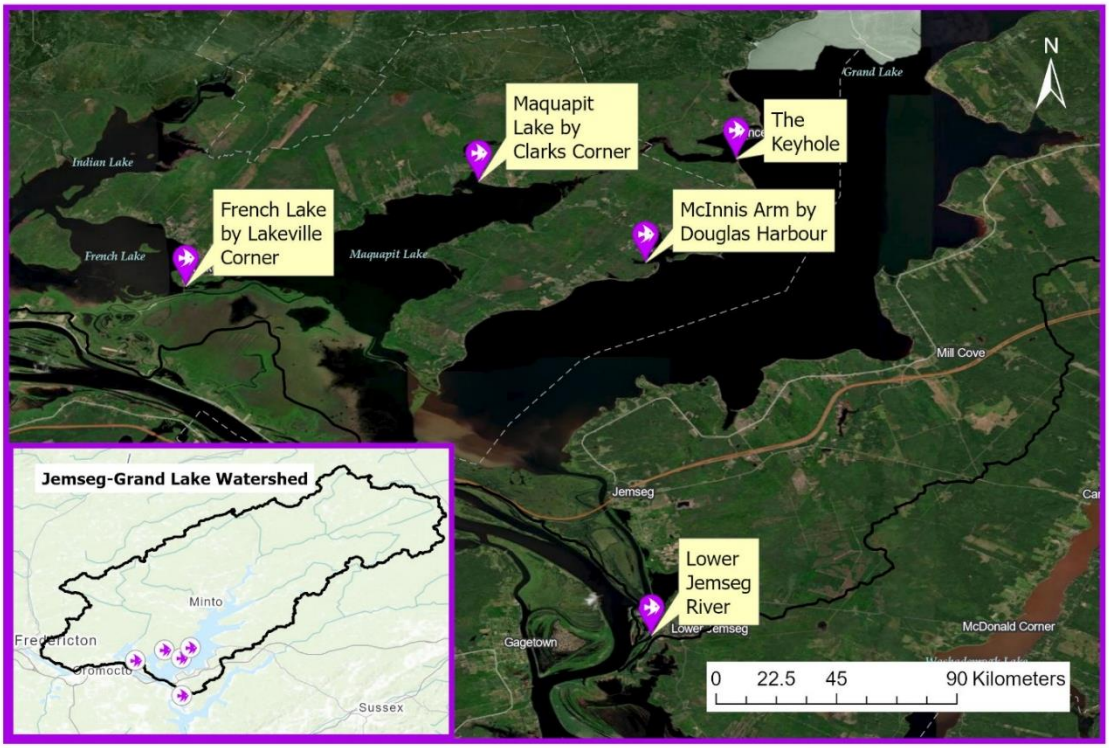
What's under the ice?
Peering into the winter fish community in the Jemseg – Grand Lake watershed

We are curious about what fish might be found in our watershed since we hear plenty of stories about what people have caught or seen – this season and in the past. In the winter of 2024, we went "fishing" in the Jemseg-Grand Lake watershed without hooks, bait, fishing lines, or underwater cameras. We used a new method to detect fish and other organisms in water called **environmental DNA** ("eDNA"). eDNA is the DNA shed by organisms, including humans, into their environments.

The analysis for eDNA is similar to how a forensic lab would extract and sequence DNA traces at a crime scene. The lab compares DNA from a sample to the DNA in a database of suspects. Similarly, we can pick up eDNA from lakes and rivers and use it to identify which fish species were recently near the locations we visited. By “fishing” for eDNA, we can learn about the fish community that is present as well as other types of organisms in our watershed, such as invertebrates, plants, and microbes!

How did we collect winter samples?

Two of our members, Greg Gillis and Mary Murdoch, ventured out this past winter to collect water samples through ice fishing holes and open water at five sites (**Map below)**. One of these locations was in McGinnis Arm near the mouth of Douglas Harbour, where Jason Glen hosted us at his ice fishing hut (thank you, Jason!).



Map of the sites where water was collected for our fish eDNA study.

In the first photo below, Jason is holding the water sampler. We dropped the water sampler through the ice fishing hole to collect samples under the ice at various depths. For open water sites, we used a bucket to collect the water samples at the surface from shore.

How did we capture the eDNA?

Back at home the same day of sampling, Mary used a kit provided by NatureMetrics to filter each water sample (0.8 µm pore size) and collect small biological particles, such as skin cells, mucous, and waste that fish leave behind as they swim. These particles may contain DNA, which is the genetic building block for biological life. Here's Mary filtering a water sample using a syringe and then getting ready to place the filter into a specimen bag for shipment.

An eDNA sample from water will contain particles with DNA from many organisms, and identifying what fish are represented in each sample is the next step. The individuals within a species of fish have similar codes

within their DNA. To figure out which species of fish are present, we sent the filters from each sample to a genomics lab (NatureMetrics) in Ontario to extract and analyze the eDNA. The lab extracted DNA from particles on the filters, sequenced the DNA, and then matched the sequences to a fish genetic database. Using these methods, we were able to learn what fish species were represented by eDNA in each of our samples.

What did we find out about fish?

