Decoding the Food web for Omak Lake, the Largest Saline lake in WA.



Alexander Reyes[1], Barry Moore[1], Timothy Taylor[1], Bryan Jones[2]

1 – Washington State University, Pullman, WA. 2 – Confederated Tribes of the Colville Reservation, Nespelem, WA.

Introduction

The Omak lake is located in Okanogan County, adjacent to the western part of the Colville Indian Reservation in North Central Washington.

The lake is a closed basin fed by drainage from the

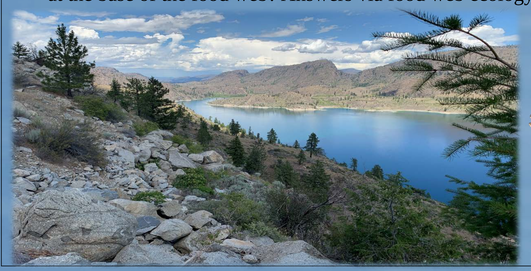
Surrounding hills and plateaus and inlet streams.

Hydrological tributaries include Kartar,

Beaver-house, Poison and, No Name Creeks.

Parameter	Length
Area	3,820 acres (15.46 Km^2)
Length/wide averaged	8/0.5 miles (12.87 / 0.80 Km) (Bennet 1962)
Volume ~	1.1 Km^3(38846.13 cubic feet)
Averaged depth ~	30 m (99 ft.)
Maximum depth ~	100 m (328 ft.) (Kucera 1985)
Limnetic Habitat ~	85 – 90% of area. (Kucera 1985)

- The lake surroundings comprise a semiarid terrain with granitic outcroppings and interspersed sagebrush with mixed grass species (Kucera 1985).
- The water chemistry depend on the carbonate system. Salinity levels come from sodium carbonate and bicarbonate (Horne and Goldman 1994). The pH of the lake is usually above 9.
- Lahontan cutthroat trout LCT (Oncorhynchus clarkii henshawi) were introduced in 1968 from a strain coming from Pyramid Lake, NV.
- Research questions: how many trophic levels are bellow Lahontan? Who eats whom? or who is at the base of the food web? Answers via food web ecology study.





Materials and Methods

1. *Fish collection and stomach content analysis:*

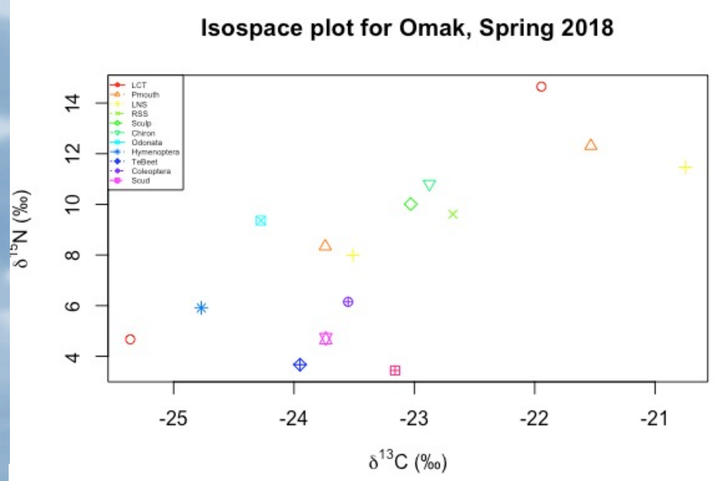
- Tribal members collected LCT in littoral areas of Omak Lake using 60 Hz pulsed-DC electrofishing equipment. Collections occurred on May, August and October in 2019-2021).
- Otoliths were extracted for aging and stomachs were removed for stomach content analysis (SCA).
- SCA identified prey species found in the stomachs of undigested items. The items were counted and identified to order. About 25 individuals from each order were measured to the nearest millimeter.
- The lengths were used to estimate wet weights from length/weight reg-equations obtained from the literature.
- The weight-% contribution for each prey type was estimated. That allowed for quantification of relative diet contributions (Hyslop 1980; Chipps and Garvey 2007).

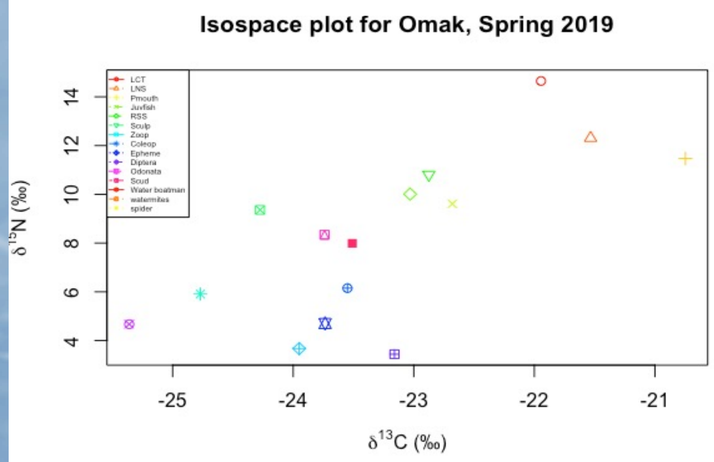
2. *Stable Isotope Analysis* (SIA)

