THE BRODIE CLUB

ROYAL ONTARIO MUSEUM OF ZOOLOGY

THE 1,037th MEETING OF THE BRODIE CLUB

The 1,037th meeting of the Brodie Club was held at 7:30 pm on March 16, 2010 in Room 432 of the Ramsay Wright Laboratories of the University of Toronto.

Chair: Sandra Eadie
Secretary: Ricky Dunn

The meeting was attended by 24 members. There were no guests this month.

Roll Call, Present: Abraham, E. Addison, R. Addison, Bertin, Bousfield, Bryant, H. Currie, Dunn, Eadie, A. Falls, B. Falls, D. Hussell, J. Hussell, A. Juhola, H. Juhola, Larsen, Lumsden, Machin, Reading, J. Rising, T. Rising, Speakman, Tasker, Tomlinson.

Regrets: J. Bendell, Y. Bendell, Boswell, Crins, Huff (in the UK), N. Martin, N. Martin

Minutes:
Several corrections to last month's minutes were sent in by email and have been made:

- Spelling of H. Curry corrected to H. Currie.
- Regrets from Risings and George Bryant have been added.
- Jean Iron reported the sighting of an adult Ivory **G**ull on the Toronto waterfront on Feb. 15. This is a rare occurrence for Toronto. Ivory Gulls normally stay in the Arctic but there have been at least five south of Newfoundland in eastern North America this winter.

Announcements:

- Oliver Bertin reminded club members to think about moving the date of May meeting from the third Tuesday of the month, to either the first or second. The date will be determined at the April meeting.
- Bruce Falls shared the sad news of the death of Madeleine Pageot, on March 13. Madeleine was the wife of Dan Strickland, the speaker at our December 2009 meeting.
- Bruce Falls reminded us that the speaker for our next meeting will be Bridget Stutchbury, an ornithologist at York University.
- Ed Addison updated us on the presentation for the May meeting. Dan Paleczny, of the Ontario Ministry of Natural Resources, will speak about "Planning, development and eco-tourism considerations for the Valley of the Whales World Heritage Site in Wadi el Rayan, Egypt."

SPEAKER:

The speaker, Dr. David Evans, was introduced by Ed Addison. David is a Senior Research Scientist with the Aquatic Research and Development Section, Ontario Ministry of Natural Resources and an Adjunct Professor at both York and Trent. David is from B.C. and obtained a B.Sc. in marine biology at the University of Victoria and his M. Sc. and Ph.D. at the University of Toronto where David was Fred Fry's last Ph. D. student. In addition to his work on Lake Simcoe, which dates from the 1970's, he has done much research on lake trout elsewhere in Ontario.

"The multi-stressor state of Lake Simcoe: influence of nutrient loading, invasive species, and climate change."

Lake Simcoe is small relative to the Great Lakes (721 km^2), but shares some characteristics of a large lake, including depth (41 m), fauna that include warm-, cool- and cold-water fish, and physical processes, especially related to hydrodynamics. Its watershed has 360,000 people living in it, a number projected to double in future. Human impact on the lake is very high, including output from 14 sewage treatment plants, extensive phosphorus (P) input from agricultural run-off and atmospheric sources (about 75 tonnes/yr), and disruption of the faunal ecosystem through stocking and harvesting of fish and repeated introductions of non-native species.

The lake is unique in being the only one in Canada with its own legislative act (Lake Simcoe Protection Act, passed by Ontario in 2008). This Act requires implementation of the Lake Simcoe Protection Plan (see http://www.ene.gov.on.ca/en/water/lakesimcoe/index.php), aimed at protection and restoration.

Past history shows why the lake needs attention. Cores from the lake bottom indicate that chlorophyll increased gradually from 1790-1890, then a further 10-fold by 1950. After that it decreased to about four times pre-settlement values; although after 1995, loads increased again. Chlorophyll levels are indicators of algal and phytoplankton growth, which in turn are correlated with amount of P in the water. Also, ^{15}N levels in cores and in historic collections of fish scales document changes in trophic levels of lake food chains from about 1840 to 1990, probably due to animal, including human, waste getting into the water.

Management of P inputs to the lake since the 1980s have helped to hold the line against further increase, but there has been no overall decrease. Nonetheless, there have been some huge changes in the food web and in fish productivity since then – demonstrating that P levels alone do not control the ecosystem dynamics.

Faunal diversity is high (49 native fish species alone), but relative numbers have fluctuated over time. A few examples: lake herring and lake whitefish have varied in abundance; two common species of sculpin became rare; rainbow smelt were introduced and had a huge

boom in population before becoming rare about 30 years later and more recently beginning to increase again.

