Diets and Food Availability of Nonnative Trout in Bright Angel Creek, Grand Canyon: Implications for Native Fish Conservation

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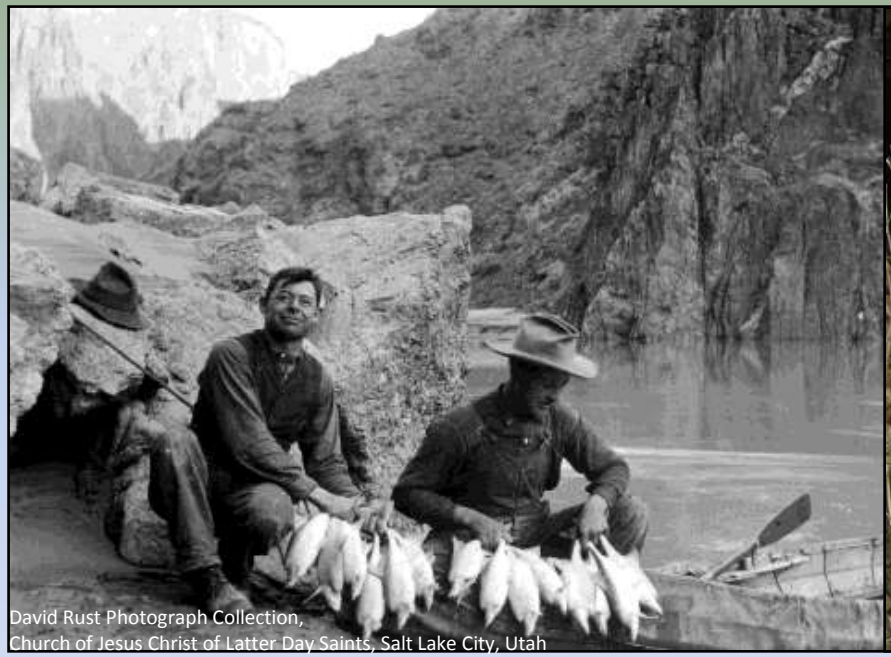
[1]University of Missouri, MO Cooperative Fish/Wildlife Research Unit
[2]Grand Canyon National Park

Changes in the Grand Canyon



David Rust Photograph Collection,
Church of Jesus Christ of Latter Day Saints, Salt Lake City, Utah

Early 1900's
Native fish

2010
Nonnative fish

Fishes of Bright Angel Creek (BAC)

Native

Speckled dace

Bluehead sucker

Nonnative

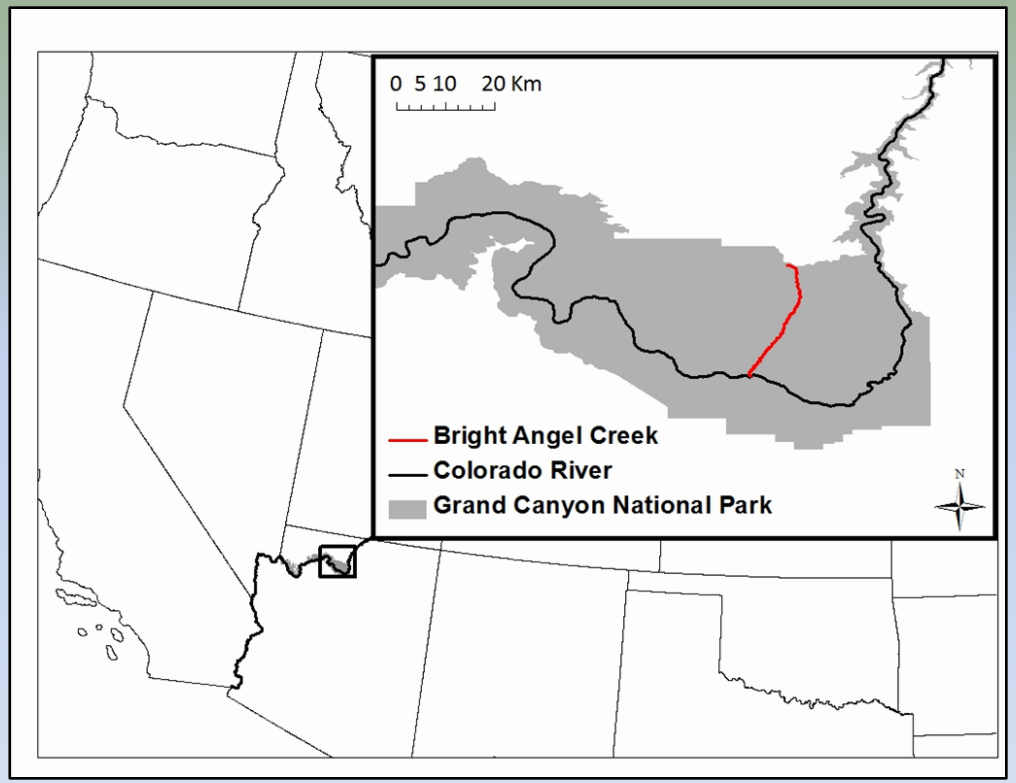
Brown trout

Rainbow trout

Native Fish Restoration

Bright Angel Creek Trout Reduction Project

Restore and enhance native fish populations in the Colorado River and Bright Angel Creek



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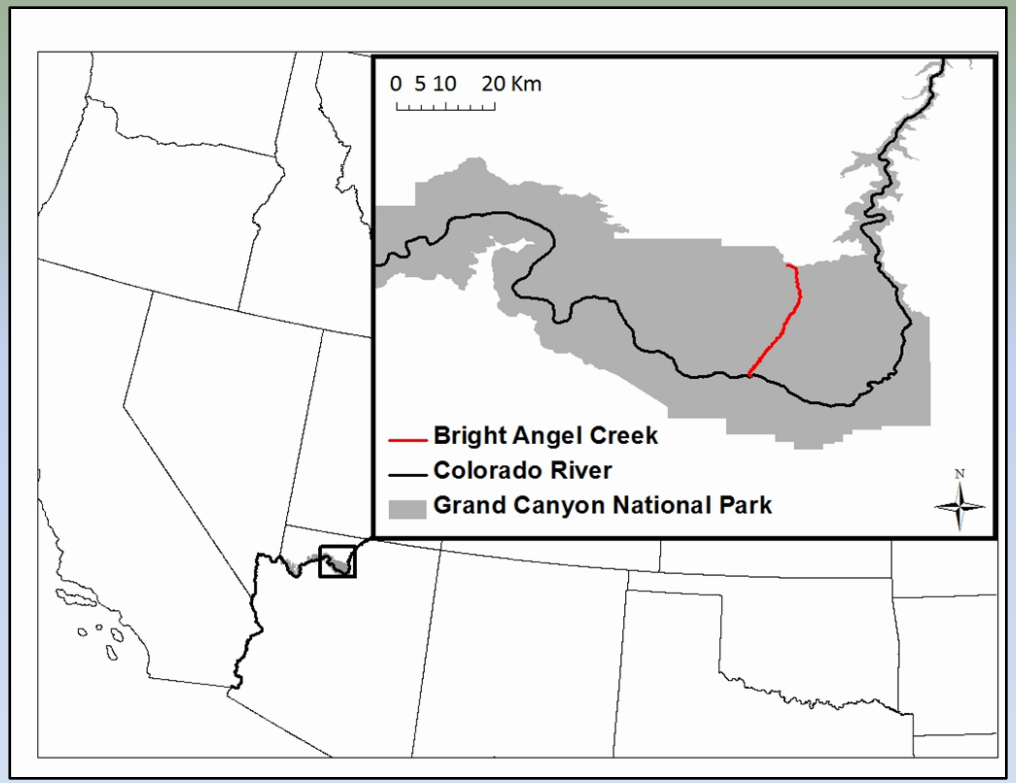


What role do nonnative trout play in Bright Angel Creek?

