

# FIELD BOTANISTS OF ONTARIO

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NEWSLETTER

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## CONTENTS:

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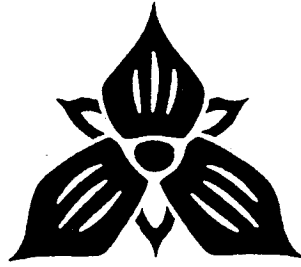
### Field trip reports:

Stoco Fen (J. Benckhuysen) . . . . .	3
Bruce Peninsula Alvars (W. McShane) . . . . .	5
Pelee Island (J Crowe) . . . . .	7
The Curious Case of Curly Grass (J. Crowe) . . . . .	9
A Quick Glance At The Genus <i>Pinus</i> (J. Benckhuysen) . . . . .	10

### ONTARIO TREE ATLAS

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# FIELD BOTANISTS ONTARIO

## NEWSLETTER

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The FBO is a non-profit organization founded in 1984 for those interested in botany and conservation in the province of Ontario.

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The drawings in this issue are by Jane Bowles and Denise Raglin. The cover drawing by Jane Bowles is Sensitive Fern (*Onoclea sensibilis*).

## STOCO FEN FIELD TRIP

On Sunday June 4 the weather seemed undecided as we made our way to Stoco Fen, not far from Tweed. We travelled down a few backroads and after a few minutes our trip leader, Don Cuddy, pulled over onto the shoulder of the road. There were no obvious landmarks or signs to indicate our arrival to this Provincial Nature Reserve, a good way of ensuring it remains little known and fairly undisturbed.

Before we even began our excursion into this fascinating, if wet, landscape, we were distracted by the flora growing along the roadside. Most were species normally associated with a fen, but it was a pleasant surprise to see them so soon on our expedition. There was Valerian (*Valeriana uliginosa*) that was just beginning to bloom and lots of Alder-leaved Buckthorn (*Rhamnus alnifolia*). Tangled amongst these and other plants were occasional specimens of Labrador Bedstraw (*Galium labradoricum*). Other species along the road included Large Yellow Lady's Slipper (*Cypripedium calceolus*) and, surprisingly enough, Small White lady's Slipper (*Cypripedium candidum*). A provincially endangered species, Small White Lady's Slipper is usually not tolerant of such exposed locations. These roadside attractions set high expectations for the rest of the day, and our 15 participants were not disappointed.

Don led the way through a tangle of White Cedar (*Thuja occidentalis*) that formed a seemingly impenetrable wall. Growing on the outer edges of this evergreen jungle was much Andromeda (*Andromeda glaucophylla*), some in bloom. The ground was spongy and covered with Sphagnum Moss (*Sphagnum caprifolium*), and although it looked dry, every step was met with the squish of ankle deep water underneath the moss.

Occasionally a deeper hole was stepped in, but this did not dampen our enthusiasm or progress. Soon the Cedars gave way to Andromeda and patches of herbaceous vegetation. Several sedges and Small White Lady's Slipper were found in these patches.

A short distance further along, herbaceous vegetation became dominant and bare ground was visible in areas. Here, where patches of Cedars, Alder-leaved Buckthorn and Andromeda were giving way to herbaceous plants; Bog Goldenrod (*Solidago uliginosa*), Flat-topped White Aster (*Aster umbellatus*), Pitcher Plant (*Sarracenia purpurea*), and Bog Buckbean (*Menyanthes trifoliata*) with a few late flowers still hanging on.

The sediment was unlike anything I had ever seen before. Approaching it, even standing on it, it looked as if it were solid silvery-grey dry chalk. I picked up a handful of sediment and squeezed it between my fingers. It's hard to describe how it felt; it was slippery, but very soft and the fine particles lined every crease of my finger prints. Don explained the source of this sediment. The groundwater entering the fen is very high in calcium carbonate. As the water heats up and evaporates, the calcium carbonate concentration increases and eventually precipitates out. Thus the sediment is nearly pure calcium carbonate.

From here we could see a large expanse of fen that was dotted with little "islands" of woody vegetation. The silky tufts of *Scirpus hudsonianus* were common as were the drooping stems of Beaked Spike Rush (*Eleocharis rostellata*) which root at the tips when they came in contact with the sediment. Also present was Bulrush (*Scirpus validus*), Cattail (*Typha latifolia*), and Common Reed (*Phragmites communis*). We hiked across the open area towards an area where Don thought we may find *Arethusa bulbosa* growing. He was right, we found several plants growing at the edges of a clump of Cedar that also contained Hoary Willow (*Salix candida*) and Labrador Tea (*Ledum groenlandicum*). We also saw the leaves of Grass-of-Parnassus (*Parnassia glauca*). As we were searching for more *Arethusa* we startled a Snipe off its nest. There were several eggs in the nest so we hurried along so the bird would come back before the eggs chilled.

