

Spatial and trophic overlap of hatchery and unmarked Columbia River Basin spring Chinook salmon during early marine residence

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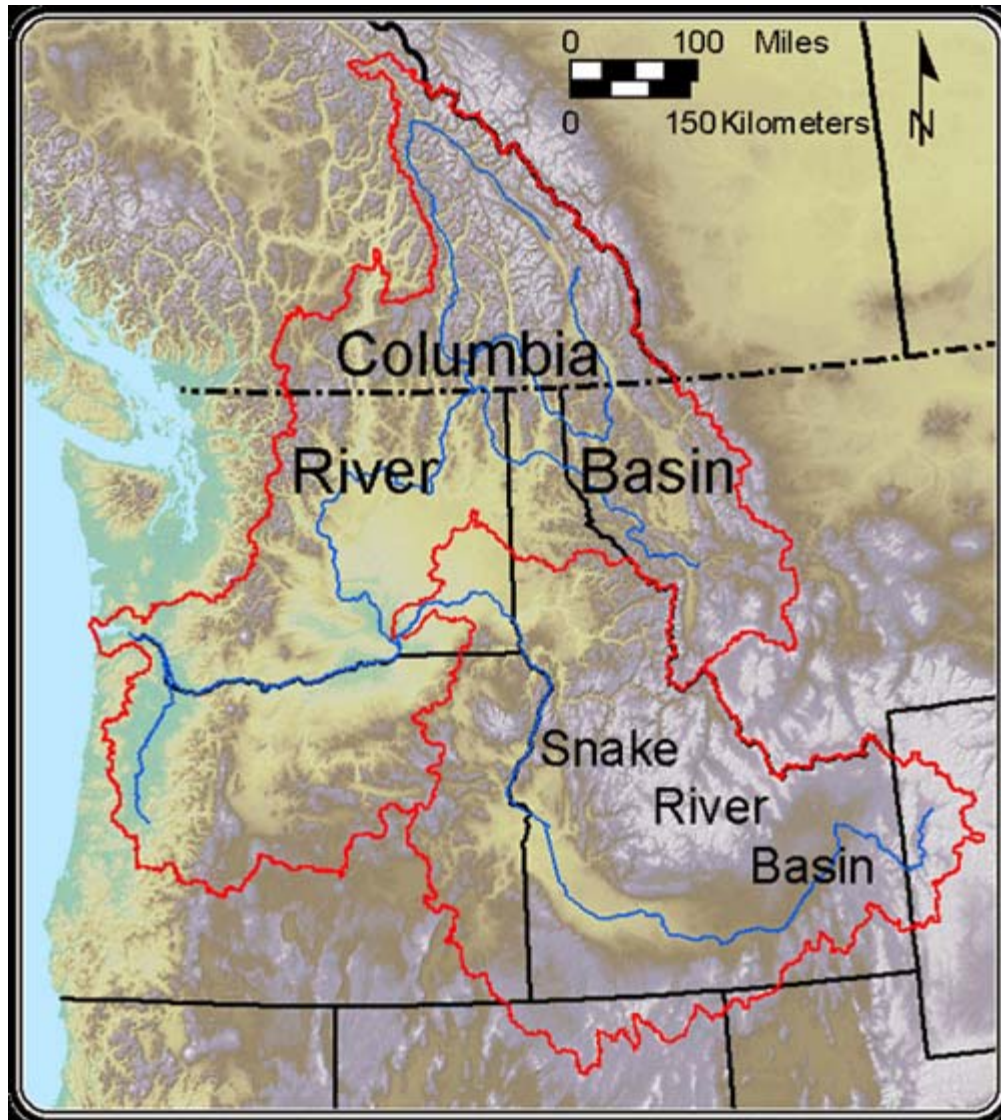
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Objective: Are their differences
between unmarked and hatchery fish
in early marine residence?
(1999-2009; May and June)

- Spatial overlap
- Diet overlap
- Physical characteristic (fork length and condition)
- Feeding intensity (as % of body weight)
- Growth (as measured by IGF-1, a hormone that correlates with recent growth)

Columbia River spring Chinook salmon:



5 distinct populations or ESUs:

- Upper Columbia River spring (Endangered)
- Snake River spring
- Lower Columbia River
- Upper Willamette River (Threatened)
- Mid-Columbia River spring (Not-listed)

**All the fish for our analysis were
genetically identified as:**

**spring Chinook salmon from
Columbia River Basin (CRB) stocks**

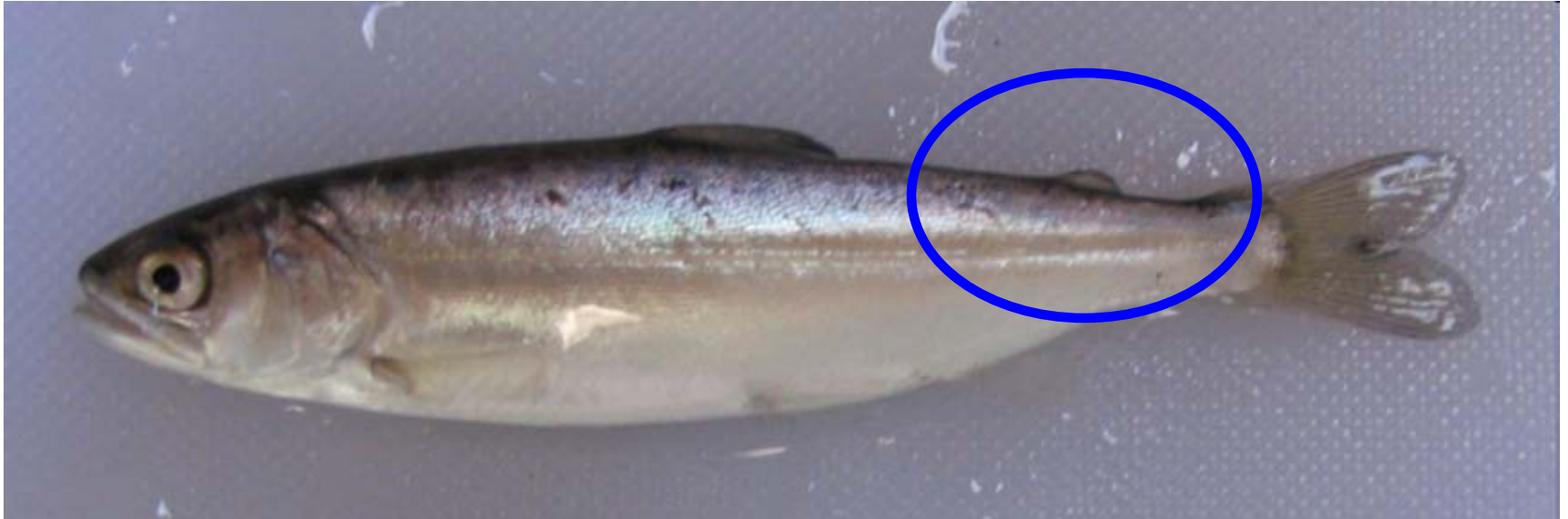
These stocks are considered to be **yearling**

