COSEWIC
Assessment and Update Status Report

on the

False Rue-anemone
Enemion biternatum

in Canada

THREATENED
2005

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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Previous report:

Austen, M.J.W. 1990. COSEWIC status report on the false rue-anemone *Isopyrum biternatum* in Canada.Committee on the Status of Endangered Wildlife in Canada. Ottawa. 32 pp.

Production note:
COSEWIC would like to acknowledge Melinda J. Thompson for writing the update status report on the false rue-anemone *Enemion biternatum.* The report has been overseen and edited by Erich Haber, Co-chair (vascular plants) of the COSEWIC Plants and Lichens Species Specialist Subcommittee.
False rue-anemone *Enemion biternatum was* previously designated by COSEWIC as False rue-anemone *Isopyrum biternatum.*

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False Rue-anemone — Drawing by M.J. Thompson.

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COSEWIC
Assessment Summary

Assessment Summary – May 2005

Common name
False Rue-anemone

Scientific name
Enemion biternatum

Status
Threatened

Reason for designation
A delicate, spring-flowering, perennial herb restricted to a few fragmented riverside forest sites in southwestern Ontario where its populations are at risk from habitat loss and decline in quality due to a variety of activities including recreational trail use, and expansion of exotic invasive plants.

Occurrence
Ontario

Status history
Designated Special Concern in April 1990. Status re-examined and designated Threatened in May 2005. Last assessment based on an update status report.

COSEWIC
Executive Summary

False Rue-anemone
Enemion biternatum

Species information

False rue-anemone is a spring-flowering herbaceous perennial. The flowers are small and delicate, with 5 white petal-like sepals, surrounding a cluster of stamens with yellow anthers. The species grows to about 40 cm tall. Although its roots are shallow and slender, they are tough and hardy — sometimes to the extent of maintaining green leaves all winter. The thin leaves are mostly divided into three segments, each of which may be divided into three leaflets that are usually olive green in colour. The white flowers of false rue-anemone are among the earliest to open in spring, starting in April and extending through to early June.

Distribution

False rue-anemone occurs in Canada and the United States. This species is generally common throughout its main range but is quite rare at the northern and western edges of its range. In Canada, it occurs as scattered populations in southwestern Ontario.

Habitat

This species inhabits open wooded slopes, river floodplains, rich woods and thickets.

Biology

In Canada, false rue-anemone flowers from April to early June, and bears fruit from May to June. Insects are the main pollinators. The seeds germinate in the autumn.

Population sizes and trends

In the ten years since the last status report, one historical population of false rue-anemone has been relocated. No new populations have been discovered. Six populations are currently extant with about one million flowering shoots.

Limiting factors and threats

In Canada, several populations of false rue-anemone are threatened by all terrain vehicle use, soil compaction, and trampling, due to their proximity to public areas and trails. Loss of habitat due to invasion of exotic grasses and other invasive plants, wood-cutting operations, soil erosion, and agricultural activities also pose a threat to Canadian populations of false rue-anemone. Spraying of herbicides and pesticides is also occurring to the detriment of these plants. Road salting may be a limiting factor for at least one Canadian population of false rue-anemone.

Special significance of the species

The species has been promoted as a valuable horticultural addition to woodland gardens.

Existing protection

False rue-anemone was first designated in 1990 as Special Concern in Canada by the Committee on the Status of Endangered Wildlife in Canada. This species has an S2 rank in Ontario (imperiled), a National rank of N2 (imperiled) in Canada, and a Global rank of G5 (demonstrably widespread, abundant, and secure). The species is now officially listed in Ontario as Special Concern under the recently approved Species At Risk in Ontario (SARO) list. The species has likely been extirpated from New York and South Dakota, is listed as Endangered in Florida, and as a species of Regional Concern in South Carolina. This species is not listed under the federal Endangered Species Act in the United States.

A part of the Medway Creek population is on land owned by the Upper Thames River Conservation Authority. The Ausable River Valley population is in an ANSI (Area of Natural and Scientific Interest). The Parkhill population is located in a conservation area owned by the Ausable Bayfield Conservation Authority. The remaining populations are located on private land. Presence in an ANSI or a conservation area does not in itself confer protection unless specific management plans are in effect for the species.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

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Update
COSEWIC Status Report

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2005

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SPECIES INFORMATION

Name and classification

Scientific name:	*Enemion biternatum* Raf.
Pertinent synonyms:	*Isopyrum biternatum* (Raf.) Torr. & Gray
Common names:	False rue-anemone, Eastern false rue-anemone, False meadow-rue
Family name:	Ranunculaceae (Buttercup family)
Major plant group:	Dicot flowering plant

Enemion biternatum is the only member of the genus represented in central and eastern North America. Three other species of *Enemion* are native to the Pacific coast of North America (Gleason, 1991) and one species (*E. savilei)* is endemic to the Queen Charlotte Islands (Calder and Taylor, 1963).

