Orchids of the Keweenaw
Beauty in the Balance

Presented by Karena Schmidt
for the Gratiot Lake Conservancy

Why do people get so excited about orchids?

- Rarity
- Only found in those special places that meet specific growing conditions
- Flowers are beautiful, charming, unique from other flowers
- Grow in exciting places -- bogs, swamps, forests, prairies
- Most highly evolved plant family
- Amazing co-evolution of orchids with insect pollinators
- Feel special for having honed-in on our observation skills
- Intriguing interactions with fungus
- Among first to respond in a negative way to changes in the environment

What is Beauty?

Beauty of utility. Something can be perceived of as beautiful because its purpose is understood

Beauty is a characteristic that provides an experience of pleasure or satisfaction

Entity being in balance and harmony with nature

Exhibits charisma and elegance

Charms the senses

Aesthetically pleasing combination of qualities, such as shape, color, or form

A few orchid facts

- 28,000 species worldwide – primarily in tropics

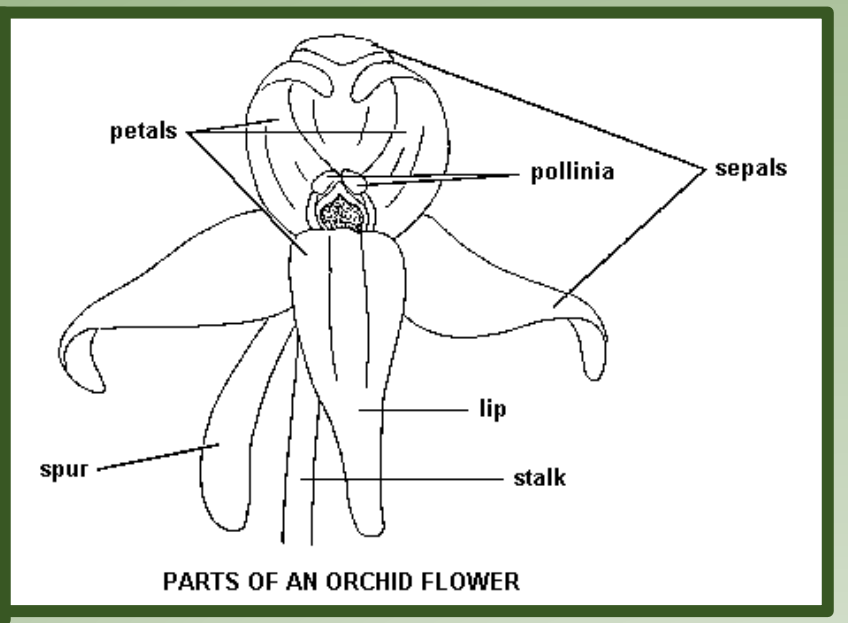
  Isle Royale, 32 species of orchids

  Michigan, 53 species of orchids

  North America, about 150 orchid species

- Monocot – simple leaves with parallel veins
- Column – fusion of male and female parts of plant
- Produce millions of minute primitive seeds
- Seeds typically dispersed by wind
- Highly specialized pollination systems
- After successfully pollinated the flower wilts within a few hours
- All terrestrial orchids have associations and dependence on fungi

