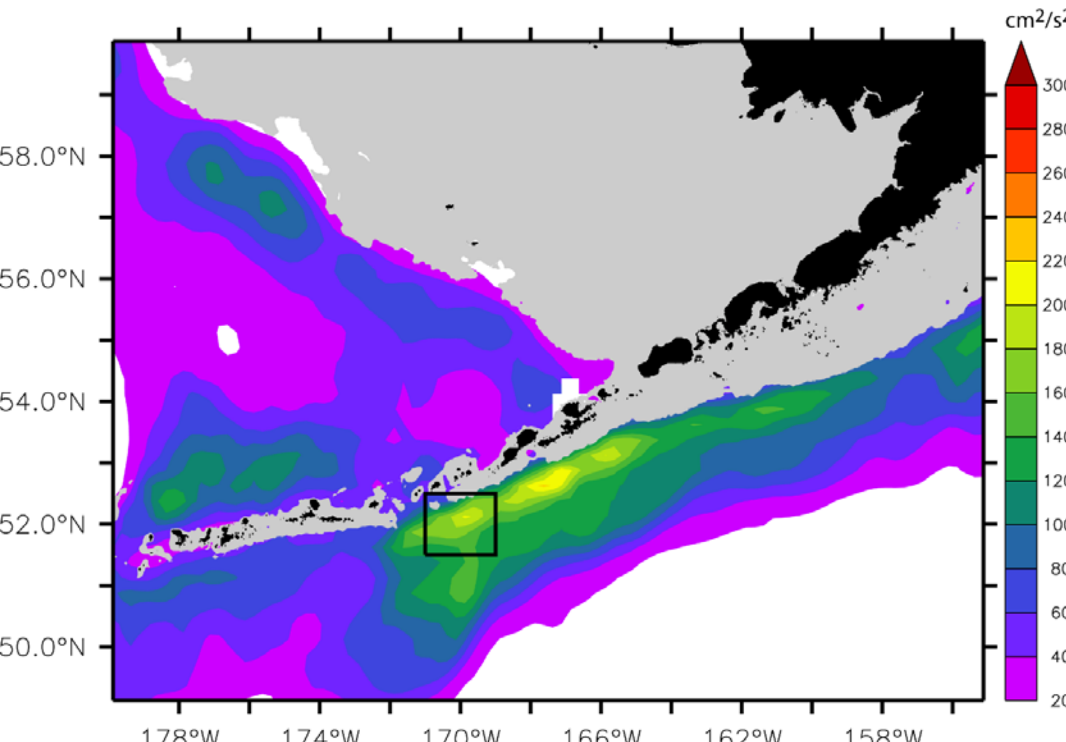
E GOA: influenced by winds (climate and gap scale)

W GOA: influenced by propagation and intrinsic variability

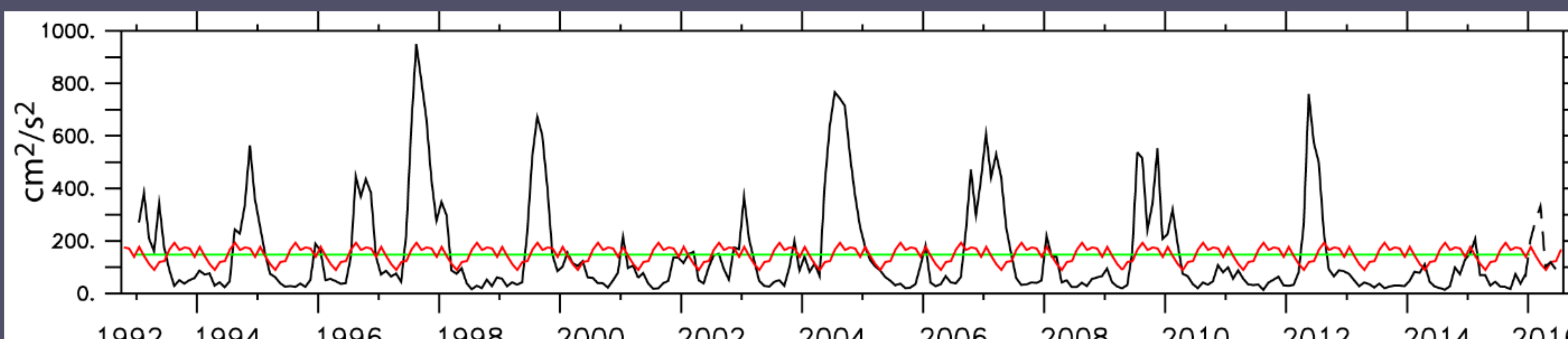
Eddies in the Aleutians

(Ladd)

Average Eddy Kinetic Energy Oct 1993 - 2015

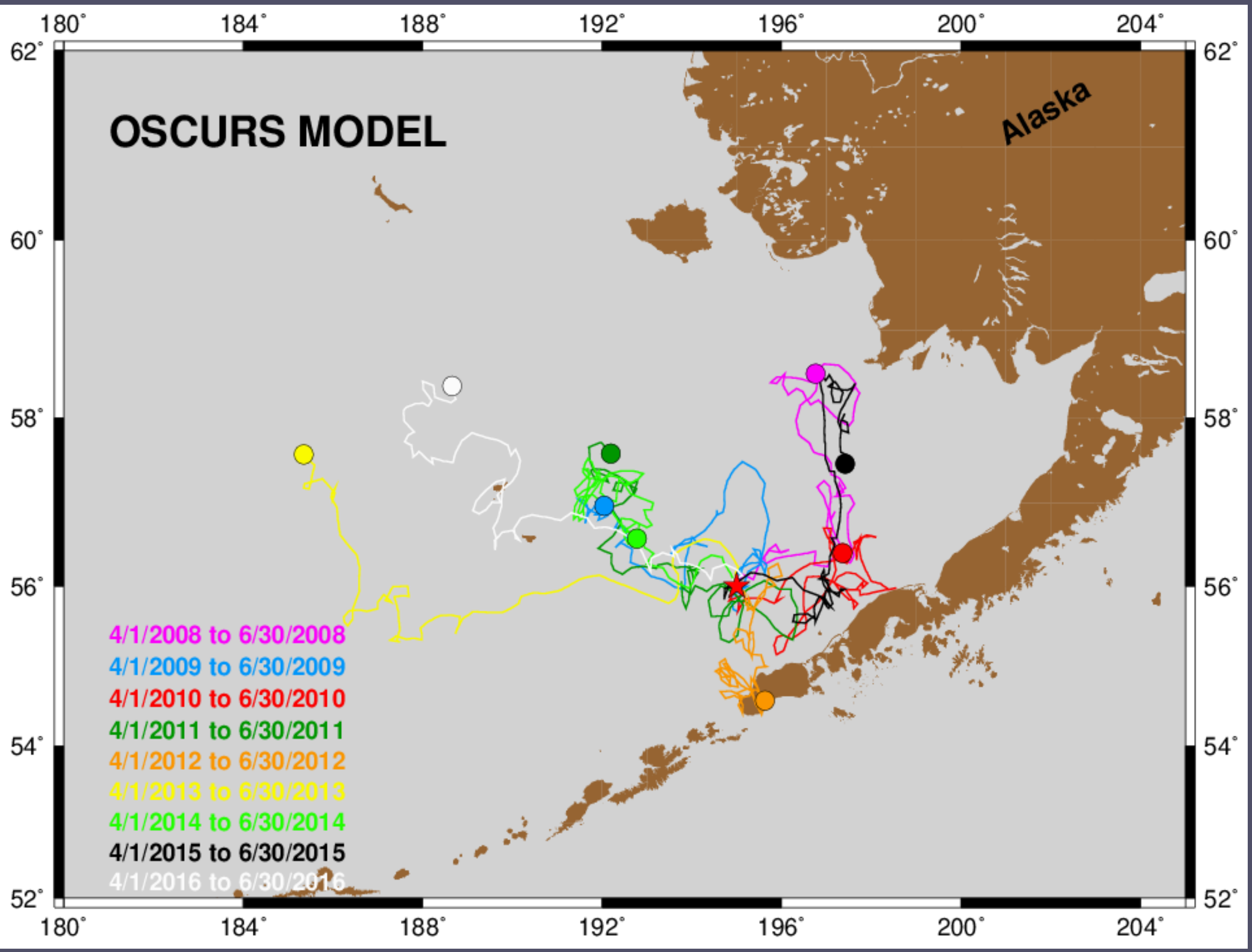


- EKE low fall 2012 –2015
- Small eddy in early 2016
- Lower than average volume, heat, salt, nutrient fluxes to BS through Amukta Pass since summer 2012; possibly enhanced 2016

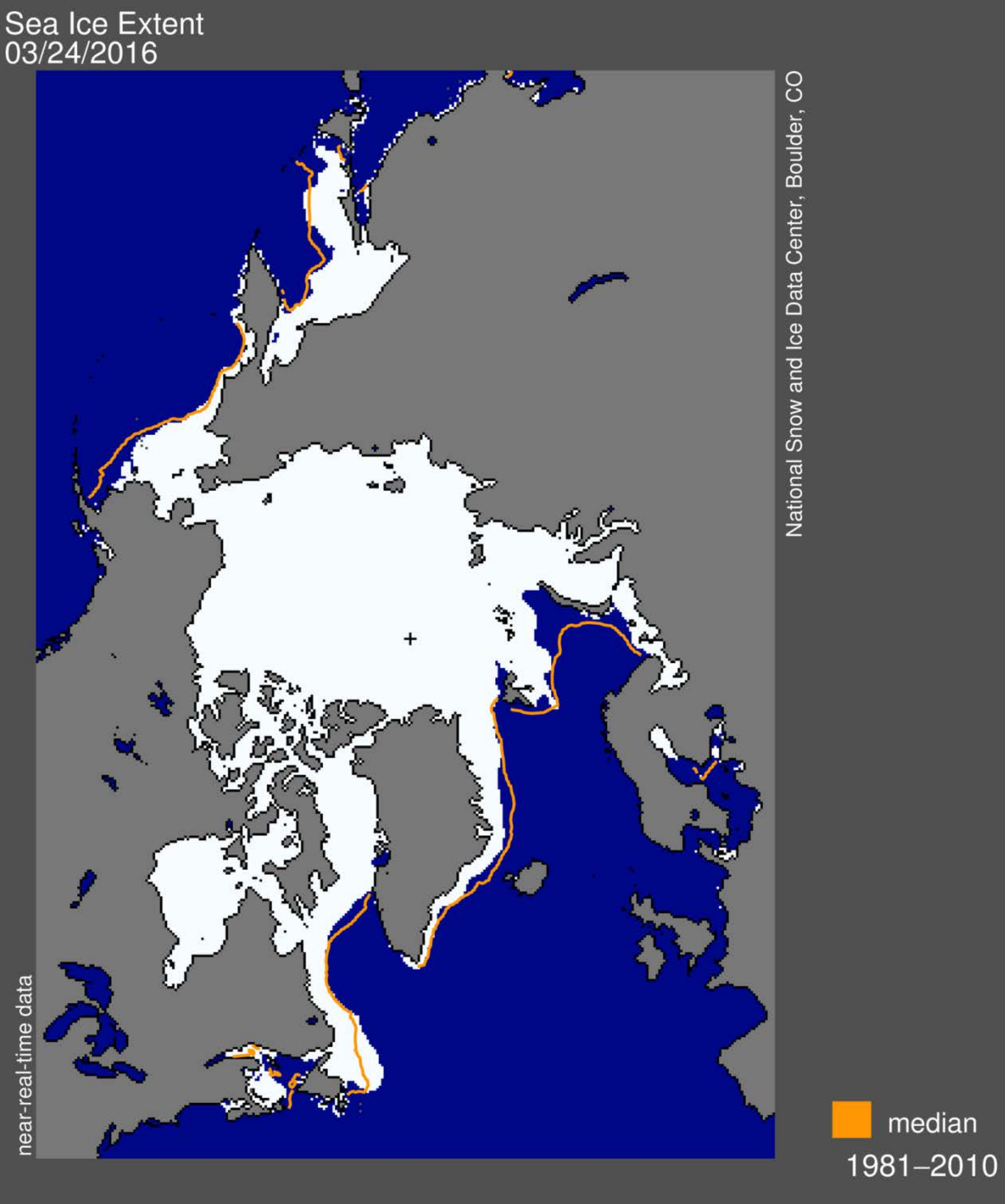


EBS Wind Forcing and Winter Spawning Flatfish Recruitment

(Wilderbuer)



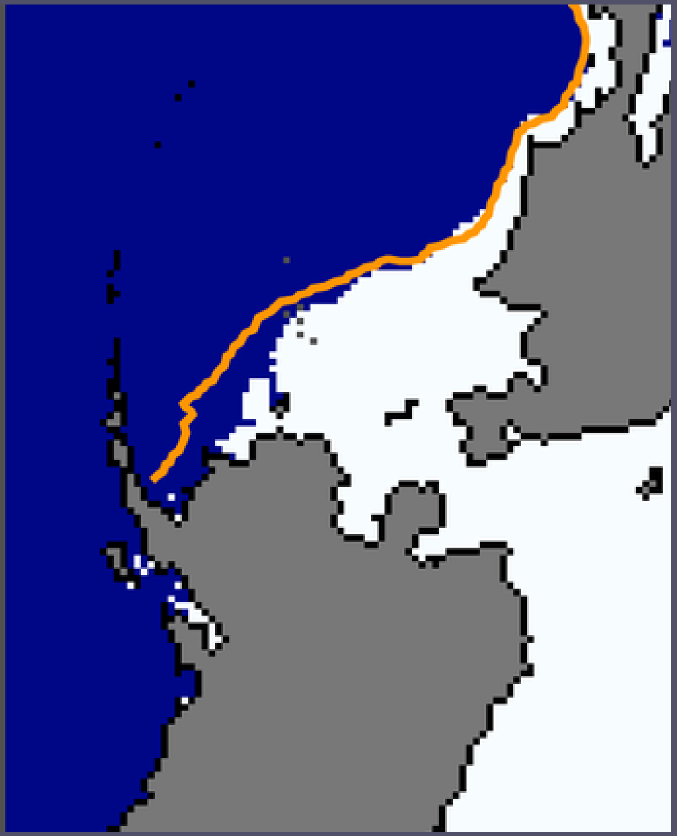
- Direction of wind-forcing during spring linked to flatfish recruitment (northern rock sole)
- Inshore advection to favorable nursery grounds in 2008 and 2015
- 2016 not favorable



EBS sea ice extent

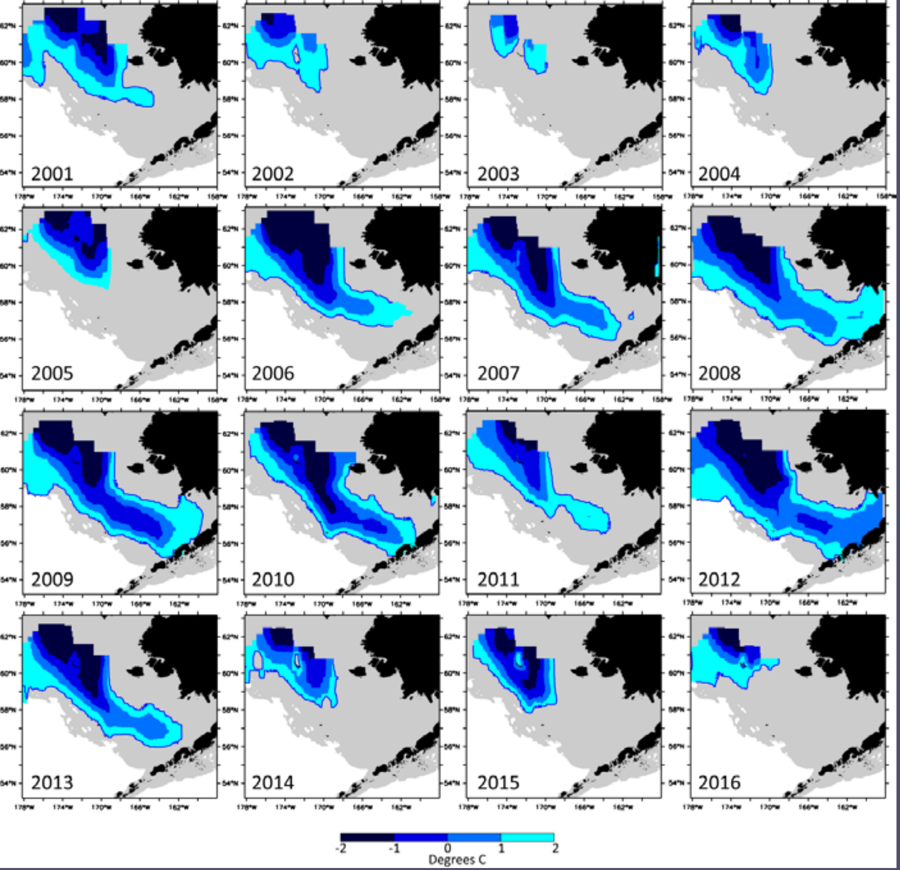
(Overland et al.)

- Record low maximum ice extent, March 24
- EBS-specific TBD



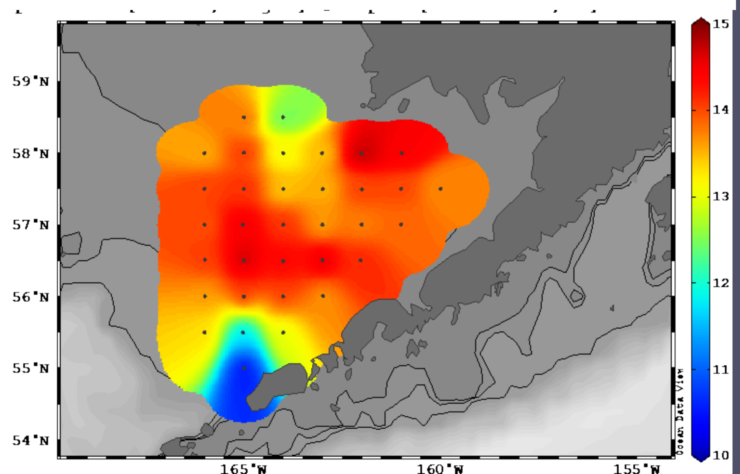
EBS cold pool

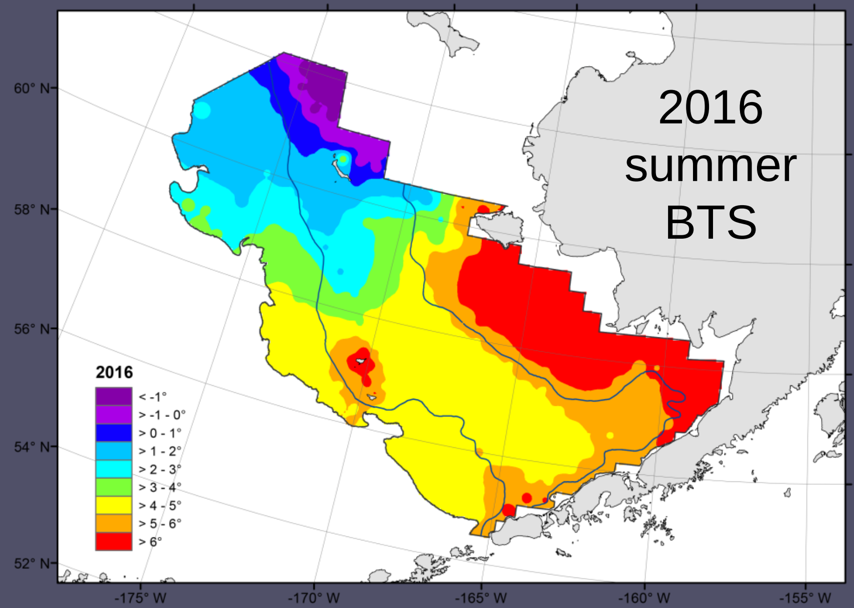
(Overland, Lauth, et al.)



