

Committee
on the Status
of Endangered
Wildlife
in Canada

Comité sur le
statut des espèces
menacées
de disparition
au Canada

Ottawa, Ont. K1A 0H3
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STATUS REPORT ON THE FALSE RUE-ANEMONE

ISOPYRUM BTERNATUM

BY

MADELINE J.W. AUSTEN

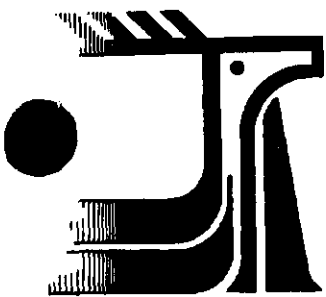
STATUS ASSIGNED IN 1990

VULNERABLE

REASON: CLONE-FORMING PERENNIAL HERB WITH
RESTRICTED RANGE AND WITH SOME
POPULATIONS SUBJECT TO POTENTIAL
THREATS FROM HUMAN ACTIVITIES AND
COMPETITION WITH AGGRESSIVE INTRODUCED
PLANT SPECIES

OCCURRENCE: ONTARIO





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JUNE 1990

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EXTINCT SPECIES: Any species of fauna or flora formerly indigenous to Canada but no longer known to exist anywhere.

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STATUS REPORT ON THE FALSE RUE-ANEMONE

ISOPYRUM BITERNATUM

IN CANADA

BY

MADELINE J.W. AUSTEN

**P.O. BOX 103
CAMPBELLVILLE, ONTARIO
L0P 1B0**

STATUS ASSIGNED IN 1990

VULNERABLE

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ABSTRACT

Isopyrum biternatum (Raf.) T. & G., False Rue Anemone is a spring-flowering perennial herb distributed from southern Ontario to Minnesota, south to Florida and Texas. It is an insect-pollinated plant and decreases in pollinator activity can limit seed production in this species.

Isopyrum biternatum is presently considered rare in Canada; and in South Carolina, Virginia and Florida in the United States of America. In South Dakota this species is considered endangered.

In Canada, extant populations are known only from the St. Thomas - Port Stanley area in Elgin County, the London area in Middlesex County and near Rock Glen/Arkona in Lambton County. The primary threats to the survival of I. biternatum in Ontario are trampling, exploitation along public trails and encroachment by introduced plants, such as Alliaria officinalis and Aegopodium podagraria.

Due to the relatively specialized wooded floodplain habitat that Isopyrum biternatum requires, its restricted range in the Carolinian zone of Ontario and the presence of the majority of populations near public-use areas, I. biternatum should be considered threatened in Ontario and Canada.

(BASED ON THE NUMBER OF SITES AND THE NATURE OF THE THREATS, COSEWIC DESIGNATED THIS SPECIES AS VULNERABLE, APRIL 1990)

I. Species Information

1. CLASSIFICATION AND NOMENCLATURE

<u>Scientific name:</u>	<u>Isopyrum biternatum</u> (Raf.) T. & G.
<u>Bibliographic citation:</u>	C. Linnaeus, 1753. Species Plantarum, p. 557
<u>Type specimen:</u>	Rafinesque, Journ. Phys. Sci., 91: 70, 1820, Herbarium of Wisconsin.
<u>Pertinent synonyms:</u>	<u>Enemion biternatum</u> Raf.
<u>Common Name:</u>	False Rue-anemone (Mitchell and Dean, 1982), False Meadow-Rue (Wherry, 1948).
<u>Family name:</u>	Ranunculaceae, Crowfoot Family, Buttercup Family
<u>Major plant group:</u>	Angiosperm, dicotyledon
<u>Current alternative taxonomic treatments:</u>	

Mitchell and Dean (1982) state that some authors (e.g. Keener, 1977) have revived the genus Enemion for this species.

2. DESCRIPTION

2.1 General description

An erect, perennial herb from 10-40 cm high found in calcareous woodlands in moist, rich soil. Stems are ribbed, glabrous originating from a tuberous rootstalk. Roots are slender and swollen at intervals to form tiny tubers (Wherry, 1948). Basal leaves are biternate, rarely triternate, with long petioles, up to 15 cm. Stem leaves are short petioled (1 mm) or sessile, usually biternate, but occasionally the uppermost stem leaves are trifoliate. Leaflets are 4 - 18 mm long, 2-14 mm wide, and usually 2 - 3 lobed (occasionally entire or five lobed) with shallow to deep sinuses. Leaflet lobes are round to acute-tipped. Leaflets are glabrous and darker green above. Isopyrum biternatum is apetalous, the 'flower' being comprised of five white, round-tipped sepals. Sepals are 4-10 mm long, 3-8 mm wide. The 'flower' is 1.5 - 2 cm wide and born singly, axillary or terminal. Flowers are bisexual. Follicles are divergent, greenish to tan, glabrous, and somewhat compressed (4-7 mm long, 3-4 mm wide) (Mitchell and Dean, 1982). Seeds are smooth. Isopyrum biternatum flowers in April to early June and fruits from May to June in New York State and Ontario (Mitchell and Dean, 1982). Technical descriptions of Isopyrum biternatum are provided in Small (1903), Britton and Brown (1913), Gleason (1968), Correll and Johnston (1970) and Mitchell and Dean (1982).

2.2 Local field characters

Superficially, Isopyrum biternatum resembles Anemonella thalictrum in the division of its leaves and its delicate white flowers. However, I. biternatum can be distinguished from A. thalictrum by the following:

- 1) alternate leaves versus whorled leaves
- 2) leaves divided and leaflets deeply lobed versus bluntly lobed leaves
- 3) leaves on the stem are borne singly, not forming an involucre (Steere, 1966).
- 4) roots bear scattered small tubers versus a cluster of tubers.
- 5) erect versus low-growing stature

Isopyrum thalictrum could also be confused with Thalictrum spp. on the basis of vegetative characters, particularly Thalictrum dioicum which is also a spring ephemeral. Isopyrum biternatum has more deeply lobed leaflets, a more reddish stem (in Ontario populations at least), brighter green leaves and a different flower structure (see Section 2).

2.3 Illustrations

This species is well illustrated in Britton and Brown (1913), Gleason (1968) and Mitchell and Dean (1982).

3. BIOLOGICAL AND ECONOMIC SIGNIFICANCE

Plants of Isopyrum biternatum have no known economic significance. The potential natural and human significance of this species is also undetermined. I. biternatum is the only member of the genus represented in central and eastern North America; three other species of Isopyrum are native to the Pacific Coast of North America (Gleason, 1968) and one species (I. savilei) is endemic to the Queen Charlotte Islands (Calder and Taylor, 1963).

4. DISTRIBUTION

4.1 Summary

Isopyrum biternatum occurs from southern Ontario to Minnesota, south to northeastern Texas, Arkansas, Alabama and northwestern Florida (Argus and White, 1983; Radford et al., 1965; Gleason, 1968; Correll and Johnston, 1970; McGregor and Barkley, 1977; Mitchell and Dean, 1982). I. biternatum may now be extirpated in New York State; only a single pre-1840 specimen labelled Buffalo, NY is known for this state (Mitchell and Dean, 1982). I. biternatum is recorded infrequently east of the Appalachian Mountains, but recent sightings in Virginia, North Carolina and South Carolina suggest that it may be more common than previously believed (Boufford and Massey, 1976). Boufford and Massey (1976) suggest that Isopyrum biternatum may be easily overlooked due to its early flowering time and resemblance to the more widespread Anemonella thalictroides.

The distribution of Isopyrum biternatum in North America is shown in Figure 1 according to herbarium records collected from Ontario and the United States (herbaria consulted are listed in Section 18) and Argus and White (1983). Figure 2 shows the rather limited distribution of Isopyrum biternatum in the Carolinian Region of Ontario; I. biternatum does not occur elsewhere in Canada.

4.2 Locality Citations

Precise locality data and land ownership, if known, is on file with COSEWIC and the appropriate provincial/territorial jurisdiction(s). This information is generally available unless the localities are considered to be publicity-sensitive.

4.2.1 Extant populations in Ontario currently or recently verified

1. Middlesex Co., Thames River. 1 population.
2. Middlesex Co., Medway Creek. 9 populations.
3. Elgin Co., Southwold/Yarmouth Townships, Kettle Creek and tributaries. 8 populations.
4. Lambton Co. Ausable River. 1 population.

4.2.2 Extirpated populations

No recent records of Isopyrum biternatum have been cited in Norfolk Co., suggesting that I. biternatum has been extirpated in its historical location east of Simcoe cited in Soper (1962). In addition, Isopyrum biternatum was not observed during late May in a limited search near Parkhill, Ontario and no recent records of this plant are known from this area. A more intensive search effort may reveal a remnant population of Isopyrum biternatum in suitable habitat along Mud Creek. Until then, however, it must be considered as extirpated in the Parkhill area.

