THE BRODIE CLUB

ROYAL ONTARIO MUSEUM OF ZOOLOGY

THE 1,042th MEETING OF THE BRODIE CLUB

The 1042nd meeting of the Brodie Club was held at 7:30 pm on November 16, 2010 in Room 432 of the Ramsay Wright Laboratories of the University of Toronto.

Chair: David Tomlinson
Secretary: Ricky Dunn

The meeting was attended by 20 members and 5 guests.

Roll Call:
Present: E. Addison, R. Addison, Aird, Bertin, Bodsworth, Crins, Currie, Dunn, B. Falls, D. Hussell, J. Hussell, A. Juhola, H. Juhola, Larsen, Machin, McAndrews, J. Rising, T. Rising, Speakman, Tomlinson
Regrets: Abraham (Quebec), J. Bendell, Y. Bendell, Boswell, Bousfield, Bryant, A. Falls, Iron, Lumsden, Norma Martin, Norm Martin, Pittaway, Reading (South America), Seymour, Sutherland, Tasker (Manitoulin).
Guests: Leslie Gray, guest of Paul Gray; Sharon Hick, guest of Jock McAndrews; Peter Hussell, guest of David Hussell; Dan Strickland, guest of Ed Addison; and Dr. Brad Anholt, Director of the Banfield Marine Science Centre on Vancouver Island, in town for a national conference of field station directors, and present as a guest of tonight's speaker.

Minutes:
Minutes of the previous meeting were accepted without correction.

Announcements and New Business:

- Bruce Falls told us Ann had suffered a fall, breaking her upper humerus. It can't be put in a cast, and there will be a long recovery period, but Ann hopes to be back at meetings before too long.
- Trudy Rising gave a report from the Outings committee (which also includes Jean Iron and George Bryant). Because of commitments by potential hosts in June and July, the committee suggested a trip to Torrence Barrens in Muskoka on September 10. This area has trails, good botany and herps and, in September, no mosquitoes. For anyone wishing to stay over to Sunday, the Bryants would host a Saturday dinner. The Bryants, Falls and Risings could handle about ten overnight visitors. Commerial options are available nearby. A half-day on Sunday could be spent at Hardy Lake, which also has trails but quite different flora and fauna. This idea is

being floated now for consideration, and will be discussed at the February meeting. If there are objections to September we could discuss options for a June trip at that time.

- The Federation of Ontario Naturalists is selling Christmas cards, and Rose Addison offered to send in order forms for anyone interested in ordering at this meeting.
- Dan Strickland has been nominated as a new member. His application has been received and unanimously endorsed by the Membership Committee.

Dan Strickland

Born in Toronto (1942), I grew up in Burlington where I discovered the world of birds and eventually fell in with the Hamilton Junior Naturalists' Club guided by the late Dr. Doug Davies and to which Brodie Club member Bob Curry also belonged. One of my fondest early memories was Bob's father in May of 1957 driving a bunch of us teenage bird geeks all night on old Highway 3 (in the days before Hwy 401) down to Point Pelee. There we put in 19-hour days of birding and thought we had died and gone to heaven.

After high school, I attended the University of Toronto (Physiology and Biochemistry) and helped pay my way by working as a summer naturalist in Quetico Provincial Park. After graduation, being disillusioned with biochemistry and lab life, I went to France for a year, returning in the summer of 1965. Penniless, I was lucky enough to fill a vacant spot on the summer naturalist staff in Algonquin, and thus began a long association with Ontario's most famous park. At first I worked there during the summers only and spent the winters travelling and doing a M.Sc. on Gray Jays in Parc de la Vérendrye, Quebec. (That work was inspired by an Algonquin Park naturalist, Russ Rutter, another member of the Brodie Club—and for a while, its secretary).