A bit of orchid anatomy for the botanists among us



PARTS OF AN ORCHID FLOWER

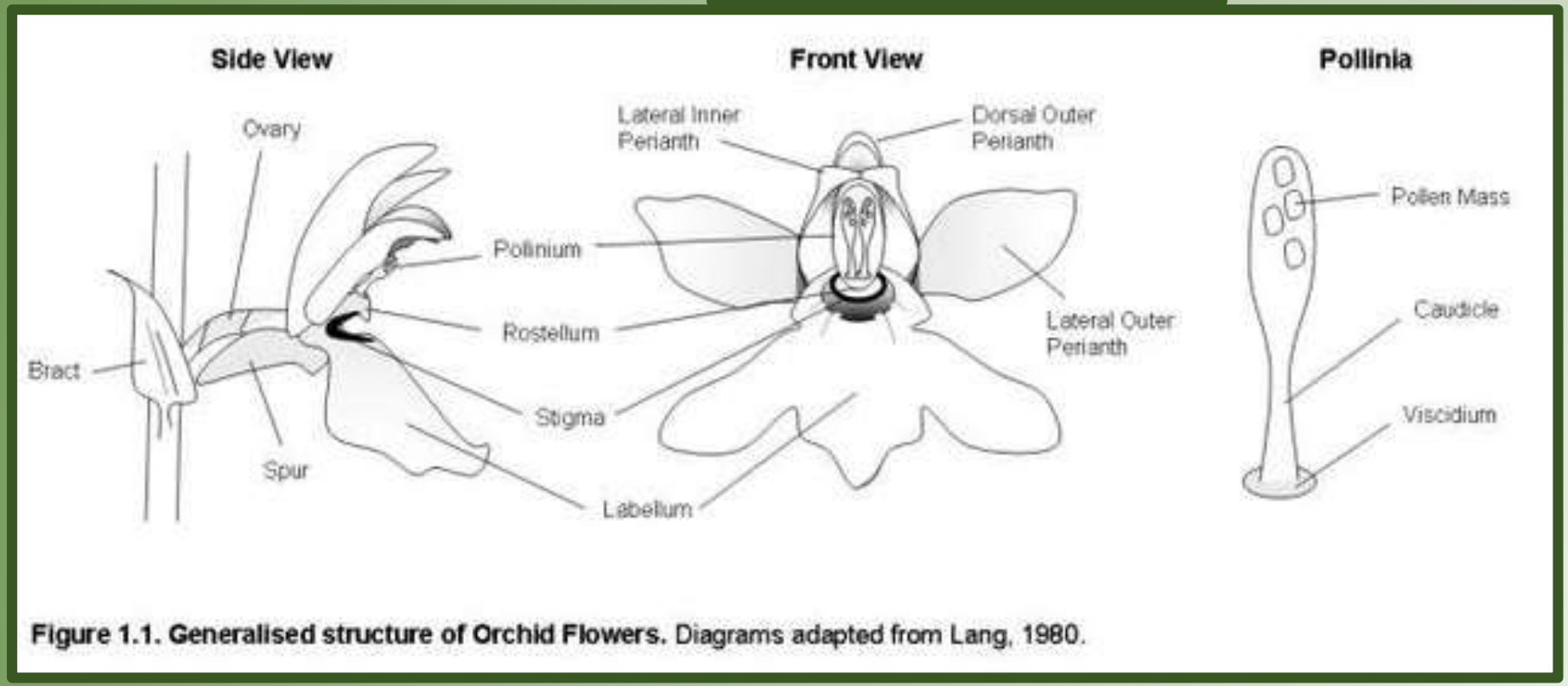
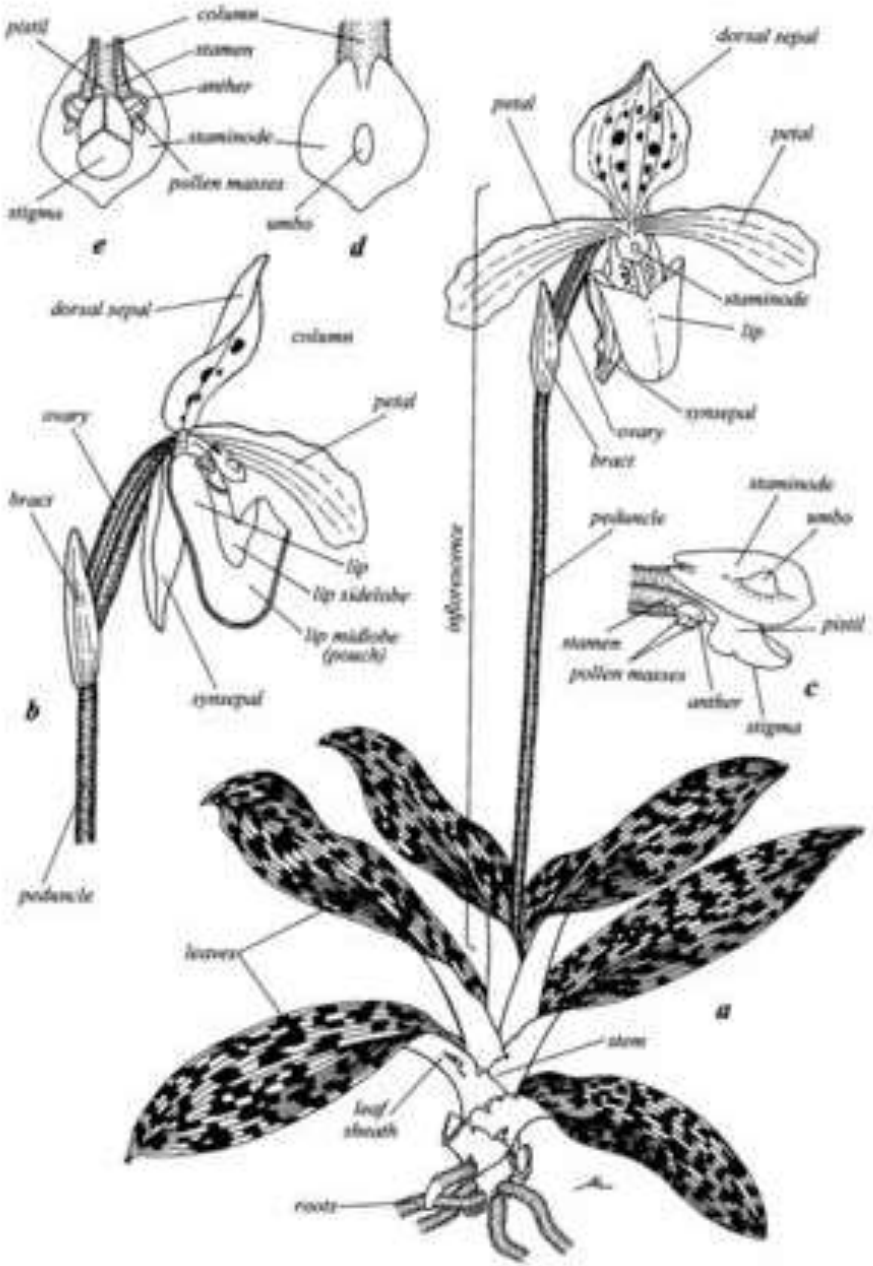


Figure 1.1. Generalised structure of Orchid Flowers. Diagrams adapted from Lang, 1980.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lip midlobe (pouch)
synsepal
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pollen masses
anther
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leaves
stem
leaf sheath
roots
a

environmental ingredients orchids need for survival

Each species of orchid has a unique and precise mix of:

- sunlight
- moisture
- temperature
- acidic soils
- bacteria
- fungal symbiosis

- insect pollinators
- time
- nutrients
- seasonal variation
- companion plants
- symbiotic energy

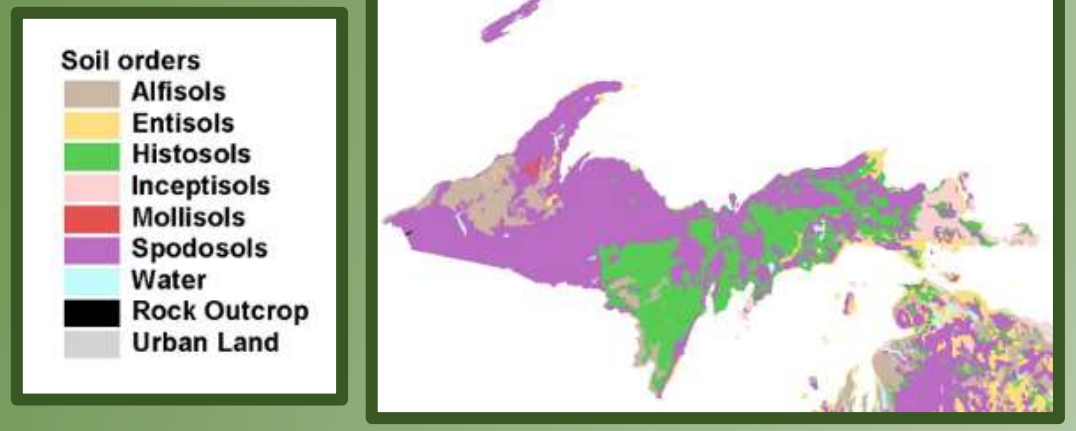
Bacteria

- About 90% of all vegetable material is consumed by bacterial decomposers
- The decaying process enables carbon and nitrogen to be cycled to new forms which support life systems
- Without bacteria and fungus, all the carbon required for life would become locked up in a growing layer of dead material that would never break down. Life would peter out in a few decades
- Although there are harmful bacteria out there, many more are beneficial
- Orchids, and all life forms, are dependent on these tiny micro-organisms

