NYFA Newsletter

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Carex flacca (Heath Sedge) a Non-Native (? Invasive) Addition to the Flora of Tompkins County and South Central New York.

By David Werier

Last winter (2005-2006) while walking along a gas pipeline right-of-way I became aware of a large clonal patch of a sedge. I was unable to identify the species as it was not familiar to me and was in a vegetative state. I was particularly intrigued because it grew in a dense patch about 25 square meters in size, to the exclusion of all other plants. This spring (May 2006) I returned to the site and collected a voucher specimen (DW 2987, to be deposited at BH). The species turns out to be the non-native *Carex flacca* (heath sedge). The site is in the town of Dryden in Tompkins County.

Carex flacca is native to most of Europe (Chater 1980) and is naturalized in New Zealand and in North America in Nova Scotia, Ontario, Quebec, Michigan, and New York (Standley 2002). The Michigan records are from collections made in 1896 and 1903 and it is currently considered a waif (i.e. a non-persistent escape) in that state (Hermann 1951, Voss 1972). In New York it appears that it has only recently been found with specimens reported from as early as 1987 from Dutchess, Lewis, and Madison Counties (Tucker 1995, Weldy and Werier 2005). Till the present it has not been recorded (Clausen 1949) or vouchered from south central New York or Tompkins County (specimens searched at Bailey Hortorium).

The Tompkins County population occurs in an open gas pipeline clearing in full sun but is adjacent to a successional forest. The soils are mesic and associated species include *Penstemon digitalis*, *Lonicera morrowii*, *Galium mollugo*, *Rosa multiflora*, *Cornus racemosa*, and *Equisetum arvense*. It is colonial and forms a very dense monospecific patch. In other parts of North America it is known from abandoned quarries, ditches, marshes, and wet forest edges (Standley 2002). In Europe it is known from various habitats but usually prefers calcareous soils (Chater 1980).

Although *Carex flacca* is only known from a few locales in North America, it is believed to be increasing (Standley 2002). The population in Tompkins County appears to be well established, robust, and dominant to the exclusion of other plants. From just seeing this one population I am obliged to believe that this species could become invasive. Unfortunately, *C. flacca* is being sold for cultivation at least in parts of the United States and this may assist it in becoming an invasive species. Mechanical eradication of even the one known population in Tompkins County would require extensive effort as the plant has long rhizomes which probably need to be removed in order to eliminate the population.

Carex flacca superficially resembles species in *Carex* section *Phacocystis* but differs from these in having three stigmas and trigonous achenes. In New York, the following set of characters distinguish it from all other Carex species: 1-3 staminate spikes; 1-3 pistillate (or androgynous) spikes; perigynia with dense, large, and long papillae and sometimes a few minute stiff hairs; achenes trigonous; 3 stigmas; rhizomes elongate; proximal bracts sheathless to short-sheathing; and dense, large papillae on the abaxial (back) side of the leaves.

Efforts should be made to learn how to identify *C. flacca* and collections should be made for all populations encountered. More observations and

research should be done on this species to help better determine if it is likely to become invasive. Perhaps eradication efforts should be undertaken before it becomes more of a problem. Still, even as we despair the loss of biodiversity caused by the increase of non-native species, let us keep in mind that the problem is more complex. Also, let us never forget the beauty, wonder, and miracle of all species, including the non-native invasive ones.

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Carex workshop in Warrensburg a Success

The New York Flora Association sponsored a two-day workshop at Pack Forest near Warrensburg July 23 and 24th. Tony Reznicek, *Carex* expert from the University of Michigan and author of the *Carex* treatment in the Flora of North America, instructed 15 participants in the finer points of identifying Carex species as well as other graminoids in the area. Field characters that can be seen without a hand lens are Tony's specialty and everyone had a great time learning these. Workshops planned for next year include one on violets, another graminoid workshop and one on asters and goldenrods. Remember, there will be another field trip this September in Ontario County at a site containing many of the fern species of New York.

NYFA Carex Workshop July 2007 Plant List

Pack Forest
First Marsh (near wood processor building)

Agrostis hyemalis
Brachyelytrum erectum (aristosum)
Carex bebbii
Carex comosa
Carex crawfordii
Carex cryptolepis
Carex echinata
Carex flava
Carex gracillima
Carex intumescens
Carex lupulina
Carex lurida
Carex normalis
Carex projecta
Carex pseudocyperus
Carex scoparia
Carex stipata
Carex vulpinoidea
Danthonia spicata
Dulichium arundinaceum
Eleocharis intermedia
Juncus dudleyi
Juncus effusus
Scirpus atrocinctus
Scirpus atrovirens
Scirpus cyperinus

Second Marsh (beaver meadow)

Carex baileyi
Carex cristatella
Carex deweyana
Carex gynandra
Carex leptalea
Carex pedunculata
Carex projecta
Carex scabra
Carex scoparia

Third Marsh (beaver lake)

Carex stricta
Carex lasiocarpa
Carex utriculata
Carex vesicaria
Eleocharis obtusa

Roadside Stop

Carex annectens
Carex brevior
Cyperus lupulinus ssp. macilentus

Fourth Marsh (Frantz's Vly)

Carex nigra - not seen in New York since 1915!
Carex hystricina
Scirpus microcarpus

South of the Glen Riverside Ice Meadows

Warrensburg Park

Bromus kalmii
Carex brevior
Carex conoidea
Carex cryptolepis
Carex flava
Carex lenticularis
Carex pellita
Carex torta
Carex viridula
Cladium mariscoides
Cyperus dentatus
Deschampsia cespitosa
Eleocharis acicularis
Eriocaulon aquaticum
Juncus articulatus
Juncus marginatus
Juncus pelocarpus
Panicum rigidulum
Rhynchospora capitellata
Scirpus hattorianus
Scleria triglomerata
Spartina pectinata
Trichophorum clintonii
Xyris torta

River Road Rock Pools

Calamagrostis pickeringii
Carex buxbaumii
Carex cryptolepis
Carex flava
Carex viridula
Dichanthelium clandestinum
Eriophorum virginicum
Juncus articulatus
Juncus nodosus