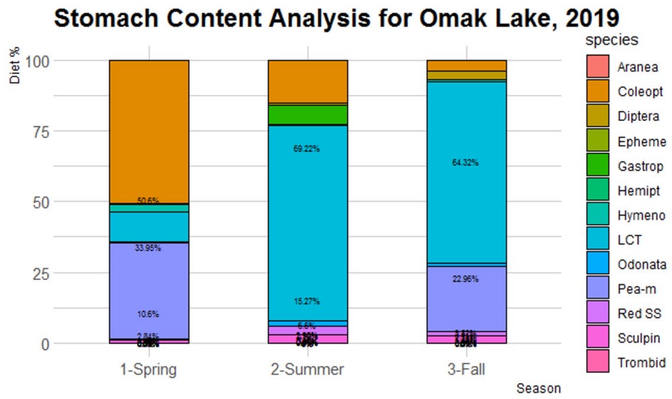
- SIA is happening on LCT livers. Livers provide representative results for estimating prey contributions to fish diets (Skinner et al. 2016, 2017).
- LCT prey items for SIA included macroinvertebrates, zooplankton, and fish (sculpins, red-side shiners, long nose sucker and pea-mouth).
- Macroinvertebrates were collected in littoral areas with a D-framed kick-net. Then, categorized by order.
- Samples were freeze dried and grounded to powder. Then placed in tin capsules for SIA.

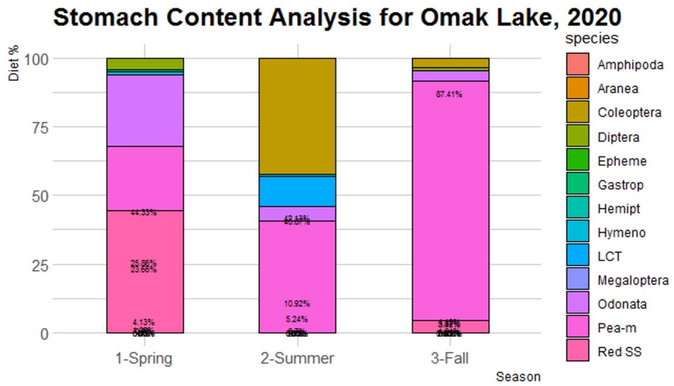


Hypothesis The SCA data suggest an important contribution of terrestrial prey items for LCT diet during Spring; season of potentially lower prey availability.









Results

- LCT seasonally collected was divided in 6 categories based on size (150 – 249, 250 – 349, 350 – 449, 450 – 549, 550 – 650, and >650 (mm)).
- For ***2018*** only 50 spring samples were collected. A huge dominance of terrestrial beetles comprised about 89% of diet vs only 11% prey fish.
- For ***2019***, 157 samples were collected.
- For 150 – 249 mm LCT, dipterans and small prey fishes were important.
- For 250 – 349 mm LCT coleopterans (beetles), dipterans (chironomids) and prey fish were central (pea-mouth, red-side shiners and sculpins).
- Diet for 350 – 449 mm LCT were similar with coleopterans and small prey fish constituting over 50% of the diet.
- For larger LCT (450 – 549 mm), cannibalism of LCT hatcheries & piscivore behavior was trendy. Although, coleopterans predominated in spring. Gastropods, odonatan and hymenopterans also contributed.
- For largest LCT (550 – 650+mm), prey fish provided much of their diet. However, the stomachs of large LCT were often empty, which may be attributed to reduced feeding during spawning.
- In ***2020***, 213 LCT were collected, the trend was similar except for spring. No beetles were found in spring stomachs. Over 80% was prey-fish for LCT for all sizes. In 2020 cannibalism was negligible.
- Terrestrial bugs appeared in summer diet and then, decreased significantly on Autumn.
- Overall, a spike on piscivore behavior characterized Autumn 2020.

Discussion

- Overall, the results so far, suggested significant ontogenetic shifts and seasonal changes, in LCT diet.
- Seasonal changes are likely due to differing seasonal prey availability. For example, coleopterans and hymenopterans (including winged and non-winged ants) of terrestrial origin are probably blown into the lake in relatively large numbers. LCT exploit this on spring, mostly littoral areas, when other food sources are scarce.
- During summer, larger LCT shifted predation from inverts to prey fish, and even to cannibalizing smaller LCT (true for 2019 but, minor in 2020).
- By early autumn, LCT diet shifted from invertebrates (gastropods, chironomids, & odonatans) to prey fish. 2020 revealed a higher fish-prey abundancy that spiked predation to 93%.

Conclusions

The importance of terrestrial contribution to LCT diet is an unexpected outcome. The SIA mixing model may reveal how significant is terrestrial prey blown into the lake vs aquatic sources during spring. The impact of wildfires can modify terrestrial prey availability.

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Timothy Taylor
Fisheries Biologist at Lummi Indian Business Council

Bryan Jones
Fisheries Biologist
Colville Tribes Fish and Wildlife
Bryan.Jones@colvilletribes.com