- Reduced cold pool ("puddle")
- Extended warm spell?
- Surface temp 10-15°C and especially warm over the middle domain

2016 late summer BASIS 5 m

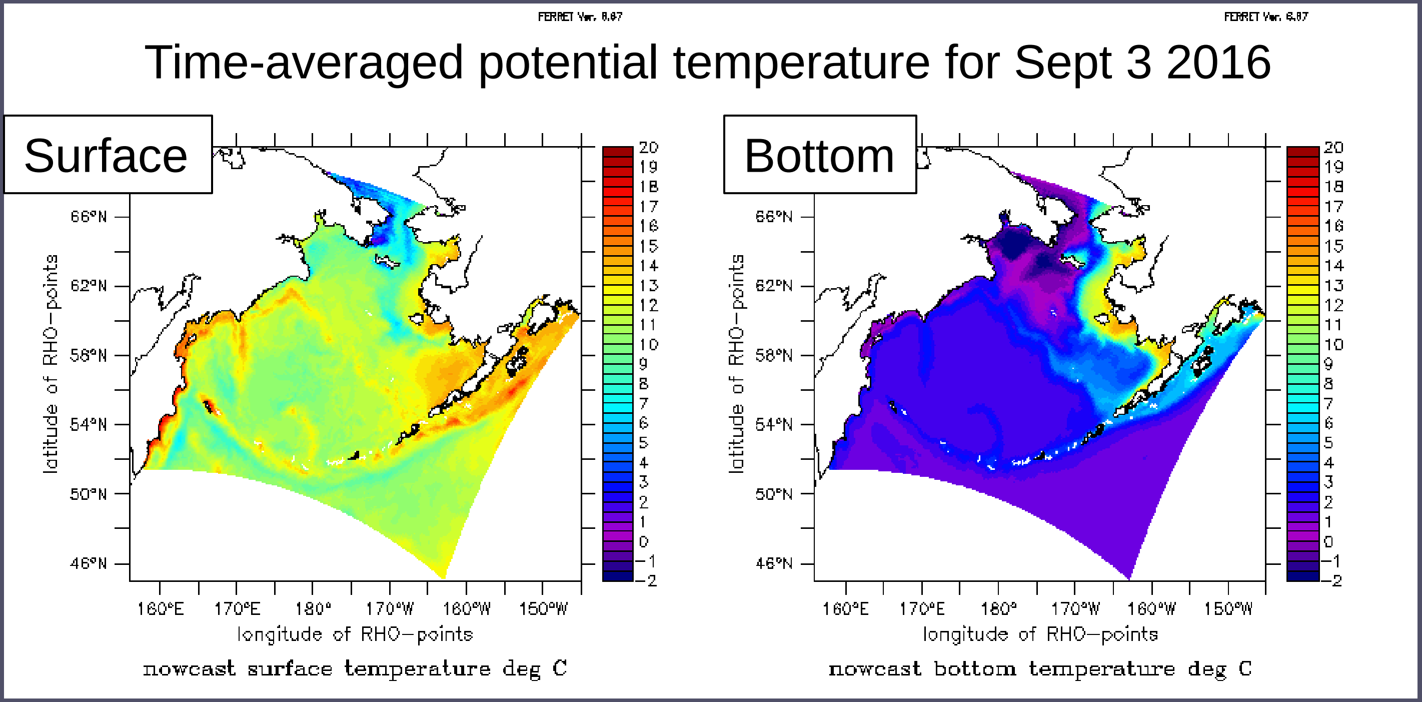




J. Cross, D. Strausz, P. Stabeno (PMEL)

First “nowcast” done (BEST-NPZ)

(Hermann, Aydin, et al.)



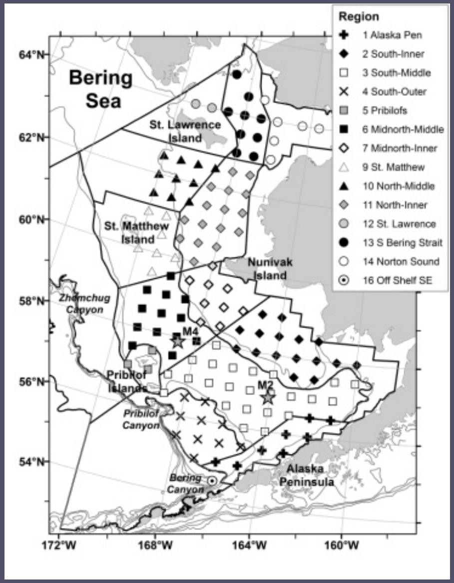
- Surface temps pattern similar to satellite data
- Model can fill in data gap for bottom temps

Variations in temp and salinity - BASIS (Eisner et al.)

Temperatures below MLD

B)

Domain	Region Name and No.		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Inner	South	2	8.7	9.3	9.5	9.2	7.9	6.3	6.5	7.3	7.1	7.0	6.5		6.3	7.3
	Mid-north	7	9.5	9.9	9.9	8.4	7.6	7.9	6.1	7.6	7.3	7.2	6.5		6.1	7.2
	North	11	7.3	7.7	9.0	7.0	6.7	7.1		6.4	6.1	6.8	6.3	5.2	8.8	
Middle	AK Penn	1	7.7	7.8	7.8	7.8	7.9	5.3	6.8	7.0	6.0	6.9	5.4		7.2	7.9
	South	3	4.9	5.2	5.2	5.9	4.1	2.9	2.9	2.6	2.2	3.9	2.0		4.8	5.3
	Pribilofs	5	4.1		7.6	7.5	5.5	4.2		4.2		5.0	3.6		5.9	
	Mid-north	6		5.7	4.3	5.5	2.2	2.9	1.9	3.4	1.9	3.5	2.2		3.4	3.9
	St Matthew	9	3.5	6.0	3.8	4.0	1.5	0.8		0.7	0.7	1.9	1.0		2.5	
	North	10	4.6		3.2	1.3	1.4	1.0		1.3	1.4	0.9		0.6	2.1	
Outer	South	4	6.9	6.8	6.1	6.3	6.0	5.4		5.6	5.0	5.3	5.3		5.5	6.3
> 63°N	St Lawrence	12	6.2	4.4	7.0		4.7	6.4		3.9	5.4	3.9	5.5	5.6		
	S Bering Strait	13	5.4	5.8	6.9	7.4	4.7	6.1		3.7	5.5	5.1	3.2	3.3	5.5	
	Norton Sound	14	7.3	10.2	11.4		8.1	10.3		8.0	8.6	7.5	6.8	8.2	8.9	
Offshore	southeast	16	5.7	6.7	5.5	6.1	6.0				5.3	5.2			4.5	



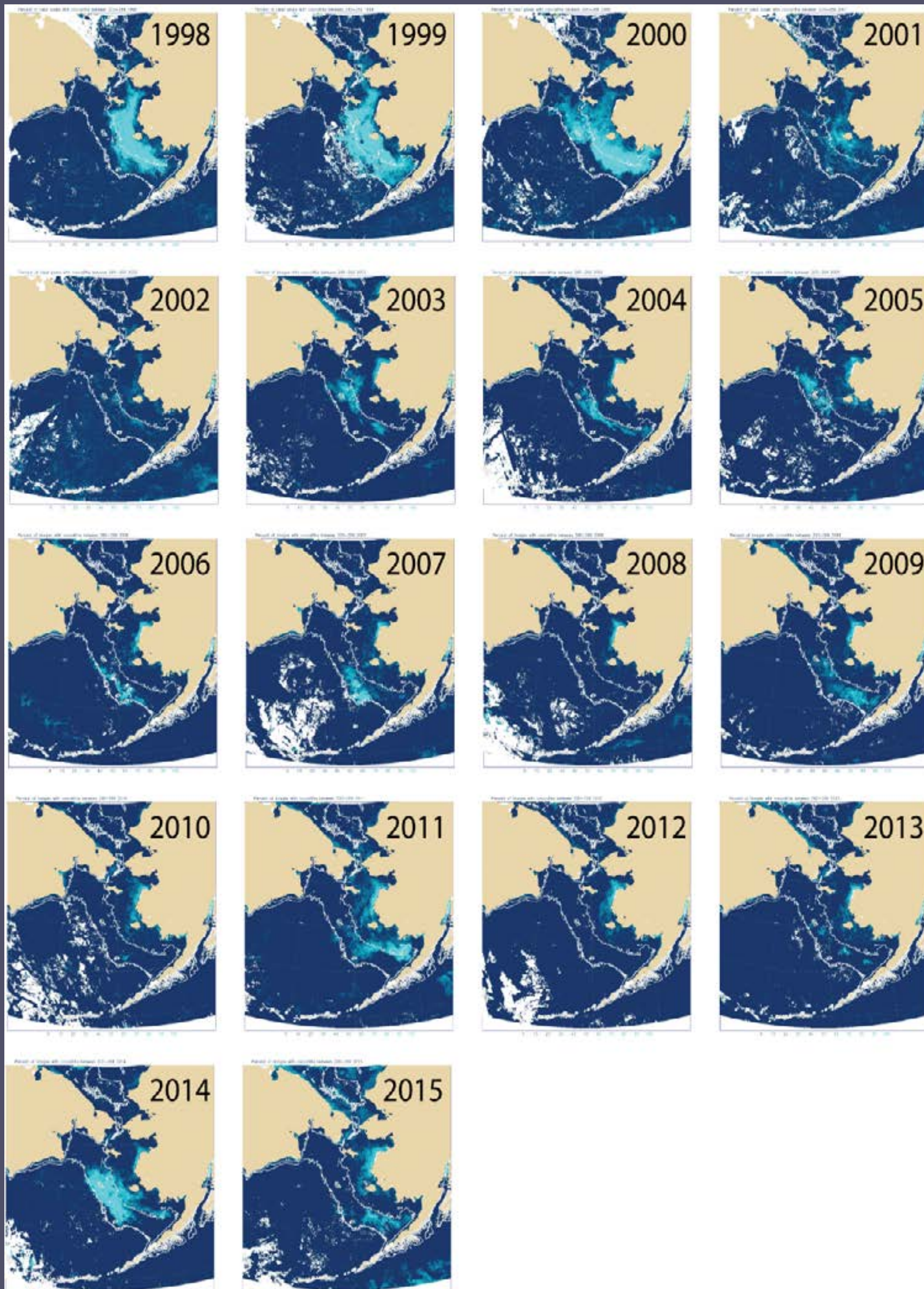
Salinity below MLD

D)

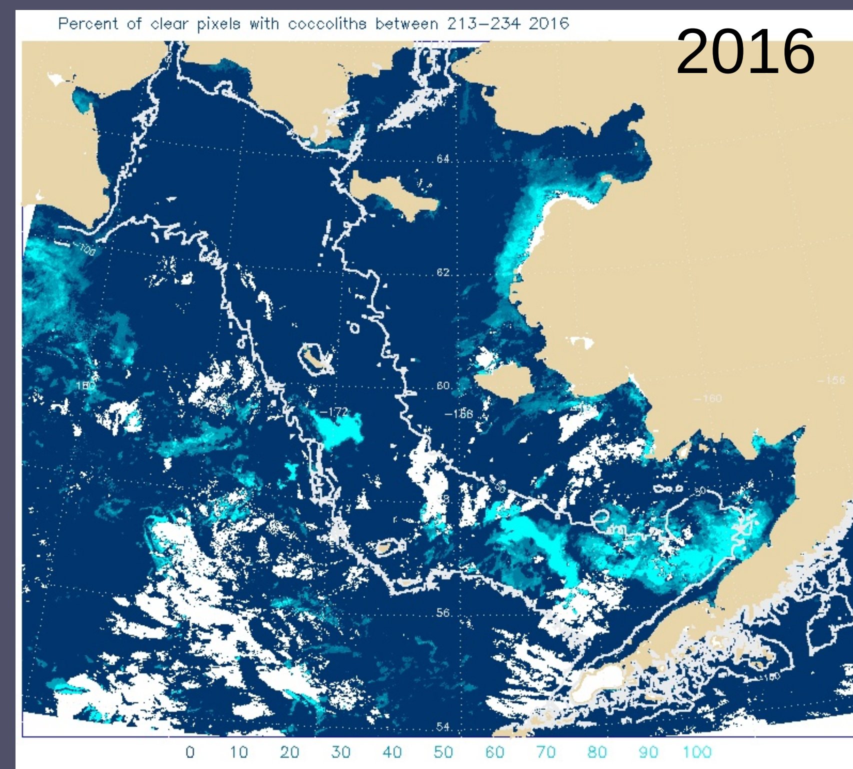
Domain	Region Name and No.		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Inner	South	2	31.40	31.25	31.05	31.17	30.96	31.30	31.18	31.07	31.26	30.90	31.30		31.90	31.82
	Mid-north	7	31.48	31.25	31.20	31.20	30.88	30.99	31.21	31.28	31.29	31.06	31.12		31.67	31.96
	North	11	30.54	30.65	30.68	31.04	30.66	30.77		30.91	30.77	30.91	30.93	30.74	30.17	
Middle	AK Penn	1	32.12	31.94	32.02	32.08	32.01	32.18	31.89	32.05	31.99	32.21	32.16		32.15	32.24
	South	3	32.07	31.88	31.96	32.08	31.88	31.81	31.91	31.77	31.73	31.94	31.81		32.08	31.93
	Pribilofs	5	33.14		32.07	32.09	32.07	31.91		32.24		32.08	32.09		32.21	
	Mid-north	6		32.06	31.97	32.07	31.83	31.64	31.74	31.61	31.53	31.63	31.72		32.03	32.07
	St Matthew	9	31.64	31.57	31.57	32.04	31.38	31.52		31.54	31.15	31.24	31.49		31.25	
	North	10	31.68		31.13	31.60	31.37	31.75		31.45	31.77	31.39		31.61	31.31	
Outer	South	4	32.76	32.61	32.48	32.49	32.53	32.59		32.66	32.51	32.64	32.61		32.64	32.45
> 63°N	St Lawrence	12	32.22	31.72	32.12		31.99	31.80		31.90	31.68	32.22	31.80	31.59		
	S Bering Strait	13	31.46	31.49	31.24	31.21	31.62	31.68		31.68	31.56	31.75	32.00	31.69	31.77	
	Norton Sound	14	29.11	27.95	29.80		29.69	29.15		29.98	29.80	29.51	29.71	29.92	29.66	
Offshore	southeast	16	33.17	32.74	33.09	33.22	32.74				32.91	33.02			33.47	

- Temps and salinity above and below mixed layer depth
- Below better reflects longer term climatic shifts
- Above influenced by episodic mixing events

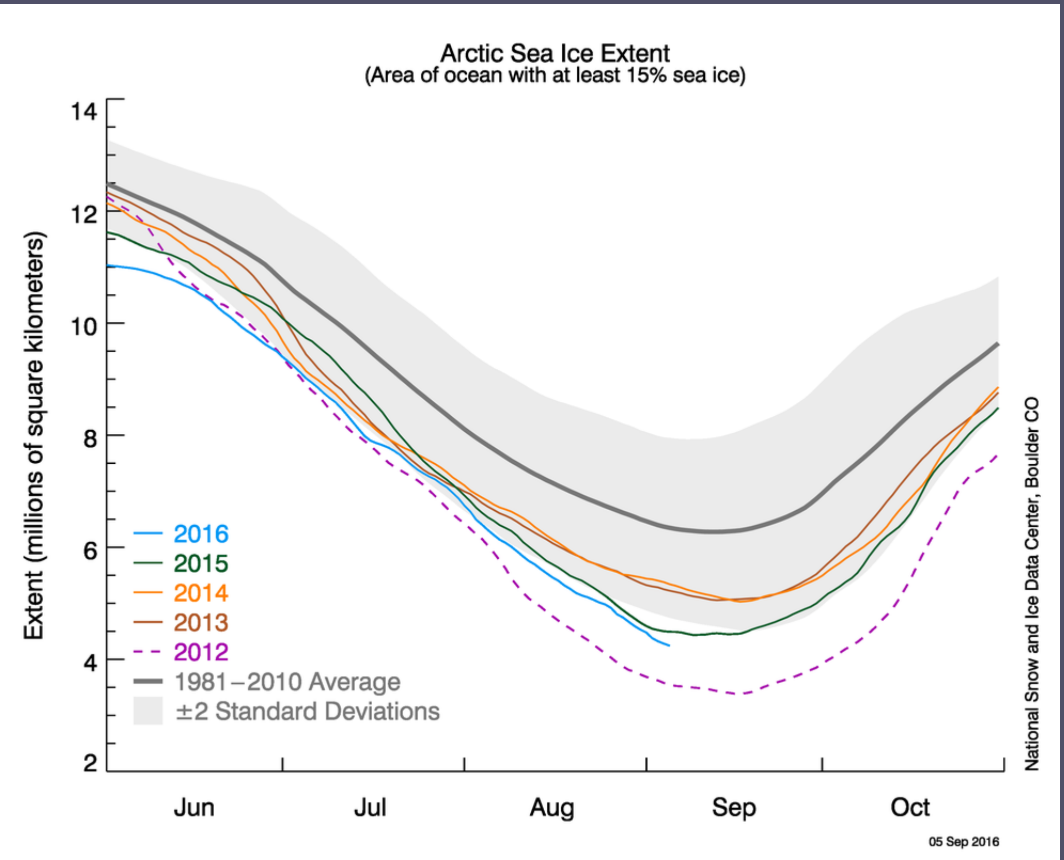
Coccolithophores
(Ladd and Eisner)



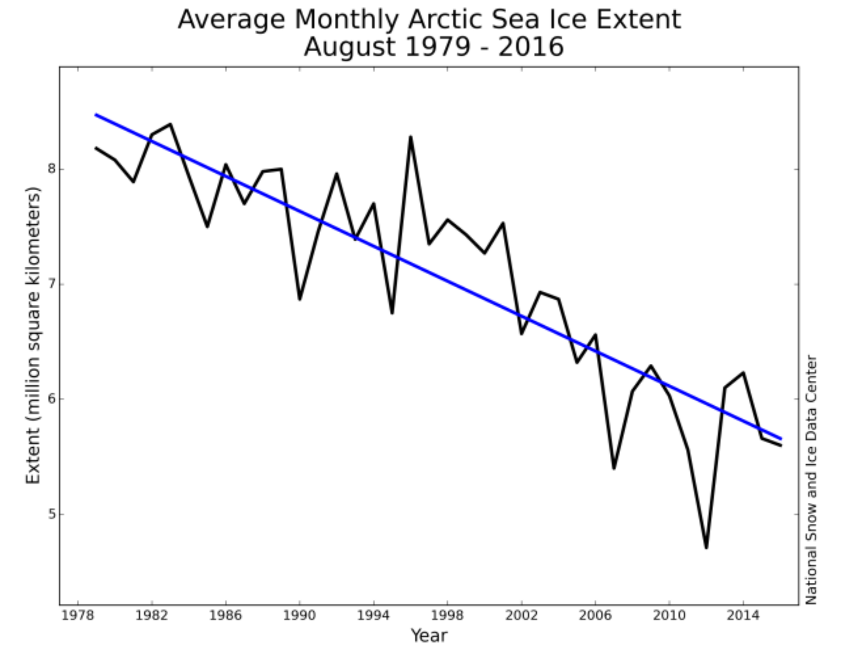
- Preliminary data suggests bloom this year
- Trophic implications – smaller than diatoms -> longer chains; less desirable for microzooplankton
- Neg impacts on visual foragers