Snake Rock

Carex buxbaumii
Carex ?tetanica
Eleocharis palustris

Workshop participants along the Hudson River Ice Meadows

Upcoming Field Trips of NYFA and the Torrey Botanical Society

Miller Field Beach, Staten Island, Richmond Co. Sunday, September 2

Observe coastal flora along the south shore of Staten Island. Meet at 10:00 AM; the trip will last approximately 3 hours. Directions from SI ferry terminal: proceed south on Bay Street (about 2.5 mi) until the traffic light just before the Ft. Wadsworth entrance; take a right and proceed south along Father Capodanno Blvd. until intersection with Lincoln Ave. (just north of Miller Field) where we will meet in huge parking lot on the left at "Midland Beach." The Midland Ave bus (no. 51), which departs from St. George Ferry/Bus terminal, has a stop one block up from Lincoln Ave on Midland Ave. Directions by car: If driving on SI Expressway, take "Lily Pond Ave" exit, the final exit on SI as one proceeds toward the Verrazano Bridge. Proceed south along Father Capodanno Blvd. (as above). We will observe late summer coastal flora along the narrow beaches of Staten Island as we walk along Miller Field beach and proceed toward the Great Kills recreation area. These areas are dominated by American beachgrass (*Ammophila breviligulata*), but there are numerous others in the community, including the native annuals *Cakile edentula*, *Triplasis purpurea* and *Cenchrus tribuloides*, and the seaside goldenrod (*Solidago sempervirens*). We will discuss patterns in the distribution of the species along the shore-to-land gradient and effects of the harsh environmental conditions (e.g., salt spray, sand deposition) on the plants and their various adaptations for surviving in this habitat. We will also discuss the role of the dominant perennial (American beachgrass) in these communities, the impacts of beach disturbance, and reasons for the encroachment of alien, weedy plants (e.g. *Digitaria*, *Mollugo*) on some beaches. Trip Leader: Gregory P. Cheplick, Ph.D., Professor of Biology, College of Staten Island, City University of New York, Staten Island, NY 10314. 718-982-3931; Email: cheplick@mail.csi.cuny.edu. Trip sponsored by the Torrey Botanical Society.

Wolf Gully, Ontario Co. Saturday, September 8 at 1 pm.

Dr. Bruce Gilman will lead a walk to this site in southwest Ontario County. It was identified in the Nature Conservancy's planning sessions for the Western Finger Lakes Landscape Conservation Area. It is a forested landscape situated around an Ice Age glacial meltwater channel and abandoned plunge pool. Wolf Gully has exceptional biological diversity, most notably in ferns, where 31 species have been described over the years, one of the highest fern diversity sites in the state. Meet to carpool to the site at the Finger Lakes Community College. The Finger Lakes Community College can be reached from the NYS Thruway, Canandaigua Exit (#44). Travel south on Route 332, which becomes Main Street once you enter the city limits. At the end of Main Street there is an intersection with Routes 5 & 20; turn left, travel east on 5 & 20. Go about 2 miles, 6 traffic lights, and you'll arrive at the intersection where Lowe's is located to the left (north) and Lakeshore Drive is located to the right. Turn right. The college entrance is just down Lakeshore Drive. Park in the first available space in Lot A (to the left side of the college driveway). Contact Dr. Bruce Gilman to sign up.
gilmanba@flcc.edu
(585) 394-3500 ext. 7255

Bear Mountain State Park, Rockland Co. Saturday, October 6.

Mycology field walk, 10:30 am to 3 pm. We will meet near the entrance to the Bear Mountain Inn. *By car:* The park is located north of New York City at the intersection of the Palisades Parkway and Route 9W. Take the Palisades Interstate Parkway to Exit 19-Bear Mountain Park. From New York City, take the George Washington Bridge to the Palisades Parkway North, follow the Palisades Parkway North approximately 45 minutes. 1.5 miles past Exit 19 is a traffic circle. Take the first right off the circle (9W South). At the first traffic light, make a right. The Inn is 200 feet down on the right. Directions from other locations are available at www.bearmountaininn.com.

By public transportation: BUS: Take 8:45 International Bus (Shortline ticket window) from

Port Authority Bus Terminal to Bear Mountain, arriving at 10:15. Meet at entrance to the Bear Mountain Inn. TRAIN: Metro North to the Peekskill or Manitou stations, and a taxi across the river to the park. Train departs Grand Central at 8:51 am, arriving at Peekskill at 9:55 am and Manitou at 10:01 am. A taxi runs up to $25 one way. This walk will focus on observing fall mushrooms. Though not plants, mushroom-forming fungi have traditionally been studied within the curricula of botany programs, and many fungi have critical interactions with plants as symbiotic partners, decomposers, or agents of plant disease. The trip leader will give a short introduction to fungi and the basic terminology used to identify fungi for members unfamiliar with mushroom identification. The walk will emphasize habitats favorable for ectomycorrhizal fungi (symbiotic associates of many tree species). Trip may be cancelled in the event of drought. Please register beforehand to make reservation and indicate if driving or not. Trip leader: Todd Osmundson, Ph.D. candidate, Columbia University and New York Botanical Garden; 914-960-0702; Email: tosmundson@nybg.org. Trip sponsored by the Torrey Botanical Society.

Dubos Point Wildlife Sanctuary, Queens Co. Saturday, October 13.

Meet at 10:00 AM at the corner of Bayfield Ave. and Beach 65th Street. Look for a NYC Parks vehicle. *By car:* take Grand Central Pkwy/LIE/I-678 exit 22A-E to Van Wyck Expwy. Merge onto I-678 S/Van Wyck Expy via exit 13 to Kennedy Airport. Merge onto Nassau Expy via exit 1E. Follow this road, Rockaway Blvd./Rockaway Tpke/ Nassau Expy, for about 5 miles. Turn right at Burnside Ave. Follow this road, which becomes Sheridan Blvd., then Beach Channel Dr., then Rockaway Fwy, for about 2.5 miles. Turn right at Seagirt Blvd. Turn right at Beach 65th St. *By public transportation:* Take the A train heading towards Far Rockaway. Get off at Beach 67 St. (Gaston Ave.). Exit near intersection of Beach 67th St and Rockaway Freeway. Head east. Turn left onto Beach 66th St., right onto Decosta Ave., left onto Beach 65th St. Dubos Point was a saltwater marsh until 1912, at which point it was filled with dredged materials. Today, it contains 26 acres of grassland and the largest salt marsh on the north shore of the Rockaway peninsula east of Rockaway Point. This is also an excellent site for birds. There are no proper trails; we will be walking along the beach and through *Phragmites*. Bring insect repellent, shoes for salt marsh and dress for ticks. Hat and sunscreen are recommended, as there is no shade. Trip leader: Marielle Anzelone, Natural Resources Group, New York City Department of Parks & Recreation, 1234 Fifth Ave., New York, NY 10029-4401; 212-360-1496; Email: Marielle.Anzelone@parks.nyc.gov. Trip sponsored by the Torrey Botanical Society.

Marshlands Conservancy, Rye, Westchester Co. Sunday, October 21.

Meet at 10 AM in Conservancy parking lot. *By car:* Take I95, New England Thruway to Exit 19. Go south on Playland Parkway to first exit on the right. Bear left on the exit road and follow road to U.S. 1, Boston Post Road. Turn right on U.S. 1. Immediately after passing the Rye Golf Club on the left, look for Marshlands entrance sign on left. Turn left and follow the roadway in to the parking lot. Marshlands offers open fields, woodlands and salt marsh areas. Bring lunch and binoculars. Leader: Carol Levine, 88 Ridge Park Avenue, Stamford, CT 06905, 203-322-2051. Email: carolflora@optonline.net. Trip sponsored by the Torrey Botanical Society.