Soils

Soils are formed through a very complex process involving the nature of the parent bedrock, climate, animals, vegetation, slope of the landform, and length of time the soil has been in existence

Most of Michigan's soils were developed from glacial sediments deposited during the Ice Age



- Spodosols (from the Greek *spodos* – wood ash) are among the most attractive soils
- Often have a dark surface underlain by an ashy, gray layer, which is subsequently underlain by a reddish, rusty, coffee-colored, or black subsoil horizon
- Form as rainfall interacts with acidic vegetative litter, such as the needles of conifers, to form organic acids. These acids dissolve iron, aluminum, and organic matter in the topsoil and ashy gray horizons
- Spodosols most often develop in coarsely textured soils (sands and loamy sands) under coniferous vegetation in humid regions of the world
- They tend to be acidic, and have low fertility and low clay content
- Spodosols occupy about 4% of the world's glacier-free land surface

Nutrients

Plant nutrition is the study of the chemical elements and compounds necessary for plant growth, plant metabolism and uptake of nutrients within their habitat

Two criteria for an element to be essential for plant growth:
(1) in its absence the plant is unable to complete a normal life cycle
(2) the element is part of some essential plant constituent or metabolite

Plants must obtain the following mineral nutrients from their growing medium

Macronutrients:

nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sulfur (S), magnesium (Mg)

Micronutrients or trace minerals:

boron (B), chlorine (Cl), manganese (Mn), iron (Fe), zinc (Zn), copper (Cu), molybdenum (Mo), nickel (Ni) and cobalt (Co)

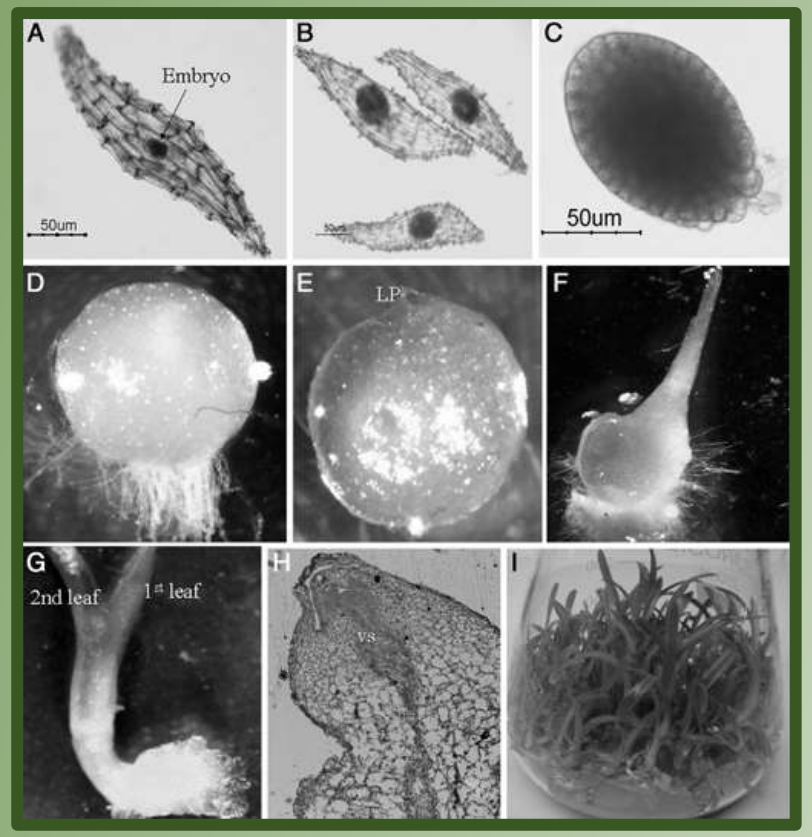
Most soil conditions across the world can provide plants adapted to that climate and soil with sufficient nutrition for a complete life cycle

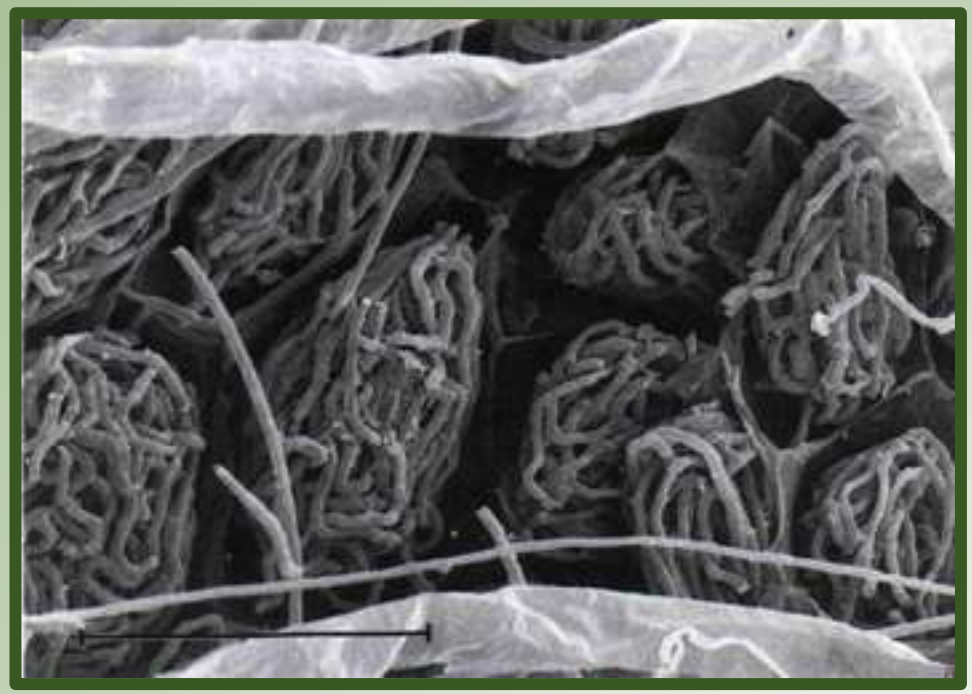
Fungi

All the orchids of the Keweenaw live in association with, or have symbiotic relationships, with at least five different fungal partners. All these fungi live in the soil. Orchid seeds, stems, roots, and leaves all in some way interact with various fungi