Enemion is thought to refer to the Greek term *anemos*, which means wind; *biternatum* is Latin for "twice in sets of three" referring to the leaves and the leaflet subdivisions. *Enemion biternatum* is commonly called false rue-anemone because the flower is almost indistinguishable from the native rue-anemone, *Thalictrum thalictroides* (*Anemonella thalictroides;* see NHIC, 2002*).*

Description

Enemion biternatum is a spring flowering perennial that grows from 10-40 cm high. Stems are ribbed and smooth originating from a tuberous rootstock. Roots are slender and swollen at intervals to form tiny tubers (Wherry, 1948). Stem leaves are short petioled (1 mm) or sessile, usually biternate but occasionally the uppermost stem leaves are trifoliate. Basal leaves are biternate, rarely triternate, with long petioles, up to 15 cm. Leaflets are 4-18 mm long, 2-14 mm wide, and usually 2-3 lobed (occasionally entire or five lobed) with shallow deep sinuses. Leaflet lobes are round to acute tipped. Leaflets are glabrous and darker green above. The compound leaves are subdivided, usually, into 3 groups, of 3 leaflets each. Leaflets normally have 3 lobes, but may have more. The leaves attach individually, and emerge both from the base of the plant, on long petioles, and from the upper parts of the stem, on short petioles. Involucral leaves occur immediately below the flowers, may attach directly without petioles, and have only 3 leaflets. Stipule-like projections occur where the petioles join the stem.

Enemion biternatum flowers are small and delicate, lack true petals but have 5 white, obovate, petal-like sepals, surrounding a cluster of stamens with yellow anthers. Stems may divide into two or more branches, each with a single flower. Flowers are 1.5-2 cm wide and are borne singly in leaf axils or at the end of stems. Flowers are bisexual. The petal-like sepals are 4-10 mm long, 3-8 mm wide. The stamens typically surround 4 leaf-like pistils that terminate in tiny, thread-like styles. Follicles are divergent, greenish to tan, glabrous and somewhat compressed (Mitchell and Dean, 1982). Seeds are smooth.

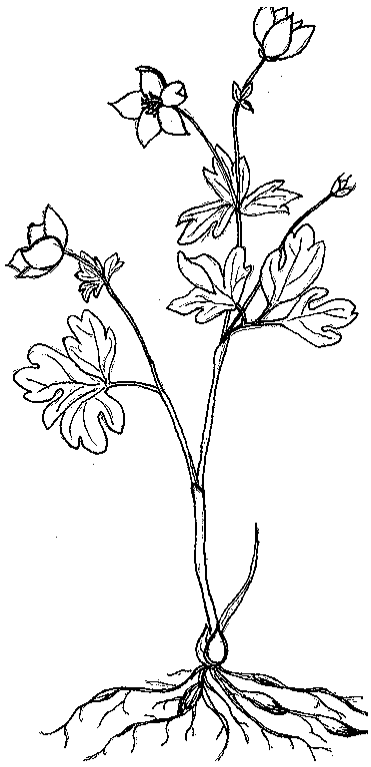

Figure 1. Illustration of *Enemion biternatum* (by M. Thompson).

This species is sometimes confused with a close relative, the rue-anemone *(Thalictrum thalictroides),* but rue-anemone generally occurs in drier woodlands and is more common under oaks than maples (NHIC, 2002). Superficially, *Enemion biternatum* resembles *Thalictrum thalictroides* in the division of its leaves and its delicate white flowers. However, *Enemion biternatum* can be distinguished from *T. thalictroides* by the following:

Enemion biternatum	***Thalictrum thalictroides***
Stem leaves, several and alternate	Stem leaves opposite or whorled and only below flower cluster
Leaflets deeply lobed with a minute apiculum at their apex	Leaflets shallowly lobed and without an apiculum
Roots bear scattered small tubers	Roots bear cluster of tubers
Height 10-40 cm	Height 10-20 cm

Enemion biternatum could also be confused with *Thalictrum* species on the basis of vegetative characteristics, particularly *Thalictrum dioicum*, which is also a spring ephemeral. *Enemion biternatum* has more deeply lobed leaflets, a more reddish stem (in Ontario populations at least), brighter green leaves and a different flower structure (Austen, 1990).

DISTRIBUTION

Global range

Enemion biternatum occurs in Canada and the United States. This species is common throughout most of its range. It is rare within those provinces or states that encompass the periphery of its range, including Ontario, Florida, South Carolina, Virginia, West Virginia, Alabama and North Carolina. This species has likely been extirpated from New York and South Dakota (Figure 2). *Enemion biternatum* is recorded infrequently east of the Appalachian Mountains but 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 *Enemion biternatum* may be easily overlooked due to its early flowering time and resemblance to the more widespread *Thalictrum thalictroides*. In Ontario, this is less likely the case since *Thalictrum thalictroides* is also provincially rare and likely would not be readily encountered.

