Spatial overlap and competitive trophic interactions of unmarked and marked Chinook salmon during early marine residence

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

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

Juvenile Columbia River Spring yearling Chinook salmon

- **Juvenile**

caught in coastal marine waters

Microsat **ically identify**
s:

- **stock**

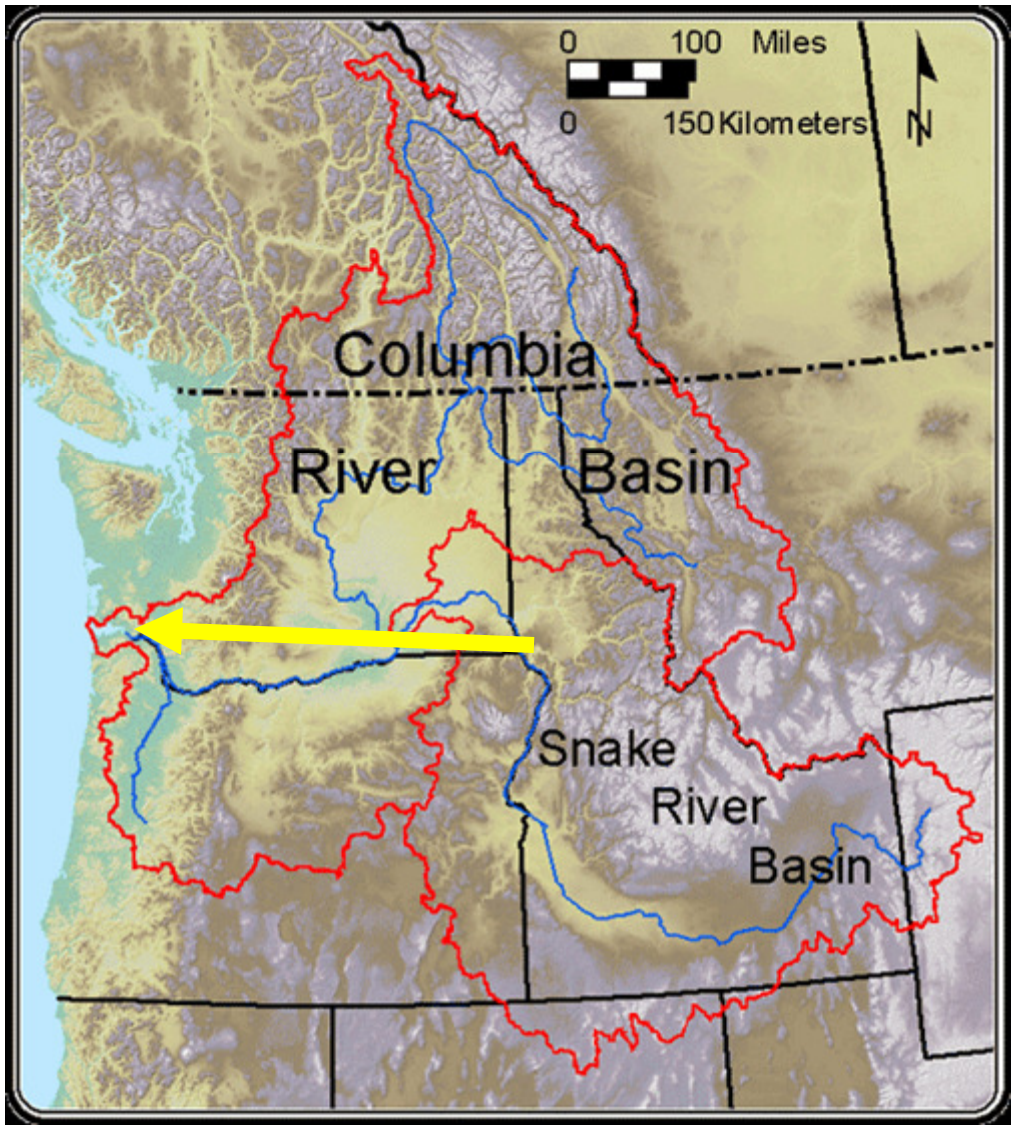
nery)

spawn

- **Yearling**

first year of life was in fresh water before smolting

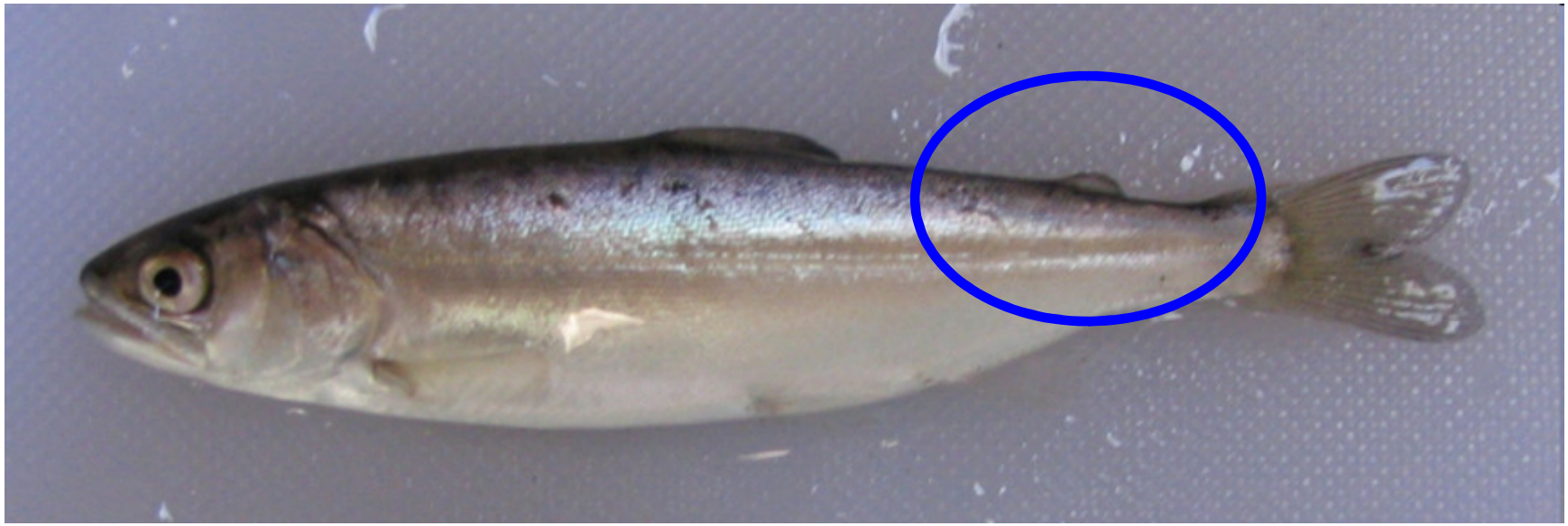
Columbia River spring Chinook salmon:



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)

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

ANNUALLY 31 million (± 2.5) **Hatchery** Columbia River spring Chinook are released

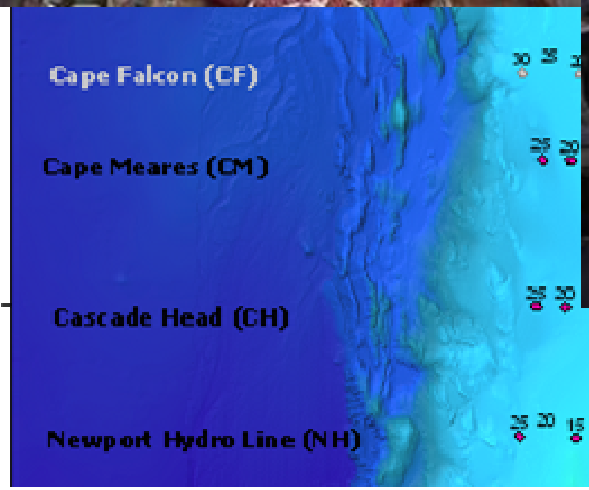
What is marking rate for our fish?