	Chinook	
Age	subyearling	yearling
	(0,0)	(1,0)
April	≤ 110	111-200
May	≤ 120	121-250
June	≤ 140	141-280
July	≤ 180	181-350
August	≤ 180	181-350
September	≤ 250	251-400

- **Hatchery**: 98.5% accurate
ageclass assignment by fork
length

- **Unmarked**: 73% accurate
ageclass assignment

Unmarked or Hatchery?

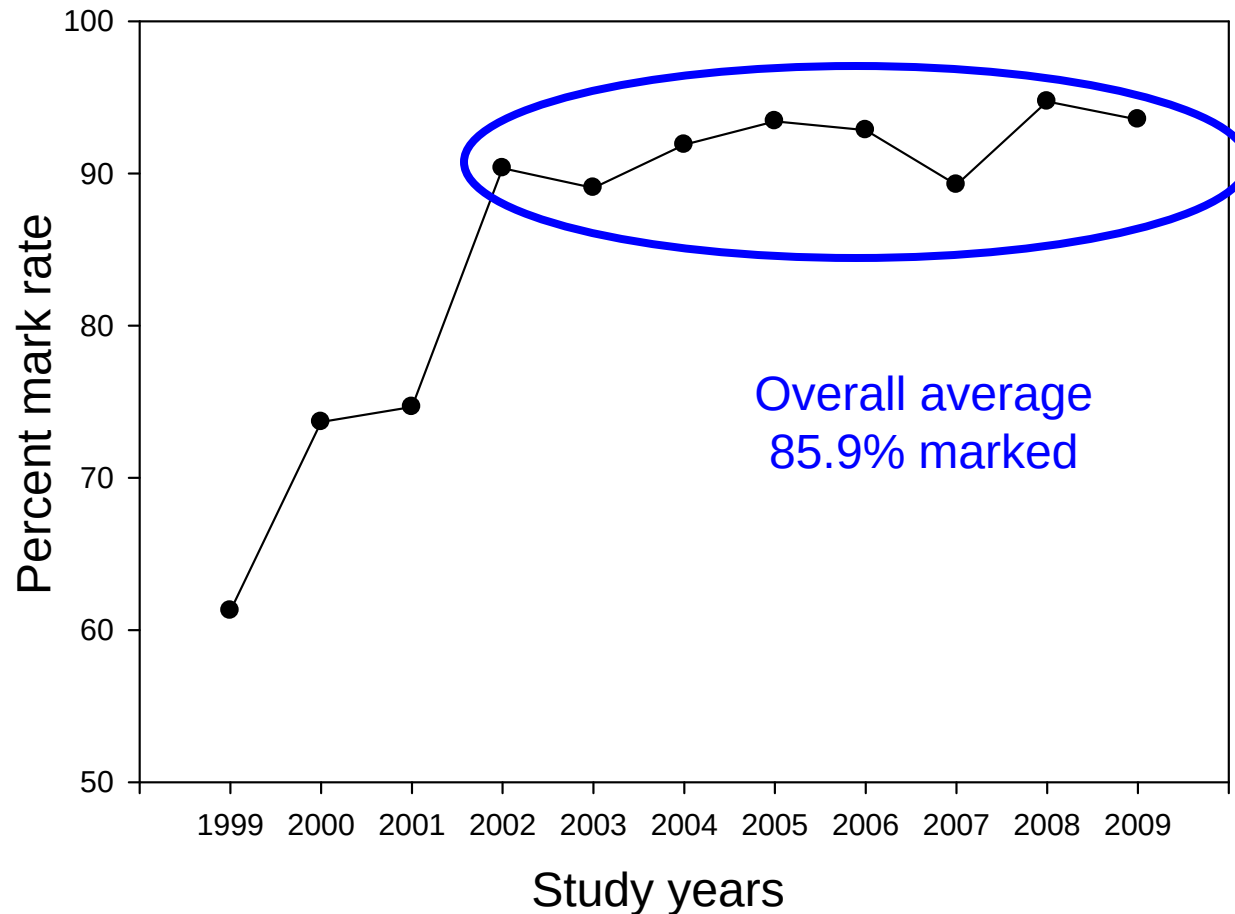


