THE BRODIE CLUB

Established 1921

Website: http://thebrodieclub.eeb.utoronto.ca

THE 1,081st MEETING OF THE BRODIE CLUB

The 1,081st meeting of the Brodie Club was held on Tuesday, 16 February, 2015 in Room 432 of the Ramsay Wright Laboratories of the University of Toronto.

Chair: Oliver Bertin
Meeting Secretary: Sandra Eadie
Editing Secretary: Ricky Dunn

The meeting was called to order at 7:35 pm and was attended by 42: 27 members and 15 guests.

Roll Call:

Present: E. Addison, R. Addison, Bertin, Currie, Daniels, Dunn, Eadie, A. Falls, B. Falls, D. Hussell, J. Hussell, Iron, A. Juhola, H. Juhola, Kotanen, Lumsden, Machin, Martyn, McAndrews, Peck, Pittaway, J. Rising, T. Rising, Seymour, Thorpe, Tomlinson, Zoladeski

Guests: P. Haist (guest of Bertin), S. Hick (McAndrews), and guests of the club brought by the speaker: Wan-Jin Liao (Beijing Normal University), Wei Zhou (Kunming Institute of Botany, CHS, Yunan), and U of T students M. Adler, F. Beaudry, S. Campbell, M. Hartfield, R. Martin, Viktor Nilsson-Örtmann, Amardeep Singh, D. Start, K. Thompson, D. Timerman, and Mackenzie Urquhart-Cronish.

Regrets: Abraham, J. Bendell, Y. Bendell, Bousfield, Bryant, Crins, Curry, Dunham, Riley, Slessor, Sutherland

George Peck has recently moved back to the Toronto area so we hope to see more of him!

Minutes: Minutes of the February meeting were read. Some corrections have already been made by email. Zoladeski, who was not at the January meeting made a comment about a Globe and Mail article mentioned in the minutes, which reported that 2014 had been the hottest year on record (based on NASA's and NOAA's official statements). He pointed out that a careful examination of the statistics behind these claim seems to contradict it, because the margin of error was more than twice as large as the temperature differential (of 0.04 C) from the previous records, set in 2010 and 2005. The minutes were approved.

Committee Reports:

Program: In March, Don Jackson, professor in the Department of Ecology and Evolutionary Biology will give a presentation on *What is Happening to Ontario Lakes.* In April, John Morris will speak on Fresh Water Mollusks. The May speaker is Shannon McCauley, who will be giving a presentation on Dragonfly Communities.

Communications: R. Addison read a letter from Paul Scott, son of deceased member Bev Scott. Paul has found a photograph from the 1960s that his father treasured. Paul thinks it is of the Brodie Club and has

only been able to identify one person in it. He asked the club's help in identifying other people. Club members were successful in naming several people.

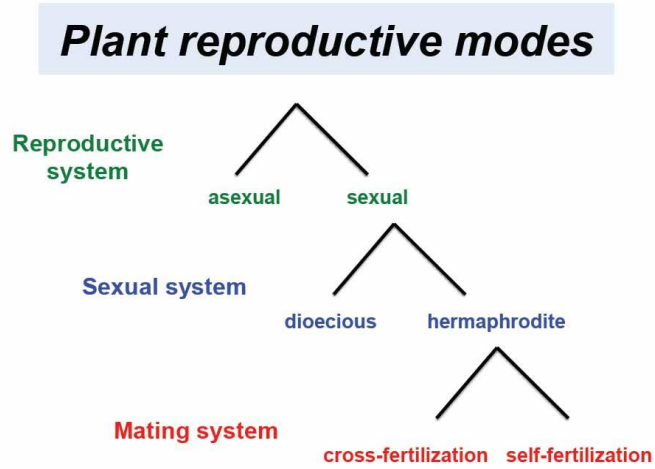
SPEAKER: Bruce Falls introduced Spencer Barrett. Barrett did his undergraduate at Reading University in the U.K. and post-graduate studies at University of California,Berkeley. Falls got to know him while teaching a field course. It is Barrett's second talk to the Brodie Club. In March, 2003, he spoke on the genetic modification of plants and biodiversity and Darwin.