Questions

How much food is available to fishes in BAC?

What resources are nonnative trout consuming?

Are native and nonnative fishes consuming similar resources?

Objectives

How much food is available to fishes in BAC?

Quantify seasonal patterns of food availability

What resources are nonnative trout consuming?

Characterize seasonal diets of brown and rainbow trout

Are native and nonnative fishes consuming similar resources?

Examine potential diet overlap between native and nonnative fishes

Methods

Sampling periods

November 2010
January 2011
June 2011
September 2011

Objective 1: Food availability

2 stream reaches (100 m)

Drift: 4 nets, 4 times / 24h

Benthic: 6 Hess samples

Identified ➡ Measured ➡ Biomass

Methods

Objective 2: Diet analysis

Backpack electrofishing

Brown trout (n=97)(68-490 mm)

Rainbow trout (n=130)(79-375 mm)

Identified ➡ Weighed ➡ Biomass

Objective 3: Diet overlap

$\delta\ ^{13}C$ and $\delta\ ^{15}N$ stable isotopes

Fin clips (all fish)

Invertebrates

Basal resources

Methods

Diet analysis

Short term diet trends

Piscivory rates

Identify actual items

Stable isotope analysis

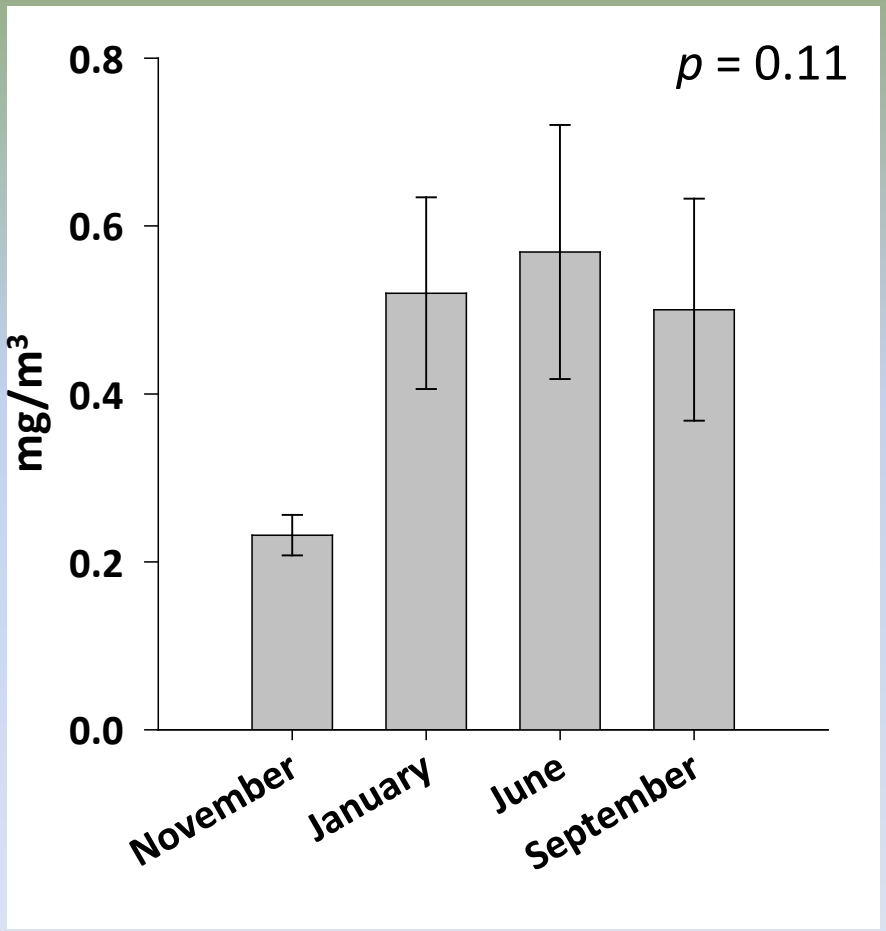
Long term diet trends

Food source ($\delta\ ^{13}C$)

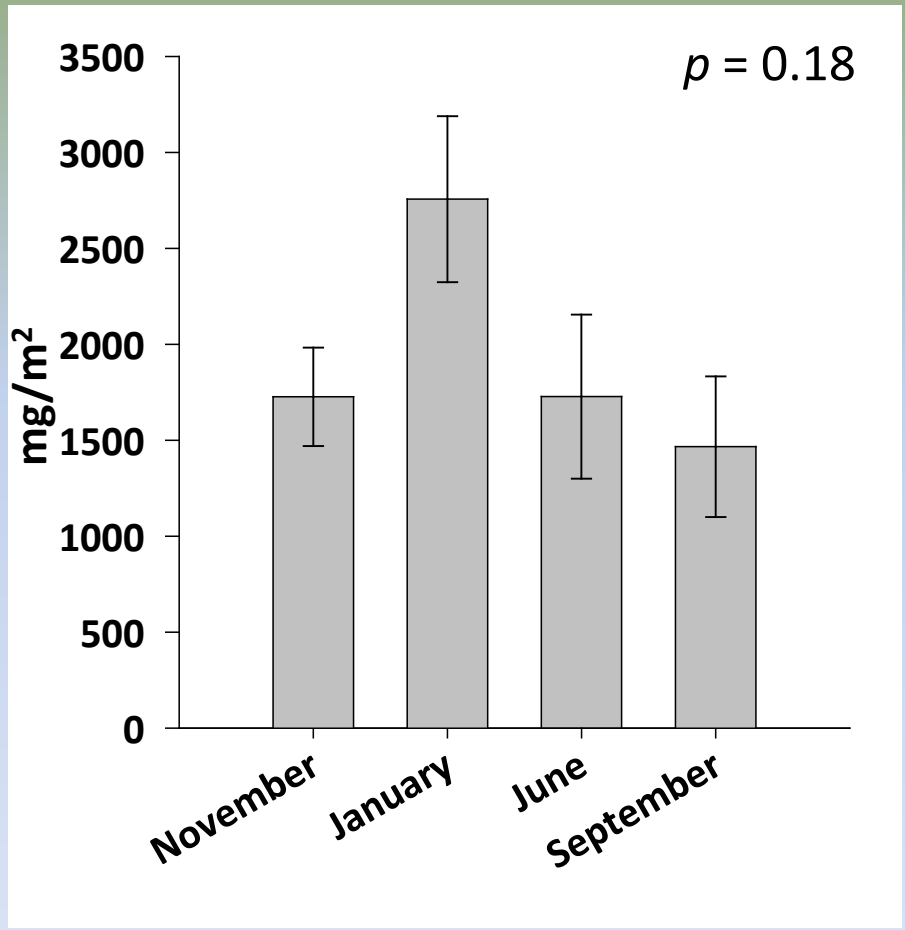
Trophic position ($\delta\ ^{15}N$)

Objective 1: Seasonal food availability

Total invertebrate drift biomass



Total invertebrate benthic biomass



Objective 1: Seasonal food availability

Source	Benthic (mg/m^2)	Drift (mg/m^3)	Taxa Richness
This study	1919	0.45	60
Bright Angel (1993)	900[a]	-	-
Colorado River	204[b]	0.16[c]	16

[a] Oberlin et al. 1999
[b] Cross et al. 2011
[c] Cross et al. in revision Ecological Monographs