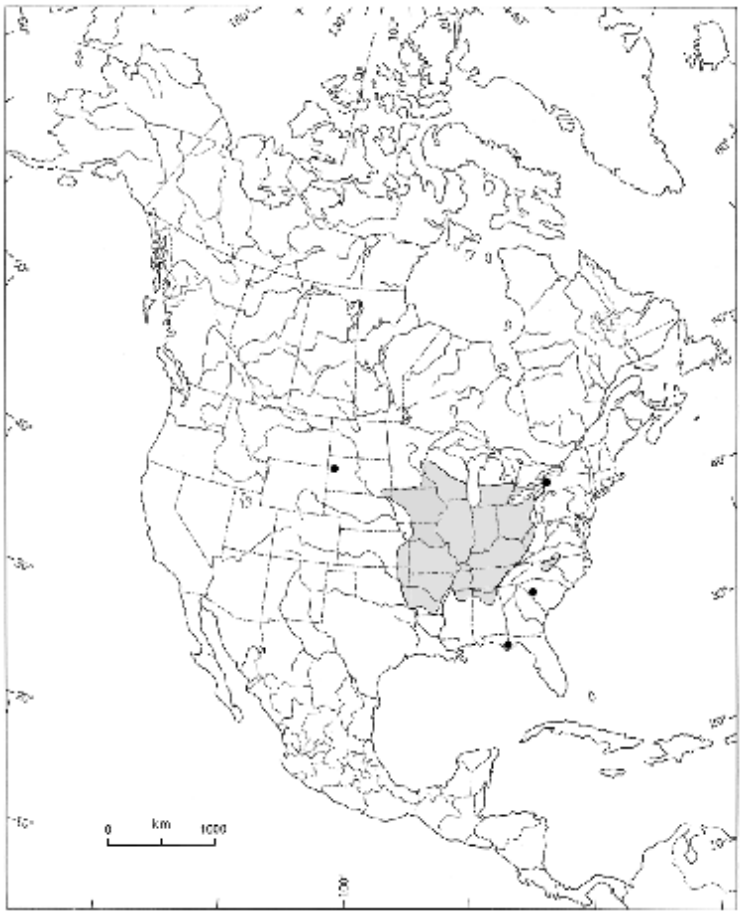

Figure 2. North American distribution of *Enemion biternatum* (based on map in *Canadian Biodiversity* located at http://www.canadianbiodiversity.mcgill.ca/english/species/plants/plantpages/ene_bit.htm).

Canadian range

The species has been known in Canada since about 1897 (Table 1). *Enemion biternatum* occurs only in southwestern Ontario in five different watersheds (Figure 3). Many individual plants (tens of thousands) can be found in some populations, but colonies are often very dense and may occupy only a small area of habitat. Populations of this species can be found in the floodplains of Medway Creek, the Thames River, Kettle Creek, Mud Creek (Parkhill), and the Ausable River.

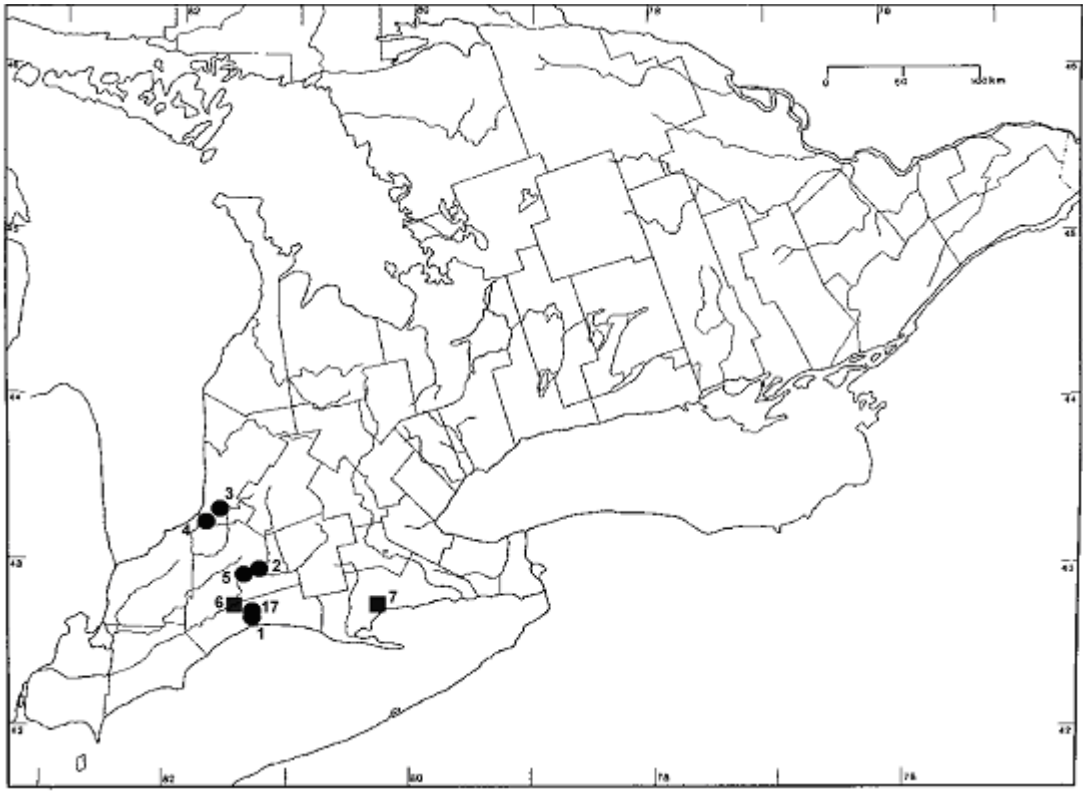

Figure 3. Distribution of *Enemion biternatum* in Ontario. Solid square symbol represents an extirpated site (7=Lynn Valley, 6=Middlemarch Forest). 1=Kettle Creek, North of Port Stanley, 2=Medway Creek, 3=Parkhill, 4=Ausable River, 5=Thames River, 17=Kettle Creek.