4.2.3 Historical populations of unknown status. Herbarium specimens.

1. Ontario. Elgin Co. Yarmouth Twp. Moist open woods. L.E. James 1924. 30 April, 1952 (TRT).
2. Ontario. Elgin Co. Tributary of Kettle Creek. Stream to open woods. J.H. Soper and L. E. James 9060. 6 May, 1960 (TRT).
3. Ontario. Middlesex Co., West Williams Twp. J. Dearness. 11 May, 1893 (TRT).
4. Ontario. Elgin Co. Southwold and Yarmouth Twps. J. White. 8 June, 1907.(TRT).
5. Ontario. Lambton Co. Bosanquet and Stephen Twps. Below falls of Rock Glen along banks of Ausable River. C. H. Zavitz. 1980. 15 May, 1959. (TRT). This population was not observed by the author in 1989, but was recorded by Dorothy Thieje in 1981. I. biternatum was listed as abundant in this area by Gaiser (1966).
6. Ontario. Elgin Co. St. Thomas. Open woods. L. E. James. 21 April, 1955.(UWO).
7. Ontario. Middlesex Co. Medway River at Thames River. Sandy riverbank in shade. G. Waldron. 10 May, 1971 (OAC).

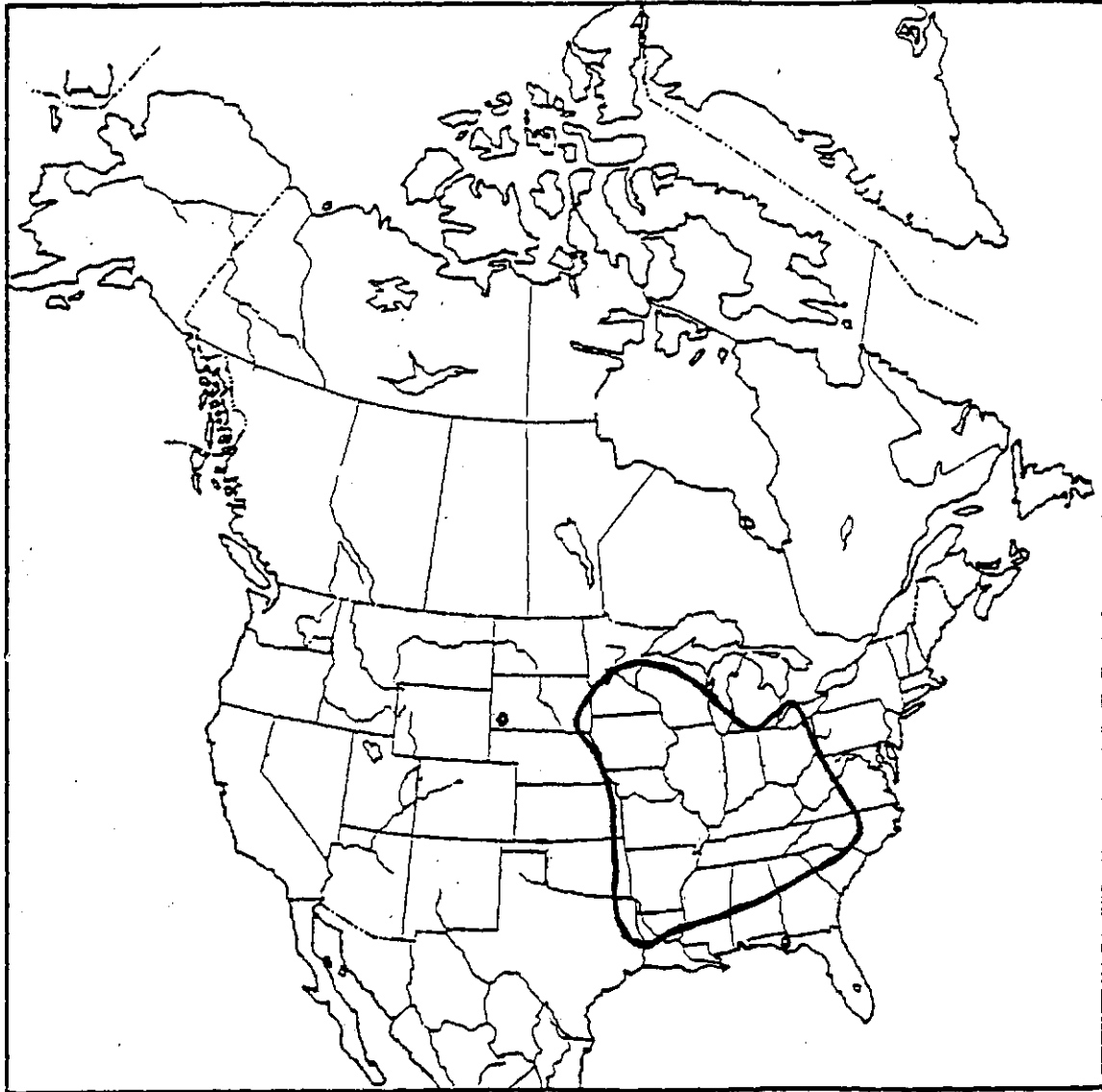


Figure 1. Distribution of *Isopyrum biternatum* in North America. Adapted from Argus and White (1983).

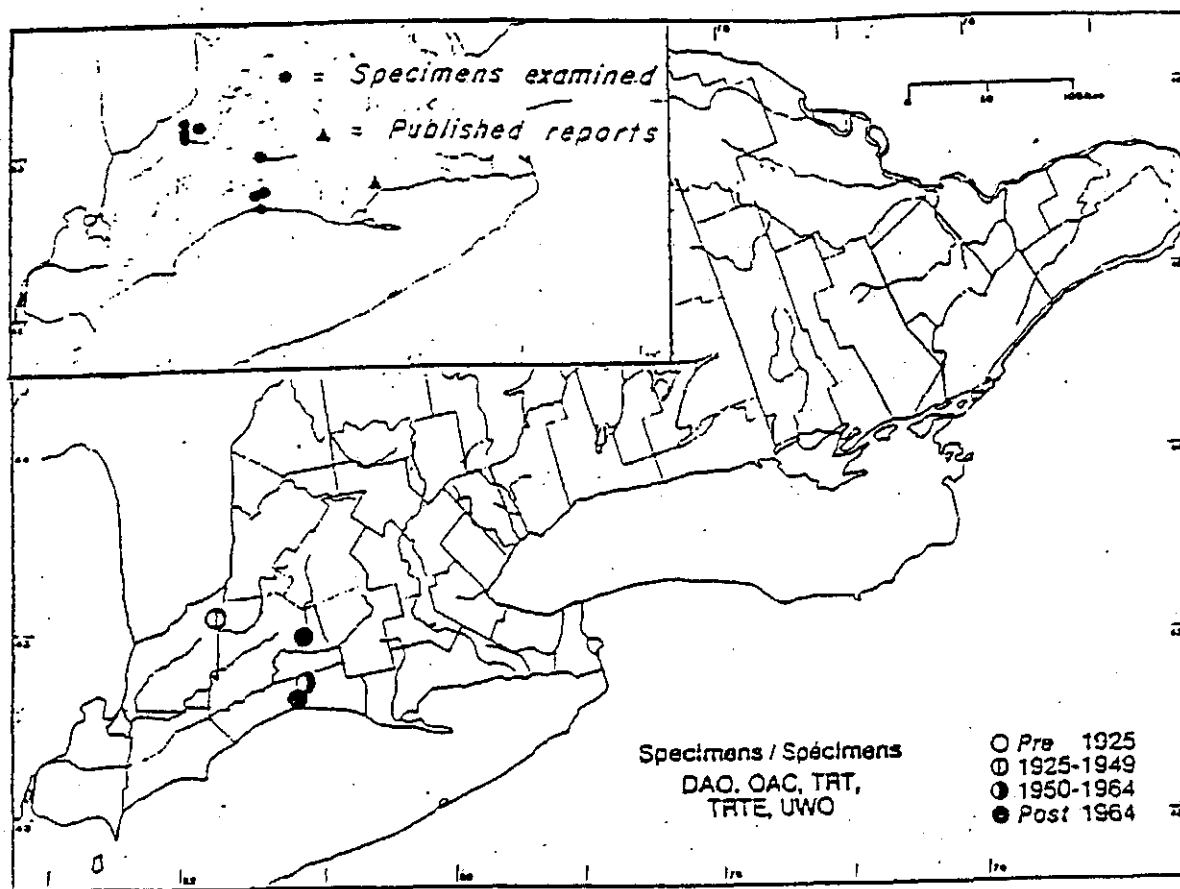


Figure 2. Distribution of Isopyrum biternatum in Ontario.
Inset illustrates former distribution cited in Soper (1962).
Adapted from Argus and White (1983).

