Changing trophic habits of juvenile Chinook salmon in coastal marine waters: an interdecadal perspective

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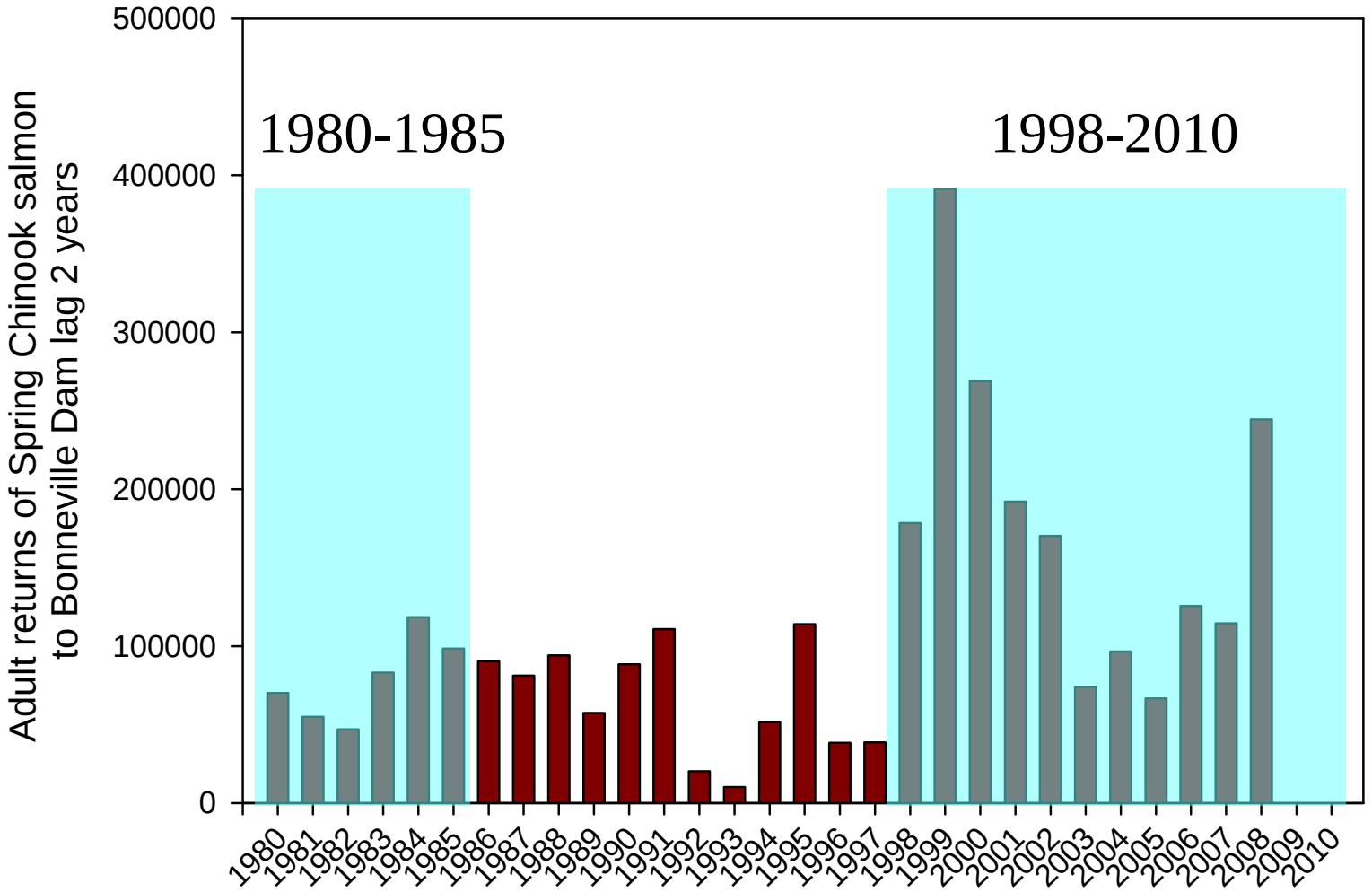
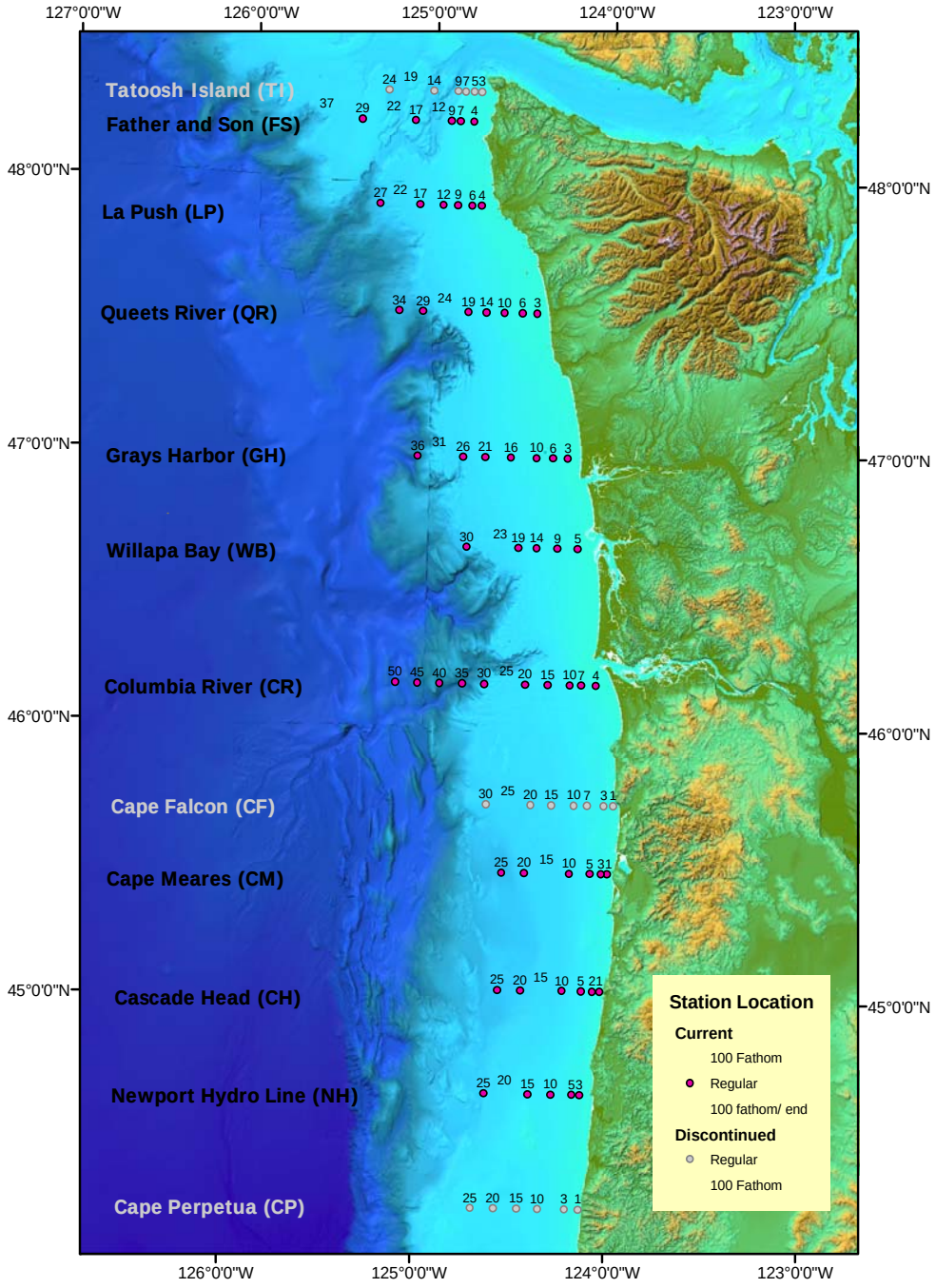
1st Summer in ocean is critical to juvenile Chinook salmon survival and return as adults.



