American Fisheries Society
Southern Ontario Chapter

Newsletter of the AFS Southern Ontario Chapter

Volume II, Issue 11 September 2002

A Message from your President

I would like to take this opportunity to welcome everyone to a new season for the AFS SOC. I took over the reins from Mike Roy on September 1st and would like to take this opportunity to thank Mike for his leadership and vision over the past two years. Under Mike's directions we established new committees for education and professional liaison. Mike is continuing in this role as co-chairman for the professional liaison committee and is actively pursuing the development of AFS SOC relationships with other profession organizations such as the Canadian Water Resources Association. These relationships are critical in terms of breaking down traditional barriers between fisheries biology and other scientific disciplines and will allow us to improve our understanding of the focus and role of these organizations in the areas in which we work. We still need a chairperson for our education committee. This committee will be responsible for promoting fisheries science both within the school system, but equally importantly, within the community at large. For a limited amount of time commitment, you could make a huge contribution to our cause.

A major disappointment of this past year was the cancellation of our annual general meeting in Dorset due to the provincial civil service strike. We worked quickly to try and get the word out once the decision to cancel had been made. To my knowledge only one person actually showed up at Dorset on that weekend and I am sworn to secrecy as to that individual's identity! We had worked very hard and had an excellent lineup of speaker's in place as well as social festivities including the return of those musical gods "The Fishheads". Although the fishheads are now in retirement we may be able to coax them into a comeback for our 2003 meeting. Speaking of that meeting, book the weekend of March 21-23, 2003 now for out annual meeting in Dorset. We have confirmed the venue and will not be bothered by a strike this year. We are just now developing the theme and will be sending out additional information before Christmas this year.

I'd like to thank you for the opportunity to work on behalf of the membership as your President this year. With the quality people that surround me on your executive committee, I am confident that 2002-2003 will be another year of growth and reward for the AFS Southern, Ontario Chapter.

Sincerely, Rob Steele

AFS SOC 2002-2003 Executive Committee

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Probability of winterkill in Central Ontario lakes.

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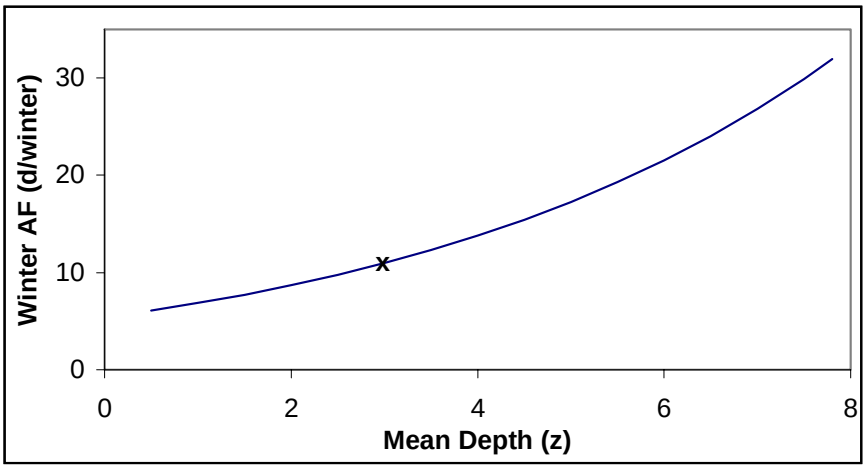
Some years ago I investigated how the number of fish species (species richness) in South Central Ontario lakes depends on anoxia, in particular, the anoxic factor (Table 1, Nürnberg 1995a). Like others before, I found that the larger the area the more fish species exist, but if the lake has an anoxic hypolimnion in the summer (high anoxic factor AF_{sum}), it tends to support less species. In fact these two variables explained half of the differences (50%; AF alone 27%) in species number in these 52 lakes with a median area of 57 ha and a median AF of 10 d/summer.