Overall average
85.9% marked

http://www.fpc.org/hatchery/Hatchery_Queries.html

Methods: Ocean sampling of juvenile spring Chinook salmon

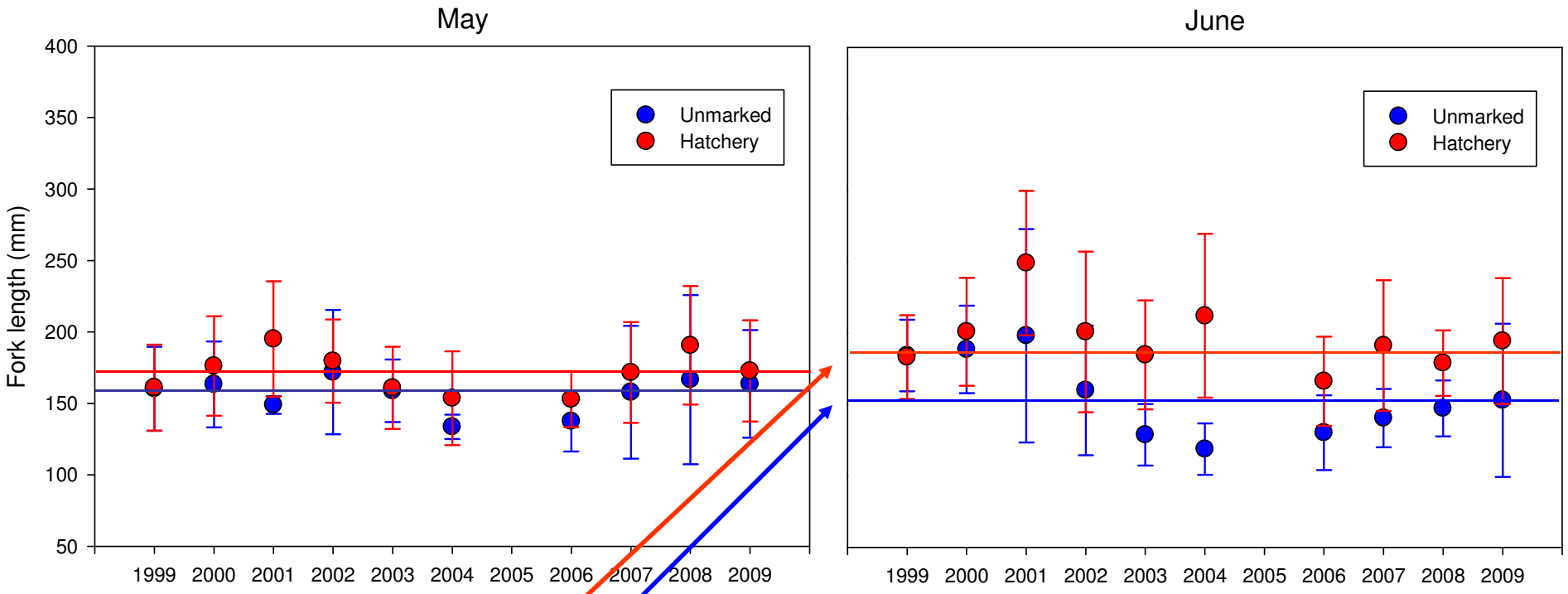
Where 98.1% spring Chinook



Catch summary: 1999-2009 Spring Chinook n = 2527 unmarked + hatchery

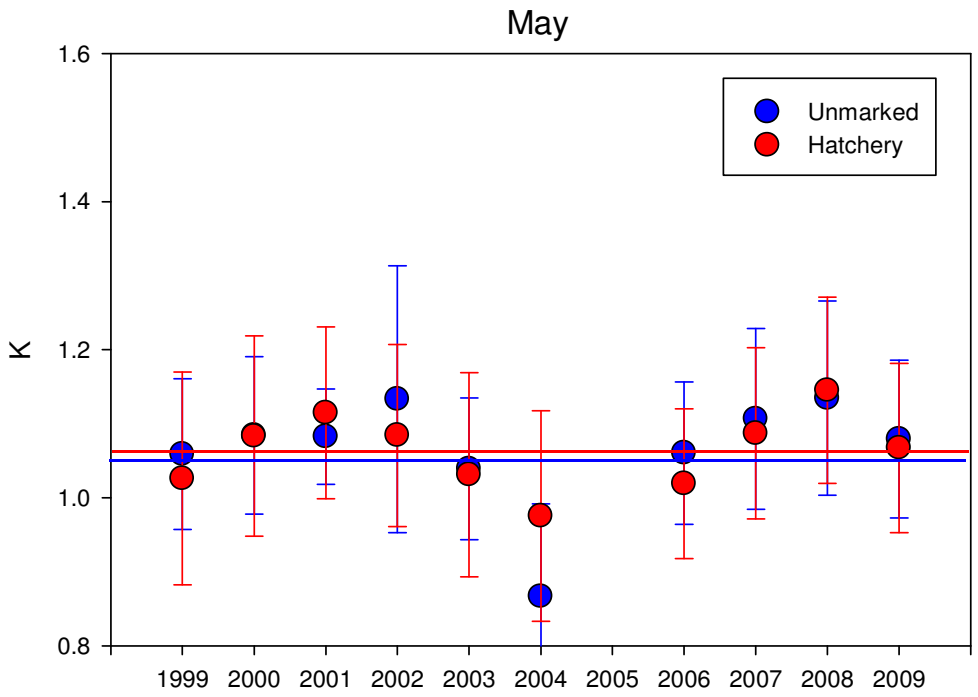
	MAY			JUNE		
Year	Unmarked	Hatchery	% catch hatchery	Unmarked	Hatchery	% catch hatchery
1999	85	120	58.5	43	86	66.7
2000	29	54	65.1	12	15	55.6
2001	14	38	73.1	11	13	54.2
2002	13	94	87.9	19	45	70.3
2003	8	71	89.9	41	53	56.4
2004	4	63	94.0	13	21	61.8
2005		3		5	7	
2006	23	168	88.0	13	29	69.0
2007	28	188	87.0	6	41	87.2
2008	25	230	90.2	46	264	85.2
2009	29	354	92.4	27	76	73.8
Total	**258**	**1383**	**82.6%**	**236**	**650**	**68.0%**

