REU 2015 – Interdisciplinary Research on Human Impacts in Lake Champlain
Dear readers,

Congrats, you’ve picked up a zine put together by a team of ten undergraduates from around the country. We have spent the summer researching environmental issues pertinent to Lake Champlain, ranging from habitat fragmentation to pharmaceutical contamination, as part of a program funded by the National Science Foundation.

At this point, you’re probably wondering what a “zine” even is. Zines are small circulation, self-published magazines. They are most commonly associated with the punk scenes of the 1970s and anarcho-punk principles. Zines, however, have largely died out since the growth of the internet, but they can still be found in hipster coffee shops around the country.

Now, you might be wondering what a bunch of scientists are doing writing a zine. As undergraduates, we exist in a weird place between the public and the scientific community. It’s easy to see the sharp divide between science and the rest of society. We think zines are a way to bridge this gap. They are cheap, creative, accessible, and fun. They come in sharp contrast to scientific journals, which are far less accessible to the general public. Unlike scientific journals, zines can be made and shared by anyone, as long as they have access to a printer.

In our first issue, we will take you on a journey beneath the lake’s surface and explore the environmental issues that affect Lake Champlain. You will get to see how harmful algal blooms, invasive species, habitat fragmentation, and other processes disrupt the native lake community. These are all the topics that guided our research questions this summer and fall under the theme of interdisciplinary research on Lake Champlain. From reading our zine, we hope you will gain a new understanding of our lake’s history, character, and challenges while learning ways in which you can help to ameliorate its conditions. So follow Champ, your tour guide, to learn more!

Signed,

The Cohort
MEET the STAFF

Ben Ramcharitar
Middlebury College 2017
Has a pet lizard named Colonel.

Lexi Jones
Wesleyan University 2017
Lives in a town called "Sandwich."

Erin Keough
Saint Michael's College 2017
I did Irish Step Dancing for 12 years!

Madeline Kelsey
Salisbury University 2016
Owns a unicycle!

Geoffrey Gray-Lobe
Augustana College 2017
Served coffee to Sarah Jessica Parker as a barista in Manhattan.

Natalie Flores
California State University 2016
Has a pet snake named Grimm!

Jessica Kane
University of New England 2017
Is scared of balloons!

Rachana Ghimire
Washington & Lee University 2014
Is originally from Nepal!

Katie Bockwoldt
Roanoke College 2015
Values her dog's life more than her own ❤

Teyana Adams
Central State University 2018
Can touch her nose with her tongue!
This comic was funded by: Plankton-Flakes

...Because you are what you eat

Stop eating this...

And you can look like THIS

What do I have to do?

EAT PLANKTON-FLAKES

.... Because you are what you eat....

Planktonflakes

Limited Time Only! - NOW (almost) Free!!!

PlanktonFlakes

....Because You are what You

Wow! I never knew that changing my diet could make me instantly a stud! I wonder what nutrients go into my food that makes it healthy...
Nutrition Facts

Serving Size 2/3 cup (55 g)
Servings per container About 8

Amount per serving
FISH UNITS 230

% Daily Value

Nutritious zooplankton
- Linoleic acid ........................................... 44%
- α-linolenic acid ........................................ 19%
- C:12 ..................................................... 18%
- C:14 ..................................................... 51%

Unhealthy zooplankton
- Linoleic acid ........................................... 2%
- α-linolenic acid ........................................ 41%
- C:12 ..................................................... 3%
- C:14 ..................................................... <1%

INGREDIENTS: NUTRITIOUS ZOOPLANKTON THAT GRAZED
ON CHRYSOPTHE PHYTOPLANKTON (DIATOMA SP., FRAGILARIA
SP., AUOCOSEA SP., ASTERIOVILLOSA SP., DIWOBRYON SP.) AND
UNHEALTHY ZOOPLANKTON THAT GRAZED ON CYANOBAC-
TERIA (MICROCYSTIS SP., AP HANIZOMON SP., WORONICH-
WIA SP., ANABAENA SP., APHANOCAPS A SP.), GREEN #1
Why is there "P" in my lake?