Botanists Discover Some Rare Plants Hereabouts

By Joseph V. Haberer, M.D.
Part III

Transcribed by Steve Young
NY Natural Heritage Program

[In the early 1900s Dr. Joseph V. Haberer, a botanist from Utica, published a series of articles in The Utica Daily Press newspaper about botanists and plants of that region. This is valuable information that was only available from microfiche copies of the newspaper. Therefore I have transcribed the information to make it available for everyone to read. The information appeared in five parts from February to June of 1924.]

Honorable Horatio Seymour

Honorable Horatio Seymour, 1810-1886, “The Sage of Deerfield,” member of the Assembly, twice governor of New York, Democratic candidate for the presidency in 1868, when at his picturesque and attractive home loved to sit in the shade of his favorite black cherry tree where he could retrace the roots of the different nations that have traversed the broad valley of the Mohawk. His library contained books on history, ornithology, and botany. He was especially fond of birds and wildflowers and with the latter cultivated his favorites in nearby woods. Among his favorites was an orchid with lurid flowers, *Aplectrum hyemale*, or Adam and Eve; a plant long since exterminated, that is occasional in leaf mold of some of the rich woods, a form with yellowish unspotted flowers is a rarity. June 4, 1883 he came forward and greeted me kindly and asked if I had found this plant elsewhere hereabouts. I answered, "Yes, near Cascade Glen."

Governor Seymour sent specimens especially of fungi to State Botanist Peck.

It is needless to tell you the gratification that was mine on meeting this "noblest Roman of them all," and I must ask your indulgence if it lends me to recount some very amusing and peculiar experiences during 50 years collecting.

In October, 1900, when on a botrychia hunt in the sand bog within sight of the Governor's home, my book was placed on the mound while searching for material, but on my return it had been stolen. Once while driving along a country road some luscious mushrooms were noticed in a pasture. Tying my horse to a post, I scaled the fence, got the fungi but my rig had disappeared. These thefts were due to farmers' helpers. The horse was found but to this day never a sign of the book. I've been threatened with arrest more than once and when collecting beard's tongue a farmer threatened to throw me into the Erie Canal. On more than one occasion I had to beat it because of the bovine species. Yes, once I had a narrow escape, strawberries were ripe and tasted good, but when a bellowing noise and clouds of dust reminded me of danger the safe side of the stone wall was reached just-in-time. His lordship within a week gored a man to death.

On one occasion a small boy watched me insert plants, he said, "Gee, you know how to press leaves, I wish my sister can see how you do it, she likes to do that. She's got lots of 'em. Shall I go and get her?" I said, "My boy I'll willingly show her, but how far do you live from here." He said, "Two miles."

When collecting thorns as I climbed out of a tall, stout shrub with bleeding hands full of fruiting specimens I was greeted by a small boy who said, "Hello mister. What are you getting? Poison ivory?"

Governor Seymour was identified with a great variety of philanthropic, civic, and rural interests and was cordially in favor of a hearty welcome home to returning regiments during the Civil War.

Dr. M.M. Bagg

Moses Mears Bagg, M.D., librarian of the Oneida Historical Society, 1889 to 1900, was a native of this city where he was born in 1816 and died May 2, 1900.

He graduated from Yale in 1837 and Geneva in 1841, studied for a time in Paris and practiced in Utica from 1846 to the day of his death. He was the author of “Pioneers of Utica,” 1877, “Memorial History of Utica,” 1892, “Forest Hill Cemetery, Utica,” 1895, and the “Founders of the Oneida County Medical Society.”

Dr. Bagg was well versed in botany, had an accurate knowledge of localities for many of our rarer species, and was oftentimes helpful and delighted to inform the writer of the exact spot where certain plants could be found, notably the *Collinsia*.

In all old editions of Wood’s Class Book of Botany, Utica is noted as a locality for *Collinsia verna*, or Blue-eyed Mary. Paine’s record is “wet meadows on the flats of the Mohawk, just below Utica.”; “borders of a small pond near Utica.” Knieskern; “near Utica.” Gray. This plant was exterminated probably over 50 years ago, by plowing and certainly by the Barge Canal if it lingered.

The lamented botanists, Edwin Hue and Benjamin D. Gilbert, as well as myself searched for it many

times without avail. Dr. Bagg was familiar with this plant and he once informed me of the exact spot where he had last seen it saying, “There were here about two dozen plants, you can’t miss it because it is very blue and purple.” It is of the order Scrophulariaceae or Figworts.

Morven M. Jones

The late Justice Morven M. Jones who was librarian of the Oneida Historical Society from 1876 to 1886, ran across some specimens of plants in an old book that had been collected by a member of the Devereaux family in 1832, and he very kindly gave them to me. Among them were specimens of the *Collinsia* and *Fedia* [*Valerianella*] that unquestionably were gathered on the Mohawk flats below Utica.

Justice Jones was a neighbor and dear friend of mine who dubbed me "weeds." He was quite a plant lover and had many rare plants under cultivation in his garden including fumitory, Hercules club, man of the earth, Lotus, false indigo and ground nut.

It was he who brought specimens from Wyoming that were shown to Asa Gray, including a mistletoe *Arceuthobium americanum*, parasitic on *Pinus contorta* and close relative of our dwarf mistletoe, which is the cause of "witches brooms" on the host plant.

By a strange coincidence a similar batch of plants, more numerous than those given to me by Justice Jones, were sent to Dr. J. M. Clark, director of the State Museum in Albany, May 1917, by John Hurley of Little Falls. These plants seem to have been preserved by a Mr. Brooks, a friend of Professor Gray's and were also collected in 1832 and probably from the same locality, as the plants now considered to be extinct were in both collections.

William C. Walker

William C. Walker, F. R., M. S., who was born in 1847 and died in this city in 1920, held for many years a prominent place among microscopists of the world. He made a special study of the Diatomaceae, minute vegetable organisms which grow in either salt or freshwater and belong to the Algae, in order of the Cryptogramit. Mr. Walker added many new species to the list of known diatoms and contributed considerable to the literature on the subject.

He was honorary and corresponding member of many continental scientific societies and author of a catalogue of Diatoms of Central New York and papers for microscopical journals.

Mr. Walker delivered a lecture on these forms of vegetable life before the Asa Gray Botanical Club soon after it was organized.

Professor Charles H. Peck

The late professor Charles H. Peck, formerly state botanist and one of the most eminent of mycologists, was well acquainted with our flora. He came to Utica on several occasions and in company with the writer collected plants at Trenton Falls, Oneida Lake, Herkimer, Little Falls, Whitestown, Ferguson's, Cascade Glen and Roscoe Conkling Park.

Among the plants collected by us were the *Halenia deflexa* of the Gentianaceae and about a dozen new species of *Crataegus*.