In 1970 I joined the Park's permanent staff and worked as the Chief Park Naturalist for the next 30 years. It was a wonderful opportunity to rub shoulders with, and learn from, a long list of university and MNR research scientists (including several Brodie Club members) and to pass along many of their insights and findings to the public. I was lucky enough also to be involved with the planning and development of major interpretive projects, particularly Algonquin's new Logging Museum and the Visitor Centre that we opened in 1993, marking the Park's one hundredth birthday. Perhaps just as important, was expanding Algonquin's system of interpretive trails and developing a comprehensive series of affordable trail guides and other publications devoted to the Park's natural and human history. That publication system also included the Raven, Algonquin's natural history newsletter begun by Russ Rutter and which I continued to write for another 36 years. Finally, I and my long-time Algonquin colleague Ron Tozer, devoted considerable time searching out the keenest young naturalists we could find for our summer staff. Many of these employees have gone on to careers as academic or management biologists all across Canada and four (Ron Pittaway, Bill Crins, Marc Johnston, and Don Sutherland) are presently members of the Brodie Club.

As a side-line to my official duties in Algonquin, I was able to continue and greatly expand the Gray Jay study begun by Russ Rutter. Since my retirement in 2000, I have been able to devote even more time to the jays, as well doing a short study on Anticosti Island and travelling to Sweden and China to see the old-world members of the genus *Perisoreus.* I am currently collaborating with Ryan Norris of the University of Guelph on further studies and writing up my over-40 years of data.

SPEAKER

Dr. Arthur Weis was introduced by Jock McAndrews. Dr. Weis was educated in Illinois and taught in southern California for 19 years before coming to University of Toronto in 2007. He is a Professor and some current research interests include selection pressures on organisms brought about by climate change. Much of his previous published research is on plant galls and the insects that cause them.

Dr. Weis is also Director of the Koffler Scientific Reserve at Joker's Hill (King City) and he prefaced his talk with a brief overview of the Reserve, the venue for the June, 2010 Brodie Club field trip and picnic. This 880 acre tract includes a variety of forests (including some old growth), as well as old pasture and hayfields that are more amenable than forests to experimentation, such as on habitat restoration. The property was given to U of T in 1995, but full possession only came about in 2006. The first proper building with lab and research facilities has recently been completed. Besides basic biological research, much work is being done on human effects on organisms (e.g. through climate change, excess nitrogen, urbanization, invasive species). Courses are also being offered, and there is an outreach program. Despite the short history, the station has already hosted 24 researchers from several countries, 24 M.Sc and 17 PhD students. Over 88 publications based on research at the Reserve have been produced.

"The Curious History (Natural and Scientific) of Plant Galls"

A general introduction on plant galls detailed some of the insects involved, including, but not limited to, certain wasps, midges, flies and even aphids. Each gall insect is associated with a specific plant species.

Woolly Oak Gall

Examples of oak galls include structures that look something like pine cones (caused when a wasp egg is laid in a bud and the stem tip stops elongating), woody bumps on twigs, structures on leaves that look like fleshy stars, and others that look like cocoons.

"Oak apples" develop following the insertion of numerous eggs into the base of a bud by a female *Andricus* (gall-wasp). The oak apples are modified leaves with a thin outer shell attached by thin "spokes"- vascular strands- to the inner mass in which the insect larvae live. In all cases, plant cells at the centre of the gall appear undifferentiated, and provide the growing insect larva with highly nutritious food.

Oak Apple Galls

Interior of Oak Apple Gall

The Pine-cone Willow gall develops when the tiny midge *Rhabdophaga* deposits a single egg into the terminal bud of a Willow branch. The bud ceases to elongate and the leaves expand into flattened scales which have the appearance of a fuzzy green pinecone. The growing maggot gets nourishment in the inner chamber.

The Goldenrod leaf blister gall is caused by a gall midge that inoculates the plant with a fungus when she lays an egg. The fungus grows under the leaf surface and forms a hard dome that protects the larva deeper in the leaf.

Cottonwood Leaf Gall

Cottonwood leaf galls are caused by female aphids, which poke holes around themselves on a leaf mid-rib, causing the leaf to grow a hard shell over the top of the insects. Inside, several generations of asexual reproduction (females giving birth only a week after their own birth) produce offspring that go off to feed elsewhere and eventually give rise to a sexual generation. The first instar "stem mothers" fight among themselves for prime locations at the base of a leaf, where they receive the most plant nutrition.