Precipitation probably washed it off the surrounding landscape.

But lots of people have been working hard doing a good job limiting phosphorus pollution. So I think the "P" is being released from sediments in the lake.

So it seems like phosphorus can be a good thing in moderation - I wonder what else enters the lake...

Well maybe... but if that's the case then how do you think the phosphorus got into the sediments in the first place?
Why is phosphorus so important?

Algal blooms may be harmful

Phosphorus concentration = growth/amount of algae

Limiting nutrient for primary production

Phosphorus used in fertilizers on farms

P runoff washed into lake by watershed

P fixed by algae and/or stored in the sediments

Algal blooms may cause liver disease, gastrointestinal problems, fish kills, loss of biodiversity.
Pharmaceuticals & Personal

What are they?

PPCPs are substances used to improve one's health, appearance, or general wellbeing.

Can you find some of the 57 pharmaceuticals entering Lake Champlain?*

By: Lexi & Jess

* Just like there's no quick fix to pharmaceutical contamination... we don't have an answer key for this puzzle!
Care Products!

Like What?

So... I have unwanted PPCPs.... How should I get rid of them?

Throw them in the trash, that's what I do with all my non-recyclables!

Flush them down the toilet, just like my mom always said!

I'll just keep them, I'll get rid of them someday...

Take them to a drug take-back program near me, like at a pharmacy or police station.

Your PPCP ends up sitting in a landfill until it rains. Then the chemicals leach into the groundwater that supply surface waters...

Your PPCP travels to a wastewater treatment plant that isn't designed to remove their chemicals before being released.

For every day you procrastinate, you risk a child, pet, or other unintended consumer getting access to your PPCP.

Your PPCPs are taken to be incinerated, the best available disposal practice. Good job!

Although they don't end up in the lake directly this is unsafe... TRY AGAIN!

TRY AGAIN for Lake's sake!
Fact OR Fiction

1. Sea lamprey is an invasive species
2. Hydrilla is in Lake Champlain
3. You can help prevent new invasions

Answers

1. Fiction! Scientists believe it is native to Lake Champlain
2. Fiction! Hydrilla poses a significant threat but has not been detected in Lake Champlain
3. Fact! Properly cleaning your watercraft helps to prevent the spread of invaders between waterbodies

Take Home

Invasive species are detrimental to both the environment and the economy

INVASIVE SPECIES & US

Most invasive species have entered the lake as a result of human activities. These species can negatively alter the native ecosystem by displacing native species and outcompeting for resources. Additionally, they have a negative effect on the economy. For example, they can cause loss to property value, recreational activities, tourism, and industry. Not to mention the high treatment costs! Public understanding of invasive species’ impacts is essential to raising awareness and preventing further invasions. Over the summer, we have found that people who see the lake more frequently and enjoy more activities on the lake show more concern for this problem. So grab a friend, hit the lake and share what you have learned about invasive species in Lake Champlain!

-Madeline & Rachana
Which pie do you want for dessert?

Key Lime Pie

Pumpkin Pie

What do you notice in others?

Looks

Brains

Are you a morning bird or a night owl?

Morning bird

Night Owl

How many foreign continents have you visited?

4 +

2-3

I don't get out much

Eurasian Watermilfoil

Hydrilla

Quagga Mussel

It's great to know that we can all do something to help stop the spread of invaders! I wonder how the causeways might affect the movement of the lake's organisms...
Habitat fragmentation is one of many environmental issues that can be caused by humans. It is the process of breaking a once continuous habitat into smaller, disconnected pieces. Think of clearcutting forests, constructing roads through grasslands, and placing dams in rivers. This is a complex issue that can affect organisms in different ways as a result of their specific ecology. Previous research on habitat fragmentation has focused mainly on terrestrial systems—and aquatic fragmentation studies that have been conducted are directed towards streams and rivers. Lake Champlain's ecology provides an ideal foundation for aquatic fragmentation studies. The lake is divided into 5 basins by 10 causeways, the effects of which have never been studied. We're particularly interested in how these barriers affect fish movements.