A total of 29 fish species were detected across the five sites. The table at the end of this article shows what species were detected at each place we sampled, with species names on the left side and sample sites along the top. Let's break these results down:

- 10 to 17 fish species were detected at each site, mostly represented by forage fish (such as golden shiner and stickleback) and recreational fish species (such as brook trout)
- Atlantic salmon was detected at McInnis Arm near the entrance to Douglas Harbour
- Shortnose sturgeon was detected at Lower Jemseg River
- Three fish species were detected at all five sites: golden shiner, pike/pickerel, and bullhead catfish
- Invasive species were detected, all from the *Esox* genus: muskellunge / chain pickerel
- At two sites, a marine fish species was detected (either silver hake or Atlantic mackerel), suggesting that ice fishers were using them as bait near where we sampled

From these results, we can see that the eDNA method is a useful way to learn what species are part of the fish community in the Jemseg Grand Lake Watershed. This method will detect common species, rare species, and invasive species. With further study, we can learn more about other species in the fish community, and when and where they might be present.

This eDNA method is very sensitive to detect low levels of eDNA in a sample, so we must be careful when sampling and filtering to avoid carry-over of eDNA from one sample to the next. In our negative control (distilled water), we detected one fish species (*Esox* sp.) but expected no eDNA. This could be an artefact from lab analysis given that no other fish species was detected or could have been carried over from another sample. This finding stresses the importance of careful sample handling to avoid contamination when sampling and filtering water.

We are excited to learn more about the fish community in the Jemseg Grand Lake watershed.

Now it's your turn - we want to hear from you!

What else interesting do you see in these results?
What fish species we might have missed from our eDNA fishing expedition?
Do you think we would find different fish species if we sampled at other times and places?
Is there a place you think we should sample using eDNA?
How else can we learn about the fish community in our watershed?
Are there other species you are interested in learning about, such as other aquatic animals and plants?
What other questions do you think we should ask?

Get in touch with us at **jemglwa@gmail.com** or follow us on Instagram **@jemseggrandlakewatershed**

Table 1 Fish Species Detected in Water Samples Using Environmental DNA In Winter 2024 In the Jemseg-Grand Lake Watershed, New Brunswick

Illustration	Common group	Common Name	Latin Name	Site Sampled[A, B]					
				LGR	FLO	ML	MA	TK	Status[C]
1	Catfishes	Brown bullhead	*Ameiurus* sp.	■	■	■	■	■	-
2	Cods	Burbot	*Lota lota*			■	■		Least-Concern
3	Cods	Tomcod	*Microgadus tomcod*	■				■	Least-Concern
4	Eels	American eel	*Anguilla rostrata*		■		■		Endangered
-	Hakes	Silver hake (marine)	*Merluccius bilinearis*					■	-
5	Herrings	Alewife	*Alosa pseudoharengus*		■		■		Least-Concern
6	Lampreys	Sea lamprey	*Petromyzon marinus*		■	■			Least-Concern
-	Mackerel	Atlantic mackerel	*Scomber scomber*		■				-
-	Minnows & Carps	Chub species	*Couesius* sp.			■			Least-Concern
7	Minnows & Carps	Creek chub	*Semotilus atromaculatus*		■	■		■	Least-Concern
8	Minnows & Carps	Fallfish	*Semotilus corporalis*		■	■			Least-Concern
9	Minnows & Carps	Finescale dace	*Chrosomus neogaeus*		■		■	■	Least-Concern
10	Minnows & Carps	Golden shiner	*Notemigonus crysoleucas*	■	■	■	■	■	Least-Concern
11	Minnows & Carps	Lake chub	*Couesius plumbeus*		■				Least-Concern
-	Minnows & Carps	Minnow family	Cyprinidae			■			-
12	Minnows & Carps	Pearl dace	*Margaristcus* sp.			■		■	Least-Concern
13	Perchs	Yellow perch	*Perca flavescens*	■	■	■		■	Least-Concern
14	Pike	Muskellunge ("muskie")	*Esox masquinongy*	■					Least-Concern
-	Pike	Pike/Pickerel	*Esox* sp.	■	■	■	■	■	-
15	Smelts	Rainbow smelt	*Osmerus mordax*	■	■		■		Threatened
16	Sticklebacks	Fourspine stickleback	*Apeltes quadracus*				■		Least-Concern
17	Sticklebacks	Ninespine stickleback	*Pungitius pungitius*		■				Least-Concern
18	Sturgeons	Shortnose sturgeon	*Acipenser brevirostrum*	■					Special Concern
19	Suckers	White sucker	*Catostomus commersoni*	■	■	■	■		Least-Concern
20	Sunfishs	Redbreast sunfish	*Lepomis auritus*	■					Least-Concern
-	Sunfishs	Sunfish species	*Lepomis* sp.		■	■	■	■	-
21	Trouts	Atlantic salmon	*Salmo salar*				■		Endangered
22	Trouts	Brook trout	*Salvelinus fontinalis*		■	■			Least-Concern
-	Trouts	Salmonid species	Salmonidae	■					-

Legend

- Marine fish detected in the freshwater sample. Potential signals from baitfish used by ice fishers.
- Detection of the species' eDNA in the sample(s) for the corresponding site.
- Unidentified species
- Invasive species

Notes

[A] Samples collected for Lower Jemseg River (**LGR**), French Lake Outlet (**FLO**), Maquapit Lake (**ML**), McInnis Arm (**MA**), and The Keyhole (**TK**).

[B] Quality control results (distilled water sample; not shown) detected one fish species (*Esox* sp.), indicating that there was potential for carry-over of eDNA between samples.

[C] Conservation rankings from the Atlantic Canada Conservation Data Centre (AC CDC)

Images 1-2 and 4-22 were acquired from the State of New York. A biological survey of the Oswego River system. Supplemental to Seventeenth annual report, 1927. Available in the public domain at www2.dnr.cornell.edu. Image 3 is an illustration by Denton, Sherman (1895 – 1909), available in the public domain on www.flickr.com.