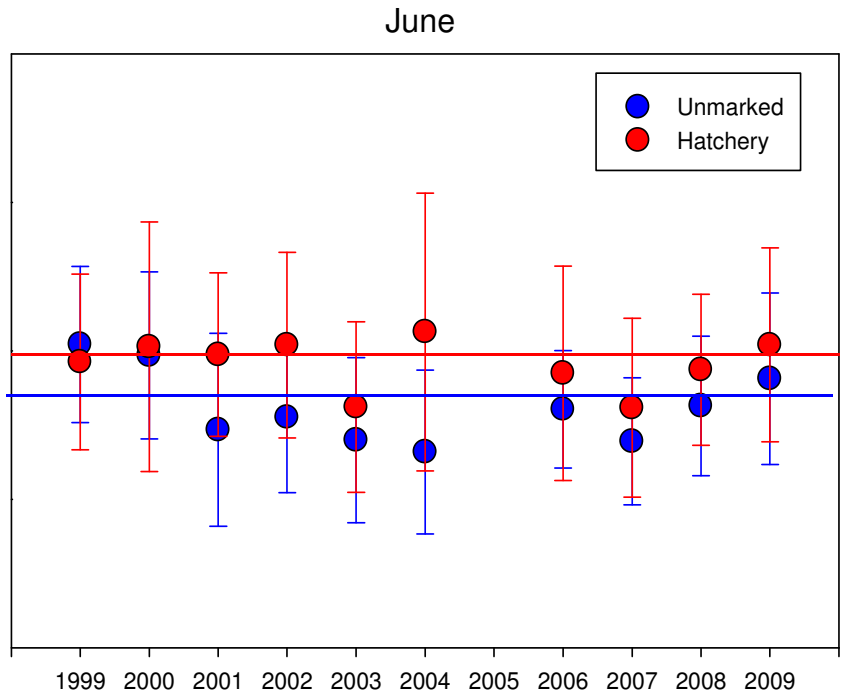
Fork length (SD bars)



- Hatchery fish are longer than unmarked
- Mean hatchery fish length increased between May and June
- Mean unmarked fish length decreased between May and June

Condition Factor
($K = W / L^3$)

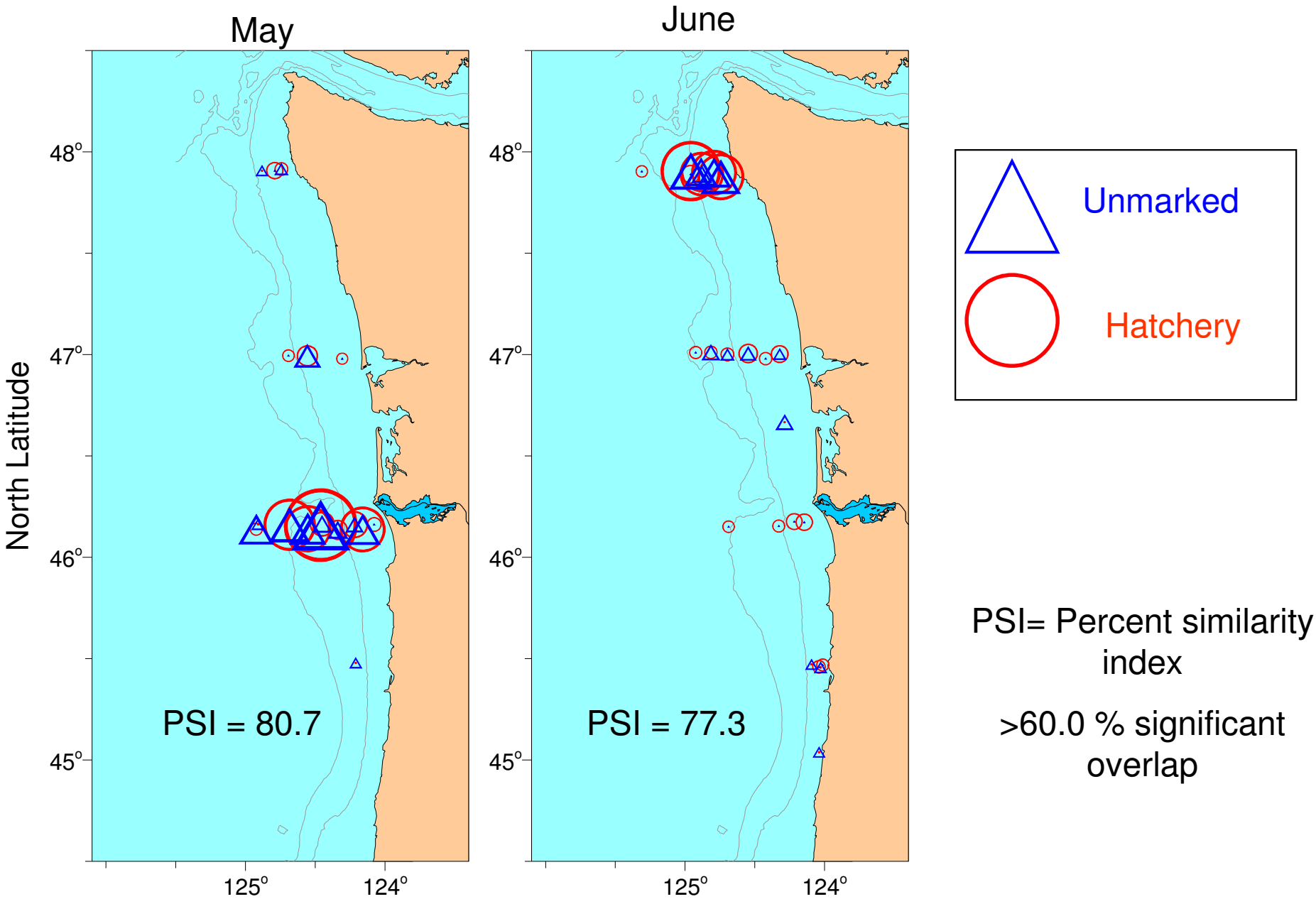




May- almost all year there was no difference in condition factor between unmarked and hatchery