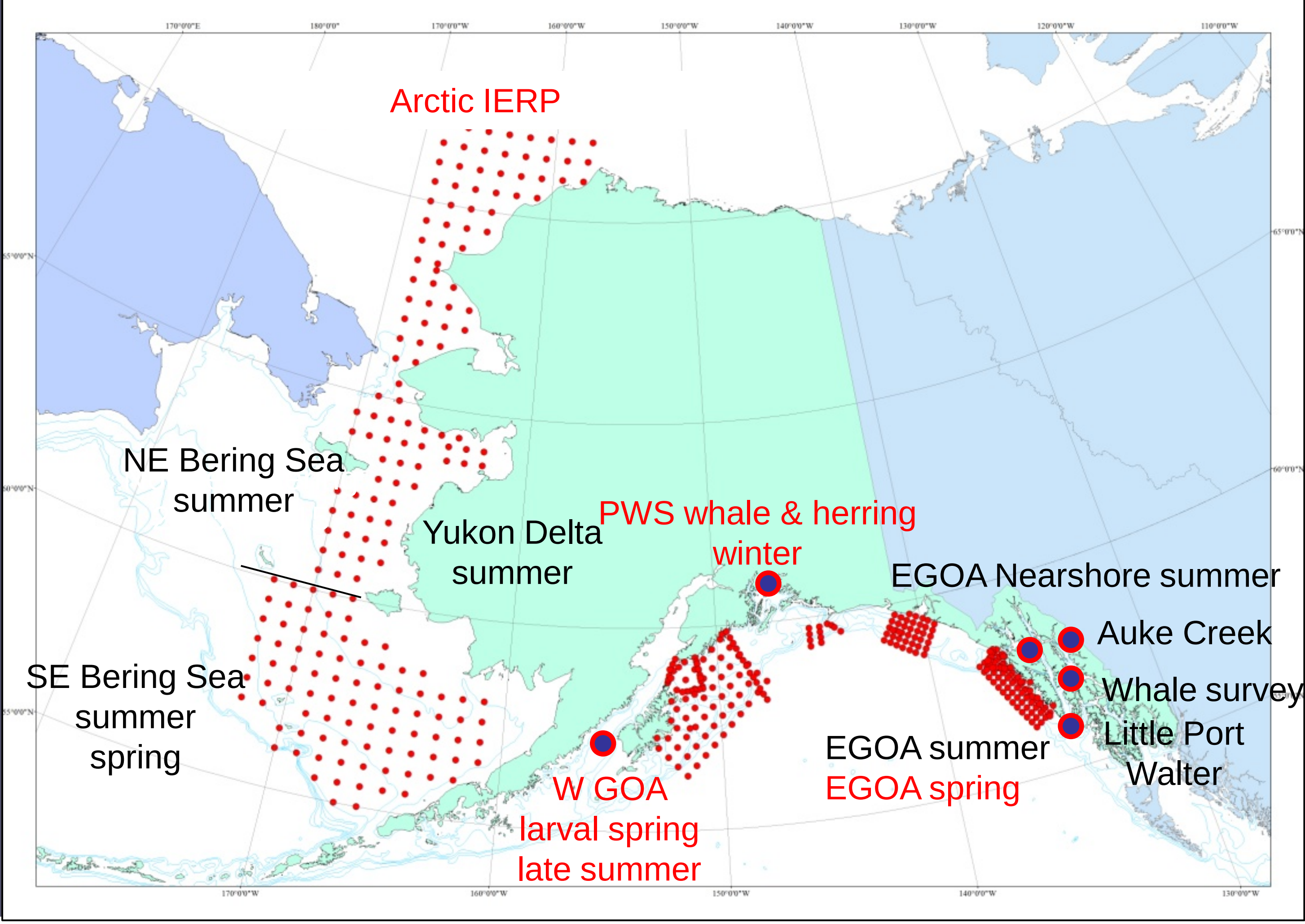
Arctic Sea Ice Extent



- 4th lowest August extent
- 10.4% decline per decade



AFSC



2016 Ecosystem Surveys & Observations

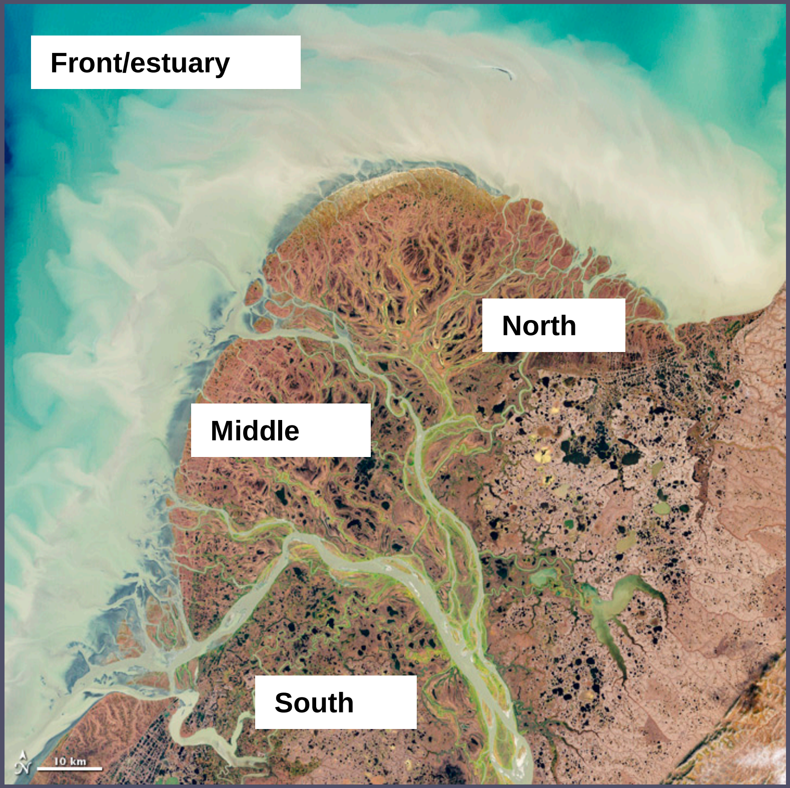
Courtesy: Farley

Northern Bering Sea Surveys

- Marine and estuary surveys
- Inform the 3 river index for Chinook salmon productivity
- Leading index for future adult returns of Chinook salmon
- Provide FEAST model input
- Assessing the impacts of the loss of sea ice on marine species

Contact: Kristin Cieciel and Katharine Miller

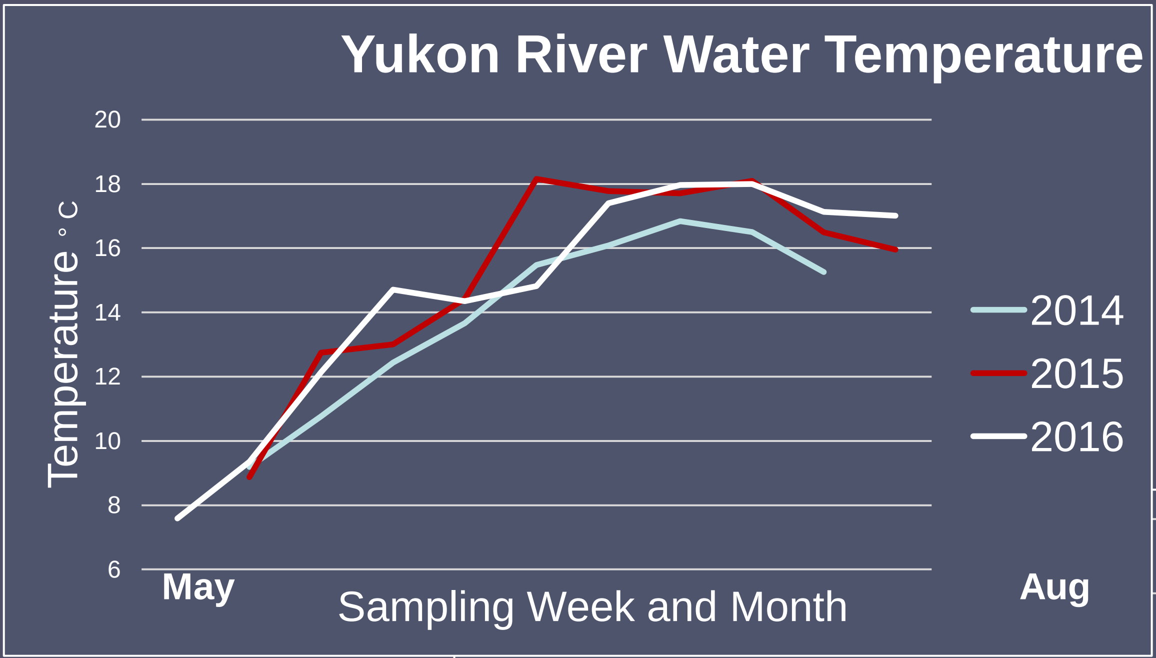
Yukon Estuary survey



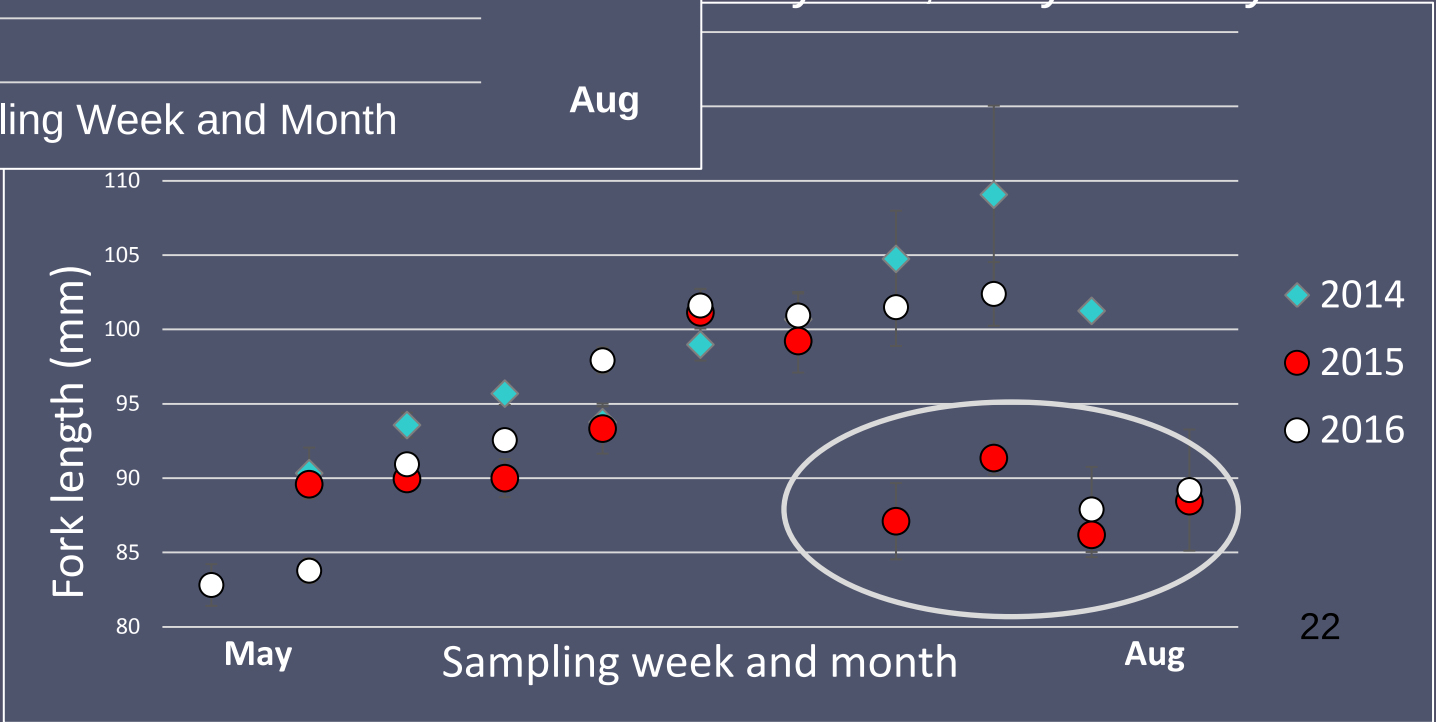
Contact: Katharine.Miller@noaa.gov

- 2014-2016
- First sampling since 1980s
- Sampling in the three lower Yukon River distributaries and river plume
- Yukon juvenile Chinook run timing, size, diet, and condition
- Targets early marine residence where mortality is high

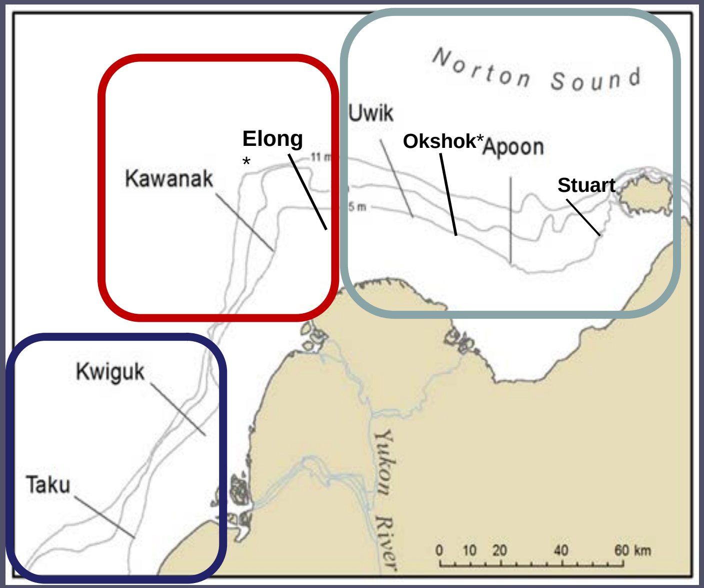
2016 Observations: Yukon Estuary



- Warmer in 2015 and 2016, than 2014
- Smaller in 2015 & 2016, larger 2014
- Age-0 emigration in warm years, early maturity



2016 Observations: Yukon Estuary

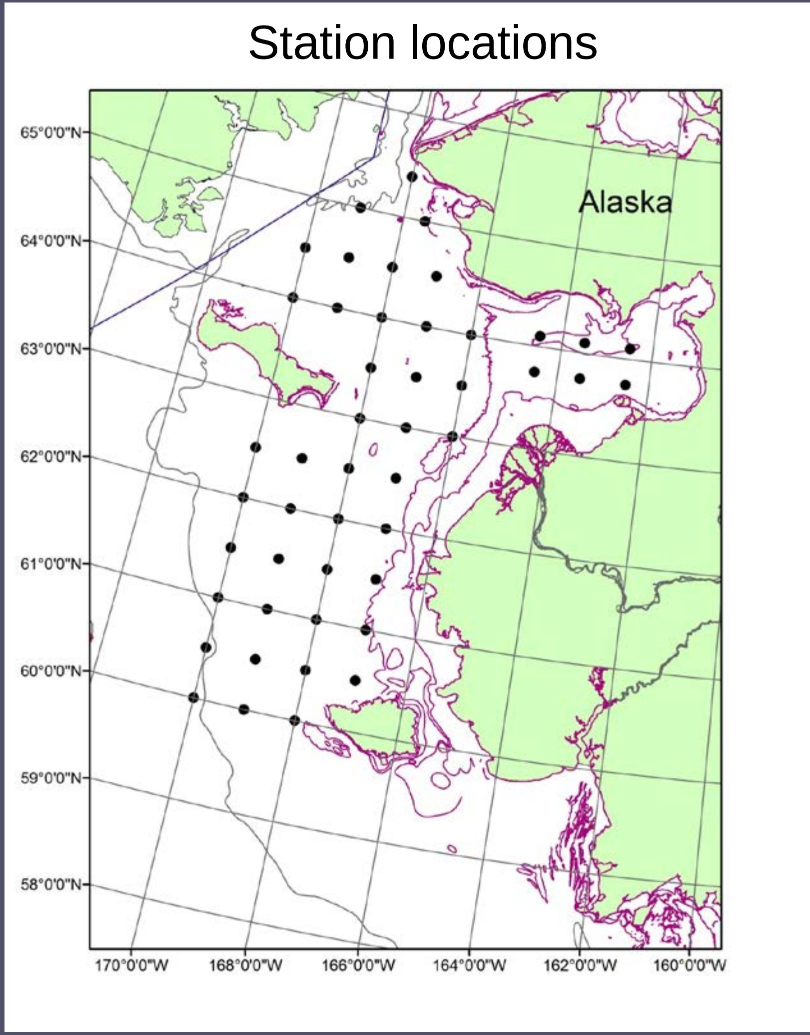


- Alternating year pattern in species composition
- Juvenile Chinook salmon moved northward after leaving distributary mouth
- J. chum salmon more evenly distributed

Species	Lifestage	2014	2015	2016
Ninespine stickleback	Juvenile	24.09%	18.38%	41.39%
Rainbow smelt	YOY	50.73%	0.51%	38.08%
Capelin	Larval	0.25%	20.59%	1.47%
Chum salmon	YOY	2.21%	13.27%	2.58%

Stations marked with * were sampled in 2016 only

Northern Bering Sea survey



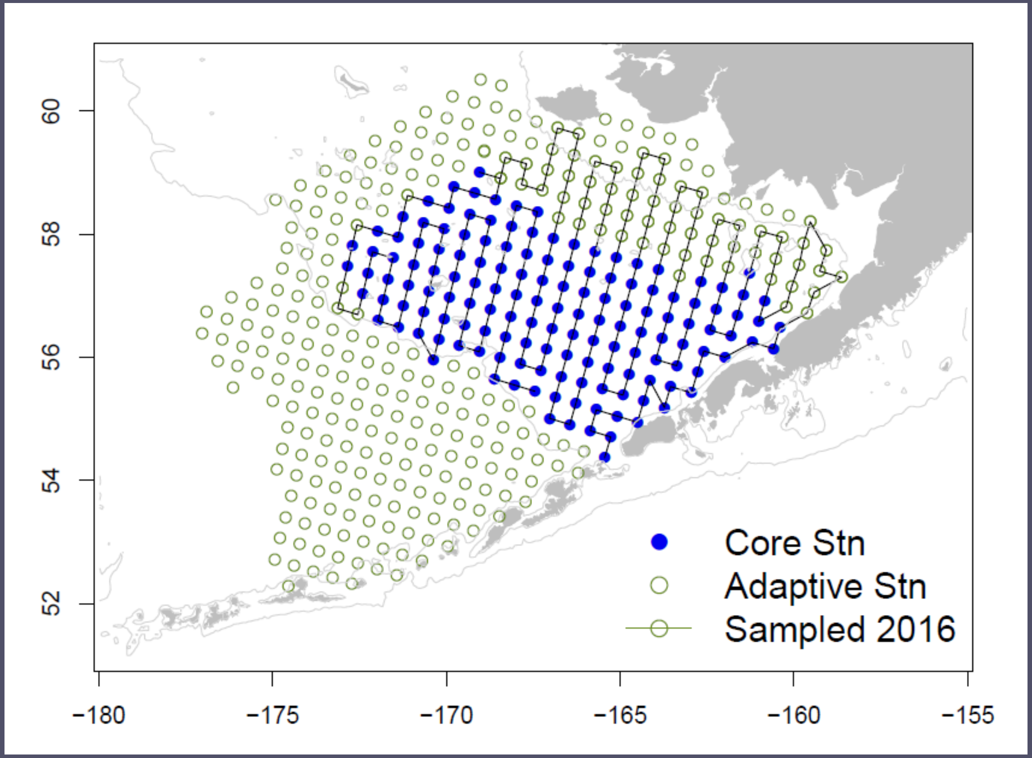
- 2003-2016 late summer
- Surface trawl and oceanography
- Pollock, salmon, forage fish, jellyfish
- Large catches of age-0 pollock
- Large catches of juvenile chum
- Juvenile Chinook salmon abundance index predict returns to the upper Yukon River (Murphy).
- In cold years, volume of river discharge predicts the abundance of juvenile Chinook salmon (Gann in prep.)

