THE BRODIE CLUB

Established 1921

# THE 1,064th MEETING OF THE BRODIE CLUB

The 1,064th meeting of the Brodie Club was held at 7:30 pm on Tuesday, March 19, 2013 in Room 432 of the Ramsay Wright Laboratories of the University of Toronto.

Chair: Martyn Obbard
Secretary: Ed Addison

The meeting was called to order at 7:37 PM and was attended by 38; 28 members and 10 guests.

**Roll Call:**
**Present:** E. Addison, R. Addison, Bertin, Boswell, Carley, Crins, Currie, Daniels (first meeting as a new member), Dunn, Eadie, A. Falls, B. Falls, D. Hussell, J. Hussell, Iron, Johnson, A. Juhola, H. Juhola, Machin, McAndrews, Obbard, Pittaway, J. Rising, T. Rising, Seymour, Speakman, Sutherland, Zoladeski.

**Regrets**: Abraham, Beadle, J. Bendell, Y. Bendell, Bryant, Curry, Kotanen, Larsen, Lumsden, Martyn, Muller, Rapley, Riley, Slessor.

**Guests**: Bill Cole (guest of Ricky Dunn), Greg Stuart (Seymour), Terry Marescaux (Bertin), Maureen Scott Harris (Johnson), Ann Bell and Jerry De Marco (J. and T. Rising), Eric Davis (B. Falls), Emily Drystek and Sandy Smith (A. Falls), and Sharon Hick (McAndrews).

**Minutes**: Minutes of the February meeting were approved as written. However, it was later noted that guest "Emily Drysek" at that meeting was actually "Emily Drystek" (a guest again this month). Apologies to Emily.

## Reports of Committees

- **Program:** B. Falls: Speaker next month will be **John Ambrose** of Guelph and Pelee Island, speaking on **trees and other curious plants of Pelee Island.** John is a former curator of the arboretum, University of Guelph and curator of botany and manager of horticulture at the Toronto Zoo.

- **Field Trip and Picnic:** B. Falls reminded us that we should further develop plans for this spring's field trip. Seymour suggested reviewing other suggestions made last year. These included Long Point and the Ottawa Valley, but both are too distant for many.

  H. Juhola suggested a visit to the Toronto Field Naturalists' Jim Baillie Nature Reserve, midway between Uxbridge and Lake Simcoe. It is part of a wetland complex described as very high quality, with undisturbed swamp forest and diverse flora with many regionally rare species. A picnic shelter and outhouses are on site, and there are about 3 km of trails. Helen suggested George Bryant and/or Nancy Dengler as potential leaders, but nothing has been arranged – volunteers welcomed.

R. Addison and others will gather more information. Additional suggestions for field trip locations/leaders are encouraged.

- **Website:** A reminder that the website URL is http://thebrodieclub.eeb.utoronto.ca/, and the password is TBC1921. We'd love to have some of your natural history photos to beautify the site and also photos of past Brodie Club activities.

- **Membership**: A. Falls announced that Sid Daniels is our newest member, and he was warmly welcomed with a round of applause.

**New Business**

Bill Cole, of EEB, extended an invitation to all members to attend the 8th Annual Atwood Colloquium to be held April 12 and 13 at UofT. Information on the keynote speakers and the Colloquium location is found at http://www.eeb.utoronto.ca/news-events/atwoodcolloq.htm The 2013 roster of presentations will be posted in the near future.

**SPEAKER:**

Bruce Falls introduced the speaker, **Rowan Sage**. Rowan completed his Ph.D. at UC Davis. He has been a faculty member at U of T for 20 years, presently as professor in Ecology and Evolutionary Biology as a plant physiological ecologist. His current particular interests regard plant responses to climate change, especially plants known as 'C4' plants that process carbon during photosynthesis using enzymes different from two other more common forms of photosynthesis in plants.

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**Global Change: It's More Than Just Climate Change**

Rowan gave a brief synopsis of some of the trends in our changing climate (CC) including the much accelerated increases in carbon dioxide [$CO_2$], particularly since 1970. Other 'greenhouse gases' rapidly accelerating in occurrence in the atmosphere include methane [$CH_4$] and nitrous oxide [$N_2O$], both of which have a vastly greater impact per unit weight on global warming than does $CO_2$.

The *International Panel on Climate Change* (IPCC) has summarized many current and expected future impacts of CC on the Earth (e.g., the ongoing bleaching of coral and rapid damage to polar ecosystems). Rowan noted one could dwell on these 'gloom and doom' matters enough that we would all want to go out after the meeting and 'jump off the building'.

Our focus needs to broaden beyond CC because if we could stop CC, other global change (GC) would continue with things like eutrophication of the planet. We must focus on GC, the bigger picture, rather than on CC which is but a part of GC.

There are different scales of these impacts. At the global level, we have increases in atmospheric $CO_2$, changes in climate, $CO_2$ increasingly damaging ocean chemistry, etc. At more regional scales we have changes in biogeochemical processes, loss of species, etc. and some of the regional changes are occurring in enough areas to collectively impact at a global scale.

