Prey availability and feeding ecology of juvenile salmon in coastal waters based on stomach content and stable isotope analyses

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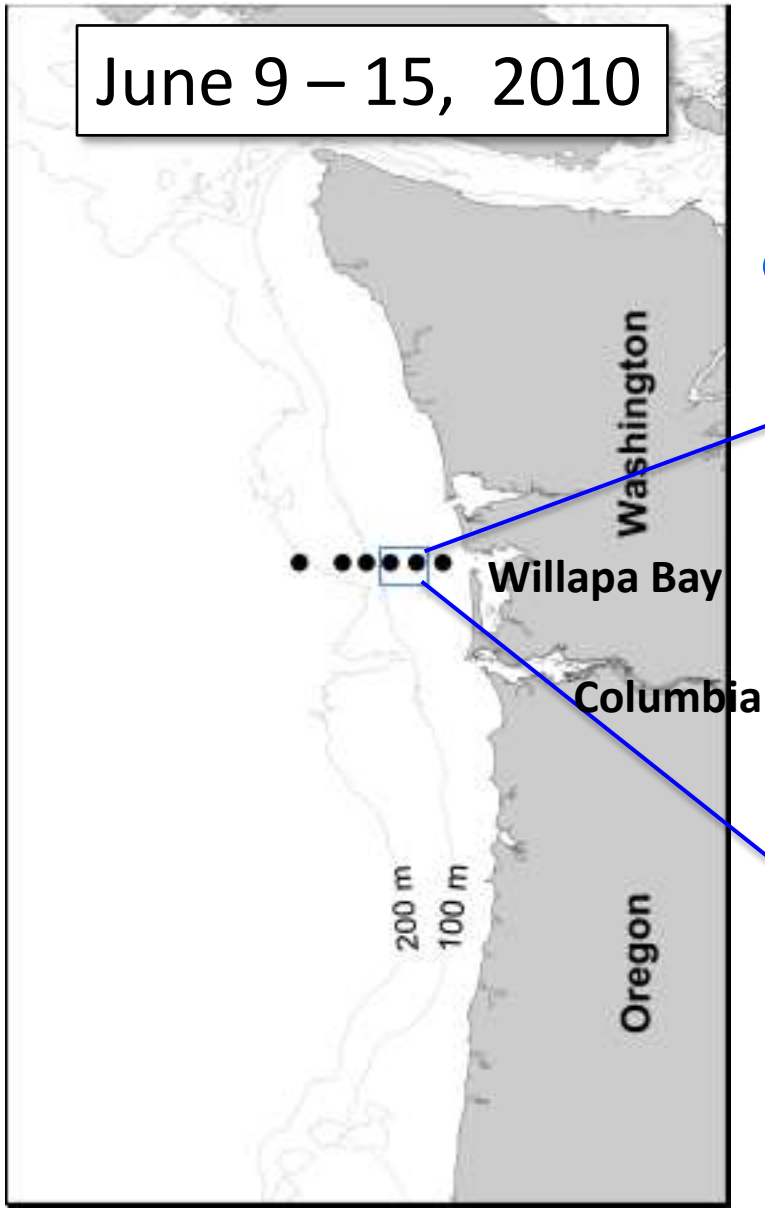
Research Objectives

1. To compare prey field communities from nets to salmon diets
2. To test whether stable isotopes of carbon and nitrogen are a good predictor of diet using a Bayesian mixing model

Outline

- NOAA *Miller/Freeman* Survey (June 2010)
- Salmon Diet Composition
- Comparison Of Catch and Salmon Diets
- Stable Isotope Results
- Stable Isotope Mixing Models

