

# Spatial and Annual variation in juvenile chum and pink salmon marine growth: tales from the NE Bering Sea to SE Alaska ~~(BC)~~

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~~Marc Trudel~~ and Ed Farley

# Why study ocean growth of juvenile salmon?

## Over-arching hypothesis:

early ocean growth is related to overall marine survival (sets cohort strength)

inter-annual variation growth = inter-annual variation in survival

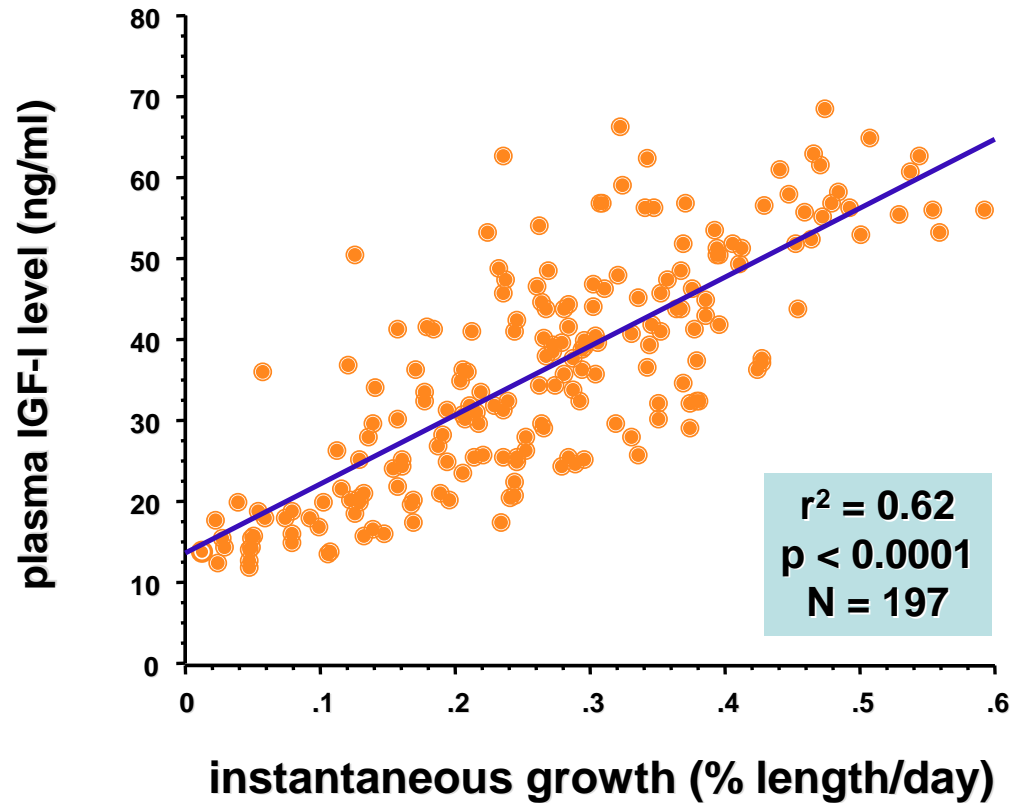
spatial variation in growth = regional variation in survival

⇒ and, provides insight into oceanographic and ecological processes regulating marine productivity and salmon growth

# How is growth assessed?

## By measuring the hormone insulin-like growth factor 1 (IGF1)

recent (~1 week) growth history

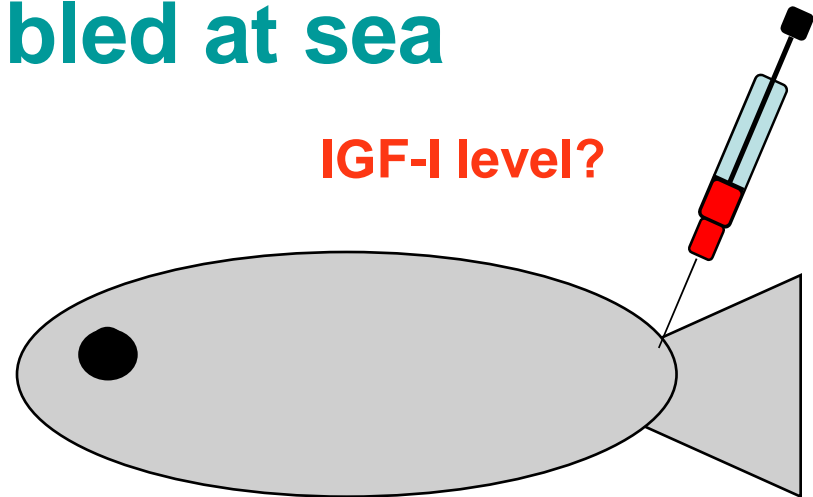


Laboratory study  
Juvenile coho salmon  
6 week growth interval  
in seawater

Beckman et al. 2004 TAFS

# How are samples collected?

## Salmon are bled at sea

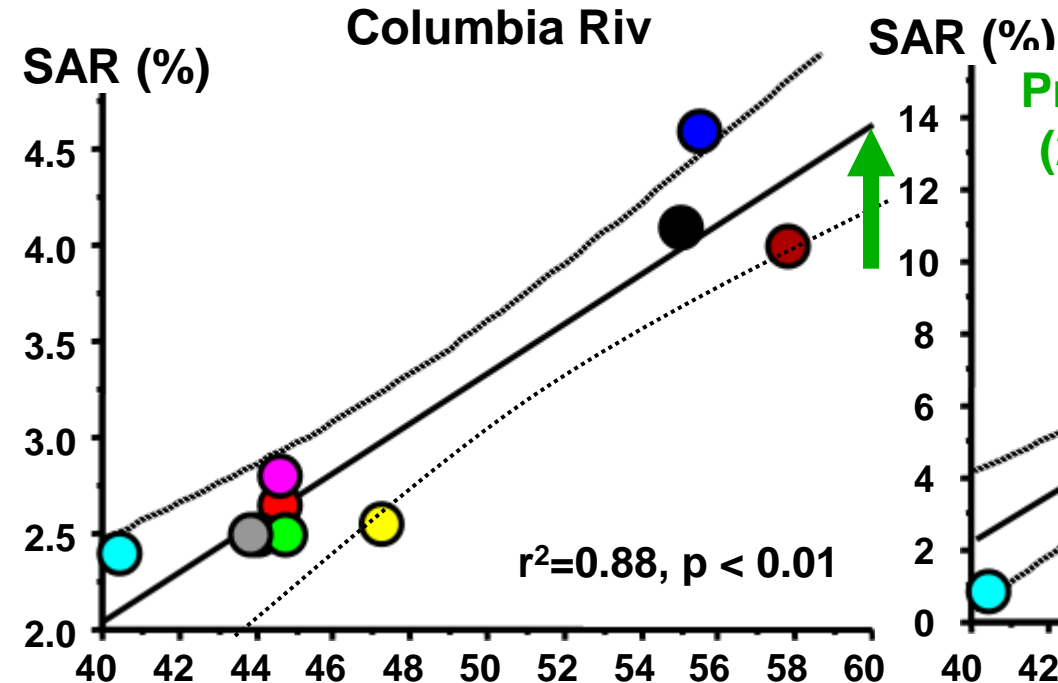


Is there any evidence that this approach is useful?

IGF1 levels are related to marine survival of coho salmon in the Northern California Current