In all cases, gall structures serve to protect the larvae, not only from predation, but also from parasitoid wasps: species that lay eggs in the gall-inducing larva and whose young then feed on the host larva from the inside out. Hard galls cannot be penetrated by the parasitoid's ovipositor, and the outer wall of galls of the oak apple-type is too far away from the centre for an ovipositor to reach the larva.

Goldenrod galls have been studied extensively by Dr. Weis and his students. Eggs are laid in the buds, and the larva burrows into the underlying undifferentiated material, avoiding the terminal meristem. The stem continues to grow above the gall formation. Each species of goldenrod has its own goldenrod gall fly. They are hard for taxonomists to tell apart. However, the flies themselves easily differentiate goldenrod species, using receptors on their feet and ovipositors to "taste" the plant. Flies can be momentarily fooled by wrapping tissue from one species around the stem of another – but the flies abort egg-laying as soon as the ovipositor penetrates the real plant.

Goldenrod gall cut open

Goldenrod galls that are less than about 15 mm diameter are regularly attacked by parasitoid wasps. Infestation levels vary widely among years. Galls larger than 20 cm never have wasp larvae, but are heavily attacked by Downy Woodpeckers, which feed on the gall larvae. The larvae of parasitoids are much smaller, so the woodpeckers avoid the smaller galls that are likely to hold parasitoids instead of gall fly larvae. Putting everything together, the optimum diameter of a goldenrod gall for larval survival was predicted to be 25 mm. The actual mean size was found to be 22-23 mm. This is an example of stabilising selection, with the galls being pushed to a middle value due to selection against either end.

Galls figure in the history of science in several interesting ways. Theophrastes, a student of Aristotle, wrote a history of plants. He assumed galls were normal plant parts, though he did wonder how the insects inside them actually got there. In the 1600s, Francisco Redi decided that gall insects were actually generated by the plants – despite his being the first to experimentally prove that rotting meat would not generate maggots when flies were barred access. St. George Mivart, one of Darwin's most ardent critics, noted that Darwin had said his theory would be destroyed if there were examples of an organism producing a structure solely for the benefit of another. Mivart raised the issue of plant galls as such an example. However, if it can be shown that a plant is forced to form a gall (such as by the insect altering a normal plant developmental process), or if the plant protects itself from worse damage by forming a gall around the insect to compartmentalize the insect's effect, then Darwin's theory is not threatened.

Today it is assumed that galls are a result of natural selection on the plant, the insect or both. As an example of the type of evidence for this, different strains of goldenrod gall flies induce different sizes of galls, providing the raw material on which selection can act on a factor that we now know greatly affects success of gall fly species. Nonetheless, surprisingly little is known about how gall formation is triggered and controlled.

QUESTIONS:

Q, Crins: Is there a correlation between size of the larva and size of the gall?
A. No. Variation in gall size is a result of variation in the thickness of the protective outer layer, which is unrelated to larva size. More likely gall size is affected by the timing of infestation relative to the plant's stage of growth.

Q. Dunn: Do studies of woodpeckers attacking galls show any geographical preference?
A. Yes, woodpeckers will feed on galls closer to woods more heavily than those further from the woods so there is a geographic component, as well as a size preference, to their selection.

Q. D. Hussell: Does the stimulus to form a gall come from the egg or the larva?
A. This differs among groups of insects. Certain sawflies cause gall formation to begin when the ovipositor is inserted, even if no egg is laid (although a full gall does not form). In other plants, such as goldenrod, the gall only forms after the egg hatches and the larva burrows down into the stem.

Q. *Bodsworth: Is it only two species, altissima and gigantea, of goldenrod that are used?*
A. Yes, here it is mostly *altissima / canadensis*. Very rarely *rugosa* will be a gall producer.
Q. Is there host-switching among goldenrod gall flies, and if not, why are they so plant-species specific?
A. There are some examples of switching, but this isn't the usual case. Specificity is probably related to the necessity of matching phenology of the insect and plant, as successful infestation can occur only during a short window of time during plant growth. The fly has to match timing with the host plant to avoid temporal separation.