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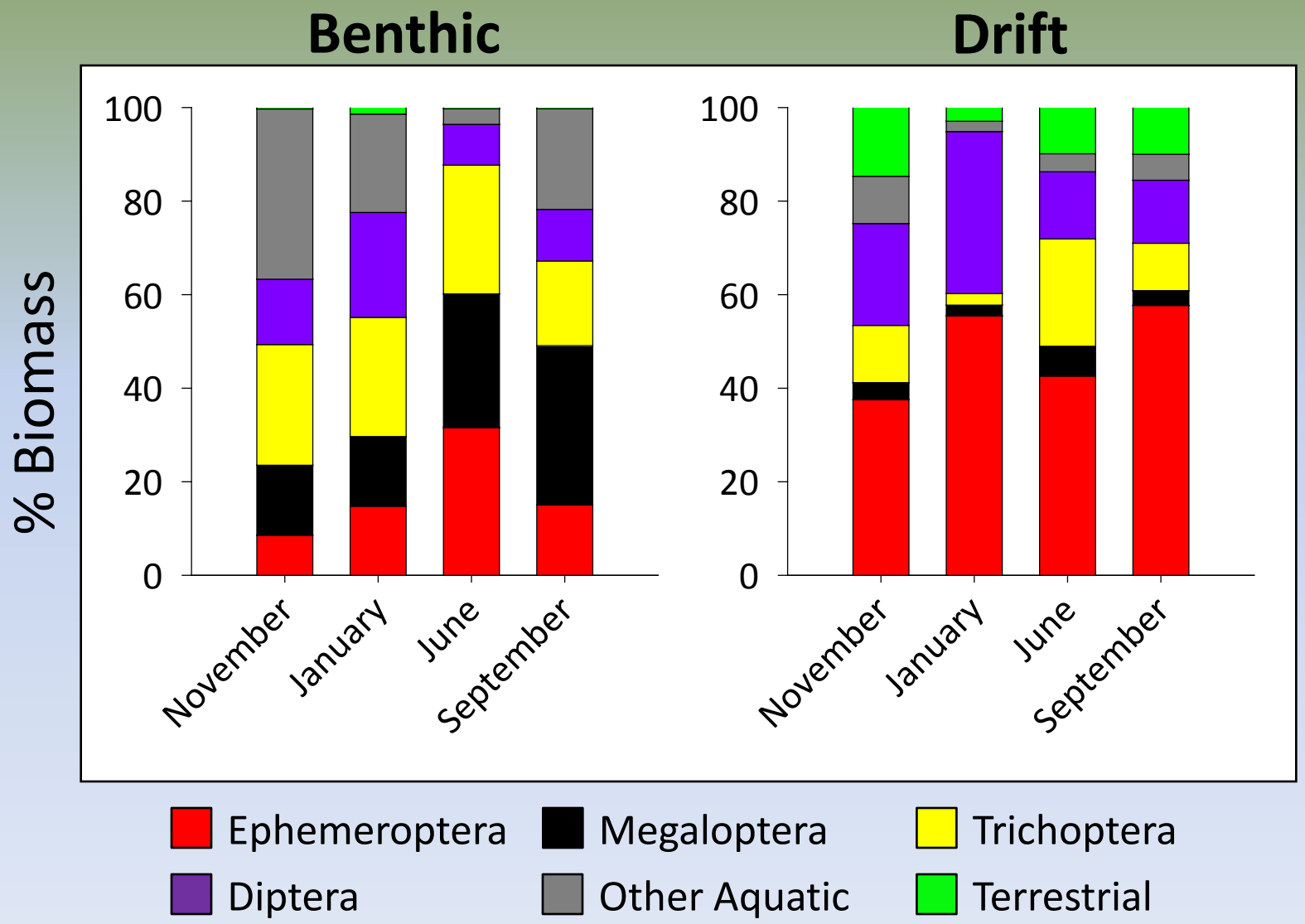
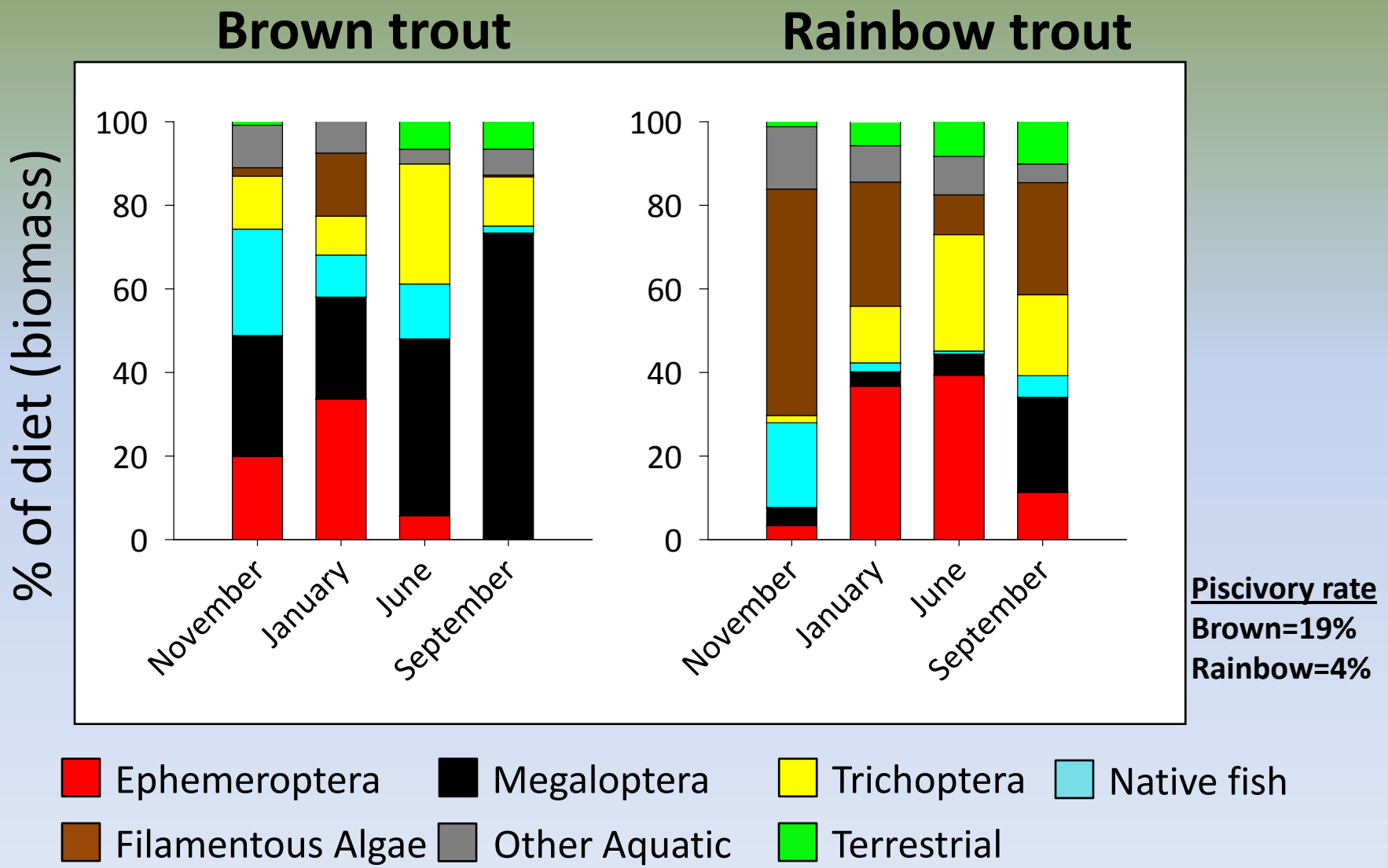
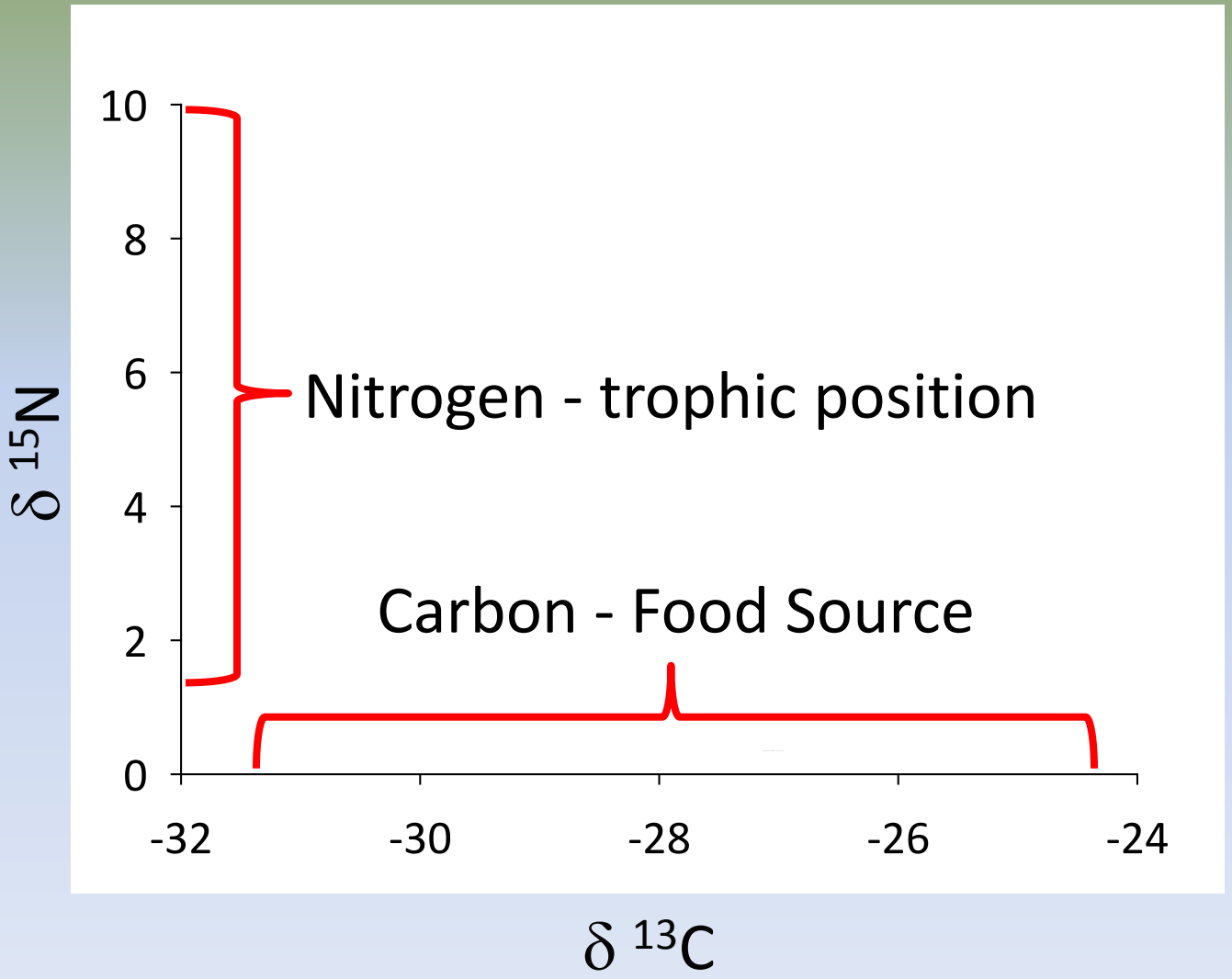


