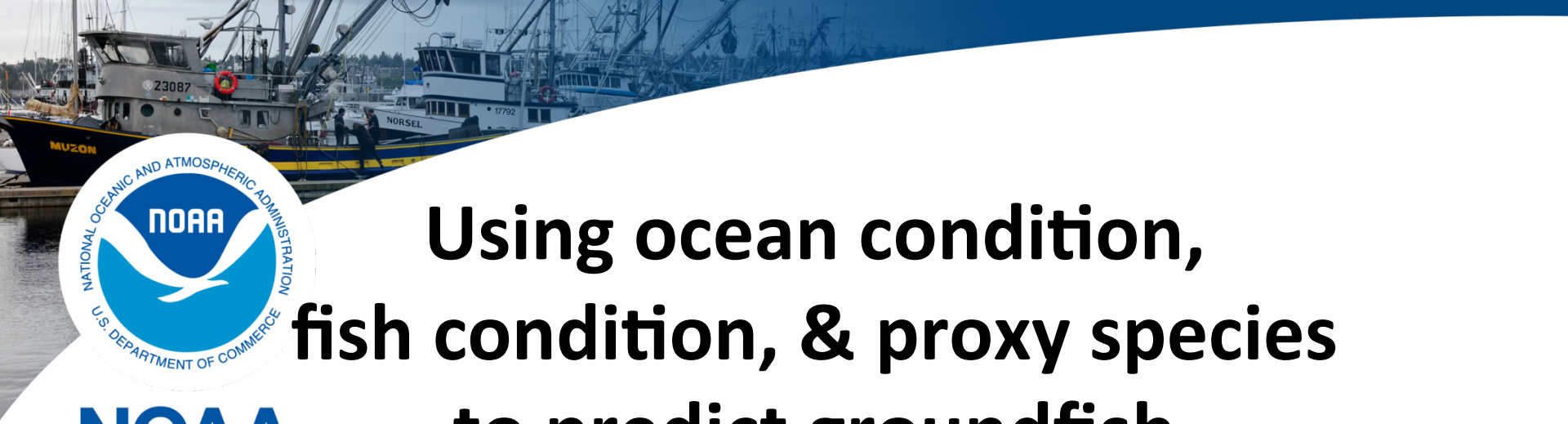

Using ocean condition, fish condition, & proxy species to predict groundfish recruitment

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AFSC Auke Bay Laboratories
Juneau, Alaska

Groundfish Plan Team Meeting September 2014

Introduction

- General approach (model & research)
- Using ocean condition, fish condition & proxy species to predict groundfish recruitment.
  1. **Alaska sablefish**
  2. **Bering Sea pollock**
  3. **Bering Sea pollock**

Approach

ECOSYSTEM RESEARCH

To determine the relationship between fish recruitment (stock assessment estimates) & fish/ocean condition.

Age-1 pollock recruitment (t) = Body condition of age-0 pollock (t-1)

-shift the model forward a time step

FORECAST

Model parameters & current fish condition to forecast recruitment.

Age-1 pollock recruitment (t+1) = Body condition of age-0 pollock (t)

Ecosystem Research

- What **causes** fish populations to change over time?
- Evaluate rearing & fish condition during **early life stage**. EMA focuses on the middle to late age-0 life stage.
- Important time in determining how many fish will **survive** to older ages & to the fishery.
- Use information on current conditions to **predict** the abundance of older fish in the population in the future.

