National Recovery Plan for Northern Monkshood (*Aconitum noveboracense*)

U.S. Fish and Wildlife Service

Cover sketch of Northern Monkshood by Marlo D. Cain,
courtesy of The Milwaukee Journal Company, Milwaukee, Wisconsin.

RECOVERY PLAN FOR

NORTHERN MONKSHOOD (*Aconitum noveboracense*)

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by

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and Wildlife Service (Region 3)

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The Northern Monkshood Recovery Plan, dated September 15, 1983, prepared by the U. S. Fish and Wildlife Service under contract with Robert H. Read and James B. Hale, Wisconsin Department of Natural Resources, P. O. Box 7921, Madison, Wisconsin 53707.

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Part I - INTRODUCTION: THE TAXONOMY, DISTRIBUTION, ECOLOGY, AND STATUS OF NORTHERN MONKSHOOD

Perspective

This recovery plan for northern monkshood, Aconitum noveboracense (Ranunculaceae), is one of the first attempts at managing a plant designated under provisions of the U. S. Endangered Species Act of 1973, as amended. The passage of this legislation offered biologists the first opportunity on the national level to protect plants deemed to be in danger of extinction through a legislative vehicle. However, preservation of a species does not simply occur as a benefit of listing; considerable responsibility is placed upon the shoulders of botanists, state and federal agencies, the general public and politicians to improve the lot of any species listed as nationally endangered or threatened.

Northern monkshood was listed as a federally threatened species on April 26, 1978 (43 FR 17916). Ironically, it was a major threat to a major population of northern monkshood which focused national attention and early research leading to its inclusion as one of the first plant species listed under the Federal law. In 1966, several extensive colonies of northern monkshood were discovered in the basin of a proposed U. S. Army Corps of Engineers flood control and recreation reservoir along the Kickapoo River in southwestern Wisconsin. This discovery, as well as that of several other rare plant species, prompted several Wisconsin botanists to petition the U. S. Fish and Wildlife Service in 1974 to list northern monkshood as Endangered. In 1976, the Corps of Engineers contracted with the Wisconsin Department of Natural Resources to ascertain the significance of

the northern monkshood and other unusual cliff-dwelling flora in the proposed reservoir area of the Kickapoo River. The resulting Corps-sponsored survey was in the large part responsible for providing the U. S. Fish and Wildlife Service with adequate biological information for a determination that northern monkshood should be listed as Threatened.

If the recovery actions recommended in this report can be implemented, a more secure future for northern monkshood will result. The ultimate success of the monkshood recovery plan is that the successful implementation of all actions could lead to the delisting of the species for which it was designed.

General Characterists of the Genus

The genus *Aconitum*, known generally worldwide as monkshood, is a highly specialized and widely distributed group of species in the Ranunculaceae, the crowfoot or buttercup family. Species of this genus have showy, zygomorphic flowers that are adapted for pollination by bumblebees, and it is from this hood-shaped flower that the genus derives is common name (Figure 1). Besides the diagnostic flower shape, monkshoods in general are perennial herbs arising from short tuberous roots, with basal and cauline leaves that are palmately cleft or dissected, and with usually blue to whitish flowers that are borne in a terminal raceme or panicle (Figures 2, 3).

The genus has been of interest pharmacologically for centuries. Most parts of the plant, particularly the roots and leaves, contain poisonous alkaloids that are paralytic to the nervous and circulatory systems. Certain Old World monkhoods have been the source for the drugs aconite and aconitine. Due to

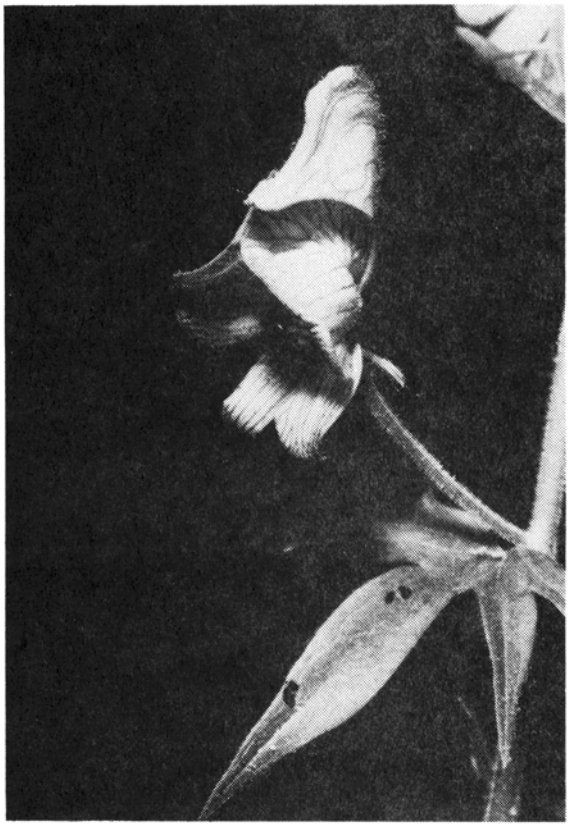


FIGURE 1. Close-up of northern monkshood flower. Taken in the Kickapoo River Valley, Vernon County, Wisconsin, June, 1978. Photo by K. Kohout.

FIGURE 2. Budding and flowering northern monkshoods at base of sandstone cliff, Kickapoo River Valley, Vernon County, Wisconsin, June, 1978. Photo by K. Kohout.

FIGURE 3. Juvenile northern monkshood on a sandstone cliff ledge along the Kickapoo River, Vernon County, Wisconsin, May, 1977. The plant on the left has produced its first adult basal leaves, while on the right are the two cotyledons of a recently germinated monkshood seed.

the large number of alkaloid compounds which are found in monkshoods, there is the potential for finding new, useful compounds in untested species, as well as for using these chemical "signatures" to understand evolutionary relationships within the genus.