Objective 2: Nonnative trout diets



Objective 3: Native/nonnative diet overlap



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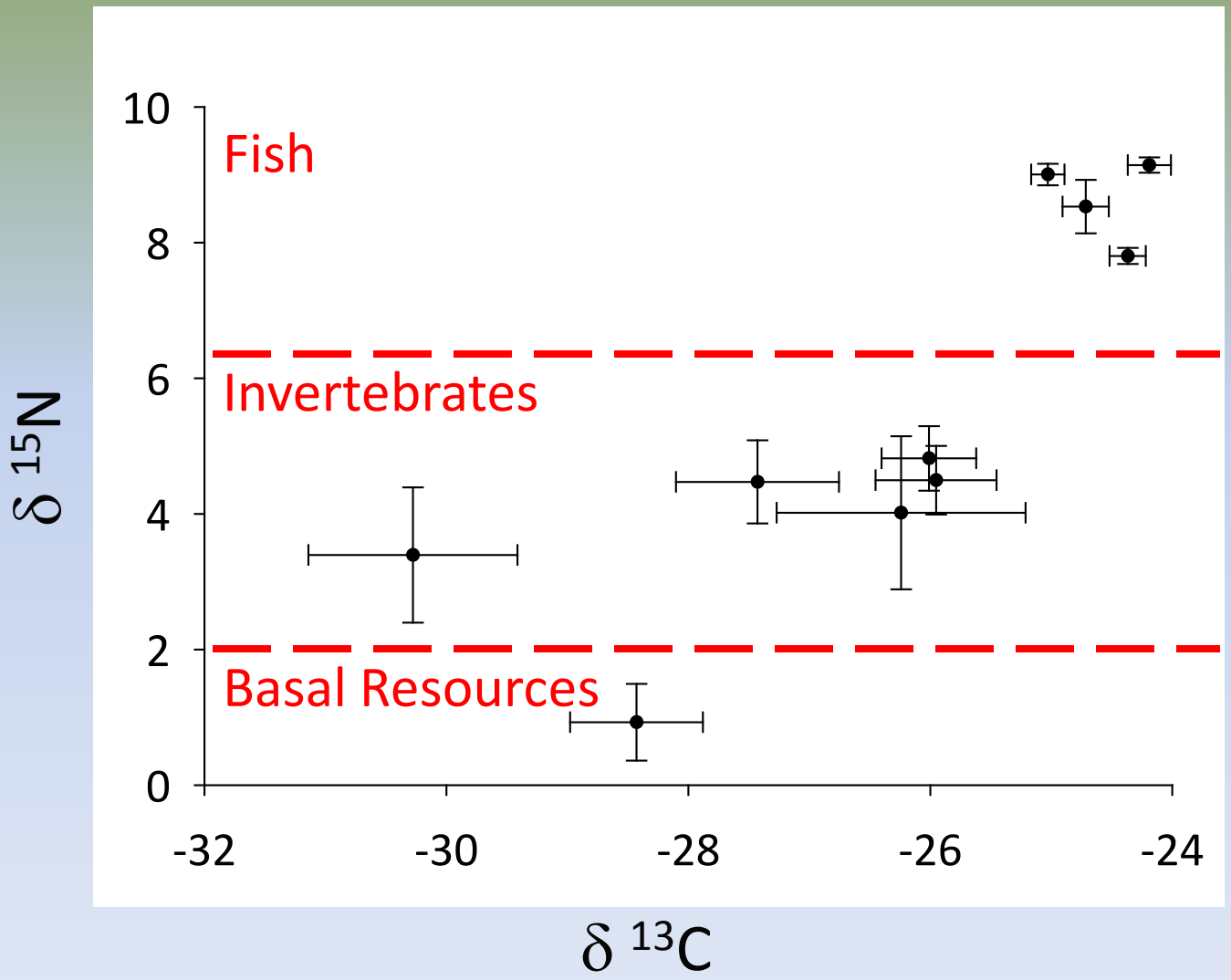