Messrs. Maxon and House

William R. Maxon, at present connected with the Smithsonian Institute at Washington, is familiar with our flora and is the author of "On the Occurrence of the Hart's Tongue in America," 1900.

Dr. Homer Doliver House, at present state botanist in Albany, is the author of "Notes on the Orchids of Central New York," 1905, "The Vegetation of the Eastern End of Oneida Lake," 1916, and various papers on violets and fungi.

Lucien M. Underwood

Lucien Marcus Underwood was born at New Woodstock, New York, October 26, 1853 and died at Reading, Massachusetts, November 16, 1907. He was graduated from Syracuse University with a Ph.D. degree in 1879, receiving his L. L. D. degree in 1896. Professor Underwood was a teacher from the time of graduation and was professor of biology in Syracuse University from 1883 to 1891. He filled the chair of Botany at De Pauw University in

Indiana from 1891 to 1895. He left there and for three years had charge of the biology department in the Alabama Polytechnic School. In 1898 he accepted the Torrey Professorship of Botany in Columbia University, which he capably filled until his death.

Professor Underwood was the author of various books and papers on botanical subjects and a member of several scientific societies. He was chairman of the Board of Scientific Directors of the New York Botanical Garden and had been president of the Botanical Society of America. He was author of "Our Native Ferns and Their Allies," "Molds, Mildews and Mushrooms;" North American Hepaticae;" "Index Hepaticarum;" "Review of Fern Genera" and "Fernwort Papers."

He was at one time editor of the Torrey Bulletin, a devoted member of the Torrey Club and of the Linnaean Fern Chapter.

Professor Underwood was not really an Oneida County botanist, but he was well acquainted with the flora, having collected at Herkimer, Oneida Lake, Sylvan Beach and quite extensively in the counties of Onondaga and Madison. He wrote "List of Ferns Growing Near Syracuse," 1878; "List of Trees and Woody Plants in Madison and Onondaga Counties," 1879; "Ferns of Scolopendrium Lake" (Green Pond, Jamesville), 1897, and in “An Index to the Described Species of *Botrychium*;" published in the Bulletin of the Torrey Botanical Club, January, 1903, he described a new species, *Botrychium Onondagense*, [*Botrychium lunaria*] his type specimen being from near Split Rock. He says, "All the stations are within 5 miles from Syracuse and Onondaga County, New York, where the writer first commenced the study of ferns in 1875, and to the memory of which as one of the most prolific fern localities in the country this species is dedicated." Dr. Underwood's work on these plants is an invaluable asset to our present understanding of these difficult allies of the fern family.

He came to Utica in July, 1903, to study these plants with the writer especially in Deerfield and at Herkimer. We met again at the New York Botanical Garden in August, 1907, and in company attended a meeting of the Torrey Club.

Professor Underwood was an independent thinker, a thorough teacher, a talented botanist, whose death was deeply mourned by his many friends and associates and it was indeed sad that in the prime of life he should cut short a brilliant career by his own act of laboring under fancied financial losses.

Father John H. Wibbe

Rev. Father John Herman Wibbe was born in the town of Munster, Province of Paderborn, Germany, September 25, 1848, and died of cardiac asthma at Schenectady, January 7, 1899. He was educated at the American University of Munster and was ordained there. He came to this country in 1870 and was appointed assistant pastor to Rev. Father Newton of Holy Cross Church, Albany, where he remained six months and then went to Sand Lake. He was then assigned to a church at Manlius, where he labored a short time and then went to Oswego, where he was stationed 10 years.

December 8, 1882, he assumed the pastorship of St. Joseph's Roman Catholic Church in Schenectady. During 15 years he labored faithfully and diligently for the church under his charge.

Father Wibbe was a man of extraordinary mental attainments, exhibiting to the highest degree the solidity and thoroughness of the German system of education. He was a fluent speaker, an able scholar, a hard worker, kindhearted, always in sympathy with the needy. Beloved by his entire congregation and all who knew him, his death in the prime of life was sincerely mourned.

Father Wibbe made botany a life study, and as a botanist he was thorough, keen, discriminating and unusually gifted. It was inborn and very pronounced in his youth. He once informed me that his tutor begged of him on his knees to give up all idea of the priesthood in order to devote himself entirely to the study plant life.

He had a national reputation, and at the time of his death he was unquestionably one of the leading botanists in this country. He had been offered a government post in 1877, and was considered by President Hayes for appointment to classify the flora of the Far West, but he was forced to decline these offers.

Father Wibbe maintained a conservatory at the parochial residence that cost him thousands of dollars, and which contained banana plants, orchids, the rarest of palms, tropical plants, flowers of all kinds, in which he took a special delight and pride. It was considered one of the finest collections and rarest of displays in the vicinity of Albany in Schenectady. It was soon sold after his death.

His knowledge of exotic plants was phenomenal. Far and wide, and no matter where he went, he was welcomed by all botanists and florists because of his capacity to call plants by name, and in this line of knowledge he had no superior in this country.

Made Many Discoveries

Father Wibbe was an enthusiastic student and close observer of plant life in every locality where he was located and made many interesting and noteworthy discoveries especially at Oswego, Lewis' Bluff on Lake Ontario, Lily Marsh and Paddy's Pond east of Oswego, Manlius, Lodi Swamp, Oneida Lake and in the vicinity of Albany and Schenectady.

He was a contributor to the Torrey Bulletin and was the author of "Oswego Plants," 1877; "Notes from Central New York," 1883, and "*Mimulus moschatus* in New York State," 1892. Father Wibbe was an honorary member of the Asa Gray Botanical Club and suitable resolutions on his death were adopted and placed in our minutes.

He accumulated a very large herbarium by collections in Germany and many parts of United States, by exchanges with prominent botanists, and by purchases from all over the world. It was my pleasure to be his guest on several occasions and spent many days in his den, often at his earnest solicitation, because his time was limited, inspecting his collections, assisting in their determination and placing them in their proper receptacles. He was very liberal so that I was the recipient of many treasured specimens.

According to Father Wibbe's wishes, the American plants were donated to the University of Louvain, Belgium. Whether they were destroyed during the World War I know not. His European plants were sent to his friend, Professor Edward L. Greene, then Professor of botany at the Catholic University in Washington.

Father Wibbe was the first to detect a little orchid, *Listera australis*, a southern species, in this part of the country. He found it June 15, 1878, while sitting on a mossy mound eating lunch, in Lily Marsh at South New Haven, Oswego County. He was one of the first to collect *Botrychium simplex,* and specimens of his from a sandy hill called Lewis' Bluff on the shore of Lake Ontario, 6 miles west of Oswego, are figured in Eaton's ferns of North America.

Father Wibbe found *Rhynchospora macrostachya* at Mud Lake, Hannibal, in September, 1877, a southern coastal region species known only in the state from Long Island. It was found growing plentifully on the shores of an island, just east of the Frenchman's Island, Oneida Lake, by the writer in August 1898.