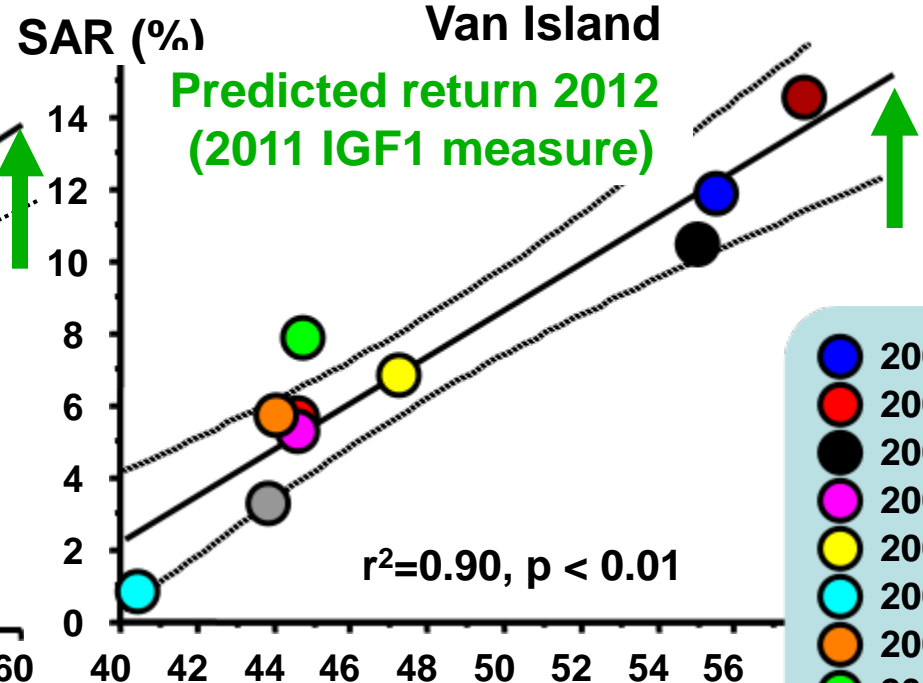
### IGF1 vs OPI SAR

Columbia Riv



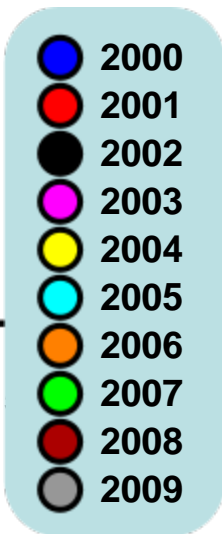
### IGF1 vs Rob Crk SAR

Van Island



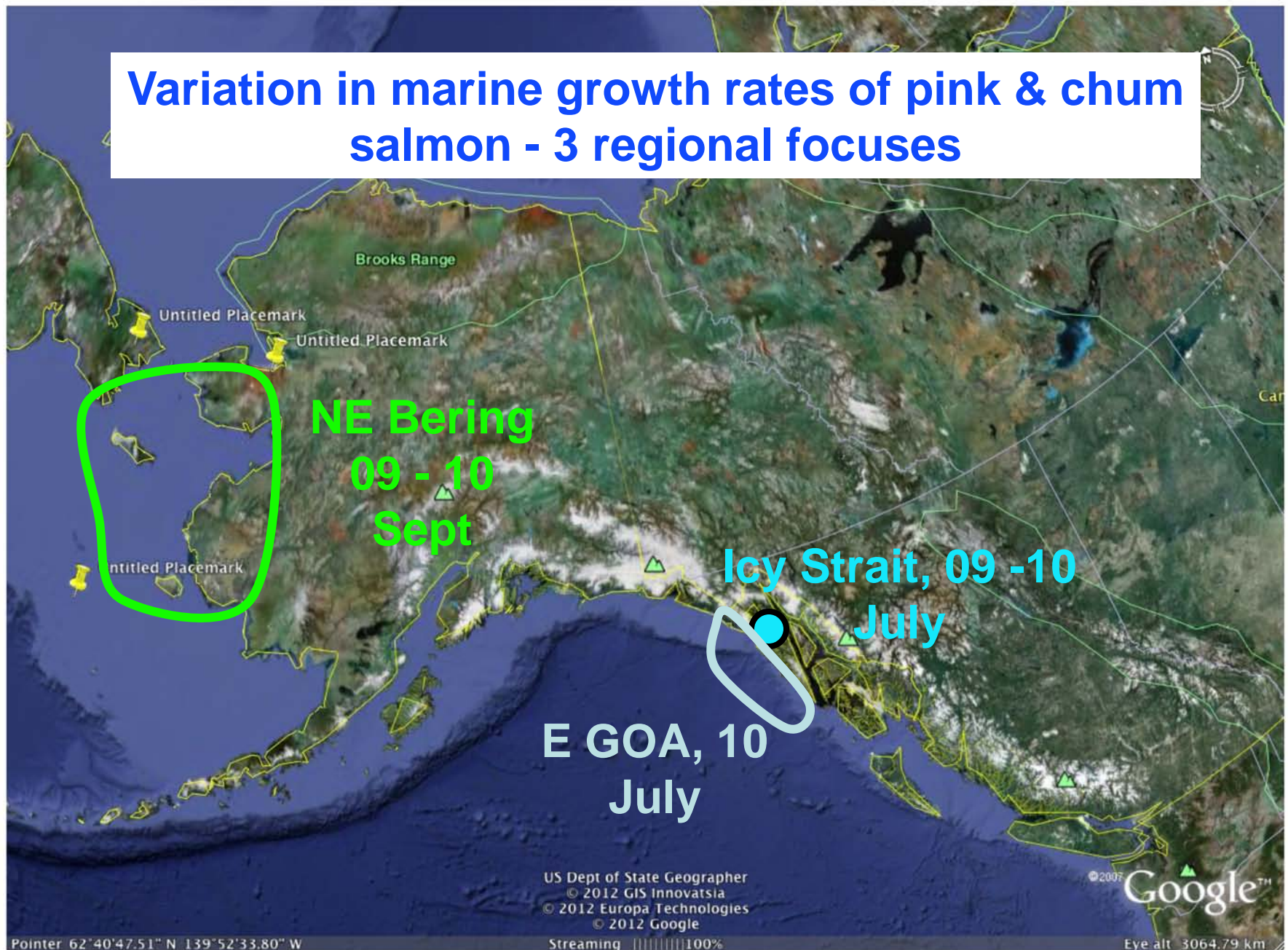
Predicted return 2012  
(2011 IGF1 measure)