Contact: Kristin Ciecie

Southern Bering Sea Surveys

- Studying mechanisms driving the variability in pollock recruitment
- Provide information on warm/cold years and zooplankton communities that influence recruitment and overwintering success of pollock
- Implications for predicting summer bycatch of chum salmon

2016 Spring egg & larval survey



Survey redesign

Core stations, stations farther apart, and adaptive sampling based on pollock abundance

Eggs and larvae of groundfish (esp. pollock, flatfishes)

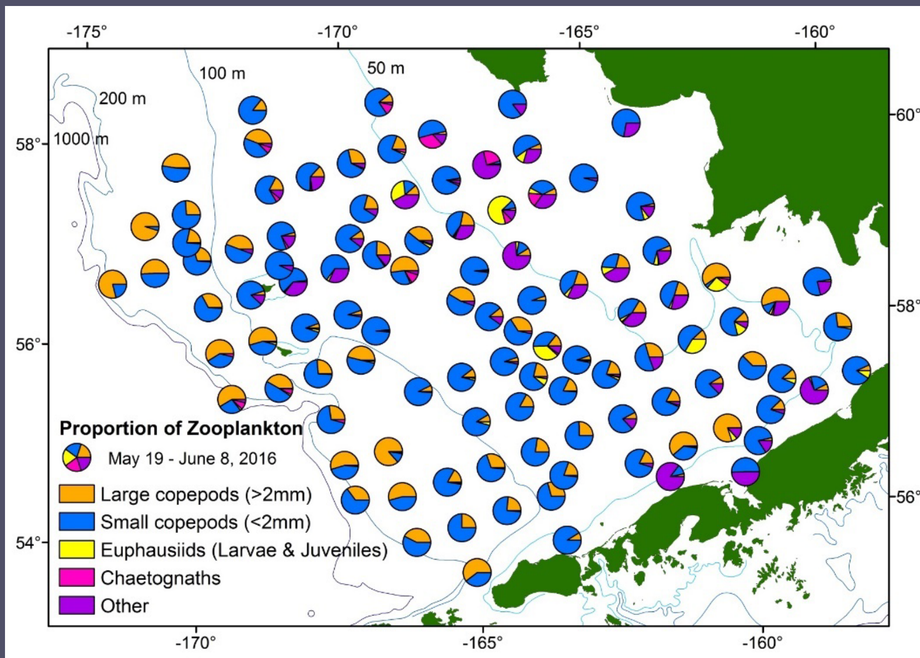
Abundance, size, condition
Zooplankton community
Temperature, salinity

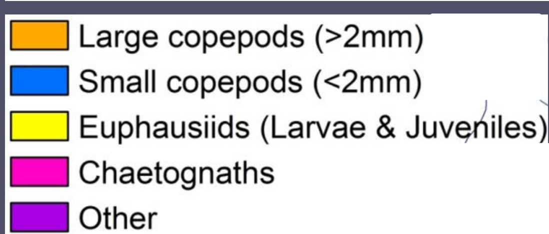
Rapid assessments at sea

Zooplankton species composition
Larval pollock abundance
Larval Pollock distribution

Contact: Janet Duffy-Andersen

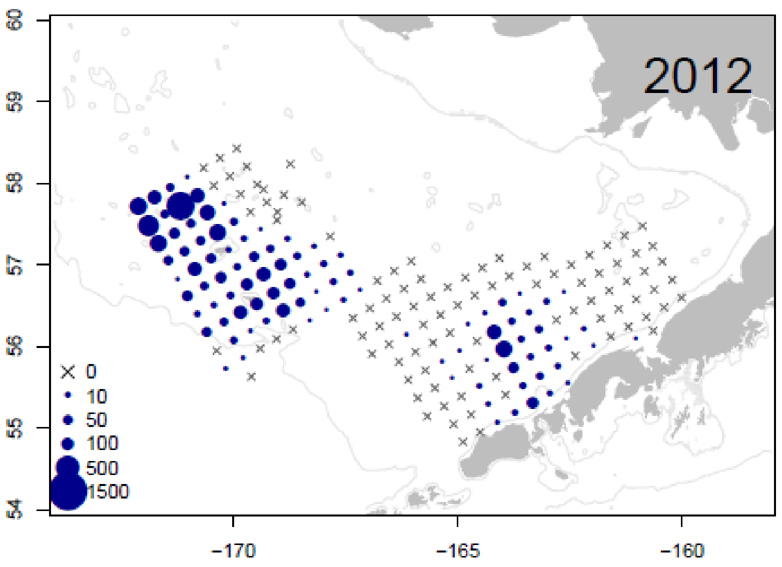
Rapid assessment spring zooplankton community

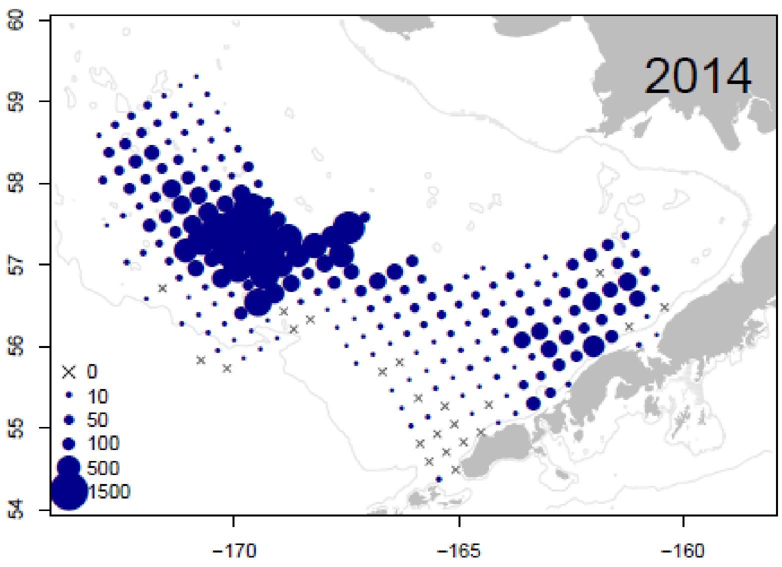


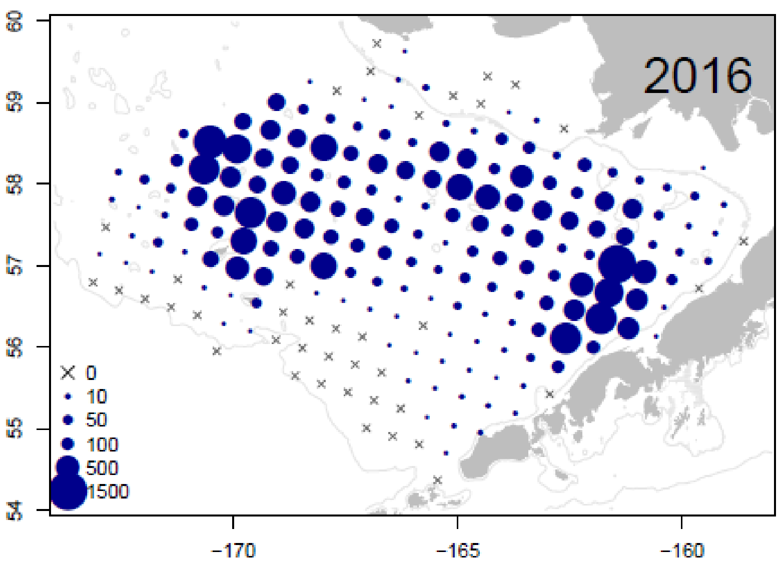


- 2016 dominated by small copepods, as expected with warmer conditions
- Smaller copepods are less energy-rich prey for pollock
- Few large copepods in the inner and middle domains, where the majority of pollock larvae were found

Rapid assessment Larval pollock counts

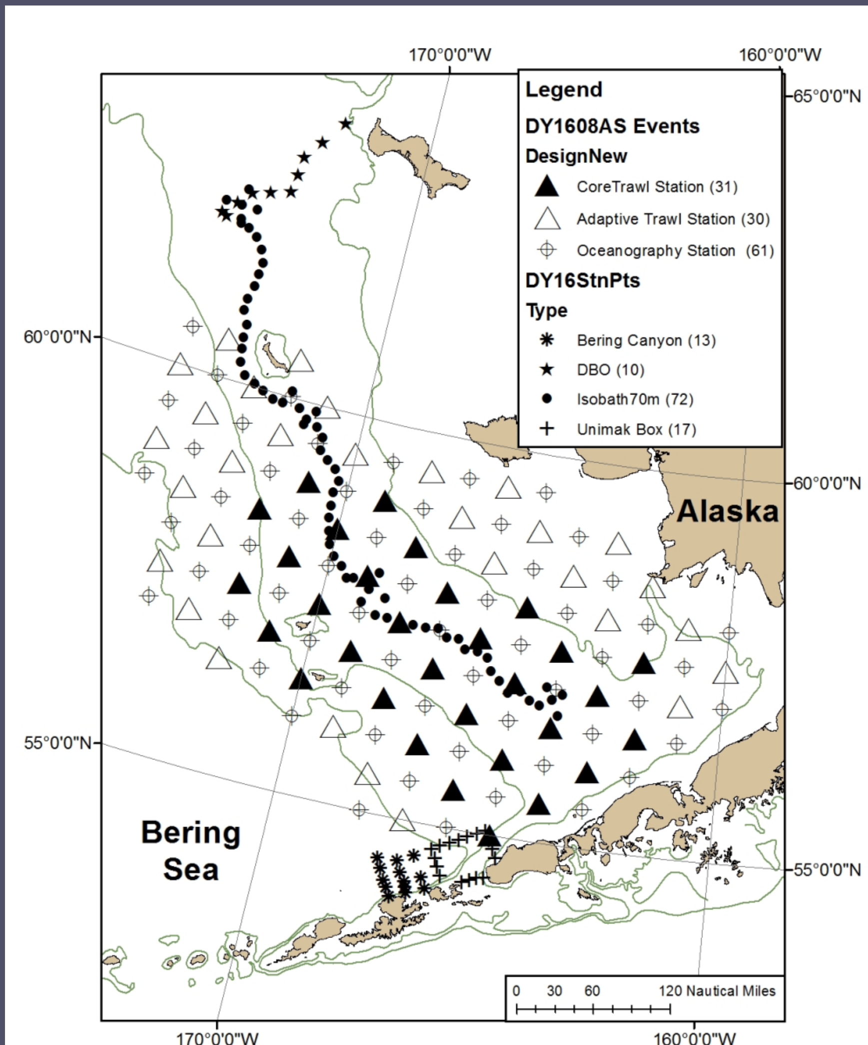






- High larval pollock counts in 2016
- Distributed on-shelf, consistent with warm-year observations
- Likely reflects changes in spawning location and currents (Petrik et al. 2014, Smart et al. 2012)
- Ongoing research: how does spatial overlap with prey affect condition, survival?

2016 late summer EBS survey



Survey redesign

Combined surface, mid-water trawls with acoustics in 2016.

Age-0 pollock, P. cod, capelin, herring, salmon, atka mackerel, sablefish, jellyfish

Energy density of age-0 pollock to predict over-wintering survival

Rapid assessments

Zooplankton

Age-0 Pollock abundance

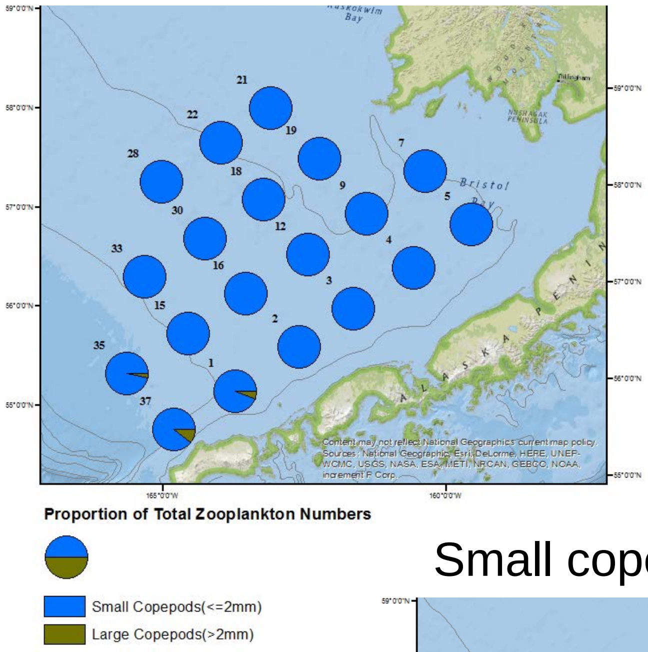
Age-0 Pollock distribution

Contact: Elizabeth Siddon

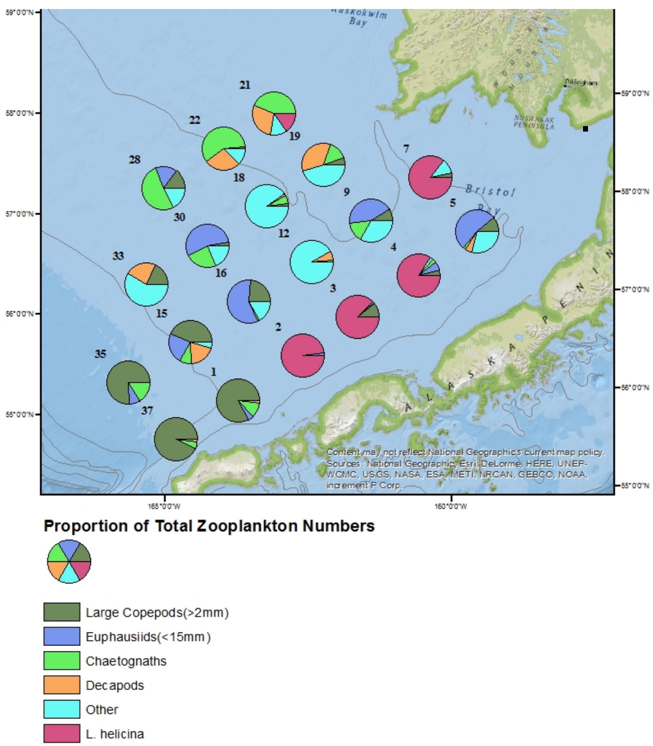
Late summer zooplankton rapid assessment

(Lamb, Spear, Siddon (RPA))

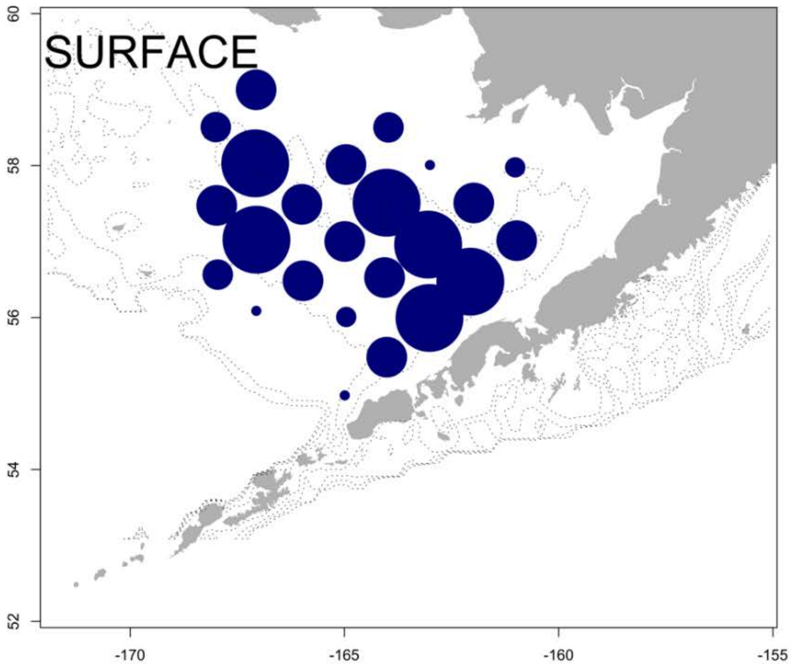
Proportion total zooplankton

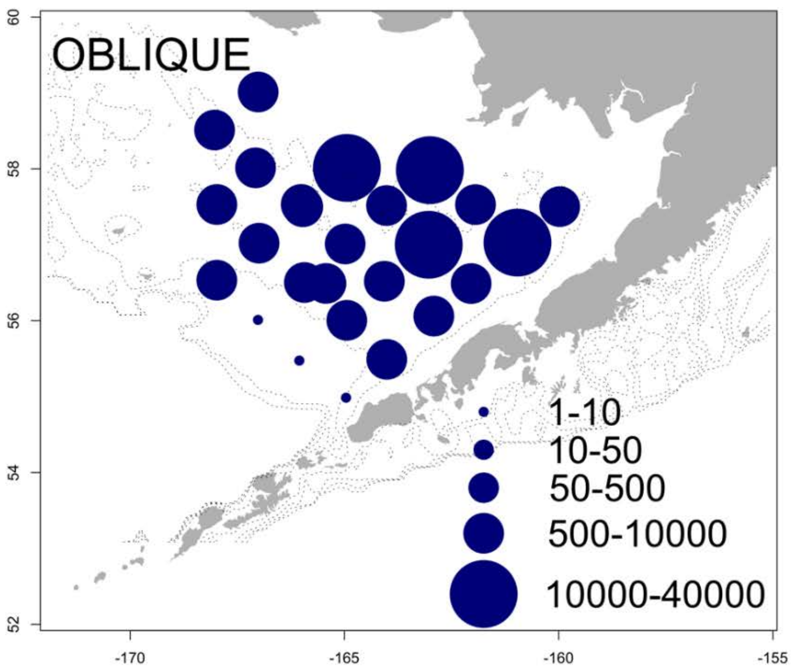


Small copepods removed



- Overall low zooplankton volume
- Small copepods dominated the rough count numbers, but *Pseudocalanus* spp. was rare
- Large copepods (i.e., *Calanus marshallae*) present in southwest.
- Euphausiids juveniles absent in northern middle to inner domains





Age-0 pollock

(Andrews, Siddon, Cooper (RPA))

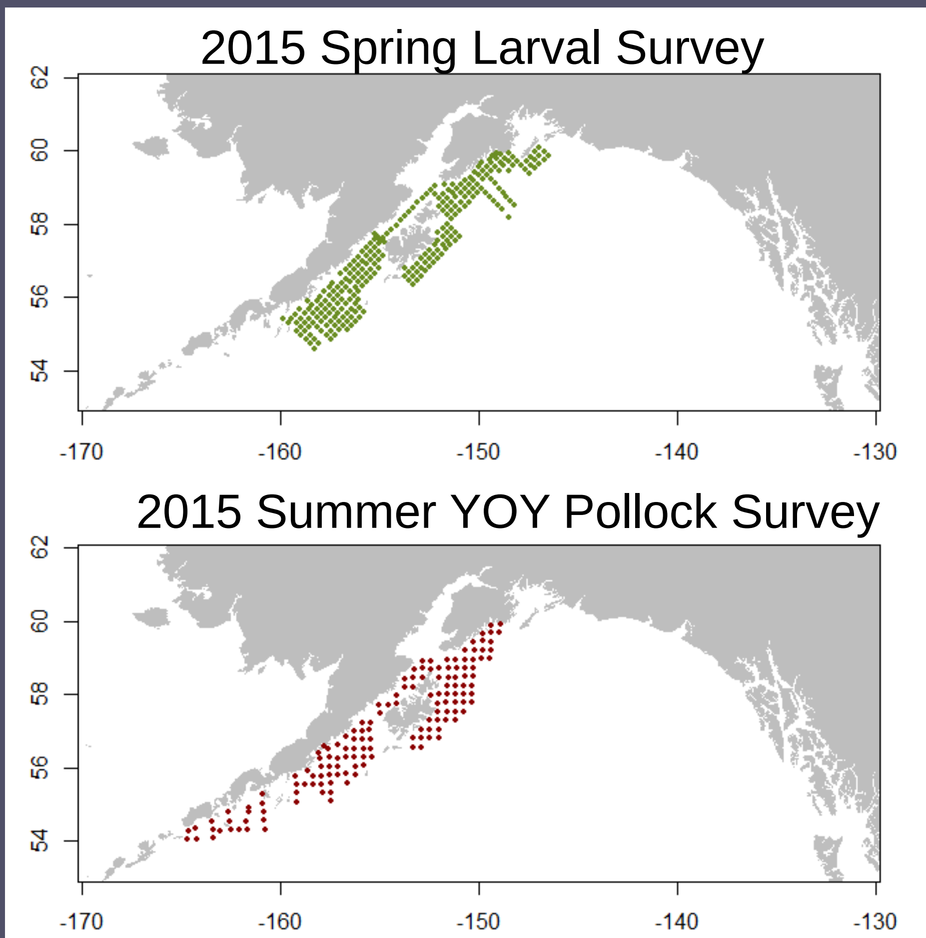
- High catches of age-0 pollock in surface and oblique (midwater)
- Age-0 pollock distribution shifted eastward (middle and inner domains)
- Outer domain increase in zooplankton concurrent with drop in age-0 pollock biomass...spatial mismatch (Siddon)
- Age-0 pollock were the dominant prey of salmon, sandfish, rainbow smelt, age-1 & adult pollock