Ecosystem indicators

Climate Prey Competitors Predators Proxies

High mortality

egg larvae

Age-0

Numbers

Body condition

Survival

Age-1+

Courtesy: Orsi

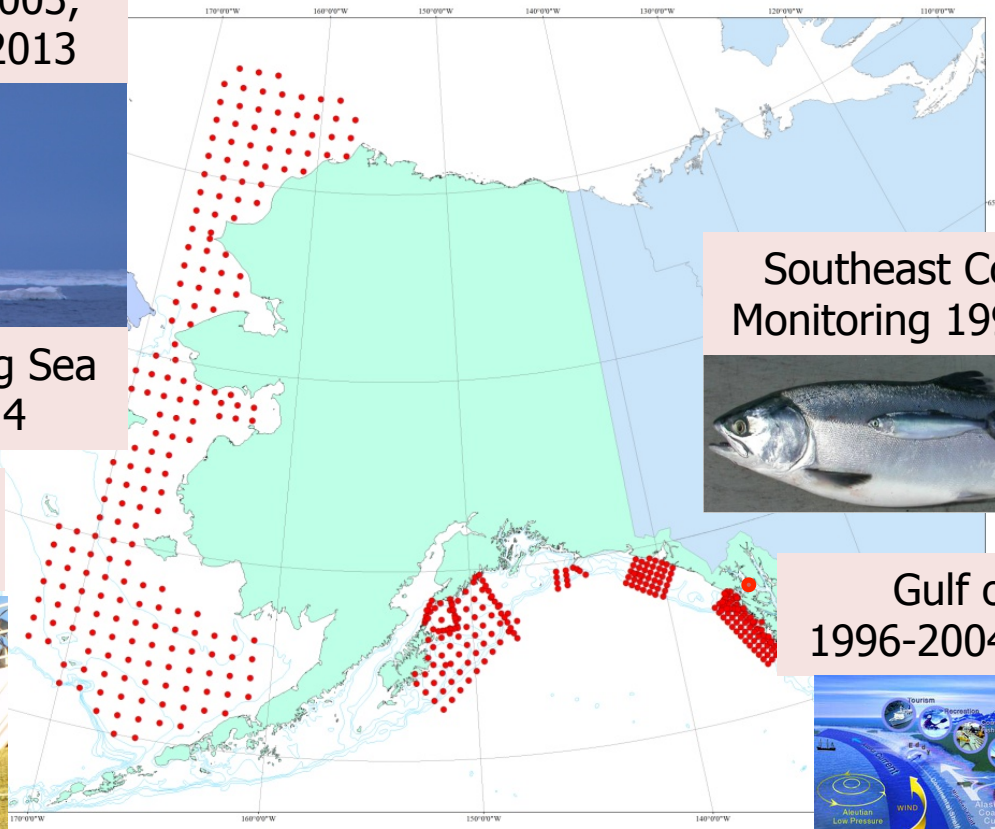
Fisheries-Oceanography surveys

Chukchi Sea 2003, 2007, 2012, 2013

Northern Bering Sea 2003 - 2014

Southeast Coastal Monitoring 1997-2014

Southern Bering Sea 1999-2012, 2014



Gulf of Alaska 1996-2004, 2010-2014

Continental shelf and inside waters
Important rearing areas

Courtesy: Farley

NOAA & charter vessels

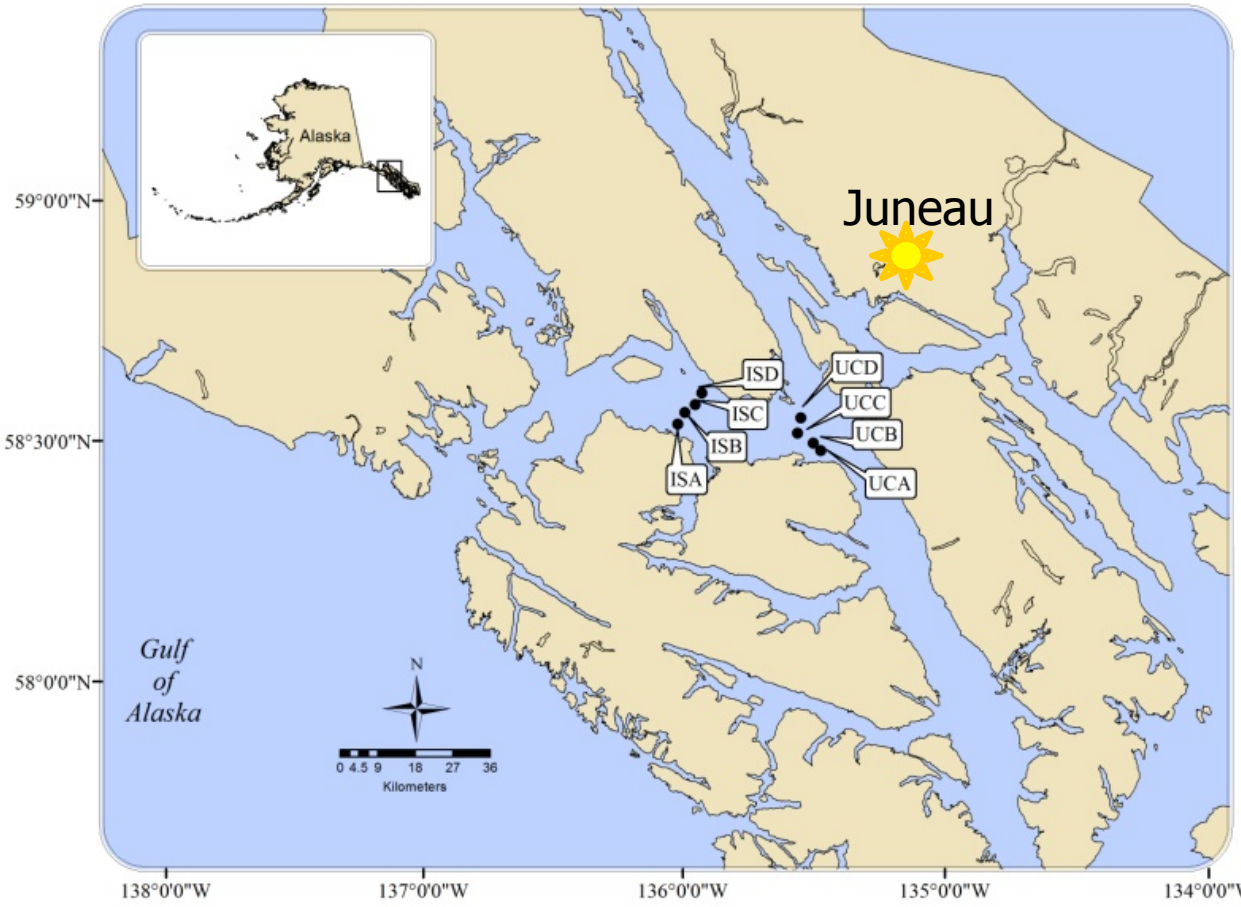
http://www.noaanews.noaa.gov/stories2005/images/oscar-dyson-panama02-18-2005b.jpg