Fungus invade and digest the orchid seed, testa

Digestion produces sugars which seed cells use to grow and develop





Peletons

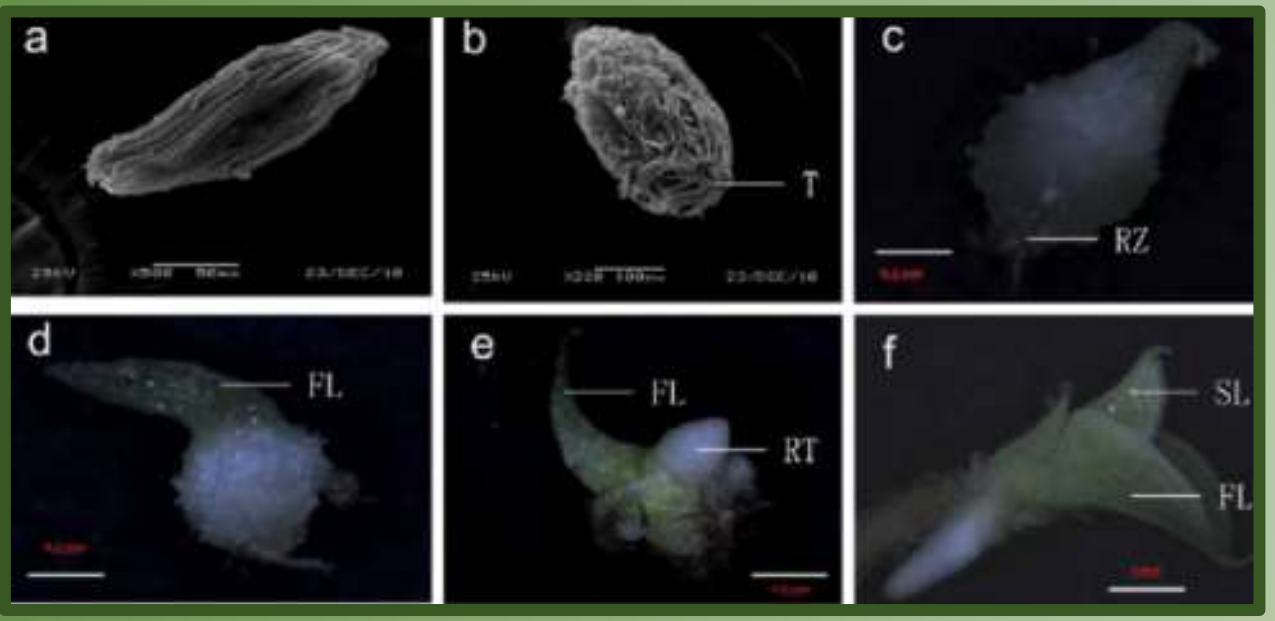
Messaging back and forth for plant to allow invasion or to put out defensive chemicals

Time

Time is a critical ingredient for the orchid

This is not a plant for impatient people. The time from seed alighting upon the ground to an actual plant emerging can take 16 years

An orchid plant can be very much alive, underground, as it cultivates relationships with fungi and makes preparations for its emergence

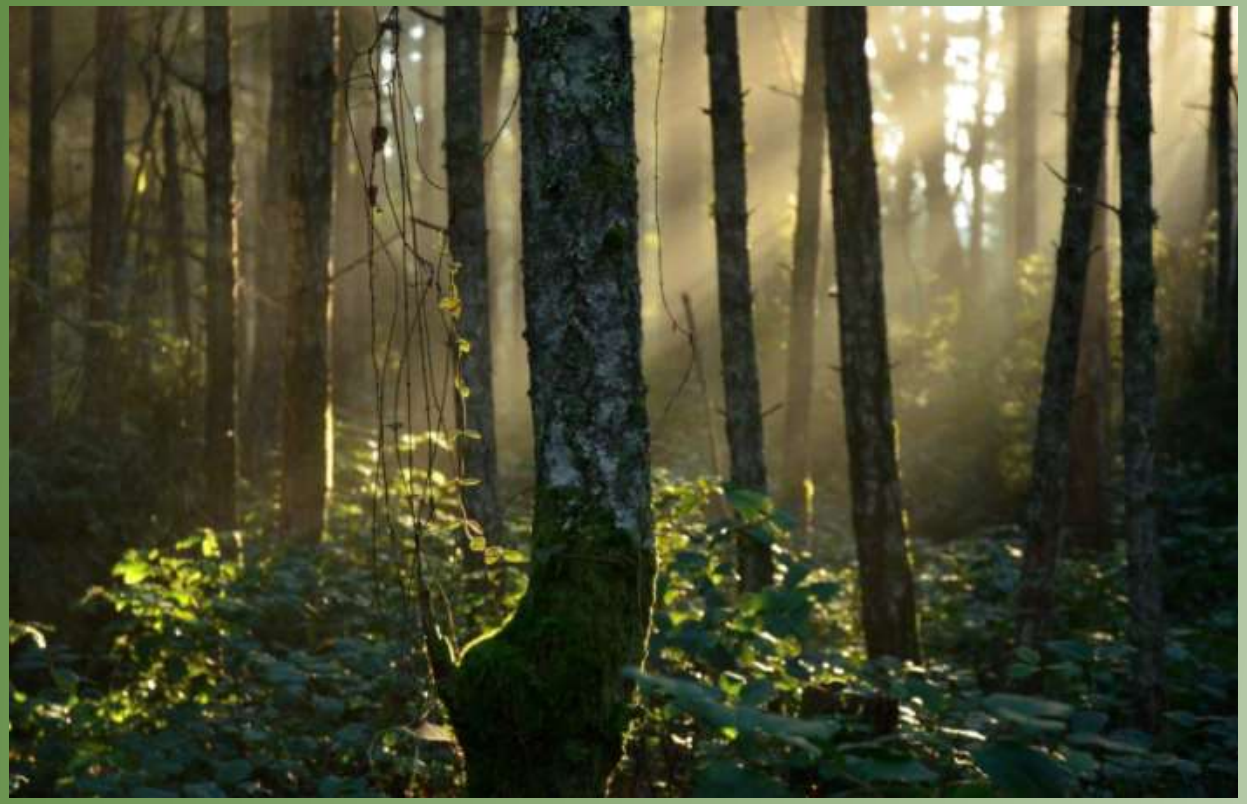


Sunlight

Sunlight is electromagnetic radiation given off by the Sun, in particular infrared, visible, and ultraviolet light