It was time for lunch so we sat in the shade of some taller cedars whose lowest branches had long since died on an "island" that was somewhat drier than the surrounding area. Sharing the shade with us were Skunk Cabbage (*Symplocarpus foetida*), Bog Laurel (*Kalmia angustifolia*) and Starflower (*Trientalis borealis*).

After lunch Don brought us to a forested area on higher ground where ferns were abundant. Here we found Royal Fern (*Osmunda regalis*), Cinnamon Fern (*Osmunda cinnamomea*), Sensitive Fern (*Onoclea sensibilis*), Ostrich Fern (*Matteuccia struthiopteris*), Bulbous Fern (*Cystopteris bulbifera*), Rattlesnake Fern (*Botrichium virginianum*), and Wood Fern (*Dryopteris* sp.). We also found some Snowberry (*Gaultheria hispidula*) here, Miterwort (*Mitella diphylla*) in bloom, and a Wood Frog that quickly disappeared under a log. There was also Canada Mayflower (*Maianthemum canadense*) and the similar Three-leaved Solomon's Seal (*Smilacina trifolia*). The most obvious difference being that Canada Mayflower has four-pointed flowers and Three-leaved Solomon's Seal has six-pointed flowers. We were also fortunate enough to see a Hummingbird Moth feeding at a Labrador Tea flower.

Nearing the end of the day and on our way back to our vehicles we encountered a few Ram's Head Orchid (*Cypripedium arietinum*), Blue-eyed-grass (*Sisyrinchium montanum*), and Nodding Trillium (*Trillium cernuum*). Seeing these was a great way to end what turned out to be a beautiful day.

J. Benckhuysen



In a recent issue of *Clintonia*, the newsletter produced by the Niagara Frontier Botanical Society, there was an article about the storage of seeds (of various species) in the seed heads of Staghorn Sumac (*Rhus typhina*). A class of fourth-grade students had collected some Sumac to examine the fruits more closely and noticed that the seeds of corn, sunflower and American Beech were also present. The speculation was that Bluejays were using Sumac clusters as winter storage containers. If anyone has also witnessed this or has information from scientific literature they would like to hear from you. The person to contact is: B.Burt, Smokey Hollow Road, Jamesville, NY 13078

## BRUCE PENINSULA ALVARS

One June 25, 1995, a group of F.B.O. members gathered at Crane River Park to spend the day exploring selected alvars of the Bruce Peninsula. Leader Claudia Schaefer has spent considerable time studying these unique areas.

The weather was humid and overcast. There seems to be an unwritten botanical law that states: alvar excursion = hot and humid weather. Initially, we had a brief introduction to alvars in general. The term alvar is of Scandinavian origin, and was first used to describe these environments in southern Sweden and Estonia. A Queen's University botanist, Dr. R. Beschel, was the first to describe Ontario alvars in 1967. An alvar is an area of thin soil over flat limestone or dolostone with specialized vegetation. They are often vernal wet, but by late spring can be extremely dry. In Ontario, alvars occur primarily along the contact zone between Ordovician and Precambrian bedrock, stretching from eastern Ontario through Victoria County and into the Bruce Peninsula and Manitoulin Island. Although alvars have unique vegetation which is able to survive in extremely dry conditions, each differs in its species composition.

There was a discussion of whether alvar vegetation is of natural occurrence on the Bruce Peninsula or due to prior logging and overgrazing. The historical record and pattern of these alvars indicate the former.

Immediately noticeable on our first alvar site was the profusion of Creeping Juniper (*Juniperus horizontalis*). This prostrate shrub is particularly abundant on alvar sites in the Bruce Peninsula and Manitoulin Island. It is the host for one of the fungi that causes "witch's broom".

Claudia also pointed out stunted, gnarled White Cedars (*Thuja occidentalis*) scattered on the alvar. These trees have not yet been dated but could have an ecological significance similar to specimens on the Niagara Escarpment. Also of significance was the darkened nature of the pavement on the alvar.

The following is a complete list of species observed during the alvar trip, compiled by Alan Croxall.