Objectives:

To compare current juvenile Chinook salmon marine diets with the 1980s

- Composition of diets (% weight of prey eaten)
- Stomach fullness or feeding intensity (prey weight as a % of predator's body weight)
- Diet characteristics and physical environment (SST)

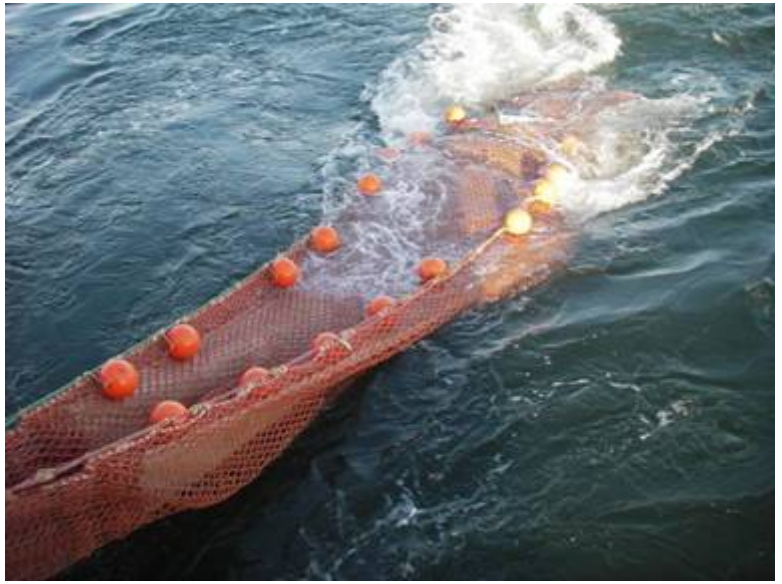


Sampling area

- *Similar stations were occupied along East-West transects from northern Washington to Newport, Oregon*

Juvenile salmon collection Methods

- *1980s: Fine-mesh purse seines*
- *1998-present: Fine-mesh surface trawls*



Salmon frozen at sea

In lab stomachs removed

Prey analyzed to lowest possible category and grouped

Juvenile fish	Invertebrates
Fish	Krill
Anchovy	Crab larvae
Herring	Copepods
Smelt	Amphipods
Sandlance	Insect
Sculpin	Pteropods
Rockfish	Other
Flatfish	

Data

- Stack bar plots with 15 prey categories
- Salmon diets have high interannual and monthly changes in prey composition
- Multivariate statistics: on station data nested within month and year
- Sea surface temperature: Mean January-June

1980s sig. more:

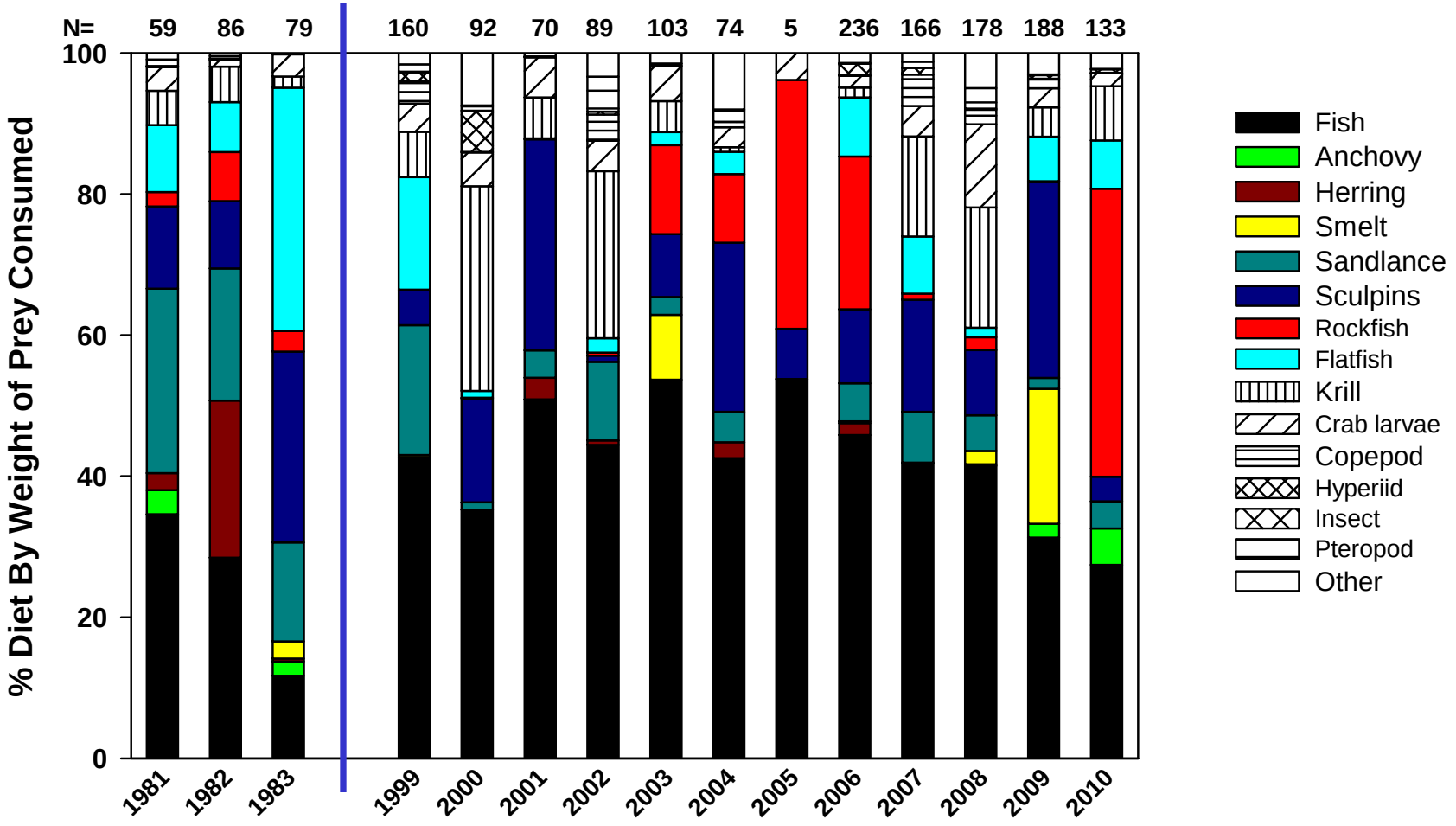
- Total fish prey (color prey)
- Flatfish ( )
- Sculpins ( )
- Sandlance ( )