Beyond these general similarities, however, monkshoods are rather variable inter- and infra-specifically. Because of the genus' phenotypic plasticity, taxonomists have had some difficulty in determining the number of distinct species which should be recognized.

Species Taxonomy

Aconitum noveborancense was described as a species by Harvard botanist Asa Gray in 1886 from material collected by F. V. Coville in Chenango County, New York. Early collections of northern monkshood from native habitats before and after 1886 in New York, Ohio, Wisconsin and Iowa were often mis-identified as Aconitum napellus L. (the common European monkshhod) or Aconitum uncinatum L. (the mainly Appalachian species ranging as far north as southern Pennsylvania).

There has been much discussion in the last 20 years regarding the relationship of northern monkshood with other species. Hardin (1964) maintained that northern monkshood is a subspecies of Aconitum uncinatum. Iltis (1965) briefly noted in an article on gentians his belief (based on critical comparisons of species) that northern monkshood is synonymous to the western ranging Aconitum columbianum. Recently published work by Brink (1982) supports this latter circumscription of at least the Iowa and Wisconsin

populations of northern monkshood.

Species Distribution

While the genus Aconitum is widely distributed throughout much of the northern hemisphere, most of the six species found in North America possess rather restricted and discrete total ranges. The species which is the subject of this recovery plan, northern (wild) monkshood (Aconitum noveboracense), ranges over nearly half the continent, from northeastern Iowa and southwestern Wisconsin to northeastern Ohio and the Catskill Mountains of New York (Figure 4). Yet across the geographically large area (1,250 km straight line distance) northern monkshood is restricted to 20 currently extant sites in three distinct regions: in and adjacent to the unglaciated (Wisconsin epoch) portion of Iowa and Wisconsin, the northeastern Ohio glaciated area and the Catskill Mountains of New York (glaciated area). In New York, northern monkshood was found in North American for the first time in the mid-1800's, not in the Catskill Mountains but rather in Chenango County, about 100 km northwest of the closest Catskill site. Two early collection sites (one of which is the type locality) in Chenango County were reinspected in recent years and the species was not found.

Despite seemingly suitable habitats within and to the south (especially in the Appalachian Mountains) of the current range, there have been no records--even casual references--beyond these three discrete areas. Table 1 lists all locations which have been substantiated by the existence of a voucher speciman in a herbarium collection.

TABLE 1. Site Name Designations Used in This Report, Ownership, and Estimated Population and Area Rankings for Northern Monkshood Locations Confirmed by Voucher Collections.

State-County-Site	Ownership	Approximate Rank of Population Size (Number of Adult Plants)[3] In State	All Sites (N=20)
Iowa[1]		(N=9)	
Allamakee County			
Yellow River	Private	4	7
Paint Creek	State	9	17
Clayton County			
Bixby Park	State	8	15
Buck Creek**	Nature Conservancy & Private	2	4
Elkader	State (Highway Right-of-way)	6 (7)	11
Pine Creek	Private	5	10
Miners Creek	Private	1	3
Dubuque County			
White Pine Hollow	State	7 (6)	12 (8)
Jackson County			
Maquoketa	Private (Most) State (Minor)	3	5
Delaware County[4]			
Backbone	State	--	--
Ohio		(N=2)	
Portage County			
Nelson	Private	2	20
Summit County			
Akron	City	1	6
New York[2]		(N=3)	
Chenango County			
Greene*	--	--	--
Oxford*	--	--	--
Ulster County			
Beaverbrook	Private	3	19
Drybrook	Private	2	16
Peekamoose	Private	1	8
Watson Hollow	Private	--	--
Wisconsin		(N=6)	
Grant County			
Chase Creek	Private	1	1

(continued)

TABLE 1. (continued)

State-County-Site	Ownership	Approximate Rank of Population Size (Number of Adult Plants)[3]	
		In State	All Sites (N=20)
Richland County			
Pine River	Private	4 (5)	13
Sauk County			
Loddes Mill	State & Private	6	18
Parfreys Glen	State	5	14
Pewit's Nest*	Private	--	--
Vernon County			
Coon Valley	Private	3	9
Kickapoo	Federal & State	2	2

* - Populations believed extirpated.
** - Includes units in tributary streams of Andy Hollow and Louse Hollow.
1 - Unconfirmed literature report from Delaware County is not included.
2 - Unconfirmed early literature and observation reports for Orange and Sullivan Counties are not included. Sites listed for Chenango County are based on collections in 1857, 1887, 1889, and may actually represent a single population.
3 - Number(s) in parentheses indicate that errors in population counts could change rank with number(s) listed.
4 - Based on one collection in University of Northern Iowa Herbarium (Schmidt, s.n., 8/8/1947): not relocated in field.