June- almost all years hatchery had significantly higher condition factor

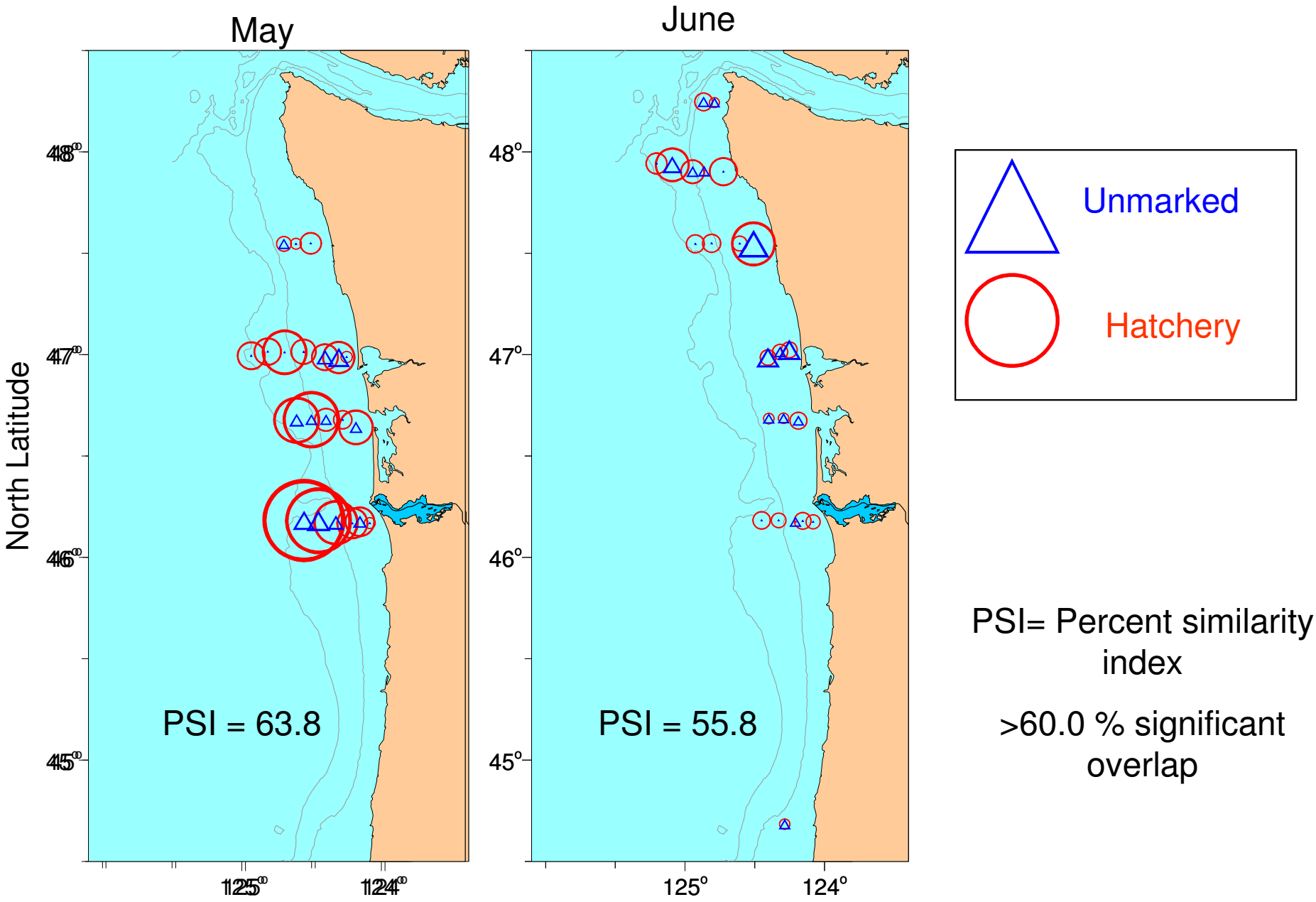
Overlap in Distribution: 1999



PSI= Percent similarity index

>60.0 % significant overlap

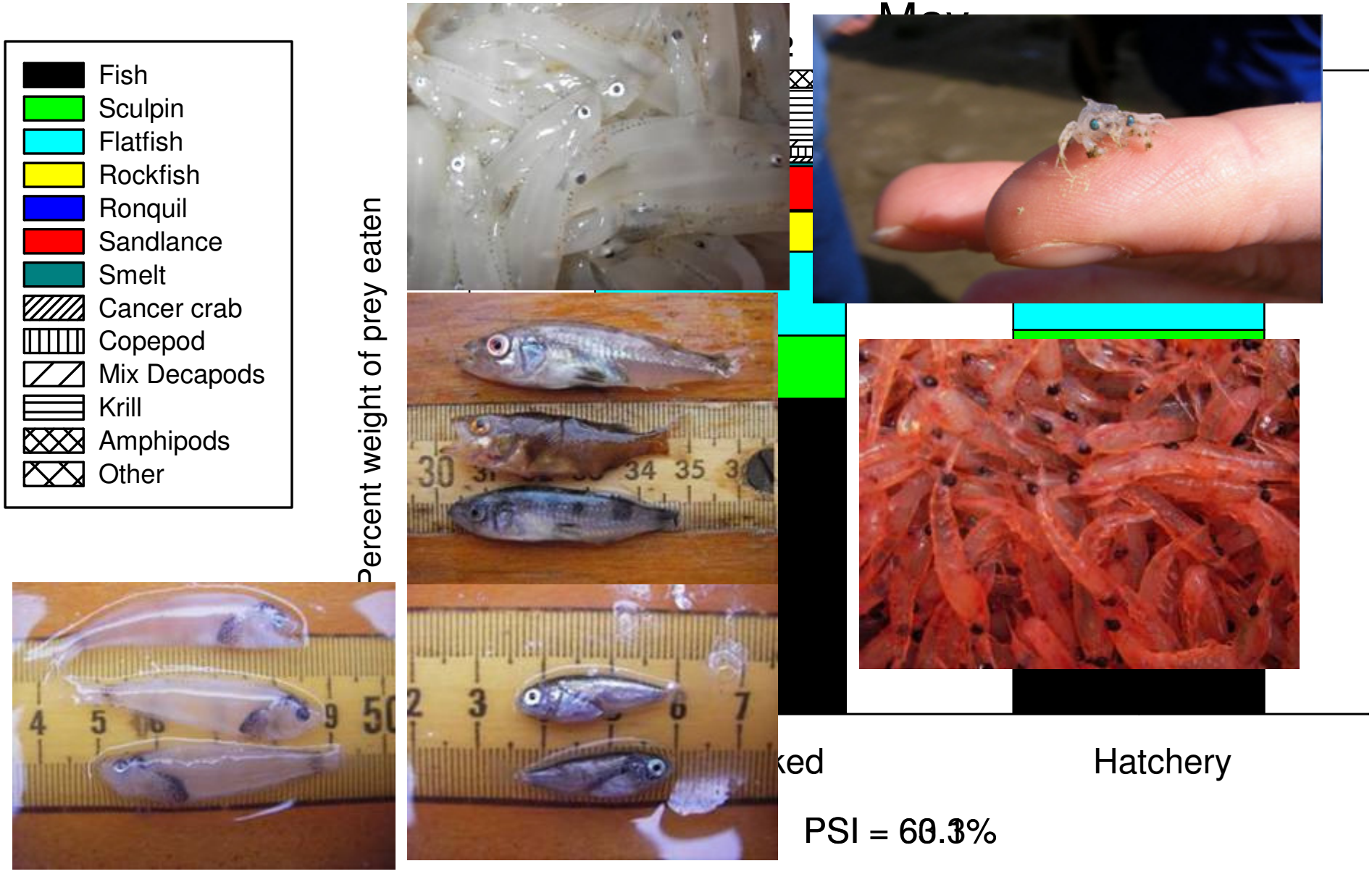
Overlap in Distribution: 2009



PSI= Percent similarity index

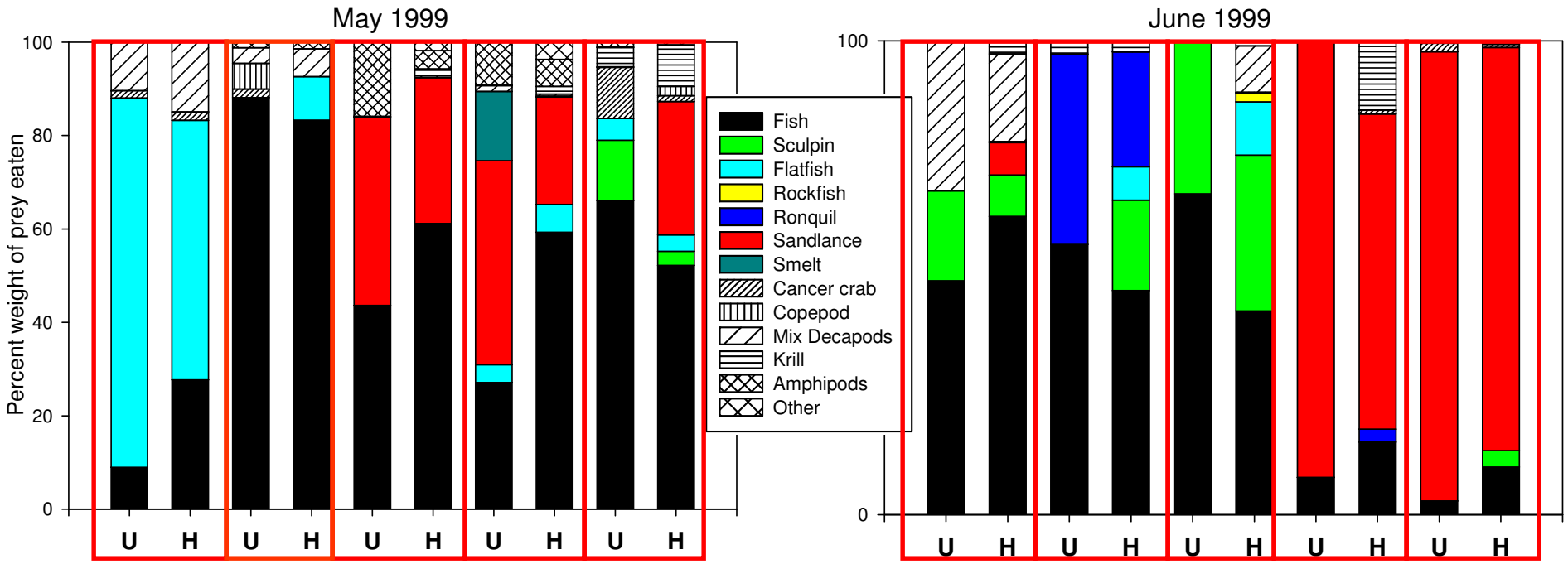
>60.0 % significant overlap

Diets


Fish
Sculpin
Flatfish
Rockfish
Ronquil