May

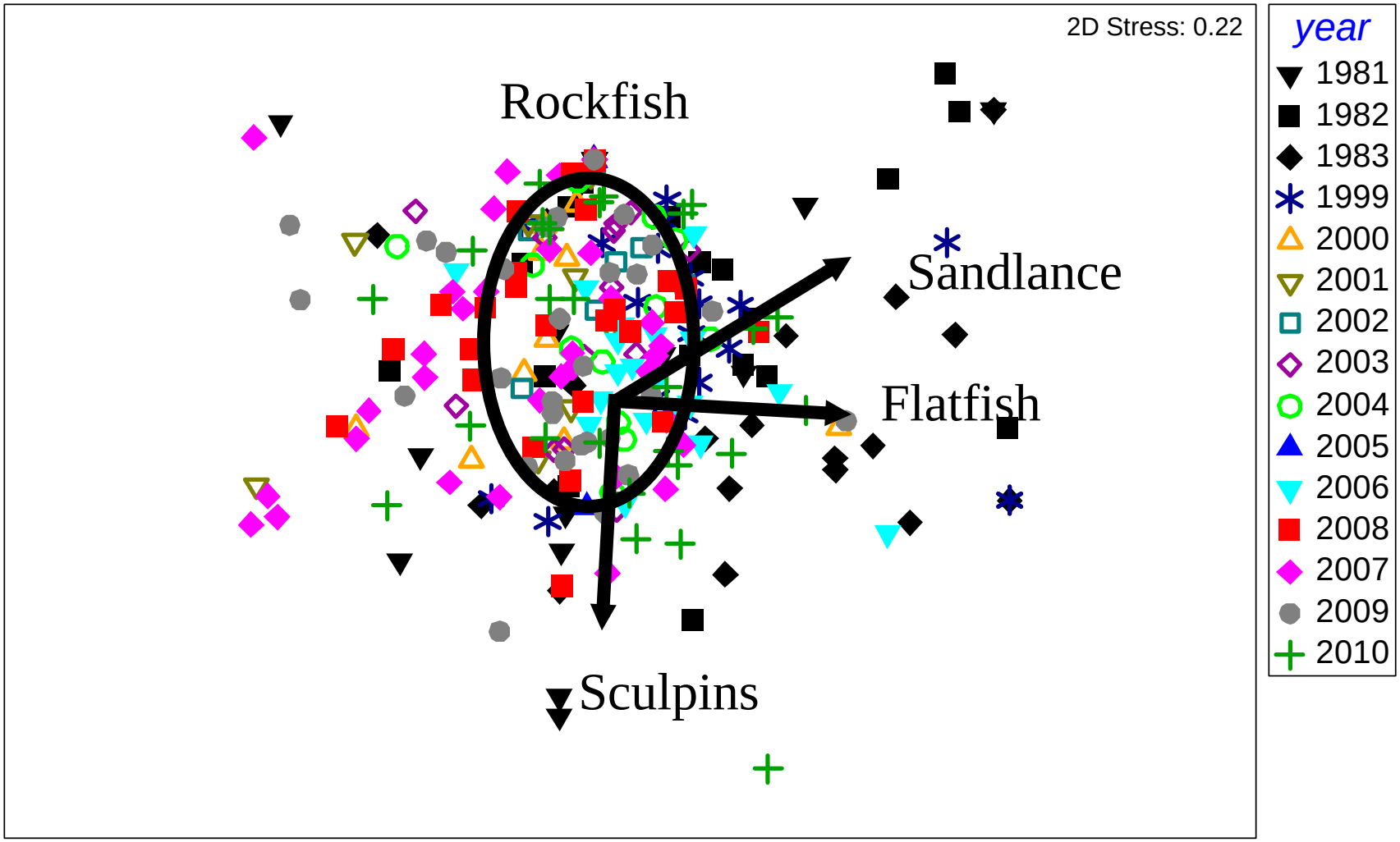
90s-00s sig. more:

- Rockfish ( )
- Krill ( )

Significant decadal diet differences between 80s and 90s-00s (ANOSIM: R=0.237; p=0.001)



Multidimensional scaling plot (MDS) of May diets



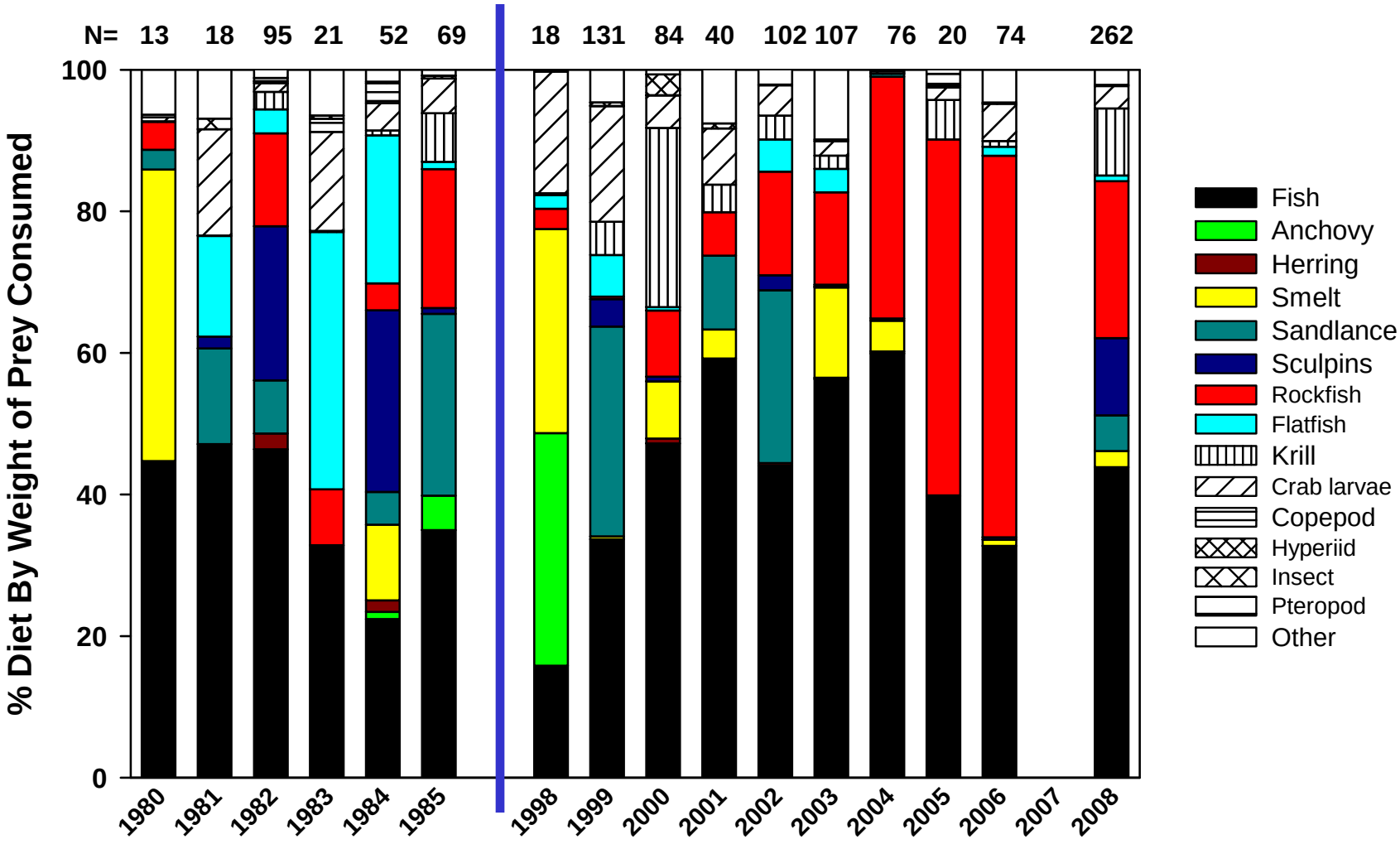
1980s significantly more: June

- Total fish (color prey)
- Flatfish ( )
- Sandlance ( )

