THE BRODIE CLUB

ROYAL ONTARIO MUSEUM OF ZOOLOGY

THE 979TH MEETING OF THE BRODIE CLUB

The 979th meeting of The Brodie Club was held on November 18, 2003, at 7:30 pm, in the Ramsay Wright Zoological Laboratories of the University of Toronto.

Chair: Norma Martin
Secretary: Trudy Rising

There were 26 members and six guests:
Marc LaJeunesse, guest of Marc Johnson
Angrag Agrawal, guest of Marc J ohnson
Kate J ackson, guest of Ellen Larson
Sharon Hick, guest of Jock McAndrews
James Thomson, guest of Bruce and Ann Falls
Ron Pittaway, guest of Jean Iron

The minutes of the previous meeting were approved with one correction: Aame Juhola was acclaimed treasurer, not secretary, as written.

NEW BUSINESS:

Jennifer Young was thanked for her term as treasurer. Hugh Currie is a new member of the Program Committee. David Tomlinson was welcomed by Ann Falls as a new member.

Ann reminded us all to leave name tags. Also a reminder that December is our meeting for homemade goodies to be brought by everyone, if possible.

TREASURER'S REPORT:

Jennifer Young reported that The Brodie Club has $642.45 in the bank, encouraged members to pay their dues, and handed over the responsibility to our new Treasurer, Arne Juhola.

COMMITIEE REPORTS

Bruce Falls reported that our guest speaker for the next meeting, December 9, 2003, will be Edward Bousfield, and his title will be "The scientific search for aquatic mega-serpents on the Pacific Coast of North America." (Please note: there will be more on this presentation at the end of the minutes.) Note that the meeting will start at 7:30 pm, one week ahead of usual because of the Christmas season.

SPEAKER:

Jim Rising introduced the speaker, Professor James Thomson, chair of the Zoology Department and pollination ecologist. Professor Thomson graduated from the University of Chicago and, as an undergraduate, was interested in studying both English Literature and biology. Dan Janzen (at the University of Chicago) was influential in his decision to continue in biology, and he did both his master's and Ph.D.s at the University of Wisconsin. He then came to the U of T to do a post-doc with Chris Plowright. After being at the State University of New York at Stoney Brook for 20 years, he agreed to become chair of the zoology department of the U of T. He continues to work on plant pollinator interactions at a research station in Colorado and in Ontario.

THE FATES OF POLLEN GRAINS AND THE NATURE OF MUTUALISM

It has been assumed that relationships between pollinators and their food source (plant nectar producers) are mutuality, i.e., a benefit is derived by both the pollen producer and the pollinator. A number of researchers have questioned this assumption and have done research that have demolished the straw man "plant-pollinator interactions" (Prof. Dan Janzen) and other assumptions. For example, there has always been a match up between animals; e.g., long tongued moths with a plant it pollinates. Co-evolutionarily, the plant will have a long nectar spur and the animal species has a long tongue. This is seen as a mutualism as both benefit -- animals getting food rewards and a plant gaining the transport of its gametes.

The idea that plant structure is this way "for this purpose" is controversial. The thought that syndromes are highly predictive has come under attack. Dan Janzen critiqued the simplistic formulation of co-evolution with regard to plant/animal interactions. Now, "co-evolution" is qualified by descriptors like "diffuse" or "indirect."

The many *Penstemon spp.,* some pollinated by bees and some by hummingbirds, make an interesting group for experimentation/analysis; for example, *P. strictus,* a flower pollinated by bees and *P. barbets* visited by hummingbirds. This talk contrasts bees and birds as pollinators. There's a conundrum of pollinator shifts (i.e. having adapted to one pollinator, how do you fire it and hire a different one)? If you have flowers that vary in length of their flower tubes, a short corolla might be better pollinated by a short tongued animal; intermediate phenotypes might have low fitness.

Intuition is that there has to be a crossing of an adaptive valley; i.e., there may be a change over time so that there will be a shift from adaptation of the plant for one type of pollination vs. another (e.g., bee vs. hummingbird); i.e., from one adaptive peak to another.

Pollen presentation theory Models of pollen removal and deposition. When is it mutualism? (conditional parasitism)

Pollinator shifts. Stabbings: *Annual Review of Ecology and Systematics 1:319* says the characteristics of a flower determines its pollinator, but that doesn't mean it's the only pollinator, only the most frequent and effective pollinator. He assumes all pollinators show mutualism. V. Grant and K. Grant: *Flower Pollination in the Phlox Family,* pp. 162-3. Why is there less than a full explanation of pollination shifts? Again the interaction is assumed to be mutuality.