Western Gulf of Alaska Surveys

Western Gulf of Alaska surveys

(Duffy-Anderson, Rogers)

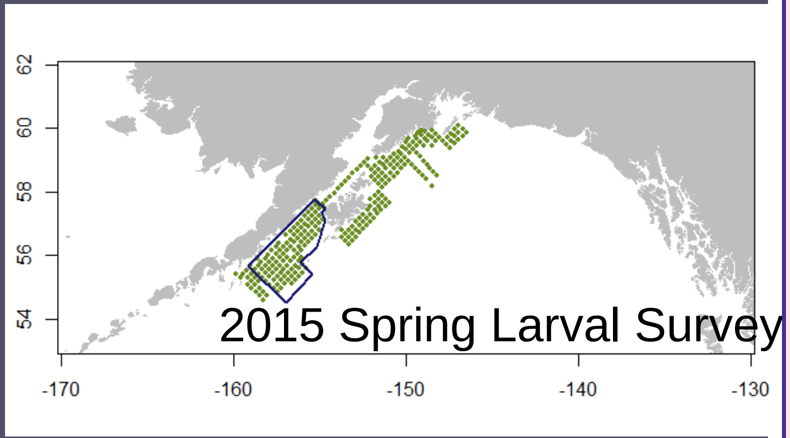
Next survey 2017



Spring 1981-2011, 2013, 2015
Ichthyoplankton time series (12 taxa)
Zooplankton Rapid Assessment
Larval pollock abundance

Summer 2000, 2001-2015, 1980s
YOY pollock (also cod, capelin, eulachon, flatfishes)
Zooplankton Rapid Assessment
Age-0 pollock time series
Forage fish time series (indicator in development)

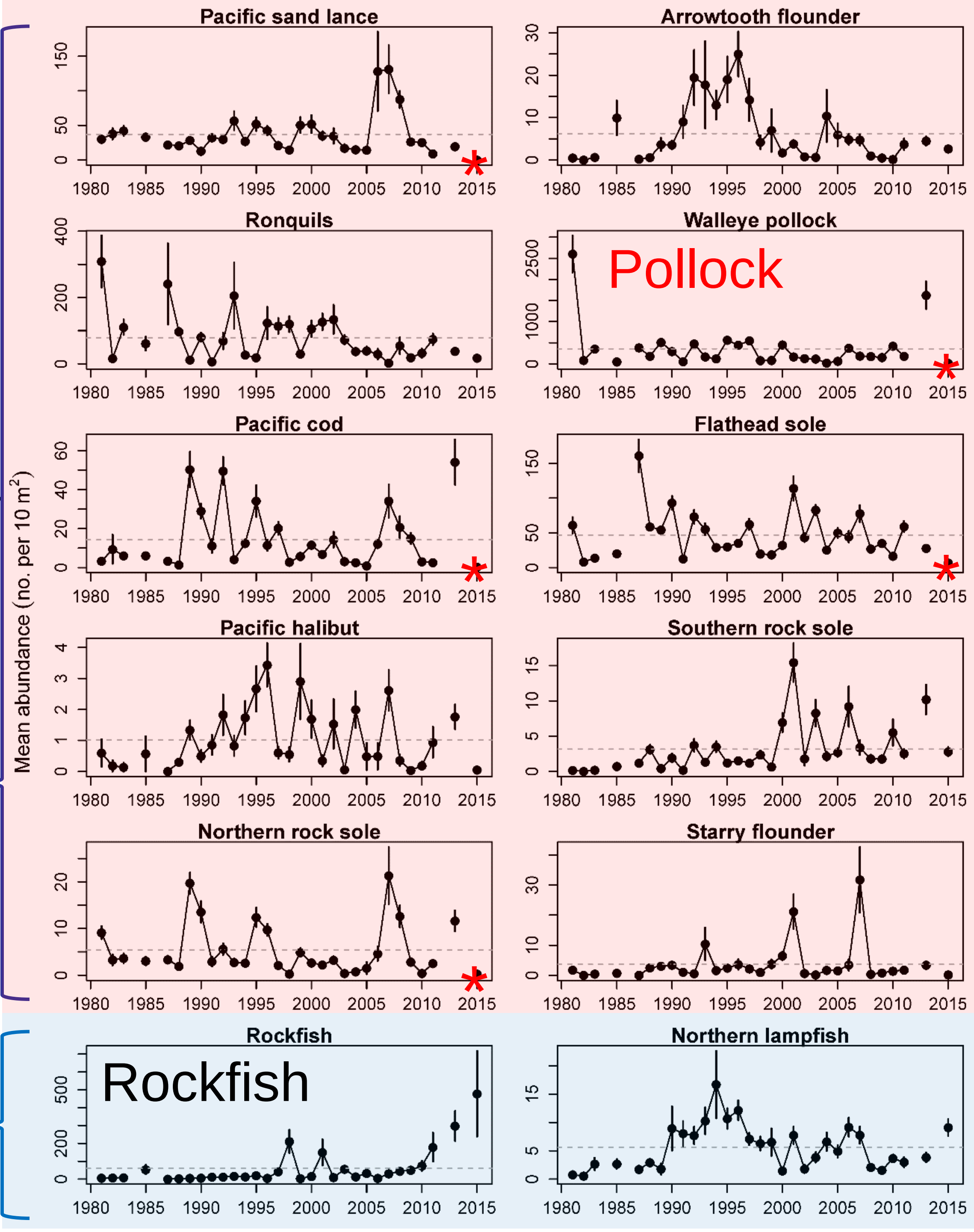
Multispecies ichthyoplankton time series (1981 – 2015)



Most species had low abundance in 2015

Negative anomalies
(*lowest in time series)

Positive anomalies



Gulf of Alaska

Whale Surveys

Humpback Whale Monitoring

- Why do we care? Whales are important because they feed on forage fish
- Population recovery: 20,000+ humpbacks in the North Pacific
- Recently reclassified under ESA requires 5 year monitoring.

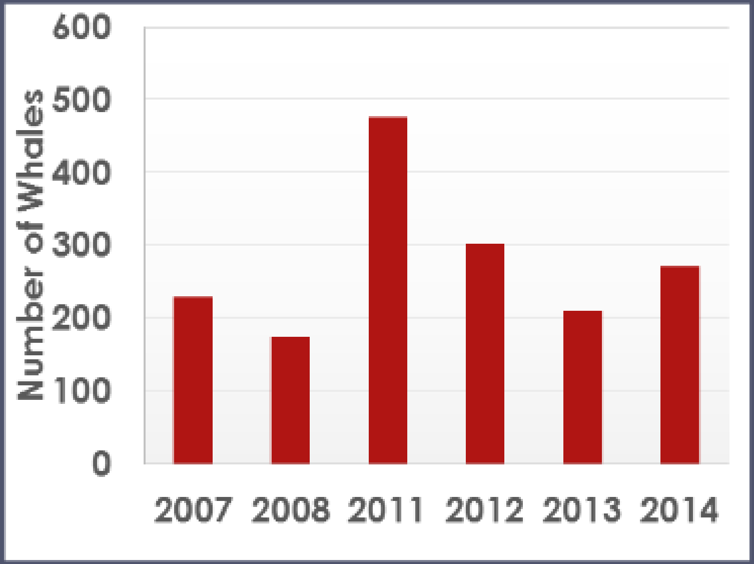
- Noteworthy changes in the populations
  1. Consumption rates on forage fish
  2. Unusual Mortality Event (UME)
  3. Disentanglements
  4. Health in 2016

Contact: John. Moran@noaa.gov

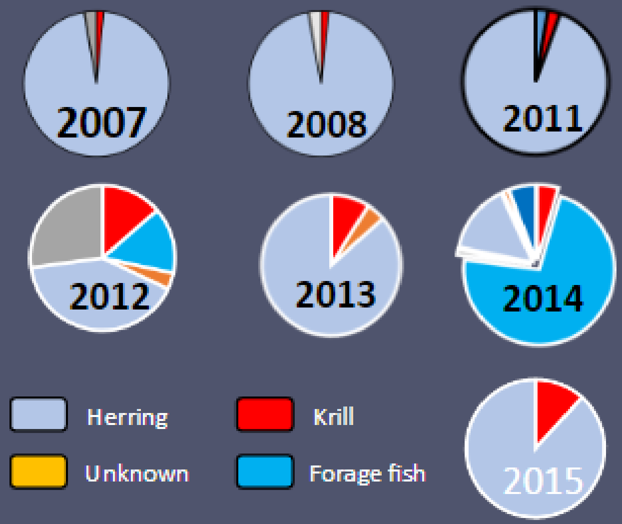
EVOS Whale & Herring study

- Humpbacks consumed 15-20% of herring
- Equivalent to a commercial fishery

Whale abundance estimates



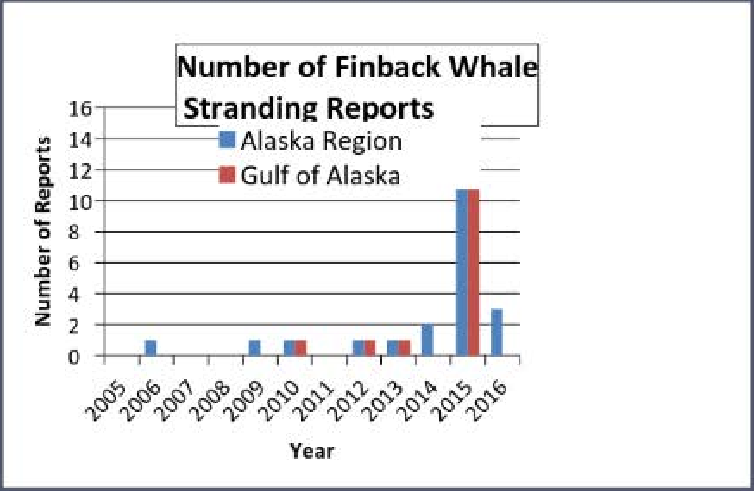
Shifts in whale diet

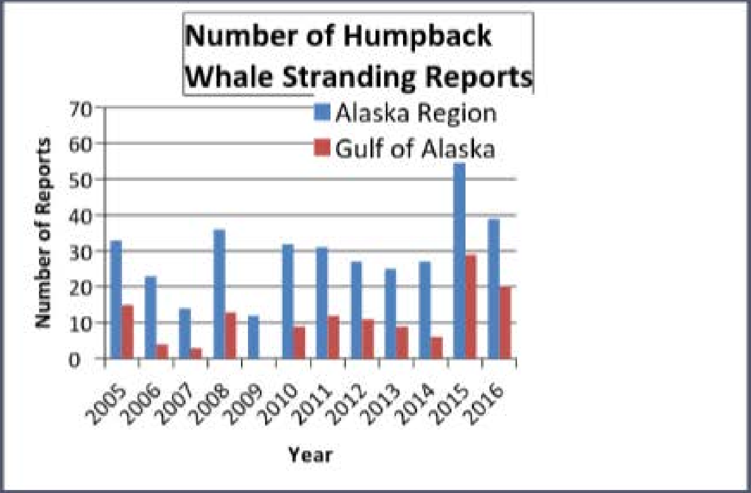


Herring consumption rates

	2011	2012	2013	2014
Low	19%	8%	18%	3%
High	38%	27%	36%	35%

Rise in Unusual Mortality Events





The Cause Remains Uncertain

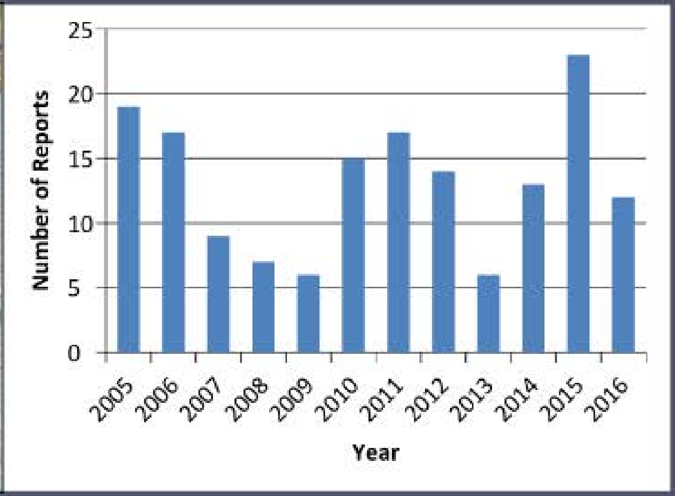
Changes in HABS, infections, predators, prey, vessel strikes, fisheries interactions, sonar

2016: killer whales killed 8 humpbacks whales

John Moran

Entanglements

Large Whale Entanglements



- Possible change in foraging behavior: Moving around more to find food.

Contact : Ed Lyman/Kate Savage

Contact : John Moran

2016 Observations: Is Whale Stress on the Rise?

Cyamid “Whale Lice”

Calf Presence

Adult condition – “skinny”

Diet shifts: krill-salmon

Low #s in Hawaii last winter

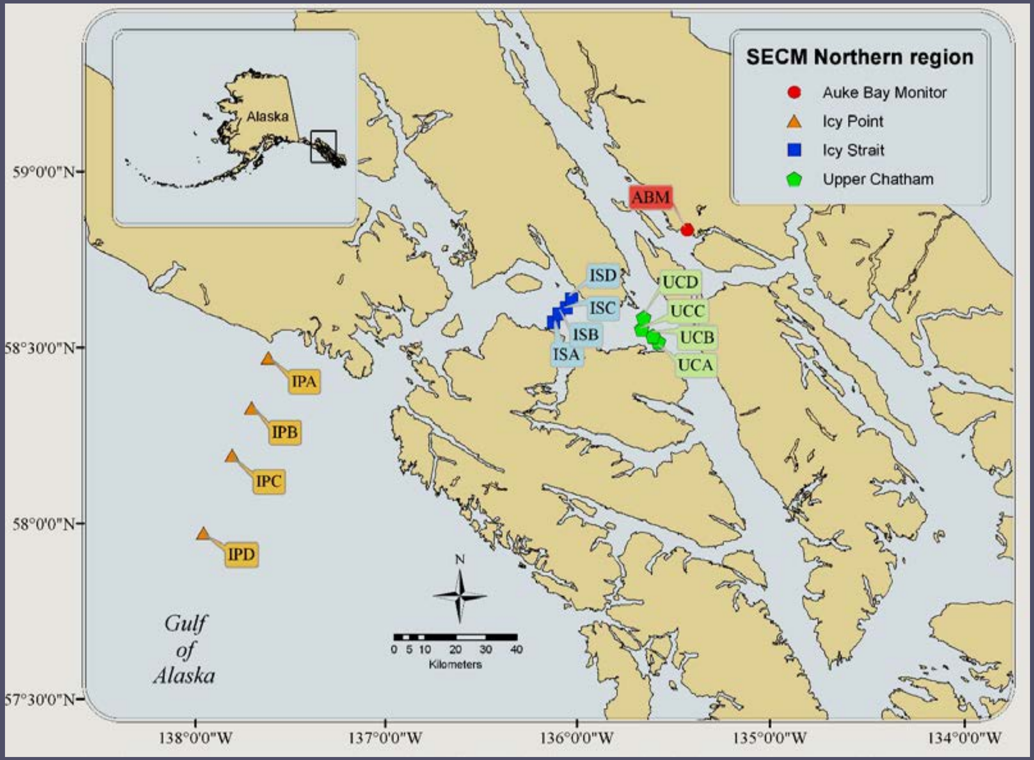
Evaluating historic observations to develop context

John Moran

Eastern Gulf of Alaska

Surveys & Research Stations

E Gulf of Alaska nearshore survey



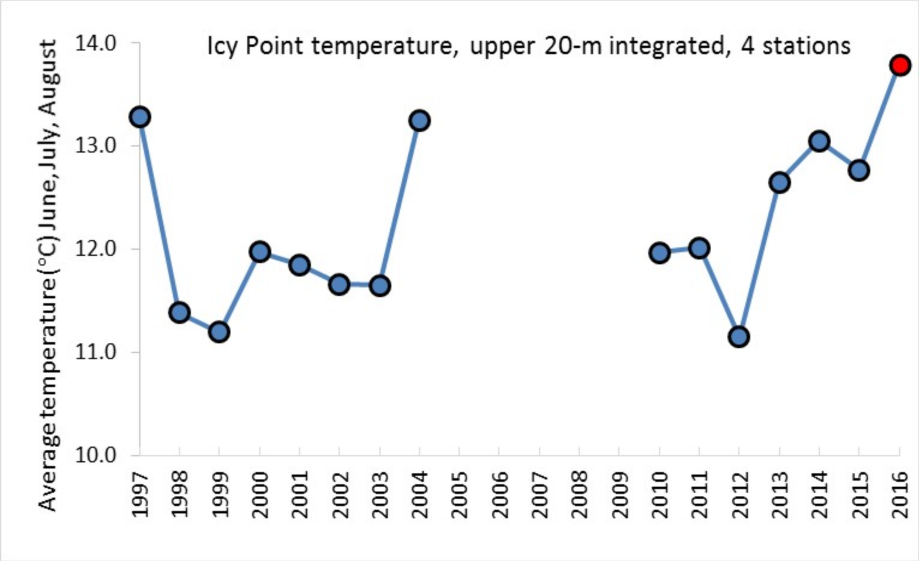
1997-2016

Ecosystem Considerations
Sea temperature
Zooplankton time series (Fergusson)
Energy density time series
Sablefish prediction (Yasumiishi)
Chinook salmon forecast (Orsi)
SEAK pink salmon forecast (Orsi)
Harmful algal bloom index (LeFebvre)