"Plant Sex in the Wild"

Reproduction of species is extremely varied, but plants are especially diverse. Angiosperms (flowering plants) exhibit greater variety in reproductive structures than any other group of organisms.

We should care about angiosperm reproduction, and how reproductive organs function during pollination and mating, for a variety of reasons. Not only does angiosperm sex provide outstanding examples of evolution and adaptation which can be studied in the wild, but detailed knowledge of plant reproduction is relevant to many applied areas: plant breeding, horticulture, biotechnology, conservation and biology of invasive species, as a short list. After all, manipulation of plant sex is the basis of today's agriculture, and conservation is all about ensuring successful reproduction.

Scientific investigation of plant reproduction can also be done in one's own back yard, the way Darwin did it. Very little field equipment is needed, and elegant experiments can be conducted without the need for a lot of expensive lab equipment. In fact, several scientific publications by Barrett and his students have resulted from work done in the garden of his Toronto home.



The figure above summarizes the main types of plant reproduction.

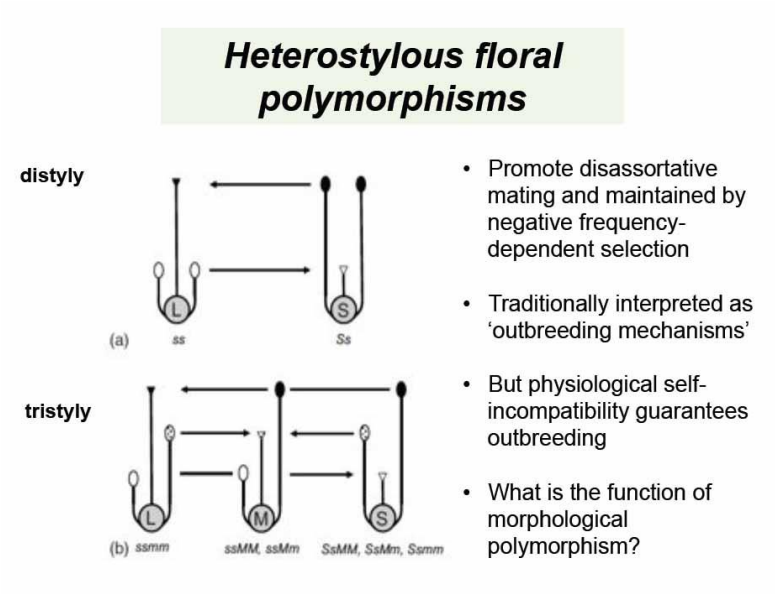
- Asexual (cloning). Most perennial plants can clone, but annuals do not.
- Sexual
  - Dioecious ("two houses"): individuals are either male or female, as in humans.
    Fewer than 5% of flowering plants are dioecious, but included in this group are some familiar forms such as yew, papaya, and kiwi. Many of them have particularly large fruits, and the separation of sexes likely contributes to differential allocation of resources to the reproduction

parts. Commercial growers of dioecious plants want to know how few males they can plant to ensure maximum rates of fertilization and fruit production.

- Hermaphrodite: each plant has male and female reproductive systems. About 96% of angiosperms are in this category. Some can self-fertilize, while others require cross-fertilization with another plant.

Mating biology of flowering plants is influenced by the kind of reproductive system, but also by the fact that plants are sessile. Immobility, and the high incidence of hermaphrodism, would seem to favour self-fertilization. However, Darwin and many after him showed that self-breeding in hermaphroditic plants produces less vigorous offspring. So how do plants encourage outbreeding?

One solution is to have heterostyly – different morphs of reproductive parts that prevent self-pollination. An example is the distylous *Primula mistassinica* (bird's-eye primose), common on the Bruce Peninsula. It flowers in May and is pollinated by flies and bees. The populations contain equal frequencies of the L- and S-morph (long and short), as pictured in the upper part of the figure below. Certain other plants have three morphs (tristyly), as shown in the lower part of the figure.