*Calamintha arkansana* (Low Calamint)  
*Thuja occidentalis* (White Cedar)  
*Hymenoxis acaulis* (Lakeside Daisy)\*  
*Asplenium trichomanes* (Maidenhair Splaenwort)\*  
*A. trichomanes-ramosum* (Green Splaenwort)\*  
*Pellaea atropurpurea* (Purple-stemmed Cliff-brake)\*  
*Salix candida* (Hoary Willow)  
*Proserpinaca palustris* (Mermaid Weed)  
*Iris lacustris* (Dwarf Lake Iris)\*  
*Iris versicolor* (Blue-flag Iris)  
*Tofieldia glutinosa* ssp. *bravistyla* (False Asphodel)  
*Myrica gale* (Sweet Gale)  
*Rhamnus alnifolia* (Alder-leaved Buckthorn)  
*Cypripedium calceolus* (Large Yellow Lady's Slipper)  
*Hypericum kalmianum* (Kalm's St. John's Wort)  
*Linnaea borealis* (Twinflower)  
*Coreopsis lanceolata* (Lance-leaved Coreopsis)\*  
*Polygala senega* (Seneca Snakeroot)  
*Zigadenus elegans* ssp. *glauca* (White Camass)  
*Senecio pauperculus* (Balsam Ragwort)  
*Geocaulon lividum* (Toadflax)  
*Comandra umbellata* (Bastard Toadflax)  
*Hedyotis longifolia* (Bluets)  
*Castilleja coccinea* (Indian Paintbrush)  
*Cirsium hillii* (Hill's Thistle)\*  
*Campanula rotundifolia* (Harebell)  
*Erigeron philadelphicus* ssp. *provancheri* (Provancher's Philadelphia Fleabane)\*  
*Lobelia spicata* (Pale-spiked Lobelia)  
*Sisyrinchium mucronatum* (Blue-eyed grass)  
*Lilium philadelphicum* (Wood Lily)  
*Aquilegia canadensis* (Wild Columbine)  
*Potentilla fruticosa* (Shrubby Cinquefoil)  
*Lonicera dioica* (Wild Honeysuckle)  
*Physocarpus opulifolius* (Ninebark)  
*Cornus foemena* ssp. *racemosa* (Grey Dogwood)  
*Minuartia michauxii* (Rock Sandwort)  
*Juniperus horizontalis* (Creeping Juniper)  
*Arenaria serpyllifolia* (Thyme-leaved Sandwort)  
*Prunus pumila* (Sand Cherry)  
*Carex scirpoides*  
*C. richardsonii*  
*C. viridula*  
*C. crawei*  
*C. flava*

\* indicates provincially rare species

This was not due to weathering, but to the presence of numerous types of algae growing on the dolostone. We also observed a myriad of moss and lichen species up close.

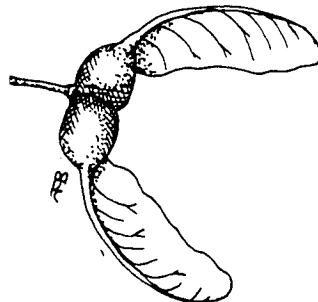
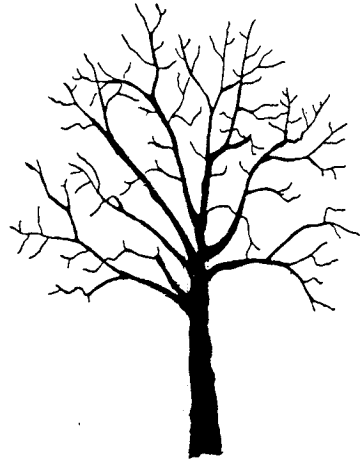
A great number of plants found growing on our first alvar were species essentially limited to close proximity to Great Lakes shorelines: Hill's Thistle (*Cirsium hillii*), Low Calamint (*Calamintha arkansana*), Kalm's St. John's Wort (*Hypericum kalmianum*), Northern Comandra (*Geocaulon lividum*) and Slender Blue-eyed Grass (*Sisyrinchium mucronatum*).

At noon we came to the scenic Lake Huron shore where we perched on slabs of dolostone to enjoy our lunch. We noted Provancher's Fleabane (*Erigeron philadelphicus* var. *provancheri*) growing in fissures along the shore. This interesting plant is known to occur only along the Lake Huron shore of the Bruce and Manitoulin Island and along the estuaries of the St. Lawrence and Hudson Rivers.

After lunch we visited another alvar noted for the presence of Stemless Rubberweed or Lakeside Daisy (*Hymenoxis acaulis*), a globally endangered species with a world distribution limited to the Bruce Peninsula, Manitoulin Island and the Marblehead Peninsula of northern Ohio.

By day's end, our appetites had been whetted for the alvars of the Bruce Peninsula.

Wayne McShane



## PELEE ISLAND FIELD TRIP JULY 15 & 16, 1995

**STOP THE PRESS:** Reznicek says "This is a Hot Day!" Thirteen perspiring participants with rivulets of sweat mixed with mosquito repellent running down their faces had, perforce, to agree with him! In spite of — or perhaps because of — record breaking temperatures, a tree-shattering thunderstorm and a six hour hiatus in the electrical supply commencing (conveniently) at the supper hour, those who attended the Pelee Island field trips had to admit that this is indeed a unique area. At latitude 41°47', it is on a level with northern California and has a growing season a month longer than the remainder of southern Ontario. This outcropping of Devonian coral reef is set in a lake which averages around 8m deep today, but past events will have seen it high and dry or totally inundated. Its proximity to the southern shore of Lake Erie has enabled it to become colonized by species whose affiliations range to the south, and at the same time, its unique conditions have resulted in an unusual number of rare plants for such a comparatively small area.