Dwarf or Small Mistletoe

Some time ago a local paper had an article on the "Witches Broom" or Hexenbesen, which are noticeable objects to be seen in swamps, infesting some of our native evergreen trees. The author claimed that it was caused by the sting of an insect, whereas, if he had consulted a botanist, he would have learned that it was mainly due to a leafless parasitic plant, the dwarf or small mistletoe. This plant was discovered by Professor Charles H. Peck in 1877, in a marsh at Sand Lake, Rensselaer County, growing on the branches of small starved black spruce trees. It belongs to the Loranthaceae or mistletoe family and he named it *Arceuthobium pusillum*, for a change it is also known as *Razonmofskya pusilla*. It is a close relative of the mistletoe lately being condemned as a menace to many of the forest trees of the Western United States.

Father Wibbe and myself were the first to discover the little mistletoe in Central New York, he in Oswego County and shortly afterward I found it in abundance at Wetmore's Pond and the Graefenberg Swamp, Frankfurt, Herkimer County, and later at Long Lake, Oneida County. It has been familiar to me ever since June, 1881, as I reported in the Torrey Bulletin for March, 1882, page 33, and it is included in my list of Utica plants. Specimens were sent to Professor Peck at the time and I then called his attention to the fact that I had observed it on

other species of conifer. It was doubted then, but in 1897 while at Albany, Professor Peck, Father Wibbe and I discussed it affirmatively.

Father Wibbe was my dearest friend. We first met in his flower garden at Oswego in August, 1873, and together we visited many botanical haunts sacred to memory and rich in material. For 26 years we were congenial botanical coworkers, exchanging notes and plants, and for 20 years he was a constant, annual visitor at my home in this city. We visited together many of the conservatories and greenhouses in Schenectady, Albany and this city, so that he was known to many of our florists and also to members of the Botany Club.

In September, 1900, a plant detected by me on the hills southeast of this city, a form of clubmoss bearing a single spike, I named in his honor which is known and recognized in the books as *Lycopodium complanatum Wibbei*, a plant that has also been found in Vermont.

Father Wibbe was very fond of music and enjoyed on many occasions the rendition of his favorites by Mrs. Haberer, to whom he wrote a letter just one week before his death in which he spoke of his illness and concern for his congregation.

Orange Jewelweed (*Impatiens capensis* Meerburgh)

by Knowlton Foote, Ph.D.
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Orange or Spotted Jewelweed is one of our most refreshing wildflowers! Its orange blossoms with reddish-brown freckles growing against the greenish background of its foliage can be the highlight a walk in the woods. One can even observe an occasional hummingbird making a visit. It is one of the most prolific nectar producers in the Northeast, making it quite attractive and important to insects. This delightful wildflower is a North American native which has spread as a gift from this continent to other parts of the world. This species has been studied by botanical illuminaries Charles Darwin, Alfred Bennett and Asa Gray. In recent decades, particularly in the 1970's and 1980s, considerable research has been done on this flower that has revealed a remarkable biology.

Names and classification

Orange Jewelweed received its botanical name, *Impatiens capensis*, in 1775 from Dutch gardener and curator of the Leiden Botanical Garden, Nicolaas Meerburgh (Burtt l938). In the past this species has also been known as *Impatiens biflora* and *Impatiens fulva*. *Impatiens* refers to the impatient behavior of its mature seed capsule. "Capensis" is actually a misnomer. Meerburgh mistakenly thought that this species had been introduced into European gardens from the Cape of Good Hope in South Africa and gave the name "capensis" meaning "of the cape" (Fernald l950). The common name, Jewelweed, comes from a characteristic of its leaves. Take a leaf and hold it under water. The leaf takes on the silvery look of a jewel (Cynthia Page, personal comm.).

Genus *Impatiens* has four species in the Northeast (Gleason and Cronquist 1991) including New York State (Mitchell and Tucker 1997). Of these species, Orange and Yellow Jewelweed (*Impatiens pallida)* are the only native species and are closely related. Indeed, these two species are often found growing on the same site and have been shown to hybridize (Clevenger 1971). The number of Yellow Jewelweed plants at a site, however, usually pales in comparison to the number of Orange Jewelweed plants. Another close relative is Garden Balsam, *Impatiens balsamina*, a native of Asia, which has been grown in ornamental gardens for over 300 years (Clevenger l971). *Impatiens*, in turn, belongs to the Balsaminaceae, the Touch-me-not family. Worldwide, more than 500 species have been described in the Balsaminaceae occurring mainly in tropical Asia and Africa (Elias l967).

Discovery in North America

Thomas Nuttall wrote in 1818 in *The Genera of North American Plants* that Orange Jewelweed was "extremely common in the alluviums of streams." Torrey (1843) in his *A Flora of North America* wrote that Orange Jewelweed was seen in moist shady places and "common everywhere." However, there is a much earlier reference to Jewelweed in North America. John Josselyn in 1672 reported in his book *New-Englands Rarities*

Discovered seeing Orange Jewelweed. Josselyn covered in North America the Massachusetts to Maine area.

Habitat and range

Orange Jewelweed is generally found where moisture is abundant - swamps and shady locations with rich soils such as along streambeds, in beaver meadows, or in seepy areas in woods. Shady locations also protect patches from early frosts since light frosts quickly decimate these plants. Large patches are often found in Cattail marshes. Under such conditions luxuriant growth occurs. However, Jewelweed can also be seen in poor sandy soils. They may be found, but do poorly, in bodies of stagnant water. Under these conditions plants can be as little as 20 cm tall (Carroll 1919). The diverse sites for Jewelweed reflect the wide ecological adaptability of this species to environmental conditions, particularly water.

Orange Jewelweed is found throughout North America from Newfoundland to Saskatchewan, south to South Carolina and west to Oklahoma (Gleason and Cronquist 1991). And it has now been reported to be a recent introduction into the Pacific Northwest (Zika 2006).

Description

Orange Jewelweed (see Fig. 1) grows from 4 to 21 dm tall, commonly 9 to12 dm. The stems are hollow and can have a basal diameter up to 4 cm. Swellings occur at the nodal areas of stems. The leaves are soft, pale green, ellipsoidal in shape with a serrated edge and 2.5 to 7.5 cm in length. The orange flowers often grow in pairs and are supported by a bending stem (pedicel) 2.5 to 4 cm long. Each flower has 3 sepals and 3 petals (Figs. 1 b-e). The flower is formed from both petals and sepals. The front 3 lobes of the flower are petals (Figs. 1d,e) with the back sac-like portion of the flower that is prolonged into an 8 to 15 mm spur formed from a single sepal (Fig. l c). Nectar is produced in the spur (Rust 1977) and stored in its lower part. The other two sepals are quite small and light green. The saccate sepal and the petals are orange.