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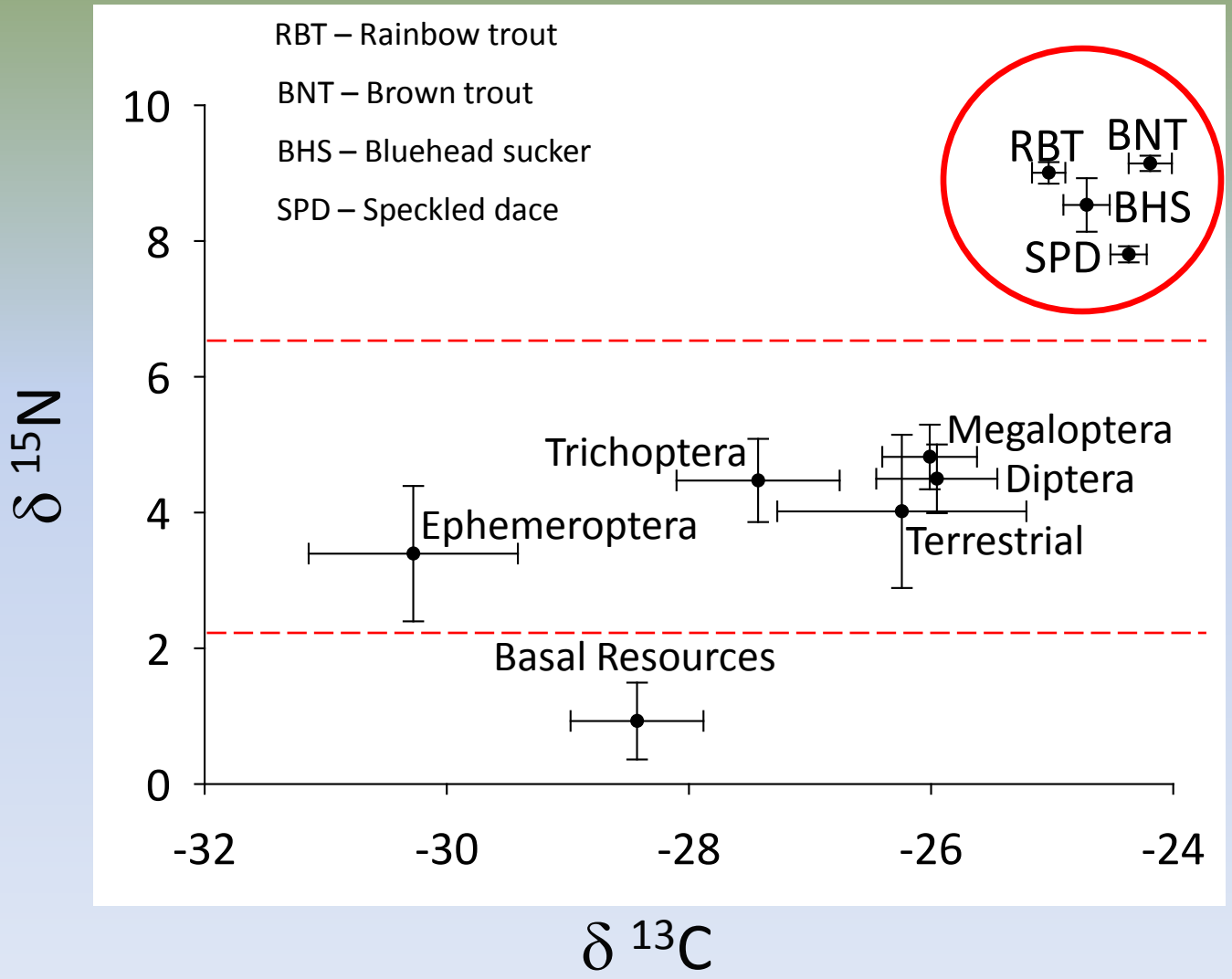

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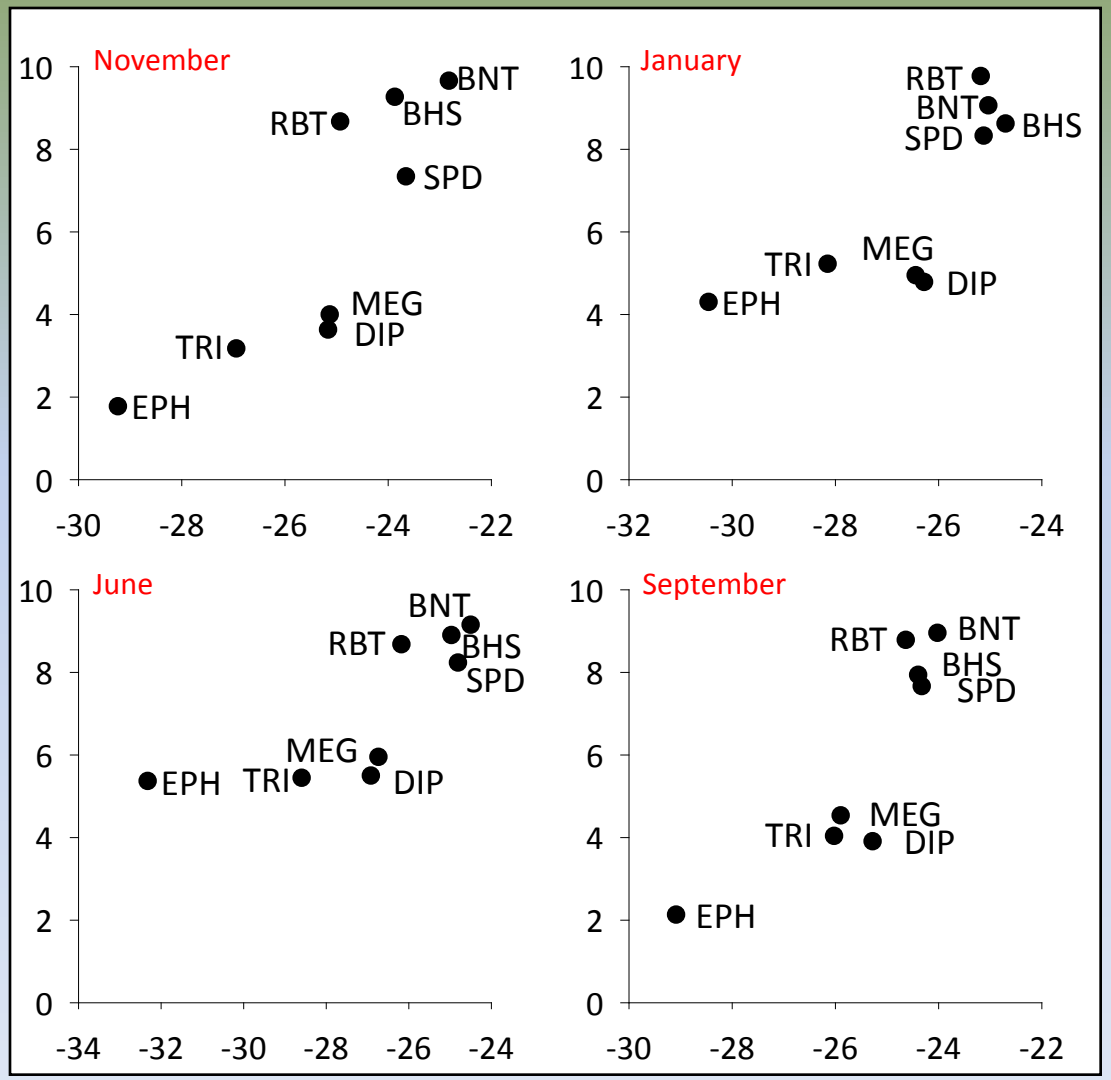


