THE BRODIE CLUB

Established 1921

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

THE 1,106th MEETING OF THE BRODIE CLUB

The 1,106th meeting of the Brodie Club was held on Tuesday, 12 December, 2017 in Room 432 of the Ramsay Wright Laboratories of the University of Toronto.

Chair: Justin Peter
Secretary: Kristen Martyn

The meeting was called to order at 7:35 pm and was attended by 25; 23 members and 2 guests.

Roll Call:

Present: E. Addison, R. Addison, Beadle, Bertin, Bryant, Carley, Currie, Daniels, Dunn, Eadie, A. Falls, B. Falls, Hussell, Iron, Kortright, Lindsay, Machin, Martyn, Peter, Pittaway, Riley, Rising, Seymour

Guests: Peggy Haist (guest of Bertin), Katie Thomas (Beadle)

Regrets: Abraham, Bell, Curry, Dengler, DeMarco, Dunlop, King, LaForest, McAndrews, Moldowan, Obbard, Slessor, Sutherland

Minutes:

Trudy Rising moved to approve minutes. Jeremy Hussell seconded motion; motion approved.

Committee Reports:

Membership:

Ricky Dunn listed Brodie Club's ten Corresponding Members, and hereby invites them to actually correspond. Short communications can be appended to the minutes in a "Correspondence" section, to which Regular members are also welcome to contribute.

George Bryant reported that almost all members renewed their memberships this year. Marc Johnson will be travelling for the next six months and is therefore unable to attend meetings.

Trudy Rising inquired about who is responsible for name tags, as there was a member without one. Rose Addison has made nametags for new members since the September meeting and will follow up with anyone who still needs one.

Program:

Ed Addison announced **next month's meeting**: Sebastian Kvist, Associate Curator of Invertebrates at the Royal Ontario Museum, who will with speak about leeches. He reminded members that the meeting will be held on January 16th, 2018.

SPEAKER:

Kathy Lindsay introduced speaker Dr. Lesley G. Campbell, Assistant Professor at Ryerson University. Her topic was "Medicines in the Landscape".

Dr. Campbell's research interests include the study of evolutionary processes, and how such properties as mating systems and genetic diversity affect the ecological function of plant populations. She studies ecological mechanisms regulating genetic diversity, phenotypic evolution, and demography in rare and invasive plants, as well as evolution of agricultural weeds, conservation of rare plants, and population dynamics of native species.

There were no botanists on staff at Ryerson when Dr. Campbell started there, and now she has 200 students in her classes. She accomplished this in part by realizing her potential audience had a lot of interest in plant-derived social drugs. Focusing her courses on these plants provided a great opportunity to draw students into botany, something particularly relevant with the impending 2018 legalization of cannabis.

The following 10 key social drug plants (named for the euphoric feeling they provide) all have secondary compounds ("drugs") that are addictive. Researchers do not understand why these compounds are produced, but theories include protection from herbivory or UV damage, or as a tool for communication.

Species	**Common Names**	**Social Drug**
Camellia sinensis	Tea	Caffeine
Cannabis sativa	Marijuana	Cannabinoids
Catha edulis	Khat / Qat	Cathinone
Coffea spp.	Coffee	Caffeine
Cola spp.	Kola Nut	Caffeine
Ephedra	Ephedra	Ephedrine & Pseudoephedrine
Erythroculum coca	Coca	Cocaine
Ilex paraguariensis	Maté	Caffeine
Nicotiana tabacum	Tobacco	Nicotine
Papaver somniferum	Opium Poppy	Morphine, Heroin

Artificial selection on small populations has led to differences between cultivated and wild populations in many of these species. Campbell and her students have been studying what happens when the cultivars go back into the wild.