Age-0 pollock

Juvenile salmon

1. A proxy survey for sablefish

Southeast Alaska Coastal Monitoring Survey



Started in 1997

Nearshore survey

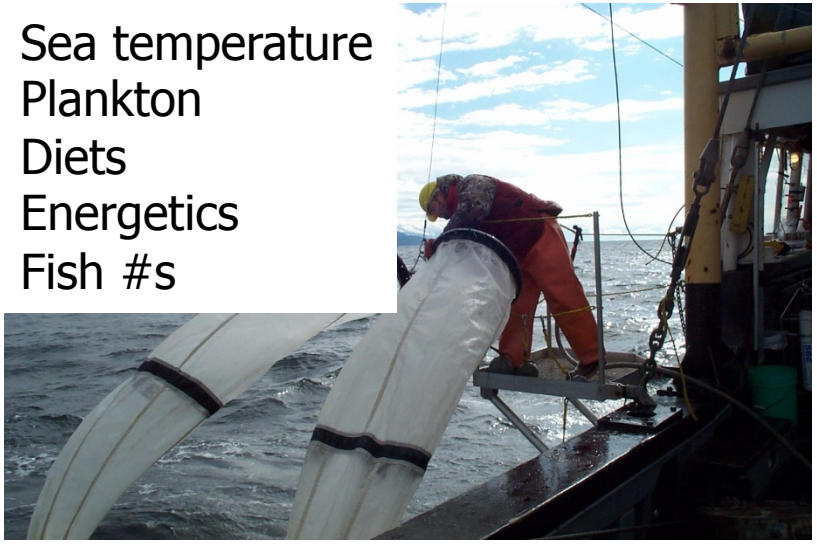
Juvenile pink salmon

Important rearing habitat for young sablefish

Courtesy: Fergusson

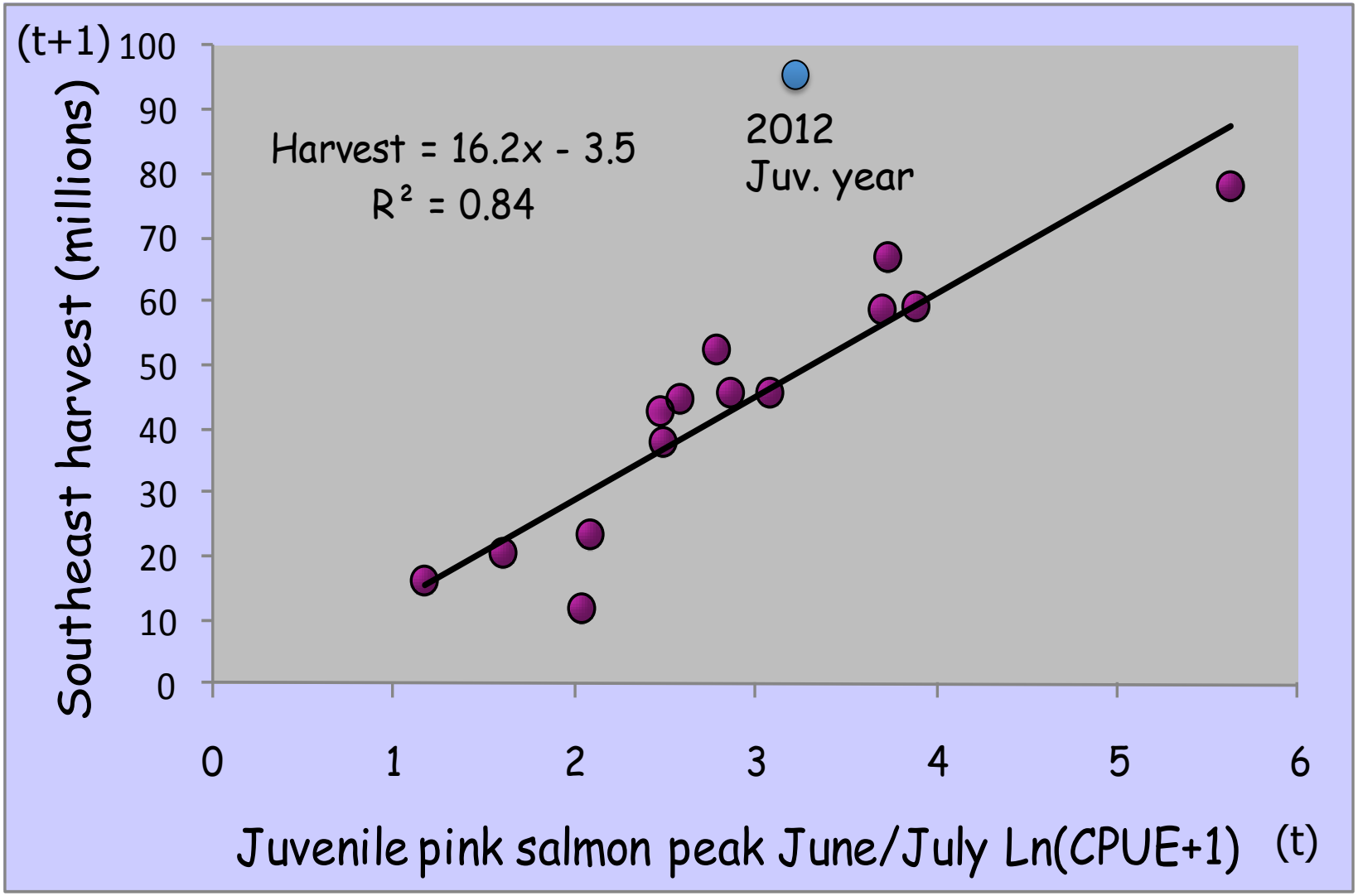
Southeast coastal monitoring 1997-2014

Sea temperature
Plankton
Diets
Energetics
Fish #s



Courtesy: Orsi

Pink salmon forecast

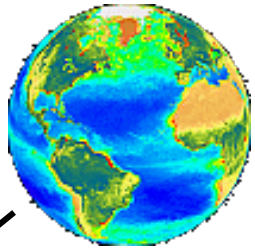


Courtesy: Orsi

Can juvenile pink salmon predict sablefish abundances?

Age-2_t = **SST_{t-2} + Chla_{t-2} + Juvenile pink $salmon_{t-2}$** - Adult $pinks_{t-2}$

Conditions during age-0 (t-2)



Late summer sea temperature & phytoplankton biomass (chl-*a*): increased growth, feeding rates

Age-2 sablefish Abundance (t)

\+

\+

Juvenile pink salmon abundance

Survival proxy

Adult pink salmon abundance: Predator

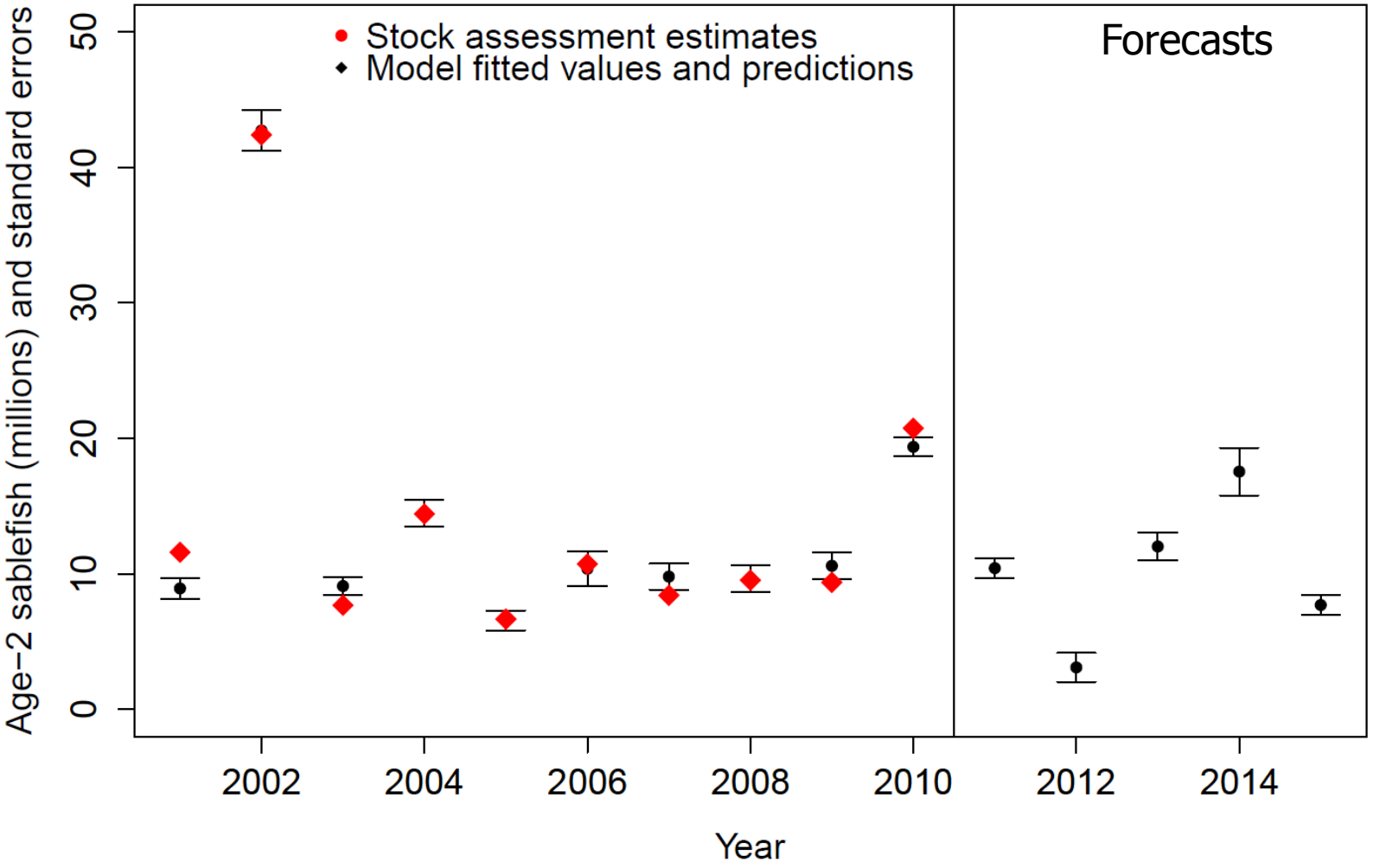
E. Loury

http://oceancolor.gsfc.nasa.gov/SeaWiFS/

Yasumiishi et al. (ICES in AFSC review)