The major drivers of GC ranked by their level of relative impact are:

- land use change
- CC

- eutrophication (mainly nitrogen)
- invasion of exotic species
- enrichment of atmospheric $CO_2$.

Land Use

Our best visual synopses of some aspects of global change arise from pictures of Earth from space. At night, we see the distribution of urbanization land use change via the patterns of light over the globe. Urbanization creates atypical habitats and on the basis of area has less of an impact than agriculture and deforestation.

The biggest impacts of human biomass are in eastern Asia, the Indian sub-continent, western Europe and eastern North America. However, impacts need to be evaluated on other bases besides distribution of humans due to "long distance teleconnectors" (LDTs) between areas where actions in one part of the globe have pronounced effects (reactions) in other areas remote from the initial action.

The U.S. Renewable Fuel Program is an excellent example of an LDT. The new goal for use of biofuels led to conversion of soybean fields to maize production (to produce ethanol). The shortage of soybeans led to increased soybean prices which made it economically viable for Brazilians to clear cut rain forest to plant soybeans! Collectively, we not only lost forest cover but liming of the acidic soil of the cleared rain forest lands to promote agricultural crops also increased carbon emissions. This is just a detailed example of the complexity of ecological linkages over space and cultures and also the damage that can be perpetrated by thinking 'locally' rather than globally when managing resources.

Eutrophication

Eutrophication refers to adding nutrients to the system, especially nitrogen (N). During pre-industrial times there was a balance between unreactive N in the atmosphere and reactive N in terrestrial systems. We have increased atmospheric N and added N to terrestrial systems providing a 200% increase in productivity of food plants. The plants (crops + others) flourishing in eutrophic (i.e., high productivity systems) are extirpating plants that have evolved in oligotrophic (low productivity) ecosystems and are thus reducing biodiversity. The N applied to the soil for agriculture, or in urban systems for lawns, etc. does not immediately return to the atmosphere as may have occurred in pre-industrial times but instead accumulates far from the point of application, often transported by water. For example, the Mississippi River valley is a large funnel transporting nitrate to the Gulf of Mexico which in turn results in explosive growth of algae which in dying removes $O_2$ and creates a 'dead zone' in the Gulf. Using space images this is particularly noticeable in the coastal areas where the dead zones diminish in size the farther the distance from the mouth of the Mississippi River.

Globally the areas of highest deposition of N are eastern North America, Europe, the Indian sub-continent, eastern Asia and Argentina (not necessarily listed in order of magnitude).

The above story involves N, but eutrophication via phosphorus is also accelerating at a rapid pace.

$CO_2$ - Amospheric and Oceanic

The rise in atmospheric $CO_2$ is something that has not occurred for the past 3-20 million years. The rise in $CO_2$ results in fixation of more N which produces more roots and more leaves, i.e. plants are generally growing more and this in turn fertilizes the soil. However, some plants respond to the extra growth opportunities more than others. Big beneficiaries include many species of vines including poison ivy and kudzu. Kudzu is a member of the pea family, native to parts of Asia and is

now spreading and effectively killing native flora in some areas of southwestern Ontario… increased opportunity for growth of flora is not always better! Another change due to the increased stimulation of plant growth is that tree communities are benefiting in competition with plant communities. Thus we see sparsely treed African savannah and California sub-alpine redwood ecosystems becoming increasingly forested. Yes, the forests sequester more carbon and for longer periods of time since most species are perennial rather than annual, but we are still trending towards reduction in diversity of ecosystems.

Oceanic acidification is occurring because increased $CO_2$ in the ocean produces increased hydrogen ions thus increasing acidity which in turn reduces ocean carbonate concentrations and reduces capability for building coral and shells for mollusks! Additionally increased acidity has been demonstrated to affect fish with decreased growth of fish and reduced survival of fish populations.

Now to the Positive News!!
By using a variety of tools, it might be possible to effect a 100% reduction in global warming by 2050! The strategies include preservation of forests and rangelands and low emission forestry and agriculture industries in addition to the following:

*Reductions of $N_2O$ and $CH_4$ (greenhouse gases)*
Eighty percent of $N_2O$ emissions are from agricultural fertilizers. Solving the agriculture N problem, would create a major reduction in greenhouse gases, particularly with $N_2O$ entrapping much more heat than $CO_2$ on a per weight basis. Advances can be made by using slow release fertilizers so that the amount needed at any one time is all that is available. Limit fertilizer application through legislation and also through a tax on fertilizers. Maintain wetlands adjacent to fertilized crop fields to capture excess N in run-off and de-nitrify the run-off using bacteria that send N up to the atmosphere instead of down to the oceans.

Flooded rice paddies produce about 25% of the $CH_4$ produced. Ruminant livestock are another major source as are wetlands. Grow rice in upland rather than flooded sites. Yes, it may be less productive but there will be less methane. Depend less on ruminants for food.

*Albedo Manipulation*
Albedo is the proportion of incident light that is reflected back up. White (e.g. ice) reflects light away, green (e.g. colonization of forests in higher latitudes) results in increased absorption of light. With current reductions in ice and increased forests, we are headed for increased absorption of light, However, clear-cutting of some of these new northern forests will create a lighter surface and reduce absorption.

