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Ecosystem Monitoring Program: Abiotic Conditions & Stable Isotope Analysis 2010—2014

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Background

- **Loss of emergent wetland habitat, greening of the river**
  - **Shift in organic matter loadings**
  - **Effects on juv. salmon food webs not understood**
  - **Conditions of existing habitats?**

- **1 site (2010); 4 “fixed” sites (2011-14)**

Overview of 2010-14 USGS Work

- **Abiotic conditions:**
  - **Characterize habitat conditions** and determine the **extent & duration of stressful conditions** for juvenile salmon
- **Food web utilization (SI analysis):**
  - Determine the **relative contributions of instream and wetland primary producers to the food web** supporting juvenile salmonids in the Lower Columbia River & Estuary

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Habitat Conditions

- Water-quality monitors:
  - Temperature
  - pH
  - Dissolved oxygen
  - Specific conductance
  - 15/30 minute logging
  - April – July (2011 – 2014)

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Habitat Conditions: Water Quality

- Sites had best water-quality conditions April-May
- All sites: unsuitable conditions by ~July most years
  - High temperature, low dissolved oxygen
  - 2013-14 warmer, lower DO than 2011-12
- Sites differed in frequency & duration of unsuitable conditions
- Primary drivers:
  - Columbia River flows
  - Tidal influence, distance to mainstem → flushing rate

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Food Web Analysis

- **Goal: determine the important food web components supporting juvenile salmon**

- **Study question: What are the dominant organic matter sources supporting juvenile Chinook salmon food webs in the LCRE?**
  - **Changes in dominant sources by time, site?**




Approach: Stable Isotopes

- Natural abundance stable isotopes of C, N as food web tracers
- δ values: ratio of heavy to light isotope, vs. a standard
- **δ values of consumers' tissues reflect food sources**
- Metabolic loss of light isotopes → consumers in higher trophic levels become enriched in heavy isotope ("trophic enrichment")
- Trophic enrichment factors (Post, 2002)
  - 0.4 ±1.3 ‰ ($\delta^{13}C$)
  - 3.4 ±1.3 ‰ ($\delta^{15}N$)

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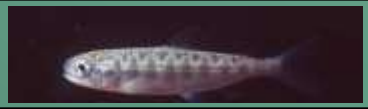
Sampling Design

4 wetland sites in LCRE, April-July

Juvenile Chinook salmon tissues



Invertebrates
Hatchery food

Phytoplankton, periphyton
Marsh vegetation
Submerged aquatic vegetation

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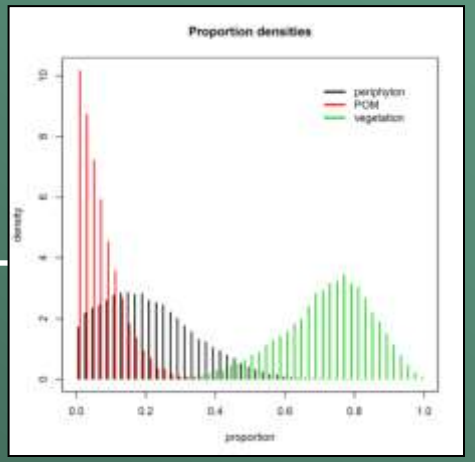
SIAR Mixing Model

- SIAR mixing model (Parnell & others, 2010)
- Estimates proportions of food sources in a consumer's diet
  - Allows for many food sources
  - Incorporates variability in SI signatures of food sources
  - Output: density of estimated dietary proportions
- Model runs:
  - Chinook salmon as consumers
  - Invertebrates as consumers



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Preliminary Results: Salmon Diets (2010-12)

- Hatchery food largest dietary source for marked juvenile Chinook
- Chironomids contribute increasingly to unmarked Chinook diets with later months of fish catch
- Hatchery/maternal influence on SI of Chinook muscle
  - Muscle: long-term integrator
  - Mucus, liver: more recent diet sources
  - Muscle, liver, mucus (2013-14)

