

# A Brief History of Aquatic Research at the W.K. Kellogg Biological Station



# Timeline

1920's W.K. Kellogg, cereal magnate, donates land for the Kellogg Bird Sanctuary, Farm and Forest to the Michigan State College (MSC)



1954 Walter Morofsky hired as first KBS director, with KBS activities focused on teaching summer field courses and hosting visiting summer researchers

1964 Dr. George Lauff hired as first year-round resident KBS director. Lauff negotiates for three KBS resident faculty positions in aquatic ecology. Dr. Allen Knight (stream ecology), Dr. Donald McNaught (zooplankton ecology) and Dr. Robert Wetzel (algae and aquatic plants)

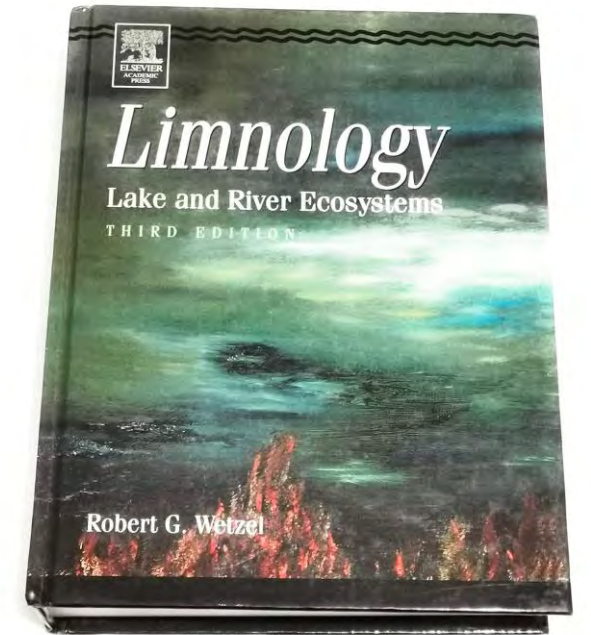




Dr. Robert Wetzel



Published 1975



# “Saving” Gull Lake in the ‘70s and ‘80s – Lauff, Wetzel and the “Ladies of the Lake”



The story begins in the late 1960's when a group of local group of women (the "Ladies of the Lake") became concerned about the increasing 'cloudiness' of Gull Lake. They approached Dr. George Lauff, the newly appointed Director of Kellogg Biological Station, to see if KBS could help.

KBS scientists had documented declines in Gull Lake water quality compared to the 1940's. Their data showed:

- 1) Composition of algae in the lake had changed, likely causing it to appear cloudier.
- 2) Mid-summer oxygen levels in the deep water had declined to levels that were lethal for fish.
- 3) These changes were likely due to increasing phosphorus in the lake, as the result of poorly functioning septic systems and lawn fertilizers.

In 1977, a group of lake residents, including the "Ladies of the Lake", formed the Gull Lake Quality Organization. They worked to raise funds to support the efforts of the four townships surrounding the lake to get the necessary state and federal approvals and the funding to build a sewer system around the lake. The data from KBS researchers was instrumental in convincing federal and state agencies of the causes – and solutions – to the problem.

1980-1984 a sewer system was installed around Gull Lake at a cost of \$12,000,000.

## Kellogg scientists predicting cleaner Gull Lake water

JEANNE BARON  
GAZETTE CORRESPONDENT

**GULL LAKE** — A flood washes over a town. A tornado crushes a department store.

Michigan is no stranger to sudden catastrophes such as these.

But human activities can result in catastrophes as well, and sometimes years can elapse before man-made environmental disasters become obvious.

Gull Lake is a case in point, but one headed for a happy ending if common sense and vigilance prevail.

When white settlers moved into the area around Gull Lake in the early 1830s, they upset a natural balance which had kept Kalamazoo County's largest body of water pristine since its formation 14,000 years ago. A mere century after settlement, long-time lake residents were noticing that the water was not as clear as it had been when they were younger.