8. Ontario. Elgin Co. Southwold Twp. P. M. Catling and S. M. McKay. 20 April, 1973 (TRT).
9. Ontario. Norfolk Co. Near Lynn Valley, east of Simcoe. L. J. Boughner (cited in Soper, 1962).

4.2.4 Potential sites for investigation.

A more intensive search should be conducted along wooded floodplains of Kettle Creek and its tributaries (Elgin Co.), Mud Creek (Middlesex Co.) and the Ausable River (Lambton and Middlesex Co.) for additional populations of Isopyrum biternatum. No herbarium records are on file for the Norfolk Co. population (Macoun, 1899 cited in Soper, 1962). Perhaps, suitable habitat in this area should be investigated to determine the status of Isopyrum biternatum in this area.

5. GENERAL ENVIRONMENT AND HABITAT CHARACTERISTICS

Populations of Isopyrum biternatum are restricted in Canada to the Carolinian Floral Region (Scoggan, 1978). Throughout its range, Isopyrum biternatum grows in shaded woods and thickets, often on rich, wooded slopes in or adjacent to floodplain zones. Boufford and Massey (1976) reported I. biternatum growing in flat bottoms of alluvial woods behind natural levees in Halifax Co., Virginia. This species is often found in close proximity to streams; Melampy and Hayworth (1980) found 50% and 74% of 147 I. biternatum clumps within 10 and 25 m of a stream, respectively, in a field study conducted in Illinois. In Ontario, the species occurs in areas dominated with gray brown luvisolic soils, rich in calcareous till and lacustrine deposits from limestone and dolostone (Hoffman, 1989). Isopyrum biternatum is generally found in shady areas within mature maple-beech forests on gradual slopes; it is not found on steep slopes or in open, highly disturbed sites. Populations in Ontario were generally found in mixed hardwood Carolinian Forests, dominated by Acer saccharum, in combination with other species including, Ostrya virginiana, Carpus caroliniana, Fagus grandifolia, Carya cordiformis, C. ovata, Tilia americana, Juglans cinerea and Fraxinus americana. This plant is found with other spring wildflowers including Sanguinaria canadense, Trillium spp., Dentaria laciniata, Anemone quinquefolia, Viola spp., and Erythronium americanum.

Isopyrum biternatum has been found in association with other rare plants in Ontario, including Mertensia virginica and Lithospermum latifolium (Keddy, 1987); and Arisaema dracontium (Keddy, 1984).

6. POPULATION BIOLOGY

6.1 Phenology

Flowering begins when temperatures are suitable for plant growth and pollinator activity, and ends before closure of the canopy (Schemske et al., 1978). In Ontario and Illinois (Melampy and Hayworth, 1980), Isopyrum biternatum flowers in late April or May and is in fruit by early June. Flowering occurs earlier in the south. For example, in central Kentucky, flowering begins in mid-March and continues until early May, with peak flowering in late March or early April (Baskin and Baskin,

1986). Flowering times of Isopyrum biternatum are earlier in warmer weather and can be postponed in colder temperatures (Schemske et al., 1978). Flowering lasts 7 - 10 days, of which 3 - 4 days are in the female phase (I. biternatum is protogynous, see Section 6.2) (Schemske et al., 1978). Delayed flowering peaks can be detrimental to seed set of Isopyrum biternatum (Schemske et al., 1978). In Ontario, seeds mature by late May/early June. Seeds have no known special means of dispersal (Schemske et al., 1978). Leaves begin to turn yellow or brown as seeds ripen, and by early to mid-June (later in June for Ontario) all have senesced (Baskin and Baskin, 1986). In central Kentucky, new leaves emerge in mid-September, remaining green all winter and a few plants may flower in the autumn. By early March, winter leaves have turned red and new spring leaves emerge (Baskin and Baskin, 1986). Autumn flowering has not been recorded in more northerly areas, such as Ontario.

6.2 Reproductive ecology

6.2.1 Types of reproduction

Isopyrum biternatum is a hermaphrodite and grows in clumps that probably represent clones (Melampy and Hayworth, 1980). I. biternatum is self compatible, but not autogamous; autogamy appears to be prevented by protogyny, with stigmas becoming non-receptive by the time the anthers dehisce (Melampy and Hayworth, 1980). Melampy and Hayworth (1980) found that Isopyrum biternatum plants were geitonogamous 26% of the time, outcrossed within a patch 16% of the time and outcrossed between patches 28% of the time.

6.2.2 Pollination

Isopyrum biternatum is entomophilous, i.e. pollinated by insects. No nocturnal pollinators were seen by Melampy and Hayworth (1980) on I. biternatum; this is probably related to the cool nights during early spring when this species flowers. A variety of insects have been found visiting I. biternatum flowers (e.g. Apis mellifera, andrenid bees, halictid bees, syrphid flies, other flies, and beetles), however, the rate of visitation of these pollinators to I. biternatum plants is low even when I. biternatum is in flower (Melampy and Hayworth, 1980). Isopyrum biternatum, which is a nectarless plant, is not a preferred resource for insect pollinators when the nectar-bearing flowers of plants such as Claytonia virginica and Dicentra laciniata are nearby (Melampy and Hayworth, 1980). Nectarless plants, may receive insect visits by extending their flowering season to include intervals when few nectar-producing plants are flowering; this tactic may be employed by I. biternatum (Melampy and Hayworth, 1980).

The key to maximizing seed set for Isopyrum biternatum is maintaining low flower availability per unit time and extending the flowering season to include gaps between, or after, flowering periods of other sympatric species. Maximum seed set for Isopyrum biternatum in a 1975/1976 study occurred after the peak in flowering for Dicentra laciniata and near the end of the peak of flowering for Claytonia virginica, suggesting that as preferred species decrease in abundance, insects begin visiting I. biternatum more often and pollinating more I. biternatum flowers (Melampy and Hayworth, 1980). The low visitation rate of pollinators to Isopyrum

biterdatum plants suggest that I. biterdatum may rely on mistakes by foraging insects that visit its flowers while searching for those of other species; mistakes may increase, or insects may be forced to visit I. biterdatum occasionally, as preferred species decline in abundance. Therefore, a lack of pollinator availability could limit seed production in Isopyrum biterdatum (Melampy and Hayworth, 1980).

Wind plays a minor role in the pollination of Isopyrum biterdatum; for example, only three of 37 flowers covered with nylon screen produced seed in a field study conducted by Melampy and Hayworth (1980).

6.2.3 Seed biology

In a field study examining the phenology of Isopyrum biterdatum in Illinois, peak seed set was achieved by flowers that were open during peak flowering in 1975, and in flowers blooming just prior to peak flowering in 1976 (Schemske et al., 1978). Therefore, it appeared that perfect timing of flowering in this species is seldom achieved (Schemske et al., 1978).

Isopyrum biterdatum seeds collected from central Kentucky were sown in soil and placed in a non-heated greenhouse (Baskin and Baskin, 1986). Seventy percent of seeds germinated over the study period (May 17, 1981 - May 1, 1982). Seeds germinated from late September to early November, with the peak between September 25 - October 19 (mean daily maximum and minimum temperatures during this period were 22.9°C and 13.3°C, respectively). Seeds of Isopyrum biterdatum exhibited embryo growth and completed germination (emerged radicle and cotyledons) in the autumn (Baskin and Baskin, 1986). Embryos grew slowly during the summer (mean daily maximum and minimum temperatures from Aug. 30 - Sept. 20 were 26.6°C and 14.1°C), but elongated rapidly in early September; seeds germinated in October (Baskin and Baskin, 1986).

Germination of I. biterdatum is similar to that of species exhibiting epicotyl dormancy (i.e. radicles are dormant and require a period of warm stratification during the summer before they emerge at favourable autumn temperatures) because radicle emergence occurs in the autumn. However, cotyledons also emerge from seeds of I. biterdatum in autumn, whereas in species with epicotyl dormancy the seed with an emerged radicle must be cold stratified during the winter for the cotyledons to emerge (Baskin and Baskin, 1986). Before seeds of Isopyrum biterdatum can germinate, embryos must elongate from less than 0.2 mm to more than 1 mm. Optimum temperatures for germination of freshly matured seeds were 20/10°C and 15/6°C, seeds eventually germinated at 30/15°C and 25/15°C (Baskin and Baskin, 1986). Embryos are non-dormant and seeds of Isopyrum biterdatum require a long time at high temperatures to complete embryo growth and germinate (Baskin and Baskin, 1986). Laboratory studies suggest that exposing seeds of I. biterdatum to high summer temperatures may enhance germination at early autumn temperatures (Baskin and Baskin, 1986).