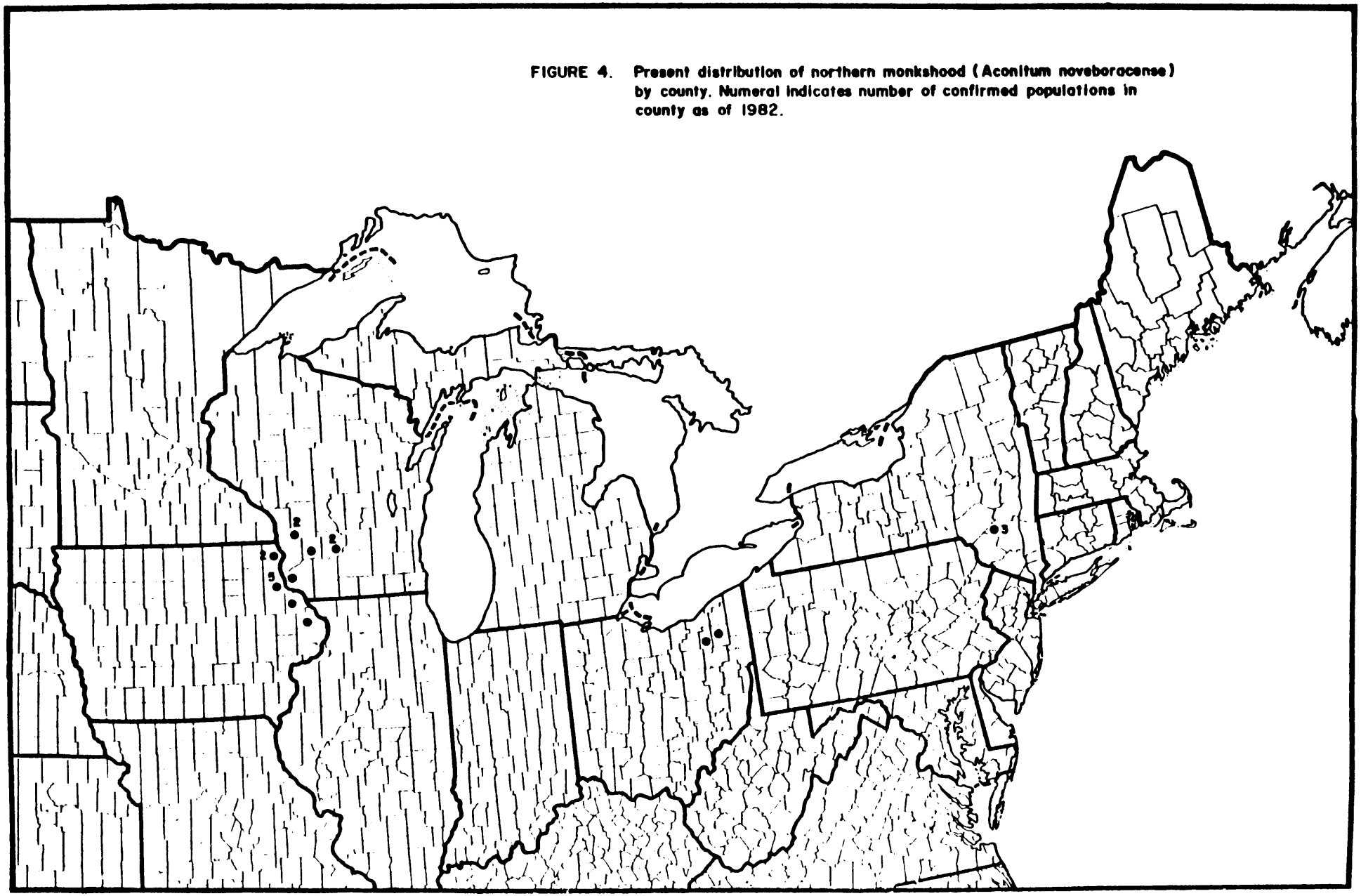


FIGURE 4. Present distribution of northern monkshood (Aconitum noveboracense) by county. Numeral indicates number of confirmed populations in county as of 1982.

Human Utilization of Northern Monkshood

The value in conserving an endangered or threatened species is often discussed in the context of its recognized or potential utilization by mankind. Although such a homocentric view--placing an economic potential on the value of a species does not recognize the fundamental right of any organism to exist on earth, the argument needs to be addressed for the sake of the species.

There are several probable uses for northern monkshood. None of them have been realized, largely due to the rarity of the species. As mentioned earlier, most if not all members of the genus Aconitum possess various combinations of poisonous alkaloids, some of which have considerable medicinal value as drugs. These alkaloids belong to a diverse class of chemicals differing in molecular structure only slightly. It may be that the alkaloids found in northern monkshood are unique or in recoverable quantities for commercial purposes, but this has not been researched.

Second, northern monkshood, like other monkshoods, has horticultural potential as a garden perennial. Its large, individual blue flowers last several days and a single plant can produce flowers from late June through September. Northern monkshood also has value as a source of hybrid genetic material. Using plant breeding research techniques, genetic attributes of northern monkshood may be incorporated into other species to produce hybrid, ornamental garden monkshood with better horticultural qualities.

Third, northern monkshood possesses considerable scientific interest. Its

FIGURE 5. Northern monkshood cliff habitat at Loddes Mill Bluff, Sauk County, Wisconsin. Monkshood occurs on this north-facing, friable sandstone bedrock exposure in small, soil-filled pockets and on ledges scattered over the cliff face.