Sandlance
Smelt
Cancer crab
Copepod
Mix Decapods
Krill
Amphipods
Other
Percent weight of prey eaten
ked
Hatchery
PSI = 60.3%

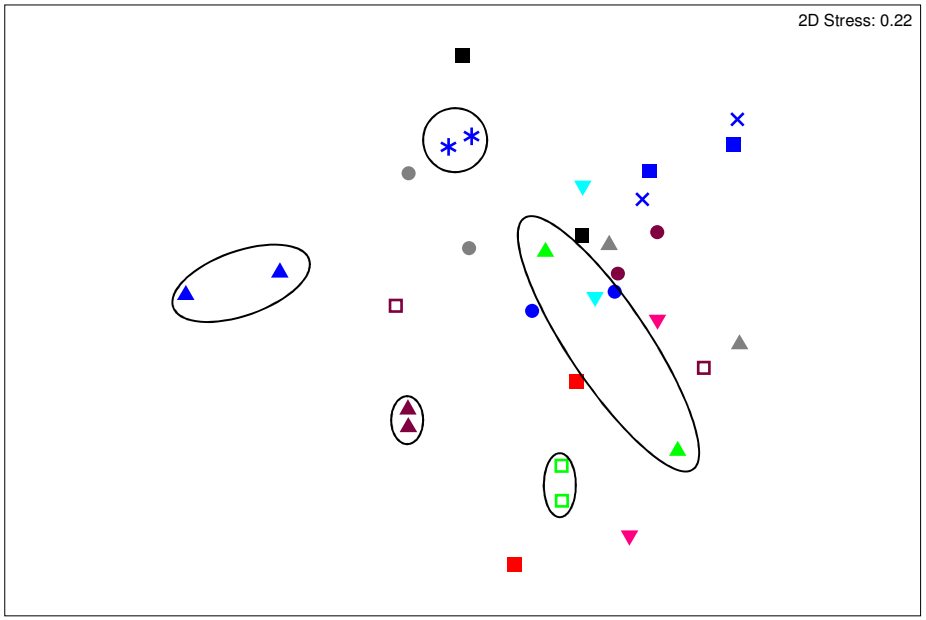
Station by Station Diet Comparison 1999 as example

(minimum 3 unmarked and hatchery per station)

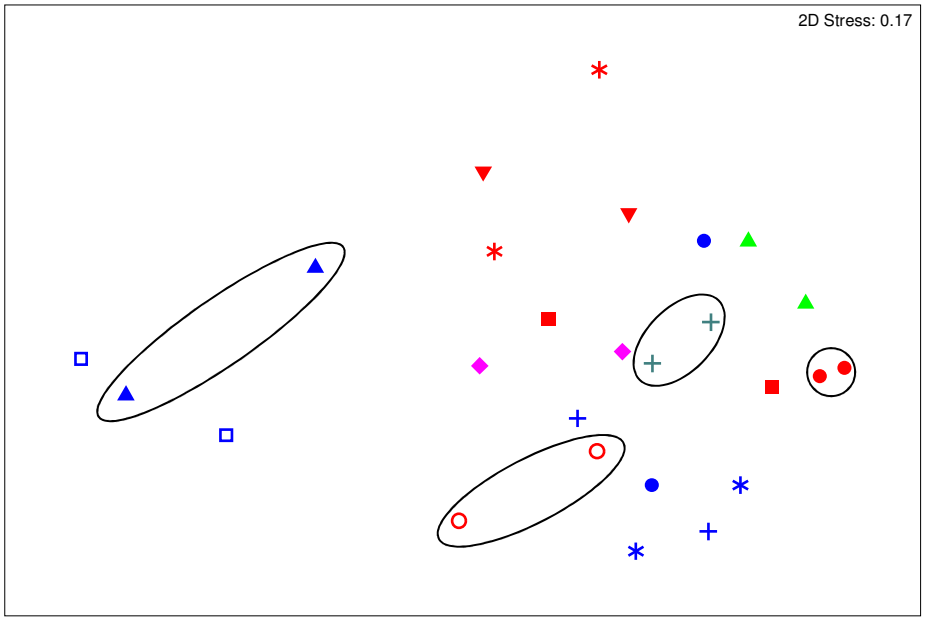


Ordination: station by station unmarked and hatchery diets

May



June



ANOSIM: (a multivariate test for sig. differences)