The different-sized structures should promote transfer of pollen to plants with the corresponding type of pistil (long or short), and discourage transfer to the "wrong" type. Heterostyly is evidently an efficient means of promoting outbreeding in plants, as it has evolved independently in diverse insect-pollinated families, including Iridaceae, Erythroxylaceae, Turneraceae, Lythraceae, Linaceae, and Primulaceae. Darwin predicted preferential pollen transfer between anthers and stigmas of equivalent height, and wrote "I do not think anything in my scientific life has given me so much satisfaction as making out the meaning of the structure of heterostylous flowers."

Heterostyly was the topic that lured Dr. Barrett into his field of study, albeit serendipitously. Darwin had noted that there should be a short-styled (S) morph of the water hyacinth, which was clearly tristylous, but for which only 2 of the morphs had been found. The plant is an alien in Europe and no-one had studied it in its native Brazil. When Barrett was in the Amazon to start a PhD project on a different topic, he stumbled across the "missing" morph in a rice field. His thesis supervisor immediately gave him the go-ahead to change his topic and the rest is history.

The speaker described his experience testing Darwin's pollen transfer hypothesis using Pickerel Weed. As predicted, the different stamen lengths deposited pollen in different places on visiting insects, which were less likely to be transferred to the "wrong" pistil (female part). Moreover, Pickerel Weed pollen grains differ in size, with larger grains produced on longer stamens, and the smallest produced by the shortest stamens. Work in Barrett's lab showed that a small pollen grain does not have enough energy to grow a pollen tube long enough to reach the ovule. Large grains, on the other hand, overshoot the ovule in a short pistil, and pass right by without fertilizing it. Thus, even if pollen is transferred incorrectly to another flower on the same plant, self-fertilization cannot occur.

The speaker then discussed plants with separate male and female plants. The sexes are often sexually dimorphic. Theory predicts sex ratios should be 1:1, but are they? In fact, studies have found a continuum of sex bias from female to male bias, with the male bias being twice as common. However, because of the work female plants do producing fruits, they tend to flower less often than males. Females also do not live as long when they have to produce fruit. Since most estimates have worked with plants in flower (it is very difficult to sex plants that are not flowering), there has been a bias towards measuring the number of males.

In a study of male-female ratio in Wild Sarsaparilla, a dioecious species, Barrett's lab laboriously plotted the sex of every individual in a 100 m-sq plot. They found a clumped distribution of the sexes, which was discovered to be related to amount of shade on the forest floor. Males, it turned out, are able to clone at a greater rate in shade than females.

Yet another system studied in Barrett's lab is the unusual case of a species (Broadleaf Arrowhead, *Saggitaria latifolia*), which has both monoecious and dioecious populations. The first group has flowers with both stamens and pistils; the second is made up of separate male and female flowers. There is ecological separation, with the combined-sex group growing primarily in low-grade habitat such as open ditches, while the separate-sexes populations grow in healthy marshes with a greater degree of natural shade. Although they can cross-breed, each type grew and reproduced most successfully in its usual habitat. The two types have different strategies for allocating resources to reproduction vs. vegetative growth, and the two habitats select strongly for one strategy over the other. Further study on this species showed that the monoecious (hermaphroditic) form was more common at the northern end of the range, again suggesting it is better at dealing with poor growing conditions.