Different from summer AF, the winter AF (AF_{win}) that quantifies anoxia under ice, was a strong predictor by itself, 44% of species number could be explained, and lake area did not have any additional effect. However, lake mean depth did (z, volume/area), so that 71% of species richness could be explained by AF_{win} and z (median 7 m for a 1.8 – 22 m range).

Using this relationship (Fish species number= 4.92 - 6.12 log [AF_{win} + 1] + 0.56 z, n=32, $p<0.001$) it should be possible to predict the potential of winterkill. If the lake is fishless and species richness equals zero the multiple regression equation can be rewritten and a threshold value of AF_{win} can be determined above which the lakes were on average fishless in these Ontario lakes. If we assume that they are fishless because of oxygen depletion, this threshold should be an indicator for winterkill. This assumption is valid since the fish belonged to the centrachid-Esox assemblage that is oxygen sensitive.

z (m)	Threshold AF_{win} (d/winter)
0.5	6
1	7
1.5	8
2	9
2.5	10
3	11
3.5	12
4	14
4.5	15
5	17
5.5	19
6	21
6.5	23
7	25
7.5	30

Threshold of $AF_{win} = -1 + 10^{\wedge(0.091\ z + 0.804)}$



If a lake is for example 3 m deep on average (see x on the figure), and exhibits seasonal anoxia equivalent to 11 days of the whole lake under ice or more ($AF_{win} > 11$), then winterkill is likely to occur. If the lake is acid stressed, low species number can occur with even less oxygen stress; e.g. most of the lakes with pH below 6 had less species and fell below the regression line of Fish species number versus AF_{win}, while the lakes above 6 fell above the line.

Cold water fish including Salmonidaes, Coregonidae and Gadidae were even more sensitive to winter anoxia and they only occurred when AF_{win} was below 4.4 d/winter.

It would be interesting to test these relationships with other lakes. Perhaps somebody has oxygen profiles and hypsographic information of lakes prone to winterkill and can try the regression out. In cases where large fluctuations of lake level occur, effectively changing mean depth, management may be optimized to prevent winterkill. Another way of using this concept is to compute hypoxic factors instead of anoxic ones by using a higher threshold of oxygen concentration, perhaps 6.5 mg/L instead of 1 or 2 mg/L (Table 1, Nürnberg 2002). Such quantification of hypoxia may be even more useful for describing the abundance of fish species in Ontario lakes.

References:

Nürnberg, G. K. 1995a. Anoxic factor, a quantitative measure of anoxia and fish species richness in Central Ontario lakes. Transactions of the American Fisheries Society **124**: 677-686.

Nürnberg, G. K. 1995b. Quantifying anoxia in lakes. Limnology and Oceanography **40**: 1100-1111.

Nürnberg, G. K. 2002. Quantification of oxygen depletion in lakes and reservoirs with the hypoxic factor. Lake and Reservoir Management **18**: 000-000.

Probability of Winterkill—Continued from page 2

Anoxic and Hypoxic Factor definitions

The **Anoxic Factor** (AF) quantitatively summarizes the extent and duration of anoxia (lack of oxygen) in stratified lakes (Nürnberg 1995b). It is based on a series of measured oxygen profiles and morphometric data and can be computed for any lake or reservoir. To render this index comparable across lakes of different sizes, AF is divided by lake surface area. Expressed this way, AF is a ratio that represents the number of days in a year or season that a sediment area equal to the lake surface area is anoxic. Hence, its units are d/yr or d/season; i.e., summer or winter. Anoxic factors can be predicted from average phosphorus concentration and lake morphometry when DO profiles are not available.

To compute the AF, first, the oxycline must be determined from oxygen profiles. The criterion for anoxia is 1 or 2 mg/ L (depending on the method of DO determination). Next, the period of anoxia (t_i) must be multiplied by the corresponding area (a_i) and divided by the lake surface area (A_o) corresponding to the average elevation for that period. These terms of n, numbers of periods at different oxyclines are then added up over the season or year. In this way, AF is comparable between lakes, like other areal measures, e.g., areal nutrient loads and fish yield.