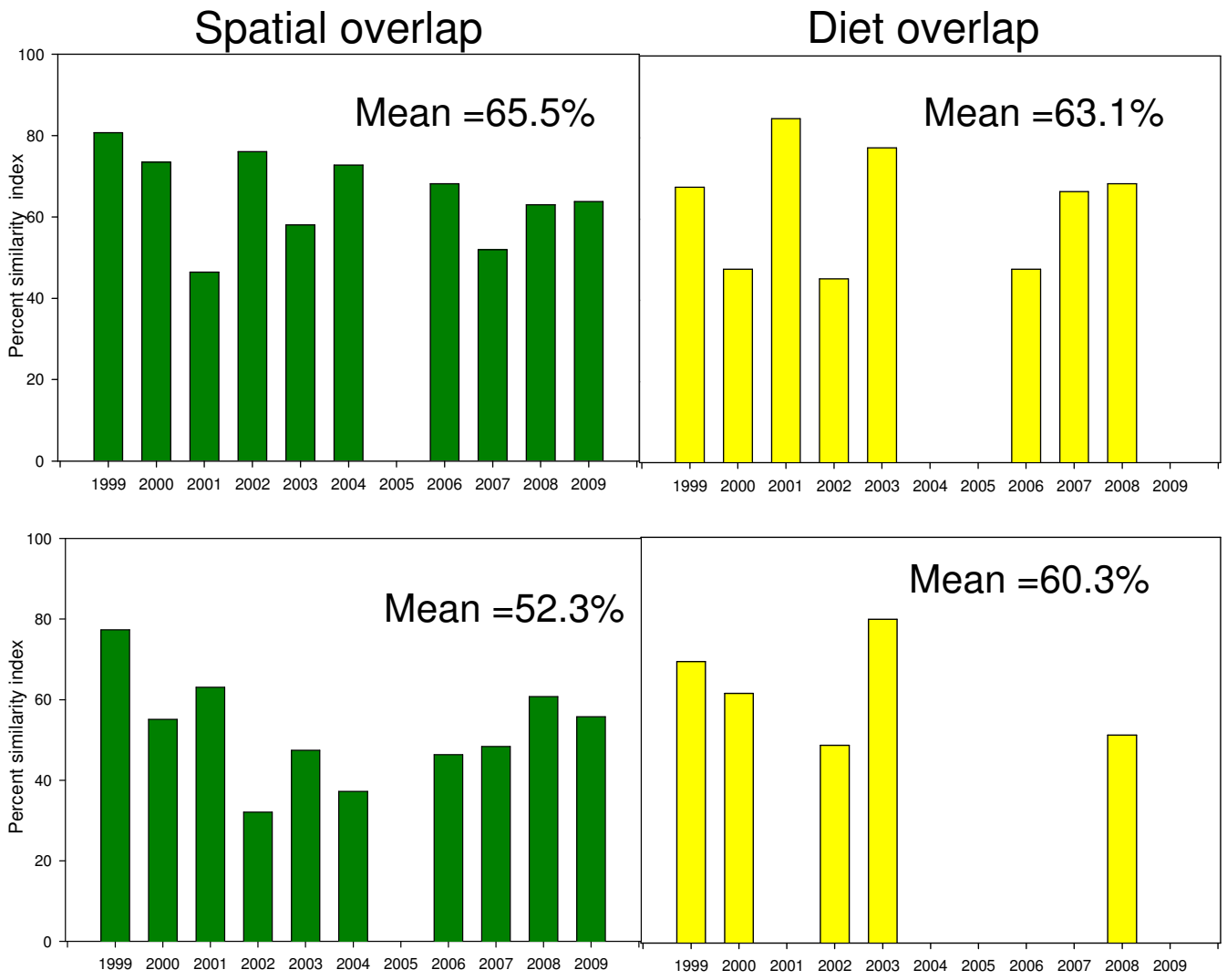
Unmarked diets were not significantly different from hatchery

May p = 0.32, June p = 0.92

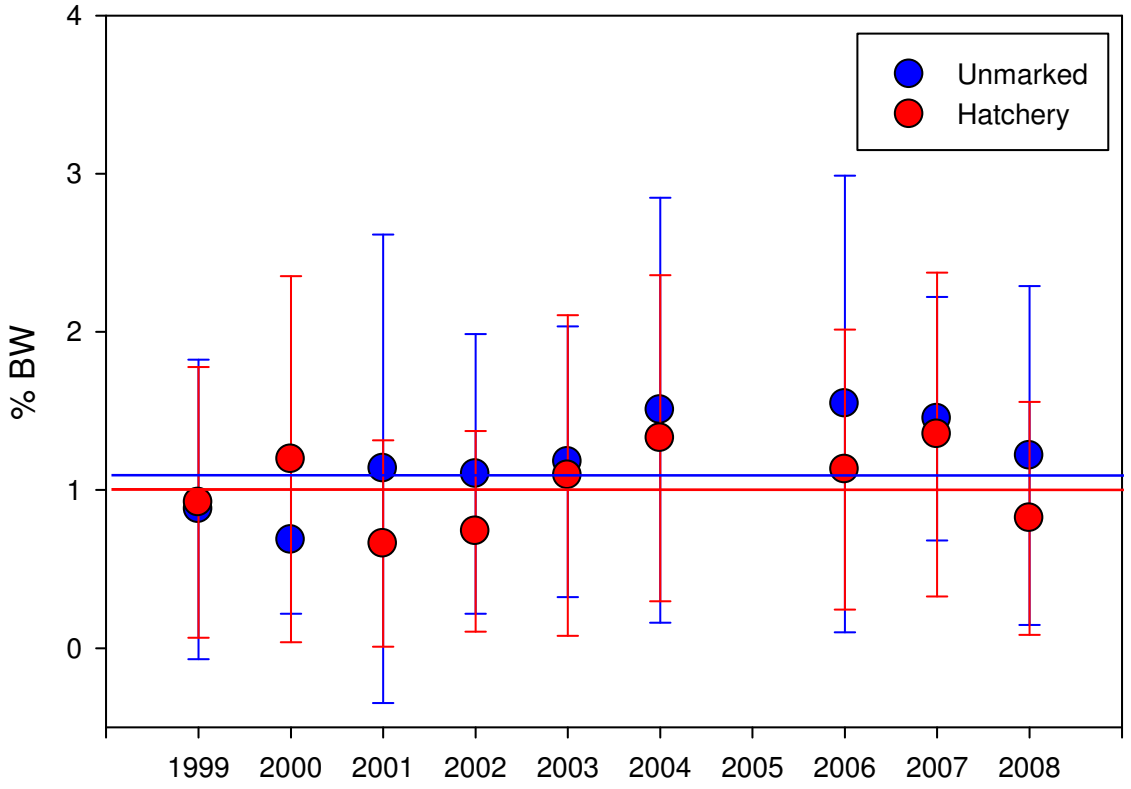
Spatial and Diet overlap between unmarked and hatchery Chinook: PSI