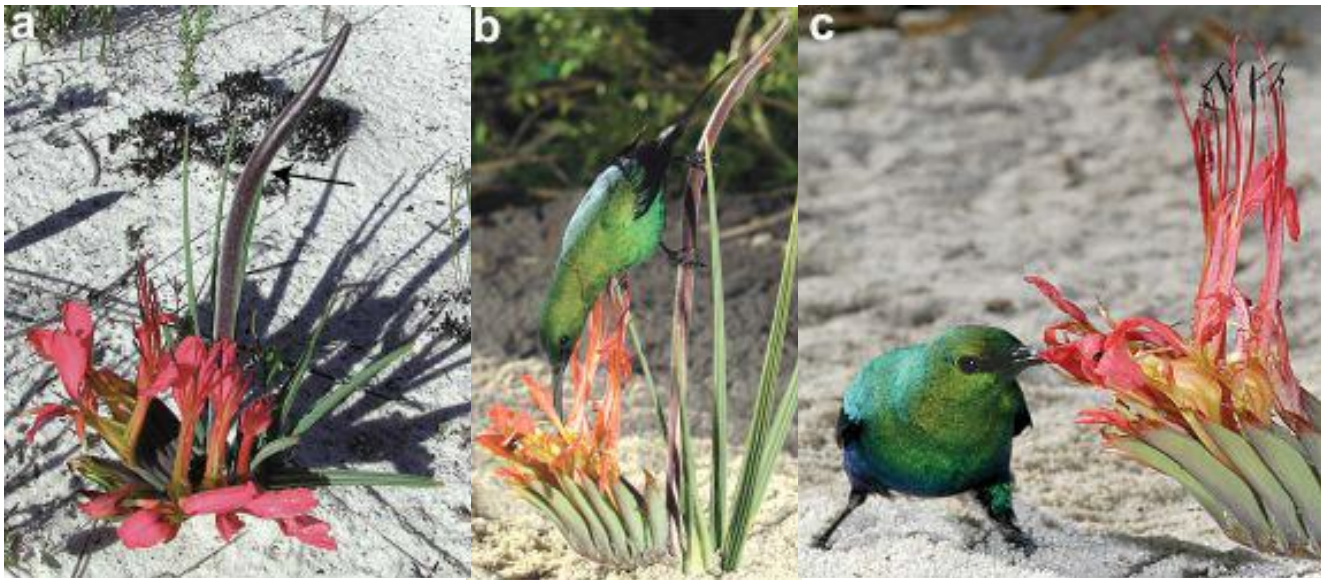
Growing conditions were also found to be a factor in reproductive biology of *Decodon verticillatus*, or Swamp Loosestrife. Populations were studied from Georgia to Ontario, and found to be far more clonal at the northern end of the range. In some populations at the range limit, the plants were actually sterile, due to dysfunctional pollen tube growth, and produced virtually no seed.

Purple Loosestrife, *Lythrum salicaria*, is a wetland invader introduced to the eastern U.S. 150 years ago, and which has spread through central Ontario in the past 50 years. It has quite diverse growth forms in other countries, and offers a good system for studying adaptation of life-history traits to new environments. Across 10 degrees of latitude in Ontario, there proved to be strong correlation between flowering time and the length of the growing season, with southern plants found in flower about 2.5 weeks longer than northern plants. When plants from the wild populations were grown in the lab under identical conditions, the same trend was found, proving that there had been genetic change – i.e. evolution – since introduction into Ontario.

Barrett ended his talk with a few bizarre examples of plant reproduction. One that is still a mystery is a Chinese plant, *Tacca chantrieri*, which has long whisker-like structures that were hypothesized to attract flies for pollination. However, Barrett's students have shown it to reproduce almost entirely by selfing,

and the function of the 'whiskers' remains unknown. A Chinese tropical orchid (*Acampe rigida*) that flowers in the rainy season, when pollinators are largely inactive, was found to take advantage of raindrops for self-pollination. Rain drops flick off the cap of the anther and propel the pollinarium onto the stigma. Finally, we heard about experiments that explain the reason for the "tail" (Fig. a below) on the South African plant the Rat Tail (*Babiana ringens*). The sole pollinator is the Malachite sunbird (*Nectarinia famosa*), which uses the "tail" as a perch while feeding on the flower's nectar – and simultaneously picking up from, or transferring pollen to, the structures stretching upward from the flower toward the perch (Fig. b). When the plant's tail is cut off, birds will still visit the flowers to feed (Fig. c), but then no longer come in contact with the plant's reproductive parts. Flowers whose perches were removed were shown to produce fewer seeds.

The take home message was that a discerning eye, enquiring mind, and simple experimentation can still produce great science, and that botanists miss a lot when they stick to model systems (plant equivalents to the white rat or fruit fly). "Plant sex is going on all the time in the wild and it is worth a careful look!"