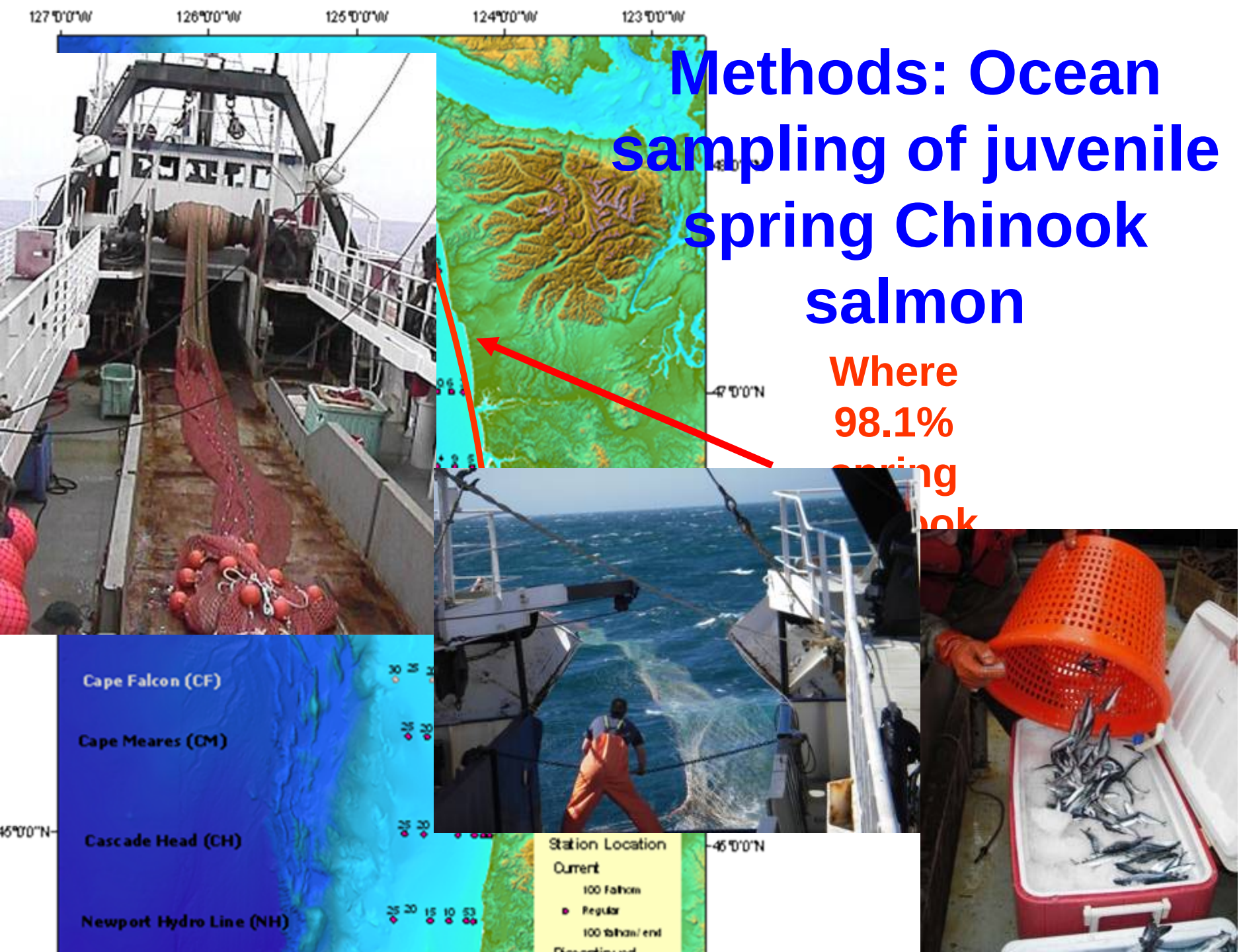
Salmon with adipose fin present, and **No** other form of marking (CWT, PIT, latex...) = **UNMARKED**

Unmarked=(Wild + non-marked Hatchery)

Hatcheries have variable marking rates

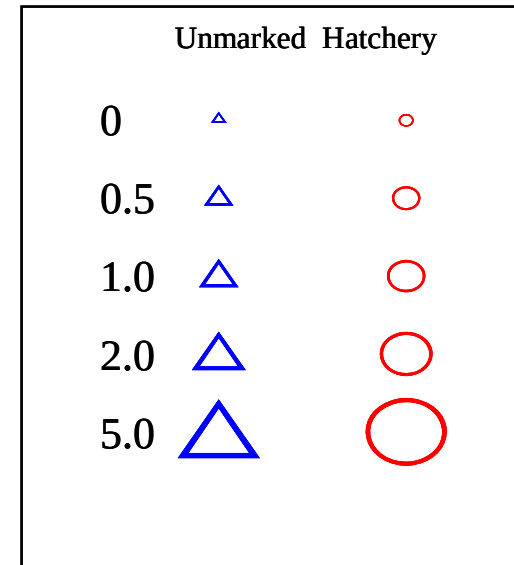
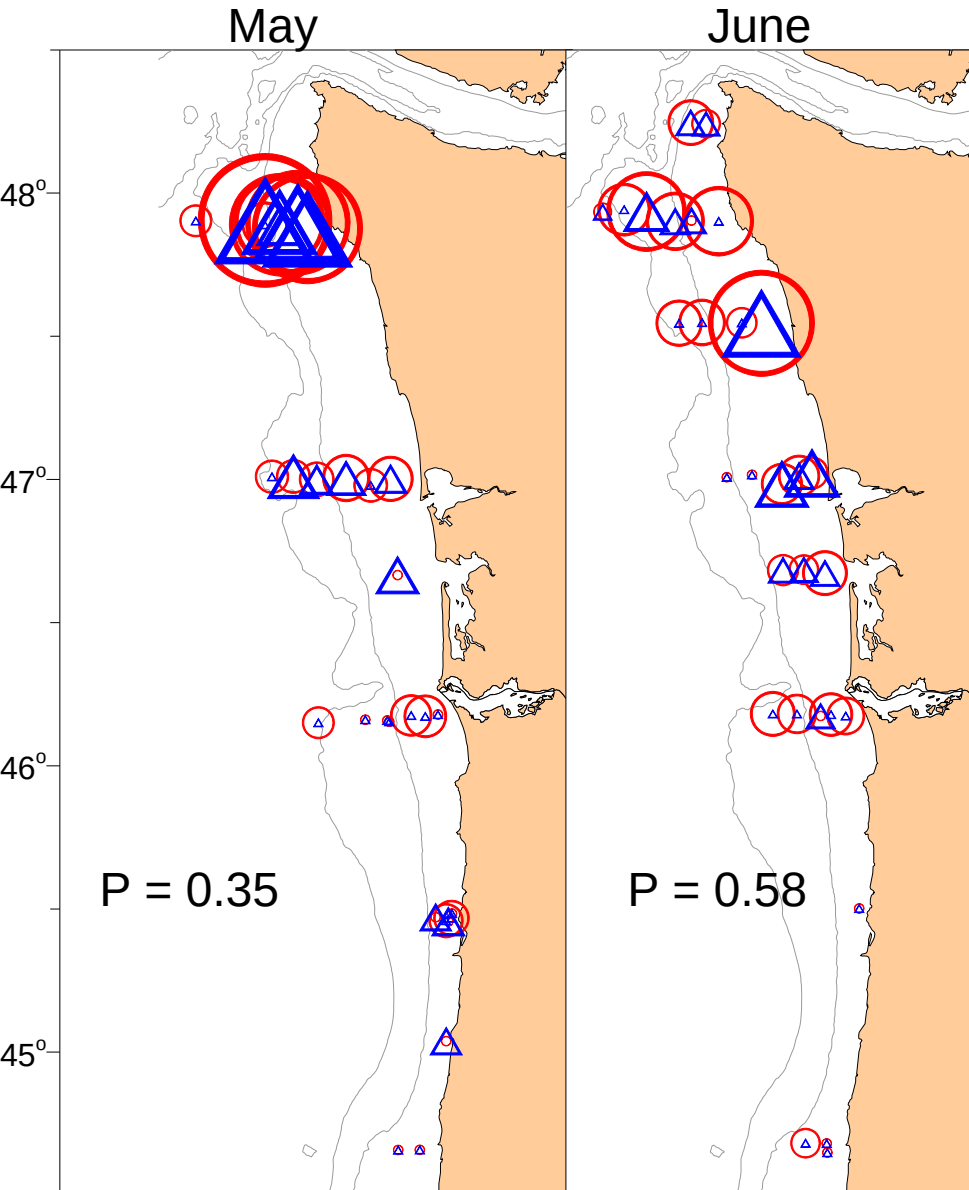
What is marking rate for our fish?