HABITAT

Habitat requirements

Enemion biternatum is a species of open wooded slopes, river floodplains, rich woods and thickets. It is often seen growing in large colonies.

Populations of *Enemion biternatum* are restricted in Canada to the Carolinian region (Scoggan, 1978). Throughout its range, *Enemion biternatum* grows in shaded woods and thickets, often on rich wooded slopes in or adjacent to floodplain zones. Boufford and Massey (1976) reported *Enemion biternatum* growing in flat bottoms of alluvial woods behind natural levees in Virginia. This species is often found in close proximity to streams. Melampy and Heyworth (1980) found 50% and 74% of 147 clumps within 10 and 25 m of a stream in a field study conducted in Illinois.

Enemion 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. In Ontario, the species occurs in areas dominated by grey brown luvisolic soils rich in calcareous till and lacustrine deposits from limestone and dolostone (Hoffman, 1989). All Ontario stations occur near the limit of the Deciduous Forest Region, also known as the Carolinian Zone. Populations in Ontario were generally found in mixed hardwood Carolinian forests dominated by sugar maple (*Acer saccharum*), in combination with other species including ironwood (*Ostrya virginiana*), beech (*Fagus grandifolia*), hickory (*Carya* spp.), basswood (*Tilia americana*), butternut (*Juglans cinerea*) and ash (*Fraxinus* spp.). This plant is found with other spring wildflowers (Austen, 1990), including bloodroot (*Sanguinaria canadensis*), trillium (*Trillium* spp.), toothwort (*Dentaria* spp.), anemone (*Anemone* spp.), violet (*Viola* spp.), and trout lily (*Erythronium* spp.).

The habitats where the six populations occur are significant sites due to the presence of large populations of *Enemion biternatum* in addition to the presence of other rare plant species such as Virginia bluebells (*Mertensia virginica*), American gromwell (*Lithospermum latifolium*) and green dragon (*Arisaema dracontium*).

Habitat trends

It is difficult to determine whether the habitat has been drastically altered since the last status report due to the dynamic nature of floodplain systems. There does appear to be an increase in the number of trails and trail usage, possibly due to an increase in the number of homes adjacent to the floodplain. In addition, a number of invasive species seem to be colonizing the floodplain habitats generally occupied by *Enemion biternatum*. These factors may have contributed to the decline (and in some cases, extirpation) of *Enemion* populations that previously occupied the floodplains. No additional information on habitat changes is possible since the original status report did not provide specific descriptions against which to compare sites that currently do not have plants or plants could not be found.

Protection/ownership

Subsequent to the designation of *Enemion biternatum* as a COSEWIC Special Concern species in 1990, the species was officially listed provincially as Special Concern.

A part of the Medway Creek population is on land owned by the Upper Thames River Conservation Authority. The Ausable River Valley population is in an ANSI (Area of Natural and Scientific Interest). The Parkhill population is located in a conservation area owned by the Ausable Bayfield Conservation Authority. Presence in an ANSI or a conservation area, however, does not in itself confer protection unless specific management plans are in effect for the species. The remaining populations are located on private land.

The extant meta-populations of *Enemion biternatum* in Ontario are largely under private ownership in Arkona, St. Thomas, and Port Stanley, and under public ownership in London. Many sub-populations are located near public trails both on private and public lands. Therefore, most populations of this species in Ontario are subjected to a high degree of public access (Austen, 1990).

BIOLOGY

Physiology

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 Heyworth, 1980) *Enemion 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 *Enemion 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 (flower stigmas are receptive before the anthers open; see Schemske *et al*., 1978). Delayed flowering peaks can be detrimental to seed set of *Enemion biternatum* (Schemske *et al*., 1978).

In Ontario, seeds mature by 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 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 observed in more northerly areas (Austen, 1990).

Enemion biternatum is a hermaphrodite (both male and female organs within the same flower) and grows in clumps that probably represent clones (Melampy and Heyworth, 1980). *Enemion biternatum* is self-compatible but not autogamous (self-pollination within a single flower); 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 *Enemion biternatum* plants were geitonogamous 26% of the time, outcrossed within a patch 16% of the time and

outcrossed between patches 28% of the time. Geitonogamous pollination, the transfer of pollen between flowers on the same genetic individual, has potential consequences such as increasing the potential for self fertilization, which can result in inbreeding depression, or reducing reproductive success due to a reduced amount of pollen outcrossing to other individuals.