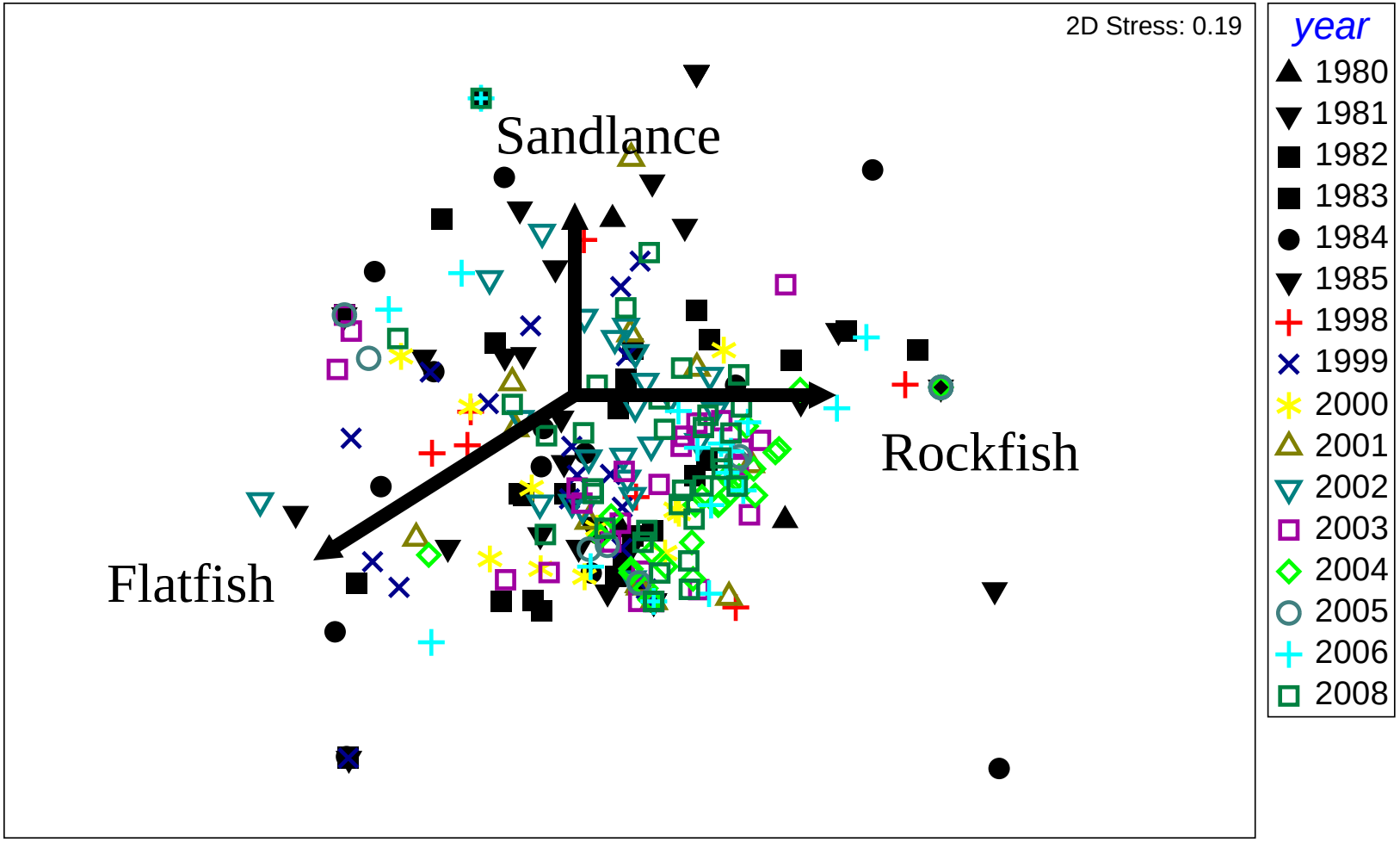
90s-00s significantly more:

- Rockfish ( )

Significant decadal diet differences between 80s and 90s-00s (ANOSIM: R=0.157; p=0.001)