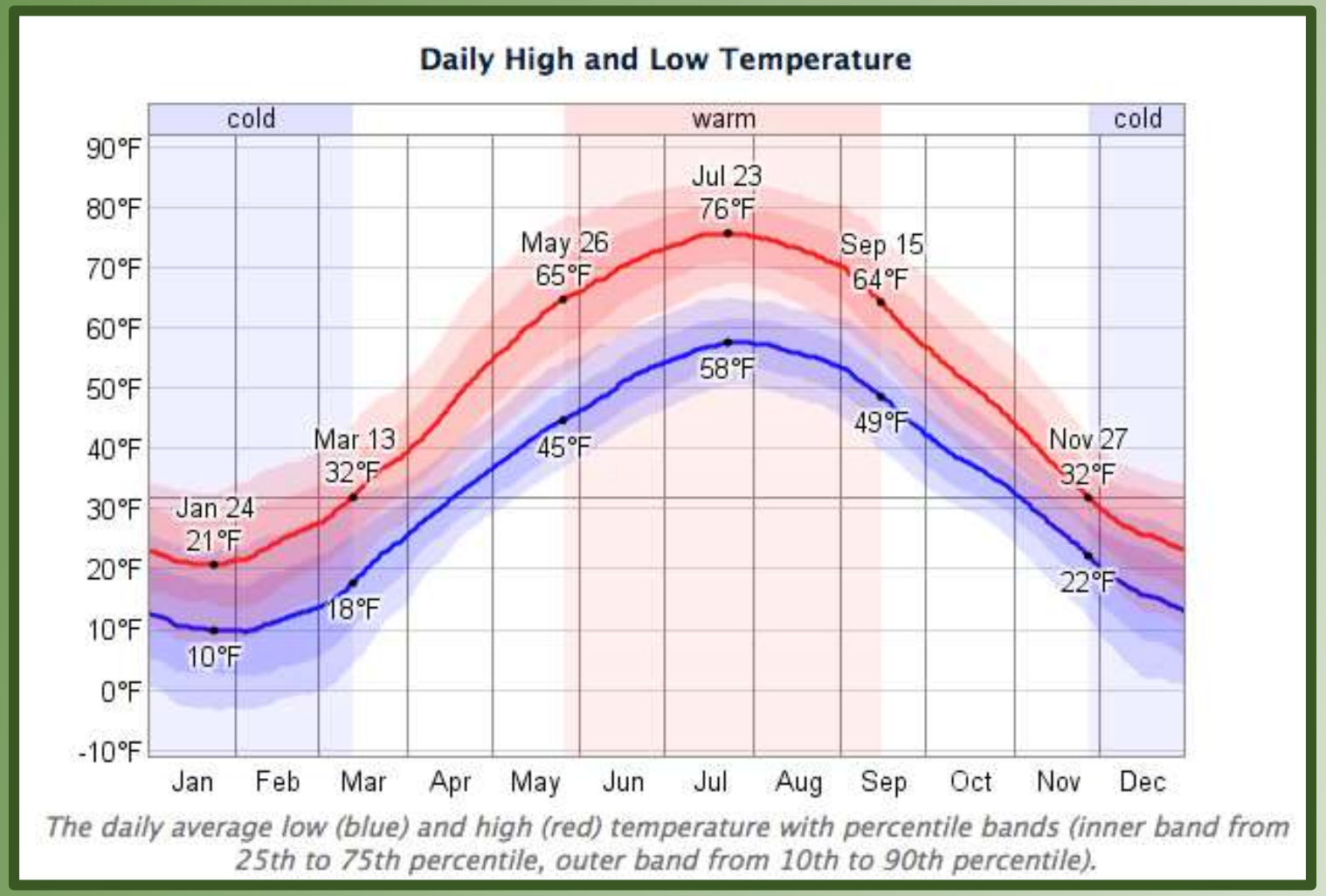
Sunlight takes about 8.3 minutes to reach Earth from the surface of the Sun

Plants are able to synthesize the sun's energy to produce their own food energy



Keweenaw Temperature Data

Over the course of a year, the temperature typically varies from 10°F to 76°F and is rarely below -3°F or above 84°F



Seasons

How grand to experience them all!

- Winter a time for dormancy
- Explosive joys of an emergent spring. That time of renewal, where hope springs eternal and showy blossoms appear
- Summer comes along and energy is devoted into seed production, maturation and perpetuation
- Autumn important for energy storage. That last little bit of photosynthesis is critical for the plant to survive. During this season, energy flows from leaf to root where important sugars and carbohydrates are stored. In spring this energy flow is reversed, and energy flows from root to leaf

Moisture

Sources from fog, rain, snow, humidity, waterfalls

- A humid continental climate
- Typified by large seasonal temperature differences, with warm to hot, humid summers and cold winters
- Precipitation is usually well distributed through the year
- Humid continental climates tend to be found between latitudes 40° N and 60° N