RBT – Rainbow trout

BNT – Brown trout

BHS – Bluehead sucker

SPD – Speckled Dace

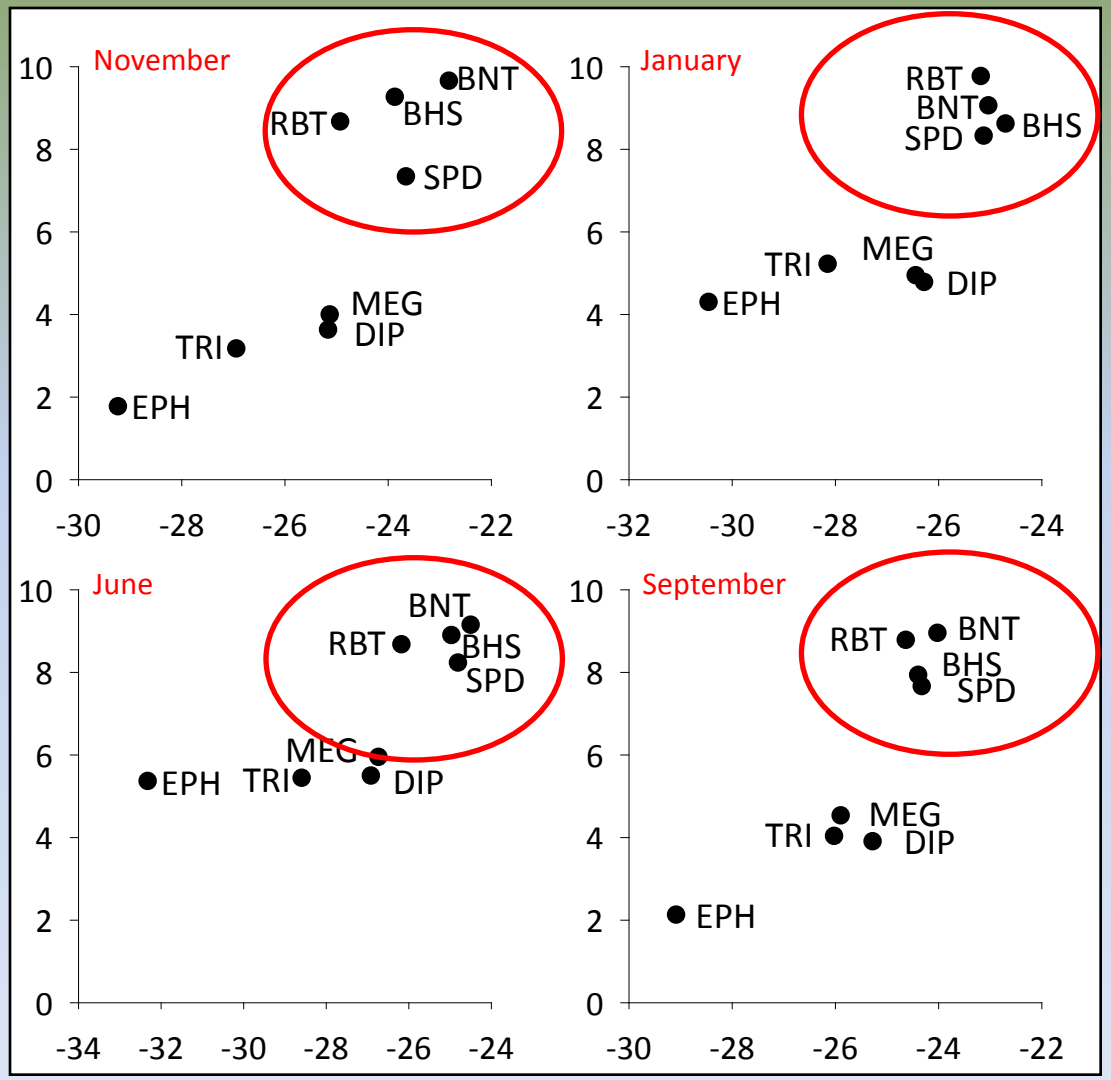
EPH – Ephemeroptera

MEG – Megaloptera

TRI – Trichoptera

DIP – Diptera

Objective 3: Native/nonnative diet overlap



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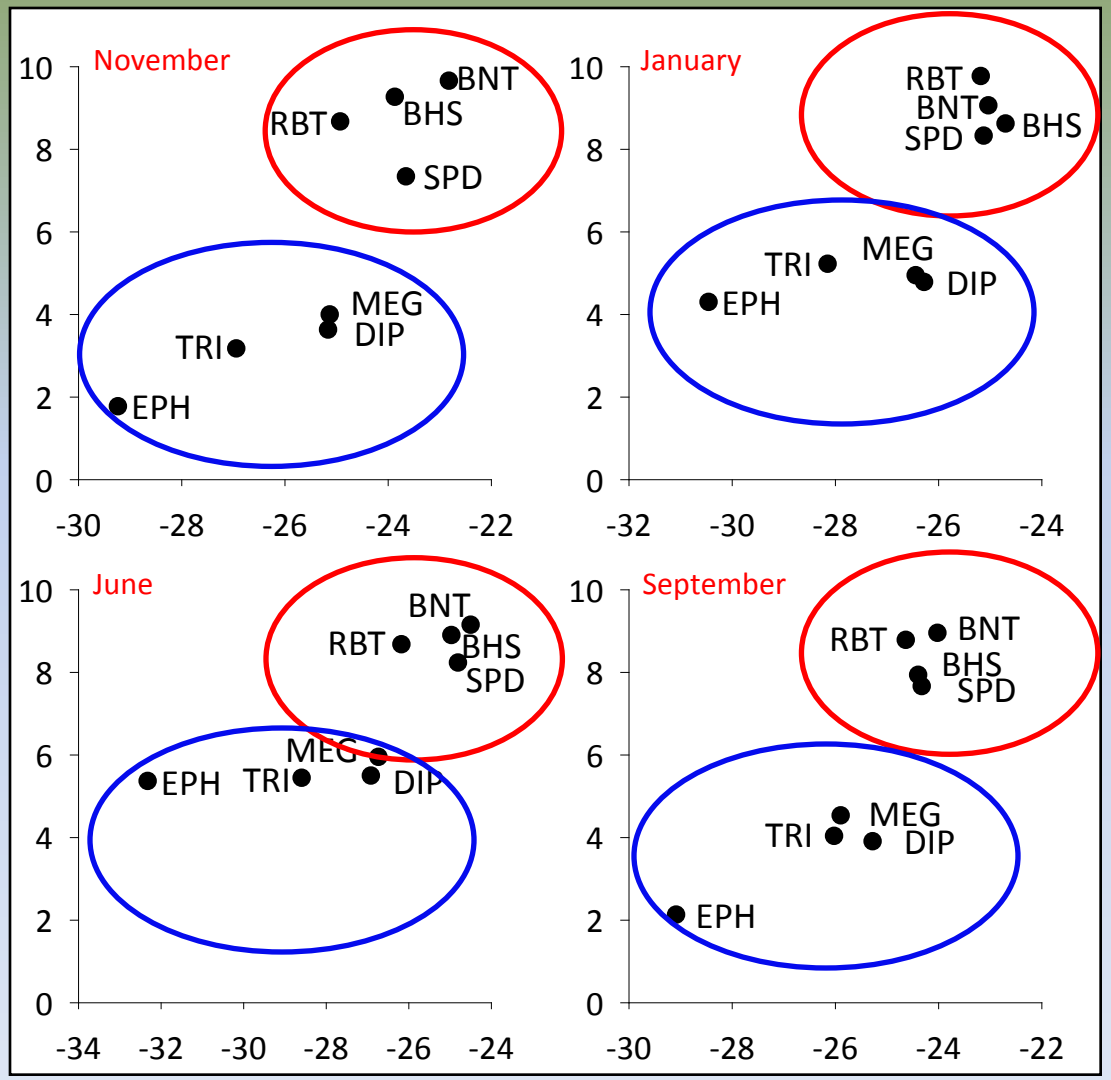