Now, Gull Lake's future depends on the residents who encircle it, and to a lesser extent, on the people inhabiting its drainage basin. The lake could degenerate into a murky, algae-filled pool, or return to the sparkling clear lake it once was.

On a scale of one to 10, Gull Lake is a five in terms of biological health, according to George Lauff, director for education and biological science programs at Michigan State University's Kellogg Biological Station, which is located at the northern end of the lake.

"I think the issue here is resource management in relation to both the lake and the drainage area," Lauff said.

But he added that, "The community has really come to the fore in working toward resolving the problem, and long-term improvement will be enhanced by the sewer system and vigilance."

For Gull Lake, the primary problem has been phosphorus enrichment from detergents, lawn fertilizers and most notably, septic system drainage fields. KES's research proved once again people have a direct effect on phosphorus

If all goes well, in 10 to 15 years the lake could be 'back to the conditions that existed in 1930.'

Robert Wetzel enrichment and whether lakes stay healthy.

Phosphorus threatens lakes because it stimulates the growth of algae, Lauff explained. As algae settles out from the warm upper water to the colder lower water, these plants absorb oxygen, which poses a problem in summer.

About 1,100 homes dot Gull Lake, causing phosphorus from sewage to eventually find its way into the lake from septic tanks. Lauff noted the lake sports a high number of people per water frontage because houses are often tiered three in a row, and many more people reside there during summer. Additionally, several institutions, including KES and a nearby Bible campus, house large numbers of people.

"In summer, the lake is strongly layered in terms of water temperature," KES biology professor Robert Wetzel said. "The water layers do not mix to any great extent. So, six months of the year, the lower water layers, which can become depleted of oxygen, are essentially cut off from the upper layers of circulating water."

The picture should improve now that the amount of phosphorus reaching Gull Lake has been reduced. With phosphorus detergents essentially banned in Michigan and a new sewer looping the lake, the biggest problems Gull Lake faces are unnecessary phosphorus lawn fertilization and residual phosphorus leaching from hundreds of soon-to-be unsewered household septic drainage fields.

"If the residual loading from septic systems is eliminated within a reasonable time, and unnecessary



Lauff (standing) and Wetzel look over shoreline water.

lawn fertilization is stopped, I would go out on a limb and say the lake will be back to the conditions that existed in 1930 in about 10 to 15 years," Wetzel predicted. "But that is a little optimistic. People must understand the sewer alone will not guarantee it. But I don't think there would be any hope if the lake had not obtained the sewer. There are just too many people."

Harvey Liss, head of KES's extension programs, said that given all the years of fertilization, soil around Gull Lake contains adequate phosphorus to maintain lush lawns. "All the soil probably needs is nitrogen," Liss said. "If the grass turns yellow, most likely the problem is a lack of nitrogen."

But most residents are able to buy only complete fertilizers which contain phosphorus along with nitrogen and potassium. So,

## Grass roots effort was driving force in sewer project

JEANNE BARON  
GAZETTE CORRESPONDENT

**GULL LAKE** — If Gull Lake once again becomes the crystal clear body of water it once was, a big share of the credit will belong to the 278-member Gull Lake Quality Organization.

The group, molded by a handful of women in the 1960s, has been the driving force in winning public support for the Gull Lake sewer project as well as educating lake residents about the hazards of contaminating the lake water with phosphorus.

Clare Vanderploeg, the organization's secretary, said the group became active at a time when environmental issues were being spotlighted nationally. Locally, lake residents heard a disturbing assessment of Gull Lake's future during a meeting publicizing data obtained by a Kellogg Biological Station student. Then an established area women's group known as the Ladies of the Lake began circulating an article concerning the phosphorus content of laundry detergents of the time.

That information caught the interest of Marian Langman, a summer resident from Jackson, Vanderploeg said. Langman spearheaded an informal group of women dedicated to limiting the amount of phosphorus getting into Gull Lake, so that the lake might flourish again. A few years later, the group became the Gull Lake Quality Organization, and in 1977, the GLQO incorporated.