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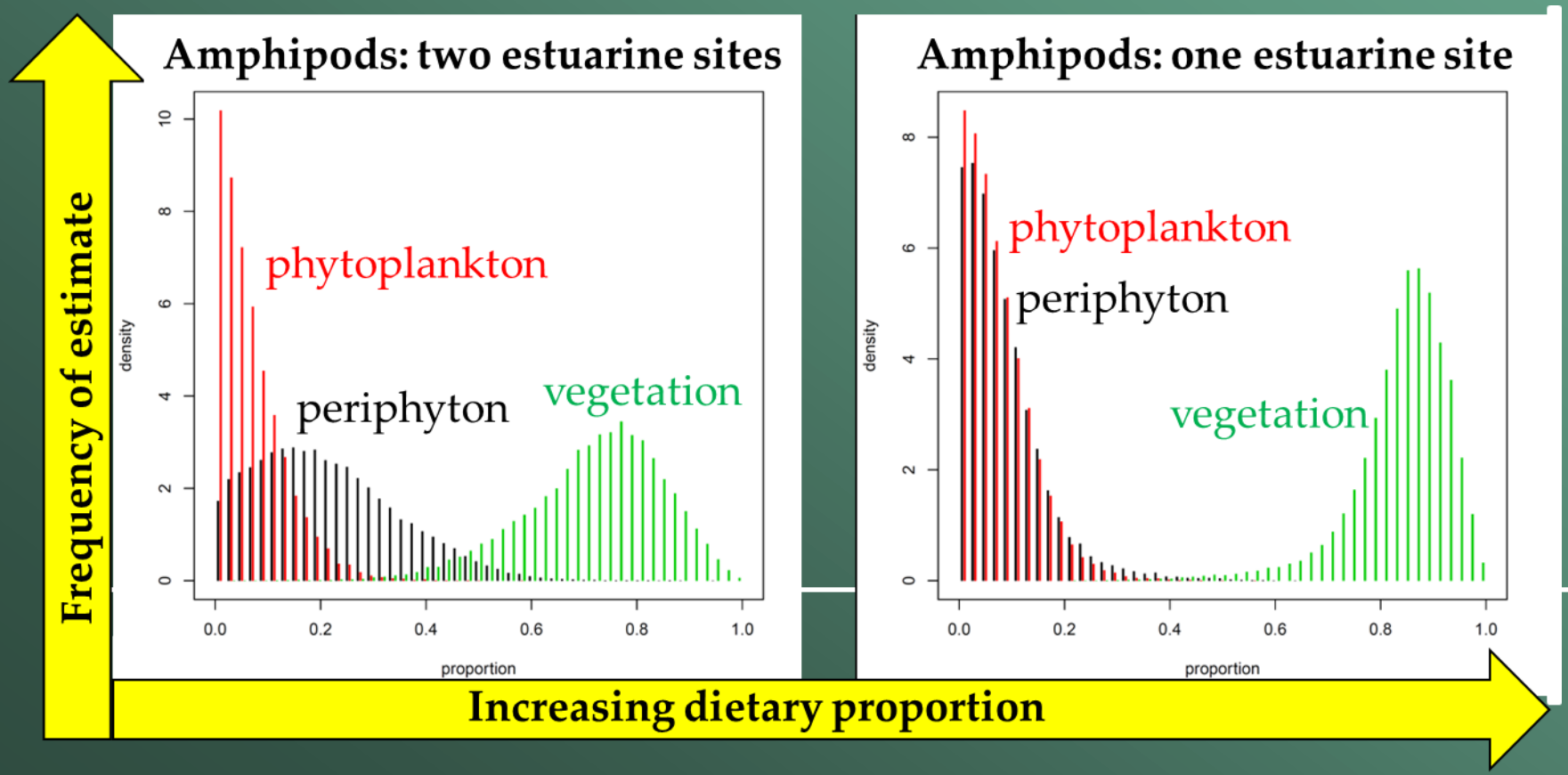
Preliminary Results: Invertebrate Diets (2010-12)

- Chironomids: Phytoplankton largest food source overall during season, esp. early season (May)
- Amphipods: Vegetation; phytoplankton not likely



Stable Isotopes: Current Status

- 2013-14 samples address spatial & temporal data gaps identified in preliminary analysis
- Summary of 2013-14 samples:

Material	Number of samples (including replicates)
Chinook muscle, liver, mucus	74, 102, 77
POM / phytoplankton	68
Invertebrates	97
Periphyton	16
Vegetation	150

- Data expected from lab ~end of 2014

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Summary of Preliminary Findings

- **Phytoplankton and vegetation both contribute to selected prey organisms' diets**
  - **Different locations, timing**
  - **Preliminary findings consistent with similar study in Columbia R. estuary and primary production patterns**
- **Importance of spring freshet magnitude & duration**
  - **affects wetland vegetation cover and phytoplankton productivity/species composition → food resources**
  - **water-quality conditions**

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Next Steps

- Incorporate 2013-14 data, journal article
- Put into context of other EMP work
  - Invertebrate prey production from different vegetation types
  - Wetland macrodetritus export calculations

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