Over the past few centuries it has been ravaged by the activities of man, starting with the felling of the red cedars on the alvar savannah areas, in some cases for masts or useful lumber, but often simply to fuel the boilers of the numerous steamers that plied these waters in the last century. This was followed by the draining of the central swamp area and the development of farming, as well as sand sucking in the waters around the island for the construction industry; in addition, a barrier of limestone blocks has been placed along the shoreline so that, not only has the natural balance of the interior been completely changed, but the dune habitats around the island have also been irrevocably damaged. The effect of the massive "release and shoot" pheasant hunt in the fall every year remains to be determined. Fortunately, about 700 acres are protected and we were able to enjoy a tour of many of the botanical highlights under the guidance of Tony Reznicek, now with the University of Michigan.

We spent a morning at the Stone Road Alvar, a Nature Reserve of the Federation of Ontario Naturalists. Species that were blooming on the alvar included Pink Nodding Onion (*Allium cernuum*), Grey-headed Coneflower (*Ratibida pinnata*), the native Winged Loosestrife (*Lythrum alatum*), Fringed Loosestrife (*Lysimachia ciliata*, a member of the Primulaceae not the Lythraceae) and Death Camas (*Zigadenus elegans*). In fruit were the nationally and provincially rare Purple Milkweed (*Asclepias purpurascens*) and Downy Wood Mint (*Blephilia ciliata*). Shrubs were plentiful, particularly Fragrant Sumac (*Rhus fragrans*) and the Cockspur Hawthorn (*Crataegus crus-galli*). In mounds of graceful sprays, Climbing Prairie Rose (*Rosa setigera*) was in full bloom. In some areas Red Cedar (*Juniperus virginiana*) was making a comeback, and it was possible to gain some idea of the savannah community which had existed in the past. There was some discussion of the role of fire in maintaining this habitat. It was noted that the alvars here had much more soil cover than those of the Bruce Peninsula and Manitoulin Island, which can allow for a thicket of thorny and scrambling species specializing in seed dispersal by clinging to botanist's socks and boot laces. Moister areas supported a denser forest where the Common Wild Leek, *Allium triococcum*, was just coming into prolific bloom and the trails were decorated with lavender spikes of the native Tall Bellflower (*Campanula americana*).

Trees observed on the island had a decidedly Carolinian flavour and included both the Common Hackberry (*Celtis occidentalis*) and the nationally rare and straggly Dwarf Hackberry (*Celtis tenuifolia*), as well as Red Mulberry (*Morus rubra*). *Fraxinus quadrangulata* or Blue Ash, with its strange 4-angled twigs, is the common ash on the island but Prickly Ash (*Zanthoxylum americanum*) and its relation, the Hop Tree (*Ptelea trifoliata*), are also present. The latter two species are the food of the Giant Swallowtail Butterfly and account for its presence on the island. There were fine specimens of Chinquapin Oak (*Quercus prinoides*) and also Honey

Locust (*Gleditsia triacanthos*). The latter is actually native to the island as is the Redbud (*Cercis canadensis*). Of more dubious provenance is the Kentucky Coffee Tree (*Gymnocladus dioica*), present in a single sex clone. Both Shagbark Hickory (*Carya ovata*), and the extremely rare Shellbark Hickory (*Carya laciniosa*) are to be found as well as Sassafras (*Sassafras albidum*) and Red or Slippery Elm (*Ulmus rubra*). This mix presents a very different aspect from the open Maple-dominated forest to which most of us are accustomed.

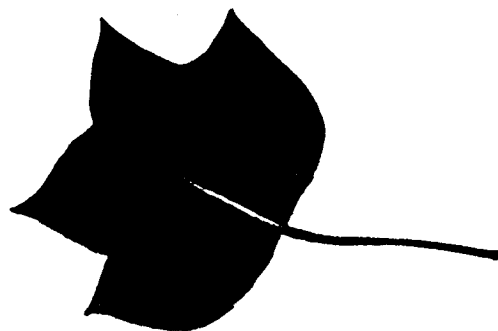
One of the strangest features of the island is the absence of ferns. Amazingly, not even Bracken Fern (*Pteridium aquilinum*) has made it from the mainland. Tony was able to point out to us a stand of Ebony Spleenwort (*Asplenium platyneuron*) near the campsite, and Bill McIlveen found some Rattlesnake Fern (*Botrychium virginianum*), but the only other known Pteridophyte is *Equisetum hyemale*, the Scouring Rush, which is present on the sand dunes. The dunes have probably suffered from interference more than any other habitat but we enjoyed the graceful, silvery wands of the Sandbar or Coyote Willow (*Salix exigua*). One of the remaining wetlands presented us with a vast expanse of Yellow Pond-lily (*Nuphar advena*), a very unusual sight in Canada, although quite common further south. The end of the day found us hot and in need of refuelling, but luckily, no trip to Pelee Island would be complete without a visit to the local winery...