Drawing upon the Biological Station and the Kalamazoo Nature Center for support, the GLQO became an increasingly important force in educating people about the dangers of phosphorus and the need for a sewer system looping the lake. Members sought donations to fund what needed to be done. Other groups and individuals also became active during the same time, creating a community of hardworking people striving to upgrade the lake they loved and

enjoyed. Fred Buckley, a past organization president, said the push for a sewer was spouted in 1953. "This was 30 years ago before we actually broke ground," he noted. He said the two main hurdles to earlier construction were convincing people a sewer was needed and finding funding for it. Part of the local money needed, about \$67,000 came from private donations, he said.

Backers of a sewer system eventually triumphed, but the effort was an uphill battle. Success meant a substantial cost to taxpayers and meeting together lake residents, four townships and two cities for a major construction project.

"I think anybody who's been around the lake as long as I have really realizes the lake in the late 1960s was certainly much clearer and cleaner," Buckley said. "Those were pretty isolate ladies who became involved."

The Biological Station's involvement began in the mid-1960s when Michigan State University established a resident research facility on the lake at its Hickory Corners campus. George Lauff, KES director for education and biological sciences, said that as more concrete data about the lake appeared, people around the lake became active.

"So I'm really pleased about the tie between the research and the relationship with the community," Lauff said. "If it weren't there, I think the GLQO would still have gotten involved. They spearheaded, we helped. Residents on other lakes should do the same."

The GLQO continues to meet periodically on an as-needed basis and holds an annual meeting each June. Membership dues, which are \$2 a year, pay for mailings to the 1,300 residents around the lake. To join, prospective members should contact Kay Backhouse, 2008 E. Gull Lake Highway, Jackson, 49001.

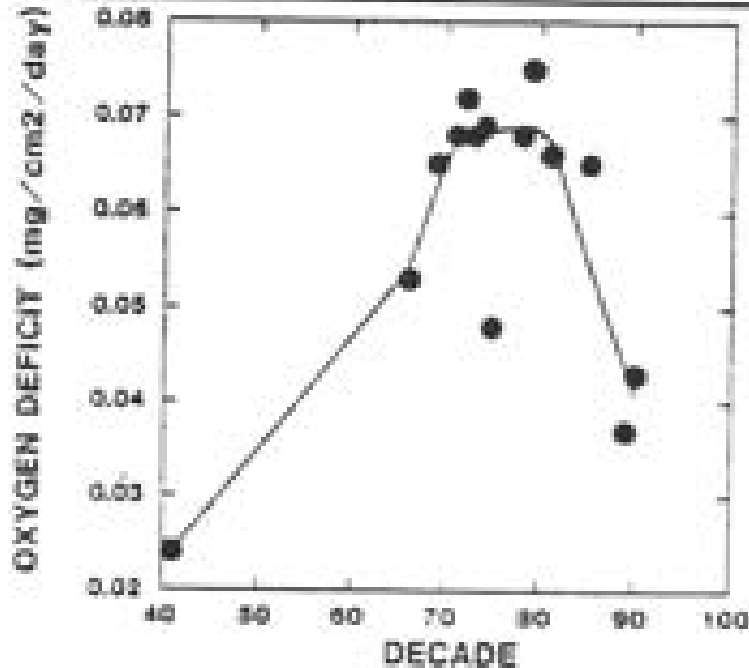
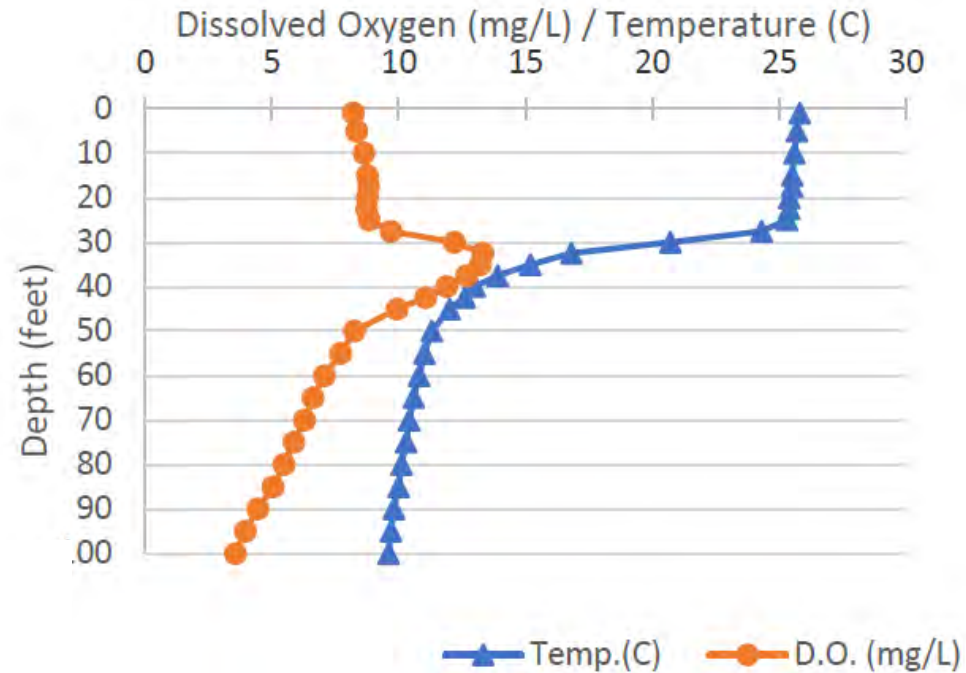