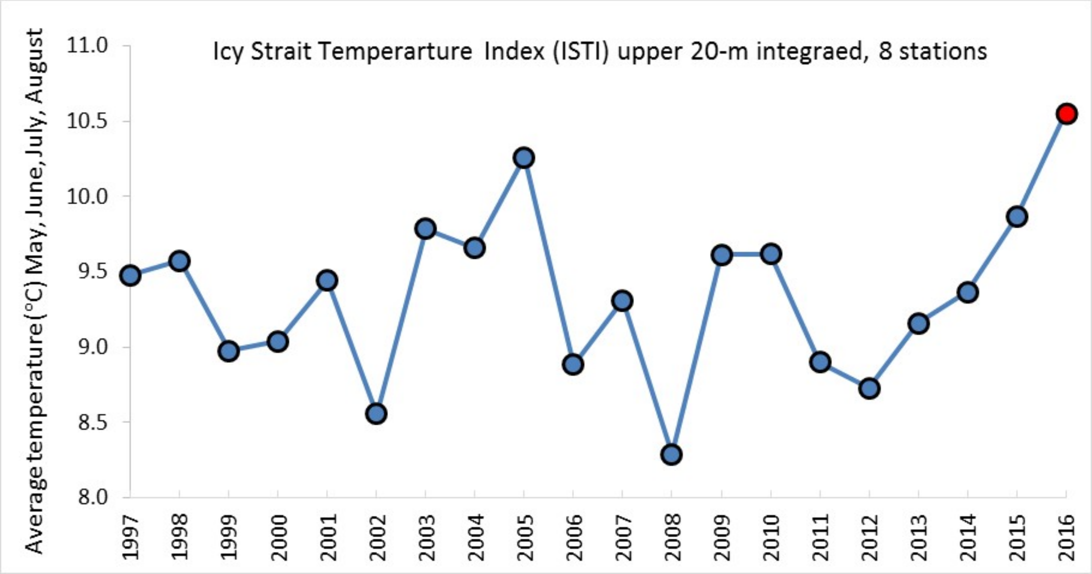
Contact: Joe Orsi

2016 Observations

Warm outside



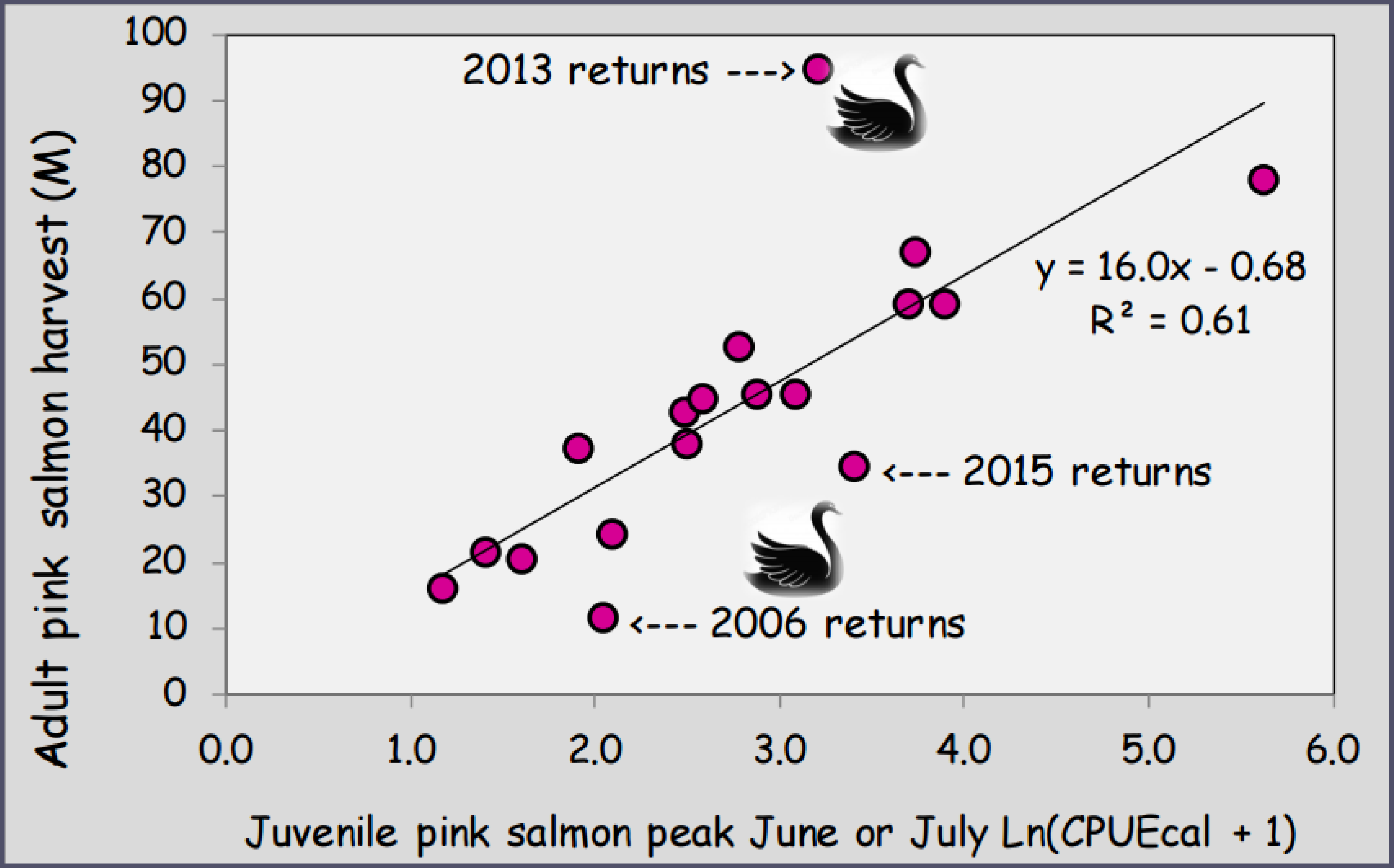
Warm inside



- Low zooplankton biomass
- Lots of gastropods (*Limacina helicina*), similar to 2015
- High numbers of juvenile pink & chum salmon in 2016, similar to 2015
- Typically juvenile pink salmon catches predicts returns of adults

Fergusson, Orsi

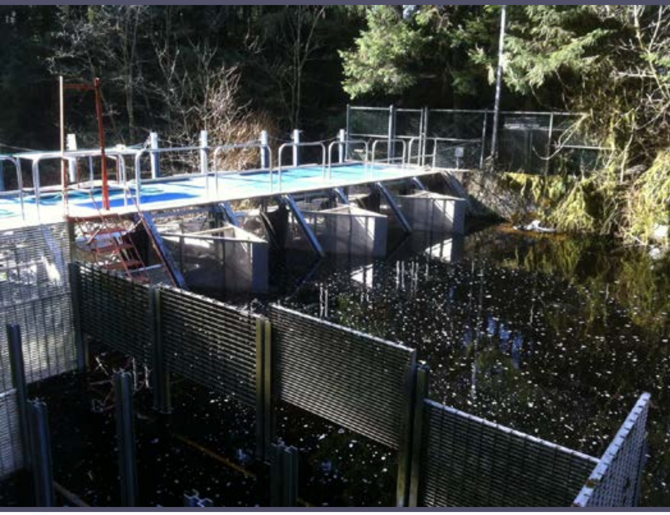
Survey results

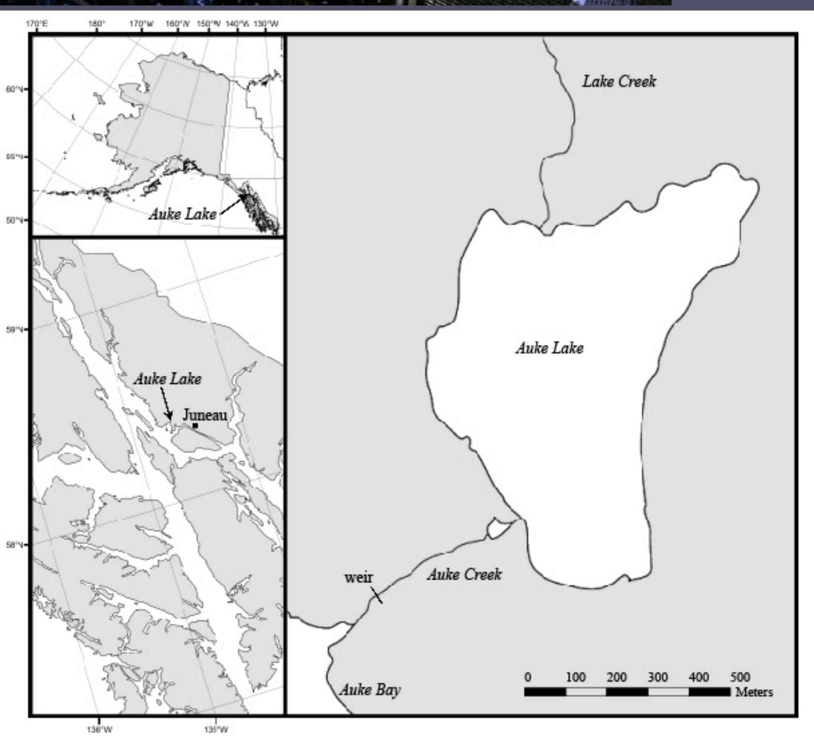


- Failure of the 2006, 2015, 2016 (predicted) returns

- 2005, 2014, 2015
- Very warm
- Low marine survival
- Poor ocean conditions

Auke Creek Research Station, SEAK

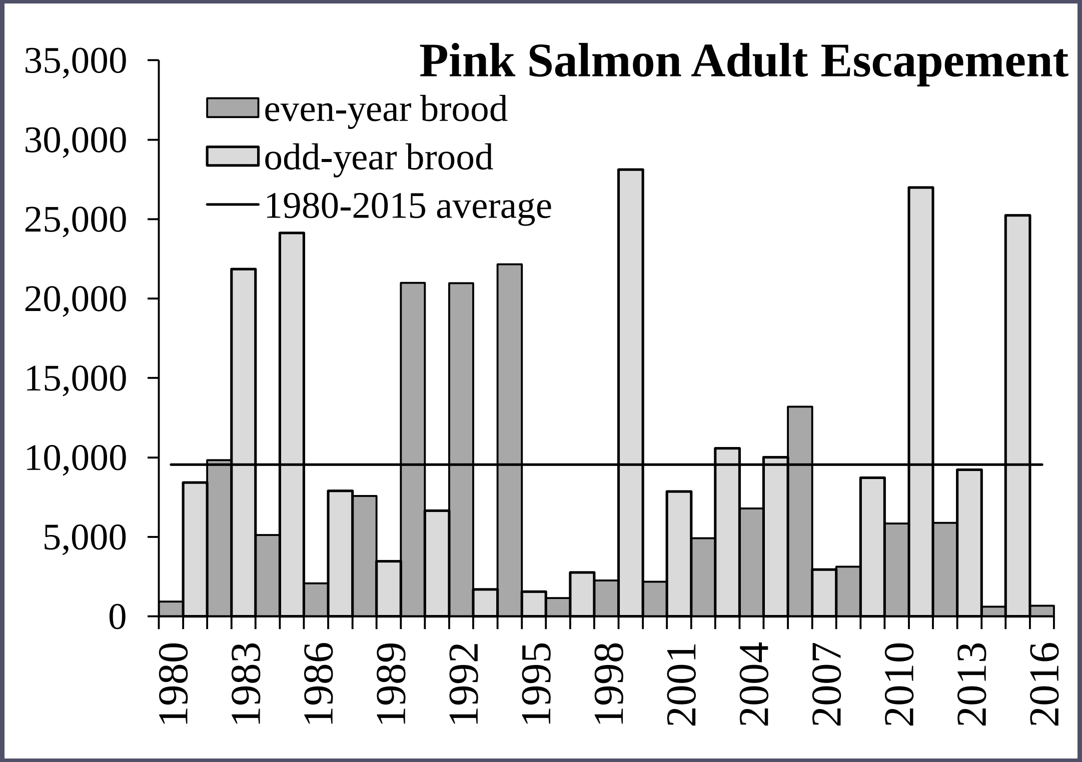




- Census of salmon 1980 through 2016
- Fry and adult counts
- Age, length, sex
- Freshwater and marine productivity
- Migration timing
- Environmental data

Contact: John Joyce & Scott Vulstek

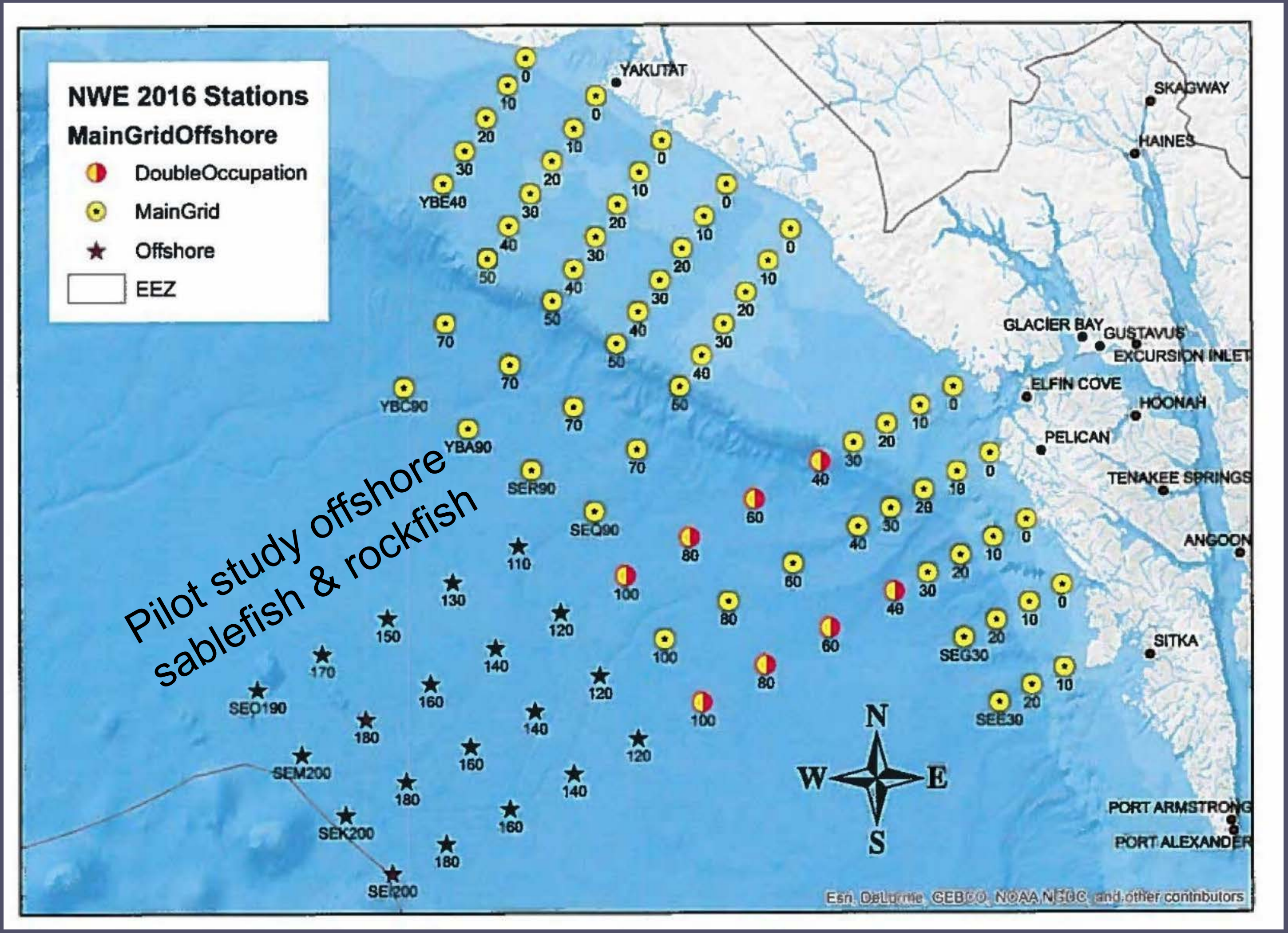
2016 Observations



- Second lowest pink salmon escapement
- 2015 poor ocean conditions

Courtesy: Scott Vulstek & John Joyce

Eastern Gulf of Alaska survey 2010-2016

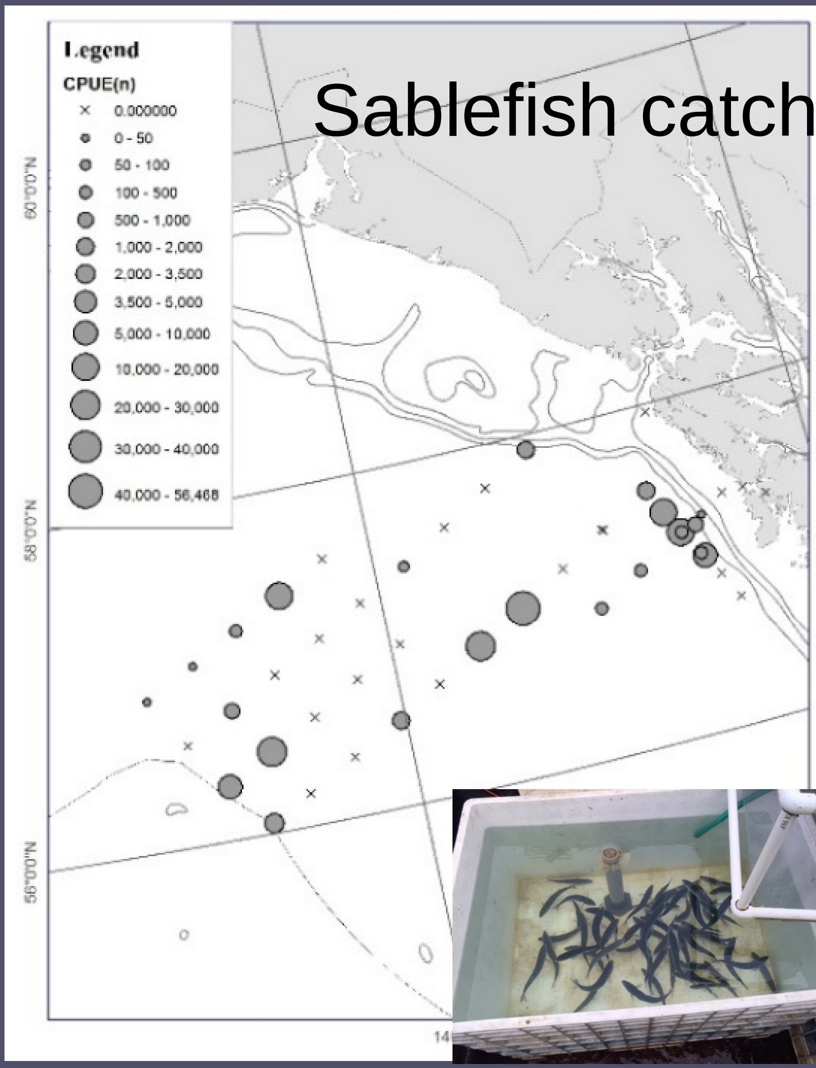


Contact: Jamal Moss and Wes Strasburger

2016 Observations: EGOA shelf

- Positive temperature anomalies continue (13-15 °C)
- Low crustacean zooplankton biomass
- High catches
  - Salps
  - Age-0 rockfish (highest, 3 species)
  - Market squid
  - Pacific saury
- Low catches
  - Pacific pomfret
  - Age-0 pollock

Pilot Study



- Concerns for low recruitment success of sablefish
- *Can we find age-0 sablefish & rockfish?*
- Gear trials: mid-water trawl, gillnet, live box, and Nordic rope trawl
- Nordic-264 rope trawl performed the best for age-0 sablefish

2016 Observations: Pilot Study

- Age-0 sablefish were in surface waters.
- Age-0 sablefish consumed age-0 rockfish when available, otherwise salps (doliolids).
- Age-0 rockfish appear to use dense layers of jellyfish (> 30 m) as refuge habitat offshore.
- AFSC proposal for EGOA spring and summer surveys to study sablefish recruitment.
- Include energetics, tagging studies in the lab.
- Provide indicators and mechanisms that influence YOY sablefish survival.

Sablefish ate rockfish or salps

Rockfish refugia~30 m

Summary of 2016 Observations

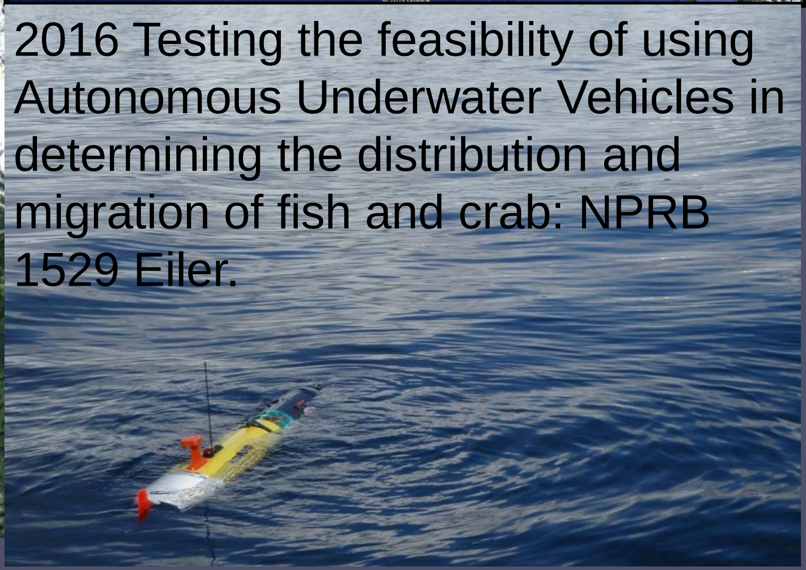
- Warm
- Low zooplankton biomass and lower-lipid taxa in EBS and EGOA
- High catches of larval & age-0 pollock in the EBS
  - Expect low overwintering survival
- High catches of juvenile chum salmon in the NEBS
- High catches of juvenile pink and chum salmon in the EGOA

Potential future Indicators

Little Port Walter Research Station

1930s: oldest year-round research station in Alaska

2016 Installing marine sensors to monitor temperature, conductivity, and pH information (ocean acidification).



2016 Testing the feasibility of using Autonomous Underwater Vehicles in determining the distribution and migration of fish and crab: NPRB 1529 Eiler.