Dan Janzen says "mutualism is not a complex subject is easily explored through the application of common sense and ... observation." How plants and pollinators "actually interact," he says, is through pollen grains.

Thomson et al. have followed up on this idea with research, first in eastern Canada, and now in Colorado. With polymorphism of pollen grains, they started looking quantitatively at how far the pollen goes. They noted that there are red grains and yellow grains in the species studied so they were able to start seeing, starting with a clean bee, when the grains travelled from each pollinator by counting pollen grains.

In bees, they found strong and fast flow of pollen grains to the basket on the hind legs. Just a few pollen grains are left on the body because of cleaning the whole time the bee is in flight. Birds are not grooming in flight so a pollen grain making it onto a bird has a better chance of reaching its destination. A plant presents grains in its anthers; most that are bee pollinated are wasted (with regard to pollination). Only about one percent makes it to the stigmas, because of the grooming behaviour of the bees.

What makes a good pollinator? Thomson used the analogy of transferring water used. Grooming causes diminishing returns of delivery on removal. Doubling the pollen on a bee does not double the amount that gets to a plant. It just grooms more.

Harder and Thomson, *Am. Nat.* 133:323-344, looked at species with high removal but low deposition; if you increase the number of inefficient pollinators, saturation occurs fairly quickly. The presence of a better pollinator can turn a worse pollinator from a mutualist into a parasite. If there's not other pollinator on the scene, then species 2 is mutuality but if a better pollinator species exists, then species 2 becomes a parasite.

Proposition: hummingbirds groom less than bees, therefore will waste less pollen. Birds should deliver much more. Prediction: plant species that are adapted to bee pollination should restrict pollen removal (by dispensing and packaging).
NSF funding to work with *Pentagon,* 270 species. Some bee and some bird syndrome, and some close enough that they hybridize.

How can *Pentagon* make their pollen available more gradually? One way: do not open all anthers at the same time (staggered anther dehiscence). Other ways: some have leathery anthers that open gradually as a result of this structure; some flowers can open more gradually over time.

Results of their studies look as if colour convergence (red) is occurring for those pollinated by hummingbirds. If one maps blue to red flowers, it shows that bird pollination has evolved from bee at least 20 plus times.

This is the so-called hummingbird syndrome; i.e., bird-visited flowers should have:

- Color more red, orange
- Longer or narrower corolla tube

- More extended anthers, stigma
- More pendent flowers or flexible pedicels
- Nectar more copious
- Nectar more dilute
- Pollen presentation less restricted (Do the bee-visited ones have more restricted anther openings? Yes, this is the case.)

The researchers used an interesting technique: a square of velvet fabric; stick it in the anther and see how much pollen you can get on the velvet squares. Wide opening ones get rid of their's quickly; more restricted ones, smaller doses over a greater amount of time. The pollen presentation idea is upheld.

Do syndrome characters match visitation? Largely yes. So where are we now? True evolutionary convergence is shown; the syndromes are upheld. Why are *Penstamons* able to change so quickly? Why does there seem not to be an adaptive valley? Length of flower tube - open to these phenotypes that are pollinated by hummingbirds -- because of their long flower tubes, etc., they deter bees; e.g., the dilute nectar.

Good evidence for convergence in *Pentagon.* Stephen J. Gould said if we could replay the evolution of life, it would come up differently every time. However, in the genus *Pentagon,* the evolution has occurred over and over and has come out about the same way every time. The process of getting to hummingbird pollination is kind of like Star Trek; it's all been done before, maybe just a little difference in "how it's told."

Which other mutualisms are non-additive?

- Pollen/pollinators: highly depletable, highly non-additive
- Fruit/dispersers: same as pollen
- EFN based ant-plant/ants: nectar depletable, non-additive
- Zooxanthellae, gut microbes, shelter-based ant-plants: non-additive if space is limiting
- External defenders cued by cheap signals (parasitoids): might be nearly additive.

Take home metaphors:

- Think of floral phenotypes as job descriptions
- Follow the money (Follow the pollen grains in this case)
- Pollinators as leaky buckets
- Anthers as bathtubs, not lakes (one visit might take it all; most of it)
- Adaptive volcanoes (phenotypes climbing peaks or new peaks)
- Evolutionary history as summer re-runs (things seen before).