The germination pattern of Isopyrum biterdatum differs from that of all other perennial herbs of mesic deciduous forests studied to date; species of Asarum, Caulophyllum, Cimicifuga, Erythronium, Hepatica, Hydrophyllum, Osmorhiza, Polygonatum, Sanguinaria, Smilacina, Stylophorum, Trillium and Uvularia are deeply dormant and complete germination in spring. Isopyrum biterdatum is non-dormant and completes germination in

autumn (Baskin and Baskin, 1986). All of these plants have underdeveloped embryos at seed maturity and dispersal (Baskin and Baskin, 1986). To date, germination patterns of Isopyrum biternatum in Ontario have not been examined.

Isopyrum biternatum seedlings produced in the autumn may have a much longer period for establishment and growth before the onset of dormancy in June, than if germination was delayed until spring. Therefore, Isopyrum biternatum may require less time from seed dispersal to reproductive maturity than plants developing from seeds that germinate the following spring. There may, however, be a disadvantage to passing the winter in a seedling versus seed stage (Baskin and Baskin, 1986).

6.3 Ontario populations

Comprehensive studies have not been conducted on the demography, phenology and reproductive ecology of Isopyrum biternatum in Ontario. Isopyrum biternatum is a perennial with considerable vegetative propagation, and therefore, this may diminish to some extent the importance of high seed production in any one year (Schemske *et al.*, 1978). Abundant seeds were produced by plants observed in Elgin County during early June. It is not known when germination occurs in the field in Ontario. Populations in Ontario vary from very small patches, less than 1 m X 1 m (approximately 50 plants), to large areas of forest that are covered with plants, numbering in the thousands.

Information about populations in Ontario is summarized below. This information is based on field visits made during May and June, 1989 and fieldwork conducted by J. Bowles in the summers of 1986, 1988 and 1989. Estimates of population area and numbers of plants per population are presented for localities visited in May, 1989 by the author. Refer to Figs. 3 to 5 for locations of populations described below.

1. University of Western Ontario campus

Isopyrum biternatum was collected from this site by Fred Cook on the following dates: May 3, 5 and 24, 1960. Johannson *et al.* collected specimens on April 24, 1958. G. Waldron collected I. biternatum on May 10, 1971 at the confluence of the Medway and Thames Rivers. The author searched this area in May, 1989 but did not see Isopyrum biternatum at the confluence of the two rivers.

Fred S. Cook suggested that Isopyrum biternatum was planted in the Thames Valley on University of Western Ontario property and has spread to other locations along the Medway River. However, I. biternatum appears to be naturalized in the Medway Valley, south of Arva, and elsewhere in Ontario in similar habitats (Bowles, 1989).

In 1989, an area 2 m X 1.5 m contained approximately 200 plants. This was the only patch of I. biternatum found by the author on this site. Isopyrum biternatum populations in this area have probably been reduced from previous years due to the increasing prevalence of Aegopodium podagraria in the area. The population is 7 m from a well-used trail running along the Thames River. At present, A. podagraria is

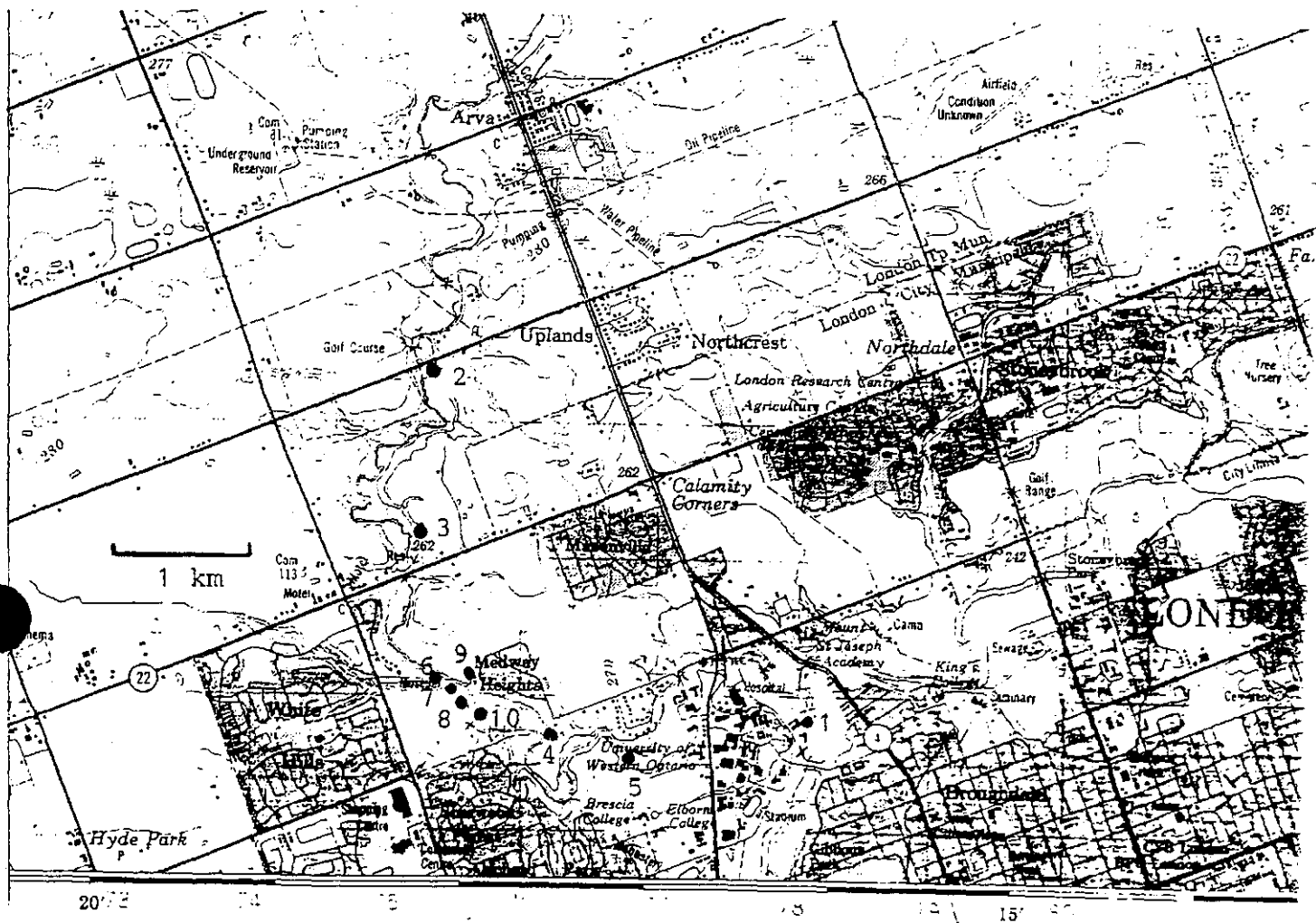


Figure 3. Distribution of Isopyrum biternatum populations presently occurring in Middlesex Co., Ontario.

not in the immediate vicinity of the population, but, is abundant on the opposite (east) side of the trail.

This area is a raised floodplain dominated by Acer saccharum, Fraxinus americana and young Prunus virginiana. Intermixed with Isopyrum biternatum were the following taxa: Erythronium americanum, Viola spp., Thalictrum dioicum, Glechoma hederacea, Smilacina stellata, Prunus virginiana, P. serotina, Celtis occidentalis, Fraxinus americana and Crataegus sp.

2. Arva area.

Scattered clumps of Isopyrum biternatum were found on a floodplain along the Medway River by J. Bowles in the spring of 1988. This population may be naturalized from introduced populations further downstream in Thames River (Cook cited in Bowles, 1988). Populations 2, 3, 4 and 5 found by Bowles, were not visited by the author in 1989 whose efforts were concentrated on searching for populations in areas less well inventoried.

3. South of Arva

A clump of Isopyrum biternatum, 1 meter or more in diameter, was found on a small floodplain slope (Bowles, 1988). Austen estimated the population size of this group to be under 500 plants based on the area covered by the plants.

4. Medway Heights, London.

Isopyrum biternatum forms large clumps or mats under red ash-deciduous bottomland forest. The population size of this group of plants was not estimated.

5. Huron College, University of Western Ontario.

One large patch of Isopyrum biternatum (several meters in diameter) was found in a woodlot south of the Medway River (Bowles, 1989). Based on the area covered by the plants, the author estimated the population size to be 2,500 plants.