Contact: John.Eiler@noaa.gov

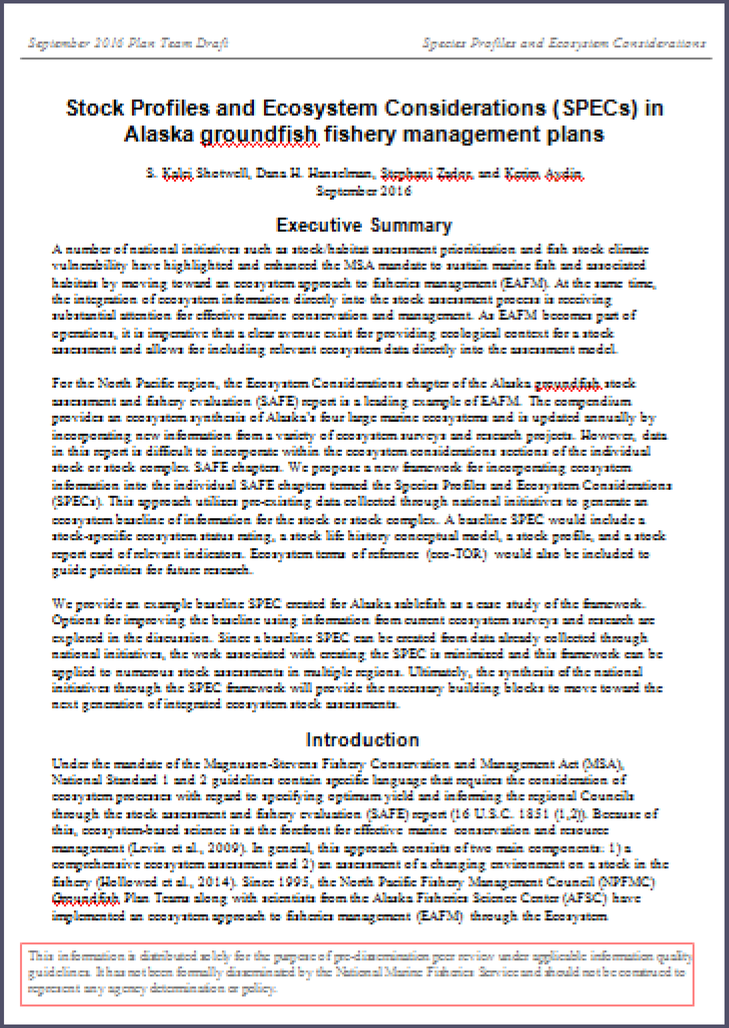
<u>S</u>tock <u>P</u>rofiles & <u>E</u>cosystem <u>C</u>onsiderations

Goal

- Create new framework to update ecosystem considerations sections within the SAFE chapters – SPEC
- Use national initiative data through updateable forms
- Rescale factor scores to generate SPEC elements
- Build stock report card and identifies research priorities

Background

- Initial framework doc 2014 Sept Plan Team
- Working Group update 2015 Sept Plan Team
- National Initiatives for Alaska 2015 - 2016
- New document 2016: Shotwell, Hanselman, Zador, Aydin



Stock Profiles and Ecosystem Considerations (SPECs) in Alaska groundfish fishery management plans

S. Kalei Shotwell, Dana H. Hanselman, Stephani Zador, and Kerim Aydin,
September 2016

Executive Summary

A number of national initiatives such as stock/habitat assessment prioritization and fish stock climate vulnerability have highlighted and enhanced the MSA mandate to sustain marine fish and associated habitats by moving toward an ecosystem approach to fisheries management (EAFM). At the same time, the integration of ecosystem information directly into the stock assessment process is receiving substantial attention for effective marine conservation and management. As EAFM becomes part of operations, it is imperative that a clear avenue exist for providing ecological context for a stock assessment and allows for including relevant ecosystem data directly into the assessment model.

For the North Pacific region, the Ecosystem Considerations chapter of the Alaska groundfish stock assessment and fishery evaluation (SAFE) report is a leading example of EAFM. The compendium provides an ecosystem synthesis of Alaska's four large marine ecosystems and is updated annually by incorporating new information from a variety of ecosystem surveys and research projects. However, data in this report is difficult to incorporate within the ecosystem considerations sections of the individual stock or stock complex SAFE chapters. We propose a new framework for incorporating ecosystem information into the individual SAFE chapters termed the Species Profiles and Ecosystem Considerations (SPECs). This approach utilizes pre-existing data collected through national initiatives to generate an ecosystem baseline of information for the stock or stock complex. A baseline SPEC would include a stock-specific ecosystem status rating, a stock life history conceptual model, a stock profile, and a stock report card of relevant indicators. Ecosystem terms of reference (eco-TOR) would also be included to guide priorities for future research.

We provide an example baseline SPEC created for Alaska sablefish as a case study of the framework. Options for improving the baseline using information from current ecosystem surveys and research are explored in the discussion. Since a baseline SPEC can be created from data already collected through national initiatives, the work associated with creating the SPEC is minimized and this framework can be applied to numerous stock assessments in multiple regions. Ultimately, the synthesis of the national initiatives through the SPEC framework will provide the necessary building blocks to move toward the next generation of integrated ecosystem stock assessments.

Introduction

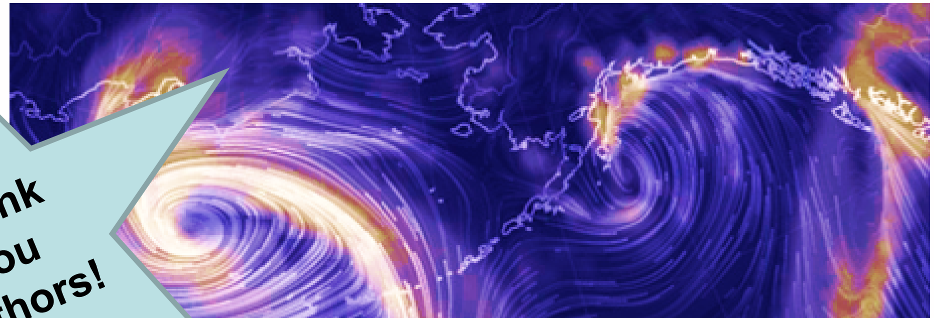
Under the mandate of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), National Standard 1 and 2 guidelines contain specific language that requires the consideration of ecosystem processes with regard to specifying optimum yield and informing the regional Councils through the stock assessment and fishery evaluation (SAFE) report (16 U.S.C. 1851 (1,2)). Because of this, ecosystem-based science is at the forefront for effective marine conservation and resource management (Levin et al., 2009). In general, this approach consists of two main components: 1) a comprehensive ecosystem assessment and 2) an assessment of a changing environment on a stock in the fishery (Hollowed et al., 2014). Since 1995, the North Pacific Fishery Management Council (NPFMC) Groundfish Plan Teams along with scientists from the Alaska Fisheries Science Center (AFSC) have implemented an ecosystem approach to fisheries management (EAFM) through the Ecosystem

Summary

- Stock & Habitat Assessment Prioritization
  - Set target assessment level and frequency
  - Determine which stocks could benefit from habitat data
- Productivity/ Susceptibility & Climate Vulnerability Analysis
  - Current and future assessment of fish stock vulnerability to fisheries and climate change
- Stock Assessment Classification
  - Tracking data availability for stock assessment

Forms

Alaska Stock Assessment Profile Part 1



This form consolidates background information that will be used to characterize a stock or stock complex for tasks such as climate vulnerability, assessment prioritization, and assessment improvement plans. The information will also be used for developing stock-specific ecosystem considerations (SEC) sections of the annual stock assessment and fishery evaluation (SAFE) reports.

Please provide information on references and the data quality of answers where requested and applicable using the following scoring metrics:

Thank You Authors!

1. Critical mass of initiative data calls for Alaska stocks
2. Used super form to collect data in standard format
3. Questions were ecological synthesis of a stock
4. Pre-filled where possible using SIS

Cost/Benefit

Qualitative

- Select set of factors relevant to the region
  - Range of responses for Alaska groundfish
  - If all responses similar or unknown then not used
- Rescale factors similar to climate vulnerability
  - 0 = no value or unknown, 1 = low, 2 = moderate, 3 = high, 4 = very high
- Categorize factor as cost or benefit (Table 1)
  - Assist with interpreting resulting SPEC elements
  - Very preliminary, can be easily changed

Cost/Benefit

Table 1: Draft profile table, SAP = stock assessment prioritization, HAP = habitat assessment prioritization, CVA = climate vulnerability analysis, PSA = productivity/susceptibility analysis

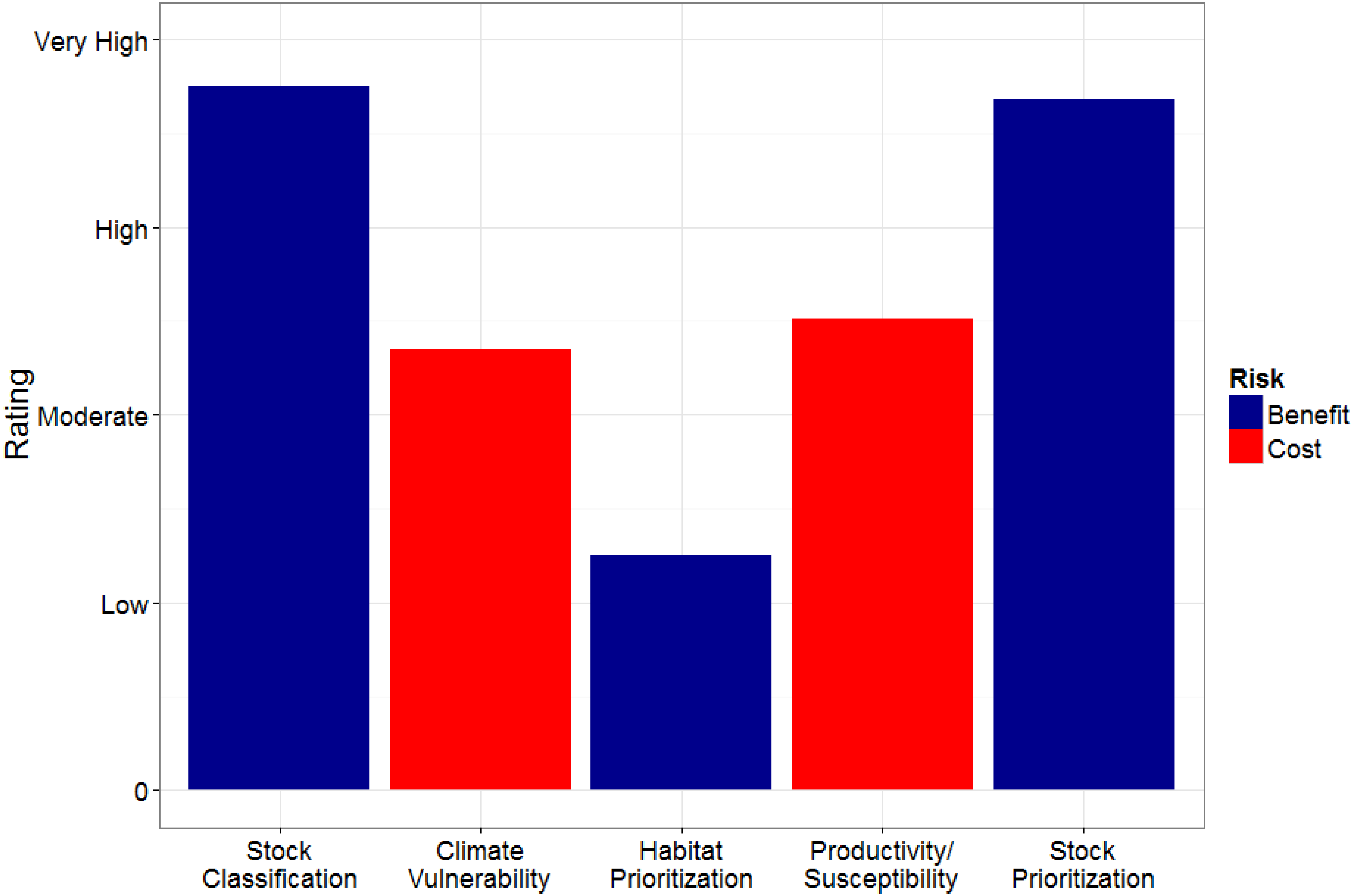
Type	Factor/Attribute	Description	Value	Cost/Benefit
Stock Status	Fishing Mortality	Based on fishing mortality rates and limits, scored in SP	0 to 5	Cost – reduce stock size
Stock Status	Recruitment Variability	Estimated in stock assessment model, continuous in SP	0.3 to 1.6	Cost – unstable population
Stock Status	Growth Rate	To estimate the relative productivity of the stock, continuous in SP and CVA.	0.02 to 0.45	Benefit – avoid predation
Stock Status	Mean Age	To determine the resilience of a stock to changes in recruitment and develop target assessment frequency, continuous in SP.	2 to 31	Benefit – more resilient
Stock Status	Total Mortality	To determine the resilience of a stock due to natural and fishing pressures that diminish older age groups, continuous in SP.	0.04 to 1.9	Cost – less resilient
Stock Status	Stock Abundance	Based on the most recent spawning biomass, targets and limits, scored in SP.	0 to 5	Cost – higher is overfished
Habitat	Habitat Specificity – Adult	To determine, on a relative scale, if the adult stock is a habitat generalist or a habitat specialist while incorporating information on the type and abundance of key habitats, scored in CVA, HAP.	0 to 4	Cost – more requirements for specialist
Habitat	Habitat Specificity – Juvenile	To determine, on a relative scale, if the juvenile stock is a habitat generalist or a habitat specialist while incorporating	0 to 4	Cost – more requirements

SPEC Elements

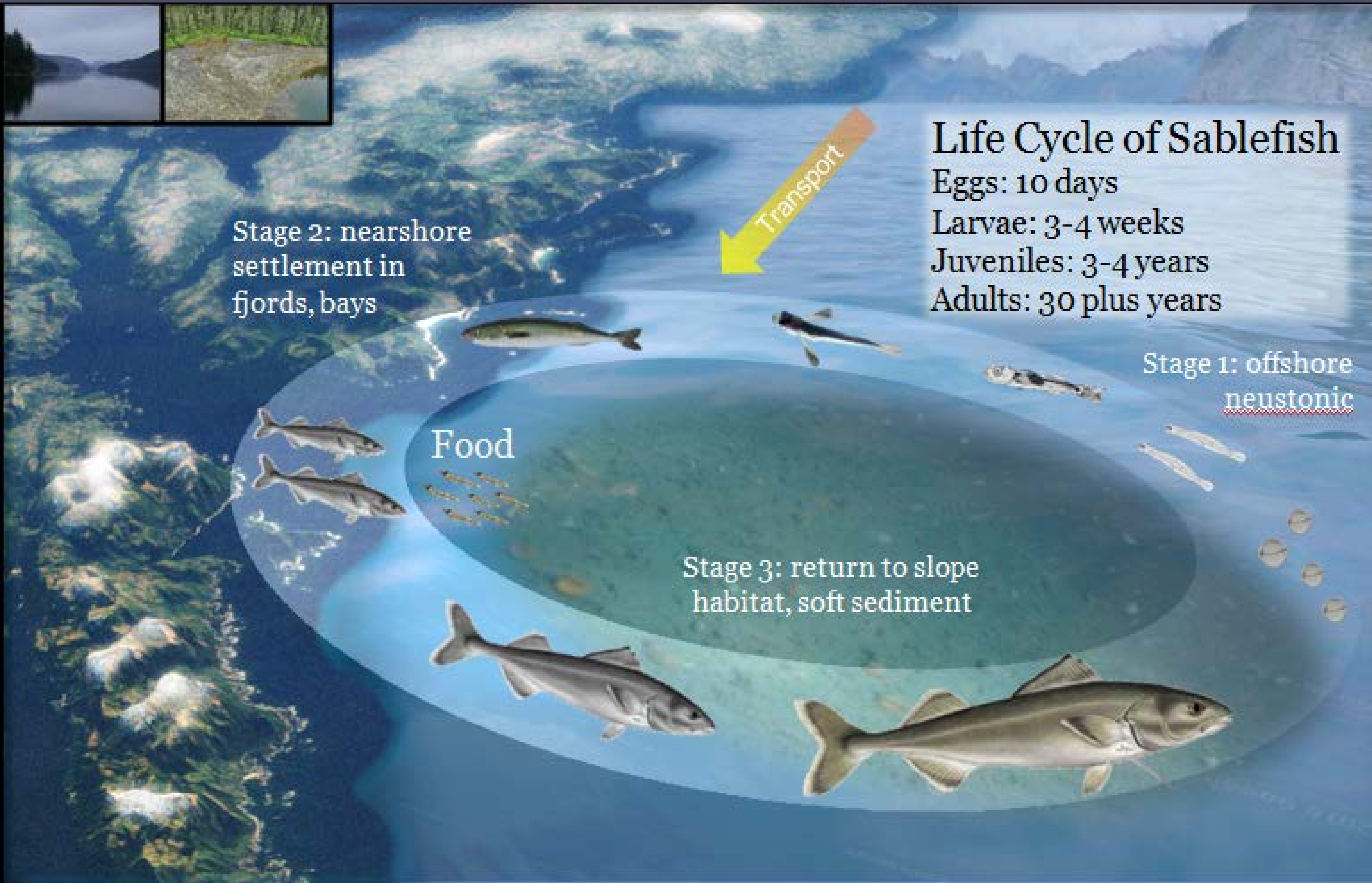
Stock-Specific – Alaska Sablefish

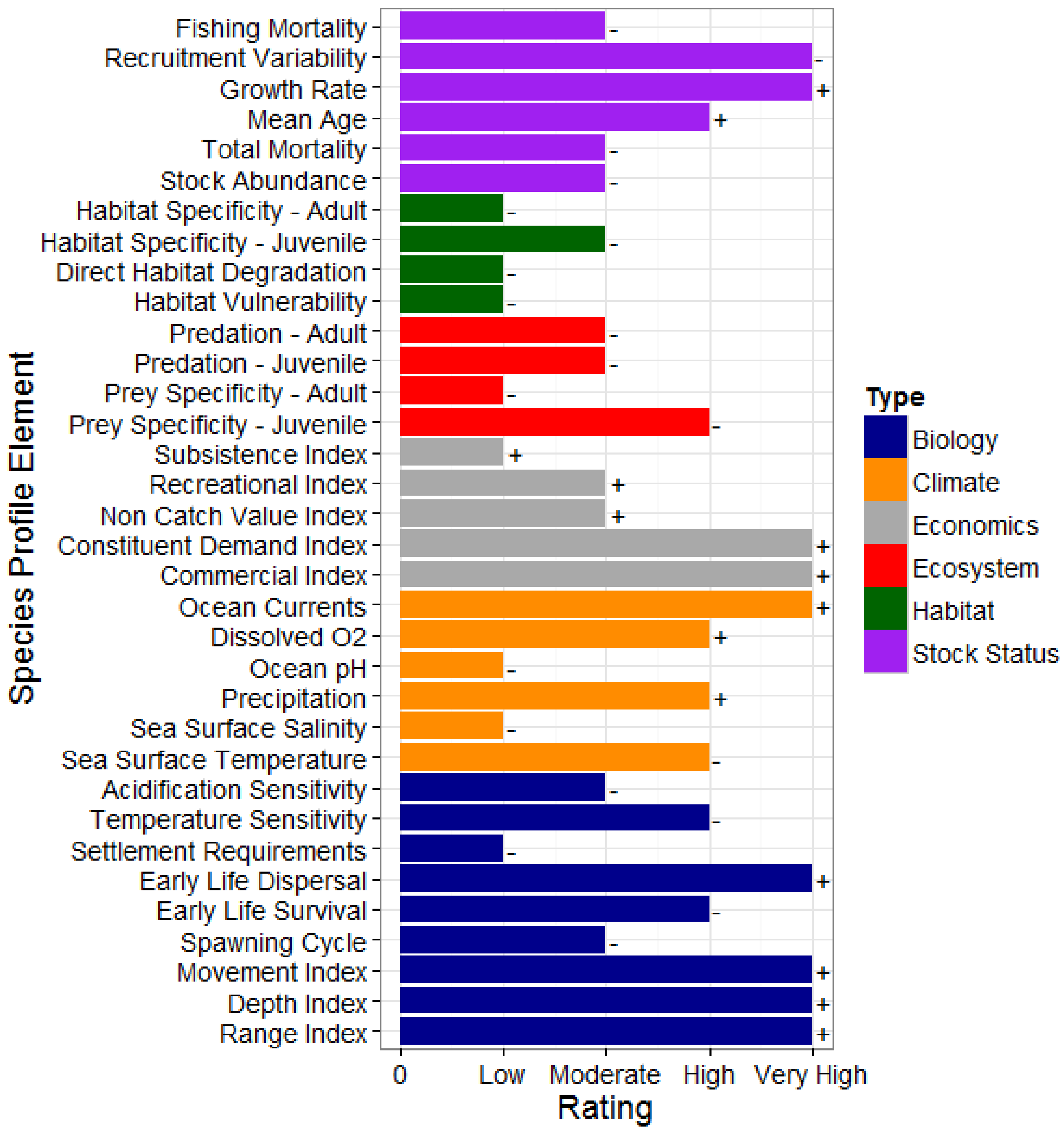
1. Ecosystem Status Rating
2. Life History Conceptual Model
3. Profile
4. Report Card