$R^2 = 0.96$

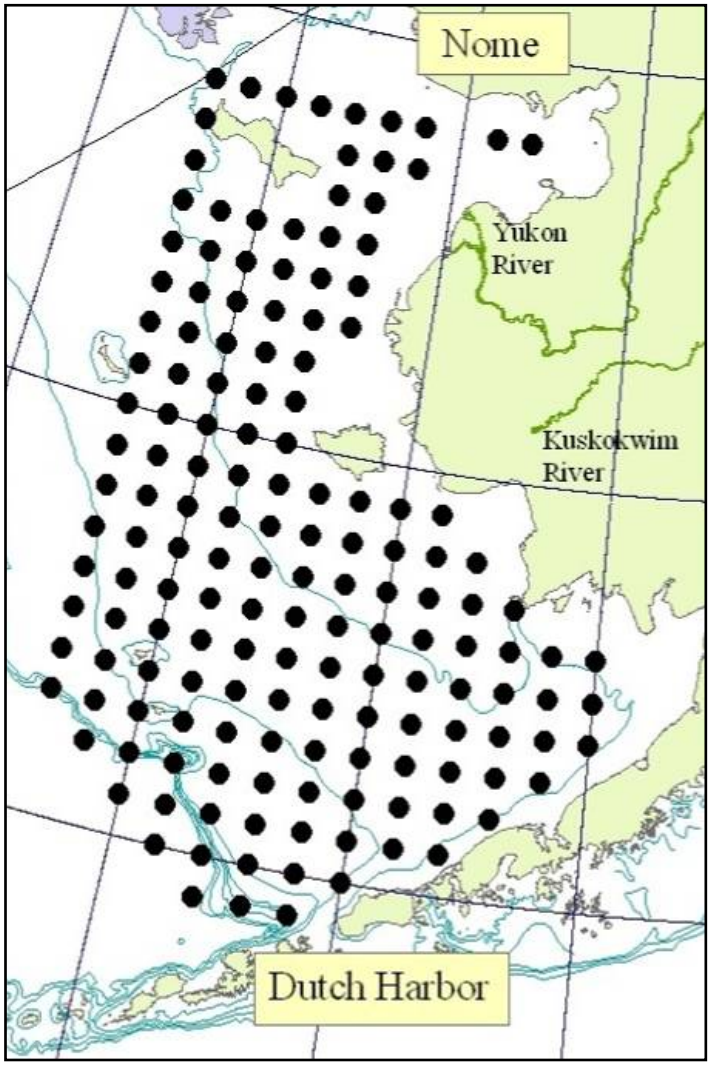
Age-2 sablefish model



2. BASIS survey index age-0 pollock

Oceanography

Stations



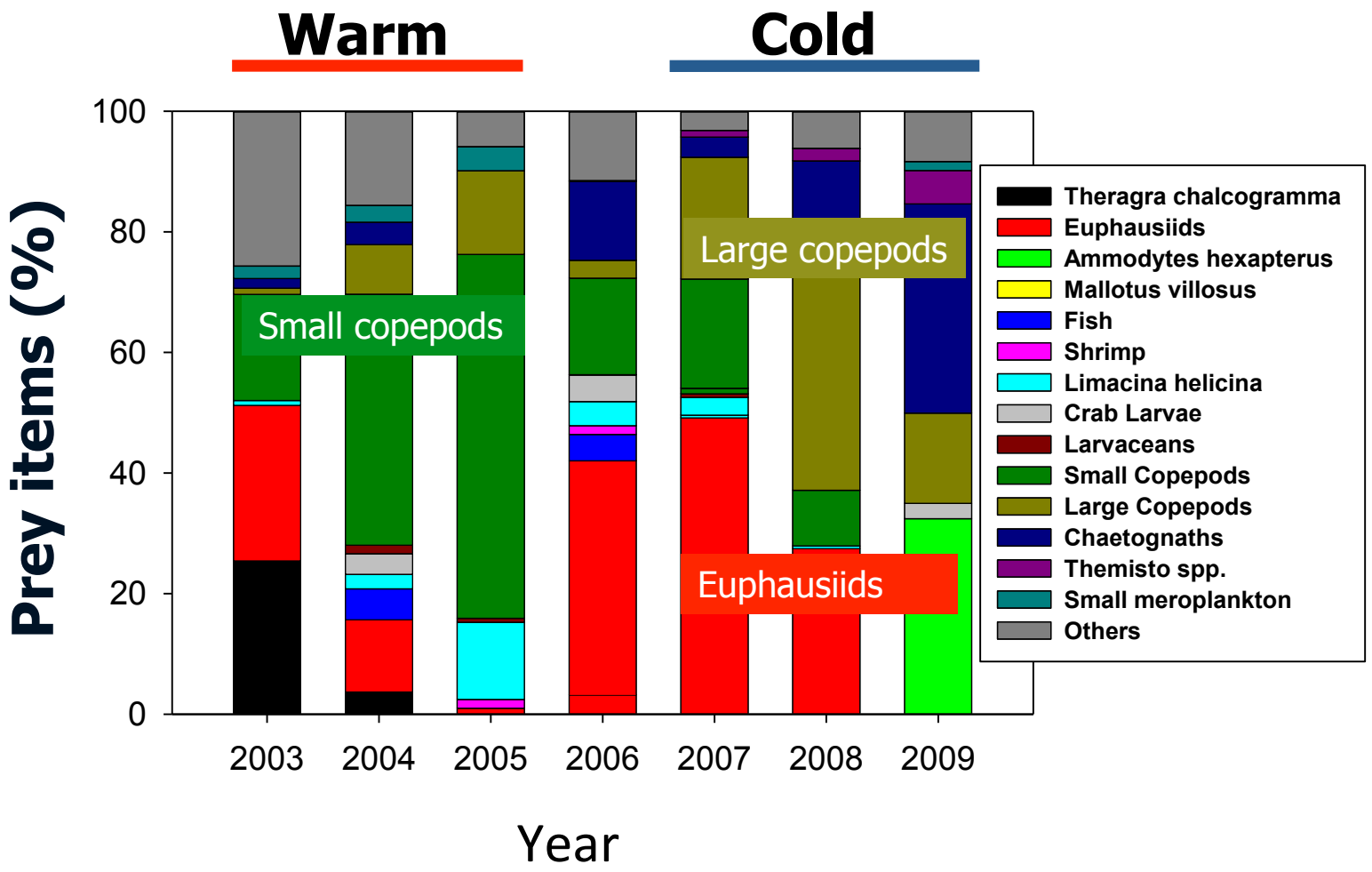
Trawl

Age-0 pollock

Lab: Diet & condition

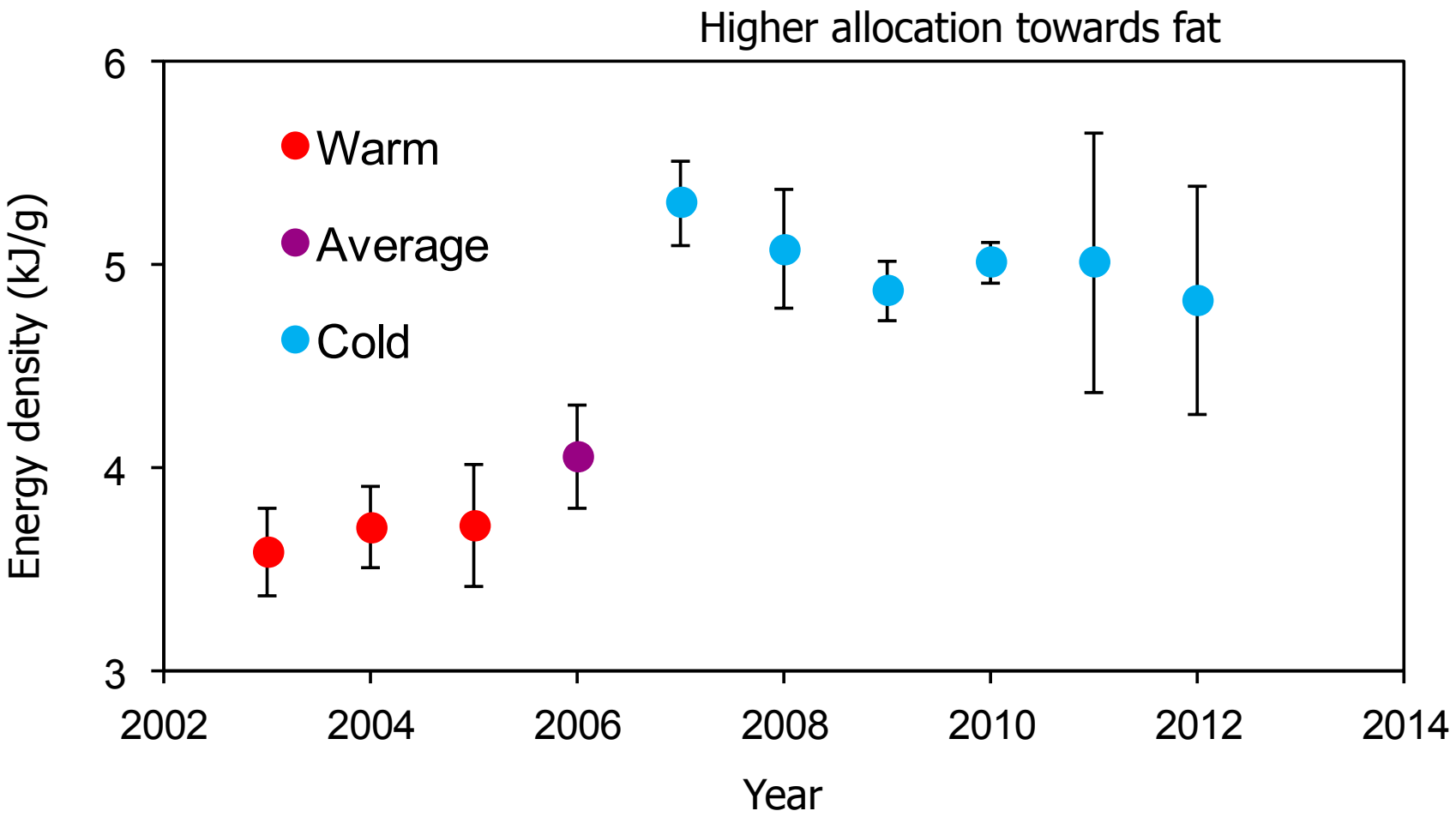
Courtesy: Farley

Age-0 pollock diets



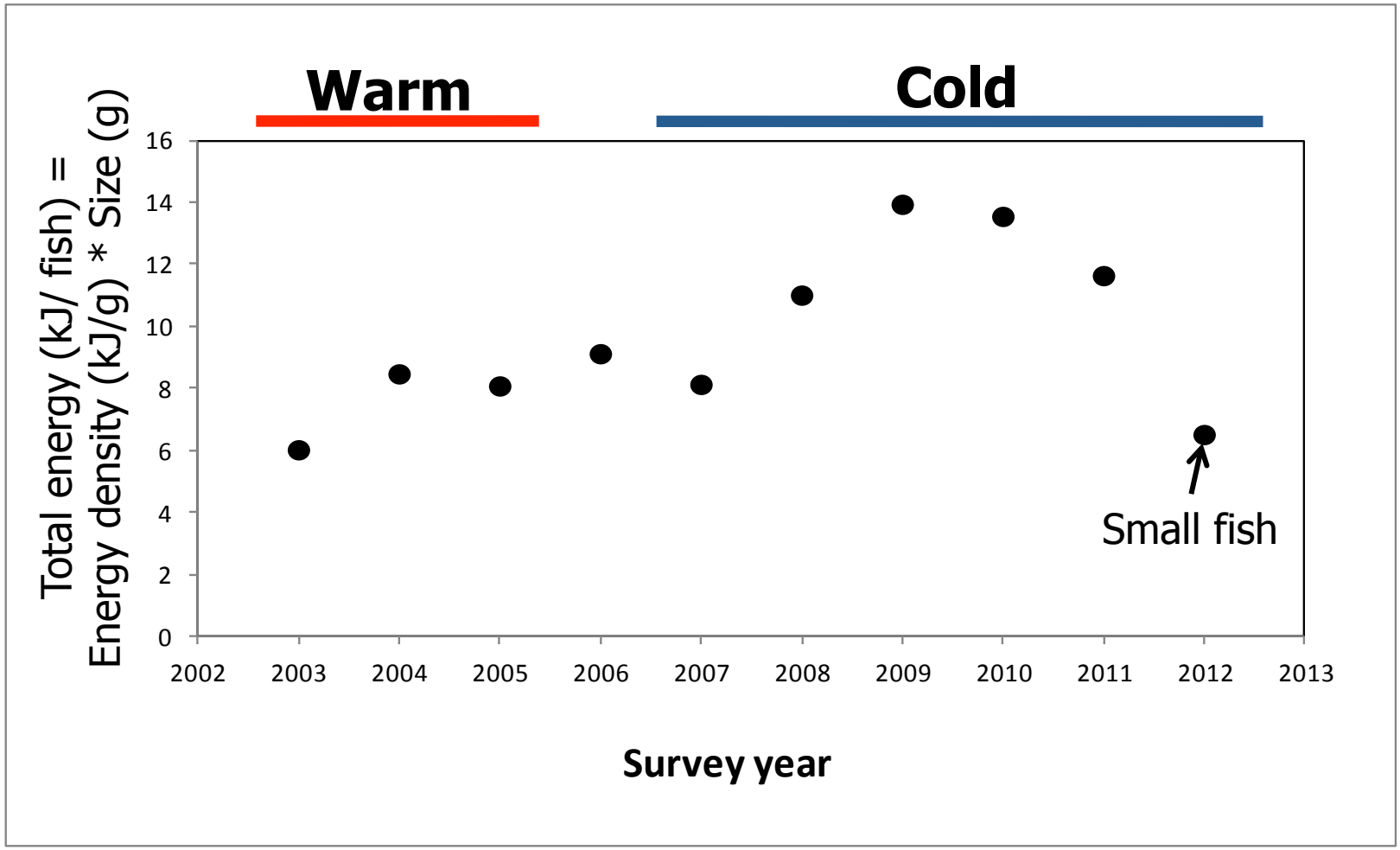
Coyle et al. 2011

Climate & age-0 pollock condition

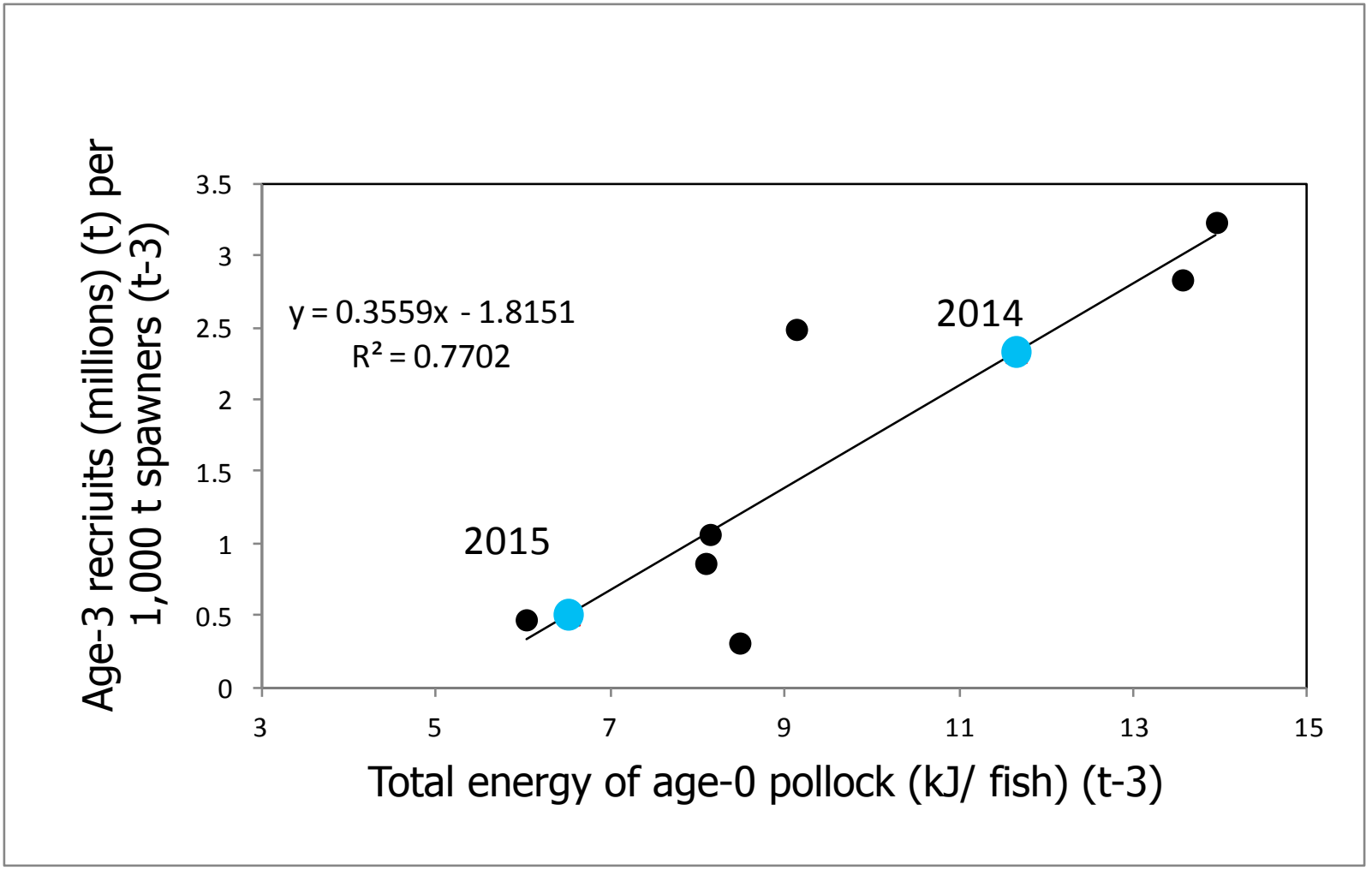