Bowles (1989) reported that "Populations of Isopyrum biternatum are scattered and widespread throughout the lower Medway Valley in wooded bottomlands. Profuse flowering was noted on most clumps".

6. Medway Creek, north of Snake Creek

This population was recorded by Jane Bowles in 1986 and re-visited by Austen on May 22, 1989. Three small patches of I. biternatum were found: 3 m X 3 m, 9 m X 10.5m and 1 m X 1 m. Population size is estimated at 12,500 plants. Plants common in the immediate area included Petasites palmatus, Trillium grandiflora, Caulophyllum thalictroides, Thalictrum dioicum, Arisaema atrorubens, Geranium maculatum in the herb layer; Acer saccharum, Prunus serotina, Fraxinus americana, Tilia americana, Ostrya virginiana, Cornus alternifolia, Carpinus caroliniana, and Carya cordiformis trees; and shrubs of Prunus virginiana, Fagus grandifolia, and Cornus alternifolia.

Other rare plants found in this area were Lithospermum latifolium and Arisaema dracontium (Bowles, 1986).

7. Medway Creek, south of Snake Creek.

Four patches of Isopyrum bitermum were found on a bank with areas of 2.5 m X 4.5 m, 1.5 X 2.5 m, 3.5 X 1 m and 3.5 X 1 m. This population consisting of small patches in a very localized area, was estimated at 1,750 plants on May 22, 1989.

I. bitermum was intermixed with the following herbs: Podophyllum peltatum, Lysimachia ciliata, Trillium grandiflora and Smilacina racemosa. Shrubs of Cornus stolonifera, Prunus virginiana, Cornus alternifolia, and Crataegus sp.; and Acer saccharum, Tilia americana, Fraxinus americana, Prunus serotina, Cornus alternifolia and Carya cordiformis trees were also found in the area. Acer saccharum and Fraxinus americana were dominant.

A population of Lithospermum latifolium was found by Bowles (1986) approximately 25 - 50 m south of this I. bitermum population.

8. West side of Medway Creek.

Here, I. bitermum covers a large area with scattered patches throughout the site. An estimate for this area was difficult, but probably is in the range of 15 - 20,000 plants. The plants are found in association with Sanguinaria canadensis, Smilacina racemosa, Alliaria officinalis, Vitis riparia, Geranium maculatum, Erythronium americanum, Rubus idaeus, Acer saccharum, Fraxinus americana, Ostrya virginiana, Quercus muehlenbergii, Carya cordiformis, Prunus serotina, P. virginiana, Tilia americana, Cornus alternifolia, C. stolonifera, Crataegus sp. and Ribes americanum.

Aegopodium podagraria was found near this population, but was not intermixed with I. bitermum plants. I. bitermum plants were often immediately adjacent to public trails in the area.

9. East of Medway Creek, near confluence with Snake Creek

A large population was recorded here on May 22, 1989 by the author. Jane Bowles had previously noted this population in the Medway Creek Valley in 1986 (Bowles, 1986). This population covers an area approximately 25 m X 25 m and may contain from 500,000 - 700,000 plants. Other plants found in the area included: Acer saccharum, A. saccharinum and Fraxinus americana trees and Arisaema atrorubens, Trillium grandiflorum, Alliaria officinalis, Geranium maculatum, Matteuccia struthiopteris, Erythronium americanum, Symplocarpus foetidus, Viola sp., Asarum canadense, and Aegopodium podagraria. Potential competitors were Aegopodium podagraria and Alliaria officinalis. A population of Arisaema dracontium was also found in the area (Bowles, 1986).

This area did not appear to be heavily trafficked by pedestrians; although there was a broad clearing on the northwest side of the site, no footpaths were observed running through the population of plants.

10. East of Medway Creek, south of its confluence with Snake Creek.

Population consists of one very small patch (1 m X 0.5 m) found along a footpath on the east side of the Medway River. This small population is less than one meter off the trail, at the edge of a second growth forest (Tilia americana, Fagus grandifolia and Acer saccharum) and a grassy riverbank. Estimated size of 50 - 75 plants.

11. 7 km north of Port Stanley

Many patches (approximately 30) were found along the floodplain at this site. The estimated population size was 12,500 plants. Acer saccharum, Salix nigra and Fraxinus americana were common in the area with Ostrya virginiana, Juglans cinerea and Ulmus sp also present. Other taxa found on site included Crataegus crus-galli, Cornus alternifolia, Ulmus rubra, Thalictrum dioicum, Trillium grandiflora, Sanguinaria canadense, Alliaria officinalis, Asarum canadense, Viola spp. and Erythronium americanum.

A significant plant found in low numbers (3 small patches) in this area was Mertensia virginica.

12. 7 to 8 km north of Port Stanley

Approximately 25 patches, varying in size from 0.3 m X 0.3 m to 10.5 m X 3 m. The majority of patches were small in size. The estimated population size is 10,000 plants.

Plants found in association with Isopyrum biternatum were Acer saccharum, Fagus grandifolia, Carya ovata, C. cordiformis, Ostrya virginiana, Fraxinus americana, Carpinus caroliniana, Prunus virginiana, P. serotina, Alliaria officinalis, Erythronium americanum, Smilacina racemosa, Arisaema atrorubens, Anemone quinquefolia, Trillium grandifolium, Podophyllum peltatum, Heracleum maximum, Rubus idaeus and Geranium maculatum.

Jeffersonia diphylla was very common along this section of the Elgin Trail.

13. 7 km north of Port Stanley, along a tributary of Kettle Creek

Eight patches of I. biternatum were found of the following sizes: 1.2 m X 0.3 m, 3 m X 2 m, 5.5 m X 10.5 m, 1.2 m X 1.5 m, 1.5 m X 2.5 m, 2.1 m X 1.8 m, 1.2 m X 1.2 m and 4.5 m X 1.2 m. The 2.1 m X 1.8 m patch was found in a low-lying floodplain, dominated by Alliaria officinalis which appears to be encroaching on this population. The 1.2 m X 1.2 m patch was found on a steep, sparsely vegetated bank adjacent to a tributary of Kettle Creek, and was somewhat isolated from the other patches. Other species in the vicinity included Acer saccharum, Ostrya virginiana, Ulmus sp., Fraxinus americana, Ribes cynosbata, Prunus virginiana and Crataegus sp. Most of the remaining patches were adjacent to a field edge, well away from the path with only a few patches close to the trail.