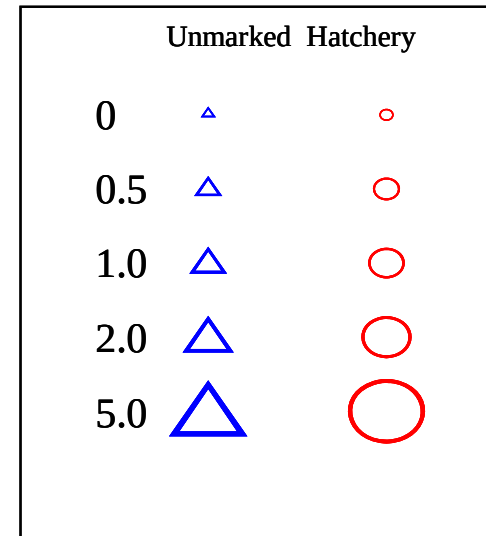
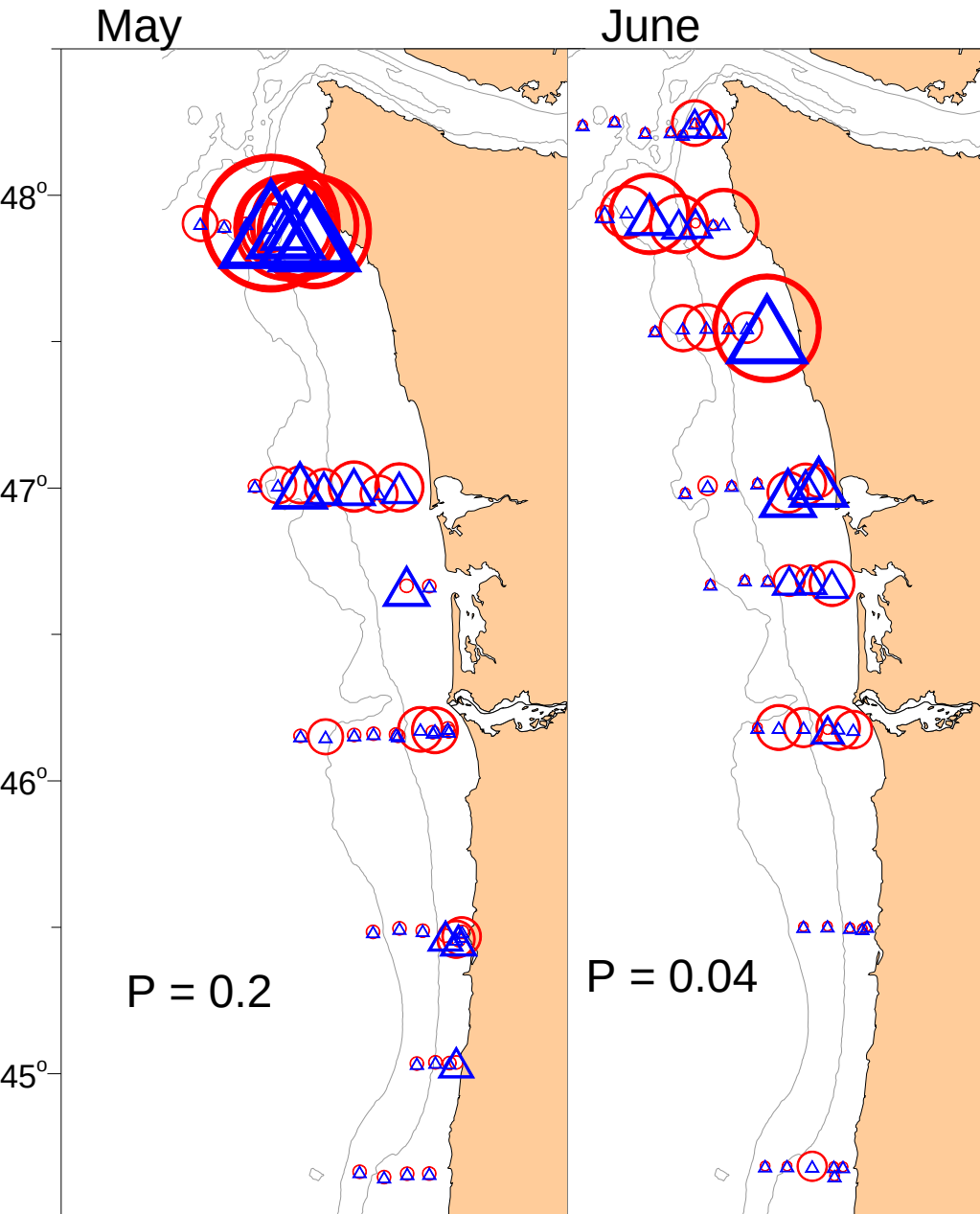
Overlap in Distribution: 1999