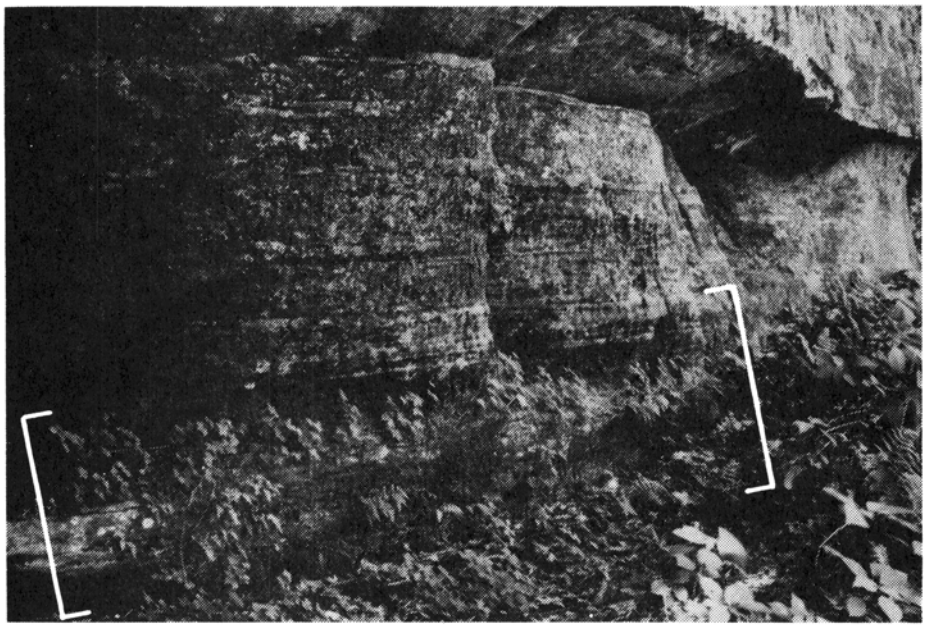


FIGURE 6. East-facing, sandstone cliff habitat for northern monkshood along the Kickapoo River, Vernon County, Wisconsin. Here, northern monkshood is usually found in dense, linear patches at the base and lower portions of the cliff, most often where there is discernable groundwater flow out of rock fissures. Such is the case in this photograph, with the monkshood growing along a line delineated by brackets. Photograph taken in June, 1978.

FIGURE 7. Semi-shaded, headwater spring habitat occupied by northern monkshood in the Cattskill Mountains (Ulster County) of New York. Northern monkshood is found at low density in such situations at high elevations (here at about 3,800 feet), contributing to the establishment of other plants downstream along shady, rocky streamsides. Photograph taken in August, 1980.

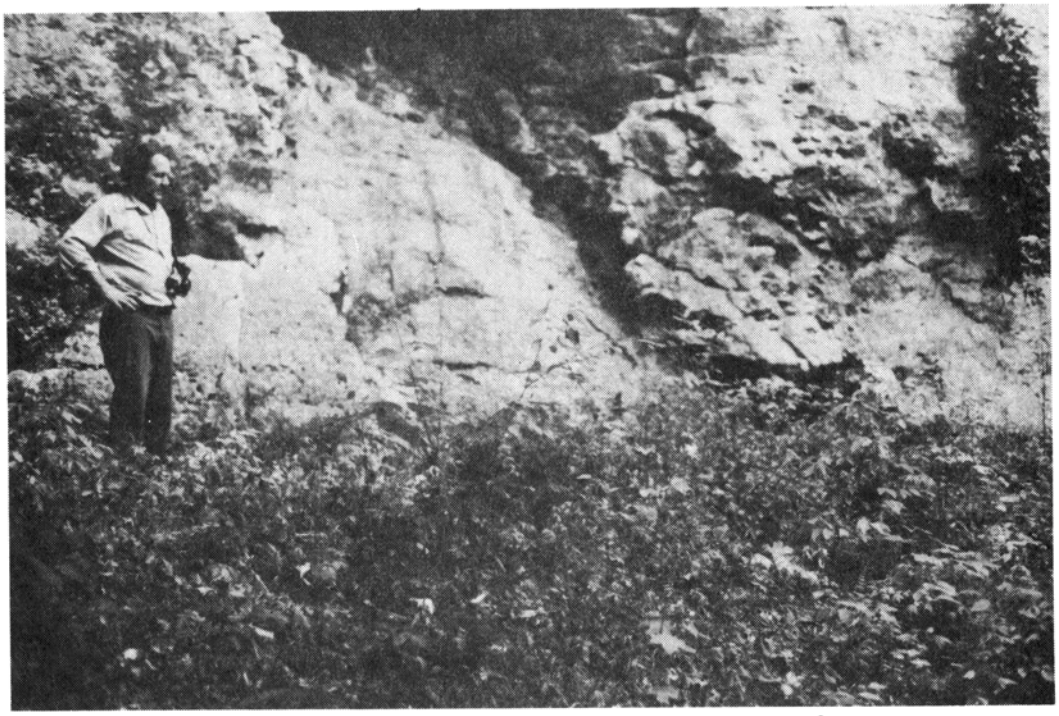


FIGURE 8. In Iowa, northern monkshood has always been found on shaded, dolomitic talus slopes and cliffs, such as in this photograph taken along the Maquoketa River in Jackson County. A large portion of this population occurs in cobblestone rubble at the base of the cliff where it is accessible to cattle grazing.

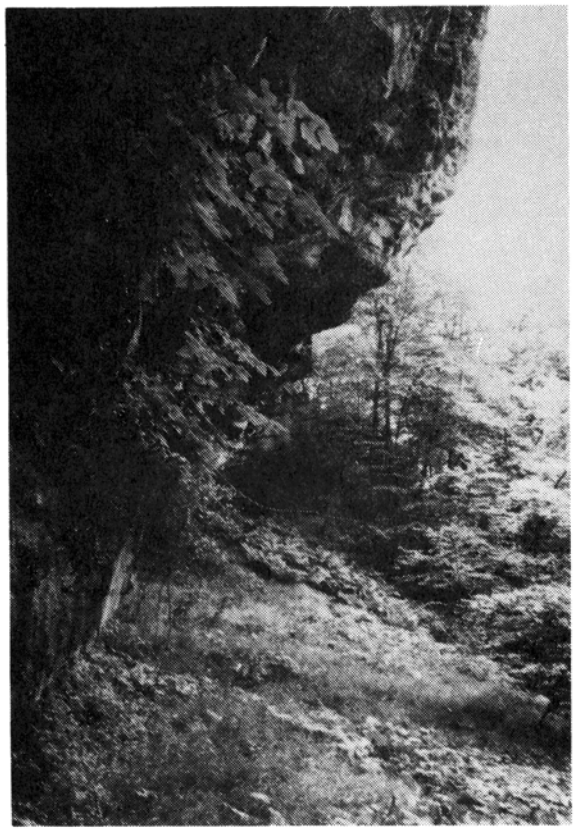


FIGURE 9. The largest of two Ohio populations of northern monkshood occurs in an urban setting of Akron. A deep gorge limits access and serves as a primary protective measure. Monkshood grows at the base and in crevices on the lower portions of this Pennsylvanian-age sandstone-conglomerate cliff, most often where there is active groundwater seepage. Photo taken July, 1980.