14. North of Port Stanley.

Ten small patches of I. biternatum were found on a slope adjacent to

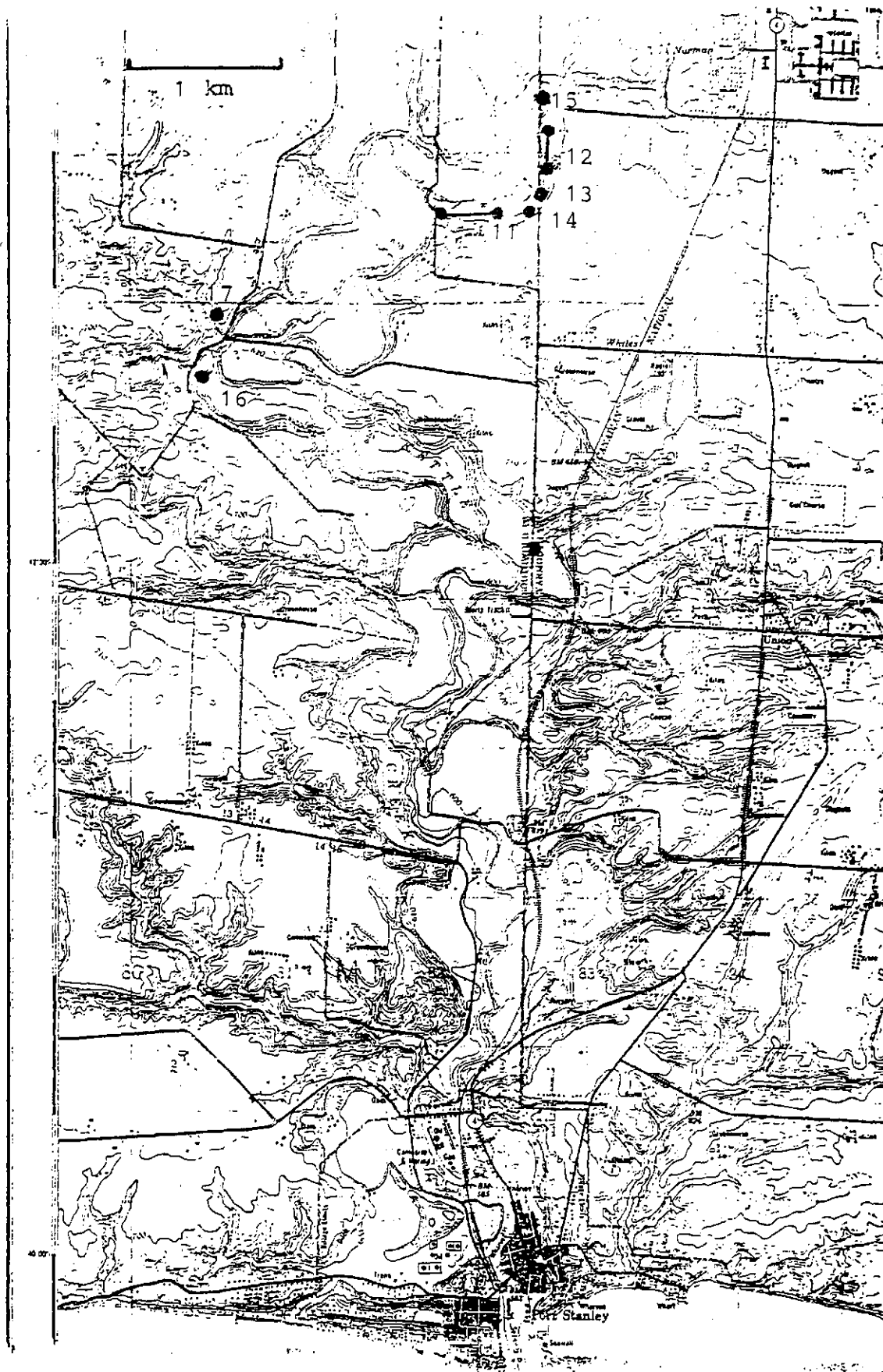


Figure 4. Distribution of *Isopyrum biternatum* populations presently occurring in Elgin County.

a field, May 20, 1989. Patches were 0.3 m X 0.6 m, 1 m X 1m and included eight other small patches, the largest of which was 1.8 m X 1.2 m. Population size was estimated at 800 plants. Acer saccharum and Carya ovata were dominant, intermixed with Fagus grandifolia, Betula alleghaniensis, Ulmus rubra, Fraxinus pennsylvanica, Carya cordiformis, Corylus americana, Ostrya virginiana, Prunus serotina, Crataegus crus-galli, Cornus alternifolia, Trillium grandiflora, Podophyllum peltatum and Viola sp. Patches were found on a slope between a small shrub-meadow, dominated by Rhus typhina, and a field.

15. Along Elgin Trail, south of St. Thomas.

A large population of Isopyrum biternatum was found in this area. Small patches were found along the forest edge and along the Elgin Trail; larger patches covering the forest floor were found further in from the road. I. biternatum was scattered throughout the floodplain. One patch found was approximately 75 m X 50 m and another was 1 m X 0.6 m. Many small patches were also found covering large areas of wooded slopes in the area. Population size is estimated at hundreds of thousands of plants.

Plants found in association with I. biternatum were Ostrya virginiana, Quercus rubra, Acer saccharum, Fraxinus americana, Fagus grandifolia, Carya ovata, C. cordiformis, Carpinus caroliniana, Amelanchier arborea, Prunus virginiana, P. serotina, Malus sp., Podophyllum peltatum, Smilacina sp., Trillium grandiflorum, Trillium erectum, Viola spp. and Thalictrum dioicum.

In many areas the plants are immediately adjacent to or actually on the trails. Trampling of plants by pedestrians, all-terrain vehicles and bicycles, in addition to camping in the area, are threatening this population. Wildflower picking is also a potential problem here.

16. Southwold Township, 6 km NNW of Port Stanley.

Large numbers of I. biternatum were found covering a localized area on a slightly graded slope. This area was well off the road and no public trails were present. Population consists of one very large patch covering a large section of a slope (approximately 300 plants) and eight small patches with another 750 plants (0.6 m X 1 m). Population size of this site was estimated at 12,000 plants.

This population is in a transition zone between Crataegus scrub and Acer saccharum - Fraxinus americana forest. Other plants in the area included Ostrya virginiana, Carpinus caroliniana, Carya cordiformis, Juglans cinerea and Crataegus crus-galli in the tree and shrub layer; and Dentaria laciniata, Trillium grandiflorum, T. erectum, Erythronium americanum, Sanguinaria canadense, Viola spp. and Solidago spp. in the herb layer.

17. Southwold township, 6.5 km NNW Port Stanley.

Six patches were found with an estimated total population size of 3,500 plants. Plants were near a tributary of Kettle Creek and adjacent to tree falls or wood cuts. Carpinus caroliniana, Carya ovata, Ostrya virginiana, Fagus grandifolia, Acer saccharum (A. saccharum X rubrum), Carya cordiformis, Crataegus sp. and Prunus serotina were found on this site.

This site is relatively isolated, that is, no trails pass through the area. Tree falls, and wood cuts were found in the immediate vicinity of this population; additional tree cuts may alter the habitat here and adversely affect this population of Isopyrum biternatum.

18. Yarmouth Township (east of Southwold/Yarmouth Twp Line), 5 km north of Port Stanley.

Two patches 6.5 m X 4.5 m and 30 m X 0.5 m, with approximately 3,500 - 5,000 plants. Former patch was found under remnant forest adjacent to a farmer's field and Kettle Creek; the latter patch was growing along a fence line bordered on either side by grasses.

Plants in immediate association with the first patch were Carpinus caroliniana, Carya cordiformis, Prunus virginiana, Tilia americana, Fraxinus americana, Ostrya virginiana, Juglans cinerea, Prunus virginiana, Cornus alternifolia, Crataegus sp., Solidago spp., Rubus idaeus, and some grasses. The second patch is surrounded by long grass.

This population is likely to decline in the future because the former population is in a very small woodlot and the latter patch is being outcompeted by grasses. Pesticide spraying in spring and summer may also affect this population. This population is not along a public trail, however, the landowner should be notified of the occurrence of this species on his property.

19. 3 km north of Arkona

Fourteen patches of the following sizes: 2.7 m X 1 m, 0.9 m X 0.3 m, 0.6 m X 0.3 m, 1.5 m X 1 m, 1.8 m X 1.8 m, 1 m X 0.6 m, 1.5 m X 1.5 m, 1.2 m X 1.2 m, 1.5 m X 1 m, 0.6 m X 0.6 m, 1.5 m X 0.6 m, 1.2 m X 0.6 m, 1.8 m X 1.2 m and 5.1 m X 1.2 m were found along the Ausable River floodplain. Estimated population size is 2,500 - 3000 plants.

Other species found here included: Acer saccharum, Fraxinus sp., Celtis occidentalis, Quercus rubra, Salix nigra, Prunus serotina, Viola sp., Erythronium americanum, Arisaema atrorubens and Caulophyllum thalictroides. Small patches of Jeffersonia diphylla were also found on this site.

Threats to the population included wood cutting in the area; people accessing the nearby area for fishing, via private property; and hikers coming from Rock Glen Conservation Area (although several steep banks and thick growths of hawthornes in various places make it an arduous journey).

7. POPULATION ECOLOGY

The population ecology of Isopyrum biternatum remains unstudied. No information was found regarding competitive interactions that affect Isopyrum biternatum populations.