Hatchery and Unmarked



The Cramér-von Mises
nonparametric test:
spatial distribution

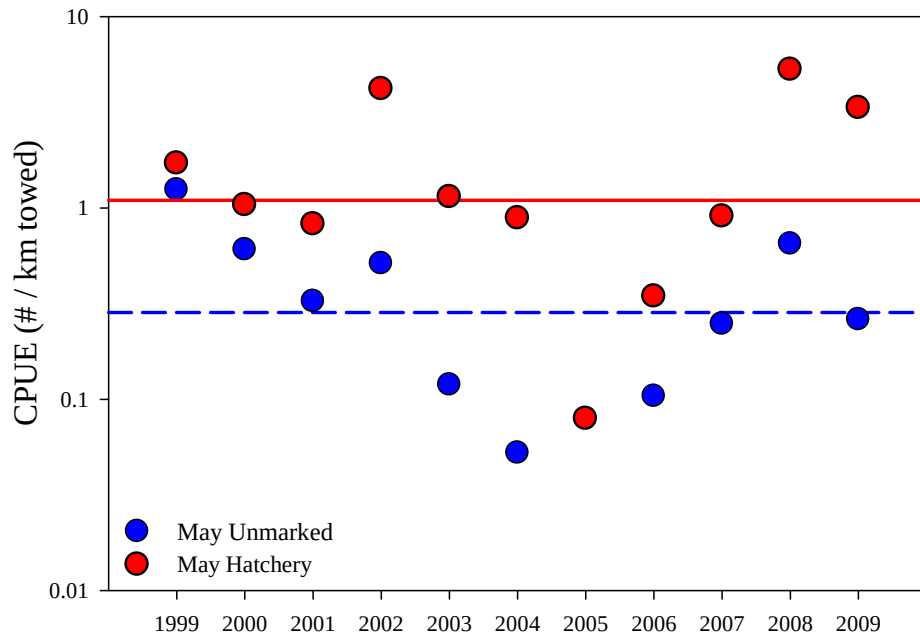
Overlap in Distribution: 2009



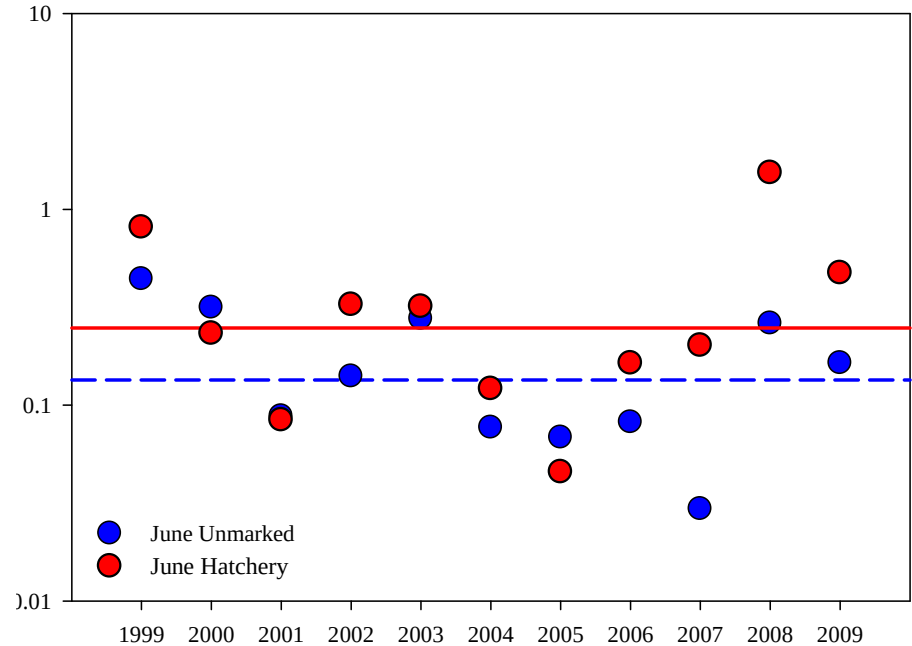
Almost all study years:
unmarked fish had high
spatial overlap with
hatchery fish