June mean IGF1 (ng/ml)  
OR/WA coast





# Variation in marine growth rates of pink & chum salmon - 3 regional focuses



# Questions to be addressed:

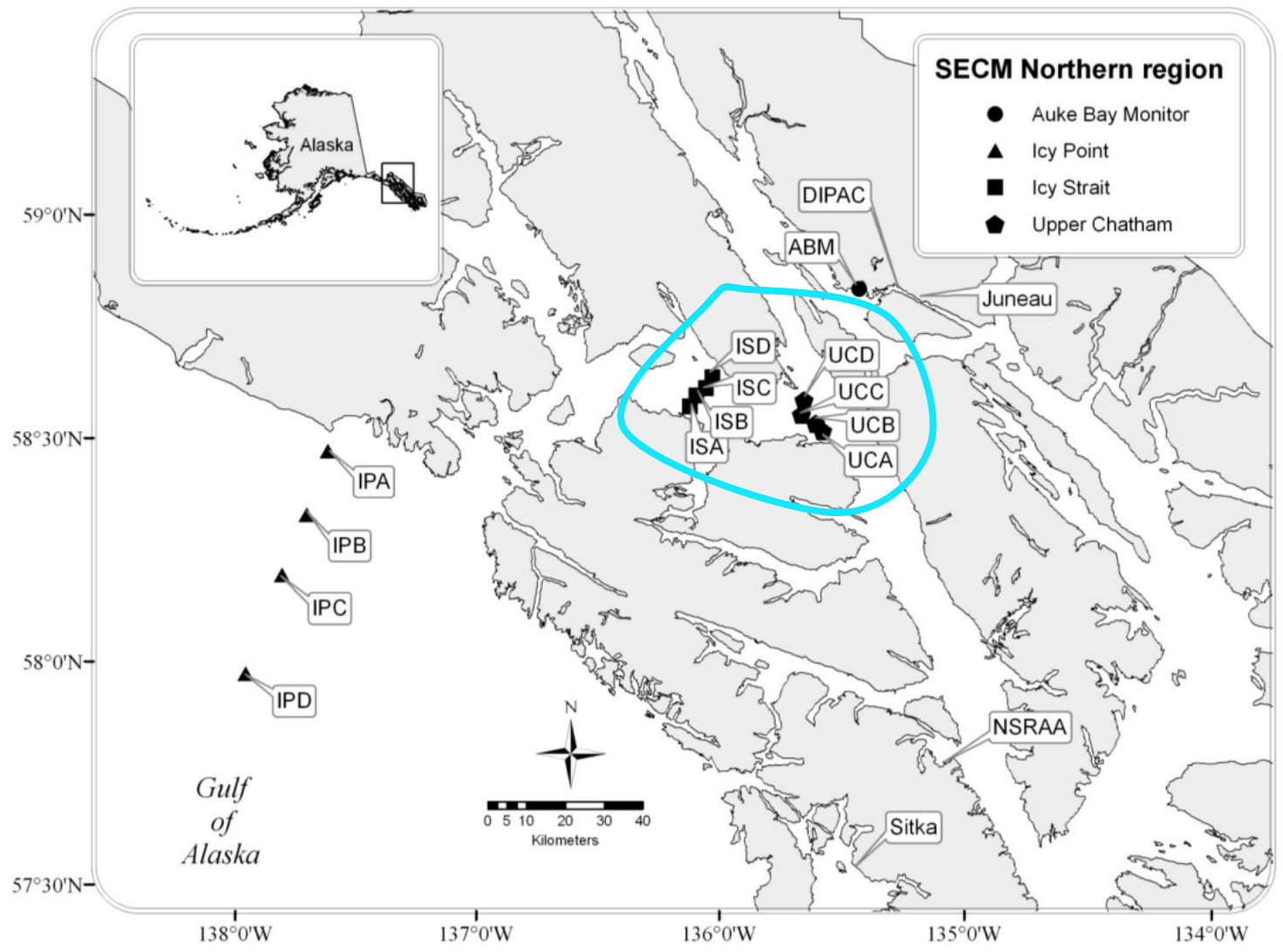
**Is there inter-annual variation?**

**Is there regional variation?**

**Is spatial variation in pink and  
chum IGF1 similar?**

**mechanism?**

# Icy Strait (SECM): Pink and Chum - 2009 and 2010

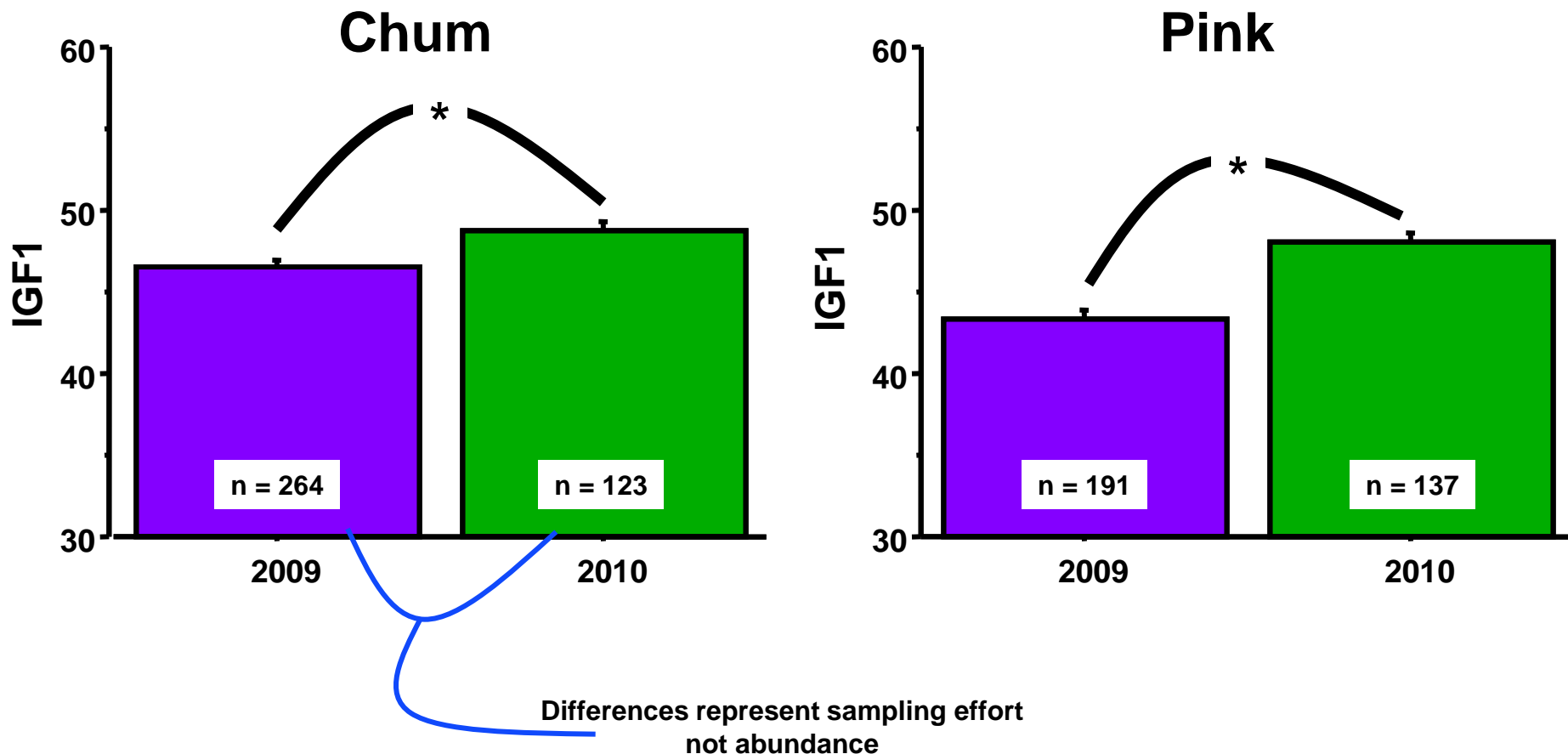




# Is there inter-annual variation?

## SECM 2009 vs 2010

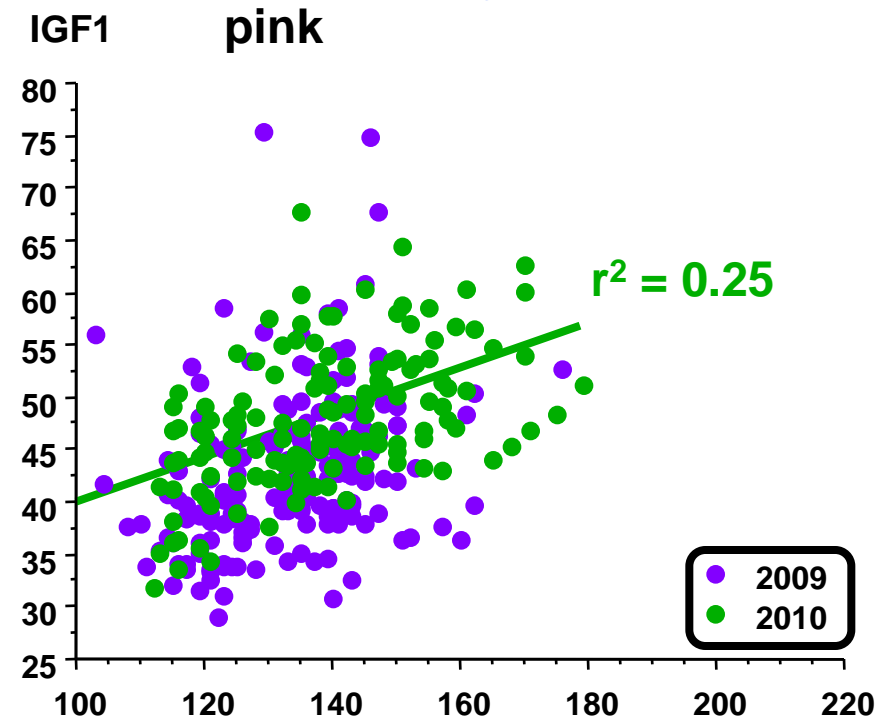
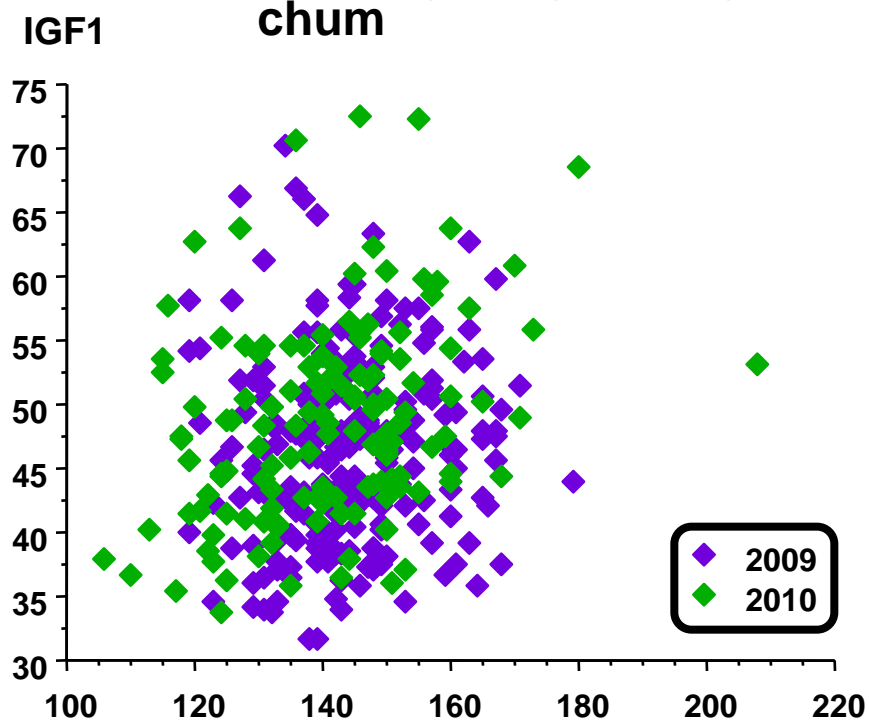
### Pink & Chum



# There is little relation between size and growth

## Growth estimate is size independent

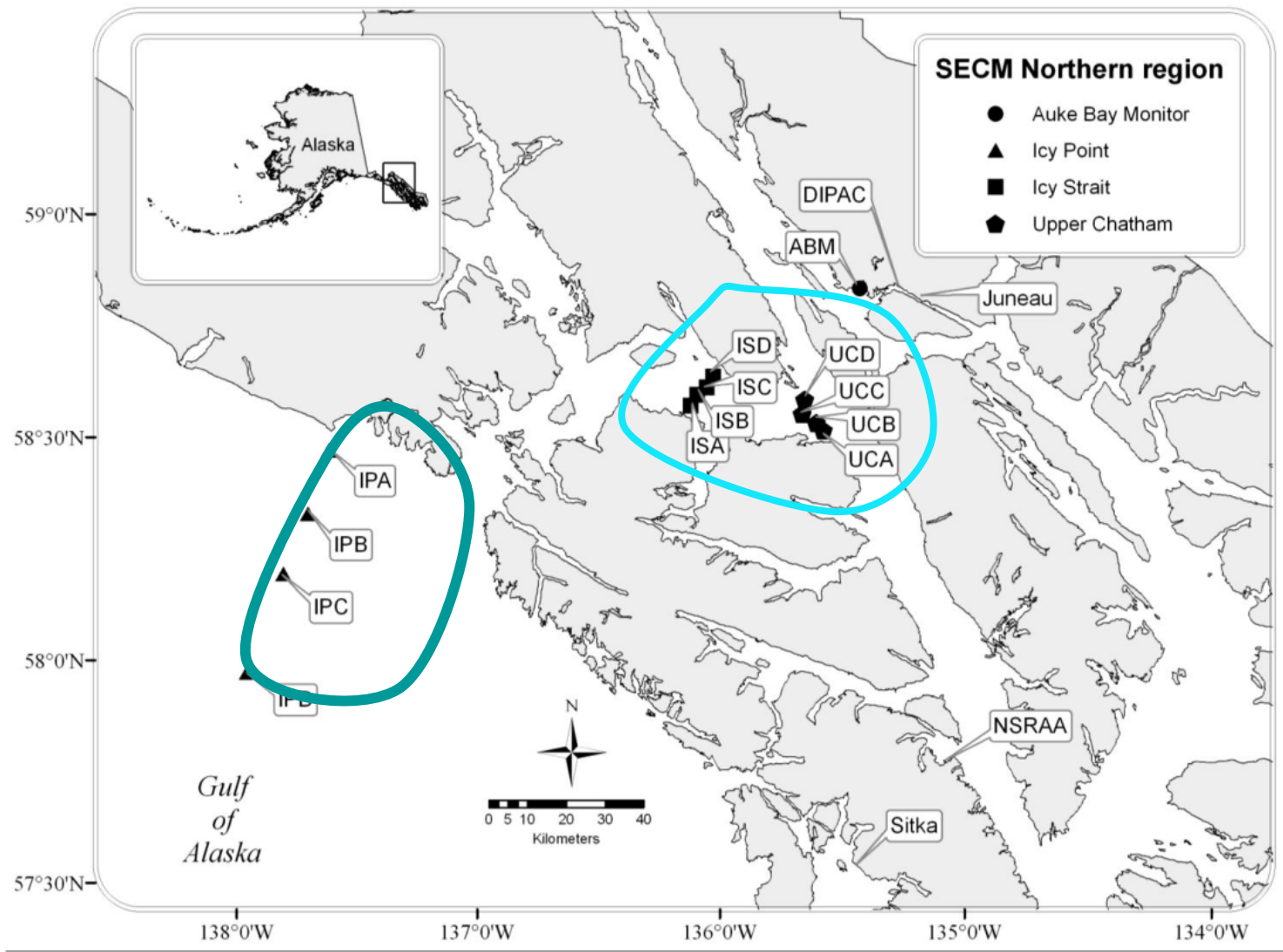
Joe/Molly/Emily - have you looked at otoliths for Hatchery/Wild ID?