NOAA R/V *Miller Freeman* Survey



Nets Used

Nordic

Methot

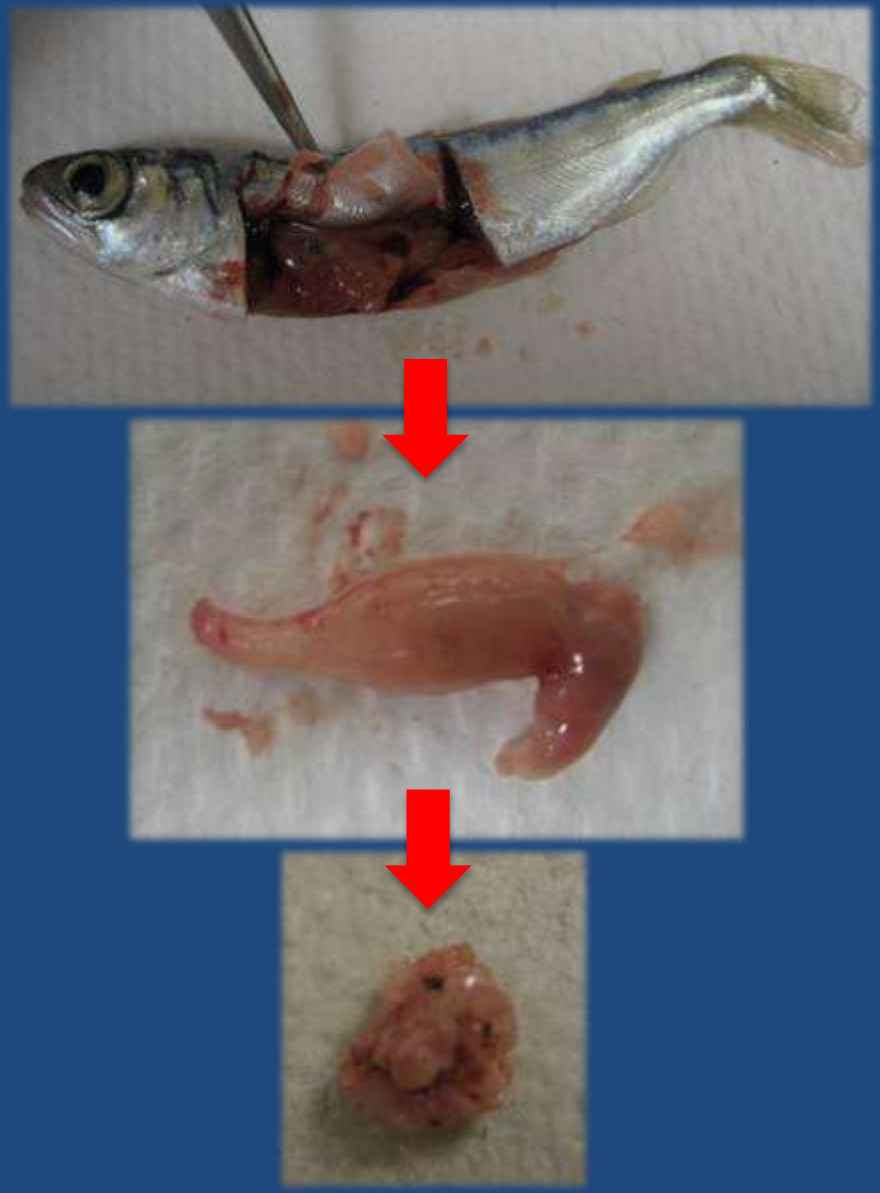
Herring

Bongo

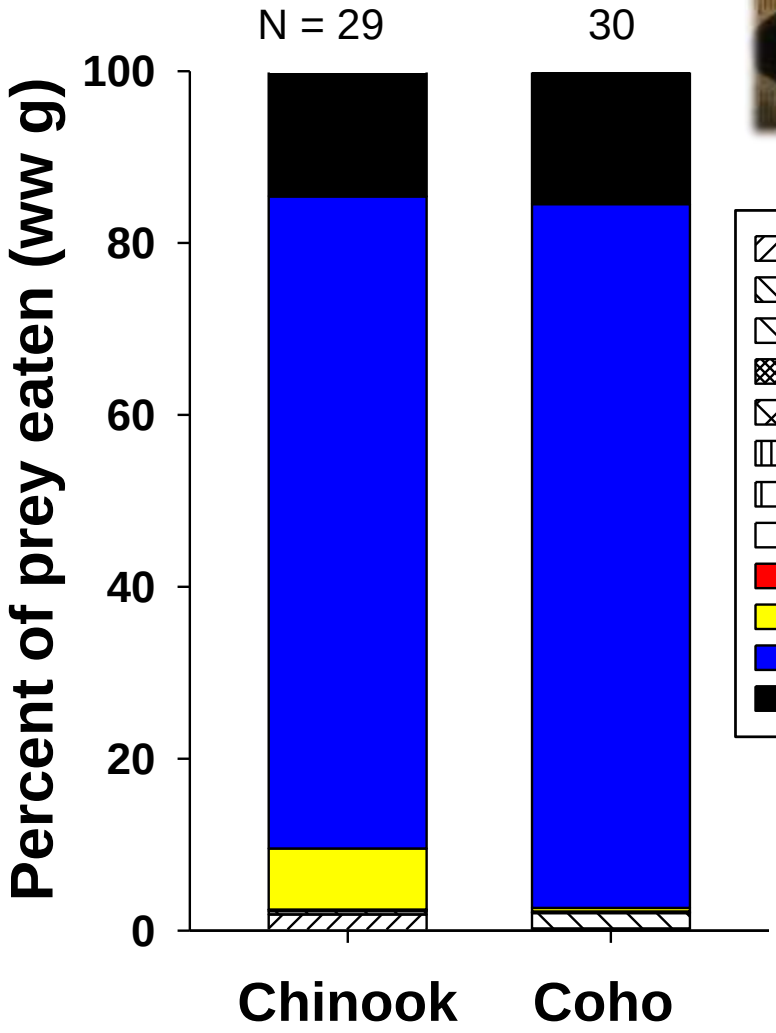
The Nets

	Herring	Nordic
Opening area (m^2)	37.2	336
Area of filtering cone (m^2)	9.29	123
Avg. Dist. travelled (m)	1784	1910
Avg. Vol. filtered (m^3)	16440	232085