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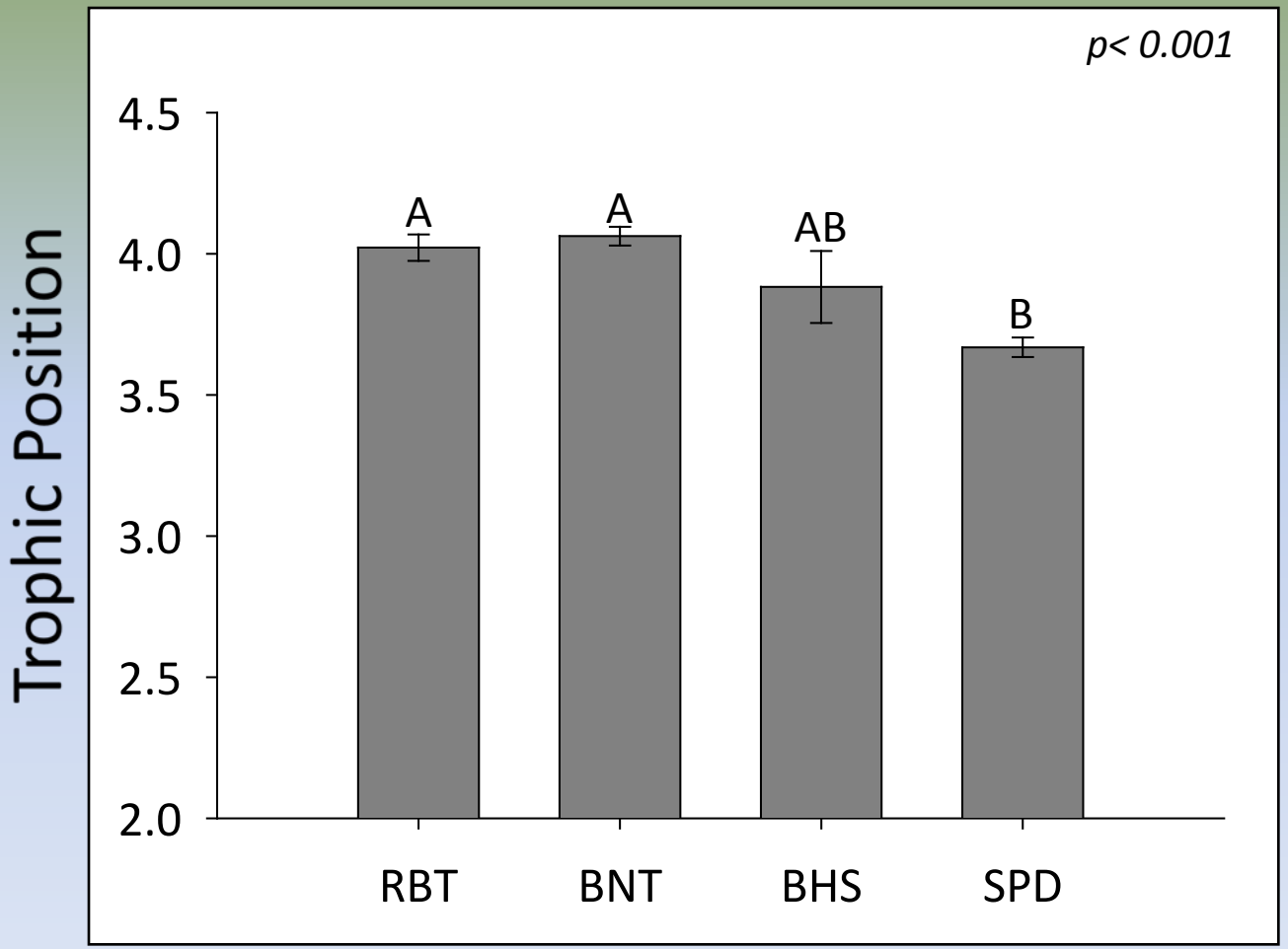
Native and nonnative fish trophic positions



Trophic Position = $[(\delta\ ^{15}N_{Fish} - \delta\ ^{15}N_{\textit{Petrophila}}) / 3.4] + 2$

Summary

Objective 1 – Seasonal food availability

- Benthic and Drifting biomass varied seasonally
  - Megaloptera (hellgrammites) highest in benthos
  - Ephemeroptera (mayflies) & terrestrial insects highest in drift

Objective 2 – Nonnative trout diets

- Diets shifted with season and differed between species
- Brown trout – fish and large insects
- Rainbow trout - filamentous algae and small insects

Objective 3 – Native and nonnative diet overlap

- Similar trophic positions and food sources

Implications to native fish

Resource utilization

- Diverse food base and high drift biomass
- Rainbow trout diets likely overlap more with natives
  - (algae and small bodied insects)
- Niche partitioning?
  - Speckled dace benthic vs. rainbow trout drift

Predation

- Both brown and rainbow trout consume native fishes
  - Brown trout predation higher and more likely to affect natives

Future Research

Effects of trout removal on ecosystem structure/function

How will the food base and native fish populations change?

Importance of tributaries to native fish in Colorado River

Do drift inputs affect native fish assemblages?

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NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION


Questions?

What resources are non-native trout consuming?

Food type	BNT	RBT
Fish	23	6
Aquatic insects	146	100
Terrestrial insects	10	9
Organic matter	8	35
Total consumption (g dry mass yr^{-1})	**187**	**150**