FIGURE 10. Adult northern monkshood plants have been transplanted into garden situations and have thrived for several years, such as this plant photographed in August, 1976, on the west side of a house near La Farge, Wisconsin. Several plants at this residence were dug from wild localities along the Kickapoo River nearby in 1969. These plants have flowered and set seed. Reproduction from seed has occurred here under such garden conditions. Transplants made from the Kickapoo River Valley population in 1976 by the senior author of this report to natural cliff habitats (those already containing monkshood as well as new habitats) have not been successful. The transplants showed progressive weakening over a four-year period, and only two of twelve original transplants remained alive through 1980.

unique and limited distribution appears to be related to glacial events which ended nearly 10,000 years ago in North America. Thus it has potential, along with other glacial relict species, in helping unravel complex ice-age events, post glacial plant migrations, and the nature of ice-age floras in the eastern United States. Because of its apparent isolation in small, disjunct populations for thousands of years, northern monkshood is a prime species for study to understand the processes of species evolution.

Lastly, northern monkshood has considerable educational and recreational value. It is a rare, native wildflower that only a handful of botanists have ever seen. Like the search for a rare bird, the search for northern monkshood is the pursuit of a special quarry for many outdoor enthusiasts and nature photographers. These people are enriched by its very presence as a rare, wild thing.

Northern Monkshood Habitats

The typical habitat for northern monkshood over much of its range is shaded to partially shaded cliffs and talus slopes (Figures 5, 6 8, 9). In New York, in addition to these more typical habitats, northern monkshood also occurs in semi-shaded seepage springs at high elevation headwaters and in stream-side crevices downstream (Figure 7).

There seems to be no rock substrate favored by the species overall, but locally the bedrock formation may be a good clue to its possible occurrence. For example, in northeastern Iowa northern monkshood is found exclusively on early Ordovician dolomite, while just across the Mississippi River in

southwestern Wisconsin the species is found, with one exception, on Cambrian sandstones (although ample dolomitic outdrops are present in Wisconsin). In Ohio, northern monkshood is found at the contact zone between shale and conglomerate sandstone of Mississippian and Pennsylvanian age. New York's northern monkshood populations are found on shale or conglomerate sandstone of Ordovician age.

The common denominator contributing most to habitat preference appears to be the cold soil environment associated with the cliff, talus slope, algific slope and spring/headwater stream situations. In most of the habitats occupied by northern monkshood there is either active and continuous cold air drainage or cold ground water flowage (Figure 6) out of the nearby bedrock. Year around soil temperatures may be as cold as 6°C (although most are in the range of 11° -18°C), and the local distribution of northern monkshood in a particular habitat is often closely associated with areas where ground water or subterranean air is emanating. Such a condition also contributes to a local microclimate with a consistently high relative humidity. It should be noted that adult northern monkshoods do survive (bloom and set seed) but do not reproduce every year, suggesting that a cold soil environment may be essential to dormancy-breaking requirements of the difficult-to-germinate seeds.

Constant cold air and/or cold ground water exiting from a cliff or talus slope contributes to a stable local microclimate, one that may be considerably different from areas only meters away. The high relative humidity resulting from the condensation of moisture from the cold air or ground water often combines with an exposure protected from direct solar radiation (by direction

or canopy vegetation) to create a local microclimate more moderate than less protected habitats close by.

Under these conditions or less extreme high and low air temperatures than the surrounding landscape, ample available water, subdued light levels, and an often continuous cold soil environment, northern monkshood has a rather unusual--but surprisingly consistent--group of associate species throughout its range. Altogether, there have been over 110 species found to grow in association with northern monkshood. Some of the species found with northern monkshood in these cool, protected habitats are, not surprisingly, considered more northerly ranging than the dominant vegetation of the surrounding region.

Many of the most consistent vascular associates throughout its range, however, are species typical of the eastern deciduous forest and of marsh or swamp wetlands. Those of the deciduous forest include sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), eastern hemlock (*Tsuga canadensis*), mountain maple (*Acer spicatum*), Canada mayflower (*Maianthemum canadense*), red elder (*Sambucus pubens*), white snakeroot (*Eupatorium rugosum*) and wood nettle (*Laportea canadensis*). Marsh or swamp wetland species which are consistent associates of northern monkshood include willow herb (*Pilea pumila*), fowl manna grass (*Glyceria striata*), and small enchanter's nightshade (*Circaea alpina*).

Ferns are often affiliated with the moist conditions of cliffs and talus slopes. Those most often found with northern monkshood across its range are

bulblet fern (Cystopteris bulbifera), fragile fern (Cystopteris fragilis sensu lato), northern beech fern (Thelpteris phegopteris), oak fern (Gymnocarpium dryopteris), lady fern (Athyrium felix-femina) and florist's fern (Dryopteris Spinulosa sensu lato).