Courtesy: Heintz

Total energy of age-0 pollock



Total energy & survival



Courtesy: Heintz

2014 BASIS survey highlights

- Warm (10-12°C)
- Older pollock and other fish eating age-0 pollock
- Shift to warm year distributions (2002-2006) for age-0 pollock and juvenile salmon (NBS)
- Higher catches of juvenile sablefish and Atka mackerel, west of 170W
- Many & big j. sockeye
- Total energy of age-0s?
- 2017 forecast

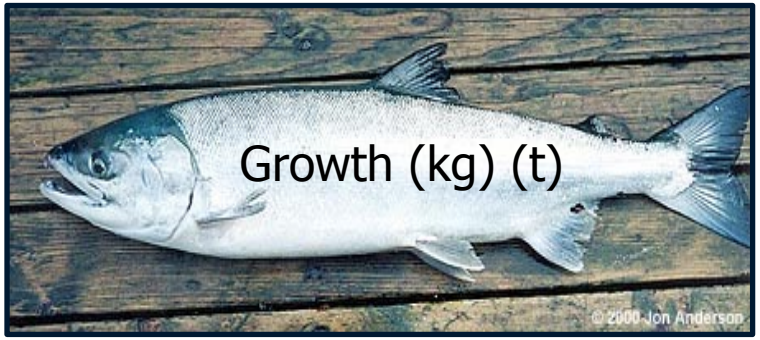
NOAA Fisheries

3. A proxy species for Bering sea pollock

Fishery

Body condition is important in pollock recruitment

Chum salmon growth as a proxy for rearing conditions for age-0 pollock and recruitment to age-1



Bycatch

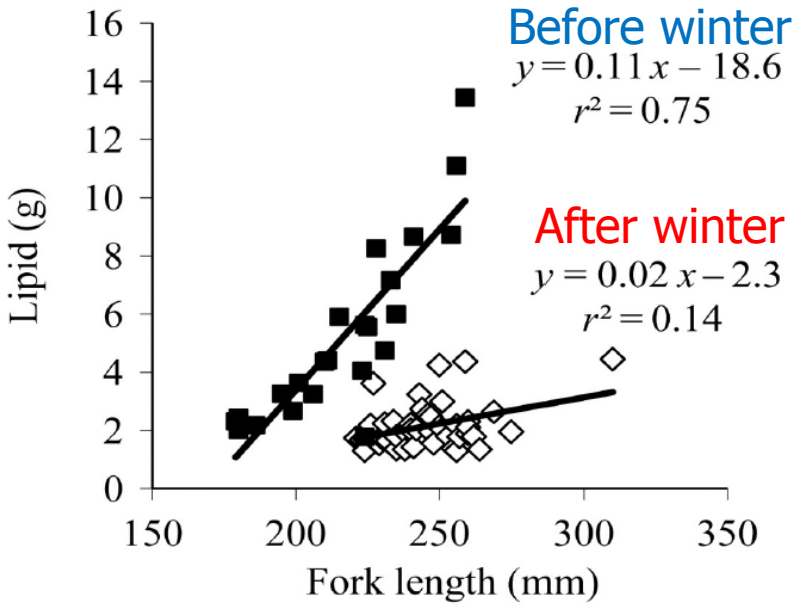
Age-1 pollock abundance (t+1)

Body weight → Energy → Survival

Body weight (g)

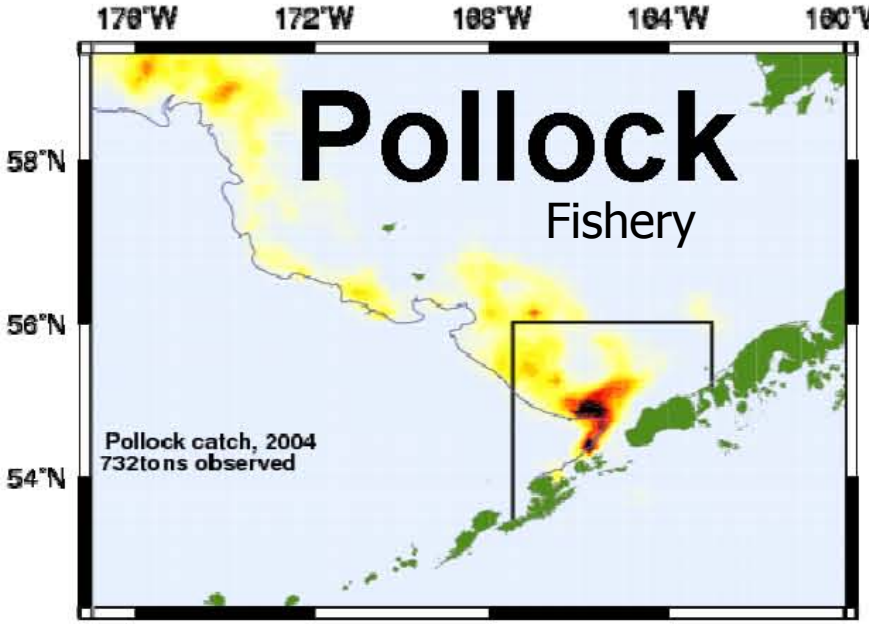
Energy density (kJ/g)