*Individual based model (1 yr)
*No growth assumed from estimates

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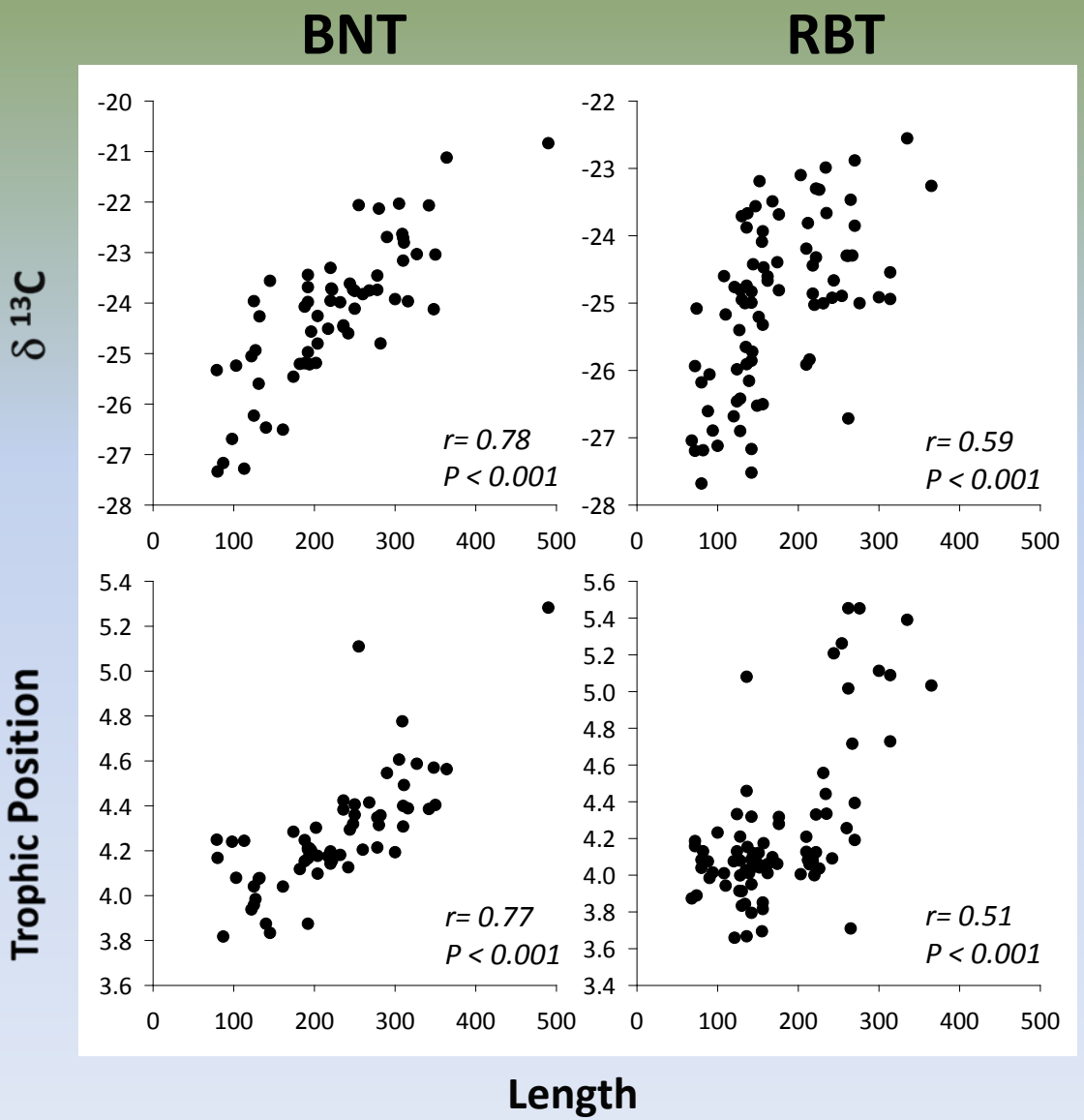
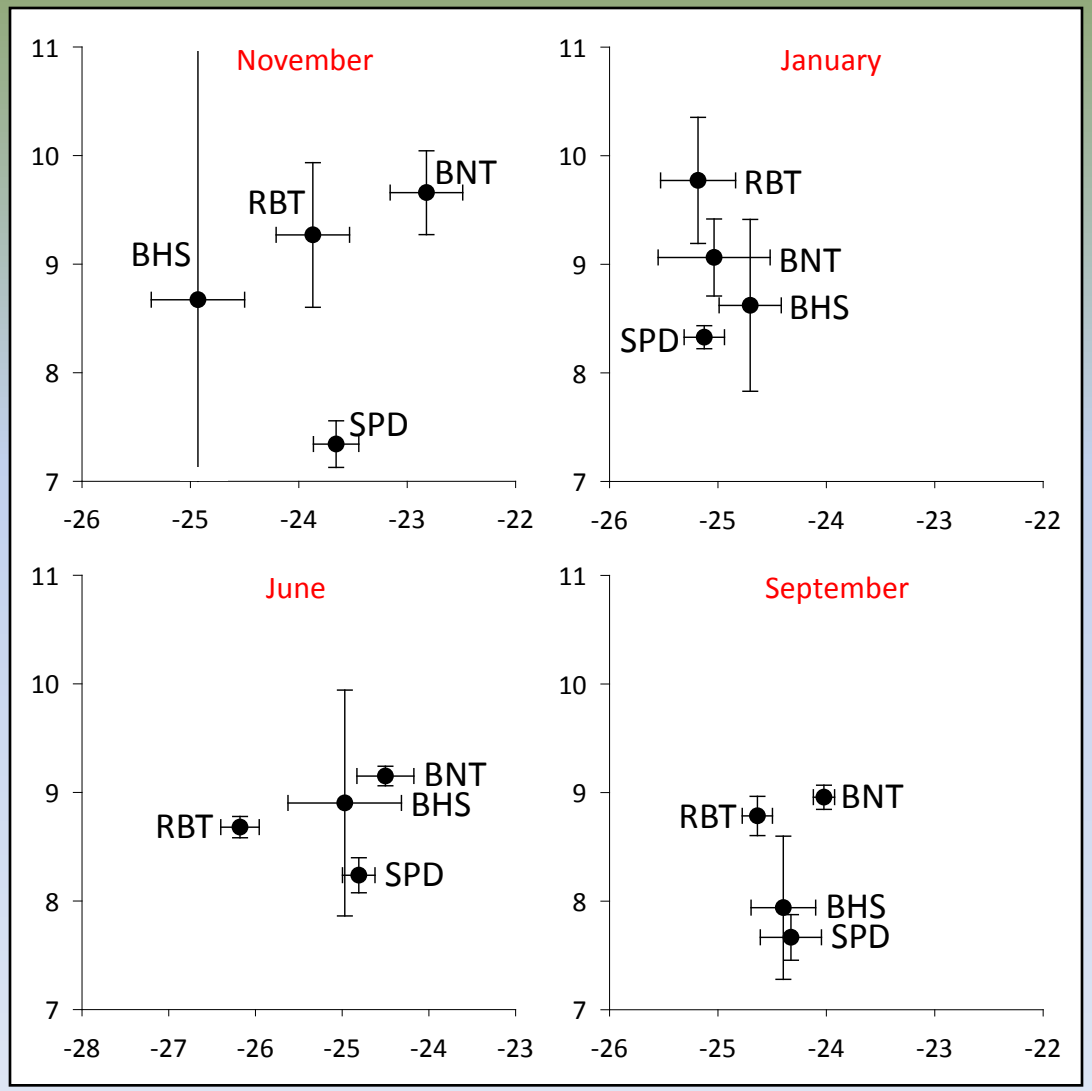
Food type	BNT	RBT
Fish	23	6
Aquatic insects	146	100
Terrestrial insects	10	9
Organic matter	8	35
Total consumption	**187 g/yr**	**150 g/yr**
# fish removed	**292**	**541**
Potential resources "not consumed"	**54,604 g/yr**	**81,691 g/yr**

Isotopes vs. Length



Are native and non-native fishes consuming similar resources?



BAC Population Estimates

	October 2010		January 2011	
Species	No. /100m	95% CI	No. /100m	95% CI
BNT	28	23-45	25	20-41
RBT	27	21-46	17	14-30
BHS	-	-	-	-
SPD	411	305-598	639	211-2947

Omana Smith, E. C., B. D. Healy, W. C. Leibfried, and D. P. Whiting. 2012. Bright Angel Creek trout reduction project: Winter 2010-2011 report. Natural Resource Technical Report NPS/GRCA/NRTR—2012/001. National Park Service, Fort Collins, Colorado.