Reproduction/dispersal

Enemion biternatum is entomophilous (pollinated by insects). No nocturnal pollinators were seen by Melampy and Hayworth (1980) on *Enemion biternatum*. This is probably related to the cool nights during early spring when this species flowers. A variety of insects have been found visiting *Enemion biternatum* flowers (*Apis mellifera,* andrenid bees, halictid bees, syrphid flies, other flies and beetles). However, the rate of visitation of these pollinators is low even when *Enemion biternatum* is in flower. *Enemion biternatum* is a nectar-less plant and is not a preferred resource for insect pollinators when the nectar-bearing flowers of plants such as *Claytonia virginica* and *Cardamine concatenata* (*Dentaria laciniata*) are nearby (Melampy and Hayworth, 1980). Nectar-less plants may receive insect visits by extending their flowering season to include intervals when few nectar-producing plants are flowering. This strategy may be employed by *Enemion biternatum* (Melampy and Hayworth, 1980).

The key to maximizing seed set for *Enemion 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 *Enemion biternatum* occurred after the peak of flowering for *Claytonia virginica,* suggesting that as preferred species decrease in abundance, insects began visiting *Enemion biternatum* more often and pollinating more *Enemion biternatum* flowers (Melampy and Hayworth, 1980). The low visitation rate of pollinators to *Enemion biternatum* plants suggests that *Enemion biternatum* 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 *Enemion biternatum* occasionally as preferred species decline in abundance. Therefore a lack of pollinator availability could limit seed production in *Enemion biternatum* (Melampy and Hayworth, 1980). There is some evidence that wind plays a role in the pollination of *Enemion biternatum*. For example three of 37 flowers covered with nylon screen produced seed in a field study conducted by Melampy and Hayworth (1980).

In a field study examining the phenology of *Enemion biternatum* 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).

Enemion biternatum seeds collected from central Kentucky were sown in soil and placed in a non-heated greenhouse (Baskin and Baskin, 1986). Seeds exhibited embryo growth and completed germination (emerged radicle and cotyledons) in the

autumn (Baskin and Baskin 1986). Embryos grew slowly during the summer but elongated rapidly in early September; seeds germinated in October (Baskin and Baskin, 1986).

Germination of *Enemion biternatum* 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 *Enemion biternatum* 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 *Enemion biternatum* can germinate, embryos must elongate from less than 0.2 mm to more than 1 mm. Optimum temperatures (day/night) for germination of freshly matured seeds were 20/10 degrees Celsius. Seeds eventually germinated at 30/15 degrees Celsius and 25/15 degrees Celsius (Baskin and Baskin, 1986). Embryos are non-dormant and seeds of *Enemion biternatum* require a long time at high temperatures to complete embryo growth and germinate (Baskin and Baskin, 1986). Laboratory studies suggest that exposing seeds of *Enemion biternatum* to high summer temperatures may enhance germination at early autumn temperatures (Baskin and Baskin, 1986).

The germination pattern of *Enemion biternatum* differs from that of all other perennial herbs of mesic deciduous forests studied to date. Most forest species are deeply dormant and complete germination in spring. *Enemion biternatum* is non-dormant and completes germination in autumn (Baskin and Baskin, 1986). To date, germination patterns of Enemion biternatum in Ontario have not been examined (Austen, 1990).

Enemion 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, *Enemion 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).

Comprehensive studies have not been conducted on the demography, phenology and reproductive ecology of *Enemion biternatum* in Ontario (Austen, 1990). *Enemion 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 in 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 small patches, less than 1 x 1 m (approximately 50 plants), to large areas of forest that are covered with plants, numbering in the thousands (Austen, 1990).

Interspecific interactions

No information was found regarding competitive or interspecific interactions that affect *Enemion biternatum* populations. The population ecology of *Enemion biternatum* in Ontario remains unstudied.

POPULATION SIZES AND TRENDS

Information about meta-populations in Ontario is summarized in Table 1. This information is based on field visits made by Austen during May and June 1989 and fieldwork conducted by J. Bowles in the summers of 1986, 1988, and 1989. Estimates of numbers of plants per sub-population are presented for localities visited in May 1989 by Austen. These estimates were based on stem counts for smaller populations and on the amount of area covered by colonies for larger populations. Updated information is based on field surveys done by M. Thompson in May 2003 and June 2004 (six days).

Numbers represent total number of stems found at the site, both vegetative and flowering. It is difficult to determine the number of clones represented in some of the sub-populations without damaging the plants. The use of the term "subpopulations" indicates separate groupings of plants (or separate clones) that are part of a larger meta-population with each of the subpopulations generally being less than 1 km apart (NHIC, 2002).

Summary of extant populations

At one time, *Enemion biternatum* was found within 8 areas of southwestern Ontario. The 1990 status report (Austen, 1990) documented 4 areas for Ontario. Six populations in Ontario were extant as of the year 2003. These sites are Medway Creek, Kettle Creek north of Port Stanley, Ausable River, Parkhill, Thames River, and Kettle Creek. Three of these populations (Medway Creek, Kettle Creek north of Port Stanley, and Ausable River) consist of 2 to 10 subpopulations.