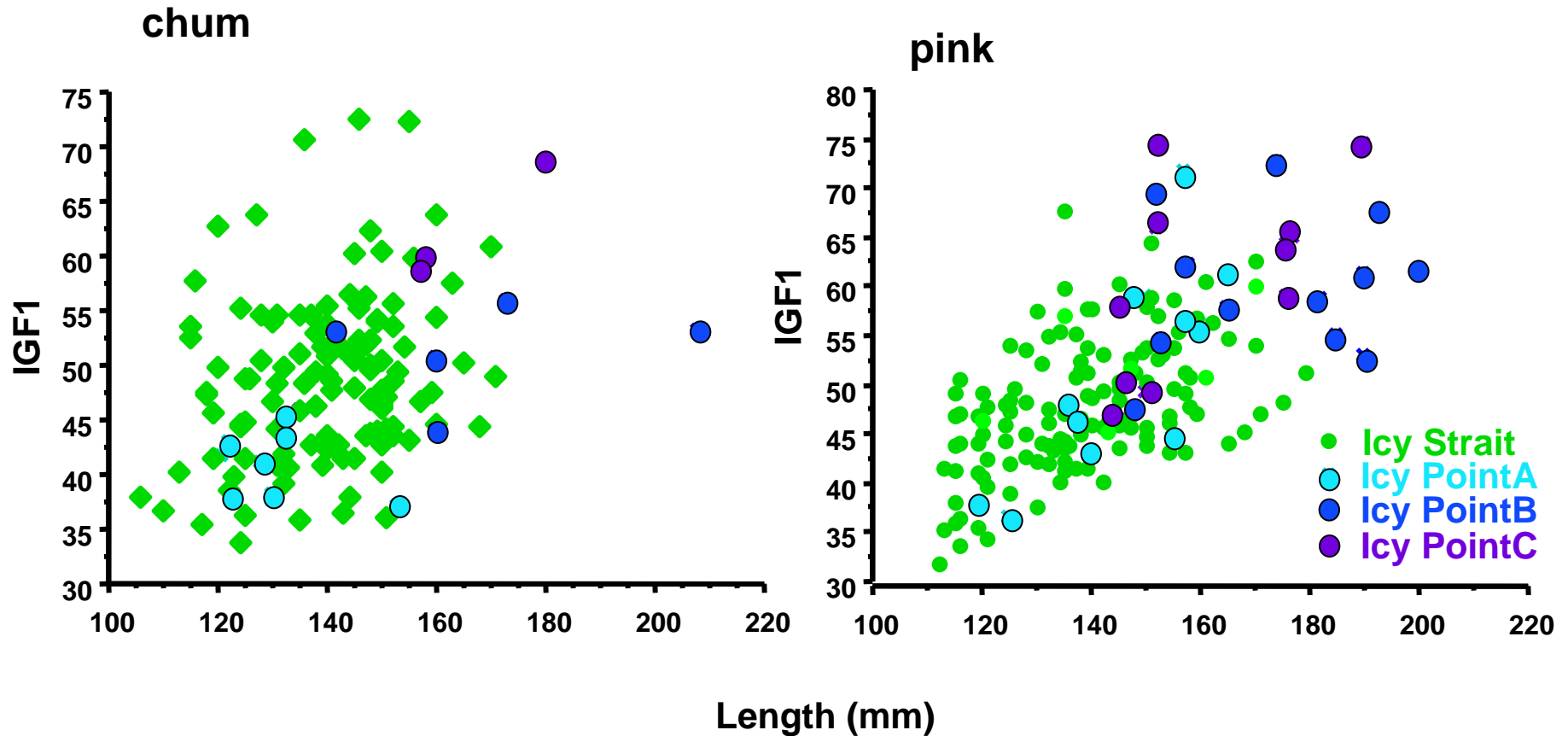
Individual data

Icy Strait

# Icy Strait (SECM): Pink and Chum - 2009 and 2010



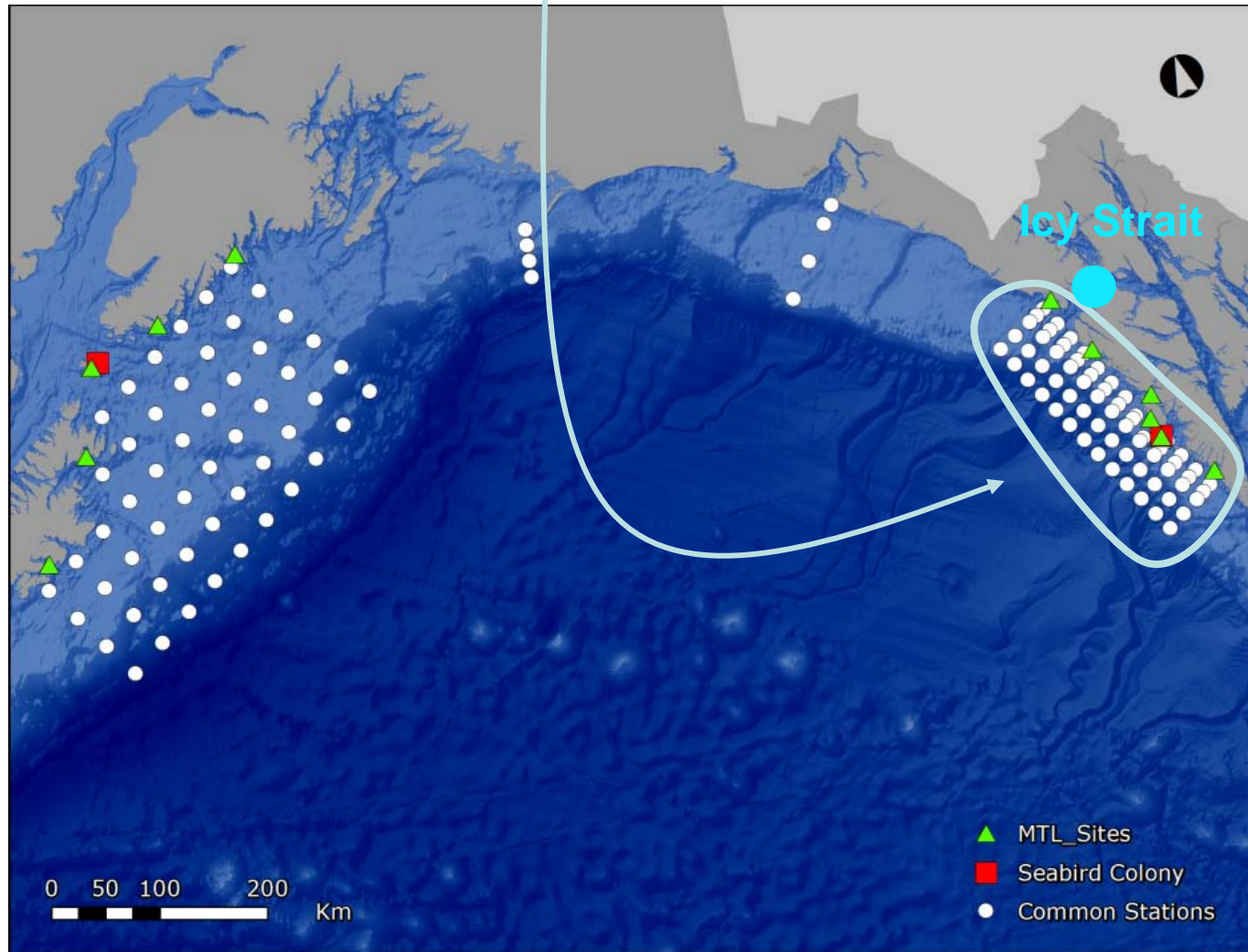
# Is there regional variation?



Individual data

Icy Strait 2010

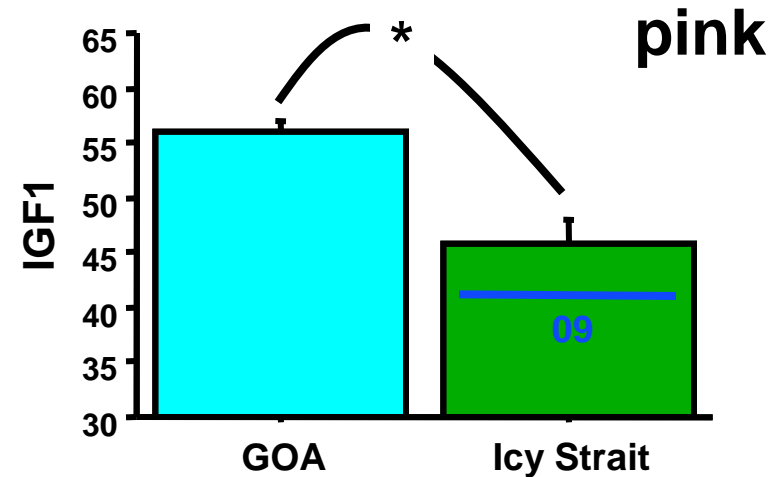
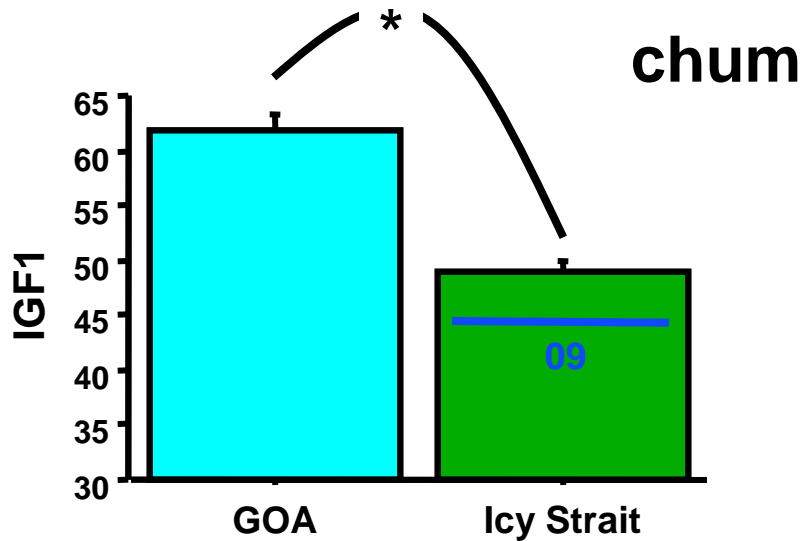
# Gulf of Alaska: Pink and Chum 2010 Different than Icy Strait?