Chinook and Coho Diet Analysis



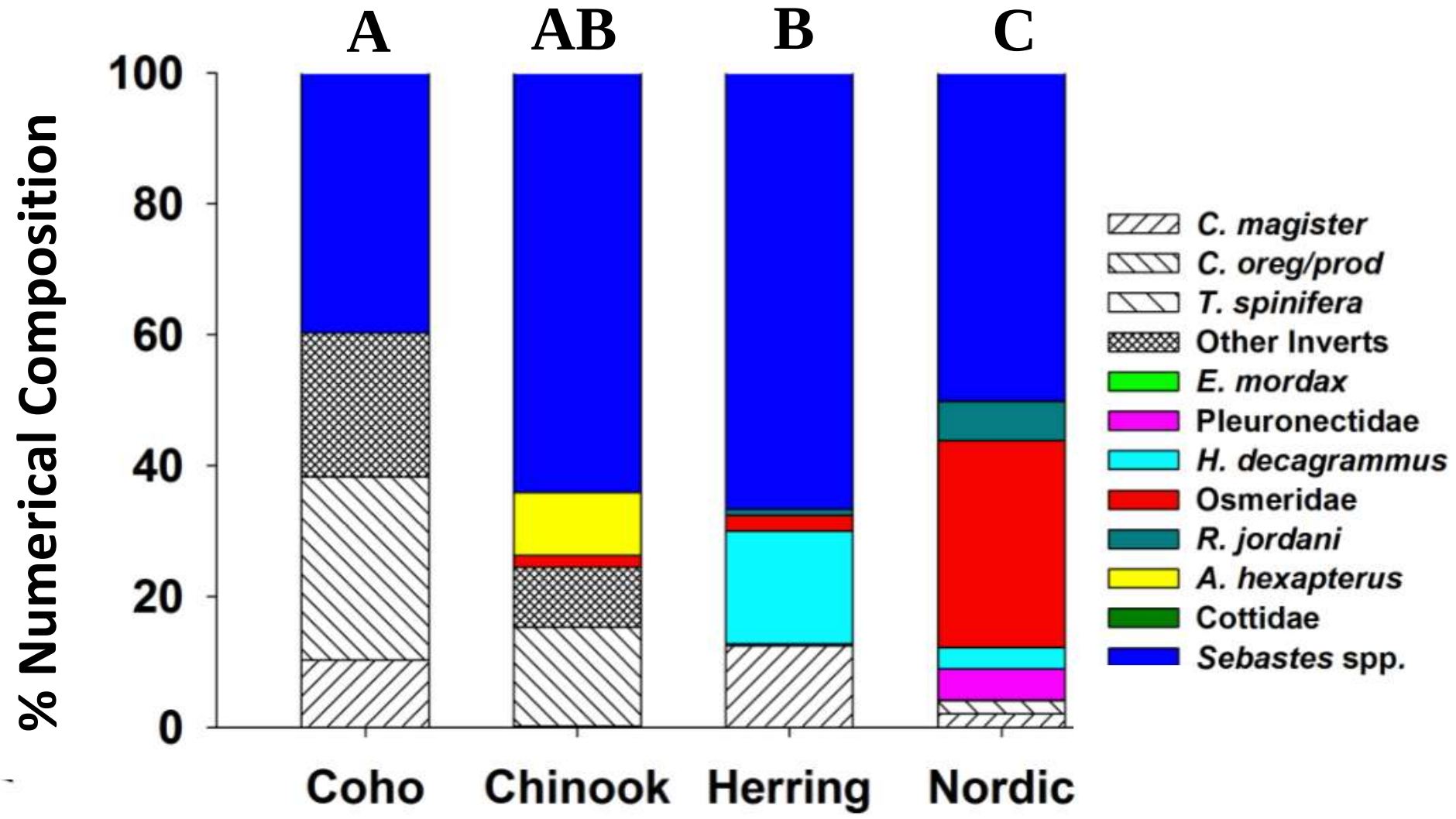
Chinook and coho diets were similar



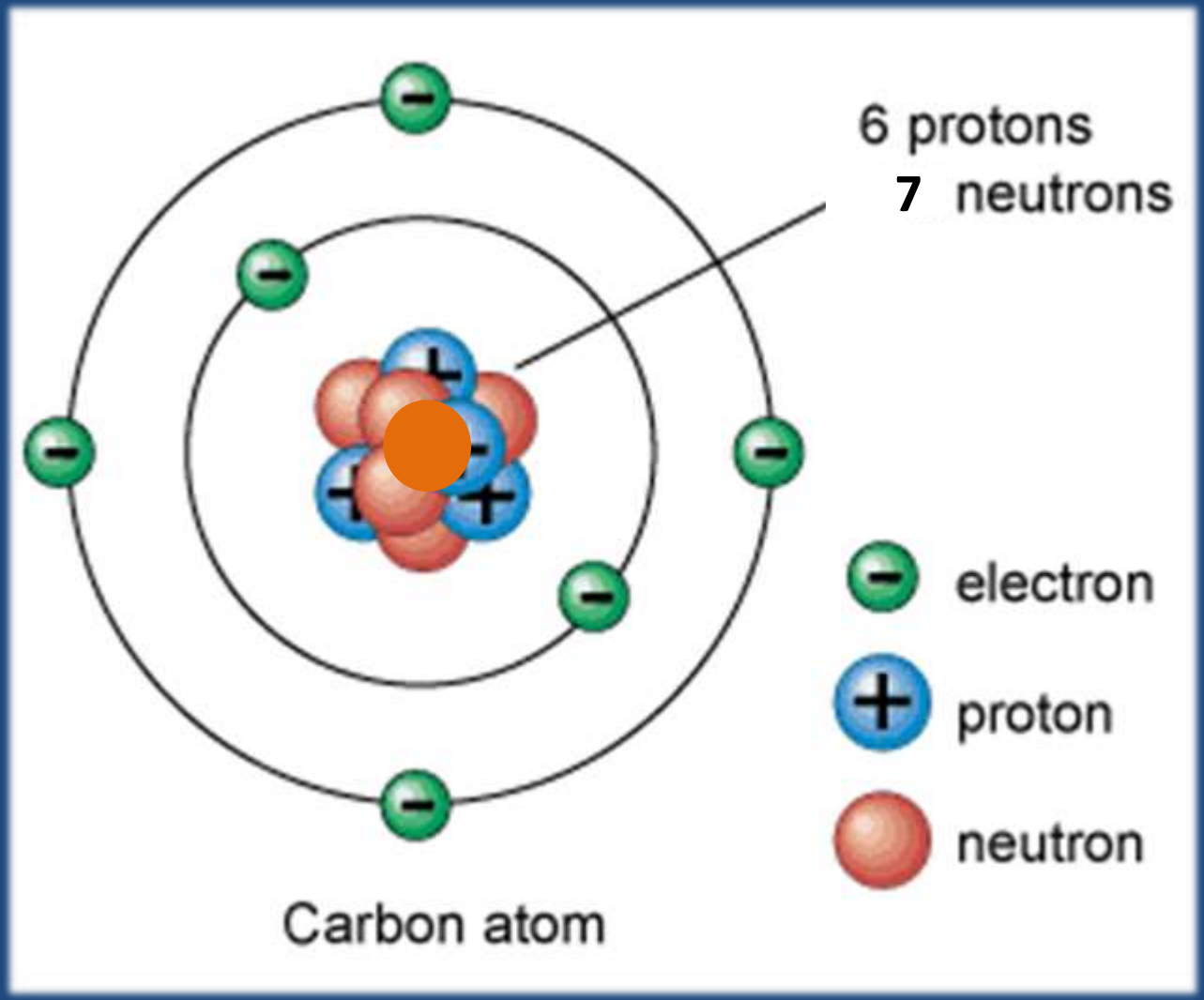
ANOSIM

P = 0.59