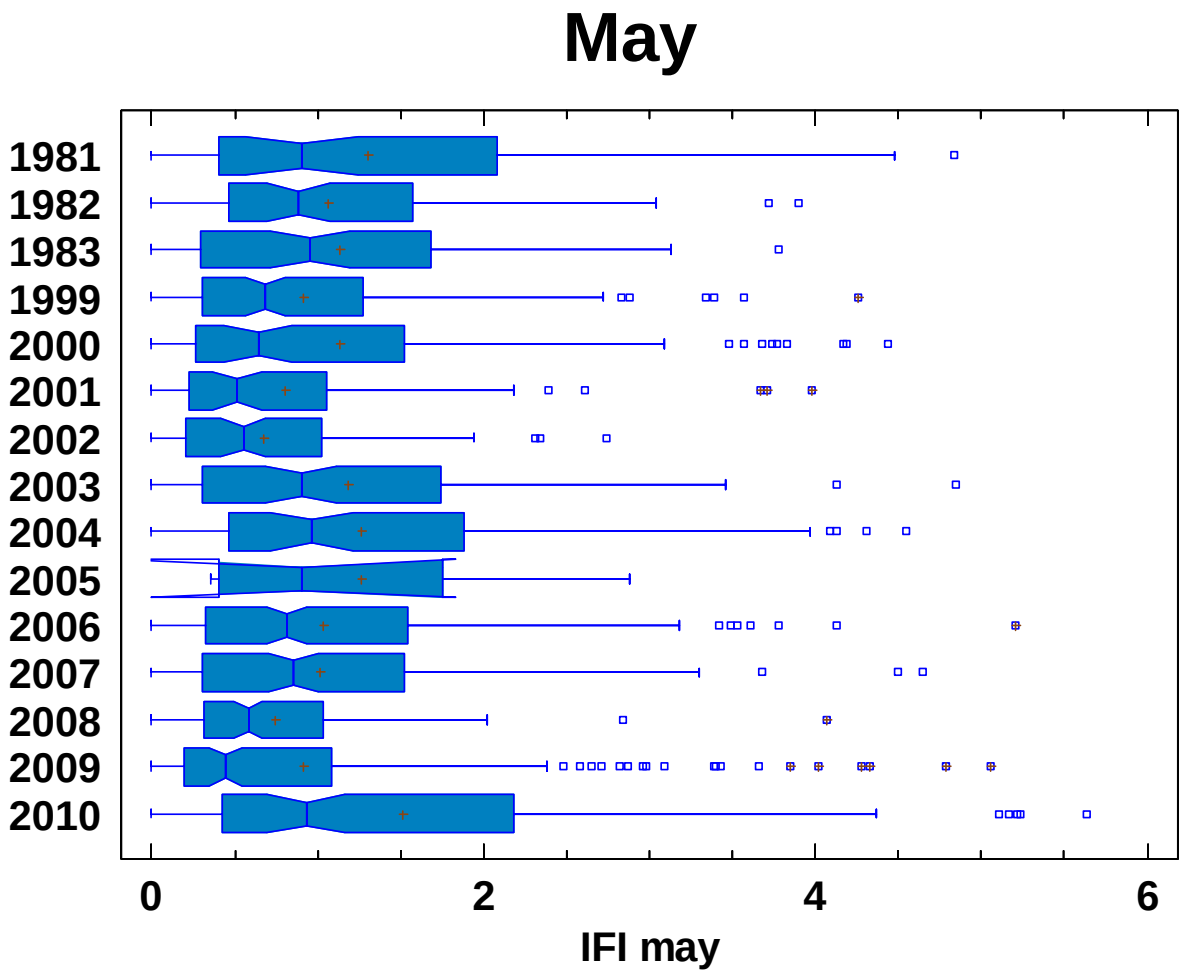


MDS of June Diets



Stomach fullness as a measure of Feeding intensity

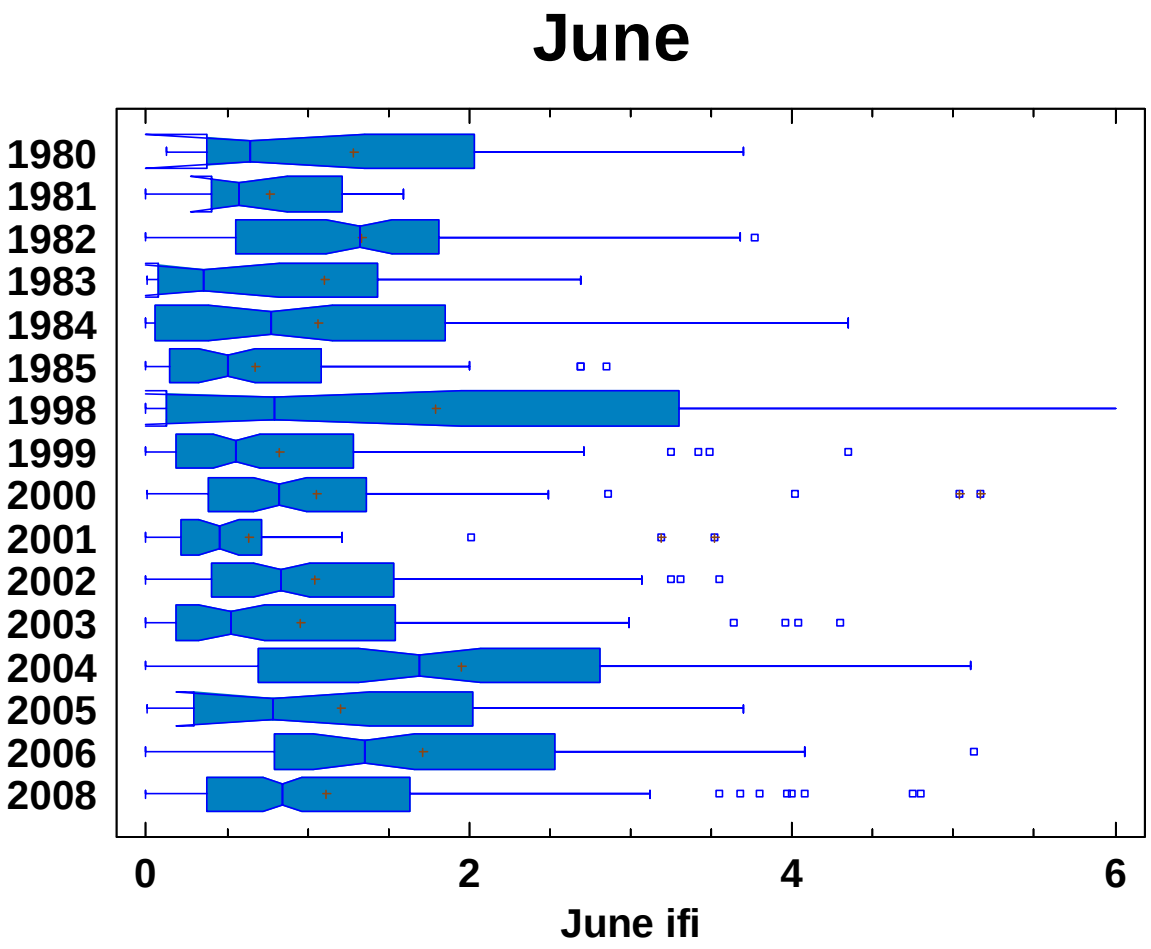
(Length as covariate in statistical analysis)



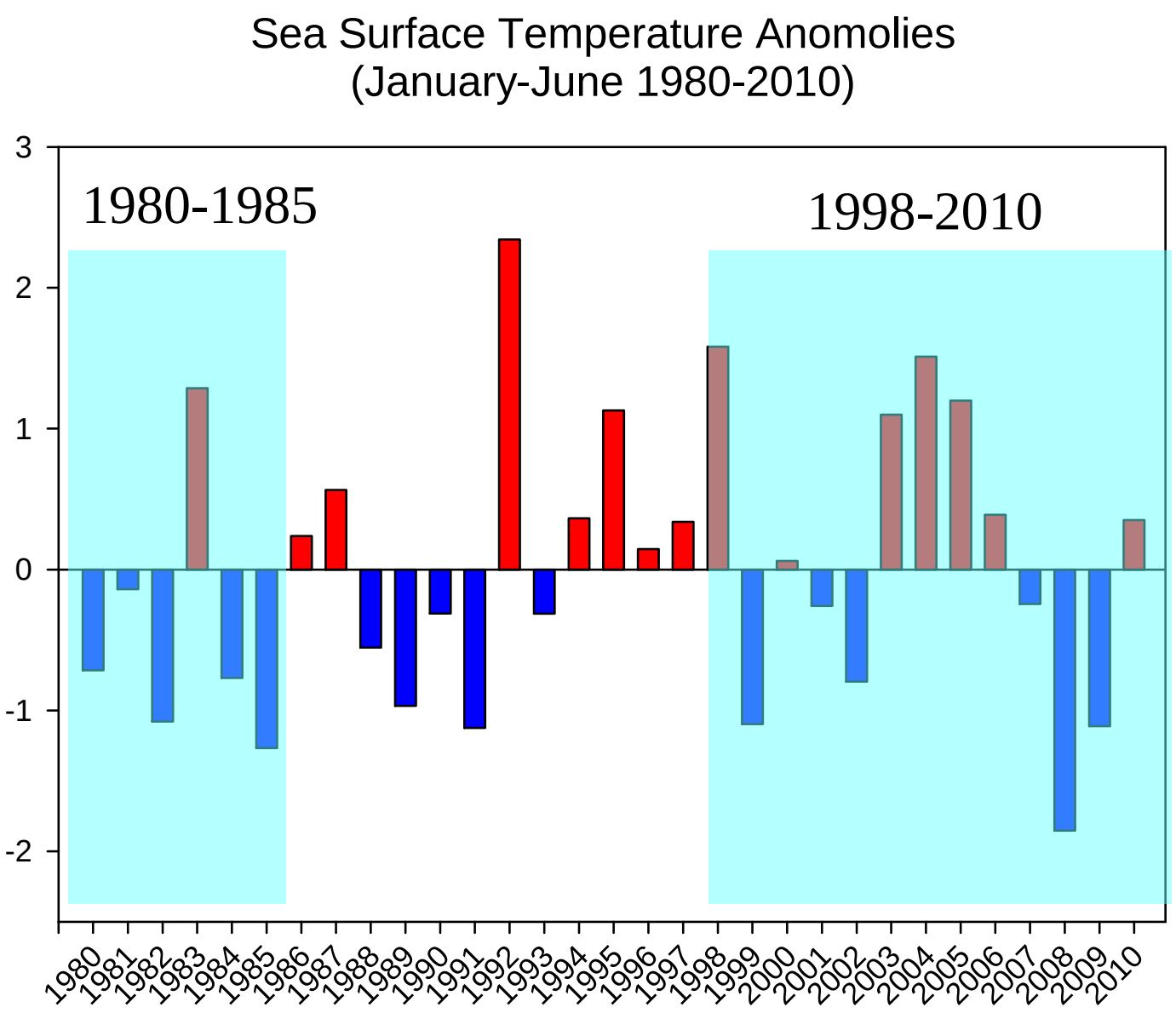
May Chinook salmon had more food in 1980s vs. 90s-00s (p=0.002)

Feeding intensity

(Length as covariate in statistical analysis)