Figure: Oxygen levels in the bottom waters of Gull Lake quickly improved following completion of the sewer system in 1984. In this graph, high values of "oxygen deficit" indicate low oxygen availability in deep waters. The datapoint for 1975 is an outlier due to an unusually cold year.



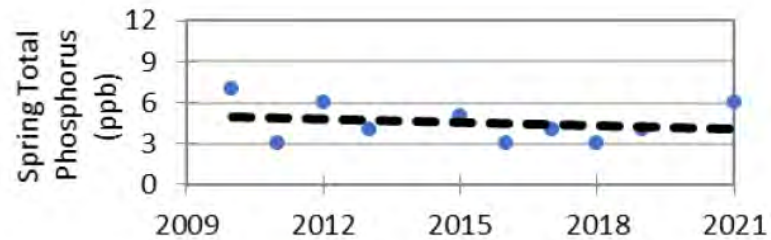
## Dissolved Oxygen and Temperature Profile

8/10/2021



## Spring Phosphorus (parts per billion)

Year	# Samples	Min	Max	Avg	Std. Dev
2021	1	6.0	6.0	6.0	NA
2016-2019	4	<=3 W	<5 T	3.5	0.6
2010-2015	5	<=3 W	7.0	5.0	1.6
2021 All CLMP Lakes	220	<= 3	100.0	14.9	11.0



CLMP data for Gull Lake collected by volunteers from the Gull Lake Quality Organization

KBS aquatic faculty hires in the late 60's and early 70's: Drs. Earl Werner, Ken Cummins, Don Hall, and Mike Klug

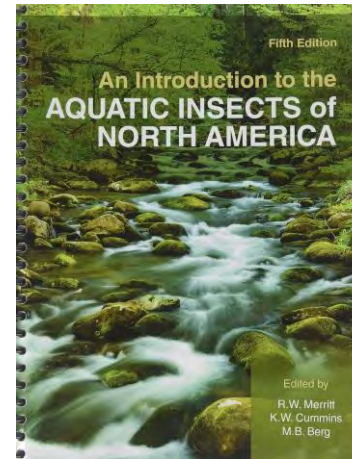
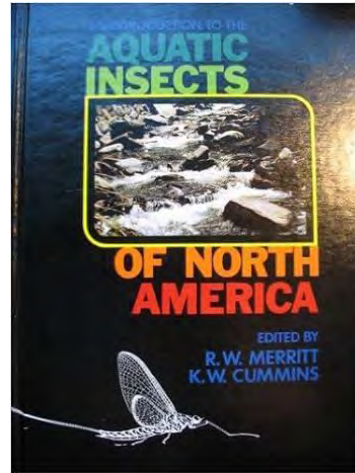