Salmon diet composition different than net compositions



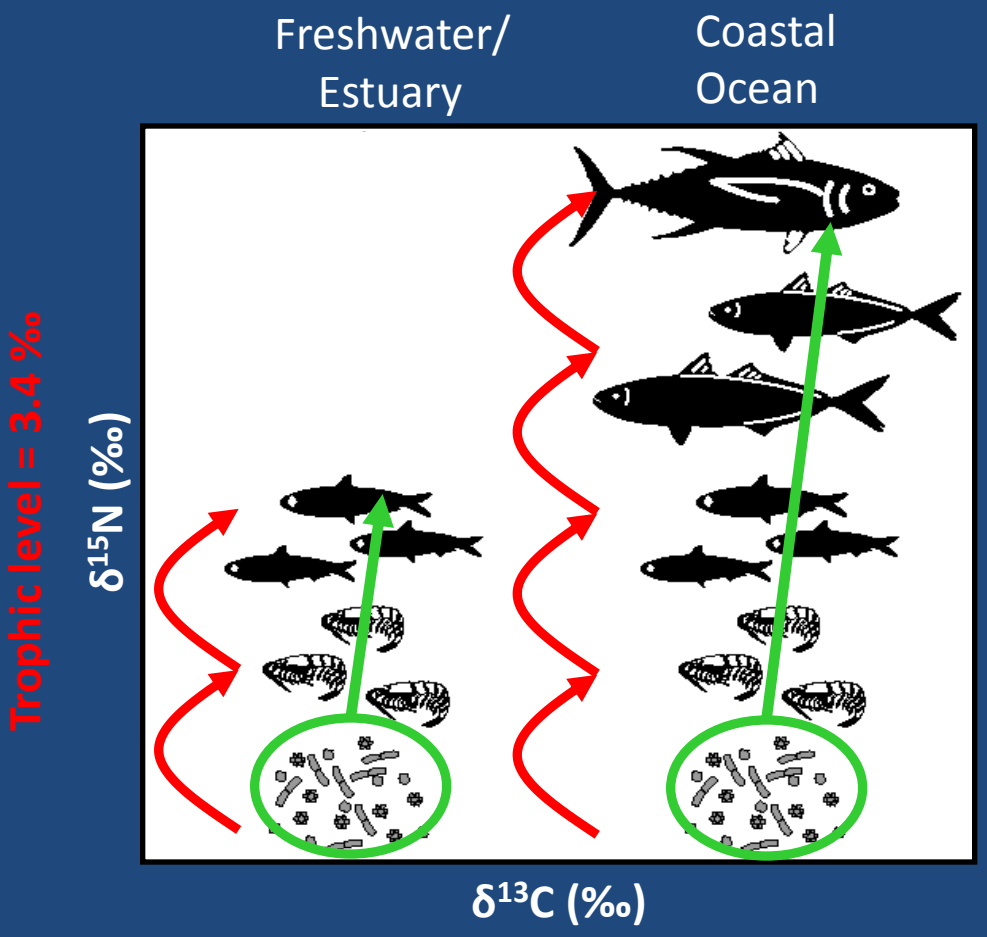
Stable Isotopes as Natural Tracers



Stable Isotopes in Ecological Studies

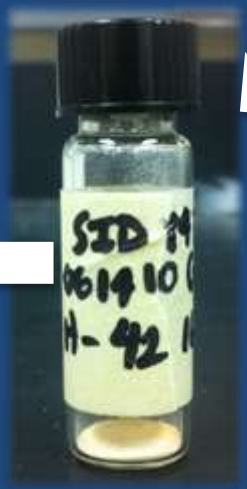
Carbon isotopes
- Indicator of source production
- Ratio changes little up the food chain

Nitrogen isotopes
- measure of relative trophic level
- changes approx. 3.4 (o/oo) per trophic level