# Is there regional variation?

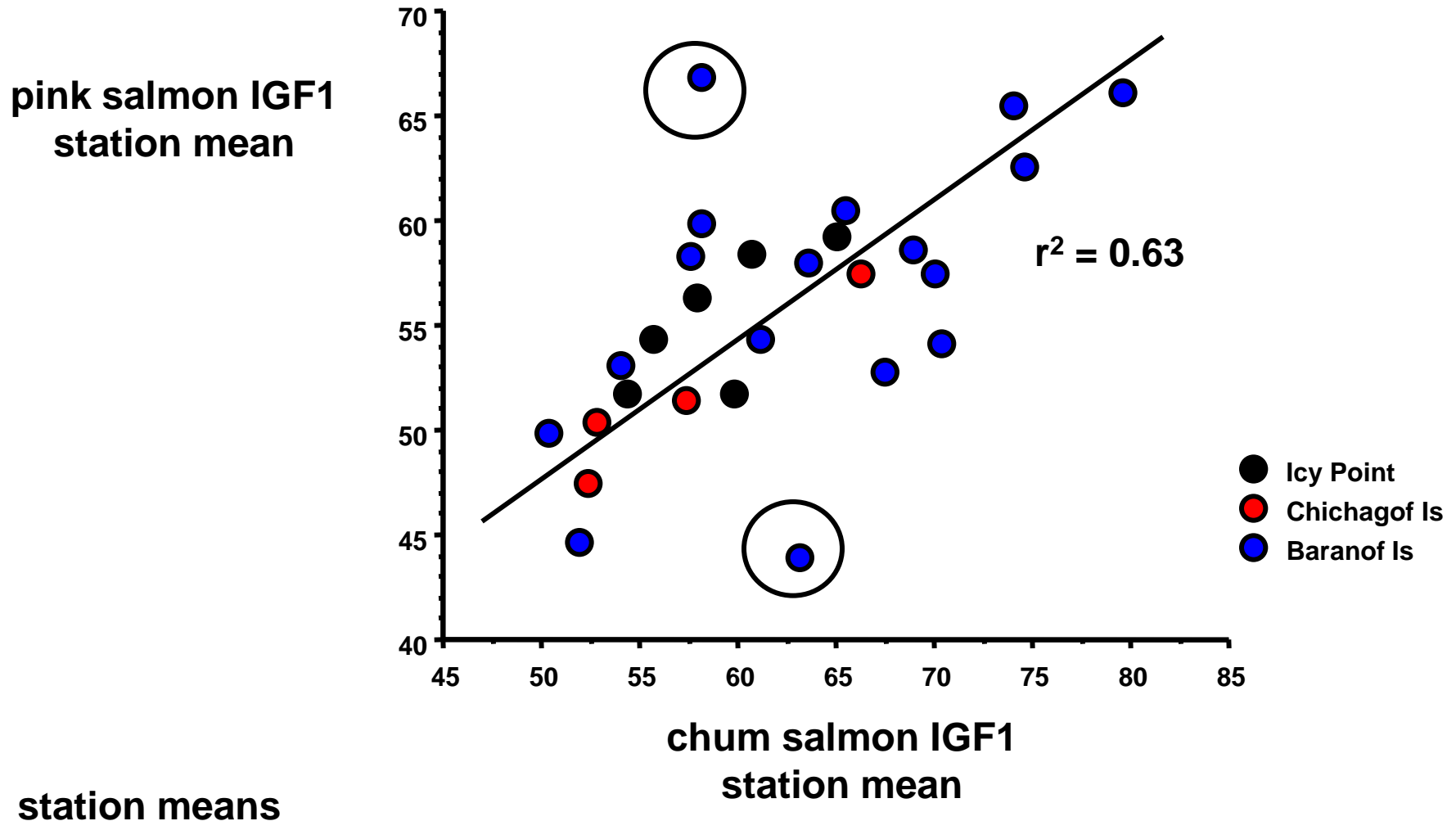
Pink & Chum 2010 Icy Strait vs GOA

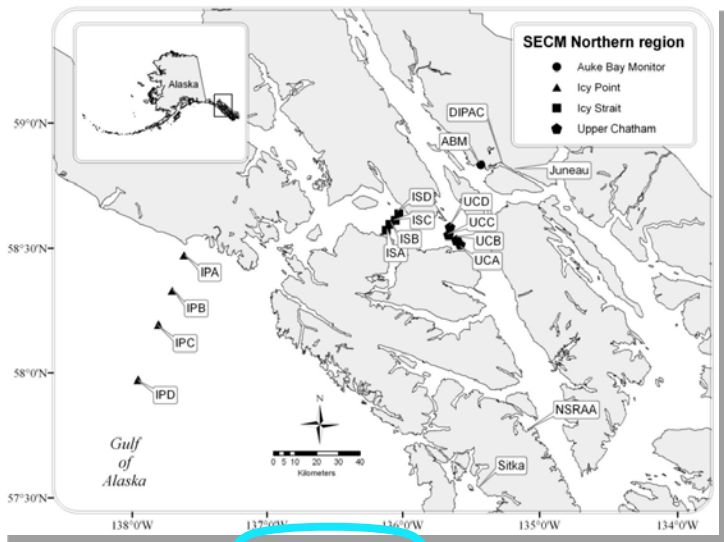


yes, pink IGF1 GOA > Icy Strait  
chum IGF1 GOA > Icy Strait

# Is there coherent spatial variation in pink and chum salmon IGF1 (GOA 2010)?

(Compare station means)





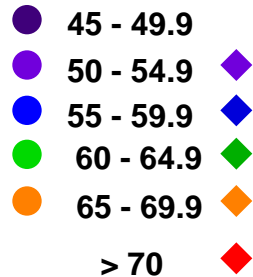
Where are higher IGF1 levels found?

somewhere off Baranof Island

IGF1 levels

pink

chum



latitude

60

59

58

57

56

55

Juneau

Sitka

-140

-139

-138

-137

-136

-135

-134

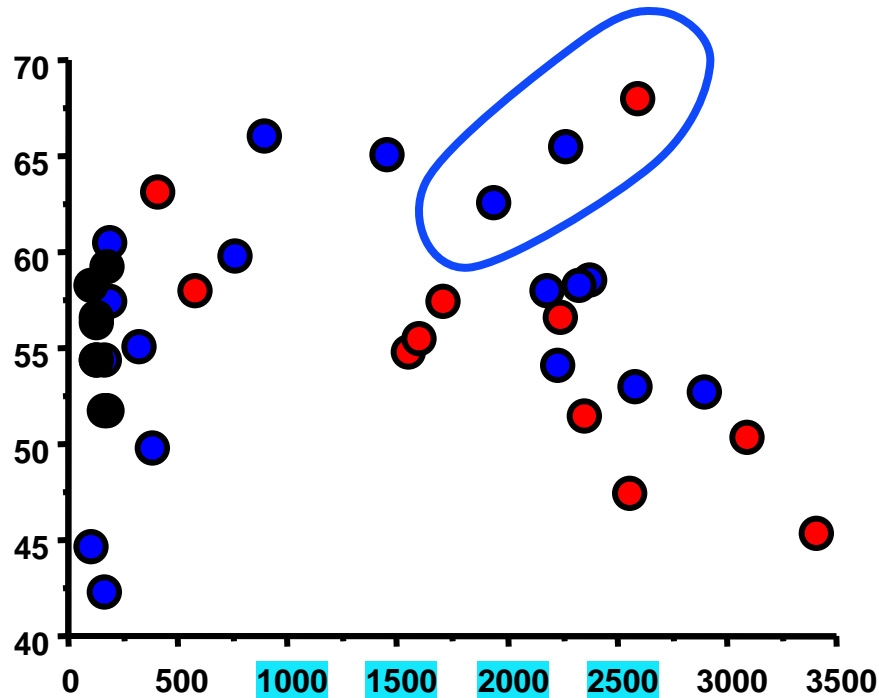
longitude

station means

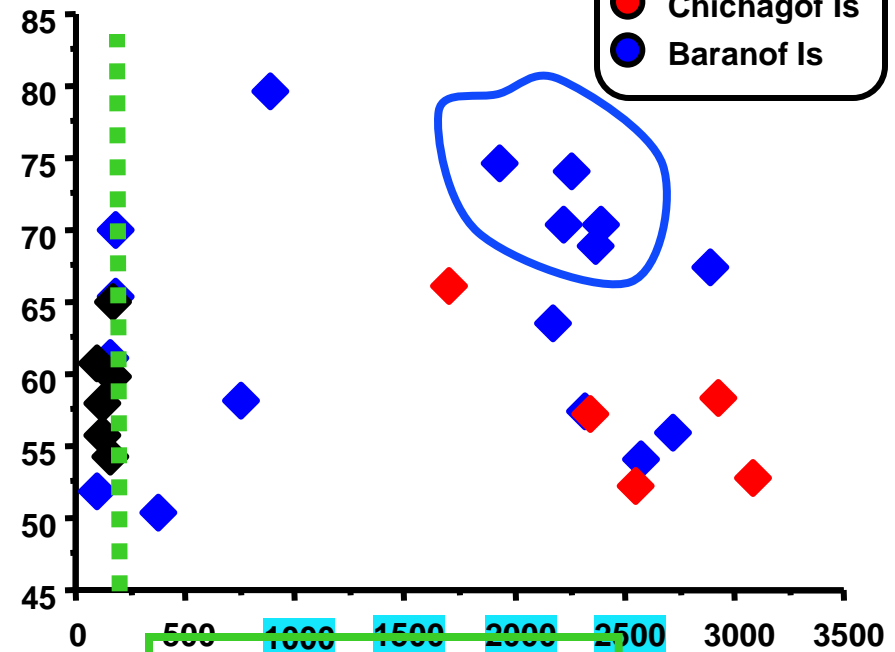
# Is there a common character for high IGF1 stations?

They're in **DEEP** water  
(but caught at the surface)

mean pink  
salmon IGF1



mean chum  
salmon IGF1

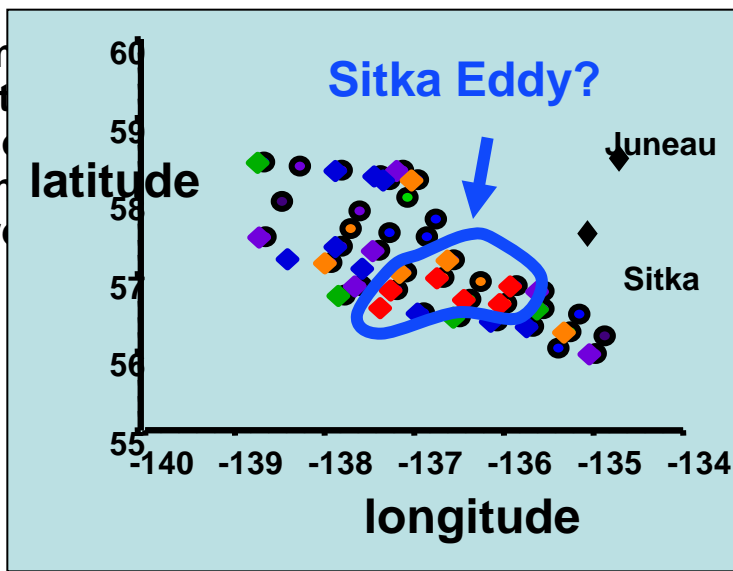


Depth (m)