The flowers may be spotted to various degrees with red. The flower of Orange Jewelweed is predominantly orange and the typical form is known as *Impatiens capensis* forma *capensis*. However, other color forms exist in our Northeastern flora, including forma *albiflora*, flowers white, spotted with red; forma *Pease*, flowers white with large patches of red; forma *citrina*, flowers lemon-yellow with spots of red; forma *immaculata* – flowers orange without spots (Gleason l963, Nozzolillo 1983). There is evidence that these color patterns are genetically inherited. The colors of the flowers come from two types of pigments. The yellow and orange colors come from carotenoid pigments located in small sac-like plastids in the flower cells. The reddish dots are due to anthocyanins located chiefly in the cell sap such as cyanidin (Clevenger 1971).

Orange Jewelweed has a unique but important characteristic. It produces an abundance of a second kind of flower – a very small nonshowy flower. Whereas the showy flower is orange and 2.5 to 4 cm long, this second type of flower is green, only 1 to 2 mm long, bud shaped and really inconspicuous. The showy flowers, which are insect pollinated, are known as “chasmogamous” flowers. The small, inconspicuous green flowers are known as “cleistogamous” flowers and are self-fertilized before the flowers ever open. Both words have a Greek derivation with chasmogamous meaning “open union” and cleistogamous meaning “closed union.”

The root system is small relative to the large size of the shoot. The root ball for a plant 15 dm tall might be only 30 to 35 cm wide. In the root ball are found several lateral roots up to 25 cm long and numerous smaller water-absorbing fibrous roots which form most of the root mass. In addition the plant is buttressed by several circles of adventitious roots growing from nodes one to two inches above the ground as seen in corn.

The green seed capsules (Fig. 1i) are cucumber-shaped, five-valved and up to 2.5 cm long from showy chasmogamous flowers and slightly smaller from non-showy cleistogamous flowers. The difference in capsule size is due to the number of seeds: there are 3 to 5 seeds in the showy flower capsule and 1 to 3 seeds in the hidden flower capsule. Both type of flowers produce seeds of similar shape, size, and weight. Once seeds are produced, they are catapulted from the capsule (the

fruit) by the slightest touch. Because of their "touchy" capsule, Jewelweeds are known as "Touch-me-nots." The reported chromosome number is 2n = 20 (Clevenger l971).

Life cycle

Orange Jewelweed is an obligate annual species – its life cycle is completed in only one season. A seed germinates in the spring and the seedling grows to full size by the end of the summer. Seeds are produced and dispersed, and the plant dies in the fall, usually with the first frost, which in central New York is mid-October. The night of October 12, 2006, for instance, the temperature dipped to 30.5 degrees F. The next day whole patches of Orange Jewelweed had turned a copper brown, even the adventitious roots, and were lying on the ground. Seeds once released are dormant requiring a period of 3 to 5 months of cold weather as provided by our winter for the seeds to germinate the following spring (Leck 1979, Winsor 1983). Unlike many annual species, a high percentage of Orange Jewelweed seeds in the soil germinate in the spring, leaving only a very small percentage in the soil bank for germination in future springs (Antlfinger 1989). There is no reported vegetative propagation.

Floral biology

The first botanist to report cleistogamous flowers in Orange Jewelweed was John Torrey in 1843 in *A Flora of the State of New York* described as follows:

> *"early in the season, and in very shady places, the flowers of this species are very minute, scarcely colored, and with only a rudimentary spur. They do not expand"*

The non-showy cleistogamous flowers are considerably more numerous than showy chasmogamous flowers. The showy flowers are found on the ends of branches near the top of the plant where there is an increased level of light and pollinators are more likely to find them. The cleistogamous flowers are found beneath leaves within the canopy on single pedicels and towards the ground where light penetration is limited. Another good source of these types of flowers is on plants growing beneath a forest canopy. In deep shade plants grow only 3 to 6 dm in height and have only the non-showy flowers. Pollination and fertilization occur only in the bud. Pollen grains germinate in the anthers and produce pollen tubes that grow directly to the stigma below them. This discovery was reported in Orange Jewelweed by English botanist Alfred Bennett in l873. The linear ovary then develops into a green capsule about 2 cm long containing 1 to 3 seeds. The petals and sepals do not develop beyond those of a small bud. The anthers are reduced in size and number only 2 instead of 4 as in the showy flowers. The quantity of pollen produced is greatly reduced and only a rudimentary nectary is found.

The production of cleistogamous flowers is widespread in the plant kingdom. One count gives 287 species in 56 families (Lord l981). A good example is the Violet family, Violaceae. Using a violet species, M. Hoffman was the first to report on cleistogamous flowers in 1660.

Nectar in the spur of a chasmogamous flower can be seen by holding it up to the light, particularly in the early morning before insects have drained it. The spur of a flower, if left undisturbed by insects overnight, will fill up with nectar and overflow into the flower. Daily nectar production ranges from 2.8 microliters in Delaware (Rust l977) to 6.5 microliters in Ontario Province (Laverty and Plowright l985). The nectar is sugar rich, being reported as high as 43% sugar. Sugar production was reported by Heinrich (l976) to be 2.76 mg of sugar per flower per day. These observations make Jewelweed one of the most prolific and energy-rich sources of nectar of all Northeastern species, including Common Milkweed (Vogel 1983).

Nectar produced and stored in the spur is valuable for another reason. It was found that Orange Jewelweed nectar contains 25 different amino acids, the basic building blocks of protein (Rust l977). Amino acids have now also been shown to enhance butterfly fecundity (Mevi-Schutz and Erhardt 2005). The major amino acids in Orange Jewelweed nectar are alanine and glutamine and to a lesser extent serine, glycine, and b-alanine. Of the 16 amino acids considered essential for insect metabolism, all but one (tryptophan) was found in Orange Jewelweed nectar.

The chasmogamous flowers generally remain open for 1 to 3 days (Rust l977, Schemske 1978, Bell *et al* l984, Laverty and Plowright l985). Nectar production in the spur begins just prior to the opening of the flower. For the first 80 to 90% of a flower's life, the flower releases pollen, but is not yet receptive to pollen, i.e. it is totally male (protandrous). The five white filaments (Figs. 1 f,g) are fused to form a complete physical cover over the stigmatic surface (Fig. 1 h) of the pistil. Even the adjacent anther walls become fused to a certain extent. Pollen may be discharged from the anthers before the flower opens as in the nonshowy flowers. The minute white pollen grains are held together by a few threads. When I viewed it with a 10x microscope, it reminded me of a cotton candy type of fabric. The 5 united filaments (i.e. the androecium) completely protect the pistil of the showy flower against self-pollination. Next, the united stamens are pushed off by the expanding pistil to expose beneath it the small greenish cylindrical pistil. The flower now remains in the female phase for only 4 to 6 hours. The showy flowers of Jewelweed, then, are functionally dichogamous – being one sex at a time. This ensures outcrossing - the flow of pollen to other flowers on the same plant or other plants.