To do this, we use different methods to study the effects of the causeways on two fish species. Natalie is using genetic techniques to study the effects on the slimy sculpin.
(Cottus cognatus). Erin is performing analysis on acoustic telemetry data to study the effects of habitat fragmentation on walleye (Sander vitreus).

While these projects focus on individual species, habitat fragmentation may affect important ecological interactions. Segmenting a habitat can affect predator-prey dynamics; the area occupied by a population could be altered, affecting predators that rely on a prey species in that region. On a smaller scale, fragmentation can affect the genes of a population such that it isn't able to cope as well with environmental changes. In Lake Champlain, this may expose a population to pollution and pharmaceutical contamination in the lake, or invasion by exotic species. Fragmentation may also affect the transport of nutrients and ecological and environmental cycles that occur within the habitat. There are many potential issues that can arise from fragmenting a habitat, but one thing is certain—in order to bring together all pieces of the picture, we must unite bright minds from many different fields to address this concern.

Fragmen_tation
in Lake Champlain

Fragmentation Frenzy!!!
Can you find your way through the maze?

I'm starting to see how all of these issues connect to each other. Fascinating! Let's look at one more example...
Ben & Geoffrey's
Brand new flavors!!

Fragalicious
Chocolate with marshmallow ripple with fudge fish fragmented by cookie chunks

Algal Bloom
Key Lime ice cream with chunky graham cracker film on top

Kiss my Fatty Acids
Salted caramel ice cream with fudge swirl and chocolate covered bacon

Daily Dose
Raspberry sorbet enriched with calcium, injected with a berry swirl

Quagga Muscles
Chocolate infused with whey protein and chocolate almonds

LIMITED EDITION
FLAVORS - SUMMER 2015
Mad Lib

Fill in the blanks to learn about a fish's journey through Lake Champlain!

One upon a time, there was a little yellow perch named _________________ who lived in ________________ Bay. One morning, _________________ asked his mommy fish if he could go see his friend in ________________ Bay. His mom said, "Sure honey, but be careful! There are invasive ________________ and ________________ in the lake!" Little yellow perch left his ________________ and, while swimming through the Main Lake, started consuming some nutritious ________________.

______________ While he was eating, he did not realize that a shadow crept up behind him—it was an invasive ________________!!! He ________________ away as fast as he could to get ________________ away from it. After a long chase, he managed to ________________. However, he soon realized that he did not recognize his surroundings and noticed that the water tasted strange and ________________.

______________ Little did he know, people were dumping ________________ into the lake nearby. He started behaving differently because of ________________ and was also feeling rather emotional. However, he carried on swimming anyways and continued his journey. After swimming some more, he ran into a big ________________ that stopped him short in his path! He didn't know what to do at first, then decided to ________________. After ________________, he found a way through the barrier. On the other side, the water seemed unclear, dirty, and ________________.

Unbeknownst to him, excess ________________ from the terrestrial inhabitants ran into the lake earlier that spring and caused a ________________. He cautiously moved on, but soon noticed his friend was ________________ and that the rest of the population in ________________ Bay was ________________. After seeing this, he turned around to ________________ back home, but suddenly the invasive ________________ from earlier in his journey came back and ________________ him!

I hope you did, too!

I've learned a lot today about how our actions can have so many consequences on our lake and all the species that call it home!
The cohort would like to extend a warm thank you to the National Science Foundation for funding our research projects. We would like to acknowledge Jason Stockwell and Michael McDonald for managing and overseeing the REU programming and for helping us integrate into the scientific community. Additionally we thank Betsy for dealing with our residential needs, the staff of the Rubenstein Lab and the Melosira (R/V) for assisting with our projects, and all of the mentors for taking the time to instill in us valuable research skills we will carry with us in the future!

And thank YOU for reading!