Chinook Salmon Diets in Lake Michigan during 2015:

An Auxiliary Indicator of Predator-Prey Balance

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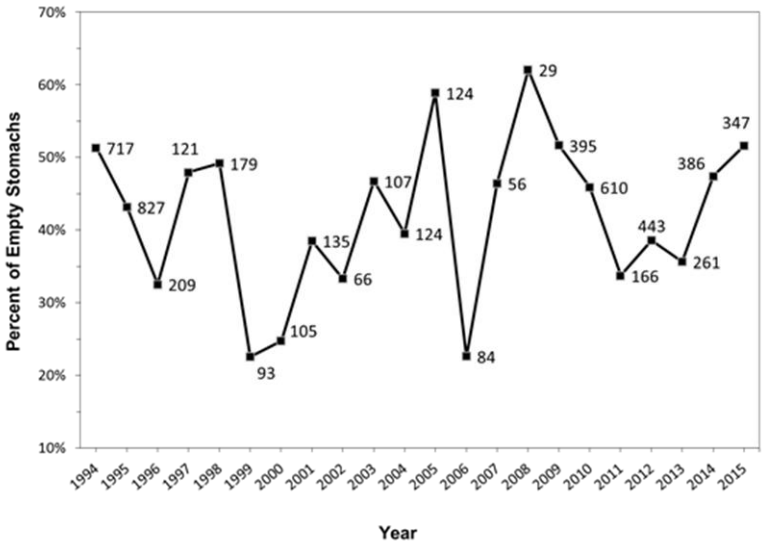
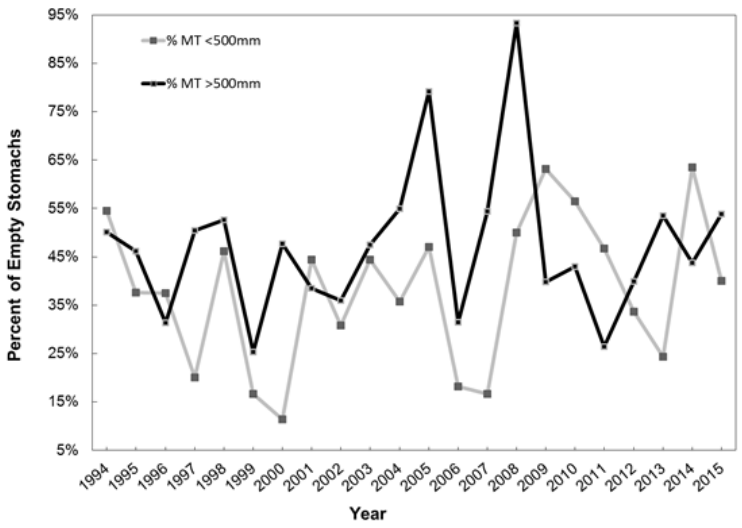
Background:

Maintaining the Chinook Salmon population in Lake Michigan, which was the preferred approach to the overabundant alewife population in the 1960s, has now become a challenge for fisheries managers. An annual assessment of salmon diet contents is important because it can be used as an auxiliary indicator to the predator-prey ratio analysis for Lake Michigan. Chinook Salmon are an important component of the Lake Michigan fish community and knowing the status of their prey availability and feeding habits will be helpful in managing Michigan's salmon fisheries resource.

Major Findings:

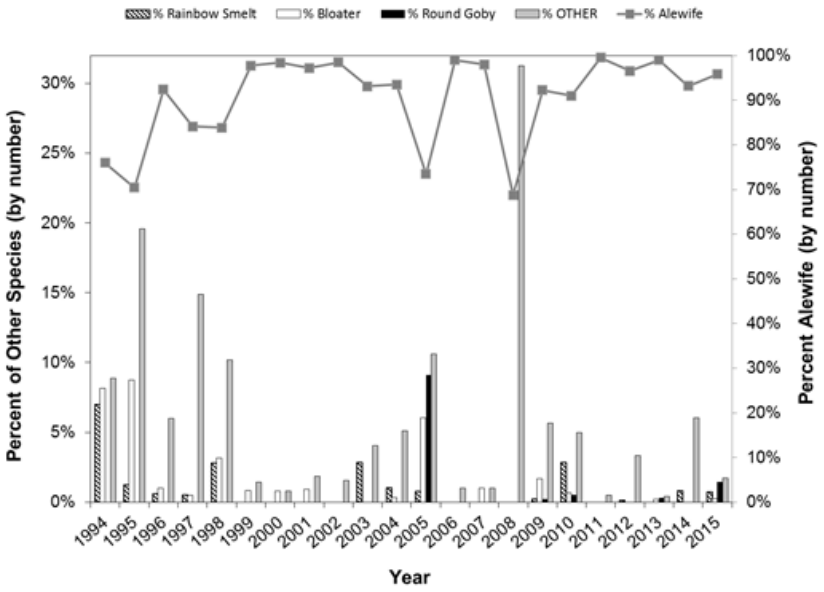
1. Prey Availability: Simple diet indices, such as the average **percent of empty stomachs** in a given year, can be a good indicator of the availability of Alewives which are the preferred prey for salmon. For Chinook Salmon in Lake Michigan, the lowest percentages of empty salmon stomachs were in years following the 1998, 2005, and 2010 Alewife year classes. The percent of empty stomachs increased from 36% in 2013 to 47% in 2014, likely as a result of the poor recruitment of Alewives in 2011 and 2013. In 2015, the percent of empty stomachs increased again, climbing to 51.6% following the weak 2014 Alewife year class. The figure (below, left) depicts the average percent of empty stomachs by year from 1994 to 2014 (the number above each data point represents the number of stomachs examined).





2. Prey Availability by Salmon Size: By separating the diet **content analysis by salmon size**, we can get an indication of the relative availability of young-of-year (YOY) Alewives versus yearling and older Alewives (YAO). The 2015 diet analysis suggested that the larger fish (>500mm) had fewer prey items available, likely in terms of YAO Alewives, as the percent of empty stomachs increased from 43.7% in 2014 to 53.9% in 2015 (above, right). In contrast to the diet analysis of large Chinook Salmon, we observed that the percent of empty stomachs for small Chinook Salmon (<500mm) decreased from 63.5% in 2014 to 40.0% in 2015. Small Chinook salmon tend to consume smaller YOY Alewives when they become available, which typically occurs after a good Alewife year class. The decrease in empty stomachs of small Chinook Salmon suggests that there was an increase in the production of YOY Alewives in 2015 and it is likely that the percent of empty stomachs for large Chinook Salmon will decrease in 2016.

3. Prey Fish Community: Even though Chinook salmon prefer to eat alewives, the relative **abundance of other prey species** (e.g., Rainbow Smelt or Bloaters) can be indexed by tracking the percent of the diet that consists of alternate prey items (below). This index suggests that bloaters can be a good alternate prey when alewives are in low abundance and bloater abundance is relatively high (e.g., 1994-1995 and 2005). In addition, feeding on other non-fish prey items, such as Mysis and *Bythotrephes longimanus*, can be an indicator of very poor salmon feeding conditions (e.g., 1995, 1997, and 2008). In 2015, alternate prey (non-Alewives) comprised 4.2% of the total prey and were mainly Round Gobies and Rainbow Smelt. The percent of Alewives in Chinook Salmon stomachs increased from 93.2% in 2014 to 95.8% in 2015 suggesting that the availability of Alewives increased during the last year.



4. Prey Quality: Comparing **salmon size to the size of alewives consumed** by Chinook salmon provides a good index of the health of the prey fish population. Historically, the average size of Alewives consumed tended to increase with Chinook salmon size. However, recently (2012-2014) there was a lack of a relationship between predator and prey size suggesting that the Alewife population is stressed in Lake Michigan. In 2015, the relationship between predator and prey size was more evident than in previous years, suggesting a rebuilding and healthier Alewife population in Lake Michigan.

Summary findings from the 2015 Chinook Salmon diet analyses:

- Prey availability in Lake Michigan increased from 2014 to 2015 for small salmon.
- The diet results suggest that an increase in prey availability for large Chinook Salmon will likely occur in 2016.
- The sizes of Alewives consumed by Chinook Salmon suggested a healthier predator-prey relationship in 2015.