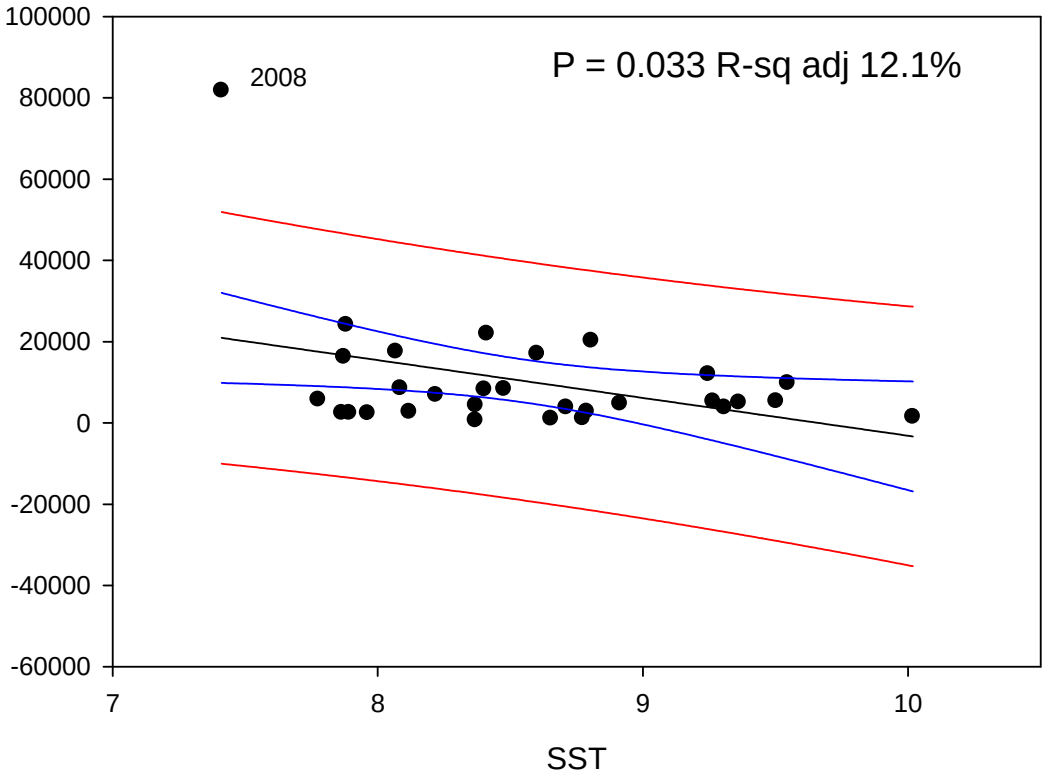


No interdecadal difference in June


Sea Surface Temperature Anomolies
(January-June 1980-2010)
1980-1985
1998-2010
3
2
1
0
-1
-2
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

Salmon survival and SST:

Index of Adult Chinook salmon returns (jack counts at Bonneville Dam) and SST of out-migration year of smolts