Our other leader was Ron Thiessen, director of the Pelee Island Heritage Centre and curator of the museum, who was a mine of knowledge about the geological and human history of the island and the surrounding water. Amazingly, the lake still throws up pieces of treasure from time to time, such as the name board of an ancient wreck, which adds to the treasure of knowledge harboured in the Centre. We learned much about the island during the morning tour of the museum, admiring a particular abundance of impressive spear points and coral limestone fossils. From there we visited various locations on the island, including a prominent early winery, where the previous night's lightning had felled an enormous Chinquapin Oak; at the shore of the property we listened as Ron relayed some of

the island folklore, which of course included fair maidens jumping to their death. After this we lunched in an old cemetery, an ancient Greek custom practised on the island, or so our leader convincingly told us. Due to the extreme heat of the weekend (remember, we were in the most southern place in Canada when the biggest heat wave hit), some of the group left to catch an early ferry, but those of us who did not were rewarded greatly. A quarry nearby provided excellent evidence of glaciation, and from the deep striations we were able to tell how the ice moved and speculate as to how it affected the prehistory of this island. A magnificent trilobite fossil on the quarry floor exemplified the richness in natural treasures that this island has, while also showing its vulnerability to development. To see more fossils and ones in a more pleasing environment, we headed to a stretch of bedrock shoreline that was rich in finds.

This was a fascinating two day expedition which highlighted the unique qualities of islands and also the extreme fragility of their ecosystems. Hopefully, as time goes on and people become better educated and more able to appreciate the value of the natural environment, Pelee Island will survive and its present protected areas will be expanded to make the future of its unique assemblage of plants and animals secure. Thanks are due to our leaders and all those involved in the arrangements for the weekend, especially to Irene McIlveen for superb organization.

J. Crowe





## The Curious Case of Curly Grass

By Joan Crowe

In the process of helping to compile a vascular plant checklist for Grey and Bruce Counties, the question has arisen as to whether Curly Grass was ever present at Sauble Beach in the 1920's. *Schizaea pusilla* Pursh is one of only two temperate members of an otherwise tropical fern family. It is an inconspicuous species, at most 12 cm tall, looking, as its English name implies, like a grass. Cody & Britton (1989) state that it is "so insignificant that only the keenest observers can find its grass-like fronds, which are hidden among other vegetation." Moreover, it is an Atlantic coastal species ranging in widely dispersed locations from Newfoundland to Delaware. However, when one looks at the habitat "damp, peaty and sandy depressions" or "wet and grassy places" (Cody & Britton, 1989) the possibility of it having been found in the Sauble Beach area seems somewhat more likely, even though it is said to be acid-loving (Gleason & Cronquist, 1991). Conceivably, a moist depression in a sandy area such as Sauble Beach might provide suitable conditions for it to survive so that it is possible that it was a relic from a past, more extensive distribution. Both Cody & Britton and Gleason & Cronquist thought the record worth mentioning.

In discussion with Nels Maher, our local fern expert and enthusiast, he mentioned that he had received some correspondence connected with this find. Thus was revealed an even stranger story, although anyone who has had experience with botanical collectors will find it believable! The collector was Eugene Moxley, a pharmacist who lived in Owen Sound and was a keen amateur bryologist with a very sound reputation. He made these collections in Sauble Beach in 1928 but shortly thereafter moved to Toronto and accidentally left them in Owen Sound. They were not rediscovered until 1945 when, presumably, someone turned out the attic. They were sent back to Moxley, the identification was authenticated, a voucher deposited at TRT, and the record published in the American Fern Journal that year by Hubert H. Brown. Unfortunately, by this time cottages had been built over the site and the plant has never been seen in the area since although many botanists have searched for it. Opinions vary as to whether this is a reliable record. Do we have a botanical version of the Piltdown Man? Or is it simply a case of mixed up collections, although there is no evidence that Moxley ever collected on the Atlantic coast, certainly not while he was living in Owen Sound. The article notes the similarity of habitat recorded by a collector who had visited locations both in Sauble Beach and on the Atlantic coast. Sadly unless, by a miracle, it is rediscovered, we shall never be sure. If it is authentic, it shows how easily in our thirst for development we can destroy a unique community that has persisted for millennia. The dune system in the Sauble Beach area, where it still exists, is one of the most fragile environments and one of the most vulnerable, a mecca for motor bikes and mountain bikes and snowmobiles. Even if, in time, the dunes rebuild, the unique plants are gone forever.

### References

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## A QUICK LOOK AT THE GENUS *PINUS*

J. Benckhuysen

*Pinus* is largest and most diverse genus in the Pinaceae family. Other familiar genera are *Abies* (fir) and *Picea* (spruce). Pinaceae belongs to the Order Coniferales and the Class of plants known as Gymnosperms. Gymnosperm means 'naked seed' in Greek, which is a characteristic feature. The ovules are not enclosed in ovaries as in Angiosperms.