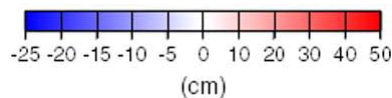
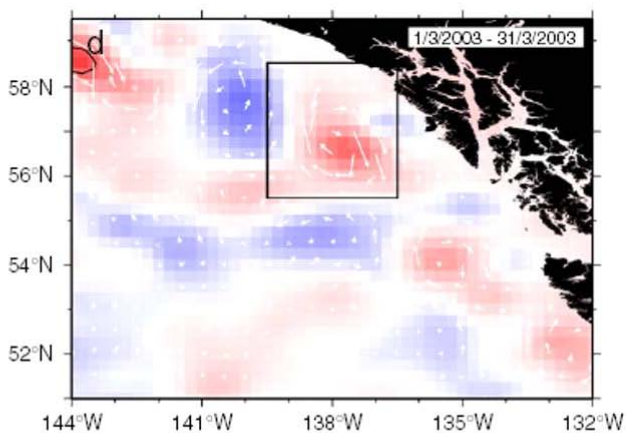
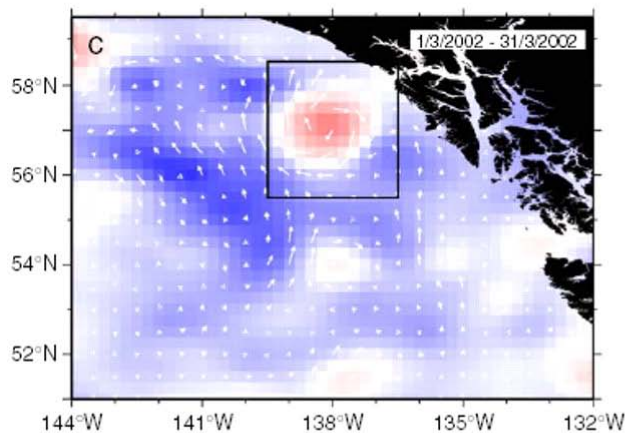
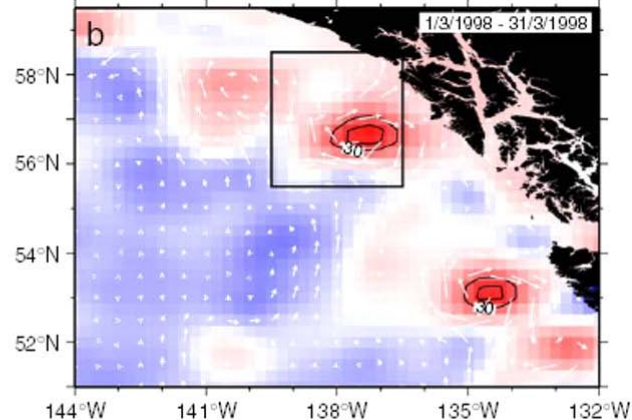
Station means

> 90% all juveniles  
off Or/Wa

(a) Time  
the Sit  
and c  
star  
curre



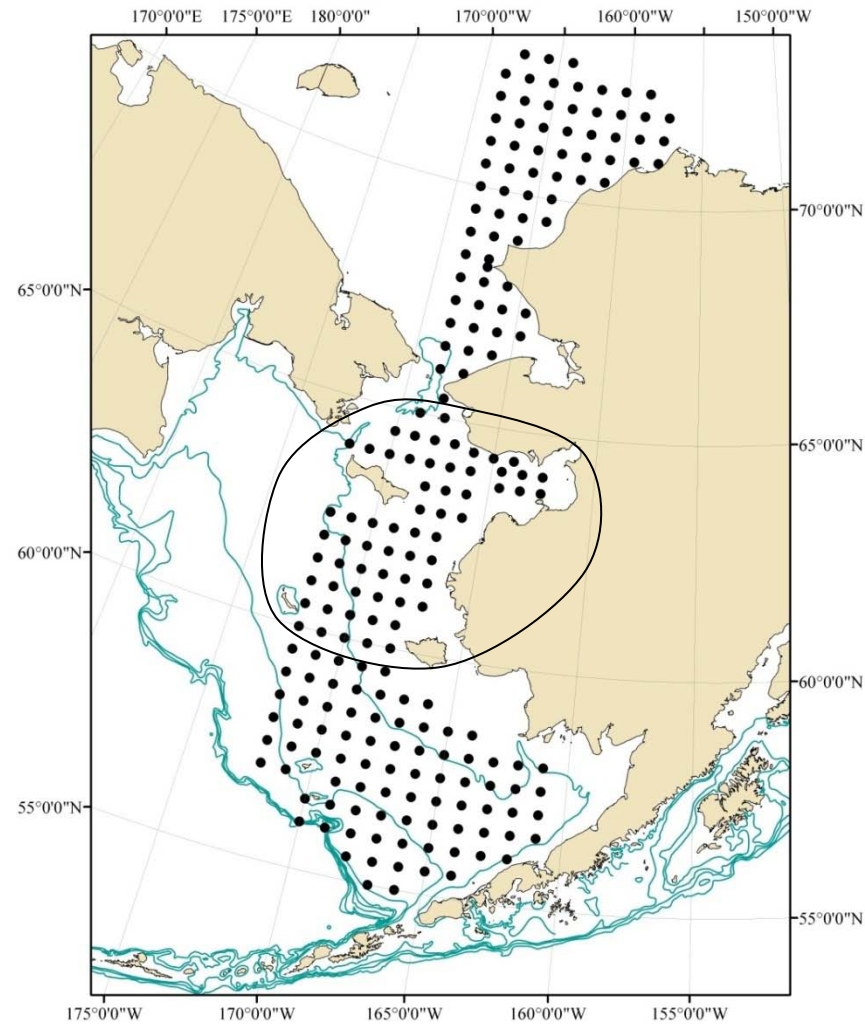
ation of TOPEX/POSEIDON and JASON-1 SSH in  
ied by the box in panels b, c, and d), 1992–2004,  
or three months (identified in panel a) with high  
eostrophic  
panels b–d).



Polovina J J , Howell E A ICES J. Mar. Sci. 2005;62:319-327



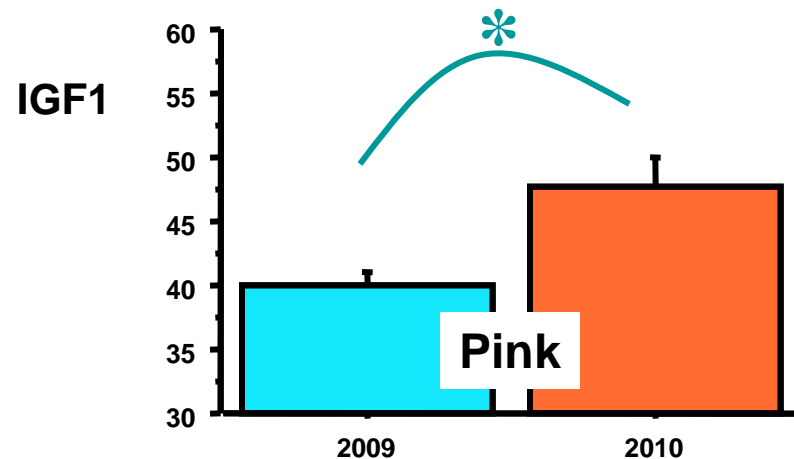
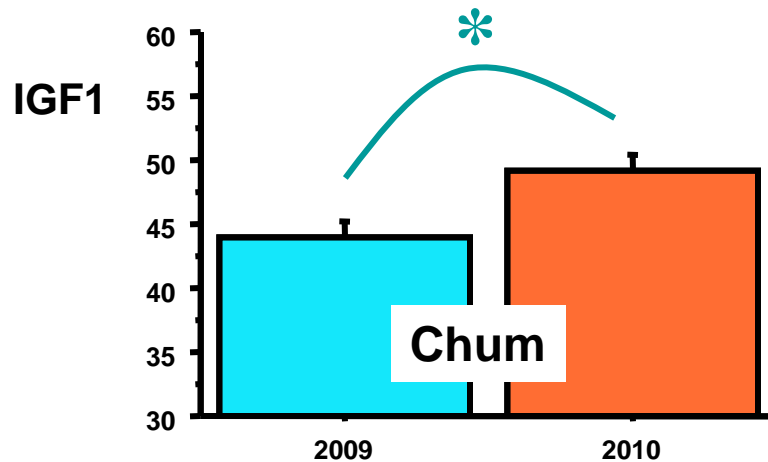
# NE Bering: Pink and Chum - 2009 and 2010