QUESTIONS:

- In the slide on phylogeny; there were lots of red arrows; why is it thought that the phylogeny changed so often. There's been lots of speciation in this group; where the phylogeny is known, it as if only one reversal from bird back to bee; it's almost always toward birds.

- From studying the evolution of flower form, is there a relative sense of the environment shaping the flower form? For example, between New Zealand and Chile, where you get hummingbirds, you don't see the red flowers outside the new world. Discussion around the fact that the hummingbirds, though not attracted to red (apparently), nonetheless, would learn quickly that certain flowers have a lot of nectar (they may happen to be red).

- Since birds as homeotherms can be active earlier in places that are cool at night, all it takes for a bee adapted pollinator to come over to bird is for bird visits to rise above some threshold. Times of day aren't being considered in his study as *Pentagon* tends to be lowland desert so birds being active earlier in the cooler mountain areas is not of importance here.

Prof. Thomson offered members an 18-page paper on mutualism that he presented last year. Copies will be distributed at the December meeting.

Thank you to James Thomson given by Marc Johnson.

NOTES & OBSERVATIONS

- George Bryant went to Ojibway Prairie Provincial Park: and saw a centimetre long larva of some kind; he was able to identify it as a slug moth caterpillar
- David Tomlinson saw a pair of ravens breeding east of Orangeville; ravens are extending south (based on this and other observations).
- Ellen Larsen, stonefly nymphs (at Head River) wait until river rises, then they're there feeding In Feb., they'll emerge.
- Oliver Bertin was sailing across Lake Ontario in early August, 19 miles from land; a bumble bee appeared, circled once and flew off. It must have flown 19 miles non-stop. Circling activity is their way of finding landmarks, James contributed.
- Ed Addison has seen around Lake Simcoe, Canada geese very successful in nesting.200-300 feeding on algae.
- Marc Johnson recommended the movie, *Winged Migration,* to all.
- Bruce Falls told a bit about his rip with Ron Tasker to northeast Brazil earlier this month; saw a large flock of Lear's Macaw. Also saw marmosets.
- Sharon Hick let us know about Fred Bodsworth's fall while birding. Discussion resulted.

Meeting adjourned at 9: 10 p.m.

NEXT MEETING

December's meeting will be at the same time (7:30 p.m.), same place on Dec. 9, one week earlier than usual. Members are invited to bring Christmas cheer to celebrate the season.

Please note the following information about December's meeting that Bruce sent via e-mail: Title: *"The scientific search for aquatic mega-serpents on the Pacific coast of North America."*

Abstract:

During the past century of colonial settlement, and previous millennia of aboriginal occupation, a very large aquatic creature of snake-like and fork-tailed body form, rapid swimming rate, but rare and brief appearance at the surface, has been recorded in c. 300 documented sightings from coastal waters of British Columbia and adjacent regions.

Popularly known as Caddy, this reptilian species has recently been formally described as *Cadborosaurus willsi* Bousfield & LeBlond, 1995, based mainly on records of four specimens in hand (3 alive) during the past 65 years. Regrettably, all specimens were subsequently discarded and lost to science. However, a 3.5 m juvenile carcass removed from the fore-stomach of a sperm whale flensed in the Queen Charlotte Islands in 1937, is represented by three different close-up photographs in the B.C. Provincial Archives.

A sketch of a small, presumably newborn animal captured alive, has been published independently. An animal of similar form and behaviour, popularly known as Ogopogo, has been documented from more than 30 large deep interior lakes of British Columbia and northern Washington state. These may have been derived from marine populations of *Cadborosaurus*, following their salmonoid prey upriver, subsequent to Pleistocene continental glaciation.

The reality of aquatic mega-serpents here and elsewhere in the northern hemisphere is supported by "hard" evidence (specimen-based photographs, sonar images) and "soft" (anecdotal and artifactial) grounds for belief. From this sizeable database can be predicted the general location and time of appearance of the species in waters surrounding southern Vancouver Island, although the frequency of sightings has declined markedly during the past ten years. Development of further knowledge of this rarely seen deep-water biological enigma, and application of a possible COSEWIC conservation category, is dependent on greater research interest by the Canadian scientific community."

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