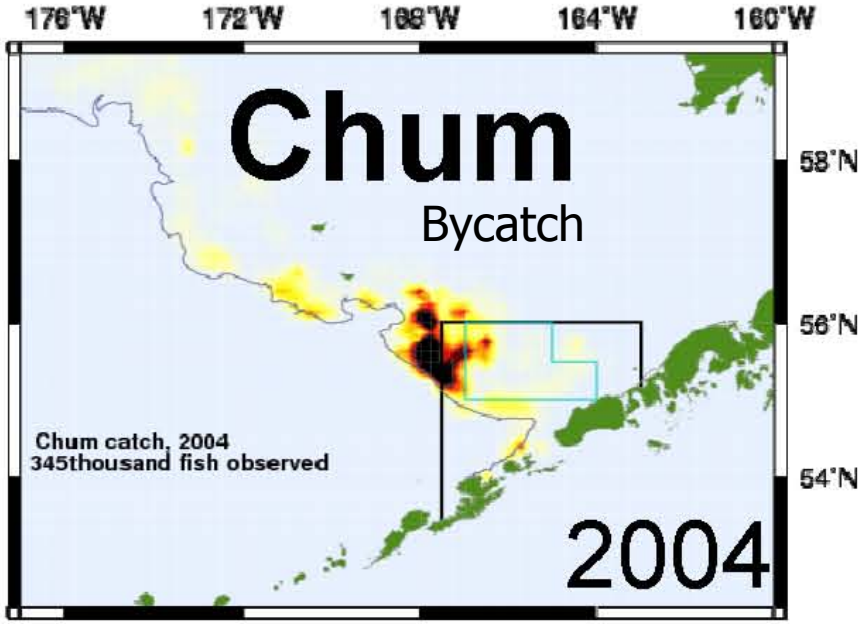
Importance of pre-winter energy reserves: burn it off



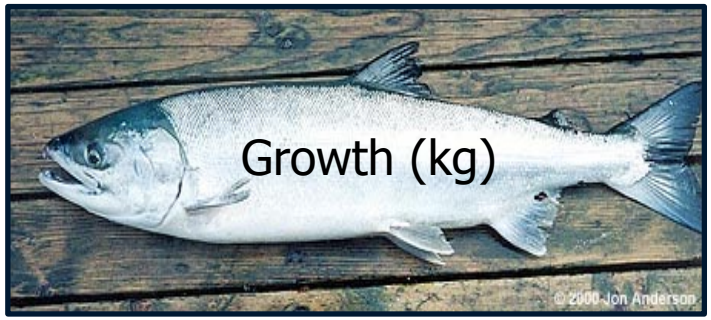
Farley, Murphy

Opportunistic samples



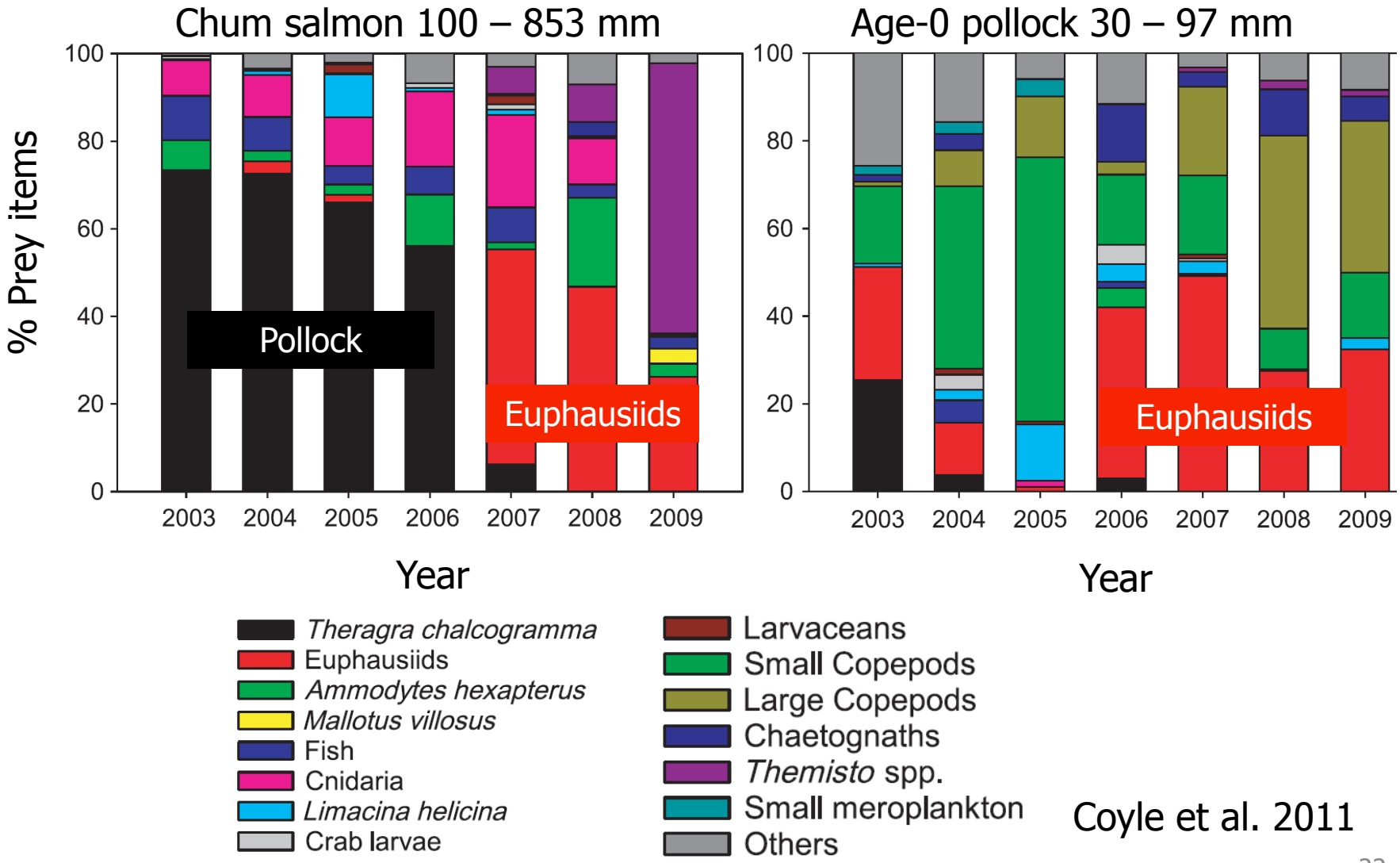


To index rearing conditions for age-0 pollock & recruitment to age-1



Stram and Ianelli

Support: Diets



Coyle et al. 2011

Age-1 pollock model

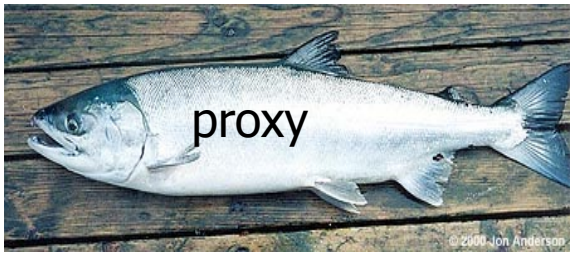
$Age1_t$ = **$Growth_{t-1}$ - SST_t - Adult pink $salmon_{t-1}$**

Age-0 conditions

Age-1 pollock abundance (t)

\+

Chum salmon growth (t-1)