# Is there inter-annual variation?

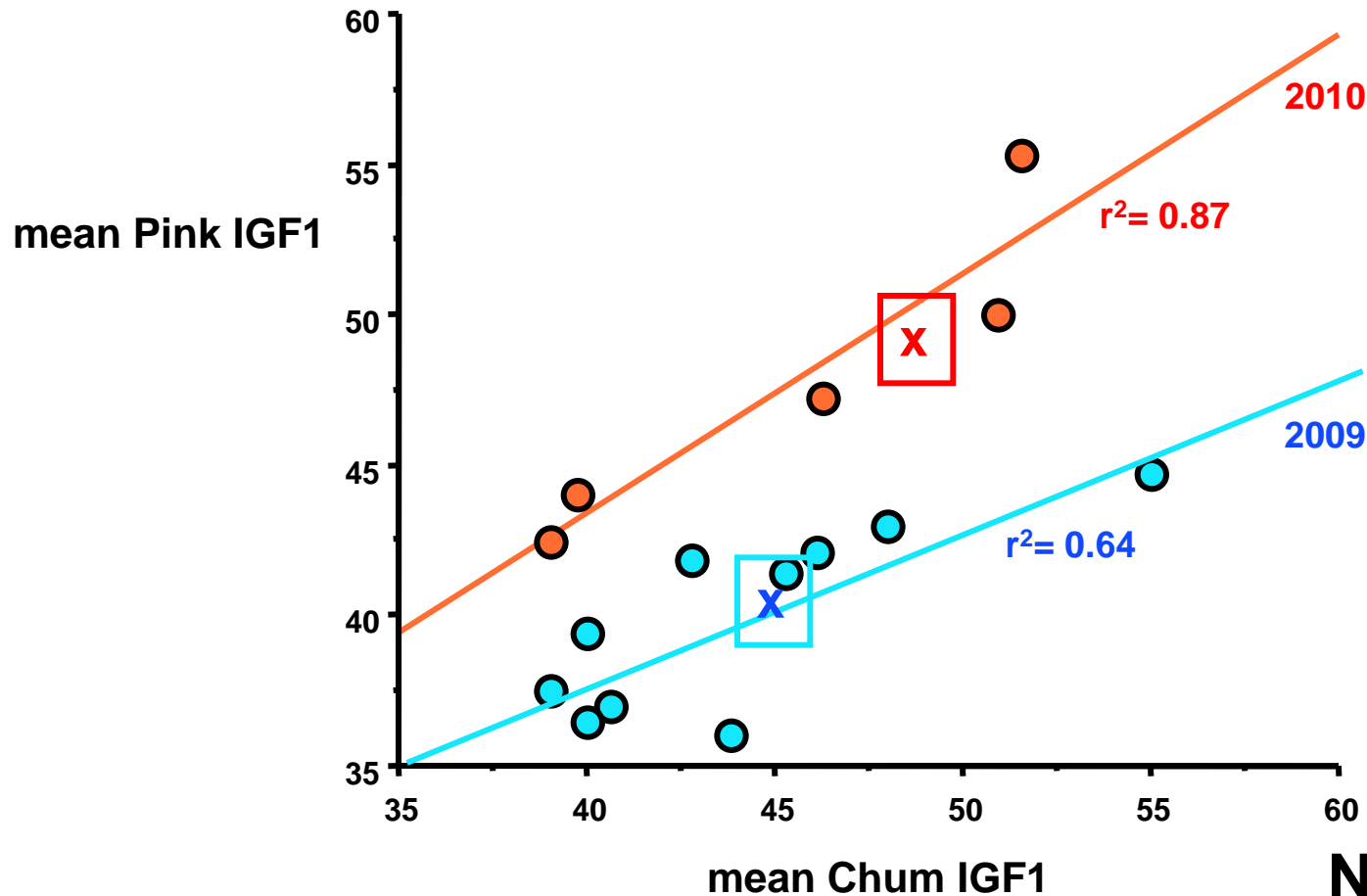
## NE Bering 2009 vs 2010

### Pink & Chum



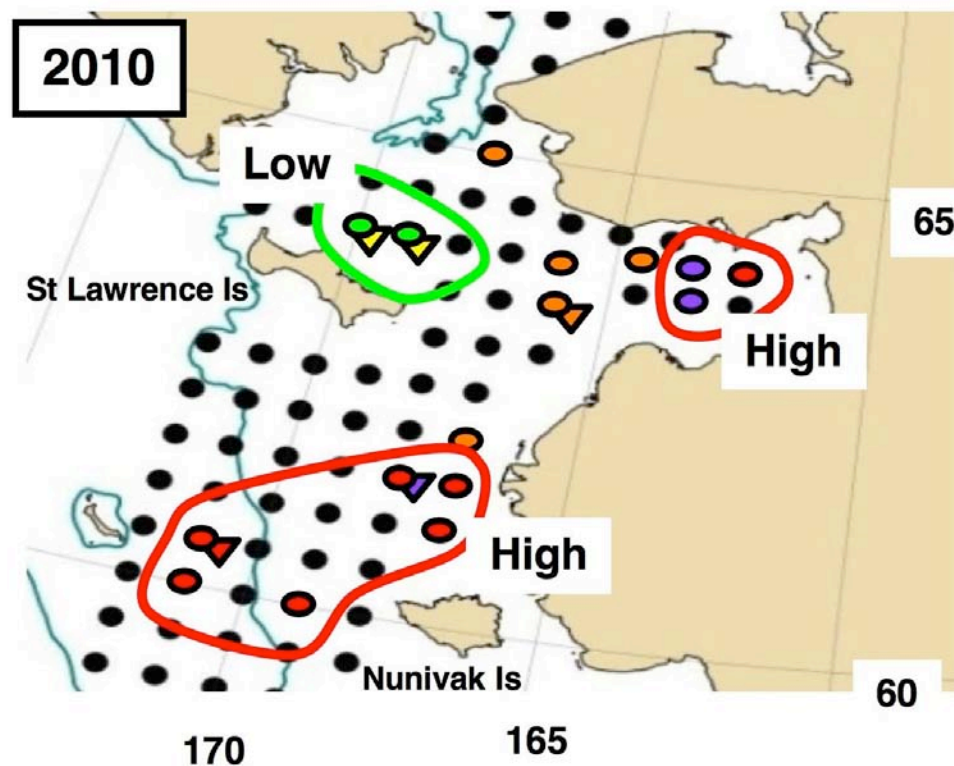
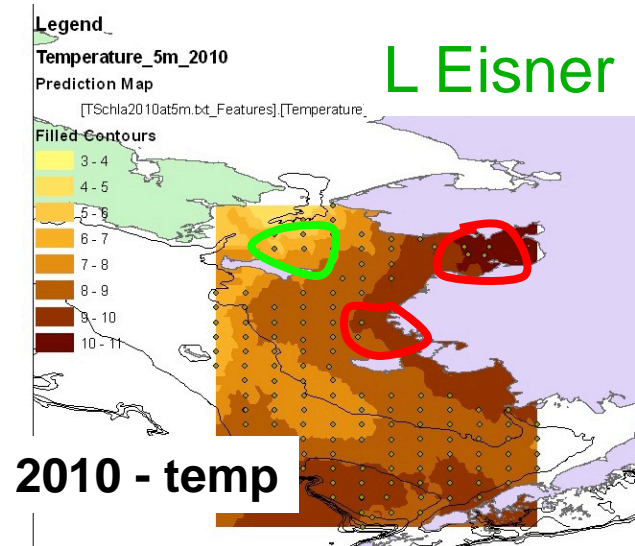
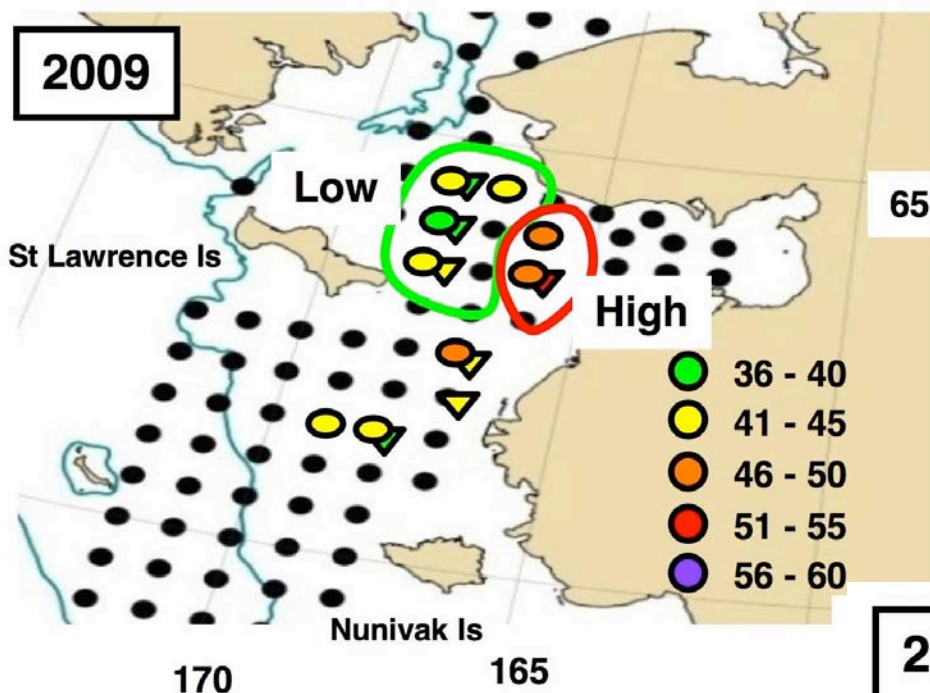
yes, pink IGF1 2010 > 2009  
chum IGF1 2010 > 2009

# Is there coherent spatial variation in pink and chum salmon IGF1 levels?



Station means

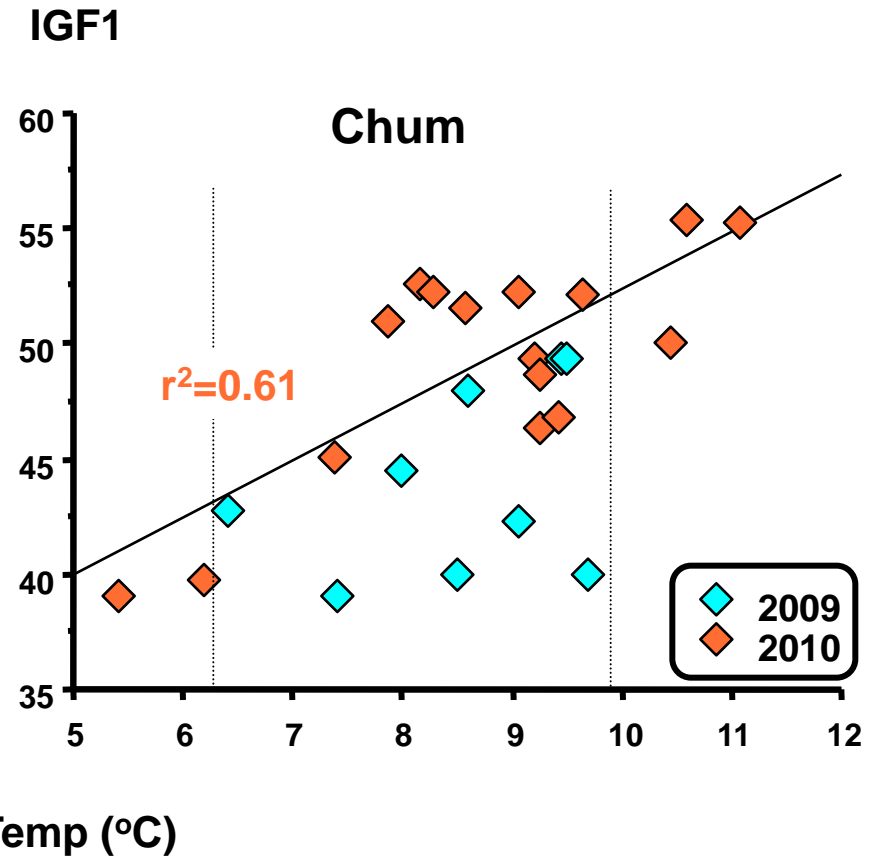
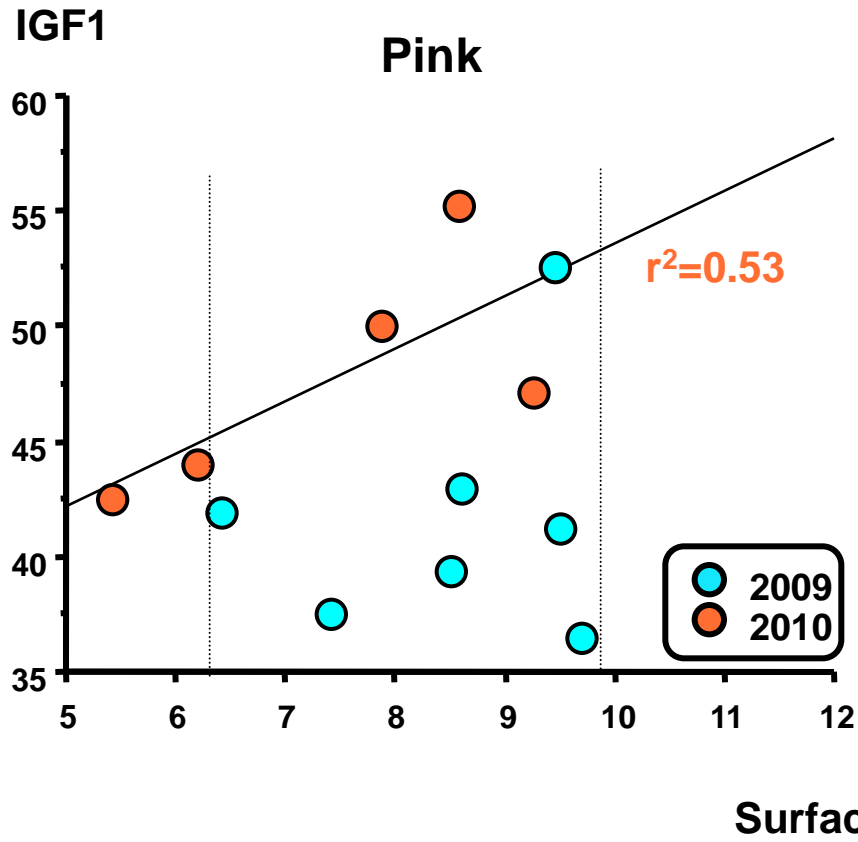
NE Bering Sea  
2009 & 2010



Is there coherent spatial  
variation?