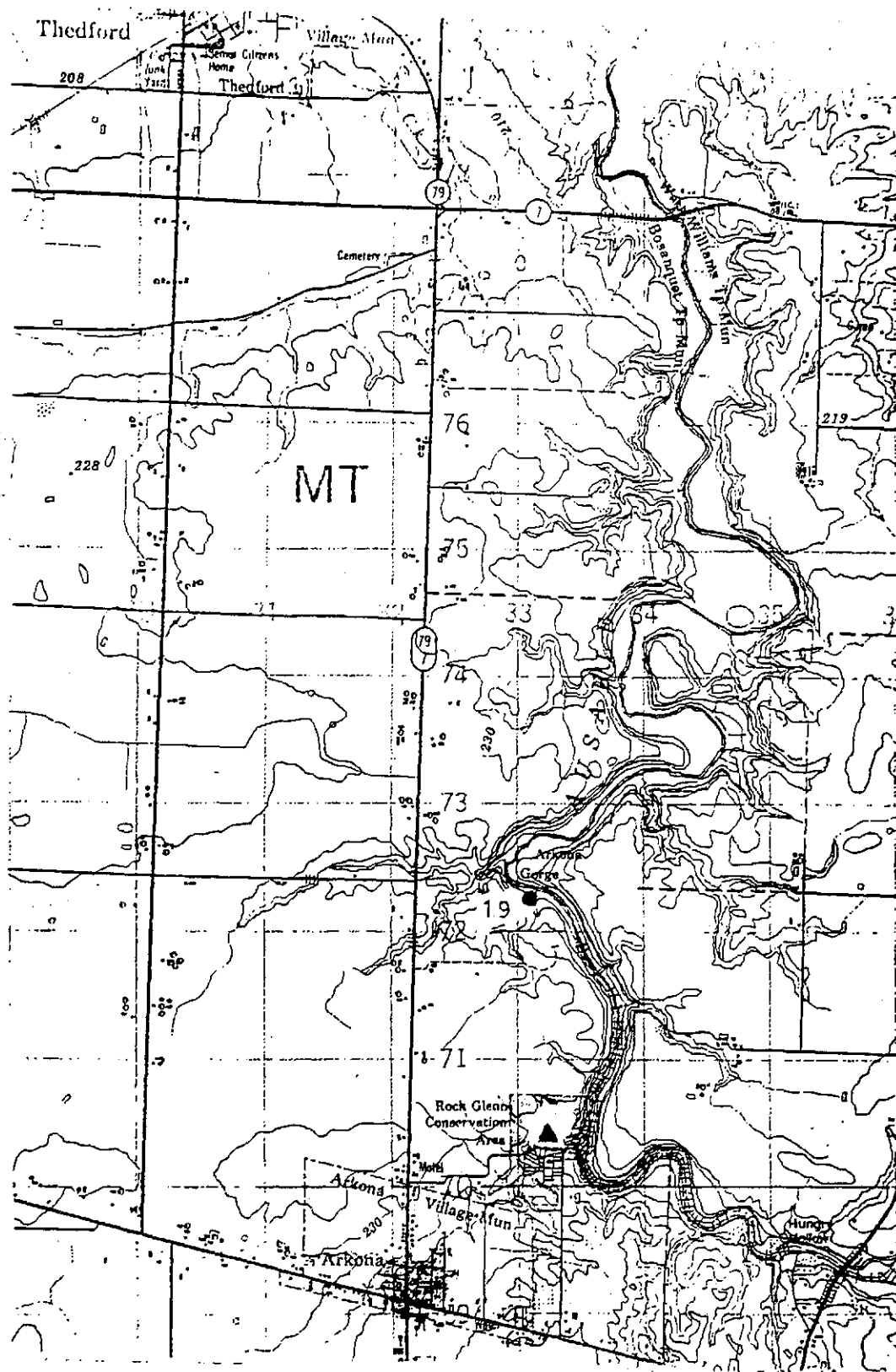


Figure 5. Distribution of *Isopyrum biternatum* in Lambton Co., Ontario. Circle indicates a population found in 1989; triangle indicates Rock Glen population reported by Gaiser (1966) and Thieje (pers. comm., 1989).

8. LAND OWNERSHIP AND MANAGEMENT RESPONSIBILITY

8.1 General nature of ownership and management responsibility

The extant populations of Isopyrum biternatum in Ontario are largely under private ownership in Arkona, St. Thomas and Port Stanley; and under joint municipal and provincial ownership (conservation authorities, etc.) in London. Many I. biternatum populations are located near public trails, both on private and government lands. Therefore, most populations of this species in Ontario are subjected to a high degree of public exposure.

9. MANAGEMENT PRACTICES AND EXPERIENCE

9.1 Summary

No formal management, other than trail maintenance on public paths, is known to be practised in areas populated by Isopyrum biternatum in Ontario. The majority of people are unaware of the rarity of this species and could easily trample plants while walking along footpaths. In addition, private landowners are often unaware of the rarity of plants, such as Isopyrum biternatum, found in their woodlots.

9.2 Performance under changed conditions

Some populations of Isopyrum biternatum were found growing in conditions considered to be atypical for the species: adjacent to windfalls and tree cuts, edge habitats, within large growths of Alliaria officinalis or Aegopodium podagraria, amongst tall grasses, and along well-used footpaths. It is assumed that plant populations in these areas are on the decline, however, research is necessary to determine how seedling growth, seed output and germination in these populations differ from populations growing in more typical habitats.

9.3 Current management policies and actions

The majority of landowners are unaware of the presence of Isopyrum biternatum on their land, or its rarity. The Upper Thames River Conservation Authority knows about I. biternatum populations growing on their property through the work of J. Bowles (1986, 1989). Other landowners should be informed of the presence of this species on their land to prevent population reduction from practices such as wildflower collecting. Landowners contacted by the author during the course of the 1989 field season expressed an interest in the project, and would be willing to preserve rare plant populations on their property.

The abundance of Aegopodium podagraria in the floodplain area of the Thames River, University of Western Ontario poses a strong threat to this Isopyrum biternatum population; perhaps, management of this introduced species could be initiated.

10. EVIDENCE OF THREATS TO SURVIVAL

10.1 Habitat destruction or modification

Populations 1, 6, 7, 8, 10, 11, 12, 15, and 19 are threatened by their proximity to public areas and trails. In these areas plant populations may be threatened by spring wildflower-picking, soil compacting and trampling by foot, bicycle, and/or ATV.

Populations 1 and 8; and 18 are threatened by encroachment of Aegopodium podagraria and long grasses, respectively. Isopyrum biternatum plants in Population 18 are already growing in a long, narrow strip, in contrast to their normal growth pattern of large clumps.

Populations 17 and 19 may be threatened by wood cutting operations or tree falls found in the immediate vicinity of the plants. Population 7 is susceptible to soil erosion. In addition, Populations 13, 14 and 18 are close to the edge of fields, where the potential for mowing-damage to plants is relatively high. Herbicides or insecticides sprayed on crops (e.g. soybeans) in the spring (May and/or June) could harm plants in the area. Population 13 is also threatened by Alliaria officinalis encroaching upon Isopyrum biternatum plants in this area. Road salting may affect Population 15 which is downslope from the road in a low-lying area. The author also observed a small group of people camping in the immediate vicinity of Population 15; because this is one of the largest populations of I. biternatum that was found in Ontario, camping here should be discouraged.

10.2 Other natural or manmade factors

Certain populations, particularly Populations 1 and 10, are limited to small clumps consisting of very few plants; therefore, these populations are at a higher risk of elimination due to their low population sizes.

11. PRESENT LEGAL OR OTHER FORMAL STATUS

I. biternatum is listed as rare, both in Canada (Argus and Pryer, 1986) and in Ontario (Argus and White, 1983). In the United States, Isopyrum biternatum is not considered federally endangered. However, it is considered rare in South Carolina, Virginia and Florida; and endangered in South Dakota (Shirley Maina, pers. comm., 1989). In South Carolina, Isopyrum biternatum is known from only one location (Stevens Creek, Modoc, McCormick Co.) which is protected by South Carolina's Natural Heritage Program; these populations are not in any current danger (S. R. Hill pers. comm., 1989). Isopyrum biternatum is not listed, or proposed for listing, in the IUCN Red Data Book, the U.S. Endangered Species Act or the Convention on International Trade.

12. GENERAL ASSESSMENT

Isopyrum biternatum is only found in specialized habitats of the Carolinian Zone in Ontario, i.e. wooded floodplain habitats dominated by Acer saccharum and intermixed with other Carolinian and Deciduous Forest Region species. This species does not thrive in edge habitats or open

areas, which dominate the landscape of Southwestern Ontario. Due largely to its habitat specificity, I. bitermatum is only known to occur in a restricted geographical range (Port Stanley/St. Thomas, London and Arkona) in Ontario. Isopyrum bitermatum survives in small to moderate populations in close proximity to agricultural and public use areas of Southwestern Ontario. This taxon is unlikely to persist unless the localized floodplain areas it frequents, particularly along Kettle Creek and the Medway River, are preserved. Several thousand plants can survive on small plots of land, provided these are designated for preservation. The presence of certain populations on conservation property may prevent development that may be destructive to Isopyrum bitermatum populations, however, public access into these areas also poses a threat to this species. Informing private landowners of the rarity of I. bitermatum, and other species, may encourage private stewardship of rare, threatened and endangered species in Ontario and Canada.

13. STATUS RECOMMENDATION

Factors such as trampling, encroachment by introduced species, and the future development of floodplain areas pose threats to certain Isopyrum bitermatum populations in Ontario and Canada. Due to the relatively specialized wooded floodplain habitat that this species requires, its restricted geographical range in the Carolinian Zone of Ontario, and the presence of the majority of known populations in public use areas, Isopyrum bitermatum should be considered threatened in Ontario and Canada. At present, no immediate peril is evident to classify Isopyrum bitermatum as endangered. However, future land use in areas of extant populations should be carefully monitored, and the status of I. bitermatum re-evaluated as necessary.