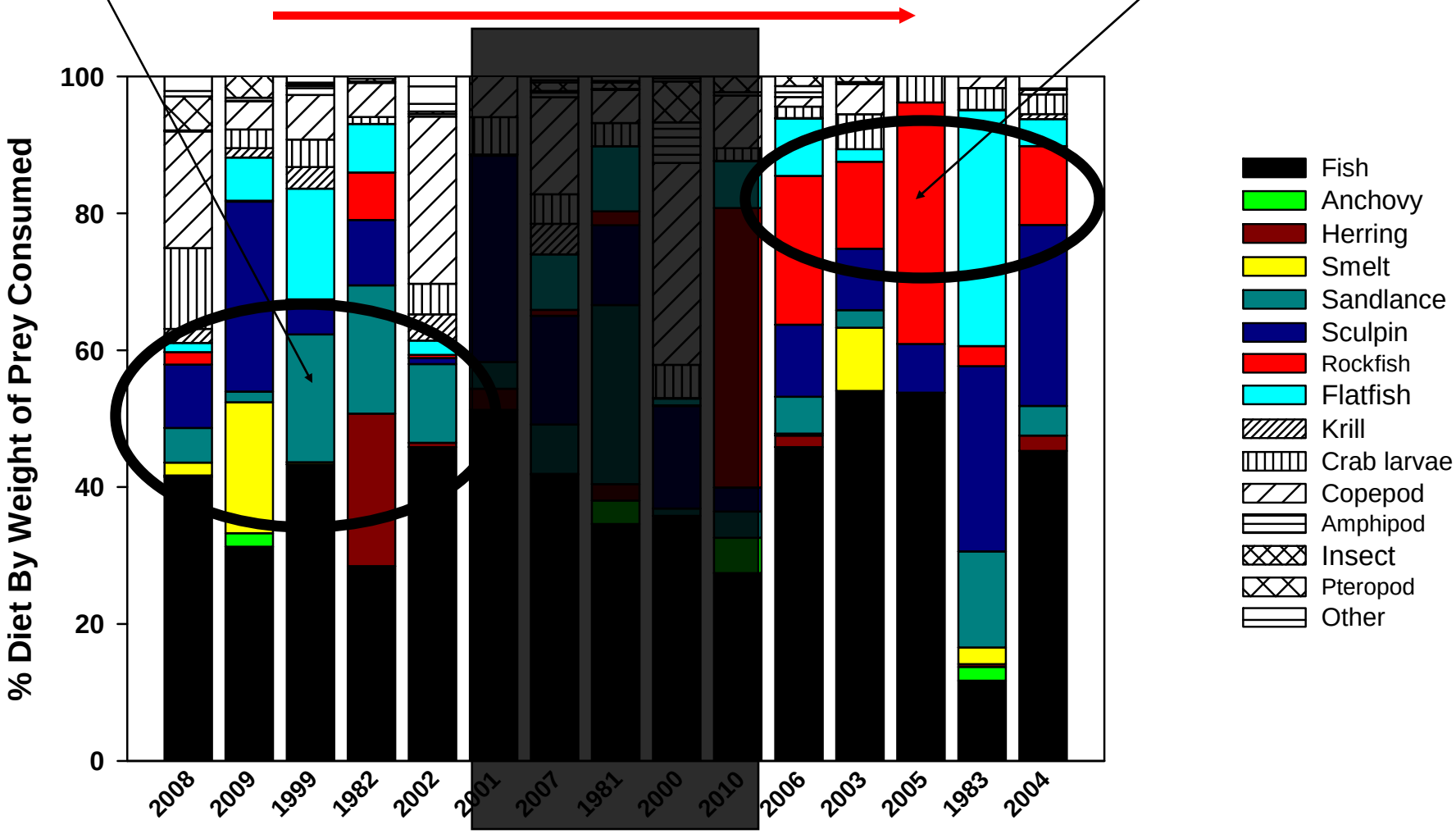


May diets arranged by SST

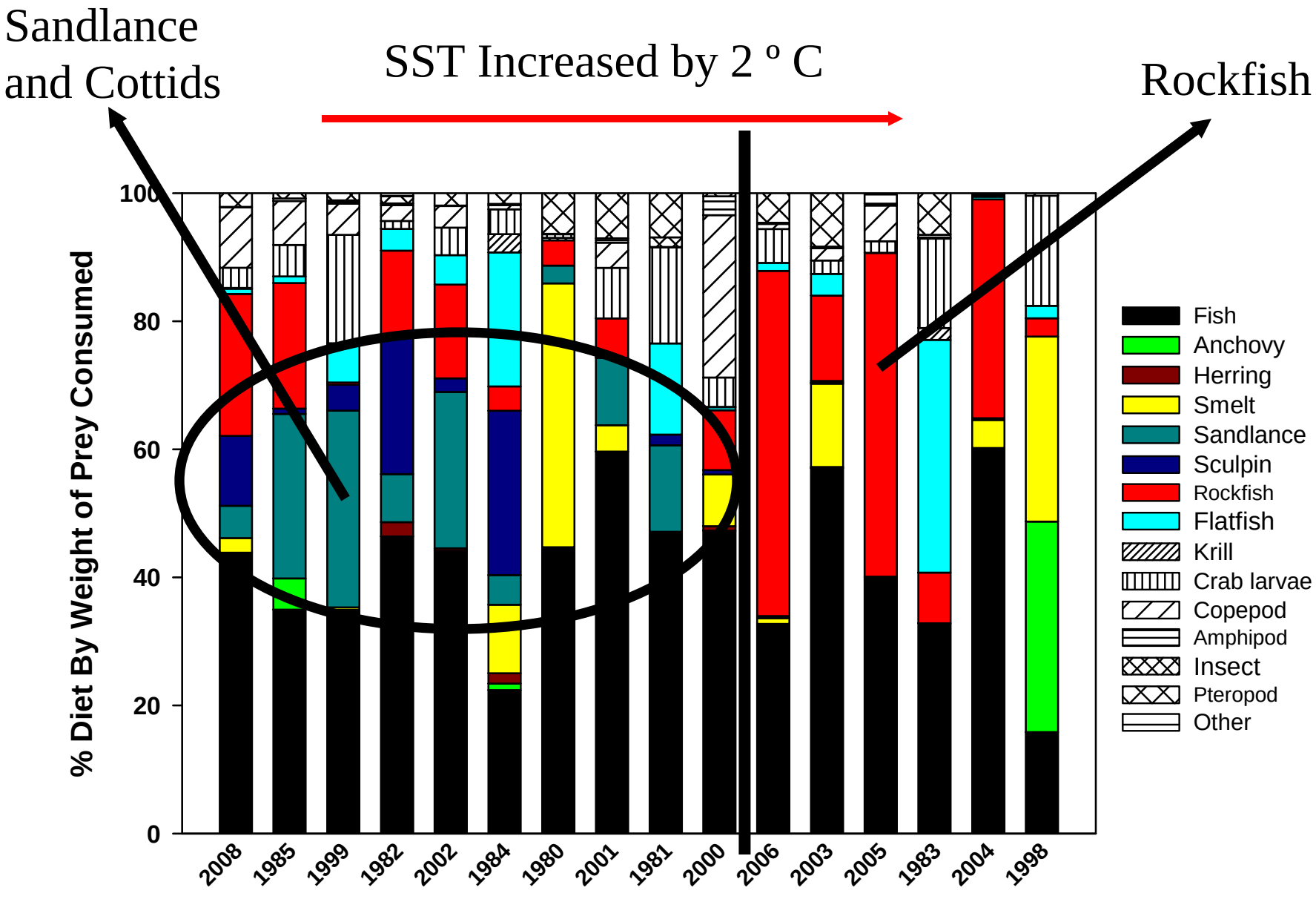
SST Increased by 2 º C

Sandlance

Rockfish

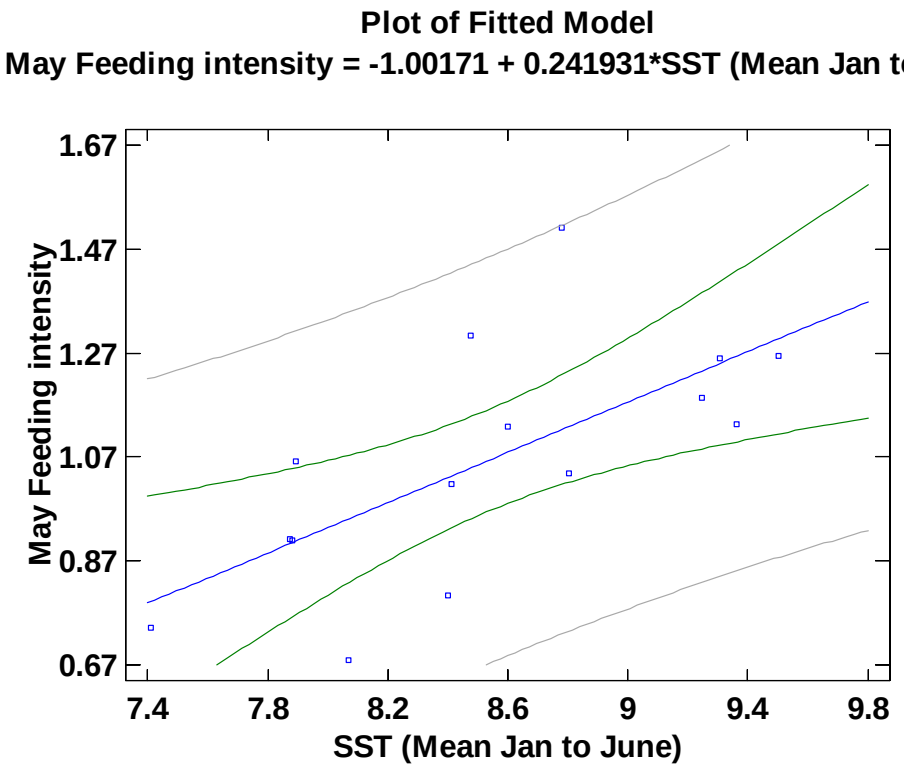


June diets arranged by SST



What happens to feeding intensity with an increase in SST?

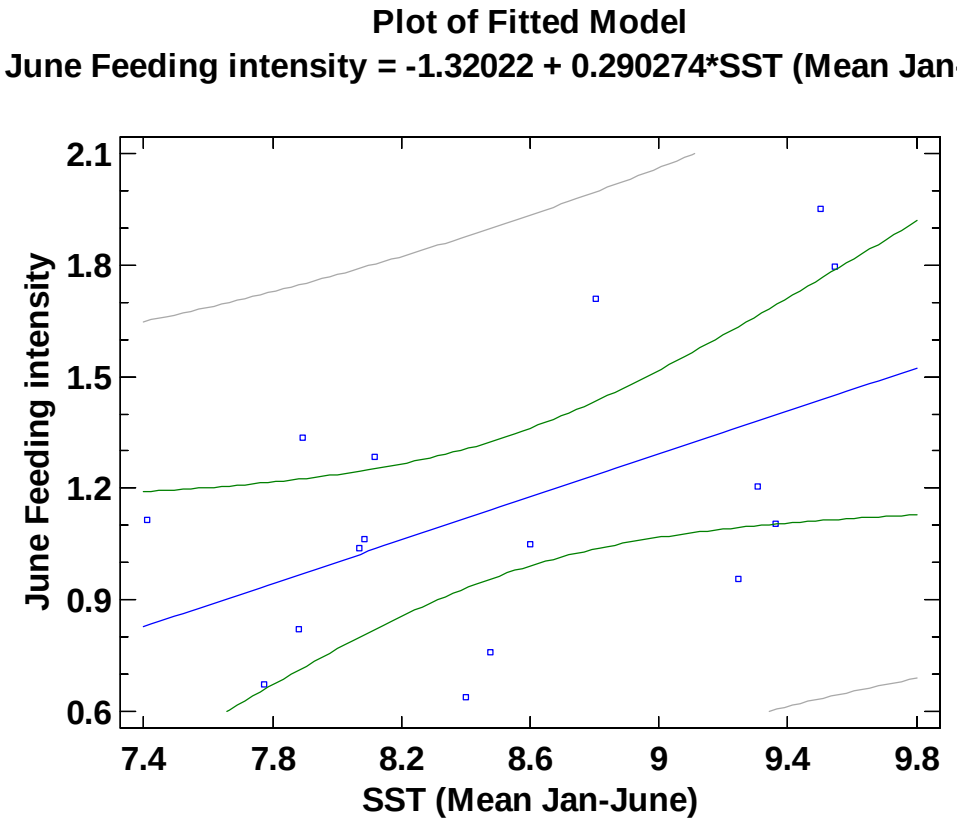
With Warmer SST there is significantly more food



May: p = 0.006;
R-sq adj = 41.0%

What happens to feeding intensity with an increase in SST?