Lastly, mention must be made of northern monkshood's associates specific to cliff habitats in the "Driftless Area" (unglaciated area) of northeastern Iowa and southwestern Wisconsin, for they exemplify the unique habitat characteristics of these cliffs and their phytogeographical significance as refugia for floral elements surviving since glacial times. Species belonging to this associate list possess contemporary contiguous ranges distantly disjunct from the Driftless Area, and are most often of western montane or arctic affinities. To this northern monkshood association list belongs such species as moschatel (Adoxa moschatellina), golden saxifrage (Chrysosplenium ioense), Lapland rosebay (Rhododendron lapponicum), arctic primrose (Primula mistassinica), and sullivantia (Sullivantia renifolia). Northern monkshood itself belongs to this extraordinary group of widely disjunct plants. Chrysosplenium ioense is itself a candidate for listing under the provisions of the Endangered Species Act, as amended (USFWS, Dec. 15, 1980 notice).

Factors Limiting Northern Monkshood Occurrence

There are many hundreds of cliff habitats within the half-continent span of the range of northern monkshood which do not possess the species, and only a handful of cliffs that do. More puzzling is the fact that there are often dozens of cliffs within watersheds containing northern monkshood that do not contain the species, even though over long periods of time seeds could have reached these habitats and plants become established. Thus, the lack of northern monkshood on superficially similar cliffs indicates specificity of its habitat requirements.

Most of the habitats containing northern monkshood are very limited in their areal extent. Suitable cliff, streamside, and wooded springy habitats usually have limited, finite dimensions. On and near cliffs, plants are restricted to a narrow band at the base (Figure 6), on ledges, and in scattered soil pockets normally on the lower portions of the outcrop (Figure 5) where it is most damp, cool and protected from prolonged direct sunlight. In these situations northern monkshood may be distributed rather densely, especially at places where there is active cold air or water seepage. In the wooded, steep spring and streamside habitats of the Catskills, the population density is much lower and the areal extent overall is greater.

Since northern monkshood habitats are usually associated with the discrete, lineal features of cliffs and water courses, the total known habitat can be estimated in terms of approximate acreage and lineal miles. It has been estimated that all known northern monkshoods together take up about 500 acres and a total lineal measurement of about 4.4 miles of cliff faces, talus slopes and stream course. These statistics indicate how limited the suitable habitat for northern monkshood appears to be.

The small number of cliff habitats possessing the right combination of exposure, and cold, root-zone microclimate, together with the particular requirements necessary for seed germination discussed next, appear to be the factors largely responsible for limiting northern monkhood's distribution.

Propagation of Northern Monkshood

Due to the attractive flowers possessed by many species of the genus Aconitum, there has been a considerable amount of interest in the propagation of monkshood species under controlled conditions. While there has been only limited experimentation with northern monkshood to date, the evidence so far suggests that this species is as difficult a horticultural material as other monkshood species have proven to be. The seeds are difficult to germinate, juvenile plants are hard to maintain, and plants are generally slow-growing. The most often successful means of propagating European monkshoods has been by lateral tuber division, a vegetative method that does not involve genetic interchanges.

Several germination trials have been carried out over the last seven years. Early attempts by Robert H. Read and James Zimmerman at the University of Wisconsin Biotron; Dr. Harold Pellett at the University of Minnesota, and Dr. Tom Elias at the Cary Aboretum in Millbrook, New York, have all indicated low germination success (less than one percent) under standard, cold stratification treatment. Dr. Elias has found that enhanced germination apparently occurs with a second cold dormancy treatment, but the rate is still less than five percent. Interestingly, in the Wisconsin and Minnesota experiments, mass germination took place during the first overwintering in cold-stored seeds while still in bags kept in protected, outdoor locations.

Another more recent germination experiment by Timothy Kessenich of the Wisconsin Department of Natural Resources at Madison has been more encouraging. Germination of first-year, cold, wet-stored northern monkshood

seeds was over 60 percent in 1982. The several dozen seedlings produced from this germination trial were individually potted and used in natural habitat and garden plantings to determine juvenile survival.

In general, survival of these greenhouse-produced northern monkshood seedlings has not been encouraging. All but one of the seedlings germinated in the pre-1982 experiments cited above have died. The only reported survivor is at the Cary Aboretum. The seedlings in the 1982 Kessenich trials were placed into five locations (three garden, two natural) where their survival is currently being monitored.

There has been one instance where garden-held northern monkshood has apparently self-seeded to produce surviving progeny. This has been reported by Bernard and Jeanne Smith at their home in the Kickapoo River Valley, Wisconsin. Two adult northern monkshoods transplanted from nearby Kickapoo River cliffs to their homeside garden in 1969 produced one or two new plants by seed that have themselves reached maturity.

In summary, the propagation experience with northern monkshood has shown the species to be unpredictable in germination and difficult to maintain as seedlings. There have been enough encouraging results recently, however, to recommend that further studies on germination and juvenile survivorship in controlled environments be conducted.

Artificial propagation should only be considered to provide stock for experimental purposes and to restock native habitat, where catastrophic loss has occurred, not as mitigation for habitat destruction.

Other methods of propagation possible for northern monkshood include the vegetative reproductive means of cuttings, stimulating lateral tuber formation, and tissue culture. Since northern monkshood does produce seeds

copiously, since these other vegetative methods would require depletion of native stock and do not provide genetic interchange, and since none of this species' habitats are highly imperiled at this time, it is recommended that development of vegetative propagation methods be given a lower priority than continued germination work and protection of native habitats.

Transplantation Experience with Northern Monkshood

Relocation by transplantation is often given as a solution to conflicts and developments involving endangered and threatened plant species. Since transplantation has been suggested in at least two development conflicts involving northern monkshood, the mixed success experienced in transplantation of this species is reviewed here.