The Medway Creek population in Middlesex County represents an important segment of the Canadian population due to the large numbers of plants. *Arisaema dracontium* and *Lithospermum latifolium*, both rare plants in Ontario, are also found in the area. The 10 subpopulations within this population are in a public use area, which is unlikely to be developed because it is a floodplain zone managed by the Upper Thames River Conservation Authority (Austen, 1990).

Table 1. Ontario population summary for *Enemion biternatum.*

EOID	Sub-population #	Location	1897, L. Boughner	pre 1986, D. Britton	1988-1989, J. Bowles	1989, M. Austen	1993, M.J. Oldham	1994, J. Bowles	2002, D. Bradley	2003-2004, M.J. Thompson
2	2a	Medway Creek				1 colony, 200 plants				Not found
2	2b				4 colonies					Not found
2	2c					<500 plants				Not found
2	2d				?					Not found
2	2e				1 colony, 2500 plants					Not found
2	2f					3 colonies, 12500 plants				Not searched
2	2g					4 colonies, 1750 plants				Not found
2	2h					15000-20000 plants				35000 plants
2	2i					1 colony, 500000-700000 plants				500000-700000 plants
2	2j					1 colony, 50-75 plants				Not found
1	1a	Kettle Creek, North of Port Stanley				30 colonies, 12500 plants				10000 plants
1	1b					25 colonies, 10000 plants				10000 plants
1	1c					8 colonies				Not found
1	1d					10 colonies, 800 plants				Not found
1	1e					100's of thousands of plants				100000 plants
1	1f					9 colonies, 12000 plants				10000 plants
1	1g					6 colonies, 3500 plants				3000 plants
1	1h					2 colonies, 3500-5000 plants				3000 plants
4	4a	Ausable River				14 colonies, 2500-3000 plants				Not found
4	4b						20-30 colonies, 50-100 plants per colony			1000 plants
5	5	Thames River						?		No permission
3	3	Parkhill							11 colonies, 400 plants	Not surveyed
6		Middlemarch Forest		?						Extirpated
7		Lynn Valley	?							Extirpated
17	17	Kettle Creek					?			Not found

Note: EOID indicates the Element Occurrence ID number associated with information stored for each occurrence at the Ontario Natural Heritage Information Centre, Peterborough. The question marks indicate that only occurrence was noted and no population data were provided.

Similarly, the population located along Kettle Creek and its tributaries (Elgin Co.) is also particularly significant since the scattered subpopulations, often with thousands of plants each, are found associated with other rare taxa such as *Mertensia virginica.* Some subpopulations here are often bordered by farmers' fields or steep wooded slopes on one side and Kettle Creek or one of its tributaries on the other. This area is under the ownership of one family. The population found along the Ausable River (Lambton County), was the only one found in the county by Austen (1989).

Population 3, located at Parkhill Conservation Area, was thought to be extirpated and was last collected in 1893. This population has since been rediscovered (Bradley, 2002).

Population 5, located along the Thames River is likely extant (M. Oldham, pers. com). There has been no data collected on this population to date. The record is based on a sighting by Jane Bowles in 1994 (NHIC, 2002).

LIMITING FACTORS AND THREATS

In Canada, several subpopulations of *Enemion biternatum* are impacted by soil compaction and trampling, due to their proximity to public areas and trails. Loss of habitat due to invasion of tall grasses, wood cutting operations, soil erosion, and agricultural activities also pose threats to other Canadian populations of the *Enemion biternatum*. Spraying of herbicides and pesticides also occurs to the detriment of these plants. Road salting may be a limiting factor for at least one Canadian occurrence of *Enemion biternatum* (Austen, 1990).

Some populations of *Enemion 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 the exotics *Alliaria petiolata* 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 (Austen, 1990).

The majority of landowners are unaware of the presence of *Enemion biternatum* on their land, or its rarity. The Upper Thames River Conservation Authority is aware of populations growing on their property through the work of J. Bowles.

The abundance of the exotic horticultural plant *Aegopodium podagraria* poses a strong threat to the *Enemion biternatum* population in the floodplain area of the Thames River, University of Western Ontario.

Populations 1 and 2 are threatened by their proximity to public areas and trails. In these areas, plant subpopulations may be threatened by soil compacting and trampling by foot, bicycle and/or ATV. These two populations are also threatened by

encroachment of *Aegopodium podagraria* and tall grasses, respectively. *Enemion biternatum* plants in subpopulation 1h are already growing in a long narrow strip, in contrast to their normal growth pattern of large clumps.

Subpopulations 1g and 4 may be threatened by wood cutting operations or tree falls found in the immediate vicinity of the plants. Population 2g is susceptible to soil erosion. In addition, subpopulations 1c, 1d and 1h are close to the edge of fields where the potential for mowing damage to plants is relatively high. Herbicides or insecticides sprayed on crops in the spring could harm plants in the area. Subpopulation 1c is also threatened by garlic mustard (*Alliaria petiolata*) encroachment. Road salting may affect subpopulation 1e, which is down-slope from the road in a low-lying area. Thompson also observed a small group of people camping in the immediate vicinity of subpopulation 1e. Because this is one of the largest subpopulations of *Enemion biternatum* found in Ontario, camping here should be discouraged.