The anoxic factor can be computed from following equation:

$$AF = \sum_{i=1}^{n} \frac{t_i \times a_i}{A_o}$$

where t_i, the period of anoxia (days),

a_i, the corresponding area (m^2),

A_o, lake surface area (m^2) corresponding to the average elevation for that period,

n, numbers of periods with different oxycline depths during the season or year

When classified with respect to trophic state, below 20 d/yr indicate oligotrophic conditions, 20 to 40 d/yr are usually found in mesotrophic lakes, 40 – 60 d/yr represent eutrophic conditions and above 60 d/yr is typical for hyper-eutrophic conditions.

The **Hypoxic Factor** summarizes the extent and duration of hypoxia, where DO concentration is below a certain threshold, e.g. 6.5 mg/L. It can be calculated from DO profiles like the AF, by substituting the oxycline depth with a depth for which the DO content is below 6.5 mg/L DO.

Some Current Research - Zebra Mussel and Spiny Waterflea Survey

Jim Muirhead, Great Lakes Institute for the Environment, University of Windsor

Effective management of invasive species requires predictions of invasion routes and transport mechanisms in order to develop preventative measures, for if populations have already become established, the mitigation of the effects of the invading species is often costly and difficult. Since being introduced into the Great Lakes via ballast water in the late 80's and early 90's, two invading species, the spiny waterflea (*Bythotrephes longimanus*) and the zebra mussel (*Dreissena polymorpha*) have spread to 80 inland lakes in Ontario.

For part of my graduate work, I will be creating a GIS model in which I compare the pattern of invaded lakes with overland boater traffic in order to predict probabilities of invasion for non-invaded lakes by the spiny waterflea and the zebra mussel based on various transport mechanisms associated with fishing habits and trailering boats. Because the two species appear in many of the same lakes, and the mechanisms of overland dispersal are slightly different – zebra mussel adults can be transported by aquatic vegetation attached to boats and trailers, the larvae by water sources such as bait buckets, whereas the spiny water flea is transported mainly by water sources – the model will begin to serve as a basis to infer successful invader characteristics in conjunction with dispersal mechanisms.

This survey is designed primarily for visitors who are trailering boats to and from marinas and public docks. Therefore, when faced with questions on your current location, please fill in information on the last lake that you fished or boated on. The survey should only take 4-5 minutes to fill out and is located at http://web2.uwindsor.ca/biology/muirhead/survey.htm.

For more information, contact:
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North American Lake Management Society's 22nd International Symposium "Staking Our Claim in the Management of Our Water Resources" Anchorage, AK, USA October 29 – November 2, 2002

Don't miss out on an amazing opportunity to learn, network, and study in one of the world's most beautiful and amazing natural environments. Join hundreds of folks just like yourself in Anchorage for over 130 technical presentations grouped into 13 concurrent topic sessions; 7 day- or half-day long workshops devoted to current topics in the aquatic areas; poster displays; commercial exhibits, and networking opportunities.

The opening general session will feature Mr. Cacye Parrish, acting Deputy Director of the Water Protection Task Force. Prior to joining the Task Force, he served as the Deputy Director of the Standards and Risk Management Division of the Office of Ground Water and Drinking Water. Mr. Parrish will speaking on the topic of "The Safety of Our Water Resources and Bioterrorism."

REGISTRATION INFORMATION AND MORE DETAILED INFORMATION IS FOUND AT www.nalms.org/symposia/anchorage/index.htm Register on-line, fax, or phone. Questions? Call 608-233-2836 or email: nalms@nalms.org

56th Annual Canadian Conference For Fisheries Research (CCFFR)

Joint CCFFR / SCL Opening Session

Protecting Canada's Waters

Themes:

1) Impacts of Invasive Species
2) Studies of Biodiversity at a Landscape Scale
3) Impacts of Multiple Stressor Interactions on Aquatic Ecosystems

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For more information on the CCFFR / SCL conference visit
http://www.phys.ocean.dal.ca/ccffr/

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