The earliest known transplantation attempted with northern monkshood was that of Longacre in the early 1940s who took Catskill Mountain plants in pots in October for chromosome studies in January. It is presumed that these plants were not maintained past the end of Longacre's studies.

The longest period of transplant success for northern monkshood so far has been with 1969 transplants from the Kickapoo River Valley, Vernon County, Wisconsin, to the nearby house-side garden of Bernard and Jeanne Smith in the Town of Webster. When observed by Read and Hale in 1982, there were four plants scattered along the north and northwest side of the house (including the two original plants). When observed by Robert H. Read in 1976, there were six or so robust and flowering plants (Figure 10). Such fluctuation in the number of house-side plants at the Smith residence has also been observed by the Smiths themselves.

Another transplant attempt with northern monkshood was initiated in 1976, this one by Robert H. Read. Adult plants were removed from the extensive Kickapoo River Valley, Wisconsin, population in May, 1976, and in November, 1976, and placed in both garden and natural habitats (those already containing native northern monkshoods and others not). All transplants have since been monitored regularly but in no way have they been maintained. By the end of the 1980 growing season, all but two of twelve of the natural habitat transplants had expired, and the two survivors had weakened (spindly, non-flowering) considerably from their original condition. The plants moved to the garden habitat, on the other hand, have survived into 1982, producing flowers and seeds, but not increasing in vigor.

From these transplant experiences, it appears that northern monkshood can be transplanted at certain times of the year (best in early spring or late fall) without high mortality due to transplant stock. The long-term survival of the transplants and the production of progeny from these transplants is not as promising, even with plants moved into habitats already containing native northern monkshoods.

Status of Northern Monkshood Locations

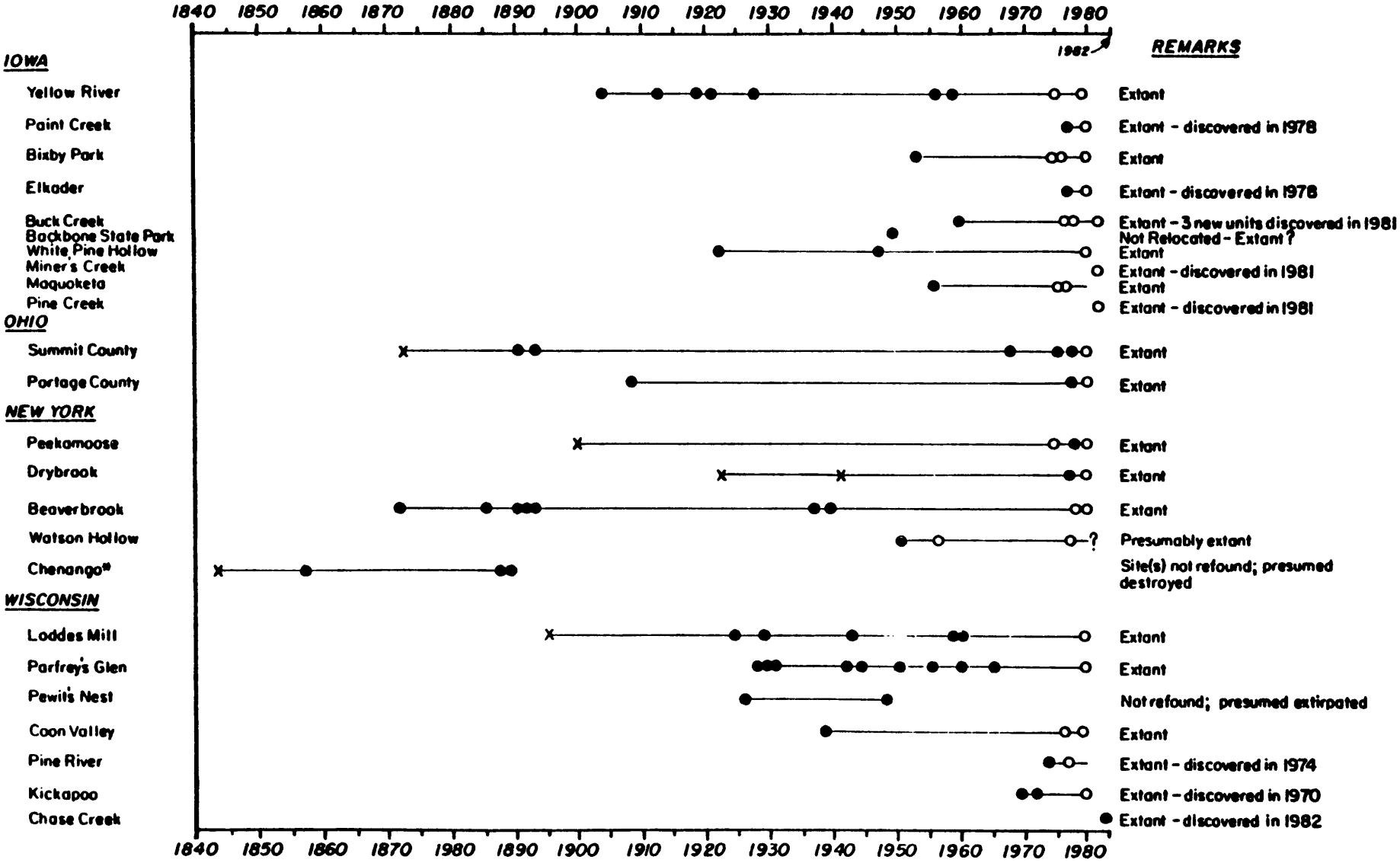
Northern monkshood has been found over the last 140 years of extensive botanical exploration in the eastern United States at 24 sites in four states: ten in Iowa, two in Ohio, five in New York, and seven in Wisconsin. One site each in New York and Wisconsin no longer have northern monkshood present. Since northern monkshood is most often found in habitats associated with water courses (river-scoured cliffs, headwater springs, talus slopes),

and since its seeds are likely disseminated by water, it is best to consider scattered sites within the same smallest division draining system as belonging to the same population. These populations are probably generally interchanging over time and are therefore considered in this report to be a single location. Table 1 gives designated names for the sites used in this report, and Figure 11 shows the length of time each of these sites has been recognized.