Certain subpopulations (2a and 2j) 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.

The limiting factors presented above are based on details provided by Austen (1990). Development in the region of the floodplain habitats has only an indirect bearing on the species. The floodplain itself is a regulated habitat but the increase in population and development surrounding the habitat likely has resulted in an increase in trail use and substrate compaction as well as general disturbance that could promote expansion of alien species.

SPECIAL SIGNIFICANCE OF THE SPECIES

There is no information regarding any special economic or biological significance of this species. The species is promoted, however, by gardeners in the United States as a suitable plant for shady woodland gardens. There is no readily available Aboriginal Traditional Knowledge pertaining to this species in the literature.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Enemion biternatum was designated, in 1990, as Special Concern in Canada by the Committee on the Status of Endangered Wildlife in Canada (Austen, 1990). This species has an S2 rank in Ontario, a National rank of N2 in Canada, and a Global rank of G5. The species is now officially listed in Ontario as Special Concern under the recently approved Species At Risk in Ontario (SARO) list (see http://www.ontarioparks.com/saro-list.pdf). This species has likely been extirpated from New York and South Dakota. This species is listed as Endangered in Florida and listed as a species of Regional Concern in South Carolina.

Table 2. North American Conservation Status Ranks for *Enemion biternatum* (NatureServe, 2002).

U.S. & Canada State/Province Heritage Status Ranks		
United States		**Canada**
Florida (S1)	Arkansas (SR)	Ontario (S2)
South Carolina (S1)	Indiana (SR)	
Virginia (S1)	Kansas (SR)	
West Virginia (S1)	Minnesota (SR)	
Alabama (S1)	Missouri (SR)	
North Carolina (S2)	Ohio (SR)	
Iowa (S4)	Oklahoma (SR)	
Illinois (S5)	Tennessee (SR)	
Kentucky (S?)	Texas (SR)	
Michigan (S?)	Wisconsin (SR)	
Mississippi (S?)	New York (SX)	
	South Dakota (SH)	

Conservation Rank
S1: Critically Imperiled
S2: Imperiled
S4: Apparently Secure
S5: Secure
S?: Unranked
SR: Species Reported
SX: Presumably Extirpated
SH: Possibly Extirpated

TECHNICAL SUMMARY

Enemion biternatum
False Rue-anemone isopyre à feuilles biternées
Range of Occurrence in Canada: Ontario

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Extent of occurrence was calculated with a GIS by enclosing all known populations within a polygon and calculating the area as well as after eliminating the extirpated site #7 (E.Haber)	about 1000 km^2 excluding extirpated site #7; or <3500 km^2 including site #7
• *Specify trend in EO*	Stable
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Area of occupancy was calculated by taking the linear distance from Lake Erie shore to populations in region of Lake Huron (ca 80 km) x maximum corridor width of riparian habitat (.25 km) = 20km^2. This is an overestimate of available riparian habitat surrounding the 6 populations which are actually discontinuous and fragmented within their riparian habitats (E. Haber).	<20 km²
• *Specify trend in AO*	Decline in quality of habitat based on impacts noted
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	6 populations
• *Specify trend in #*	Stable ?
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Habitat quality decline due to exotic plants in floodplain habitats
Population Information	
• *Generation time (average age of parents in the population)*	Unknown (likely several years to flowering of a new individual or new shoot of a clone)
• *Number of mature individuals*	1 million stems in scattered sub-populations (species is clonal)
• *Total population trend:*	Stable
• *% decline over the last/next 10 years or 3 generations.*	No data
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	Yes, between watersheds but likely not within watersheds
• *Specify trend in number of populations*	Stable
• *Are there extreme fluctuations in number of populations?*	No
List populations with number of mature individuals in each: See Table 1	
Threats (actual or imminent threats to populations or habitats)	
Habitat destruction, invasive plants, trampling	

Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA**: **Stable** [other jurisdictions or agencies]	
• *Is immigration known or possible?*	Unknown
• *Would immigrants be adapted to survive in Canada?*	Possibly
• *Is there sufficient habitat for immigrants in Canada?*	Possibly
• *Is rescue from outside populations likely?*	Unlikely due to lack of specialized means of dispersal
Quantitative Analysis [provide details on calculation, source(s) of data, models, etc]	N/A
Current Status COSEWIC: Threatened (May 2005)	

Status and Reasons for Designation

Status: Threatened	**Alpha-numeric code**: Met criteria for Endangered, B1ab(iii)+2ab(iii), but designated Threatened because the populations appear stable and not at imminent risk of extirpation. Criteria met for Threatened: B1ab(iii)+2ab(iii); D2.

Reasons for Designation:
A delicate, spring-flowering, perennial herb restricted to a few fragmented riverside forest sites in southwestern Ontario where its populations are at risk from habitat loss and decline in quality due to a variety of activities including recreational trail use, and expansion of exotic invasive plants.