*Bioenergy*
There are three main options:

- continue to use 1st generation crops (e.g. sugar cane, maize, palm oil, wood, dung, peat)
- use more efficient 2nd generation plants (e.g. $C_4$ grasses, *Miscanthus*, cordgrass, poplars)
- exploit algae.

We know that use of 1st generation crops is leading to reduction in land currently suitable for food crops. However, there are great advantages of $C_4$ plants because they have evolved in adaptation to high light intensities, high temperatures and aridity. $C_4$ plants dominate grassland floras and biomass production in tropical and subtropical regions. The $C_4$ plants are perennials, hence they capture lots of carbon, require no annual tilling of the ground and flourish with low energy and low fertilization. If we were to choose marginal grounds not currently seen suitable for agriculture and often degraded by prior unsuccessful attempts at agriculture (e.g. dry parts of the U.S. southwest)

and promote $C_4$ plant communities there, we could meet 86% of the US biofuel goals without negatively impacting global agriculture. *Miscanthus* is tolerant down to -12$^{o}$C before it dies; hence it has potential as a biofuel over a wide geographic range including here into Canada.

Algae have great potential as a source of biofuel. Rapeseed, palm and algae produce 130, 700 and 10,000-20,000 gallons of oil/acre respectively. Algae from the oceans could be a major source of biofuel and because they are within an aqueous medium would require no watering. We already have experience harvesting kelp beds. An island of algae the size of New Guinea could replace 80% of the U.S. annual gasoline needs and be worth in excess of $500 billion.

Clearly we need to think and work to develop opportunities beyond the use of 1$^{st}$ generation plants for bioenergy.

## QUESTIONS AND ANSWERS

*Q. Johnson: What species would de-nitrify the agricultural run-off?*
A. A variety of marsh plants including cattails.

*Q. How do you de-nitrify without excess methane production?*
A. I'm not sure how this works.

*Q. Bertin: Could these techniques for production of biofuels compete with $130/barrel for oil?*
A. No, definitely not. There would need to be higher energy prices to make this work. The U.S. military is funding a lot of current research including the conversion of palm oil into aircraft fuel.

*Q. T. Rising: Are slow release N fertilizers too expensive to encourage their use by farmers?*
A. The major problem is that use of slow release fertilizers equates with decreased production hence decreased income (unless increasing costs to consumers). However, there are great costs in not stemming the flow of N into water bodies (e.g. Lake Erie is apparently again heavily stressed by eutrophication).

*Q. Zoladeski: Chris does not like to hear about biofuels because they are so heavily subsidized and we have a good supply of fossil fuels.*
A. That is alright if one accepts not reducing $CO_2$ emissions and, yes, we have lots of fossil fuels…supply is not the current problem. The problem now is acidification of oceans, extinction of coral ecosystems, etc.

Rowan notes that we can grow *Miscanthus* grasses and other $C_4$ plants in Canada on marginal lands and that will reduce some of the biofuel problems. We could make biofuel pellets from the $C_4$ plants and use them to heat local schools, homes, etc.

The speaker was thanked by Johnson.

## OBSERVATIONS:

*Carley:* John had two new books in the City of Toronto Biodiversity Series: Mammals and Amphibians & Reptiles. John emphasized that these were produced by volunteers and cost the City of Toronto $0. He distributed copies to many in attendance.

*Davis:* Eric had some polyspore fungi from a Toronto oak tree that needed identification.

*Bertin:* Why is Canada's position on harvest of polar bears different from that of many countries? Obbard answered that the current threat to polar bears varies with regional populations with greatest problems where sea ice is seasonal.

*Falls:* A Red-necked Grebe at Col. Sam Smith Park was observed to stretch its neck up to great height to come face-to-face with a considerably larger Western Grebe in comparable pose. It was fascinating to see this interspecific behavioural display.

*Johnson:* Skunk cabbage is flowering on the edge of Mississauga Road.

*Eadie:* Little Egrets are increasingly common in England, a place from which they had disappeared in the 1600s. B. Falls and A. Falls saw quite a few on a recent birding trip to Trinidad.

*R. Addison:* For the third year in a row, Turkey Vultures have populated a roost behind her house in central Aurora. This year the first vulture was seen on March 17 as compared to March 16 and March 15 the previous two years.

*Daniels*: Also saw a Turkey Vulture on the 15th soaring over buildings just north of the 401-Yonge Street area.

*Currie*: Three Black Vultures were seen last Saturday and six the next day. Hugh birded for 30-40 years before he saw Black Vultures in Ontario.

The meeting was adjourned at 9:22 P.M. and refreshments were enjoyed by all.

**NEXT MEETING**

The next meeting will be held Tuesday, April 16 at 7:30 pm in Room 432 of the Ramsay Wright Zoological Laboratories. **John Ambrose** will speak about **trees and other curious plants of Pelee Island.**

**FROM THE ARCHIVES**

*March 1988:* Speakman read a letter from Ken Reading, describing his prospecting activities in Central America, his interactions with the residents and their incredulity that anything good could come from studying rocks, which they regard as no more than impediments to their agricultural pursuits.

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