KBS Aquatic Ecology Celebration 2013

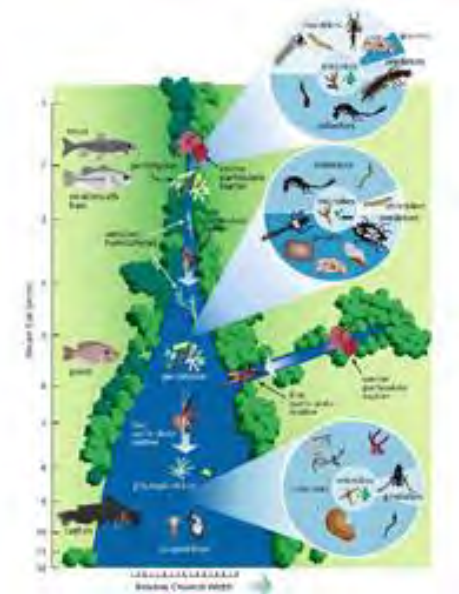


Ken Cummins, in collaboration with Rich Merritt (MSU campus) and others

Aquatic Insects of North America  
1<sup>st</sup> edition 1978  
5<sup>th</sup> edition 2019



“The River Continuum Concept” Published in 1980.  
over 10,000 citations (Goggle scholar)



**The River Continuum Concept**  
(Source: Vannote et al. 1980. Used with permission of NRC Research Press)

# Earl Werner and Don Hall

Experimental studies of species interactions  
using the KBS Experimental Pond Facility



18 experimental ponds, constructed in 1971 with funding from the National Science Foundation and MSU.

# Predation risk and habitat use in bluegill sunfish

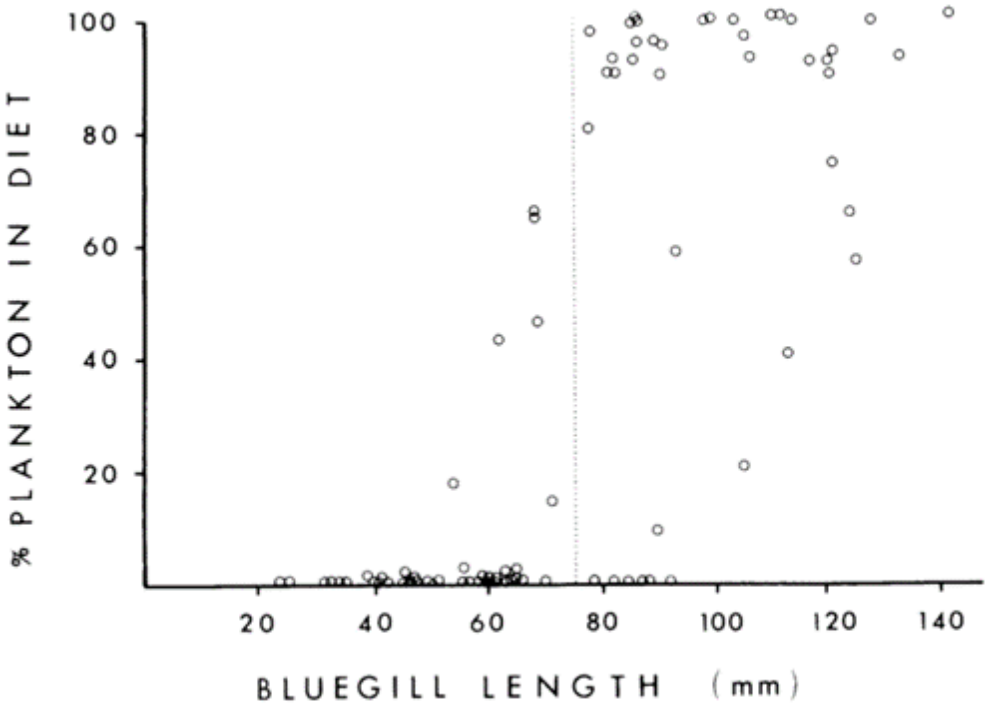
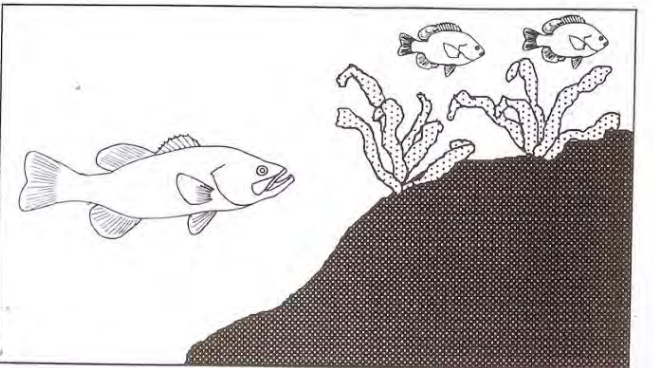
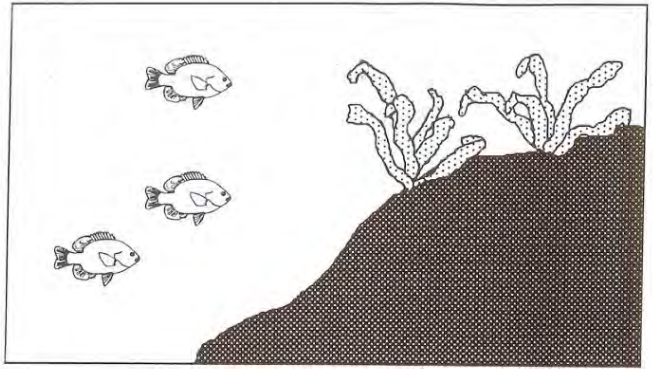