Without question, more of the hidden flowers are produced than showy flowers. Schemske (l978) observed levels as high as 80 to 98% of all buds produced were the nonshowy, self-fertilizing type. And in adverse conditions, 100% of the buds were non-showy. There is also a large difference in seed output dependent on site conditions. In a New Jersey study, Simpson et al (l985) found at 8 different sites a cleistogamous flower production ranging from an enormous 119,538 flowers per square meter per year for an open, well drained field to only 83 flowers per square meter per year in a Cattail marsh. The corresponding chasmogamic showy production was 9569 flowers per square meter for the field and 0 flowers per square meter for the Cattail marsh.

Why have showy flowers?

Are the showy flowers needed by plants? Why don't plants just produce the non-showy flowers? Cleistogamous flowers are a rather inexpensive way for Jewelweed to make its seeds compared to the showy flowers. There are virtually no sepals or petals, sharply reduced pollen production, great reduction in size and number of anthers, and virtually no nectar. These flowers also are not dependent on insects for pollination. Cleistogamous flowers take less time to produce seeds: 24 to 33 days from bud to seed compared to 36 to 42 days for the showy flowers (Schemske l978, Waller l979). As a result, energy cost per seed for showy flowers is 2 to 3 times higher than non-showy flowers to produce. Cleistogamous flowers generally are produced before the showy flowers and for a longer period of time – usually up to the time of the first frost.

Showy chasmogamous flowers are definitely needed, however, to attract insects so pollen is transferred from one plant to another plant of a different clone in order to create new genetic combinations and avoid "inbreeding depression" where the vigor of plants slowly diminishes as first described by Charles Darwin in 1883. This outcrossing provides the possibility of producing plants that are better adapted for a changing habitat or a new habitat. Outcrossing to different clones is essential, therefore, to the longtime genetic health of the species. At the same time the cleistogamous flowers guarantee seed production for this annual species. Seeds from these self-fertilizing flowers will exhibit the parental genotype, but still benefit from meiotic gene reshuffling. Waller (1980) calculated that the probability of a flower receiving only pollen from the same plant was only 86 out of 1,000 for normal size plants, since the lifespan of flowers is short and only very large plants produce enough flowers at one time for cross pollination to occur on the same plant.

Pollinators

In New Jersey a detailed pollinator study was conducted by Richard Rust (l977, l979). He found that showy chasmogamous flowers of Orange Jewelweed were visited by 35 different species of insects. Of these only 11 were pollinators and the remainder were nectar robbers. The nectar robbers appeared not to interfere with pollination. In fact, they may even cause potential pollinators to visit more flowers to obtain the nectar they need and therefore carry out more cross pollinations (Zimmerman and Cook 1985). The most frequent pollinators were bumblebees (*Bombus vagans, B. terricola* and *B. impatiens*), honey bee (*Apis*

mellifera), and a paper wasp (*Vespula maculifrons*). The thoraces of these species are high enough (3 mm) to contact the sexual parts of the flower while foraging for nectar and thus carry out cross pollination. Charles Robertson (l928) in Illinois observed 11 species visiting Orange Jewelweed including a hummingbird. More long-tongued (6 mm or more) bee species (*Bombus* spp., *Apis mellifera, Megachile* spp.) were observed than any other group. The primary flowering period of Orange Jewelweed in Illinois was observed to coincide with peak Ruby-throated hummingbird (*Archilochus colubris*) sightings indicating that in that area Jewelweed has co-evolved with the southward migration of this hummingbird (Schemske 1978). Robert Dirig of the Bailey Hortorium at Cornell reports seeing three butterfly species nectaring on Orange Jewelweed in New York: Spicebush Swallowtail (*Papilio troilus*), Pearl Cresent (*Phyciodes tharos*) and Monarch (*Danaus plexippus*) and another in West Virginia - Pipevine Swallowtail (*Battus philenor*).

Pollination

Pollination begins when an insect approaches a showy flower and lands on the enlarged lower lip of the flower. As it makes its way back into the corolla towards the deep spur, it brushes its back (thorax) against the stamens above it. Upon emerging pollinators have their backs covered with pollen. They now carry the pollen to another flower. Bumblebees find Jewelweed pollen distasteful (Heinrich 1979). The pollen accumulates on their backs and is removed by grooming. Rust (1977) observed pollinators visiting at a rate of 4 to 8 flowers/minute. He concluded that Orange Jewelweed requires multiple visits to ensure successful pollination.

When pollination bags were placed over flowers to exclude insects, no seeds were produced (Rust l977). When Rust bagged and emasculated (removed the anthers) flowers, no seeds were produced indicating that no apomixis occurs. The showy flowers must receive pollen from another flower, either from the same plant or from another plant. When a pistil is hand pollinated from the anthers that have fallen off of that same flower, seeds were produced (Carroll l9l9).

Male preference

In a study done at McGill University in Montreal, Bell *et al* reported in l984 an important discovery about the floral biology of Orange Jewelweed. Recall that the showy flowers are first in the male phase for 80 - 90% (1-3 days) of their lifespan followed by the female phase (4-6 hours). They found that the nectar of flowers in the male phase contained about 50% more sugar than that of flowers in the female phase. Over the life of a flower, at least 6 times as much nectar was produced during the male phase as during the female phase. In a population of plants, insects showed a strong and consistent preference for the male-phase flowers. In both male and female phase flowers, nectar taken by insects was continuously replenished. This suggests that many insect visits are necessary to remove most of the pollen from the anthers, but only a single visit may suffice to fertilize the 5 ovules of a flower.

Insects do not base their decision on whether to enter a flower on the visual sighting of white stamens being in place or not, but on nectar level. The antennae of honey bees have been well studied and been found to have multiple detectors that can detect differences in humidity and nectar scents that might fluctuate depending on the level of the nectar in the flower (Dr. Richard Novogrodzki, personal comm.).

Interaction between pollinators

Bernd Heinrich (l976, 1979) observed that the shorter-tongued workers of the bumblebee *Bombus vagans*, with a tongue length of 8 mm, were most active in the early morning while the longer-tongued *Bombus fervidus* workers, with a tongue length of 11 mm, forged later in the day and could still find nectar after *B. vagans* could no longer reach any.

In a study in Ontario, Canada, Laverty and Plowwright (l985) studied the competition between hummingbirds and bumblebees for Jewelweed nectar. Hummingbirds with a tongue length of 20 mm can easily reach the end of the spur. Hummingbirds were found to forage exclusively from the outer edges of the flower patch. In contrast, two bee species displayed a preference for the inner flowers, with again, shorter tongued

Bombus vagans most active in the early morning, followed by the longer tongued *Bombus fervidus* later in the day.