The native distribution of many social drug species is usually very limited geographically, and the alleles that confer pharmacological properties may have developed locally rather than being widespread across the species' range. Now, however, social drug plants have escaped into natural landscapes far beyond their original distribution. Humans carry them on travels and plant them elsewhere. Seeds from outdoor grow operations can disperse naturally through the help of insects, birds and other wildlife. Ephedra seeds, for example, are dispersed by both small rodents and wind. When cultivars meet up with their native forebears, there will often be hybridization and movement of genes into other populations and even other species.

Hybridization plays a far greater role in evolutionary processes in plants than in animals. All angiosperms resulted from hybridization events, and roughly 65% of all plant families have undergone significant evolutionary change through this process. Coffee, chocolate and wheat are all examples of plants that are the product of hybridization. While some social drug plants cannot hybridize, many can and do mate with wild relatives, with the result that wild relatives of many social drug plants are now extinct or threatened. For example, species in the coffee genus hybridize so readily that a high percentage of the wild relatives of *Coffee arabica* are listed as potentially endangered because they might hybridize with that cultivar. Marijuana has already interacted extensively with crop plants, to the extent that the original wild cannabis that lacks THC no longer exists.

Dr. Campbell's research is mainly on cannabis, investigating how frequently the alleles that produce the psycho-active ingredients get transferred to non-social drug plants, how frequently, where, and under what environmental conditions. She collaborates with commercial growers, which offers benefits to both parties.

The documented use of cannabis for medicinal purposes goes back to 3000 BC and probably much before that. The Chinese used it to help treat malaria, constipation and rheumatic pains among other things. It was popularized for medical use in the 1800s, but by the mid-20th century was in rapid decline due to unstandardized product, the rising use of synthetic drugs in medicine, and the development of hypodermic needles and morphine injection – which in turn led to scare propaganda directed at drugs in general. The US listed cannabis as a Schedule 1 restricted drug, making it difficult to study. Only in 1964 was THC identified as the main psychoactive ingredient and recognized as a pain reliever. Later in the 1990s many other discoveries on cannabis were made, including the discovery of anandamide, a cannabinoid chemical that humans synthesize naturally. When too little cannabinoid is produced we experience pain. Plant-derived cannabinoids simply replace human-produced cannabinoids to reduce many forms of pain.

The human body produces two types of endocannabinoids, and has two different kinds of receptors that receive the signal to respond to pain. CB_1 receptors are mainly located in the brain, but also found in the spinal cord, and respond primarily to pain and inflammation. CB_2 receptors are predominately located peripherally in other tissues such as the spleen and tonsils, and respond to infection as well as to inflammation. They also regulate numerous metabolic processes. CB_1 receptors in the brain are extraordinarily abundant -- ten times more abundant than opioid receptors -- and the brain needs them to work properly.

There are few CB_1 receptors found in the cardiorespiratory areas, which means that cannabinoid drugs do not shut down the heart or lungs following an overdose in the way that opioids do. However, cannabis can be very dangerous for people with mental health issues, as it can lead to suicide (especially in people under the age of 25). All other vertebrates also produce endocannabinoids and have cannabinoid receptors and respond to cannabis when consumed; but that is not true of insects.

There are two species of cannabis, *Cannabis sativa* (Afghanistan) and *C. indica* (India), which are similar genetically and differ mostly in appearance. The medicinal components of cannabis include two acids: THC (a hallucinogen) and CBD (cannabidiol; a depressant). Licensed marijuana producers must constantly measure the amounts of both chemicals in their product. Both THC and CBD are derived from one single parent chemical, and heat is required to produce the hallucinogenic – which is why marijuana is either smoked or cooked into edibles.

Cannabis have separate male and female plants, which reproduce through wind pollination. Industrial cannabis propagate plants instead through cloning, to produce genetically identical plants and greater consistency in narcotic levels. Only female plants are propagated, as the "drug" is produced in a resin harvested from females, and because cloned females produce more THC and CBD than pollinated plants. In contrast, hemp production focuses on males. Feral populations of marijuana reproducing through pollination have a roughly 50:50 ratio of male to female plants, and produce levels of THC that are harmless to the majority of animals that consume it; so producers want to keep male plants far from their operations.