NE Bering - pink & chum

# Is IGF1 related to temperature?

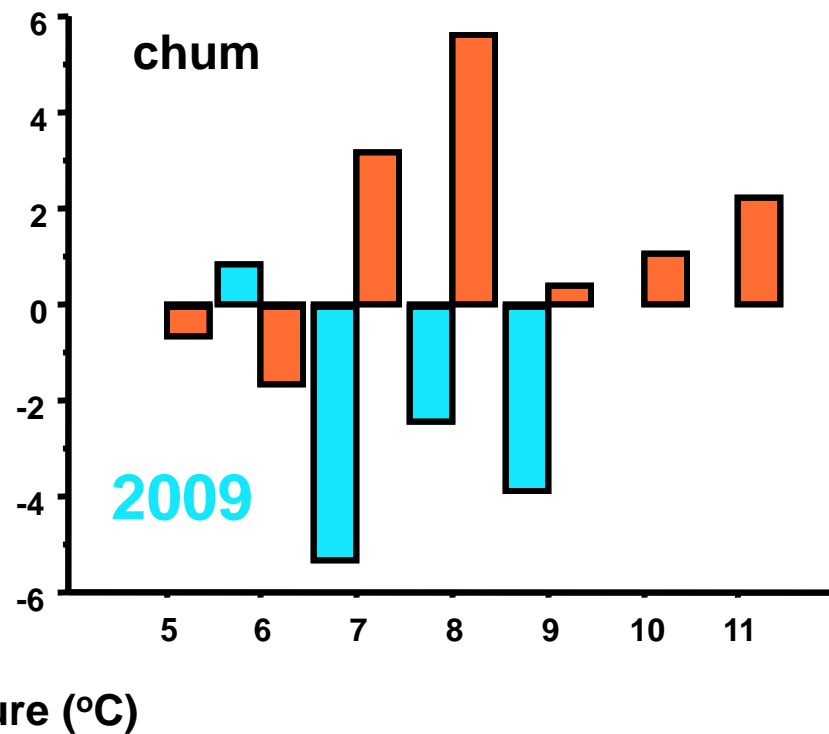
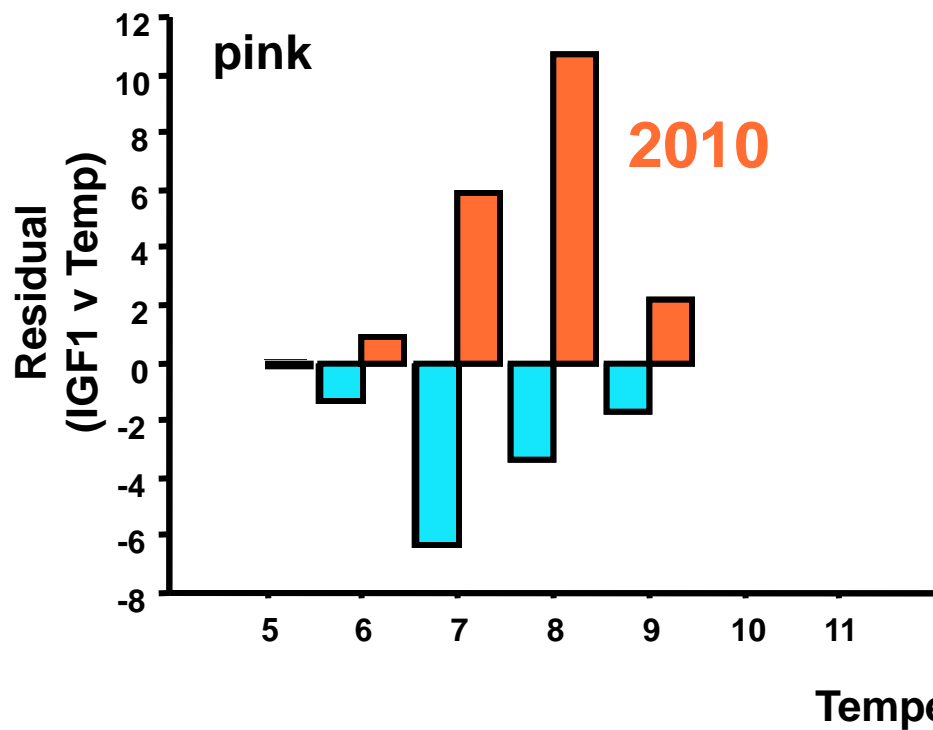


Station means

NE Bering



**For a given temperature, IGF1 is higher  
in 2010**

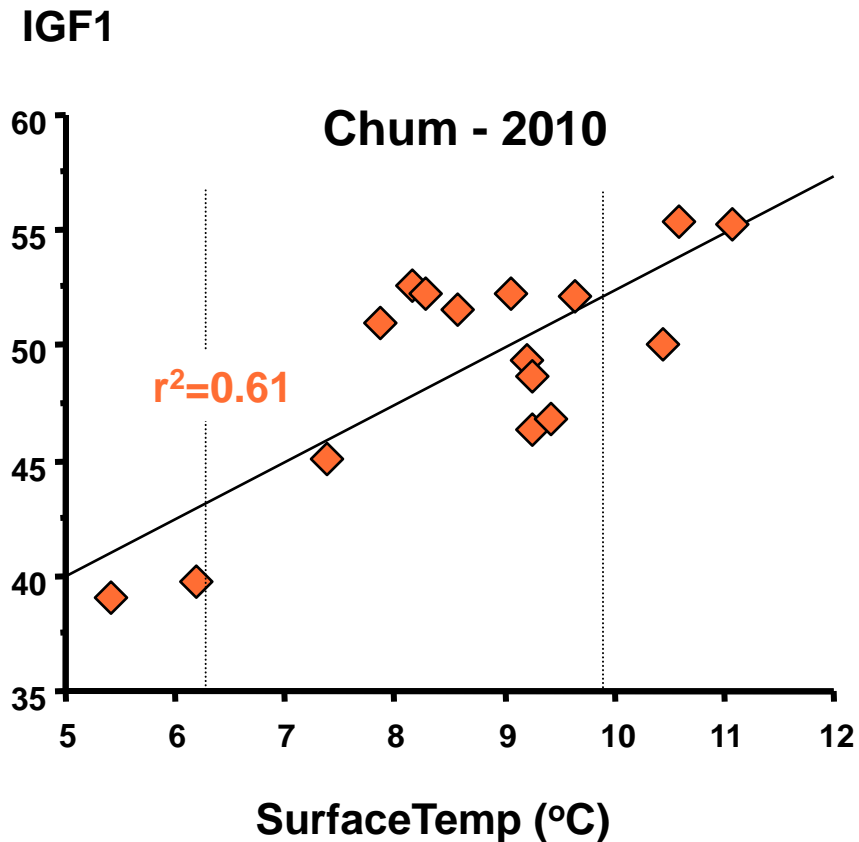


**=> Suggests greater food  
availability in 2010**

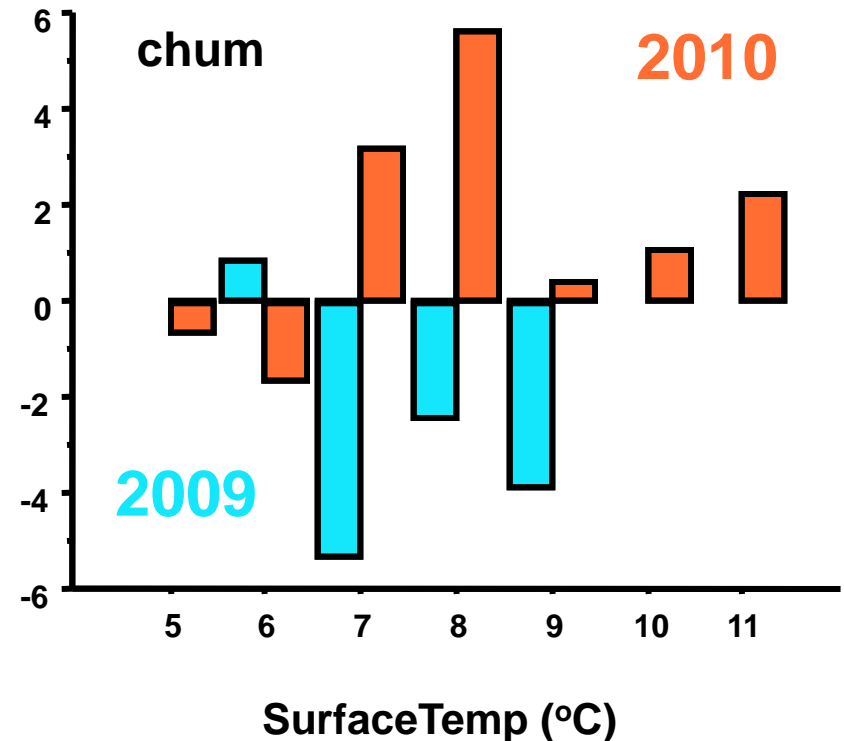
**NE Bering**

# Mechanisms regulating growth?

## Intra-annual variation temperature?



## Inter-annual variation food?



# Summary

1. **Inter-annual variation in IGF1 was found**
  - **Weak but significant in Icy Strait**
  - **Greater in the NE Bering**
  - **Both Pink and Chum**
  
2. **Similar spatial variation in IGF1 for Pink and Chum**
  - **Icy Strait to GOA**
  - **Within GOA**
  - **Within NE Bering**

⇒ **Suggests oceanographic processes affecting them similarly**

**Food?**

## acknowledgements

Thanks to a gazillion people - some of whom I'm sure I've missed but here is a start: Larissa, Louisa, Deb, Shel, **Em**, Alex, Molly, Kris, Jeanette, Sarah, Melissa, Lisa, others I haven't remembered at the moment, and ship captains and crew, except for one cook that will remain nameless unless you ask me.

**Do I have any time left?**



# Marc Trudel!!

## Regional variation off the BC coast

### Chum 2010, June - July