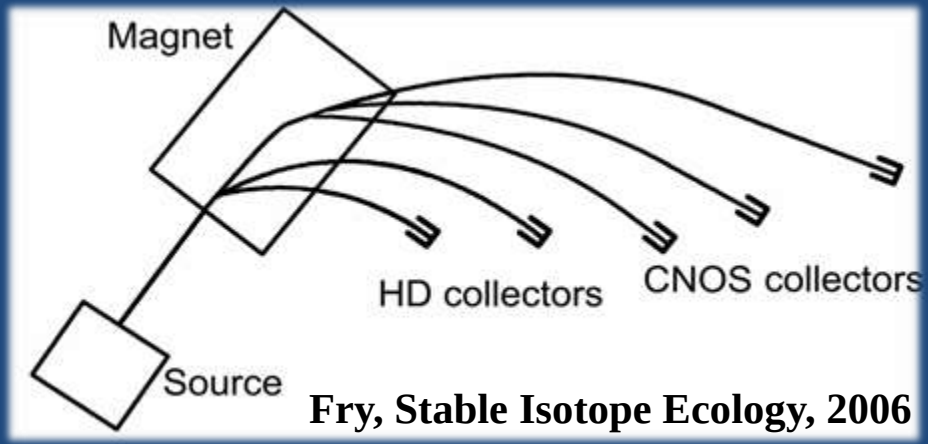
Base production changes little between trophic levels

Stable Isotope Analysis



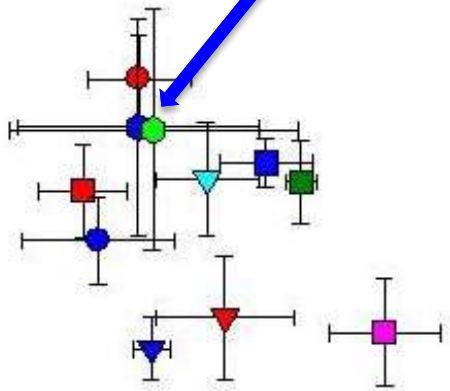
Stable Isotope Analysis

Elemental analyzer coupled to a stable isotope ratio mass spectrometer



Fry, Stable Isotope Ecology, 2006

Stable Isotope Biplot

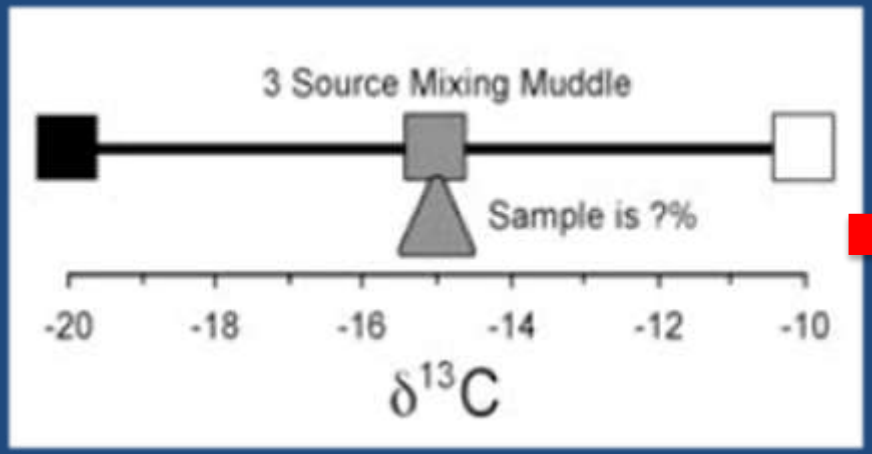


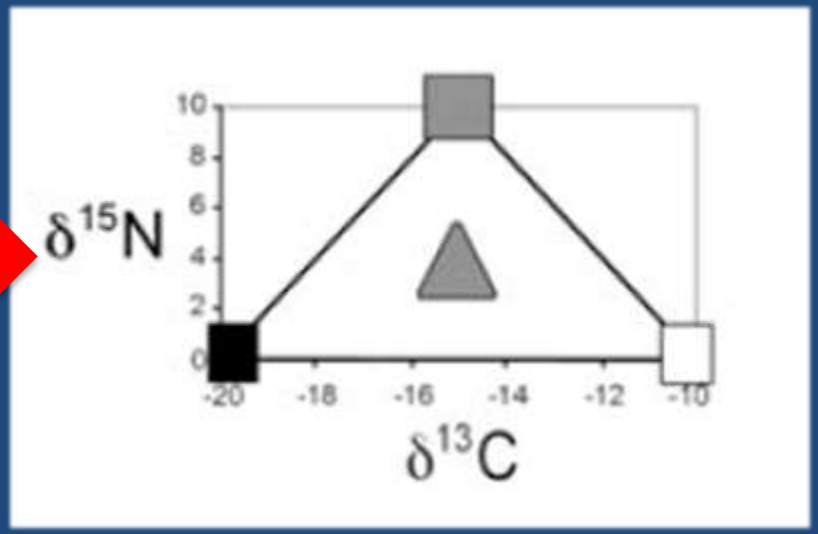
Values from Maier and Simenstad (2009)

