Burbot Post-spawn Diet

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Burbots have become an increasingly popular game fish among anglers and have become a strong predator within the systems, consuming a wide variety of organisms. Therefore, the objective of this study was to compare male and female burbots diets post-spawn in a system. Burbots angled from Bad Medicine Lake were sacrificed and the stomach contents were observed, categorized by the lowest taxonomic key, and then weighed in grams. Percent by weight was calculated for each category of organisms and presented in a pie charts. In all three analyses, crustaceans were the main source of the diet structure at more than 50%. This leads to a conclusion that there are no notable differences between male and female Burbot diets post-spawn.

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Introduction

Burbot, *Lota lota,* is a highly sought out, once thought of as a nuisance, northern hemisphere freshwater fish. Also known as eelpout, this now gamefish is the only one in the family Gadidae that is not marine (Page and Burr 2011). Burbot are found throughout the northern United States, across Canada, and Eurasia (McPhail 2000).

Found in freshwater lakes and deep rivers, Burbot juveniles prefer the littoral zone while adults are located in the lakes' colder profundal zone (Hofman 2002). Burbots have regularly been found in burrows at 300 m deep in Lake Superior (Boyer 1989) Riverine burbots tend to stay in low-velocity areas in main channels and inside channels behind deposition bars (McPhail 2000). With the preferred substrates in rivers being sand, fine gravel, or silt, it changes drastically in lakes as coarse gravel and cobble stones are the favored substrates (McPhail 2000). A study conducted on Moyie Lake observed Burbot in several different habitats, generally classified as areas consisting of steep banks dominated by a mix of gravel, boulder, and cobble substrates: no Burbots were observed over fine sand or silt in the lake (Neufeld 2011). These preferred and sought out conditions, have a powerful influence on Burbot spawning.

The spawning season of Burbot is winter through early spring with a short spawning period of only two to three weeks under the ice (McPhail 2000). Cold water temperature is preferred for spawning. The range of 1-4˚ C has been found to be ideal and temperatures above 6˚ C showed high mortality in larval Burbot (Paragamian 2003). Egg production from female Burbot range between 6,300 – 3,477,699 semi buoyant and non-adhesive eggs that rely on the substrate to be caught or lodge into (McPhail 2000). One study conducted looked at Burbot energy metabolism before, during and after spawning, which focused on several aspects of the fish's metabolic demands. In particular, one area focused on two essential hormones, leptin and the ghrelin-immunoreactive peptide. Before and during spawning, concentrations of these hormones were low but spiked after spawning (Mustonen 2002). Leptin regulates appetite, adiposity, and metabolism while ghrelin's main role is to stimulate food intake (Johnson 2000; Unniappan 2005). These hormones influence the fish to eat and regulate the overall body mass through prey selection.

A study of Burbot diets conducted on Lake Michigan found that diet varies with burbot size as well as depth. Smaller Burbot were found consuming mostly invertebrates at shallower depths while larger fish at deeper depths were consuming crustaseans, and smaller fish such as Yellow Perch, *Perca flavescens* (Fratt 1997). Burbots diets consists of 80% fish or higher but also shows a shift in species of fish consumed with season change (McPhail 2000). Chisholm (1989) found that in winter, adult Burbot prey on largescale bottom feeders as the main diet but changes to Yellow Perch in the spring.

As shown, many studies group male and female Burbots together to get an overall diet analysis. But there is little information or studies conducted that focus on the differences between the two sexes. There is also minimal amount of information about diets after the spawning season. Therefore, this research aims to compare the differences in the diets of male and female Burbots post spawning period

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Methods

Burbot were caught by anglers through the ice using standard ice fishing equipment from 18 March – 1 April 2019, across Bad Medicine Lake, MN. Fish caught were immediately measured for total length (mm), weight (g) and then sacrificed to be sexed (male, female, unknown) after capture. Stomachs were removed and placed into sample jars with 70% ethanol for preservation and brought back to the lab for analysis. Later, each Burbot stomach was dissected, and the contents were observed. A scalpel was used to cut the stomach open while avoiding the contents inside. Using a tweezer, each organism was taken out, placed in a pan, and sorted by species. All organisms within a stomach were identified to the lowest taxonomic unit possible: crustaceans, fish, invertebrates, substrate/rocks, worms/leeches and unidentifiable material were observed (Figure 1).

After all organisms were sorted, each group was the weighed to the nearest hundredth of a gram. All unidentifiable material was also weighed and recorded. Percent by weight was then calculated for each group of organisms (weight of organisms/total weight of contents x 100).

Figure 1: Visuals of Burbot stomach contents (Crayfish, fish, invertebrates and unidentifiable material).

Results

A total of 52 Burbot stomachs were dissected, and the contents varied by stomach (Appendix 1). Crustaceans made up over half of the diet analysis at 55% and worms and leeches only being 2% (Figure 2). The female diets had over 50% of the diet consisting of crustaceans with fish at 25% (Figure 3). The male diets also had more than 50% of the diet as crustaceans with substrates/invertebrates at 22% (Figure 4).

