Balancing Seasonal Food Web Interactions to Manage Kokanee Production in a Mixed Fishery

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Confederated Tribes of the Colville Reservation Fish and Wildlife
No outlet!

Buffalo Lake Watershed
Max Depth:
• 35m

Length:
• 2 miles

Surface Area:
• 224 ha
2014 WSU began working with Colville Tribe to assess Buffalo Lake’s fishery and water quality, and determine threats to both
Food Web Analysis

Our goal was to apply stomach content analysis (SCA) as a measure of resource usage, predator/prey interactions, and seasonal diet overlap for all fish in Buffalo Lake further guiding fishery management decisions.
Methods- Fish Collection

- Quarterly 2014, 2015, 2016, & 2017
  - Gillnets/Trawl
    - Kokanee and Rainbow Trout
  - Electrofishing
    - Warmwater Fish
    - Salmonids in colder months

- 10–15 fish selected, predetermined size classes
Methods:
Stomach Content Analysis (SCA)

• Stomachs were extracted or contents obtained with gastric lavage and preserved in 70% alcohol for laboratory analysis.

• Prey species present were identified to order and wet weight biomass estimated using length-weight regressions of measured prey items found (Benke et al. 1999, Dumont et al. 1975)

• Percent by weight was calculated for each prey item present to determine proportional diet composition of all fish species. Fish with empty stomachs were omitted from analysis
Data Analysis-

• Schoener’s Diet Overlap Index (SDOI) to determine biologically significant overlap between:
  • Kokanee/Rainbow Trout
  • Kokanee/Black Crappie
  • A value greater than 60 indicates significant biological overlap (Schoener 1970, Wallace 1981)

• Seasonal variation in Cladocera consumption:
  • Rainbow Trout & kokanee
  • Difference between seasons & years tested using glm
2014–2017 Rainbow Trout SCA: % weight

### < 400 mm

- **Spring (n=41):**
  - PKS: 0%
  - Cladocera: 0%
  - Chironomidae: 100%
  - Decapoda: 0%
  - Other: 0%
  - Misc Littoral Invertebrates: 0%

- **Summer (n=33):**
  - PKS: 0%
  - Cladocera: 25%
  - Chironomidae: 50%
  - Decapoda: 0%
  - Other: 0%
  - Misc Littoral Invertebrates: 25%

- **Fall (n=27):**
  - PKS: 0%
  - Cladocera: 0%
  - Chironomidae: 75%
  - Decapoda: 0%
  - Other: 0%
  - Misc Littoral Invertebrates: 25%

- **Winter (n=33):**
  - PKS: 25%
  - Cladocera: 0%
  - Chironomidae: 75%
  - Decapoda: 0%
  - Other: 0%
  - Misc Littoral Invertebrates: 50%

### > 400 mm

- **Spring (n=35):**
  - PKS: 0%
  - Cladocera: 0%
  - Chironomidae: 100%
  - Decapoda: 0%
  - Other: 0%
  - Misc Littoral Invertebrates: 0%

- **Summer (n=31):**
  - PKS: 0%
  - Cladocera: 25%
  - Chironomidae: 50%
  - Decapoda: 0%
  - Other: 0%
  - Misc Littoral Invertebrates: 25%

- **Fall (n=10):**
  - PKS: 0%
  - Cladocera: 0%
  - Chironomidae: 75%
  - Decapoda: 0%
  - Other: 0%
  - Misc Littoral Invertebrates: 25%

- **Winter (n=17):**
  - PKS: 25%
  - Cladocera: 0%
  - Chironomidae: 75%
  - Decapoda: 0%
  - Other: 0%
  - Misc Littoral Invertebrates: 50%
2014–2017 Largemouth Bass SCA: % weight

100–199 mm

Spring (n=10)  
Summer (n=32)  
Fall (n=17)  
Winter (n=2)

200–299 mm

Spring (n=23)  
Summer (n=29)  
Fall (n=18)  
Winter (n=2)
2014–2017 Largemouth Bass SCA: % weight

100–199 mm

Spring (n=10)
Summer (n=32)
Fall (n=17)
Winter (n=2)

200–299 mm

Spring (n=23)
Summer (n=29)
Fall (n=18)
Winter (n=2)
2014–2017 Largemouth Bass SCA: % weight

300–399 mm

- Spring (n=23)
- Summer (n=24)
- Fall (n=17)
- Winter (n=4)

- PKS
- LMB
- BLC
- Chironomidae
- Decapoda
- Other
- Misc Littoral Invertebrates

> 399 mm

- Spring (n=13)
- Summer (n=13)
- Fall (n=17)
- Winter (n=6)

- PKS
- LMB
- RBT
- KOK
- Decapoda
- Misc Littoral Invertebrates
2014–2017 Pumpkinseed Sunfish SCA: % weight

Spring (n=22)
Summer (n=22)
Fall (n=18)

Cladocera  | Chironomidae  | Decapoda  | Other  | Misc Littoral Invertebrates
>100 mm

0% 25% 50% 75% 100%
2015 SDOI

Schoener’s Diet Overlap Index (%)

- **Kokanee/Rainbow Trout**
- **Kokanee/Black Crappie**

- **February**: No Black Crappie
- **May**
- **July**
- **October**

- **Kokanee/Rainbow Trout**: Circles
- **Kokanee/Black Crappie**: Triangles
2015 SDOI

Schoener’s Diet Overlap Index (%)

- Kokanee/Rainbow Trout
- Kokanee/Black Crappie

February: No Black Crappie
May: Kokanee/Rainbow Trout
July: Kokanee/Black Crappie
October: Kokanee/Rainbow Trout
Schoener's Diet Overlap Index (%)

- March 2016: Black Crappie n=1
- May 2016: Black Crappie n=1
- July 2016
- October 2016
- March 2017: No Black Crappie

- Kokanee/Rainbow Trout
- Kokanee/Black Crappie
Kokanee Cladocera consumption

Significant summer 2015 (p < 0.001)
Rainbow Trout Cladocera consumption
Significant, summer (P=0.035) & winter (P<0.001) 2015
Moving Forward: Bioenergetics

• Bioenergetics modeling for consumption of:
  • Zooplankton by Kokanee
  • Zooplankton by Rainbow Trout
  • Kokanee by bass

• Use Consumption to aid in determining competition
Quantify Predator-Prey Relationships

• Prey biomass
  • Crayfish & Zooplankton

• Zooplankton consumption
  • Determine surplus zooplankton
    • Simulate Rainbow trout stocking strategies

• Kokanee Predation
  • Connect Kokanee consumption with Largemouth Bass and Kokanee populations to determine predation threat
  • Harvest bass to limit predation
Thank you &
Questions

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Washington State University
World Class. Face to Face.
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