FIG. 4. Percent plankton by dry mass in the diets of bluegills collected from Lawrence Lake and Three Lakes II. Data





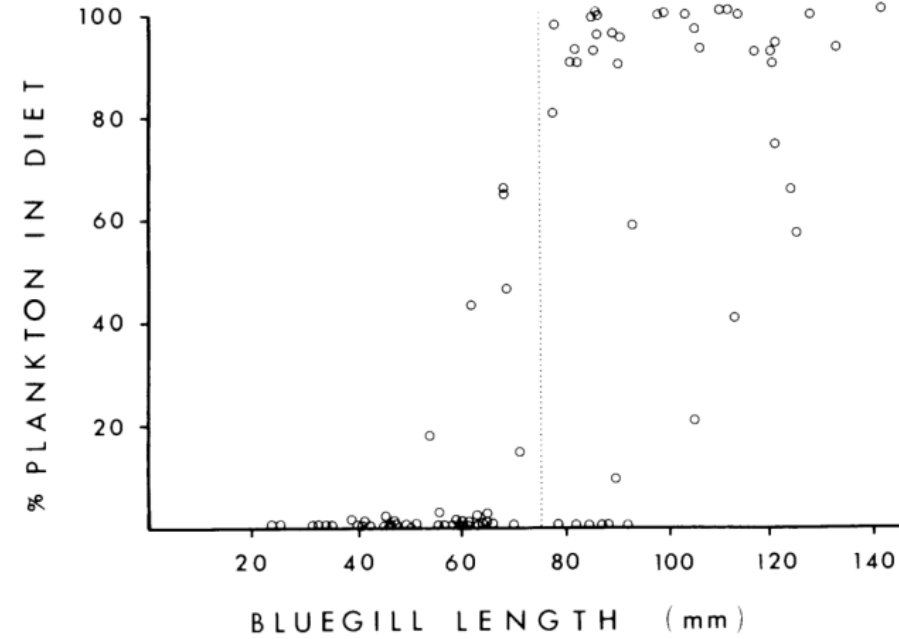
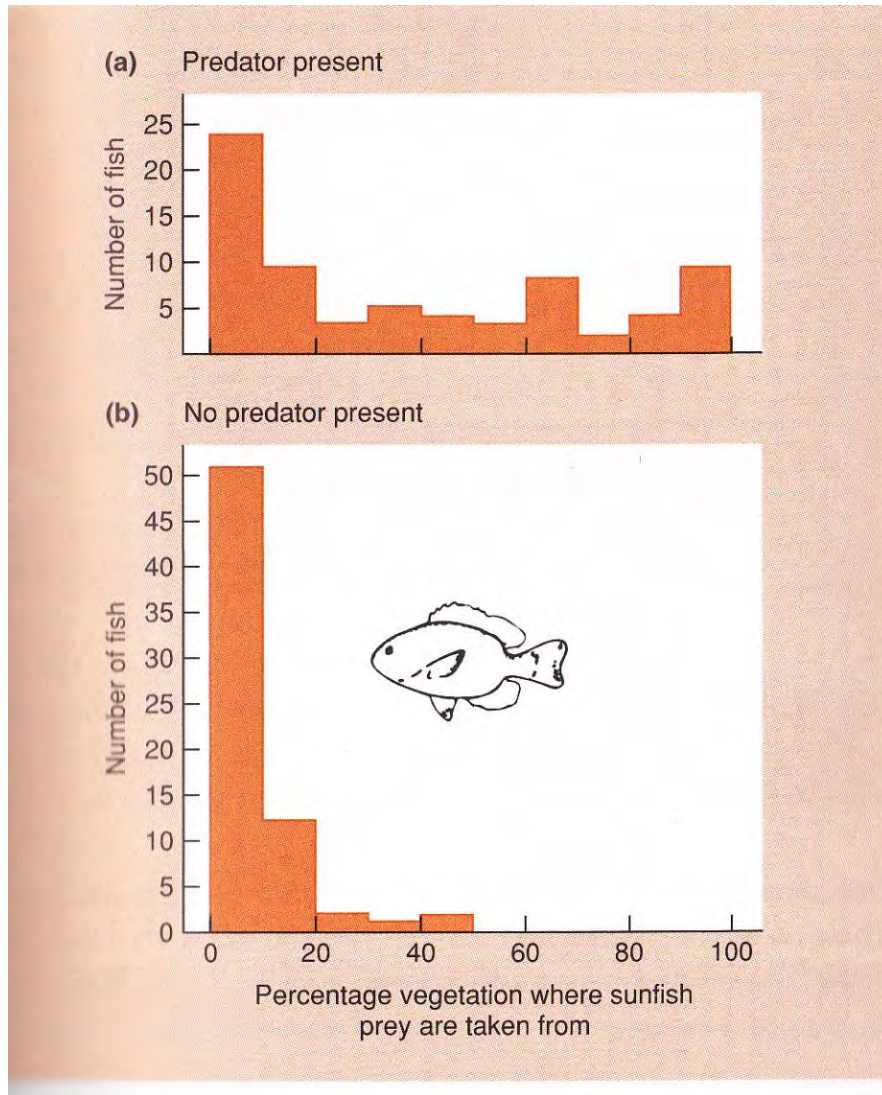
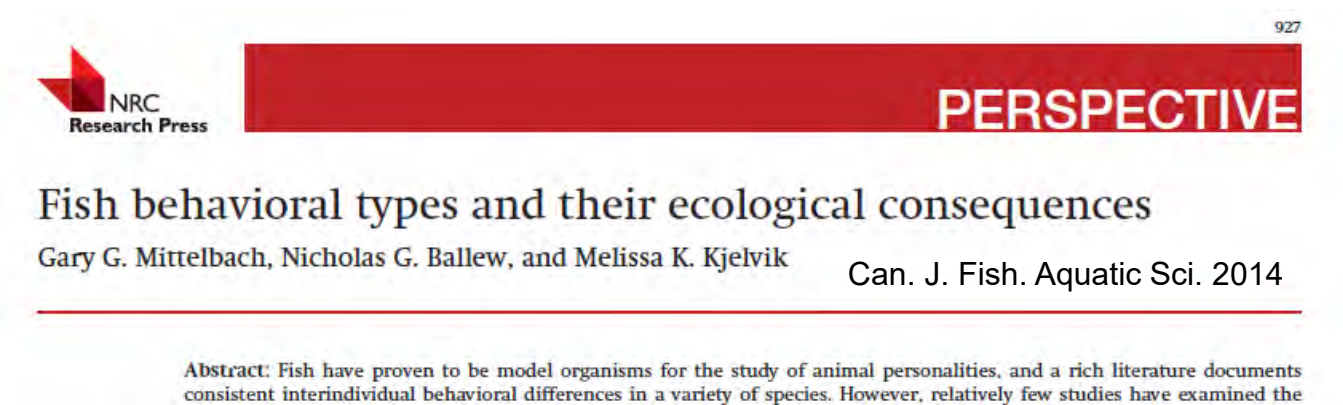