Applicability of Criteria

Criterion A (Declining Total Population): Insufficient information

Criterion B (Small Distribution, and Decline or Fluctuation): Meets Endangered B1ab(iii)+2ab(iii) based on extent of occurrence and area of occupancy well below critical maximum levels and the populations are severely fragmented due to the fragmented nature of the wooded areas in southwestern Ontario. A continued decline in quality of habitat can be inferred based on the proximity of trails and expanding populations of exotic invasive plants. Populations of this perennial, clonal, species are not known to fluctuate. Since the populations seem to be relatively stable and not at imminent risk of extirpation but decline in habitat quality is on-going, the species is best regarded as threatened.

Criterion C (Small Total Population Size and Decline): Not met. The estimate given of perhaps 1 million stems does not take into account that the plants produce tubers and that they likely form clonal patches. Nevertheless, there are more than the maximum limit of 10,000 plants under this criterion.

Criterion D (Very Small Population or Restricted Distribution): Meets Threatened D2 based on an area of occupancy that is likely much less than 20 km^2 and a variety of direct threats are known.

Criterion E (Quantitative Analysis): No analysis is available.

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Authorities contacted

- Staff at The Natural Heritage Information Centre, Peterborough, ON
- COSEWIC Secretariat for information on sources of Aboriginal Traditional Knowledge
- Jane Bowles, Department of Botany, University of Western Ontario
- David Bradley, Ontario Ministry of Natural Resources

INFORMATION SOURCES

Argus, G.W., K.M. Pryer, D.J. White, and C.J. Keddy. 1982-87. Atlas of the Rare Vascular Plants of Ontario. 4 parts. National Museum of Natural Sciences, Ottawa, Ontario. Looseleaf

Austen, M.J.W. 1990. Status report on the False Rue-Anemone, *Isopyrum biternatum*. COSEWIC. 32 pp.

Baskin, J.M. and C.C. Baskin. 1986. Germination ecophysiology of the mesic deciduous forest herb *Isopyrum biternatum*. Bot. Gaz. 147 (2): 152-155.

Boufford, D.E. and J.R. Massey. 1976. *Isopyrum biternatum* (Raf.) T & G (Ranunculaceae) new to Virginia and its distribution east of the Appalachian Mountains. Rhodora 78: 790-791.

Bowles, Jane. 1990. Medway Valley Heritage Forest Conservation Master Plan. Life Science Inventory. London Public Utilities Commission, Upper Thames River Conservation Authority.

Bradley, David. 2002. The Spring Flora of Parkhill Conservation Area, Middlesex County, Ontario. Prepared for the Ausable Bayfield Conservation Authority. 10 pp.

Ford, B.A. 1997. *Enemion* . *In* Flora of North America, north of Mexico, vol. 3. *Edited by* Flora North America Editorial Committee. Oxford University Press, New York.

Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, Second Edition. The New York Botanical Garden, New York. 910 pp.

Melampy, M.N and A.M. Heyworth. 1980. Seed production and pollen vectors in several nectarless plants. Evolutions 34(6): 1144-1154.

Mitchell, R.S. and J.K. Dean. 1982. Ranunculaceae (Crowfoot Family) of New York State. New York State Museum, Bulletin No. 446. The University of the State of New York, The State Education Department, Albany, New York.
NatureServe Explorer: An online encyclopedia of life [web application]. 2001. Version 1.6 . Arlington, Virginia, USA: NatureServe. Available: http://www.natureserve.org/explorer. (Accessed: November 21, 2002).
NHIC. 2002. *Enemion biternatum* : NHIC Element Report. Natural Heritage Information Centre, Peterborough, Ontario. Unpublished data.
SARA. 2004. Species at Risk Act Public Registry, http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=3 (accessed January, 2005)
Scoggan, H.J. 1978. The Flora of Canada. Part 1. General Survey. National Museum of Natural Sciences Publications in Botany.
Schemske, D.W., M.F. Willson, M.N. Melampy, L.J. Miller, L. Verne, K.M. Schemske, and L.B. Best. 1978. Flowering ecology of some spring woodland herbs. Ecology 59(2): 351-366.
Wherry, E.T. 1948. The wildflower guide, northeastern and midland United States, Doubleday and Co., Garden City, N.Y., 202 pp.

BIOGRAPHICAL SUMMARY OF REPORT WRITER

Melinda J. Thompson graduated in 1998 from McMaster University with an Honours degree in Geography and Environmental Studies. She has been working as a botanist through various positions in Southern Ontario, specializing in aquatic and woodland plant communities. In addition to an interest in botany, Melinda has obtained a Geographic Information Systems Specialist Certificate through Mohawk College and McMaster University. She has prepared COSSARO status reports for Vulnerable, Threatened and Endangered species in Ontario, including white wood aster (*Eurybia divaricata*) and Virginia mallow (*Sida hermaphrodita*) and a COSEWIC status report for white wood aster (*Eurybia divaricata*). She is also involved in the recovery of many species in Ontario and has prepared RENEW recovery strategies for hoary mountain mint (*Pycnanthemum incanum*), white wood aster (*Eurybia divaricata*) and eastern prairie fringed orchid (*Platanthera leucophaea*).

COLLECTIONS EXAMINED

No collections were examined additional to those reviewed for the initial report by Austen (1990).