Q. Gray: Is gall formation of some benefit to the plant?
A. Plant genes are being turned on, similar to oncology genes. Those genes have other functions. There seems to be insufficient selection pressure to shed the parasite.

Q. Aird: Has the chemistry of gall formation been studied?
A. Several approaches have been tried – hormone levels, gene expression – but none have done well.

Q. Anholt: How much variance in resistance is there among goldenrod families?
A. Some make large galls, others make small ones, but it's not clear whether this is related to variation in resistance.

Q. Falls: Are people trying to inject plants with derivatives of insects to study responses?
A. Yes. We mashed gall fly salivary glands, but failed in our attempts to inject the extract into goldenrods.

Q. Bodsworth: Some years the galls on my White Oaks are very abundant, but as a rule they are not. What is the difference in the years?
A. Timing is probably key- if the wasps come out at just the right time. Also in the city, the leaves generally are raked in the fall.

The speaker was thanked by Bill Crins.

NOTES & OBSERVATIONS

Jock McAndrews noted that Ron Tasker had wondered how to tell the age of Inuit artifacts he had found in the Arctic. McAndrews said that harpoon heads have a hole in them that allowed a cord to be tied between the head and the spear handle. Holes gouged using horizontal movements indicate Dorset harpoon heads, while Thule (more recent) artifacts have drilled holes. He hopes Ron will get his artifacts aged and report back.

Ed Addison waxed poetic about the joys of nature experienced by hunters, even when the hunt is unsuccessful. While moose-hunting in the Thunder Bay area, Ed 'heard' true silence, a rarity in our times. He also watched two Hawk Owls being followed by a Hairy Woodpecker and was impressed at how vocal the owls were.

Ricky Dunn reported that the Long Point Bird Observatory captured two species for the first time ever this fall: Green-tailed Towhee and Spotted Towhee (both western species). It's amazing that new species are still being captured after 50 years of operation.

David Hussell commented on the record high number (120) of Gray Jays caught this year at Thunder Cape. This species is usually sedentary, but a few smaller 'irruptions' had previously been noted at Thunder Cape. *Ed Addison* also mentioned seeing lots of Gray Jays in that area during his hunting trip. Most of the irrupting jays turned out to be young of the year.

The meeting was adjourned at 9:05 pm.

CORRESPONDENCE

By E-mail from Ed Bousfield:

"Very sorry to have missed the Brodie Club meeting on Tuesday evening. My intentions were honourable. I departed here at 6 pm but ran into such horrendously slow traffic and rain on the 401 and, with the car nearly out of gas, could not reach my destination, and sought shelter at my sister's apartment at Yonge St.!
I may not have mentioned that I am moving to Ottawa on Monday, Nov. 29, in an attempt to complete, during the next 6-12 months, a major piece of research (~40 mostly new species of holarctic sedimentary crustaceans) that has kept me running back and forth between cities for the past 8+ years! The "bottom line" to completion and publication of this program is that the study specimens are at the CMN lab in Aylmer, Que., and nowhere else.

If it should come in handy after Dec. 1, my new address is attached below:

With best wishes, and an early "Merry Christmas"
Ed

New address: Dr. E. L. Bousfield
Suite 414, Amica at Westboro Park,
495 Richmond Rd.,
Ottawa, ON K2A 1G4.
Phone: (613) 422-8869
Email: elbousf@rogers.com"

Ron Tasker has sent along news that long-time member Charlie Lennox died in September. Ron will speak about Charles at the next meeting.

NEXT MEETING

The next meeting will be held on Tuesday, **December 14**, 2010 at 7:30 pm in Room 432 as usual. Note that this is earlier in the month than other meetings, and that everyone is invited to contribute Christmas goodies.
The speaker will be our own Jim Rising.