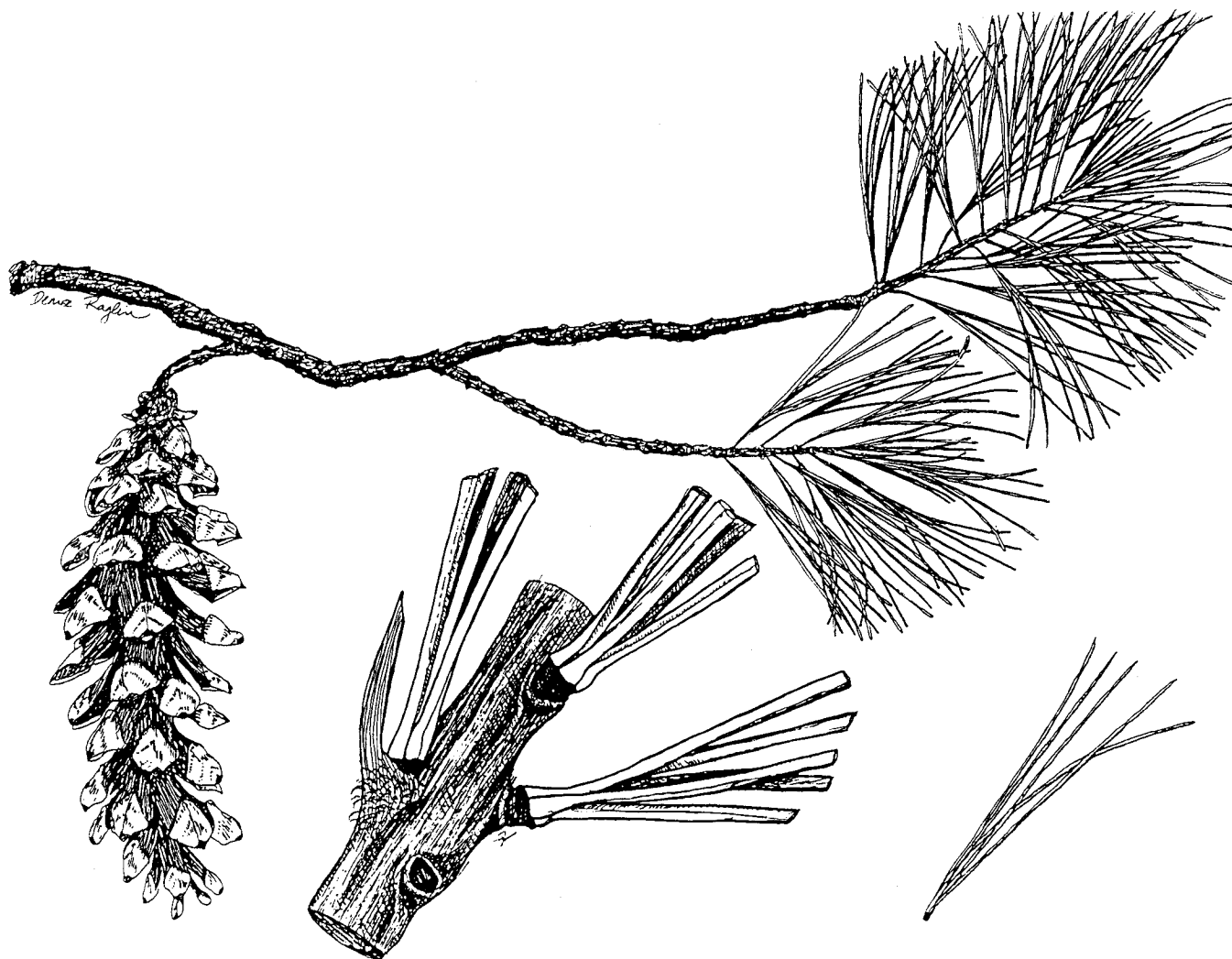
Here are a few pointers to differentiate a Pine from a Fir or Spruce.

**Pines (*Pinus*)** are distinct from other conifers in having dimorphic leaves. The first type of leaf is the small triangular brown leaves that fall off early in the season. The second type of leaf is the familiar green needle. The needle leaves are triangular and usually in bundles (fascicles) of 2, 3 or 5.