Trophic Level

Source Production

Stable Isotope Mixing Models: C & N





Fry (Stable Isotope Ecology, 2006)

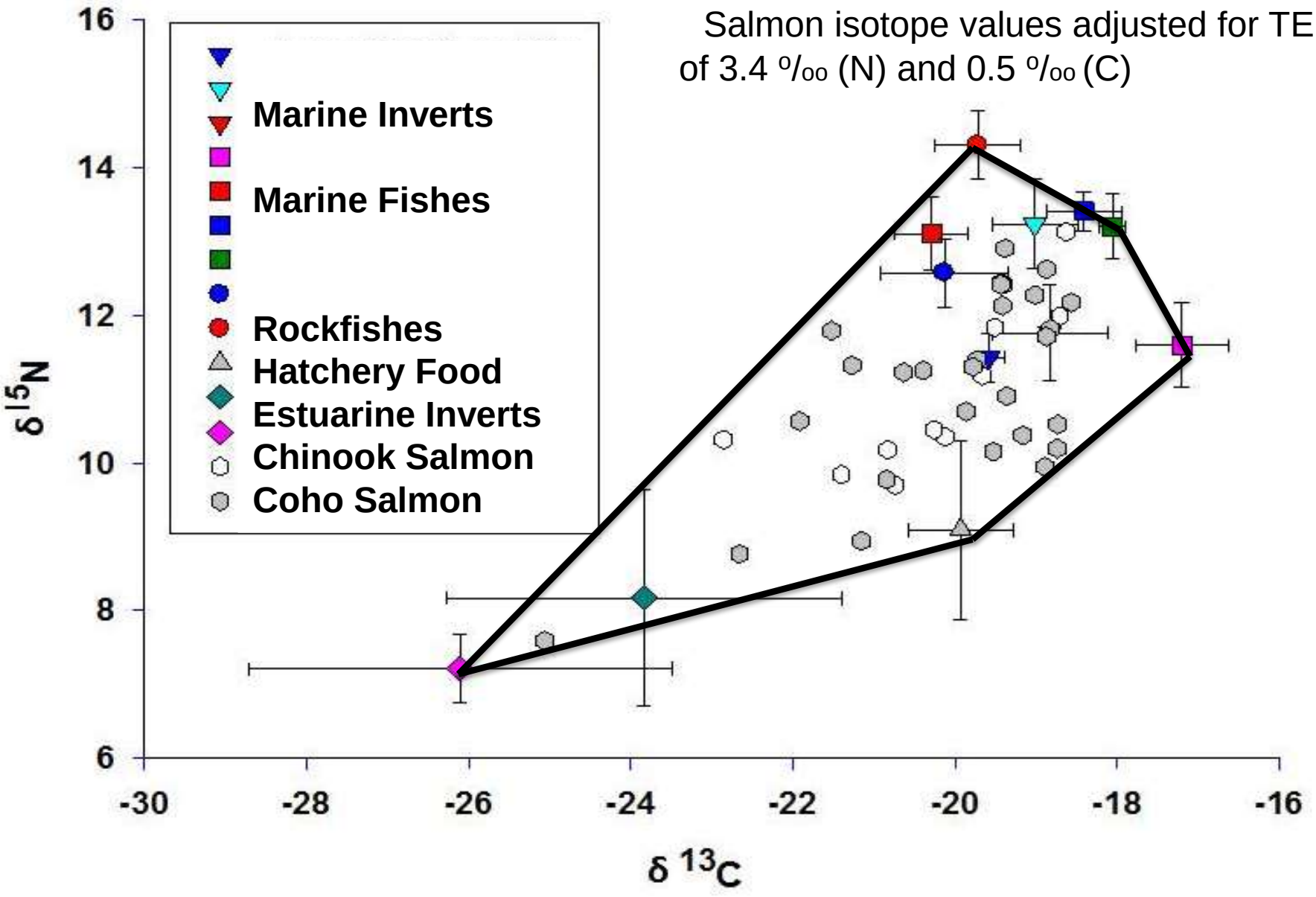
$$\delta^{13}C_{consumer} = f_1\delta^{13}C_a + f_2\delta^{13}C_b + f_3\delta^{13}C_c$$

$$\delta^{15}N_{consumer} = f_1\delta^{15}N_a + f_2\delta^{15}N_b + f_3\delta^{15}N_c$$