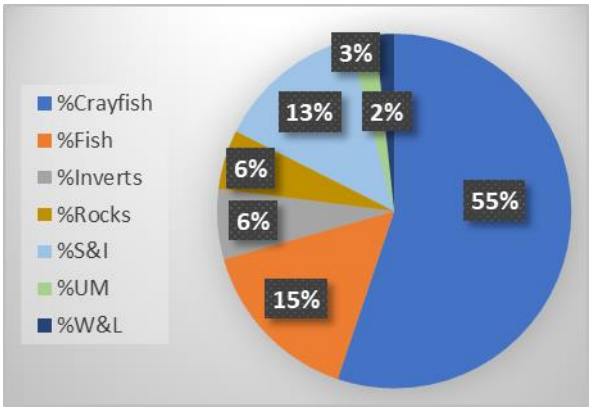

Figure 2: Diet graph of both male and female Burbot stomach contents (percent by weight).

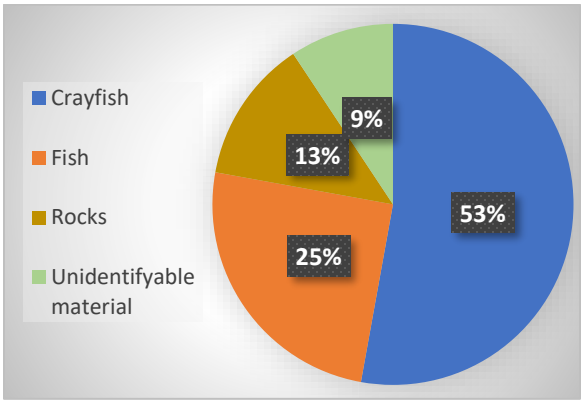

Figure 3: Female Burbot diet graph (percent by weight).

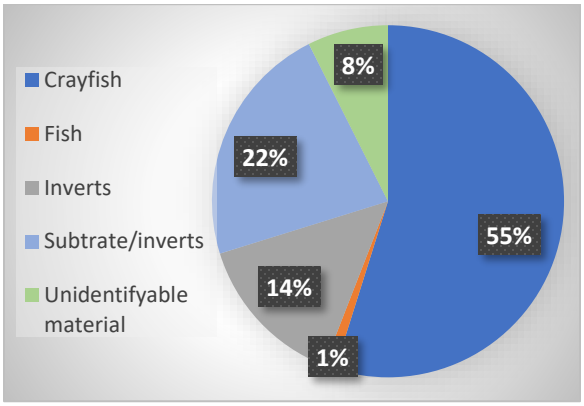

Figure 4: Male Burbot diet graph (percent by weight).

Discussion

A finding through this study is that male and female Burbot diets consist mainly of crustaceans and fish. Both male and female percent by weight analyses showed crustaceans dominated the diet of

Burbot by more than 50%, followed by fish and substrate/invertebrates. The only noticeable difference being that female Burbot had a much larger percentage of fish and male had a higher percentage of substrate/invertebrates than females. This could be due to females needing a larger amount of energy intake, such as fish, after laying eggs.

One way these findings could be useful would be the population control of invasive crayfish species in certain bodies of water. A controlled Burbot population could have a significant impact on the invasive species and allow the native crayfish population to rise. A study conducted on Lake Constance showed that invasive and aggressive crustaceans, heavily influenced young Burbot behavior and health, which will affect the overall future Burbot population (Hirsh 2008).

The objective of this study was to determine if male and female Burbots have a different diet structure after a large energy expelling event such as spawning. The results showed that there was too much similarity between the diet analyses of the male and female Burbots to conclude a notable diet difference.

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Appendix 1: Stomach content data of all Burbot collected. All weights of prey items are in grams.

ID	Length (mm)	Weight (g)	Sex	Crustaceans	Fish	Inverts	Rocks	Substrate	Worms/ Leeches	Unknown
13	475	1235	M	5.04						
17	501	1267	F		1.36					
22	561	1820	F	25.64			2.30			16.59
26	568	1373	M	12.79						
28	454	623	U	1.03						
32	449	875	M							
59	574	1748	F	0.85			0.73			
64	585	1507	U	36.86	1.45		2.79			
78	415	665	U	15.55						
81	357	450	U					3.76		
82	525	995	M					5.36		
98	539	1289	F	8.10						
103	423	698	U			0.18				
128	435	769	M			0.65				
133	491	1076	U	11.94						
140	529	1067	U	3.99				5.54	0.44	1.88
142	440	519	F		2.50					
176	419	506	U	0.33	0.40				0.43	
179	486	960	M	5.17	1.06			8.14		
181	531	1203	F	36.87				5.40	0.68	
185				4.19		0.70				
186	382	561	M	4.35						4.71
187	616	2054	F							
188	394	503	M	3.62						
189	487	1268	F							
191			M	4.90						
193			F	1.15						
194			F							
195			F							
196			M		14.69					
197			F	2.94	8.98					
198			F					3.95		
199			F	1.82						
200			M							
202			M	61.43			1.15			
203			M	10.78	2.59					
204		557	IF	7.46						
205			F		23.36	0.15				
206		873	F				10.90			
207			M	0.47		0.70				
208			F	3.78	1.74					
209			M	20.61					0.43	
210			M	10.16						
211			F	0.34			2.09		0.99	
212			M	0.60	9.51			15.56		
213			M							
214			F	2.44	2.16		0.32			
215			F							
216			F	15.28	2.19		1.15			
217			F							
218			F					3.57		
300				2.42						
Ave				10.09	5.54	0.48	2.68	6.41	0.59	7.73
Sum				322.90	71.99	2.38	21.43	51.28	2.97	23.18