For 20 years there was no natural recruitment of lake trout, and the fishery for this species was sustained only by annual stocking. Failure of natural recruitment in lake trout is related to lack of dissolved O_2 in bottom layers of the lake in late summer, resulting from high P inputs. Adult lake trout move to greater depths in summer to avoid warmer surface waters, and young trout move even deeper to avoid being eaten by adults. If the O_2-deficient layer is too thick, there is no space between that layer and the predatory adults, greatly impacting survival of young. Large reductions in other prominent fish species (whitefish, herring, rainbow smelt) occurred at somewhat different times than the drop in trout, and were probably due to different factors in each case.

The establishment of zebra mussels in the early 1990's led to amazing changes. In only four to five years, numbers reached up to 80,000/m^2. That many mussels can theoretically filter the entire surface waters of the lake daily. Water clarity improved markedly, plant growth increased (due to better solar penetration of the water column), in turn increasing plant grazers and productivity on up the food chain (e.g., greater than 20-fold increase in non-mussel benthic invertebrates). Mussels also prevent much particulate matter and P from reaching the deeper waters of the lake (where it would reduce O_2), and mussel excreta and pseudofeces provide a rich near-shore nutrient resource. Large year-classes of lake whitefish and lake herring were produced in 2004, and sculpin have again become common. Reduction in offshore phytoplankton and a shift of production to the inshore zone appears to have resulted in improved O_2-conditions in the deeper waters of the lake—which has led to renewed natural recruitment of lake trout.

A review of factors affecting the ecosystem show multiple causations. Although climate change has had measurable effects on Lake Simcoe, it is not thought to be a major perturbation of the system currently, although reduced duration of ice cover is correlated with warming climate during the past 50 years and duration of thermal stratification is increasing. Delayed spawning of lake trout appears to be one consequence and other biotic effects will undoubtedly emerge as understanding increases. Introduction of new exotic species, which is ongoing, appears to be having much stronger effects on ecosystem function. Phosphorus inputs continue to be too high and reduction is definitely needed.

The effects of perturbations to the food chain on ecosystem function are beginning to be recognized and appear to be having important broad effects on water quality, production processes and community structure. Decline in the top predator (lake trout) leads to increase in the fish they eat; which in turn reduces numbers of what THEY eat, and thus an increase in the next lower level--leading to alternating increases and decreases in successive trophic levels down the food chain. When P-sequestering fauna and flora decline, phosphorus appears to increase in the water. At the same time dissolved O^2 improves when algal biomass declines, which positively benefits the survival of the top predators. Effects can go from bottom-up as well: If something alters abundance of animals at a particular trophic level, that affects numbers of whatever depends on it higher in the food chain, and so on upwards through the chain. Perturbations do not have to start

at top or bottom, but can come anywhere along the chain, setting off cascading effects both upwards and downwards.

The effects of zebra mussels made things look good for Lake Simcoe for about a decade, but in 2009 there was a marked drop in dissolved O_2 in bottom waters, back to pre-zebra mussel levels. What is happening? While not yet fully understood, it may be related to the large 2004 year-class of lake herring having cropped the zooplankton grazers, allowing an increase in phytoplankton production. Data are still being analyzed that will help to clarify these relationships. Also, zebra mussel density appears to have declined by as much as 10-fold from its initial peak. Sustained P input and regular perturbations of the food web make it likely that the future will bring continued volatility. Some progress is being made in controlling perturbations; for example, annual stocking has been reduced by half to provide a better balance between the abundance of lake trout and their prey.

More work is needed on management of phosphorus (both agricultural and atmospheric), protection and restoration of riparian and wetland areas in the watershed, sustainable usage of water in urban areas, continued lake monitoring and adaptive management of the fishery, and prevention of transport of non-native species between watersheds.

Note: Thanks to David Evans for prompt suggestions for improving the first draft of this account.

QUESTIONS:

Given the 2009 drop in dissolved O_2, what's the prediction for future?
More of the same – perhaps a long-term return to pre-mussel conditions, and continued volatility in the food web. Herring numbers may not immediately be affected, as they are pelagic.

Are there comparable studies of other lakes this size?
Lake Simcoe is quite unique in Canada in terms of its size, latitude, morphometry and availability of long-term ecological data, but relevant studies are available from the Laurentian Great Lakes and a few large European lakes. For example, ecosystem level responses to eutrophication, oligotrophication and invasion of non-native species, such as Dreissenid mussels, have been widely studied in other large lakes.

What happens to O_2 levels under the ice in winter?
There is not much information. Oxygen depletion definitely occurs but depletion rates are slower in cold water and total depletion is less because the duration of ice cover is shorter than summer stratification, i.e. when the deeper waters are isolated from the atmosphere. Sensors were installed during winter 2010, so there will be some data to begin looking at winter depletion rates in more detail.