Climate data for Houghton, Michigan, 1971-2000 normals, extremes 1887-present [hide]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °F (°C)	50 (10)	60 (16)	79 (26)	88 (31)	95 (35)	99 (37)	102 (39)	97 (36)	92 (33)	86 (30)	71 (22)	64 (18)	102 (39)
Average high °F (°C)	21.6 (−5.8)	24.8 (−4)	33.7 (0.9)	47.1 (8.4)	62.3 (16.8)	70.8 (21.6)	75.9 (24.4)	73.6 (23.1)	63.3 (17.4)	51.6 (10.9)	36.8 (2.7)	26.0 (−3.3)	48.96 (9.43)
Average low °F (°C)	7.6 (−13.6)	9.1 (−12.7)	17.6 (−8)	29.5 (−1.4)	40.8 (4.9)	49.3 (9.6)	55.2 (12.9)	54.7 (12.6)	46.2 (7.9)	36.4 (2.4)	25.1 (−3.8)	13.8 (−10.1)	32.11 (0.06)
Record low °F (°C)	−29 (−34)	−30 (−34)	−23 (−31)	−4 (−20)	19 (−7)	28 (−2)	32 (0)	34 (1)	24 (−4)	12 (−11)	−7 (−22)	−19 (−28)	−30 (−34)
Average precipitation inches (mm)	4.26 (108.2)	2.28 (57.9)	2.45 (62.2)	1.71 (43.4)	2.49 (63.2)	2.84 (72.1)	2.97 (75.4)	2.75 (69.9)	3.24 (82.3)	2.56 (65)	2.84 (72.1)	3.42 (86.9)	33.81 (858.6)
Average snowfall inches (cm)	68.4 (173.7)	33.4 (84.8)	24.0 (61)	7.1 (18)	1.1 (2.8)	0 (0)	0 (0)	0 (0)	0.1 (0.3)	4.0 (10.2)	23.8 (60.5)	56.1 (142.5)	218 (553.8)
Average precipitation days (≥ 0.01 inch)	22.7	15.8	12.6	9.6	10.3	10.8	10.0	9.9	12.7	13.1	15.4	19.7	162.6
Average snowy days (≥ 0.1 inch)	23.6	15.6	10.3	4.8	0.9	0	0	0	0.1	2.5	12.0	19.7	89.5

Source #1: National Oceanic and Atmospheric Administration[30]

Source #2: National Oceanic and Atmospheric Administration[33]

Lake Superior

- The lake has a tremendous moderating effect on the climate
- Summers tend to be cooler
- Lake Effect Snow -- the ground here generally does not freeze, thus accommodating plant species which are generally seen further south
- This blanket of snow serves as an insulator, so although air temperatures can be sub-zero, the plant roots within the soil are protected from cold winter temperatures

Insects

- Orchids utilize a variety of intricate strategies for attracting the specific pollinators on which their survival depends. In virtually all cases the orchid and pollinator have evolved together
- Orchids commonly use nectar to entice their pollinators, but they also employ color, shape, or fragrance
- Color is often important for insects active during the day
- Orchids pollinated by hummingbirds and butterflies tend to have red, orange, or pink flowers. Often not fragrant. They frequently have yellow blotchy patterns to mimic the anthers and pollen of the other plant types visited by these nectar lovers, but this mimicry is deceptive because the orchids rarely offer a nectar reward
- The flowers of most moth-pollinated species are green or white and are usually very fragrant only at night so they can be found by these night-flying insects
- Some orchid flowers deceive their pollinators by mimicking the appearance and scents produced by female insects

Symbiotic energy

- In symbiotic relationships, two species are dependent upon one another for survival; one cannot exist without the other as they each provide some thing or some service to the other that it cannot obtain on its own
- Saprophytic relationship -- fungus feeds on decaying organic matter and directs these minerals and nutrients to another plant
- Coral roots are saprophytes. These orchids have no roots at all, rather, a fungus infects the stem of the orchid and feeds the plant directly with the nutrients it requires from the digested organic matter

Many relationships are yet to be understood

Stable Climate

Having stability enables a species to endure

Note changes in phenology in recent generations

Winter has been encroached upon from either end, longer autumns and earlier springs

With these alterations in climate, it should be interesting to document how orchid species, indeed entire ecosystems, are being influenced by these significant climatic changes occurring in our lifetime

Companion Plants

Presence of this or that…

Time to solve the orchid ingredient puzzle

Corallorhiza trifida Early coral root

Found in moist coniferous, deciduous, or mixed forests, and in swamps or bogs

Corallorhiza maculata Spotted Coral root

In forests of all kinds: conifers, hardwoods, mixed; moist or dry; from sandy oak-hickory or red pine to wet cedar-hemlock; often common in pine and spruce forests on old dunes as well as in beech-maple stands

As a backup in the absence of insects, this orchid is capable of self-pollination

Corallorhiza striata Striped Coral root

Grows in forests, woodlands, and occasionally on lake shores and often forms large patches

The flowers are large and showy and well suited for insect pollination

The parasitic wasp, *Pimpla pedalis*, is a documented pollinator of this orchid

Arethusa bulbosa Dragon's mouth

Typically found in acidic, boggy conditions, especially favoring beds of sphagnum mosses

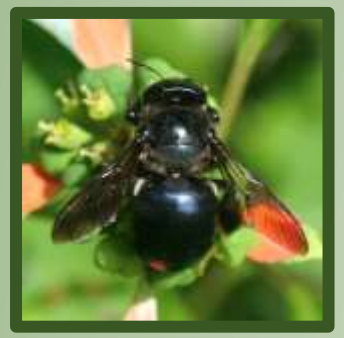
Bombus ternarius and *Bombus terricola* are attracted to the ultraviolet absorbing anther-like bristles on the lip and crawl toward the base of the lip searching for nectar

Pollination is dependent on inexperienced bees that emerge throughout the blooming season because bees quickly learn to avoid these flowers that do not offer a reward

Calopogon tuberosus Grass pink

Prefer full sun and generally grow in moist meadows, grasslands, and savannas

This orchid is pollinated by a variety of bees including *Bombus fervidus, Bombus nevadensis, Bombus ternarius, Bombus terricola, Bombus vagans, Megachile melanophaea* and *Xylocopa micans*



Pogonia ophioglossoides Rose pogonia

Found in boggy habitats, including moist prairies, meadows, and woodlands, swamps, and along riverbanks and roadsides

It can be distinguished from other species with similar flowers, such as *Calopogon tuberosus* or *Arethusa bulbosa*, by its bearded labellum

This orchid is pollinated by many species of bumblebees. Pollen transfer occurs as the bee puts its head deep inside the flower. As it searchers for pollen and nectar the anther of the flower brushes against the head of the visiting bee and pollinia attaches to the bee's head. Pollen is then transferred from the head of the bee to the stigma of the next flower it visits

Cypripedium arientum Ram's head lady's slipper

Grows in coniferous or mixed forests, swamps, and mossy bogs, often near cedar, spruce, or juniper trees