May

June



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



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

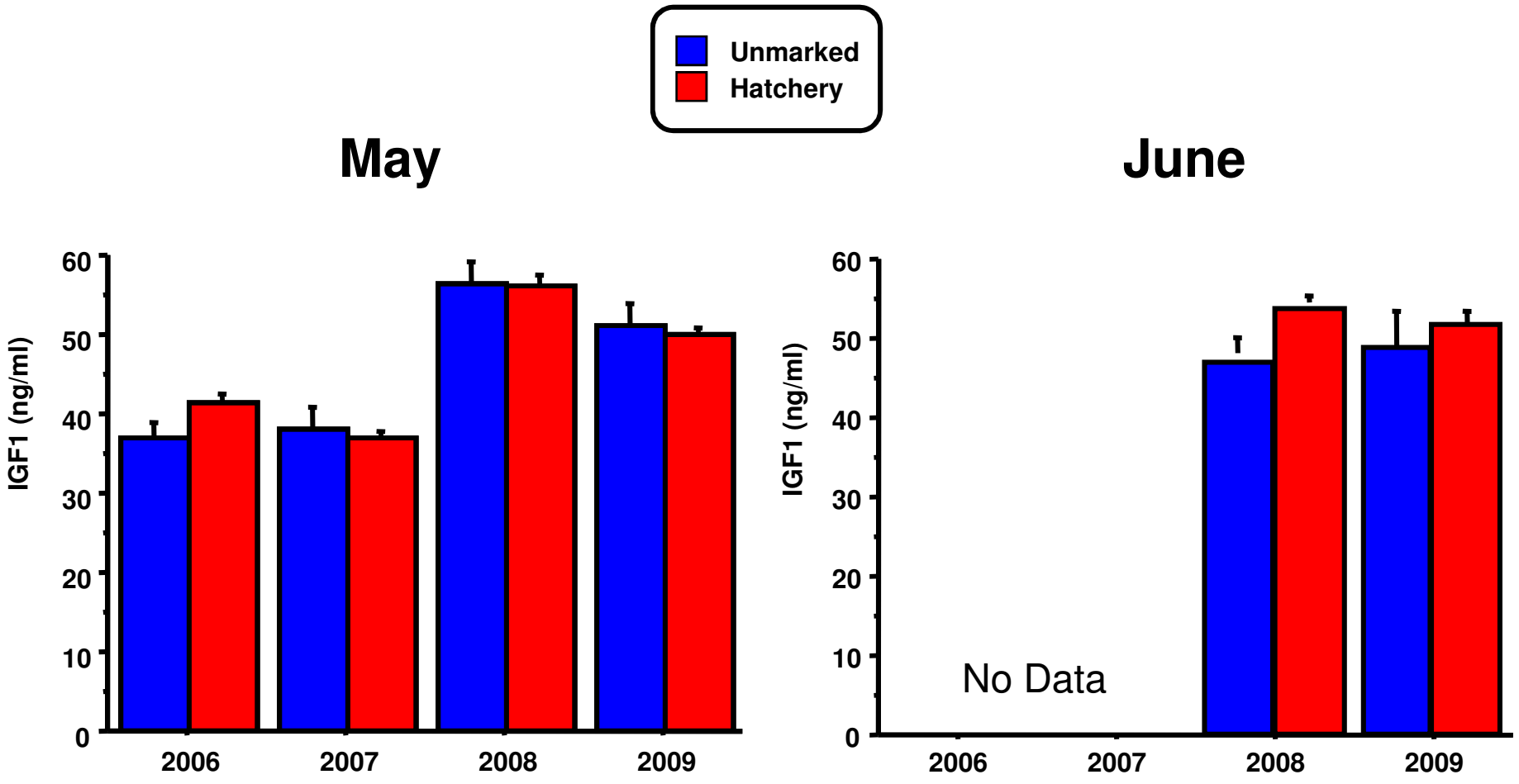
Analysis of Covariance

$p = 0.82$

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)



Conclusions

Unmarked and hatchery Chinook salmon in coastal waters:

- High spatial and dietary overlap
- Hatchery fish are larger than unmarked fish
- No difference in feeding intensity or in recent growth

ACKNOWLEDGEMENTS

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

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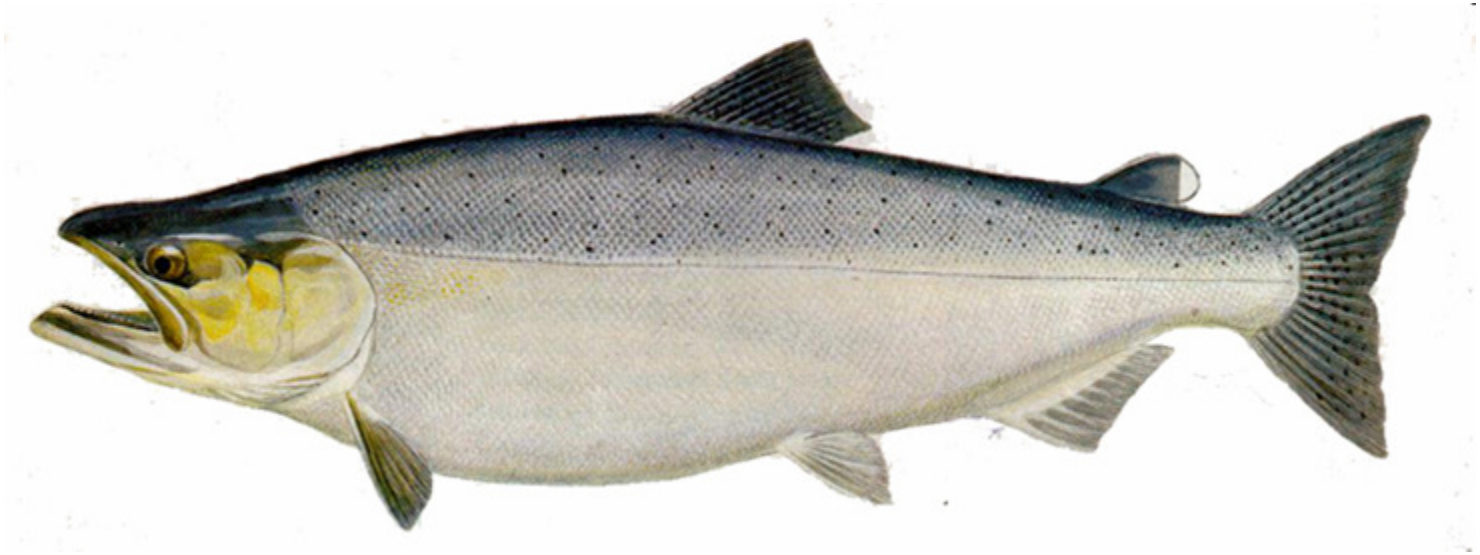
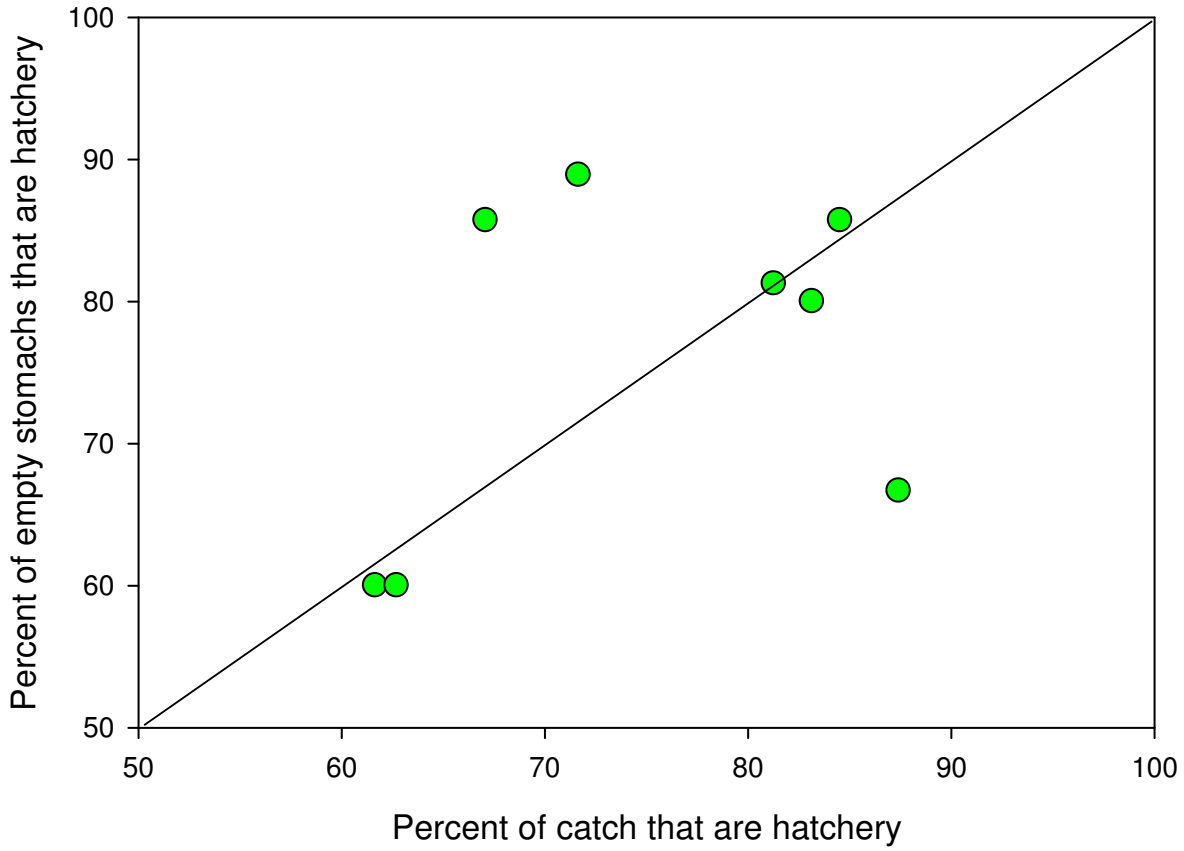