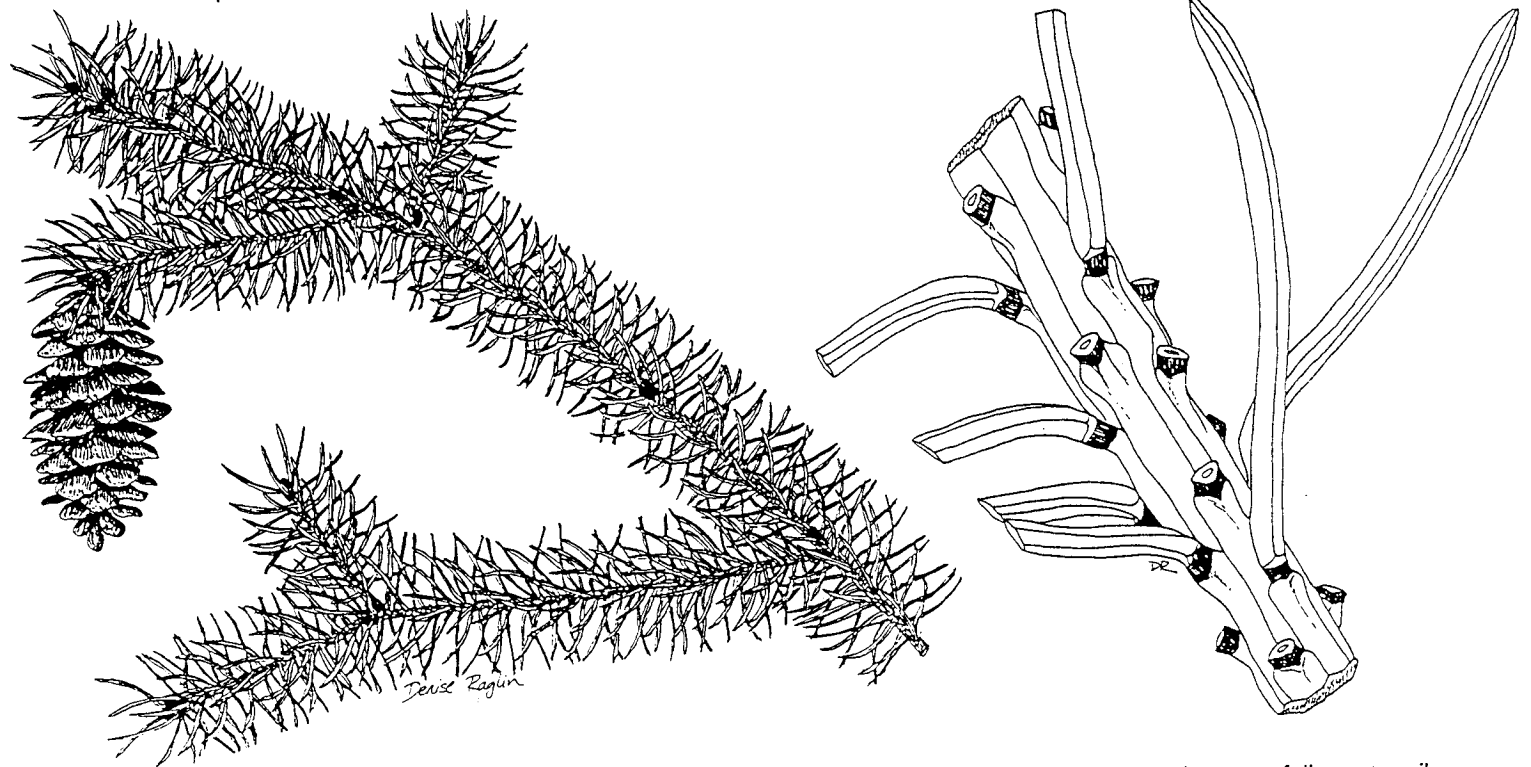
The following are five pine species found in Ontario with the number of needles per fascicle.

- P. strobus* (Eastern White Pine) - 5
- P. rigida* (Pitch Pine) - 3
- P. resinosa* (Red Pine) - 2
- P. banksiana* (Jack Pine) - 2
- P. sylvestris* (Scots Pine) - 2