Primarily reproduces vegetatively through offshoots from its rhizome, sometimes resulting in clusters of over a dozen plants in a single location

The showy white and magenta flowers produce a sweet vanilla fragrance that attracts bees into the pouch. Pollinated by female halictid bees

Cypripedium acaule Pink moccasin flower, Pink lady's slipper

Found in forests and woodlands, often near pines or conifers, and occasionally in bogs or swamps

This orchid, like most Lady's Slippers, attracts pollinators through deception. Several species of bumble bees are lured into the pouch by the bright color and sweet scent of the flower

Inside, they find no reward but are trapped with a single exit. Hairs lead to a pair of openings, one beneath each pollen mass. As the bee crawls towards the opening, it rubs against the stigma and any pollen it is carrying pollinates the flower. Finally, as it squeezes out of the flower, new pollen is pressed on to the bee to be carried to the next plant

Bees quickly learn from this experience and soon avoid these flowers which accounts for low pollination rates for this orchid

Cypripedium reginae Showy lady's slipper

Requires moist soil, grows in damp fens, meadows, forests, swamps, and on river banks

In favorable conditions, a single plant can produce over 200 flowering stems

A clonal plant that grows slowly, occasionally taking over 16 years to produce its first bloom; a single plant can live over fifty years

Pollinated by medium-sized bees, including *Anthophora abrupta, Megachile centuncularis* and *Megachile melanophaea* which are effective at removing the sticky pollen as they escape the flower. Beetle pollination in orchids is rare, but *Trichiotinus assimilis* has been observed visiting this flower and emerging with pollen

Cypripedium parviflorum Yellow lady's slipper

- Grows in dry to mesic forests, woodlands, fens, prairies, and meadows
- It often produces a natural hybrid with other yellow slippers
- Many documented pollinators including species of *Agapostemon, Andrena, Apis, Ceratina, Eristalis, Osmia* and *Lasioglossum*
- Differences in fragrance and flower size between the varieties of this orchid may account for variation in insect pollinators

Neottia auriculata Auricled twayblade (formerly *Listera*)

Found in moist coniferous or mixed forests, swamps, sphagnum bogs, and along riverbanks

Pollinator not reported

Neottia convallarioides Broad leaved twayblade

Found in mesic to moist woodlands, swamps, boggy meadows, and along riverbanks

No pollinator information reported

Neottia cordata Heartleaf twayblade

Grows on peat-moss hummocks in forested swamps, as well as in moist woodlands and in coniferous or mixed forests

Pollinated by Hymenoptera and fungus gnats in the genera *Mycetophila*

Insects land on the labellum and crawl up it to feed on nectar

If the head of the insect touches the trigger hairs on the rostellum, a sticky secretion is released and pollinia are then attached to the head of the insect

This process happens nearly instantaneously once the trigger hairs are touched

Goodyera oblongifolia Western rattlesnake plantain

Goodyera repens Creeping rattlesnake plantain

Goodyera tesselata Tesselated rattlesnake plantain

Goodyera pubescens Downy rattlesnake plantain

Goodyera oblongifolia
Western rattlesnake plantain

Goodyera repens
Creeping rattlesnake plantain

Goodyera tesselata
Tesselated rattlesnake plantain

Goodyera pubescens
Downy rattlesnake plantain

Goodyera tesselata Grows primarily in coniferous or mixed forests and woodlands, and only rarely in swamps or bogs

Goodyera oblongifolia found in forests and woodlands, often in mixed coniferous forests. The central white stripe on leaves distinguishes this orchid from *Goodyera tesselata*

Goodyear pubescens grows in coniferous, deciduous, or mixed forests, and occasionally in moist humus or swamps

Goodyera repens grows in mixed or coniferous forests, preferring shady, moist woods. Rarely, it grows in bogs or swamps. **Generally found only in forests at least 95 years old**

Bumblebees, such as *Bombus perplexus* are important pollinators of these orchids as they search for nectar. Also pollinated by halictid bees and syrphid flies

Bees usually work their way from the bottom to the top of a flower spike because flowers at the base of the spike mature first and produce more nectar. These flowers have exposed stigmas and pollen can be easily transferred from the bees' proboscis as it probes for nectar

Flowers on the same spike nearer the top produce less nectar and the stigma is not accessible for pollination

Dactylorhiza viridis, Coeloglossum viride Long bracted orchid

Prefers growing in moist habitats, such as wet coniferous forests, tundras, prairies, meadows, and bogs

The pollinators of this orchid not yet known

The generic name *Coeloglossum is derived from the Greek koilos glossum meaning "hollow tongue", referring to the hollow spur on the tongue-like labellum*

Platanthera dilatata Tall white bog orchid
Platanthera aquilonis Northern green rein orchid
Platanthera huronensis Lake Huron Green orchid

P. dilatata is primarily a wetland species, found in wet marshes, fens, bogs, along riverbanks and roadsides
It can be distinguished from *P. aquilonis* by its white instead of green flowers and by its dilated labellum

P. aquilonis can be found in moist meadows, marshes, fens, and bogs, as well as along roadsides and riverbanks
Although it shares a similar habitat as *P. dilatata*, it can be distinguished by its green instead of white flowers and its tapered labellum

P. huronensis is found in wet meadows and woodlands, marshes, fens, bogs, and along riverbanks and roadsides

This orchid is thought to have descended from a cross between *P. aquilonis* and *P. dilatata*

Flowers are typically intensely fragrant

dilatata

aquilonis

huronensis

Platanthera dilatata
Tall white bog orchid

Platanthera aquilonis
Northern green rein orchid

Platanthera huronensis
Lake Huron green orchid

Platanthera hookeri Hooker's orchid

Coniferous or mixed forests, thickets, and borders, especially on forested dunes and sandy soils, less often in deciduous forest or hemlock-hardwoods, and occasionally in pine barrens

This orchid is pollinated by skippers (Hesperidae) and possibly nocturnal moths

The combination of the downward column projecting over the entrance to the spur and the upturned lip is thought to possibly restrict pollen access. This forces the pollinator to approach from the side. Eventually pollinia attaches to its compound eyes as it probes for nectar

Platanthera orbiculata Round leaved orchid

Found in mesic to moist forests and woodlands, either coniferous or deciduous, and occasionally in shaded bogs