CPUE **hatchery** and **unmarked** fish

May

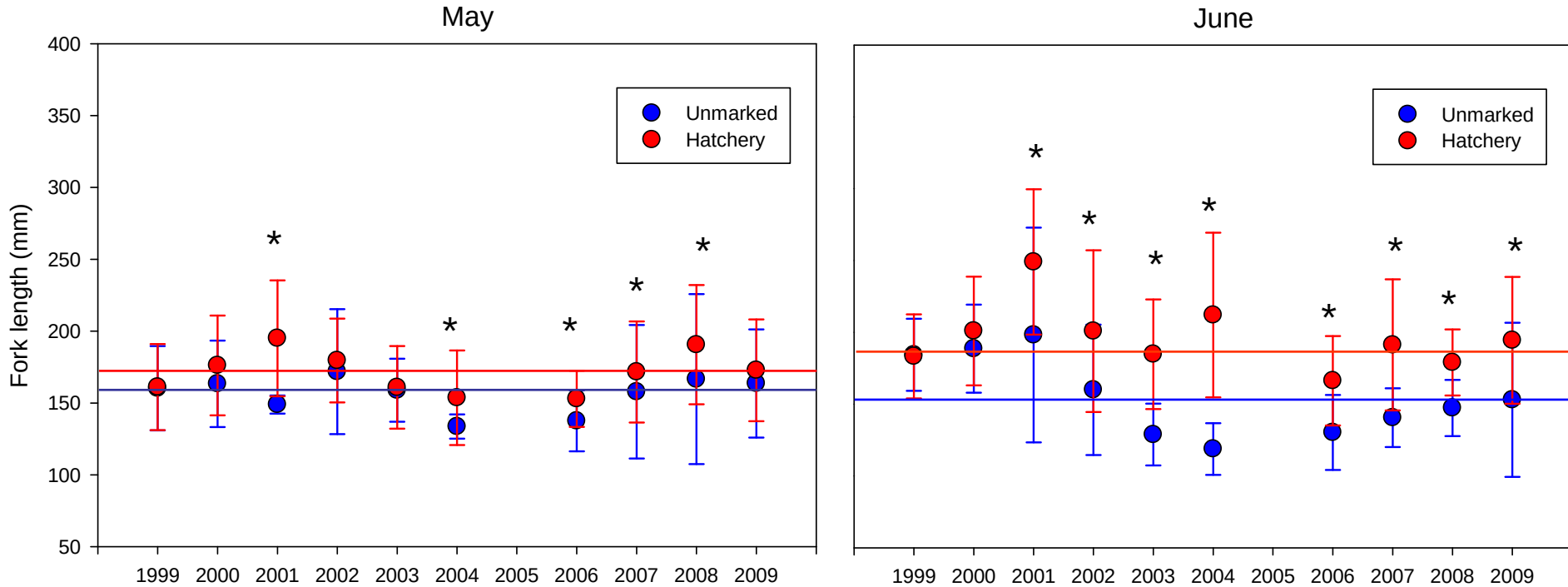


June



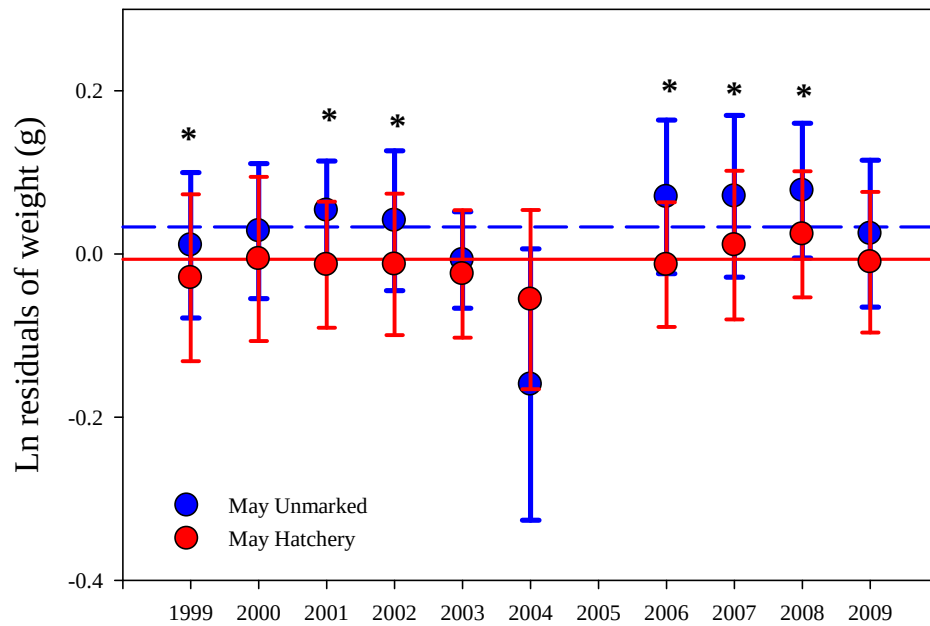
- More **hatchery** caught than **unmarked**
- More CRB fish caught in May than June
- Interannual variability of both groups followed similar trends

Fork length (SD bars)

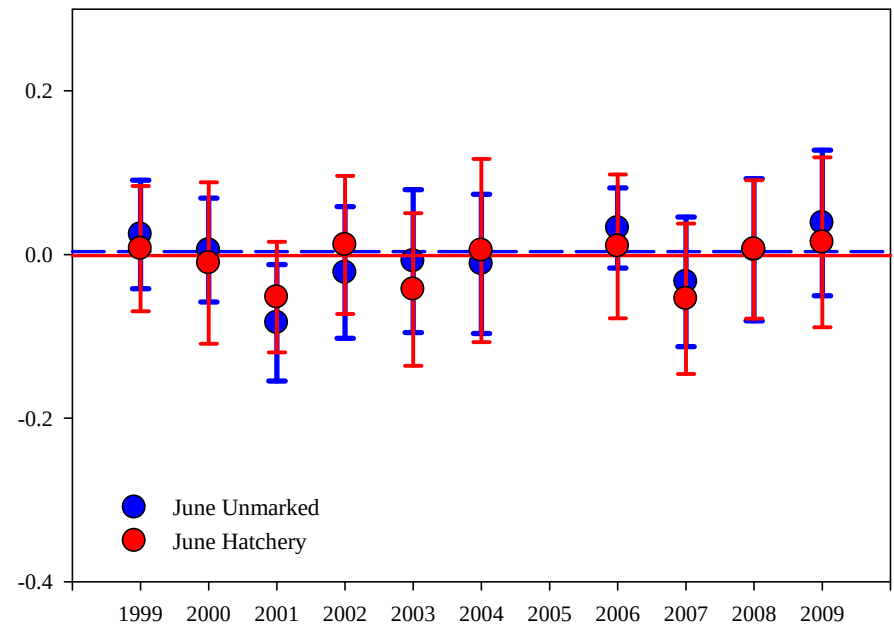


- Hatchery fish tend to be longer than unmarked
- Mean hatchery fish length increased between May and June
- Mean unmarked fish length decreased between May and June

Body condition (based on length-weight residuals)



May- 6/10 years
unmarked fish significantly
higher condition



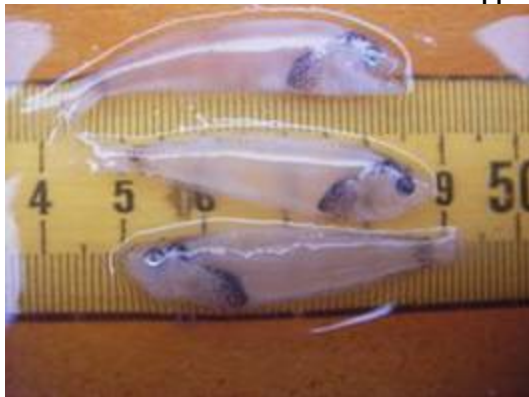
June- All years no
difference

Unmarked fish significantly higher condition in May than June

Diets

- | | |
|--|--------------|
|  | Fish |
|  | Sculpin |
|  | Flatfish |
|  | Rockfish |
|  | Ronquil |
|  | Sandlance |
|  | Smelt |
|  | Cancer crab |
|  | Copepod |
|  | Mix Decapods |
|  | Krill |
|  | Amphipods |
|  | Other |