14. RECOMMENDED CRITICAL HABITAT

Three sites should be designated as critical habitats for Isopyrum bitermatum in Ontario. These sites are important due to the presence of large populations of I. bitermatum or other rare plants, such as Mertensia virginica and Lithospermum latifolium in the area. In addition, each site is geographically separated from the others; preserving critical habitats in these areas will maintain I. bitermatum populations in Elgin, Lambton and Middlesex Counties.

Populations 6 to 10 along Medway Creek (Middlesex Co.) should be conserved due to their large numbers of plants, particularly Populations 8 and 9. Arisaema dracontium and Lithospermum latifolium, both rare plants in Ontario, are also found in the area. These populations are in a public use area which is unlikely to be developed because it is in a floodplain zone managed by the Upper Thames River Conservation Authority. General UTM coordinates for the area are 17MT 75 62, map 40 P/3 (Lucan).

Populations 11 to 15 along Kettle Creek and its tributaries (Elgin Co.) should also be considered as critical habitat for I. bitermatum. Scattered populations, often with thousands of plants, along with other rare taxa, such as Mertensia virginica, occur in the area. Populations here are often bordered by farmers' fields or steep wooded slopes on one side, and Kettle Creek or its tributaries on the other. This area is largely under the control of one family, George and Betty Shaw; therefore,

it should be logistically easier to preserve these populations. General UTM coordinates for this area are 17MT 82 30, map 40 I/11 (Port Stanley).

Population 19 along the Ausable River (Lambton Co.), although smaller in size than the aforementioned populations, is worthy of conservation. This population was the only one found in Lambton Co. during the 1989 field season by the author. Therefore, in order to maintain the maximum number of geographical localities for Isopyrum biternatum, this site should be regarded as another critical habit for the species.

15. CONSERVATION RECOMMENDATIONS

The author's recommendations for the conservation of this species have been transmitted separately to the appropriate provincial jurisdiction (Ontario). All inquiries regarding these recommendations should be addressed to the appropriate jurisdiction or COSEWIC and are available at the discretion of these agencies.

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17. OTHER PERTINENT PUBLICATIONS AND KNOWLEDGEABLE INDIVIDUALS

Dr. Fred Cook, Botany Department, University of Western Ontario, London, ON, N6A 5B7. Possible introduction of Isopyrum biternatum on UWO property.

Dr. Karl Keener, Pennsylvania State University. Expert on Ranunculaceae (S. R. Hill pers. comm., 1989).

Dr. Larry Morse, Chief Botanist, The Nature Conservancy, 1815 North Lynn St., Arlington, VA. 22209, (703) 841-5361. Information on recent field studies.

18. COLLECTIONS CONSULTED

Specimens of Isopyrum biternatum are kept in the following herbaria: Department of Agriculture Herbarium, Ottawa (DAO); University of Guelph Herbarium, Guelph (OAC); University of Toronto Herbarium (TRT); Erindale College Herbarium (TRTE); and the University of Western Ontario (UWO).

In addition, the following individuals and herbaria were consulted regarding the distribution of I. biternatum in the United States:

Daniel F. Austin, Curator of the Herbarium, Department of Biological Sciences, Florida Atlantic University, Boca Raton, Florida, 33432.

George Estabrook, Herbarium of the University of Michigan, North University Building, Ann Arbor, Michigan, 48104.

J. W. Hardin, Curator, Department of Botany, North Carolina State University, Box 7612 Raleigh, North Carolina, 27695-7612

Steven R. Hill, Curator of the Herbarium, Department of Biological Sciences, College of Sciences, Clemson University, 132 Long Hall, Clemson, South Carolina, 29634-1903.

M.B. Huneycutt, Curator of the Herbarium, Department of Biology, College of Liberal Arts, The University of Mississippi, University, Mississippi, 38677.

Almut G. Jones, Herbarium, Department of Plant Biology, University of Illinois at Urbana-Champaign, 505 South Goodwin Avenue, Urbana, Illinois, 61801.

Deborah Qualls Lewis, Curator, Ada Hayden Herbarium, Department of Botany, Bessey Hall, Iowa State University, Ames, Iowa, 50011-1020.

C. Roberta Lombardi, Herbarium, University of Massachusetts at Amherst, Morrill Science Center, Amherst, Massachusetts, 01003.

Michael O. Moore, Curator of the Herbarium, Department of Botany, College of Arts and Sciences, The University of Georgia, 2502 Plant Sciences, Athens, Georgia, 30602.

Charles J. Sheviak, Curator of Botany, The State Education Department, The University of the State of New York, Albany, New York, 12230.

Edwin B. Smith, Department of Botany and Microbiology, J. William Fulbright College of Arts and Sciences, The University of Arkansas, 401 Science-Engineering Building, Fayetteville, Arkansas, 72701.

Olga Lakela Herbarium, Duluth Branch, University of Minnesota, Duluth, Minnesota, 55812.

Herbarium of Northeast Louisiana University, Monroe, Louisiana

19. FIELDWORK

Field investigations of Isopyrum biternatum populations were conducted from early May to mid-June, 1989 by M. Austen. Realizing that the Medway River was already under investigation by J. Bowles, the author's efforts were focussed in suitable habitats in the St. Thomas/Port Stanley, Parkhill and Arkona areas of Ontario. In most cases, old herbarium records, including those with latitude and longitude coordinates, were not accurate enough to direct the author to specific locations with suitable habitat for I. biternatum. Therefore, a broad search was initiated in probable locations (e.g. along Kettle Creek and its tributaries) and habitats to find I. biternatum populations.

20. KNOWLEDGEABLE INDIVIDUALS CONSULTED

Jane M. Bowles, R.R.#3 Thorndale, Ontario, NOM 2P0, (519) 461-1932.
Populations along Medway River.

Laurie Consaul, Herbarium, Botany Department, University of Western Ontario, London, Ontario, N6A 5B7, (519) 679-2111 Ext. 6500.
Populations at UWO and herbarium vouchers.

Shirley Maina, Botany Division, Smithsonian Museum of Natural History, Washington, D.C., U.S.A., (202) 357-1858. Rarity of I. biternatum in North America.

Mike Oldham, Assistant Regional Ecologist, Ontario Ministry of Natural Resources, Southwestern Region. P. O. Box 5463, London, Ontario, N6A 4L6. Location of Populations 6 and 18. Photographs of Population 18.

Ruth Schallert, Librarian, Botany Division, Smithsonian Museum of Natural History, Washington, D.C., U.S.A., (202) 357-2715. Sent information on the distribution of Isopyrum biternatum.

Bill Stewart, 6 Yarwood St., St. Thomas, Ontario, N5P 2Y3, (519) 631-0775.
Flora of Elgin Co. and historical populations of I. biternatum.

Dorothy Thieje, 1060 Bruce St., Sarnia, Ontario, N7V 3B1, (519) 542-4537.
List of plants in Lambton Co. and population near Rock Glen
Conservation Area, Ausable River.

21. OTHER INFORMATION SOURCES

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plants growing north of Mexico. Wiley & Putnam, London.

22. SUMMARY OF MATERIALS ON FILE

All known published material concerning Isopyrum biternatum, including original descriptions, floristic treatments, field and laboratory studies, etc., are on file with the author. Field notes and photographs from the 1989 field study by the author are also on file. J. Bowles (Section 20) and M. Oldham also have photographs of I. biternatum on file.

23. INITIAL AUTHORSHIP OF STATUS REPORT

Madeline Austen

Home:	P.O. Box 103	or	R. R. # 2
	Campbellville, ON		Rockwood, ON
	CANADA LOP 1B0		CANADA NOB 2K0
	(416) 878-4249		(519) 856-2089

Work: E. L. I. Laboratories Inc.
143 Dennis Street,
Rockwood, ON
NOB 2K0
(519) 856-9591

24. MAINTENANCE OF STATUS REPORT

This report will be maintained by M. Austen. Additional information subsequently acquired should be sent to her for amendment of the report.

25. NEW INFORMATION

A recent conversation (November 30, 1989) with Bill Stewart revealed that two populations, previously believed to be historic populations have been confirmed by Stewart in the last five years. These populations are listed below. No details as to population sizes are known offhand. Stewart also concurs with the author that Isopyrum biternatum is locally abundant along Kettle Creek in the Port Stanley/St. Thomas area. Scattered populations are found over a distance of approximately 15 km between Port Stanley and St. Thomas, along Kettle Creek.

1. Ontario. Elgin Co. Yarmouth Twp. Sparse, in clay soil of moist woods. April 30, 1952 (Stewart and James, 1969).
2. Ontario. Elgin Co. Lot 1 Conc. II. Yarmouth Twp. Open woods. W. Stewart 1465. 27 April, 1969. (UWO).