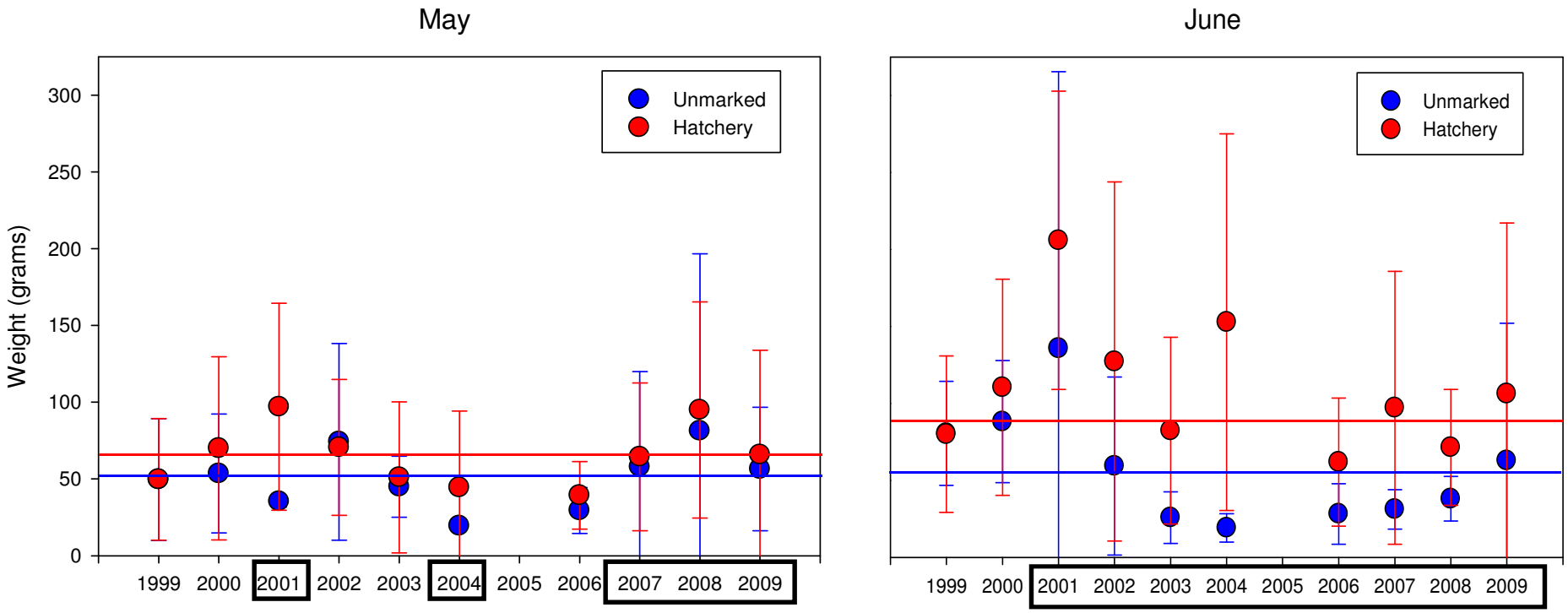
NOAA FISHERIES SERVICE

Bonneville Power Administration

Hatchery fish: Percent empty stomachs and percent of total catch

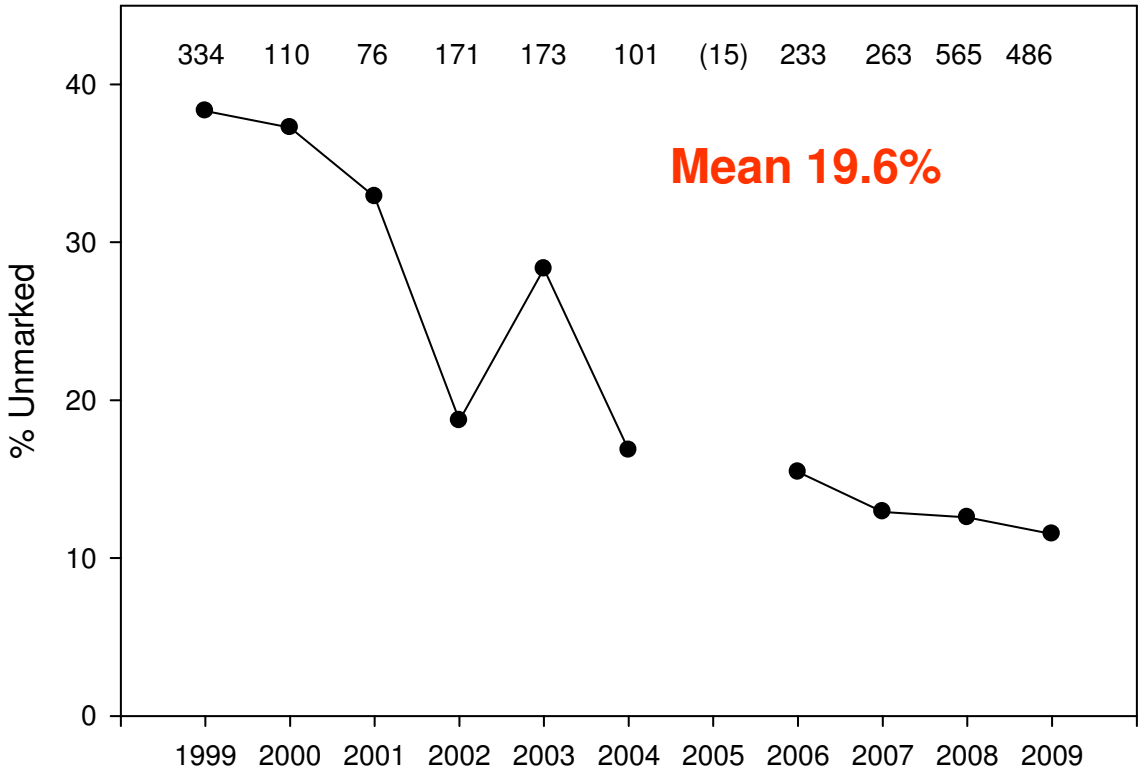


Weight (grams)



- Hatchery are heavier than unmarked fish
- May to June increase (hatchery) and none for unmarked

Percent of spring Chinook: Unmarked



http://www.fpc.org/adultsalmon/adultqueries/Adult_Annual_Totals_Query_Results.asp