Ecosystem Status Rating



Life History Conceptual Model





Profile

Factors

0-VH Rating

+ = Cost

- = Benefit

Type

6 Colors

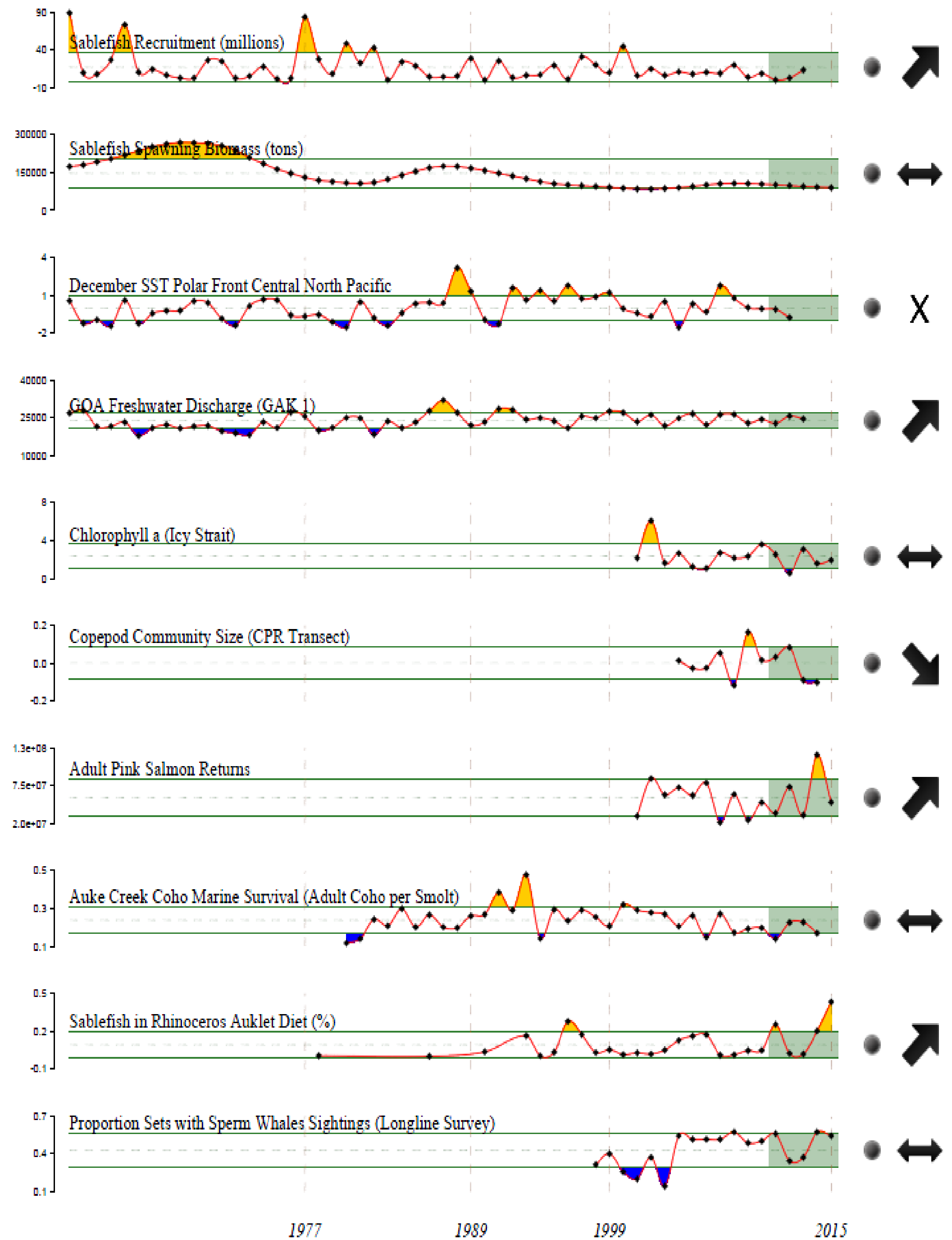
*Alternative

Low = good

High = bad

Report Card

1. Sablefish Recruitment
2. Sablefish Spawning Biomass
3. SST along Polar Front
4. GOA Freshwater Input
5. Nearshore chlorophyll *a*
6. Copepod Community
7. Adult Pink Salmon
8. Auke Creek Coho Survival
9. Sablefish in Auklet Diet
10. Sperm Whale Sightings



Special thanks for rapid data to: S. Hatch, J. Joyce, S. Vulstek, E. Yasumiishi, and S. Zador

Report Card Descriptions

Indicator	*Description*
Trending Stock Assessment Time Series	
Recruitment	Estimates based on the most current sablefish stock assessment model for age 2 recruits lagged to cohort
Spawning Stock Biomass	Estimates based on the most current sablefish stock assessment, in metric tons.
Regional Climate Indicators	
Sea Surface Temperature	Surface temperature index along the North Pacific Polar Front in the central North Pacific, derived in Shotwell et al. 2014
Gulf of Alaska Freshwater Discharge	Freshwater index taken from Ecosystem Considerations GOA Report Card (Zador, 2015), similar to index from Coffin et al. 2014
Early Life History Indicators	
Chlorophyll a (Icy Strait)	In situ measurements of chlorophyll a taken from SECM survey in Southeast Alaska, from Yasumiishi et al. 2015
Copepod Community Size (CPR Transect)	Index taken from Ecosystem Considerations GOA Report Card (Zador, 2015), related to food web complexity
Adult Pink Salmon Returns	From Yasumiishi et al. 2015
Auke Creek Coho Marine Survival	Measure of predation influence on juvenile sablefish
Percent sablefish in Rhinocerous Auklet Diet	Seabird forage index useful as ecosystem indicator
Adult Indicators	
Proportion sets with sperm whales	Index from AFSC longline survey, depredation influence on adult sablefish is an area of active research

- Trends
  - Temporal
  - Spatial
- Climate
  - Large-scale
  - Regional
- Life History
  - Egg/Larvae
  - YOY/Juvenile
  - Adult

Ecosystem Terms of Reference (Eco-TOR)

Research Priorities

- Identified through SPEC elements
  - Overall rating determines potential for research
  - Profile highlights unknown factors or limited-data
  - Report card identifies indicators for improvement
- Update with SAFE comments
  - Include ecosystem type PT/SSC/Council comments
- Update with CIE review
  - Can be used to target a specific eco-TOR
  - Used for future research priorities

Ultimately we do this so we can upgrade this…

Table 3.19. Analysis of ecosystem considerations for the sablefish fishery.

Indicator	*Observation*	*Interpretation*	*Evaluation*
ECOSYSTEM EFFECTS ON STOCK			
Prey availability or abundance trends			
Zooplankton	None	None	Unknown
Predator population trends			
Salmon	Decreasing	Increases the stock	No concern
Changes in habitat quality			
Temperature regime	Warm increases recruitment	Variable recruitment	No concern (can't affect)
Prevailing currents	Northerly increases recruitment	Variable recruitment	No concern (can't affect)
FISHERY EFFECTS ON ECOSYSTEM			
Fishery contribution to bycatch			
Prohibited species	Small catches	Minor contribution to mortality	No concern
Forage species	Small catches	Minor contribution to mortality	No concern
HAPC biota (seapens/whips, corals, sponges, anemones)	Small catches, except long-term reductions predicted	Long-term reductions predicted in hard corals and living structure	Possible concern
Marine mammals and birds	Bird catch about 10% total	Appears to be decreasing	Possible concern
Sensitive non-target species	Grenadier, spiny dogfish, and unidentified shark catch notable	Grenadier catch high but stable, recent shark catch is small	Possible concern for grenadiers
Fishery concentration in space and time	IFQ less concentrated	IFQ improves	No concern
Fishery effects on amount of large size target fish	IFQ reduces catch of immature	IFQ improves	No concern
Fishery contribution to discards and offal production	sablefish <5% in longline fishery, but 30% in trawl fishery	IFQ improves, but notable discards in trawl fishery	Trawl fishery discards definite concern
Fishery effects on age-at-maturity and fecundity	trawl fishery catches smaller fish, but only small part of total catch	slightly decreases	No concern

To this

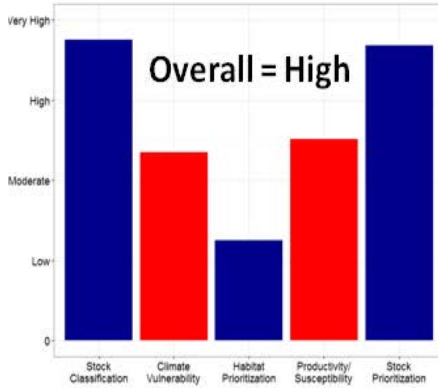
NOAA FISHERIES

Sablefish (*Anoplopoma fimbria*)

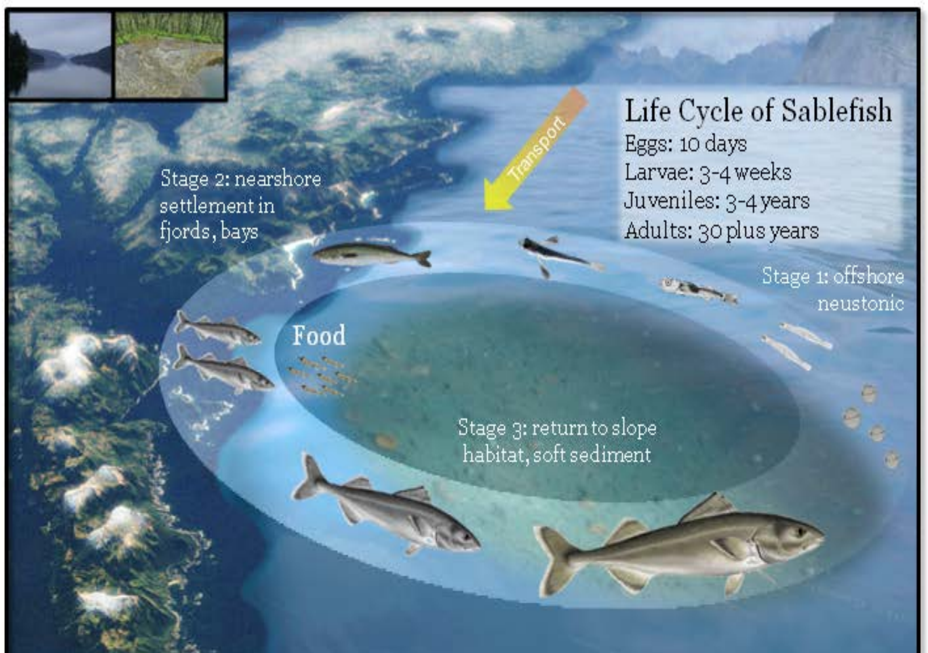
Stock Assessment Linkages: recruitment, growth, movement

Ecosystem Surveys: egg/larval tows, young-of-the-year (YOY) surface trawls, juvenile nearshore tagging, whale depredation, seabird diet

Profile: extreme neustonic larvae/YOY, rapid early growth rate, euphausiid juvenile diet, high lifetime movement



Life History Conceptual Model



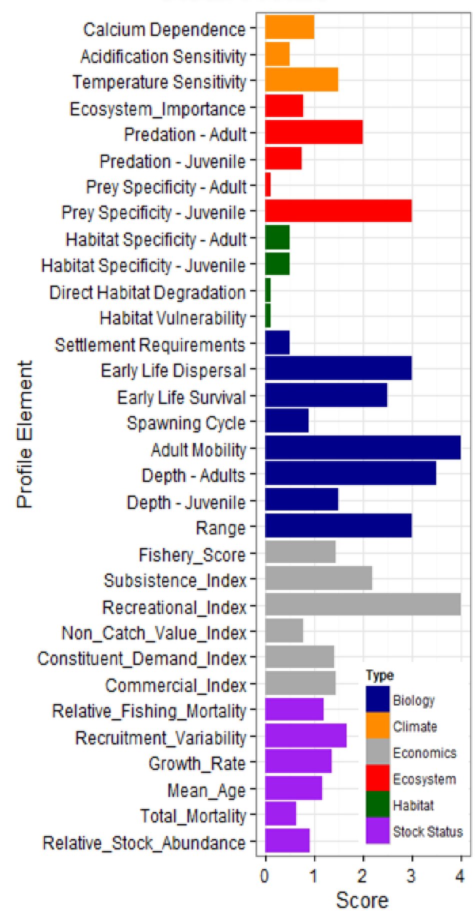
Contact for this stock: Kalei.Shotwell@noaa.gov

NOAA FISHERIES

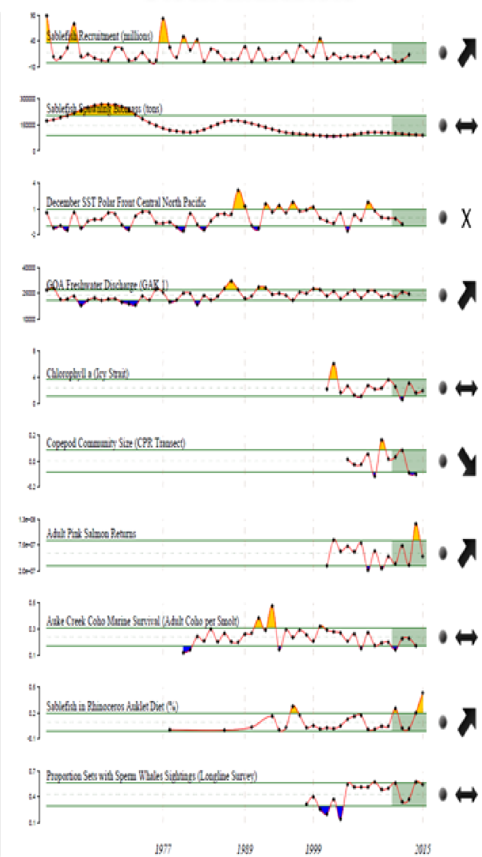
Sablefish (*Anoplopoma fimbria*)

Mechanisms: alaska-wide climate events, spawning match to offshore myctophid mid-water biomass, along- and cross-shelf transport to nearshore habitat, juvenile match to euphausiid biomass, whale depredation

Stock Profile

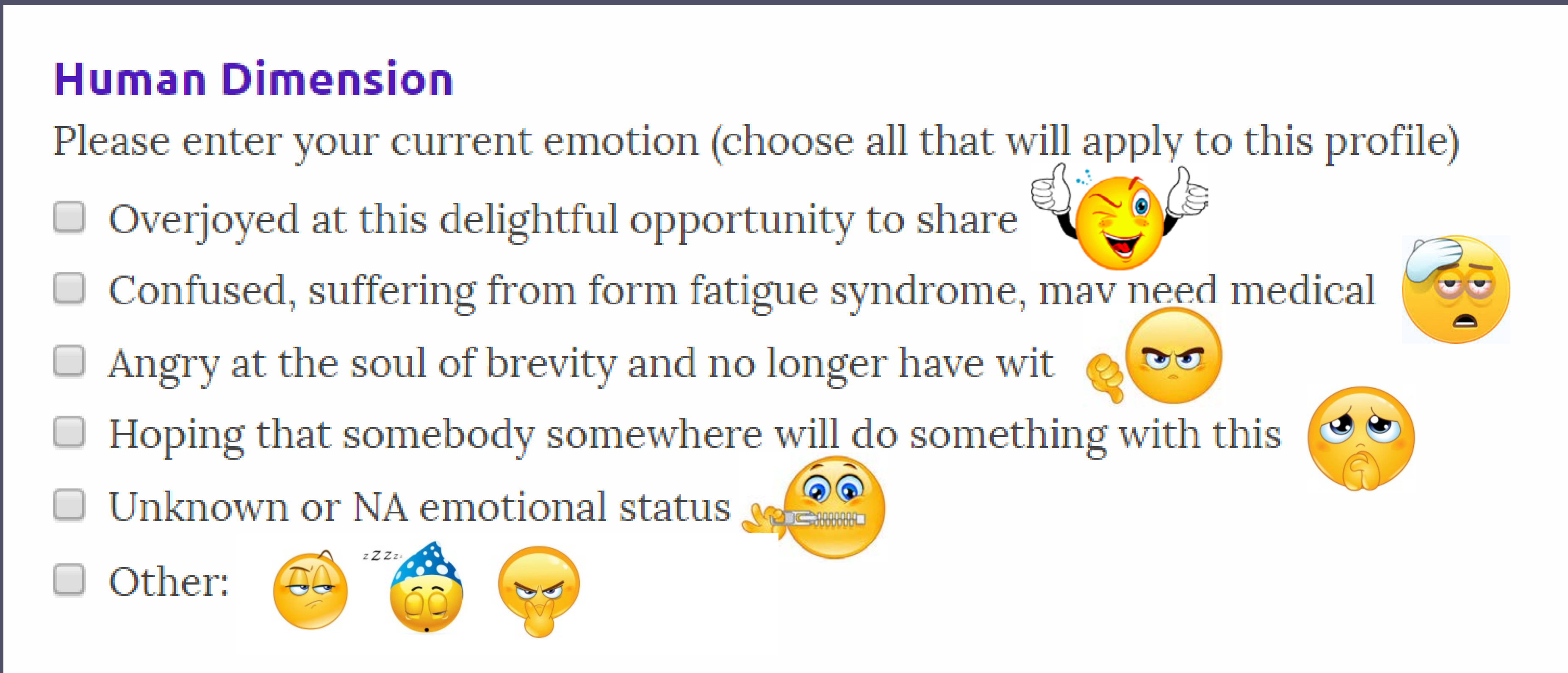


Stock Indicators



Contact for this stock: Kalei.Shotwell@noaa.gov

One last form question…



Human Dimension

Please enter your current emotion (choose all that will apply to this profile)

- [ ] Overjoyed at this delightful opportunity to share
- [ ] Confused, suffering from form fatigue syndrome, may need medical
- [ ] Angry at the soul of brevity and no longer have wit
- [ ] Hoping that somebody somewhere will do something with this
- [ ] Unknown or NA emotional status
- [ ] Other:

GPT Discussion

- Does the GPT have questions on the SPEC?
  - Methods are somewhat fluid
  - Definitions for profile elements can be update
- Does the GPT agree to move forward with the baseline SPEC framework?
  - Replace current ecosystem consideration sections
  - Create baselines on schedule, not all at once
- Work with authors to generate baseline SPEC
- Does the GPT like the proposed “all ecosystem” Sept presentation organization of climate, surveys, new indicators, and eco issue for the year?