Fruit and seed production

Seed production follows closely the observed flower production with the number of seeds less than the number of ovules in the flowers, since not all ovules are fertilized and some ovules abort due to adverse growing conditions (Carroll l9l9). As an example, one Orange Jewelweed site in New Jersey had 633 nonshowy buds per plant with each bud capable of producing up to 3 seeds. Yet only 305 seeds were produced or 16% of potential seed production. The number of showy flowers at the same site was 87 buds per plant with each bud capable of producing up to 5 seeds. Yet only 28 seeds per plant or 6 %, were produced (Schemske l978). Simpson et al (l985) observed overall Orange Jewelweed seed production on 8 different sites to range from 35 to l7,076 seeds per square meter per year. The most important environmental variable affecting seed production was light.

The seeds are large for a wildflower. Simpson et al (l985) observed the seed weight for 8 different sites to range from 6.4 to 26.9 mg or l6,900 to 70,900 seeds per pound. The overall average for all sites was 13.0 mg. For comparison with other wildflowers growing in New York, seeds of Blueweed (*Echium vulgare*) weigh 2.7 mg, Evening Primrose (*Oenothera biennis*) 0.5 mg, St. John's Wort (*Hypericum perforatum*) 0.1 mg, and Canada Goldenrod (*Solidago canadensis*) 0.04 mg.

Ejection of seeds

Seeds are released by being literally catapulted from the capsule (Fig. 1 j). The 2 cm long capsule is composed of 5 longitudinal valves. There is a significant turgor pressure built up in the cells that compose the walls of the capsule leading to an instability in the structure. The pressure is released by each of the valves rolling up within itself like a coiled spring from the bottom to the top in the capsule (Beer and Swaine l977). Each valve has a single seed attached to it and the seed is flung – if space is available in the canopy – as far as 6 feet. To hold a mature capsule and feel it rupture in your fingers is a surprising and moving experience even for a veteran botanist. Seeds can be transported by floating on water, an important advantage for this species that often grows near water. The seeds of the cleistogamous flowers are packaged in a capsule a little smaller than that of the chasmogamous flowers. As a result the valves are smaller and the catapulting distance is shorter. Also the cleistogamous flowers are located on the lower branches, so their seeds tend to end up closer to the parent plant than those from showy flowers (Schmitt et al l985).

Germination

Germination of Orange Jewelweed is early and so rapid that it captures a niche among the surrounding vegetation. Generally, there is a large population of seeds at a site which germinates in synchrony to provide a closed canopy. The seedlings then develop into a dense clump of plants that are successful in retaining habitat dominance. Jewelweed in establishing this habitat dominance dominates light, moisture, space, soil nutrients, and possibly even pollinators. Even seeds when released by the exploding capsules often hit another plant nearby thus reducing the distance seeds travel and thus bringing about a clustering of plants. As a result Orange Jewelweed lives at a site very possibly for years, even decades, as long as environmental conditions don't change too dramatically.

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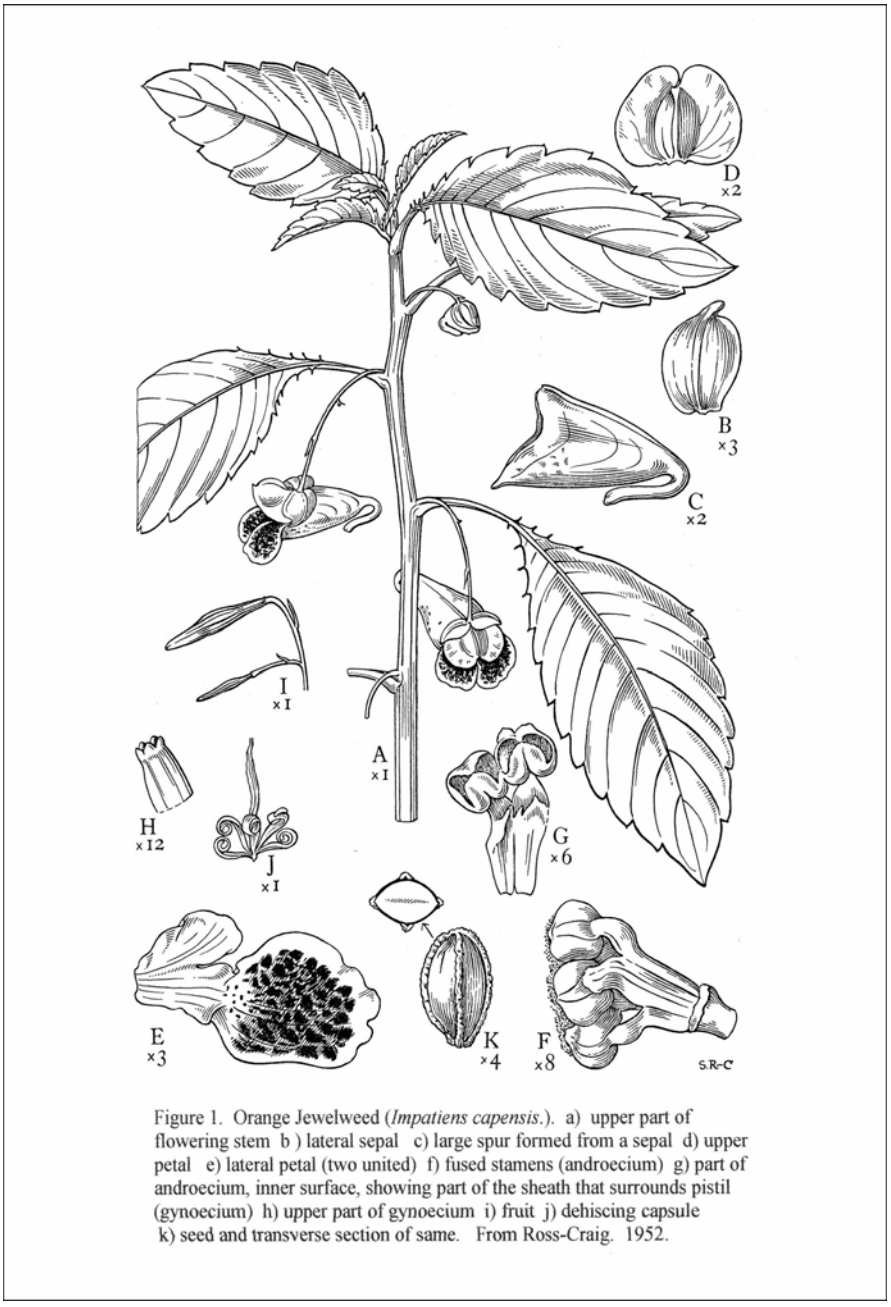

Figure 1. Orange Jewelweed (*Impatiens capensis*.). a) upper part of flowering stem b) lateral sepal c) large spur formed from a sepal d) upper petal e) lateral petal (two united) f) fused stamens (androecium) g) part of androecium, inner surface, showing part of the sheath that surrounds pistil (gynoecium) h) upper part of gynoecium i) fruit j) dehiscing capsule k) seed and transverse section of same. From Ross-Craig. 1952.

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