Hemp farmers also face problems with pollination. A single gene in cannabis determines the Mendelian inheritance of THC and CBD, so pollination of hemp crops (legally grown) with feral marijuana plants can potentially cause them legal problems.

Should social drug plants mate with their relatives there are a variety of known evolutionary consequences, and probably many that are unknown. And while a lot has been learned on this topic for cannabis, the consequences of gene flow for many other social drug plants (including coca, ephedra and khat) is still essentially unknown. Gene flow is known to be common in some species, including coffee, cannabis, opium poppy and tea; whereas species such as the kola nut and tobacco rarely have very little gene flow and are therefore of little concern.

The ecological consequences of social drugs on the landscape vary greatly. All of the social drug plants exist within a food web and there are generally consequences (both positive and negative) for organisms that consume the plant. For example, when caffeine is introduced to pollinators it enhances their memory retention and cognitive performance. On the flip side, cannabis impaired the performance of rats in memory trials. However, many of the consequences are unknown, for example the effects on non-human consumers of the kola nut has not been studied.

Questions following the presentation:

Trudy Rising- inquired about grad students. Dr. Campbell responded that she has several grad students who are doing a lot of work on growing procedures. After working with Dr. Campbell they can immediately get jobs with the 60+ licensed marijuana producers that now want university trained employees.

Ed Addison- inquired why basic biology did not precede the social controversy. Dr. Campbell noted that the first published paper about the horticultural of cannabis was released in November 2017 (from the University of Guelph).

John Carly- commented that the penalties of research were so severe that it simply was not possible previously to run controlled experiments or publish results. Even now, due to security procedures and concerns, Dr. Campbell's lab is in a room with intense artificial lights with no windows.

However, there is actually lots of knowledge regarding the horticulture of marijuana, passed down by word of mouth from one generation to the next growing small crops to avoid detection.

Ed Addison- it there not a statistically data based understanding of marijuana now that it's becoming legal? No. There was only one federal research project that was largely field based, and that work was mainly on concentrations of THC and CBD. Research on cannabis has been incredibly underdone.

Ed Addison- is there anything known about the specific things that influence naturally grown plants? Many growers would say that specific differences among plants are due to the grower rather than soil, climate, etc. One of the things Dr. Campbell is working on in her lab is the effect of 'terroir' on cannabis.

Oliver Bertin- mentioned that when he was studying fish, poachers knew more about fish than he did and he felt that illegal growers may know more about growing marijuana than do researchers. Dr. Campbell agreed and wants to study home growers and gather community based observations.

Kathy Lindsay- inquired whether there might be experiments with growing cannabis outdoors. In Canada, Dr. Campbell suspects that cannabis will always be indoor grown, however soil could be brought in from an outdoor source. It is also still unknown whether people will be allowed to grow their own plants outdoors, but Dr. Campbell suspects it will be.

John Riley- inquired about the demand for organic vs non-organic. Dr. Campbell commented that most marijuana consumers want something that is organic and not genetically modified.

Sandra Eadie- mentioned that she was under the impression much of the good cannabis is grown outside. Dr. Campbell confirmed that this was true due to light conditions. However, because of security concerns and government mandates it is not possible to grow commercially outside. As a result, controlled indoor growing conditions with full spectrum light is currently the only option. Licensed producers must have video footage stored for up to two years (offsite) for each plant. Producers also must control microbial load for the safety of consumers. This means they have to provide four microbial counts (including *E. coli* and *salmonella*) for every bud since many users are immunocompromised.

Sid Daniels- wondered where the seeds from non-pollinated female plants come from. Female plants are kept in non-flowering state and clones are harvested repeatedly off the same plant. Eventually the clones get tired and stop producing as much THC. An interesting fact is that the sex of seeds can be reversed by exposure to a particular chemical.

John Riley thanked the speaker.

Observations and book reviews were left for a later meeting, to allow more time to socialize over festive treats.

Meeting adjourned at 21:05.

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