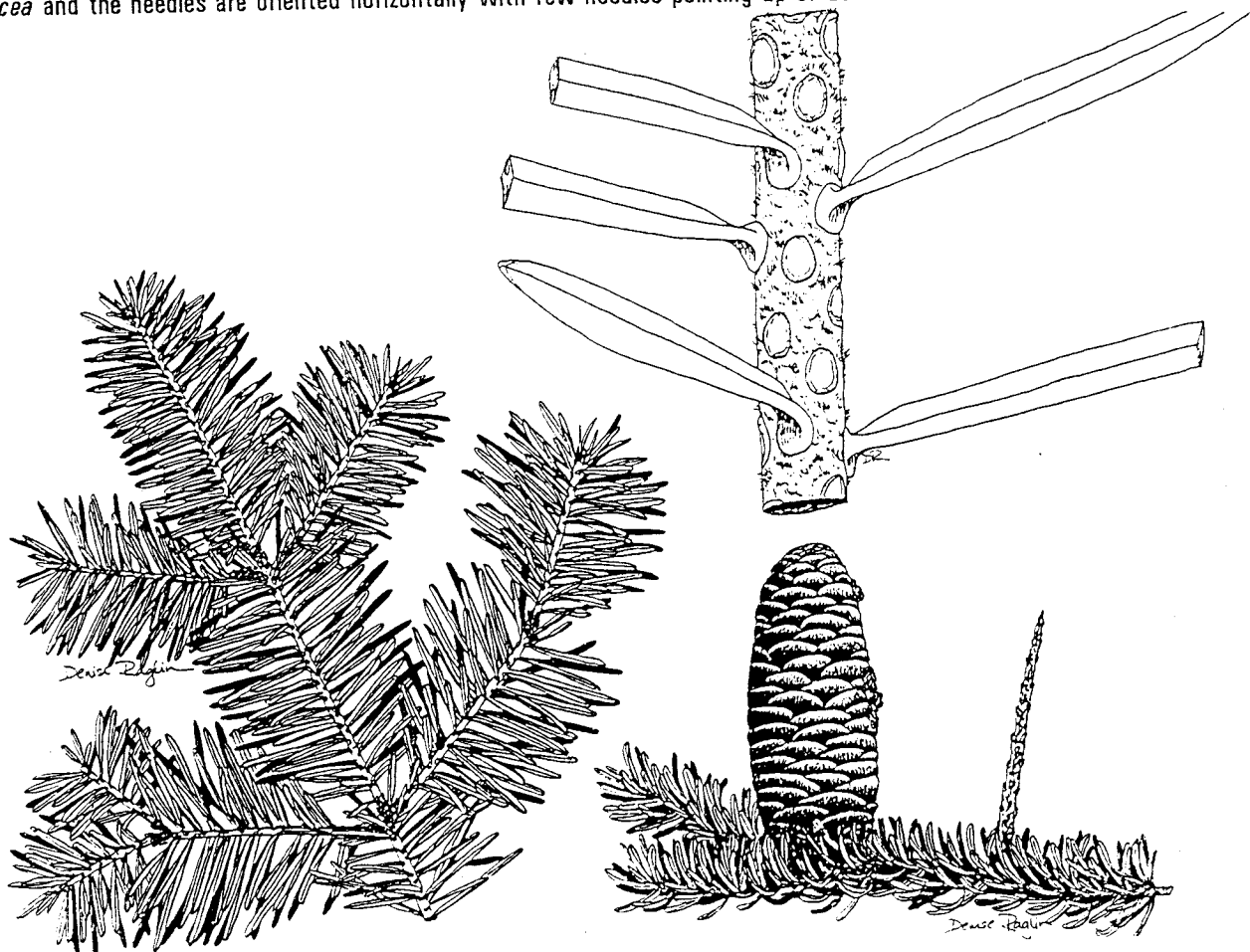
The female cones of pines are pendulous and require two years to mature and do not readily fall apart.



**Spruces (*Picea*)** leaves grow singly, are flat or triangular but grow from a peg-like projection (pulvinus) on the twig. When you run a twig or branch between your fingers it will feel very rough. The needles and branches are prickly and hard, and needles point in all directions. The female cones are pendulous and mature in one year but do not readily fall apart.



**Firs (*Abies*)** leaves grow singly, are flat and the female cones are upright and ripen in one year. The cones fall apart easily when they reach maturity. Ontario's native fir, Balsam Fir (*Abies balsamea*), has soft needles and branches compared to *Picea* and the needles are oriented horizontally with few needles pointing up or down.



## Pine Reproduction

Seed production takes two years. Pollen is released in early summer at the same time that female cones are receptive. Pine pollen is smaller than that of any other genera in Pinaceae and the pollen grains have two air sacs which helps keep them airborne. The pollen sticks to a sugary sap on the receptive parts of the female cone. The pollen grain germinates immediately but grows slowly. It does not fertilize the ovule until the following summer. After fertilization the cone begins to grow rapidly and seeds are usually mature by the winter.

## Growth

The growth of shoots is peculiar. In the spring a shoot elongates in a vertical position. After a few weeks the needles will begin to develop and only then will the new branches begin to adopt the familiar spreading posture. The erect young shoot is termed the 'candle' stage.

Pines are adapted to xeric conditions. Pine needles have a low surface to volume ratio, a thick cuticular layer and sunken stomata. Stomata and new shoots are also covered with a layer of wax. All of these features help reduce water loss. Although there is often an abundant supply of water during the growing season, in the winter no water is available and loss of water to dry winter air must be avoided.

## Uses of Pines

For thousands of years pine wood has been an important resource to human civilization. It was used by many cultures for food and medicine. For a long time it was favoured as shipbuilding material. Plutarch declared that the Umbrella Pine (*Pinus pinea*) was sacred to the god Poseidon (Neptune), not because it grew near the sea but because it produced the best timber for shipbuilding. Before the Napoleonic wars in the early 1800's Britain obtained timber for shipbuilding from the Baltic region. In an attempt to starve the British empire of goods Napoleon blockaded this area and Britain was forced to find an alternate supply of lumber. The obvious choice was North America. From that time onwards White Pine (*Pinus strobus*) was reserved for the Crown to build navy ships. Had it not been for this historical turn of events northern Ontario may not have been explored or developed so soon or rapidly.

Distilling Pine also yields valuable products. A cord of wood (28 cubic feet) of *P. palustris* (Longleaf Pine) yields 7 gal of turpentine, 2 gal pine oil, 32 gal of tar oil, and 41 gal of tar and pitch. Artificial vanilla extract is also a product of pulp and paper industry.

## References:

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