GBF Write-Up

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Do cage-cultures alter fish behaviour? A case study using SONAR

The release of excess feed and waste from freshwater cage-culture operations into surrounding lake ecosystems introduces a high density of novel food resources for the surrounding food web. Therefore, the cage-culture may act as a 'birdfeeder' in the system and attract top predators and consumers from local and regional habitats to create high densities of fish around the cages. These high densities suggest that top predators and consumers have altered their normal foraging behaviour to access these new food resources, which has implications for food web interactions that may ultimately alter the stability of the food web over time. We are using hydroacoustic SONAR technology to determine if the cage-culture operation in Parry Sound is altering the behaviour of different top predators and consumers in the lake food web and causing them to aggregate in high densities around the cage-culture operation.

In July of 2017, we conducted a day-time and night-time SONAR survey around the Parry Sound cage-culture operation and on transects leading away from the cage culture. These surveys will show how the density of fish change in relation to distance from the cage culture, how cage-culture feeding times (i.e., active feeding with pellets during day vs. none at night) influence fish densities in relation to the cage-culture, and finally which species are responding the most to the resources by identifying species using species' specific target strengths. The data that was collected is currently in the process of being analyzed and we hope to have results in the next few months. We are expecting that we will see higher densities of fish surrounding the cage that decrease with increasing distance and that there will be a greater aggregation of fish during the day when feed pellets are actively being released into the lake. We also expect that pelagic top predators and consumers will respond more than littoral top predators/consumers because the cage-culture is located in the pelagic zone.

Investigating Cage-culture Impacts on Fish Diets Using Fatty Acid Analysis

Consumers and top predators that consume these novel cage-culture feed and waste food resources alter their normal diets (i.e., lower trophic level fish and invertebrates) to that of these resources. This also means that these species are assimilating the waste from the cage-culture facility, reducing the negative environmental implications (e.g., eutrophication) and maintaining a stable population. To determine if species surrounding cage-cultures are assimilating these novel resources, we need to determine if they are part of the surrounding food web's diet. The fatty acid composition of the cage-culture feed is very different than natural food resources due to the presence of marine and terrestrial components, which can be detected using key fatty acids (Feed Indicator Fatty Acids (FIFA)). Since fatty acids work in a 'you are what you eat' manner, we can determine if top predators and consumers are altering their diet and assimilating these cage-culture resources by analyzing their fatty acid composition and

detecting these FIFA. Certain fatty acids (e.g., omega-3 and omega-6) are important to fish health and alterations in the fatty acids consumed due to shifts from natural to cage-culture resources may therefore alter fish health. To determine if the surrounding food web is assimilating the excess feed and waste released from cage-culture operation and the potential implications this may have on fish health, we are analyzing the fatty acid composition of a representative species from each functional group in the Parry Sound food web.

In the summers of 2015-2017 we collected fish, invertebrate, cage-culture feed, and fish waste samples from Parry Sound and the AquaCage cage-culture operation and control fish and invertebrate samples were collected from several control sites in Georgian Bay (e.g., Colpoys Bay, Shawaniga Bay, Key Harbour). Fatty acid composition analysis was conducted on the muscle tissue samples collected from each of the targeted species in the food web (i.e., lake trout, walleye, smallmouth bass, cisco, alewife, yellow perch, mayflies, mussels, snails; collections varied from year to year). The fatty acid data from 2015 and 2016 indicate that lake trout and cisco have higher proportions of FIFA and omega-3 and omega-6 fatty acids, characteristic of the cage-culture feed. However, no presence of feed was detected in the yellow perch and invertebrates. This indicates that the cage-culture resources are being assimilated into the surrounding food web through the pelagic food chain. The 2017 data is in the process of being analyzed and we will also be collecting further samples from Parry Sound this upcoming summer. This additional data will determine if other top predators (e.g., smallmouth bass and walleye) are altering their diets to that of the cage-culture resources. These alterations in diet and assimilation of these cage-culture resources influence consumer-resource interactions and thus may influence the stability of the food web over time. Further research is needed to fully understand the implications of released cage-culture resources on fish diet, health, ecosystem function and food web stability.