Zebra mussels have crashed in other places where they were introduced – will they here?
There has been a reduction; as much as 10-fold fewer mussels currently compared to the initial two years after establishment of zebra mussels, based on surveys done during the early 90's and 2008 – but information is not available for the intervening years.

What is the effect of Double-crested Cormorants, which have exploded in numbers and must be eating significant numbers of fish?
Expect that significant fish predation occurs as has been seen in Georgian Bay of Lake Huron, but studies have not yet been undertaken on Lake Simcoe. Will discuss with colleagues to generate interest.

Are round gobies going to explode in Lake Simcoe, as they have elsewhere?
The goby population is known to be expanding spatially around the lake and food web effects are expected through predation on other species potentially including invertebrates and fish – we want to track this.

How do warm water fish fit into the picture?
Our studies of stable isotopes of C and N suggest that yellow perch and smallmouth bass have benefited from the zebra mussel trophic enhancement of near-shore waters, but work is in progress and results are not yet complete.

The speaker was thanked by John Speakman, who has connections to Lake Simcoe going back 75 years. John commented that that there are 50,000 fish huts on the lake each winter and that the annual value of the fishery is a billion dollars.

NOTES & OBSERVATIONS

Bruce Falls commented on the weather – a high of 15C today, with several more days of temperatures in the mid-high teens predicted for the rest of the week.

Sandra Eadie noted a report of a melanistic King Penguin on South Georgia, a sub Antarctic island. Photo taken by National Geographic photographer, Andrew Evans.

Bruce Falls found a report on the web of a hybrid White-throated X Song Sparrow. He decided it was a tan-stripe morph of the former species, and after discussion, convinced the reporter of that. The rub is that the reporter was a former Falls student!

David Tomlinson saw a honeybee on snowdrops today; this was the earliest record for his garden.

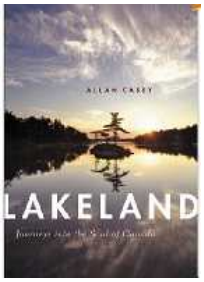
John Speakman recommended that anyone who has not yet looked at the photos on the photographer's website circulated to Brodie Club by Ron Pittaway and Jean Irons a while back should take a look, as they are really fine (**http://peregrineprints.com/ind__WhatsNew.htm**).

Ron Tasker reported appearance of hibernating butterflies, as well as lots of robins.

David Hussell looked at weather maps and predicted arrival of Tundra Swans at Long Point 10 days ago—so he went to look. No swans. Two days later they were reported present, and a trip the next day turned up several thousand. Winds on the day they actually arrived had slight easterly component, whereas Hussell's predicted day would have faced swans with some headwind. Hussell's conclusion: the swans know what they are doing.

Sandra Eadie mentioned a book that may be of interest: "Out of Thin Air: dinosaurs, birds and the earth's ancient atmosphere," by Peter Ward. It indicates that there was less O_2 in the atmosphere in the time of dinosaurs, and birds may evolved in those conditions, making it possible for them later on to exploit high-altitudes (where O_2 is low).

Helen Johola has provided the title of a book that makes good reading following this month's talk. It is titled Lakeland and was written by Allan Casey and published in 2009 by Greystone Books.



The meeting was adjourned at 9:40 pm.

NEXT MEETING

The next meeting will be held on Tuesday, April 20, 2010 at 7:30 pm in Room 432 as usual.

CORRESPONDENCE

Mar 17, 2010 –from Yorke Edwards.

The Birds We See Almost Daily

Glaucous-winged Gulls: Every day there are gulls flying by while others are standing at the edges of small rocky islands that are not far beyond our view.

Harlequin Ducks: Almost every day we see some passing by slowly beside our shore, except in summer when they go into the USA mountains to nest.

Great Blue Heron: Rarely one is seen beside the sea, usually standing there all day. It seems to eat very early in the morning.

Great Cormorants: A few are often seen standing alone on the small rocky islands that are near our shore.

Bald Eagles: Just stands upon a post by the sea on an island through most days. In very early morning it goes to hunt for breakfast.

House Finches: They live in groups around our houses, singing their poor songs every morning except in rain or in the cold of winter.

Northwestern Crows: They live near beside the sea, flying about in cities as well as into farmer's fields. These crows are smaller than the eastern variety.

House Sparrows: Walking along our road, in some places there are rather loud noises coming out from garden bushes.

American Robins: Near our house they stay into December and some stay through winters. Many mornings I walk under them on the wires above.

Oystercatchers: They are often seen beside the sea, big and black with long red bills. There is usually just one or two but sometimes in a bigger group.

Cooper's Hawk: Sometimes one flies near our windows, going back and forth across the street, and into the trees of the nearby golf course.

Red-winged Blackbird: Here there are a few living by the sea and daily come often to gardens near the sea to the several food boxes on the small trees.