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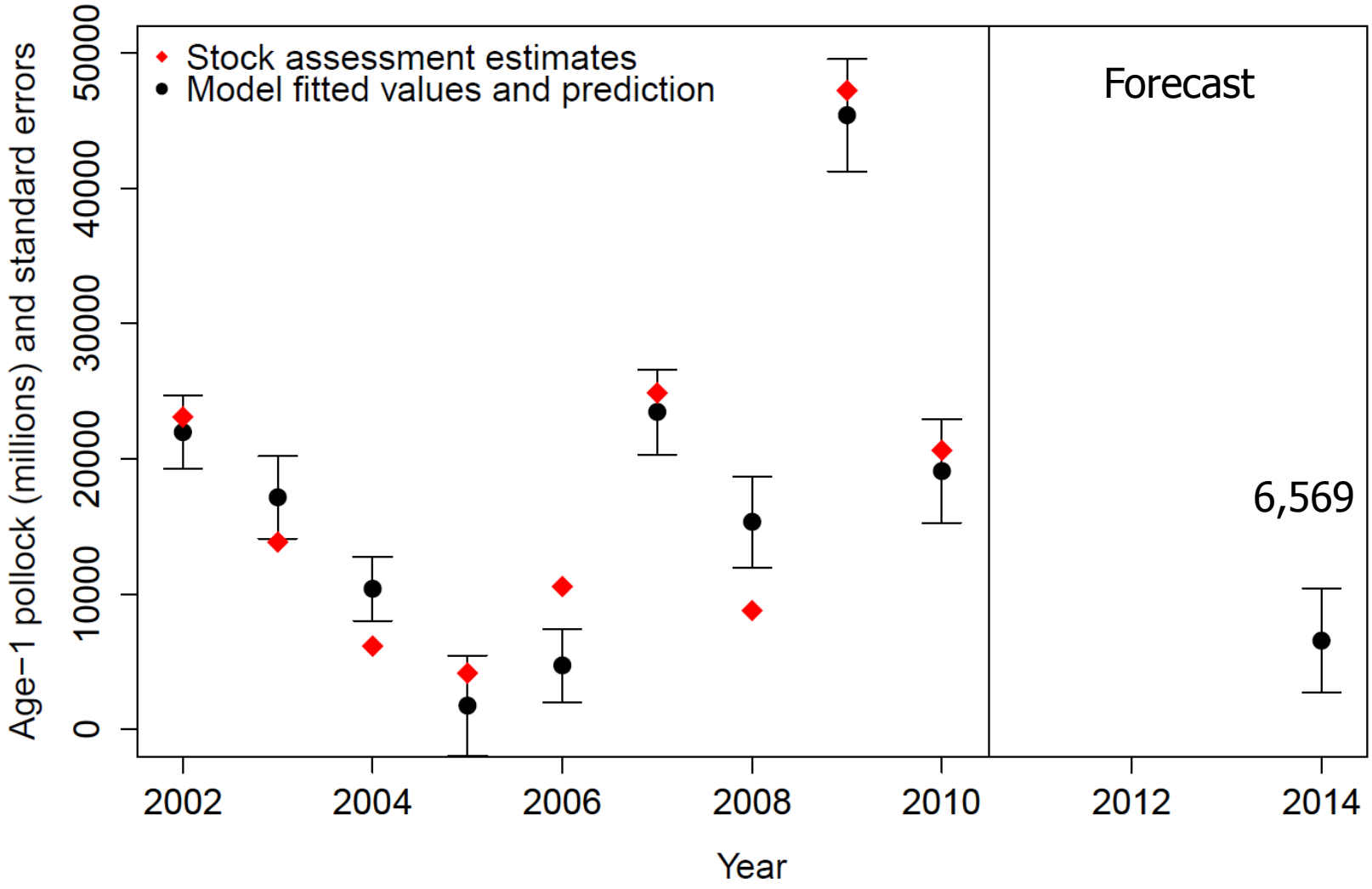
Spring SST during age-1 (t)

\-

Adult pink salmon abundance (t-1)

Age-1 pollock model

R^2= 0.92



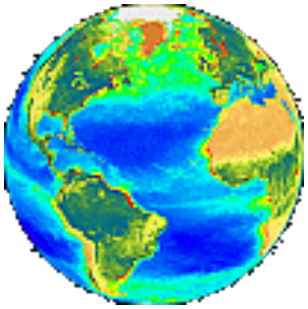
Summary

- Identified new indices for groundfish recruitment

Age-2 sablefish

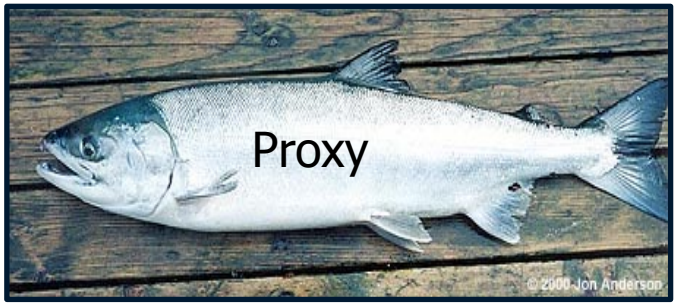
Juvenile pink salmon abundance

Late summer phytoplankton bloom & warm nearshore



Age-0 pollock

Chum salmon growth

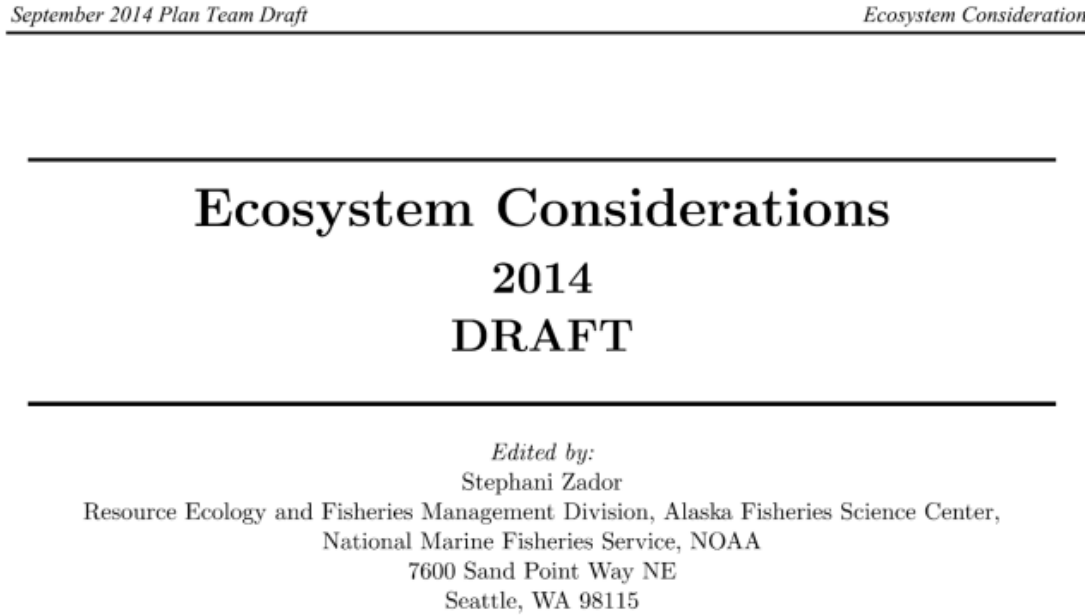


Adult pink salmon abundance

Conclusion

- Products
- Feedback

Thank you



Ecosystem Considerations

2014

DRAFT

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