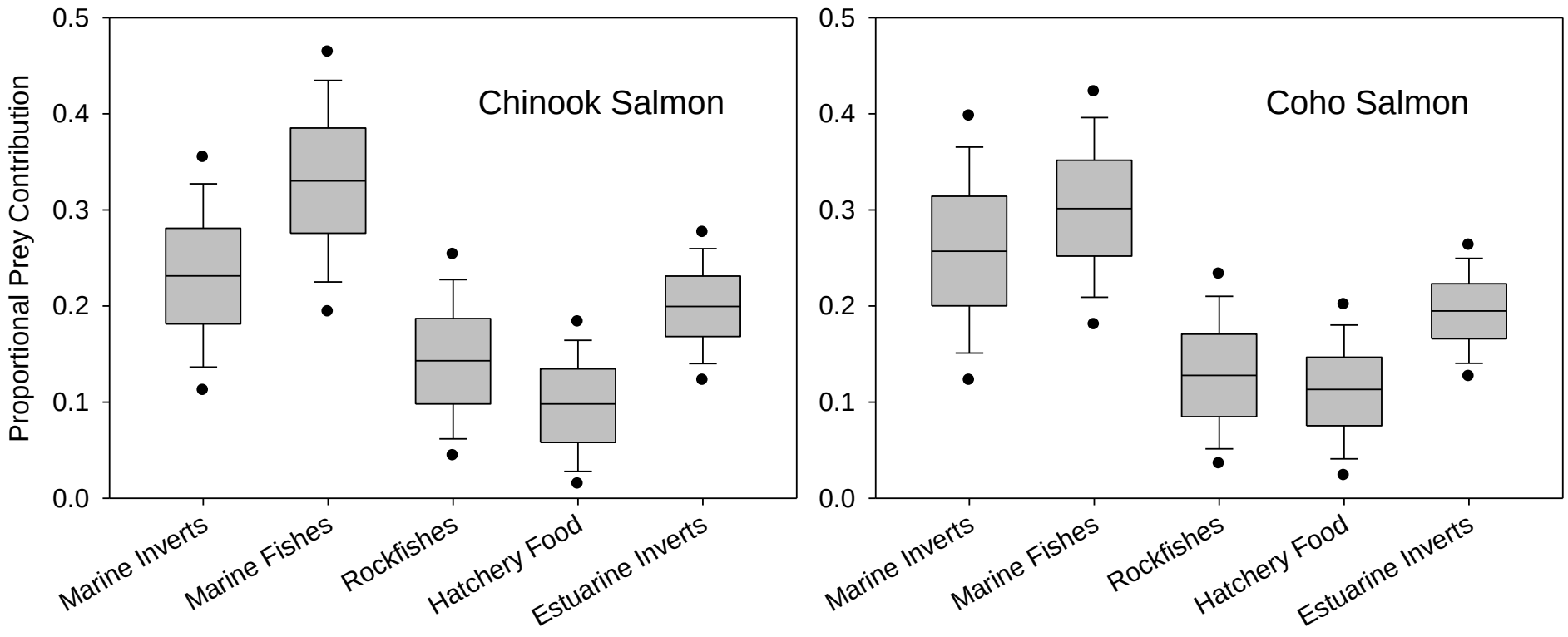
$$f_1 + f_2 + f_3 = 1$$

➡ **Bayesian Mixing Model (Stable Isotope Analysis in R (SIAR))**

What Data Do We Need To Use Mixing Models?



Marine Prey Constitute The Largest Proportional Prey Contribution to Both Chinook and Coho Diets



Based on 5 x 10^6 Iterations of Model for Each Species

Conclusions

- Chinook and coho juveniles have similar diet composition
- Stable isotopes indicate that salmon have recently consumed mostly marine prey although estuarine and hatchery contributions are still evident
- Stable isotopes can be used to estimate diet proportions, but we need to take into account stable isotope turnover rates (34 days in juvenile salmon)

Future Studies

- Sample stable isotopes along gradient in salmon from hatchery to coastal ocean, along with potential prey from each habitat
- Examine tissues (liver or blood) with faster turnover rates than muscle tissue
- Compare hatchery vs. wild or fish from different stocks
- Look at other isotopes (^{34}S) and use in a mixing model

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Bayes' Rule

$$P(A \mid B) = \frac{P(B \mid A)P(A)}{P(B)}$$

$P(A \mid B)$ = the posterior, is the degree of belief in A

$P(A)$ = the prior, is the initial degree of belief in A

$\frac{P(B \mid A)}{P(B)}$ = the quotient, represents the support B provides for A

Bayesian Approach to Mixing Models