Questions followed the presentation, but a failure of communication led to no one keeping notes. Members who want their questions inserted into the official minutes should contact the Editing Secretary (EricaHDunn@gmail.com).

For more on research projects in the Barrett lab, see http://labs.eeb.utoronto.ca/BarrettLab/Research.html#EvoGen, and for a sample of Barrett's fabulous photos, see http://labs.eeb.utoronto.ca/BarrettLab/B-lab_Photos.html

Jim Rising thanked the speaker.

OBSERVATIONS

Tomlinson commented on the low number of birds around because of the cold winter.

Jeremy Hussell brought in photos of little piles of snail shells he found near shrew holes. The shrews gather them, store them in an underground larder as winter food, and then toss out the empty shells.

Dunn saw several large groups of turkeys today in fields along the road from Port Rowan to Hamilton.

Chris Zoladeski reported on a new development in the fight again the blight that has killed off most of American chestnut trees. The blight is suspected to have come in the 1800s from Chinese chestnut trees that are immune to the blight. At one, time one quarter of North American trees were American chestnuts. The Passenger Pigeon depended on them for food. William Powell has been working with some success at isolating the gene in the Chinese tree that fights the blight, and inserting it into the American chestnut genome.

Kotanen reported on his family's participation in a Mudpuppy Night. Once a week in the winter months (since 1984) there is organized viewing of mudpuppies in Oxford Mills (near Ottawa), where they can be reliably seen in winter. Mudpuppies are permanently aquatic salamanders that grow to about a foot long. They are active in winter, perhaps this because their prey are sluggish in winter and easier to catch, but go torpid in summer and seem to disappear.

The meeting was adjourned at 9:26

NEXT MEETING:

The next meeting will be on Tuesday, March 17. Don Jackson, EEB professor, will give a presentation on *What is Happening to Ontario Lakes*

CORRESPONDENCE

This letter from Paul Scott, son of Bev Scott, was shared with the club at the February meeting, along with the photo which accompanied it.

The photo was taken in the ROM theatre on 1 Feb. 1960, and includes several Brodie Club members. Harry Lumsden and other Club members identified those in the photo, from left to right, as Shelley Logier, Jim Baillie, Lester Snyder, Terry Shortt, Levi Sternberg, unknown, and Ralph Hornell.

If you can provide any other names and/or suggest a date or other information please contact Rose Addison.

January 23, 2015

Rosemary Addison, Secretary,
The Brodie Club,
107 Kennedy St. W.,
Aurora, ON
L4G 2L8

Dear Ms Addison:

Please find enclosed a photograph taken in 1960 in the auditorium of the Royal Ontario Museum, which I found among our family photographs. My dad had a framed copy of this picture in his office at the ROM, which he took with him to the Huntsman Marine Science Centre, and later to his homes in Kingston, and Lindsay. I think it may be of a meeting of the Brodie Club.

My father is not in the picture. The only person I recognize is Terry Shortt, who is the younger man sitting in the first row, fourth from the left, having dark hair and wearing a black suit jacket and lighter coloured pants. Terry was a nature artist and spent most of his working life at the ROM. He and my dad were friends and Terry confided in him that during WWII, while serving with the Canadian Army in Italy, he had been shot in the right arm by a sniper. The army surgeon apologized to Terry that in order to save his arm, he had had to cut some of the nerves, and Terry would never have complete use of his arm. Terry found many ways to disguise his injury, and few people knew about it. However he experienced a great deal of anguish about being able to pursue a career in art as he had hoped. This was further exacerbated because Terry's older brother was already an established commercial artist, and viewed by the family as their star in the art world. However Terry took the time to understand the environment in which his subjects lived, and discern something of their character and personality, which brought a deeper more profound insight to his paintings. He was a technical instructor, teacher and mentor for many aspiring artists at the musueum, including Pete Buerschaper who became artistic director, and several of this generation's most eminent nature artists.

I hope the photograph is of interest to members of the Brodie Club and brings back some happy memories.

Best wishes.

Paul James Scott

Paul Scott
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