FIG. 4. Percent plankton by dry mass in the diets of bluegills collected from Lawrence Lake and Three Lakes II. Data

Today, there is great interest in the study of **animal personalities**, defined as individual differences in behavior that are maintained through time and across contexts

“Shy” versus “Bold” individuals



Thanks for listening



# Current aquatic research at KBS

Dr. Alisha Shah

Assistant Professor

W.K. Kellogg Biological Station

Department of Integrative Biology





# Shah Lab

- Ecological and evolutionary physiology of aquatic insects.
- Thermal physiology of aquatic insects to understand distribution and response to climate change
- How temperature and predation/competition jointly influence thermal performance
  - Focus on damselfly-dragonfly-fish communities (described by Mark McPeck in 1990s)
- Determining the genomic architecture that underpins thermal tolerance
  - Glacial meltwater stoneflies in Glacier NP and Grand Teton NP

Alisha Shah, Assistant Professor  
aashah@msu.edu



# Janzen Lab

- Ecology, evolution and conservation of freshwater turtles in Mississippi River Basin (ongoing work for 35 years!)
  - Interactive effects of droughts and heatwaves on turtle embryonic development
  - Impact of storm-induced atrazine runoff from ag fields on embryos
  - Anthropogenically-driven flood effects on turtle populations



Fred Janzen, Professor  
janzenf1@msu.edu



# Gerson Lab

- Proposed work: PFAS transport and accumulation in surface water



Jackie Gerson, Assistant Professor  
gersonja@msu.edu



# Litchman Lab

- Interplay of biotic and abiotic factors in structuring aquatic microbial communities
  - Effects of light and nutrients on competitive interactions in phytoplankton
  - Understanding ecological traits and trade-offs to predict plankton community structure
  - Global change and harmful algal blooms



Elena Litchman, MSU Foundation Professor  
[litchman@msu.edu](mailto:litchman@msu.edu)



# Fitzpatrick Lab

- Evolution, ecology, and conservation of small populations, often through the lens of genetic rescue
- Particularly interested in conservation of aquatic organisms including amphibians, turtles, and fishes.
  - Studied native rainbow darters in the Kalamazoo River drainage and found link between higher levels of genetic variation and higher thermal tolerance, suggesting that genetic diversity may be an important factor in tolerating stress.
  - Has revived a long-term mark-recapture project on painted and Blandings turtles at a nearby marsh that began in the 1960s. The goal of that project is to understand how survival and sex-ratios are changing over time, potentially as a result of climate change.



Sarah Fitzpatrick, Associate Professor

[sfitz@msu.edu](mailto:sfitz@msu.edu)



# Hamilton Lab

- Water quality and water level monitoring in several local lakes
  - Gull Lake
  - Crooked Lake
  - Fair Lake
  - Kalamazoo River
  - Local streams around KBS
- Entire database publicly accessible



Steve Hamilton, Professor Emeritus  
hamilton@msu.edu