With Warmer SST there is significantly more food



June: p = 0.041;
R-sq adj = 21.4%

Future efforts: Is there a difference in prey quality between cold and warm years?

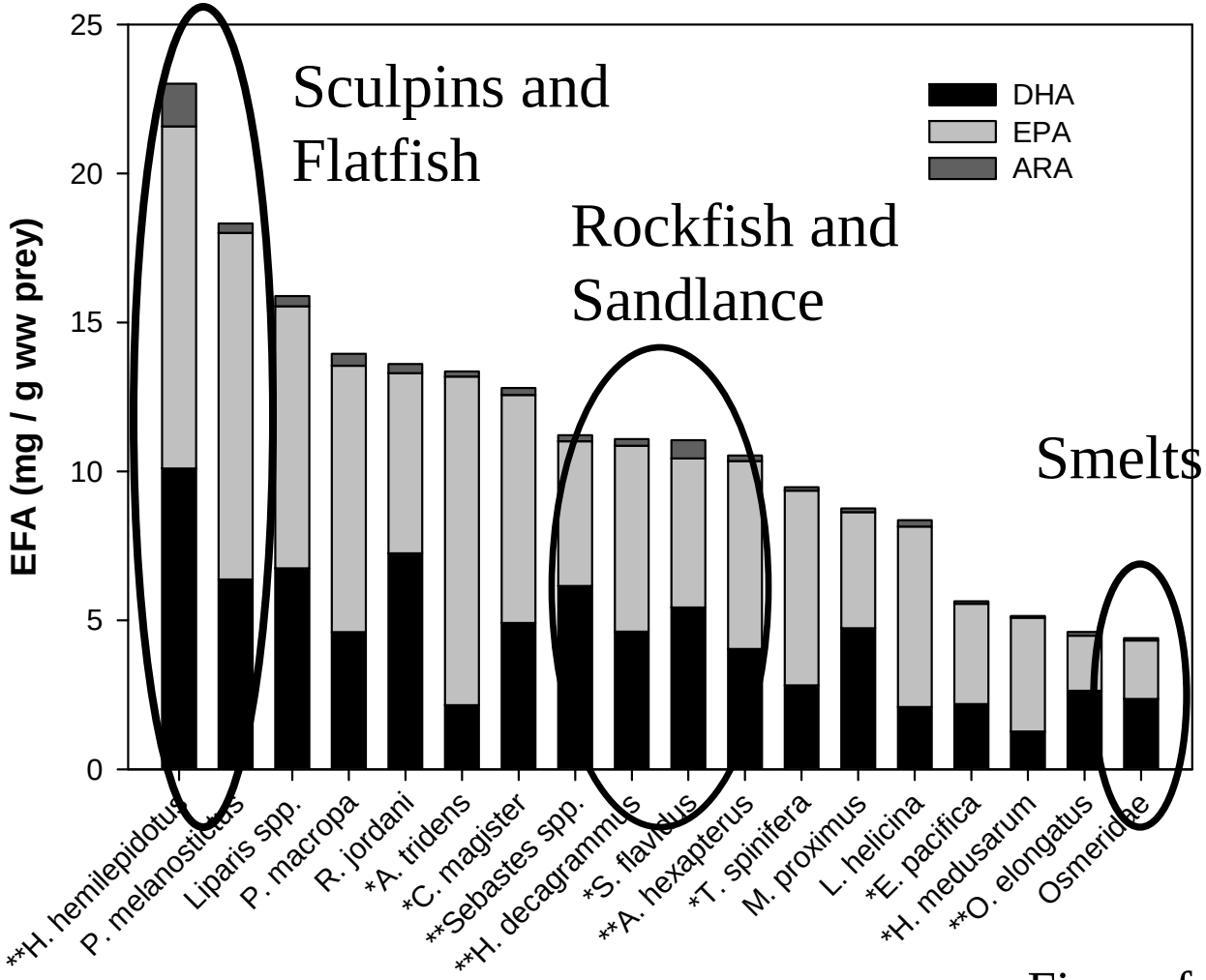


Figure from Daly et al. 2010

Conclusions

- Prey composition and feeding intensity changes were observed between the study periods, and may be related to ocean SST differences
- More food may be necessary during warmer years due to lower quality of available prey??

ACKNOWLEDGEMENTS

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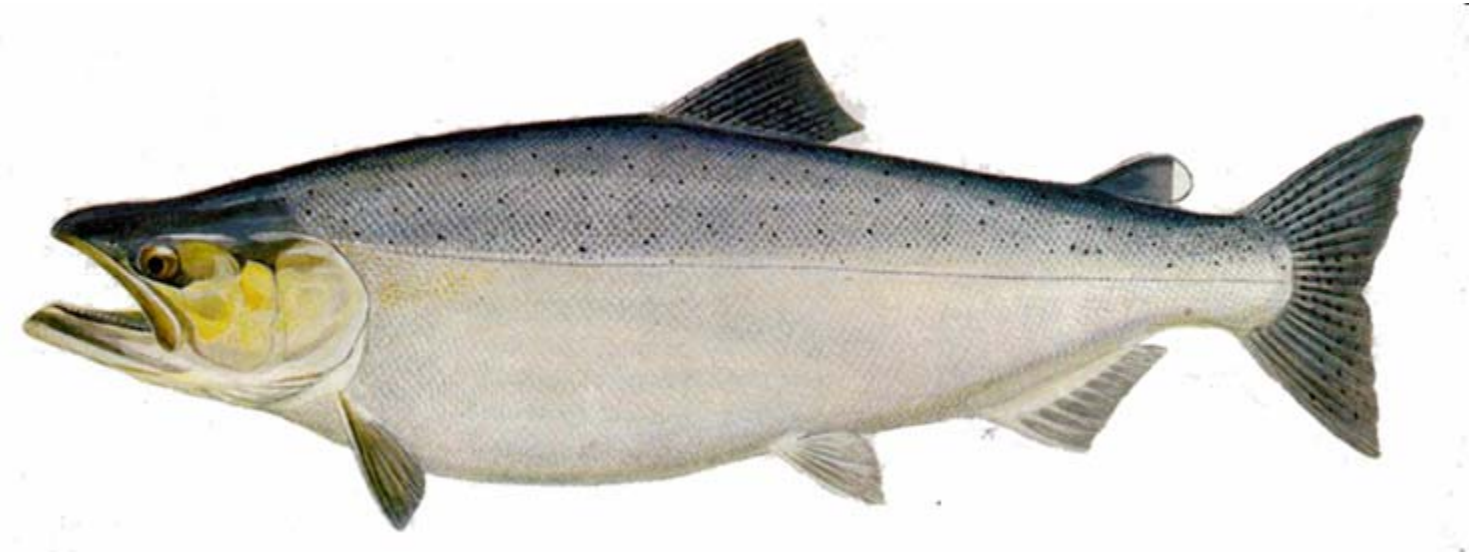

NOAA FISHERIES SERVICE

Bonneville Power Administration