When not in flower, it may be distinguished from *Platanthera hookeri* by latter's absence of stem bracts

Pollinated by noctuid moths by moths such as *Autographa ampla* and *Diachrysia balluca*

Platanthera clavellata Club spur orchid

An inconspicuous yellow-green orchid in bogs, older cedar or tamarack swamps and coniferous forests, red maple swamps, mossy stream banks, boggy beach pools and shore meadows; often thriving along roadside ditches and in shallow sandy excavations

This orchid is capable of self-pollination, although insects have been observed visiting this orchid

Platanthera obtusata Blunt leaved rein orchid

Found in moist coniferous forests, wooded fens, bogs, swamps, and along riverbanks and roadsides

It can be distinguished from *P. clavellata* by its linear, more elongated, and unlobed labellum

Pollinated by moths including *Anageshna primordialis, Eudonia lugubralis* and *Xanthorhoe munitata* and several species of mosquitoes

The mosquito enters the flower in search of nectar, which the orchid produces and stores in the slender, downward projected spur. At the slightest touch, the pollinia spring forward and attach themselves by their sticky base to the head and eyes of the mosquito

On departing, the insect often can be seen carrying on its head what looks like one or two tiny yellow horns. When the mosquito visits a second flower, the pollinia are put in contact with the stigma, transferring pollen

Platanthera psycodes Purple fringed orchid

Primarily a wetland species, found in swampy forests, marshes, moist meadows, and along riverbanks and roadsides

Pollinated by moths and butterflies

Known pollinators include *Autographa ampla, Epargyreus clarus, Hemaris diffinis, Hemaris thysbe, Papilio glaucus, Papilio polyxenes, Papilio troilus* and *Polites mystic*

Pollinia attach to the proboscis and transfer to subsequent flowers visited

Platanthera lacera Ragged fringed orchid

In open bogs and under tamarack or cedars, also in moist meadows, ditches, edges of moist forests, swampy thickets

The flowers are pollinated primarily by noctuid moths and Sphinx moths

Anagrapha falcifera (Celery Looper Moth), *Allagrapha aerea* (Unspotted Looper Moth), and *Hemaris thysbe* (Hummingbird Clearwing) have been observed sucking nectar from the flowers

Liparis loeselii Fen orchid

Found in moist meadows, fens, and bogs, as well as shorelines and disturbed areas

This orchid is autogamous – self-fertilizing

As the flower ages the anther cap browns and raises up against the column, releasing the pollen mass. The sticky Pollinia are then held to the stigma

Malaxis monophyllos White adder's mouth

Usually grows in bogs or swamps

Its small size and green coloration make it virtually indistinguishable from the surrounding vegetation

Pollinated by fungus gnats

Malaxis unifolia Green adder's mouth

Generally grows in swamps and bogs

Pollinated by species of *Aedes* (mosquitoes), *Bradysia* (fungus gnats) *and Trioxys* (parasitic wasps)

It can be distinguished from *M. monophyllos* by its three-lobed labellum

Spiranthes lacera Slender ladies tresses
Spiranthes romanzoffiana Hooded ladies tresses

S. lacera found in open, wet areas, including moist meadows, prairies, fens, marshes, and bogs.
S. romanzoffiana found in open, wet areas, including moist meadows, prairies, fens, marshes, and bogs
In *romanzoffiana* the labellum has rounded edges and is contracted in the middle which distinguishes it from *Spiranthes cernua*

Spiranthes cernua Nodding ladies tresses

Spiranthes casei Case's ladies tresses

S. cernua found in moist fields, woodlands, bogs, marshes, and fens, as well as along roadsides, riverbanks, and in lawns

S. casei found in fields and savannas in moist to dry sandy, acid soils, often with bracken

Distinguished from *S. cernua* by its single, instead of multi-ranked, inflorescence and by its smaller flowers

These orchids may be capable of autogamy. Several bumble bees are known insect pollinators

As in most *Spiranthes*, bumblebees move upward on the inflorescence in search of nectar. Older flowers at the base of the stalk have more nectar, which makes them an efficient first stop for the foraging bumble bees

Galearis rotundifolia Round leaf orchis (formerly *Amerorchis*)

Found near northern white cedars and in high-pH swamps and fens

The scentless flower relies on food deception with its nectar-free spur to attract pollinators such mason bees and hoverflies

The pollinating bee or fly lands on the lip and probes the spur which is approximately the same length or longer than the insect's tongue. In the process of pushing into the flower and backing out, the sticky pollen attaches to the front of the insect’s head and is carried off to the next flower it visits

A curving spur hangs down at the back. A very cheerful and merry clown-like flower with a pink hood, white draped side arms and purple polka-dot pantaloons on

Aplectrum hymenale Putty root, Adam-and-Eve

Rich forests, both upland beech-maple and swamps in moist ground

Flowers lack fragrance and do not produce nectar

Capable of autogamy - as the flower matures, the column bends and presses the pollen onto the stigma

For pollination to be successful, the anther cap covering the pollen, must be removed or fall off to expose the pollen. Visiting insects, such as *Lasioglossum oblongum*, have been observed dislodging this cap as they explore the flower. In this way insects, such as bees and ants, may indirectly assist the pollination process even if they don't actually transfer the pollen onto the stigma

Epipactis helleborine Helleborine

In addition to disturbed habitats such as lawns, sidewalks, gardens, and roadsides, *Epipactis helleborine* grows in forests, swamps, and riverbeds

It grows so aggressively in some states, such as Wisconsin, that it is considered a weed

Suspected to be pollinated by wasps

Two orchids found in Ontonagon County, not in the Keweenaw

Galearis spectabilis
Showy orchis

Spiranthes lucida
Shining ladies tresses

Calypso bulbosa Fairy slipper

Found in wet coniferous or mixed forests and bogs; sometimes in drier, shady coniferous forests

Pollinated mainly by newly emerged queen bumblebees

It seems wonderful that so frail and lovely a plant has such power over human hearts.

This Calypso meeting happened some forty-five years ago, and it was more memorable and impressive than any of my meetings with human beings excepting, perhaps, Emerson and one or two others.

As a final ecosystem ingredient
Orchids give us the opportunity to
protect their homes by our expression of
Gratitude