Percent weight of prey eaten



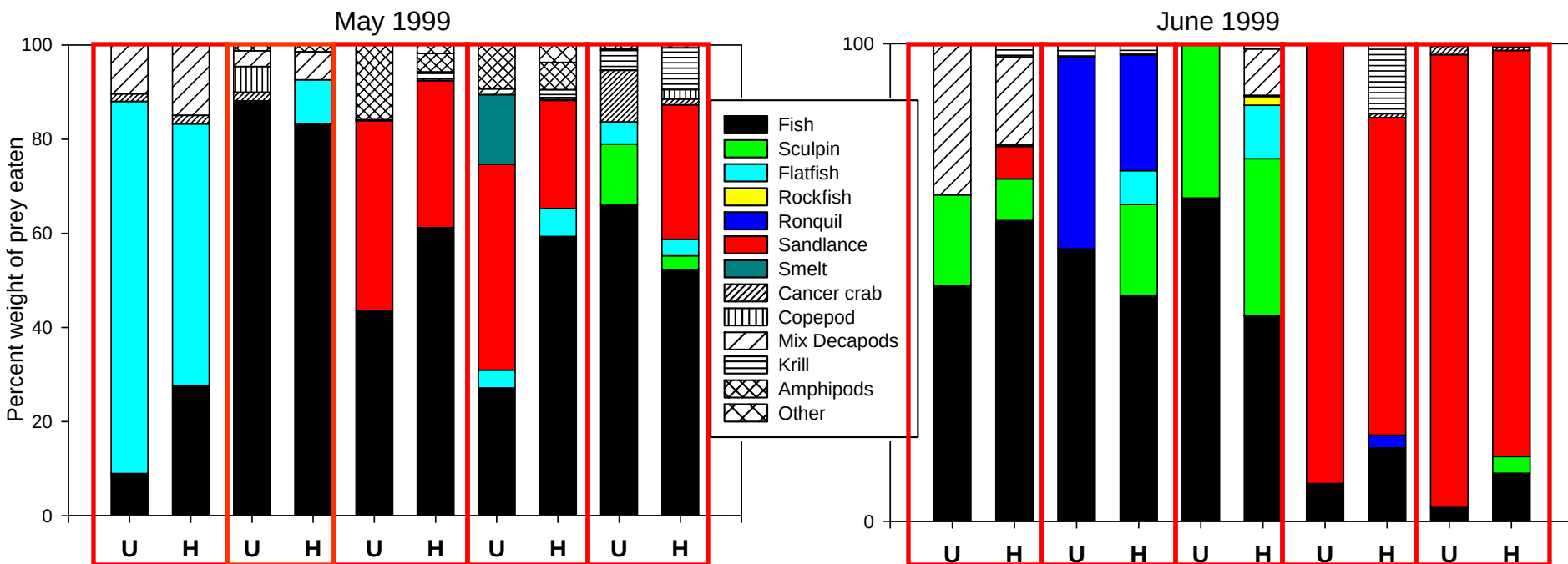
ked

Hatchery

Station by Station Diet Comparison

1999 as example

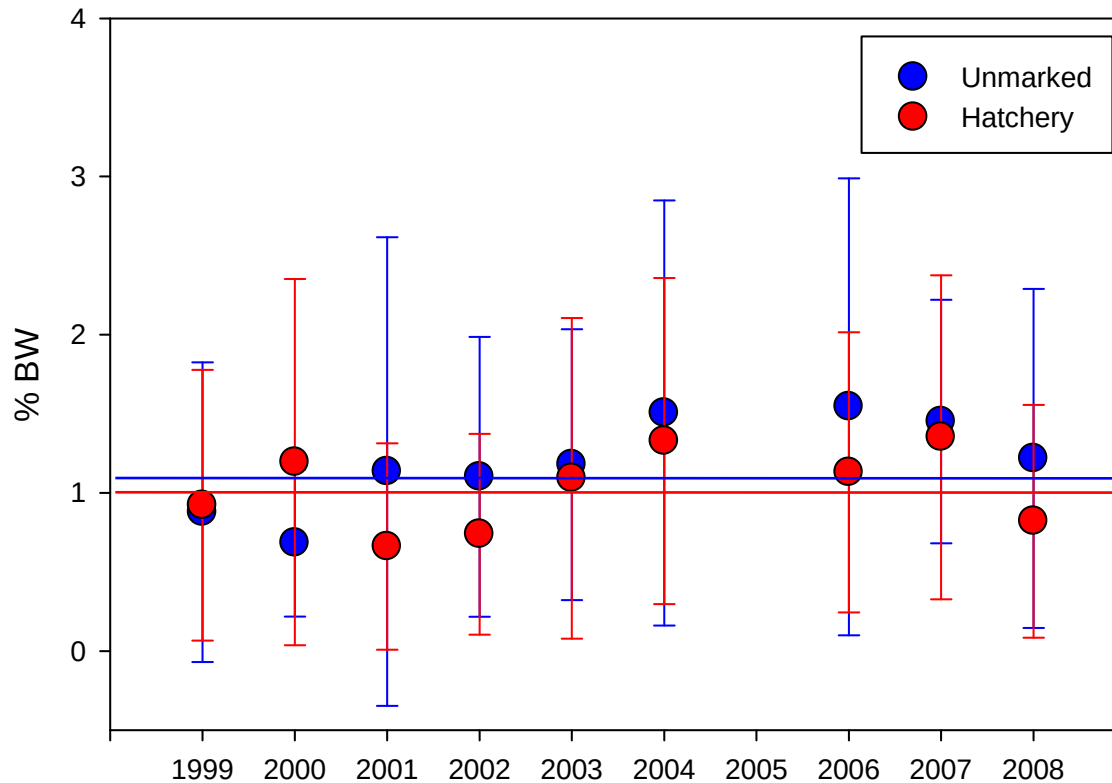
(minimum 3 unmarked and hatchery per station)



Almost all month/years unmarked
and hatchery fish had **similar**
distributions and **ate the same**

	May		June	
	Spatial	Diet	Spatial	Diet
	Distribution	composition	Distribution	composition
Year	P-value	P-value	P-value	P-value
1999	0.35	0.17	0.58	0.66
2000	0.12	0.56	0.51	0.01
2001	0.03	0.90	0.10	0.47
2002	0.24	0.30	0.26	0.50
2003	0.35	0.90	0.59	0.68
2004	0.02	-	0.64	-
2005	-	-	-	-
2006	0.55	0.04	0.40	-
2007	0.20	0.50	0.03	-
2008	0.20	0.95	0.25	0.88
2009	0.20	-	0.04	-

Stomach fullness (% of body weight): no significant differences



Significant negative
correlation between FL
and fullness ($p < 0.001$)

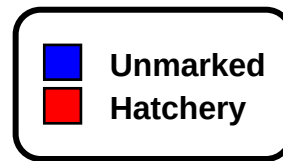
Analysis of Covariance

$p = 0.82$

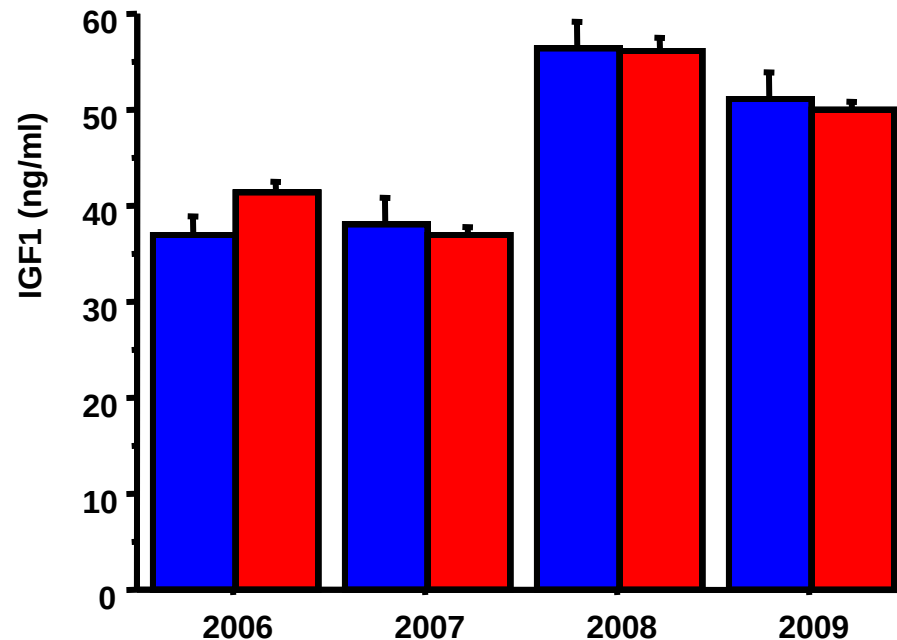
Smaller fish have bigger
stomachs relative to their
body size

Recent growth was not different between unmarked and hatchery fish

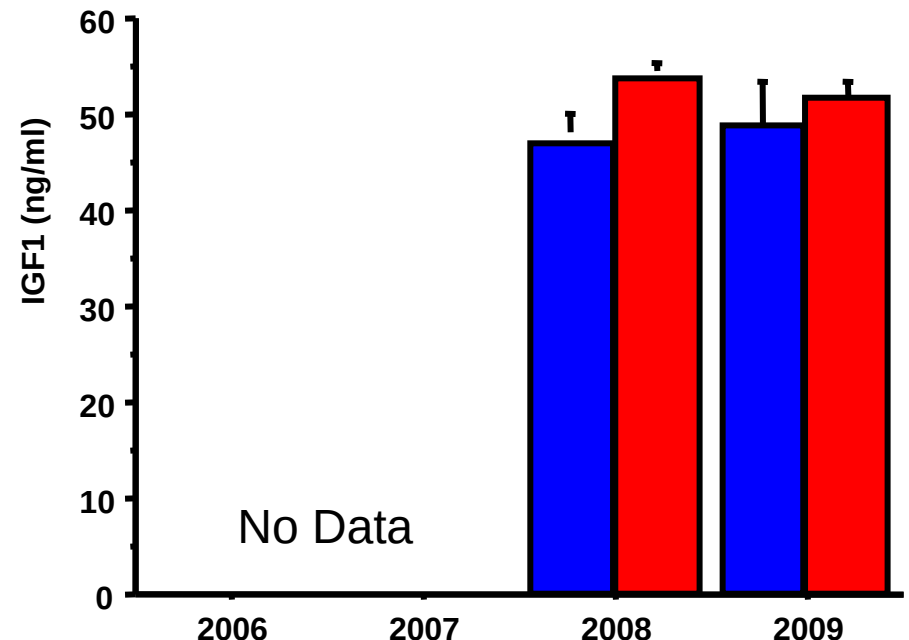
($F = 0.972$, $P = 0.325$)



May



June



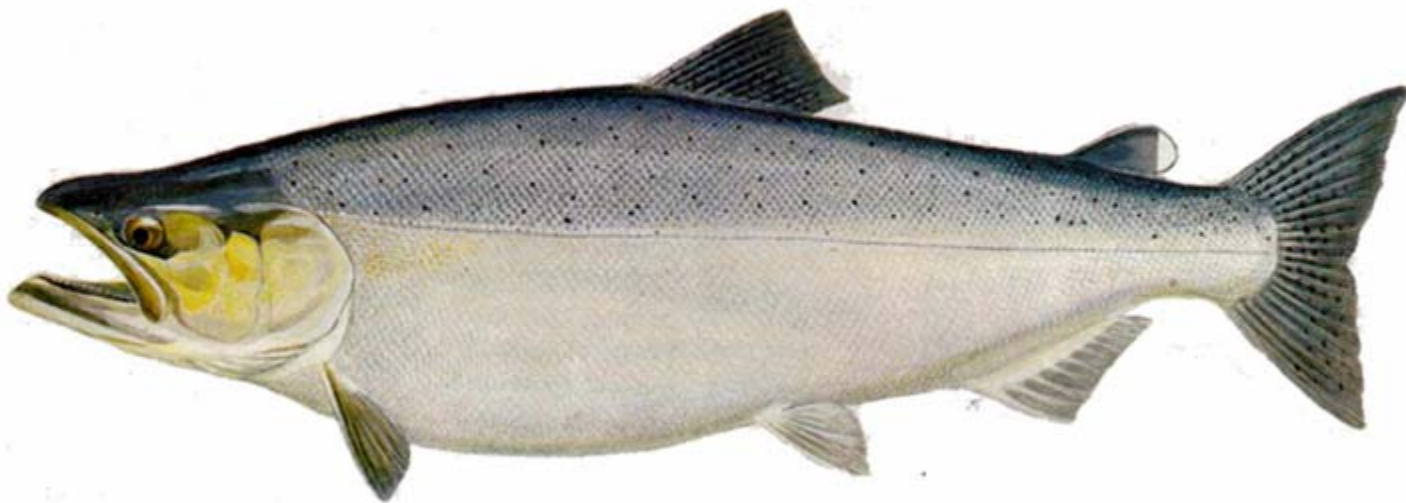
Conclusions/ Recommendations

- High spatial and dietary overlap: potential for competition yet we found no difference in feeding intensity or in recent growth which may indicate a lack of competitive impact
 - 100% marking of hatchery fish could enhance our understandings of interactions
- Effect of ocean conditions similar between two groups
- Manipulations of hatchery releases especially in years of predicted poor ocean conditions may enhance survival of both hatchery and unmarked fish

ACKNOWLEDGEMENTS

**Thanks to all those who went to sea
and helped processed data!**

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NOAA FISHERIES SERVICE