The discovery of new sites for northern monkshood has happened rather regularly over time, but all discoveries have occurred within the area of present range of species. Within the last twenty-five years, for example, over one-half of the known sites have been discovered, but all have been in or adjacent to the rugged unglaciated portion of southwestern Wisconsin and northeastern Iowa where northern monkshood has been known since before the turn of the century. A heavy emphasis in floristic studies in this region is largely responsible for these recent discoveries.

The heightened interest in northern monkshood as a nationally threatened species has also resulted in a great deal of exploration for new sites and reexamination of historical locations. Many of the old sites were imprecisely described by their discoverers, the locations not passed on to other botanists, and thereby were essentially lost over time. It has been only through diligent, recent field work that many of these sites have been refound. For example, available records and interviews with Ohio botanists indicated that neither northern monkshood site in that state was visited for nearly 70 years, and one was refound only recently after intensive field work. In Wisconsin, one site discovered in 1939 was identified by the

Figure II. Length of time northern monkshood has been known from sites, from herbarium records (●), literature records (x), reliable observations (o).



* Records from 2(?) sites combined

collector to the closest post office location two miles away; refinding the site took weeks of field work in the late 1970s. Even with the rather precise habitat configurations required by northern monkshood, searching for populations described imprecisely by early collectors is often like looking for a needle in a haystack. One never knows whether failure to find a long-lost site is due to the population's demise or because one is searching in the wrong place. The judgement on current existence with reverification must be made taking into account the quality of the original label information, the amount of potential habitat in the vicinity, and the intensity of the recent searches made by experienced botanists.

Given the more-or-less steady number of discoveries of northern monkshood over time and the increasing floristic knowledge of the areas within the species' range, how much more northern monkshood is likely to be found? This is, of course, a difficult question to answer. However, an estimate can be made based upon the amount of recognized habitat, the amount of potential habitat, and the level of exploration which has been done in each area within northern monkshood's range.

The probability for finding additional sites in Ohio is not high. There are very few cliff habitats in Summit and Portage Counties that are suitable for northern monkshood, and the ones that are have been botanically explored independently in recent years by a number of botanists. The last discovered site in Ohio occurred in 1908.

In New York, likewise, the possibility is not good. The state has been explored intensively by botanists for over 300 years, and the amount of

potential habitat is limited. Much habitat has been altered by logging, reservoirs, road-building, and other developments. One new site has been found in New York recently, and the ruggedness and inaccessibility of portions of the Catskills may still hide one or two additional monkshood sites. A survey of most likely habitats by the New York State Botanist has been funded by the U. S. Fish and Wildlife Service for the 1983 field season.

Two sites, including the very large Kickapoo River Valley location, were discovered in the last eleven years in Wisconsin. Since those discoveries, however, searches have been made of cliff habitats in and around the "Driftless Area" in southwestern quarter of the state for additional northern monkshood populations, and only one has been located. It is therefore unlikely that new northern monkshood sites will be discovered in Wisconsin.

Of all the states within the known range of northern monkshood, Iowa has the greatest potential for the discovery of new sites. While the Driftless Area and surrounding region have been studied carefully floristically through a number of theses done in the 1950s and 1960s by the students of Dr. Robert Thorne at the University of Iowa (most notably Thomas Hartley's 1962 work, "The Flora of the Driftless Area"), there is much rugged topography in this region which has not been explored due to poor accessibility.

In an attempt to predict how much potential northern monkshood habitat exists in Iowa, in 1979 the Iowa State Preserves Board and the U. S. Fish and Wildlife Service requested the help of the Land Use Analysis Laboratory at Iowa State University. Using geographically digitized information on geology, land use, and soil types for eight northeastern Iowa counties, those features judged to have varying potentials for containing northern monkshood were weighted and compared to each other by means of a computer-generated map.

The resulting map of these eight counties showed, by use of different map symbols, the degree of correlation of heavily weighted features as a representation of the potential for containing northern monkshood. The map suggested that there are about 190,880 acres of potential northern monkshood habitat in the 3,677,000-acre area of study, based upon the coincidence of the highest weighted variables (dolomitic bedrock geology, woodland land use, and the steepest slope soils) in a 160-acre map cell. While this computer mapping tool identifies only 5% of the study area as capable of supporting northern monkshood (based on the correctness of the assumptions), the large number of acres involved as potential habitat requires further refinement--using aerial photographs and topographic maps--prior to field analysis. Follow-up field work to test the value of this computer-assisted search has not yet taken place. However, given the extent of the potential habitat and the generally limited knoweldge of Iowa's flora, several additional northern monkshood locations are expected to be found. A systematic cliff and slope survey such as the one done in Wisconsin is recommended.

Northern Monkshood Protectin Efforts to Date

Because of its preference for habitats possessing other scenic and natural attributes, northern monkshood has fared well in its preservation without concerted and directed efforts. The increased interest in protective measures offered endangered and threatened species in the 1970s has added to the opportunities for recovery of the species. So far, conservation measures for nortern monkshood have taken two major directions: protective ownership and the passage of legislation.

In the twenty sites in which northern monkshood is confirmed or believed to be extant, ownership may be divided into five classes: (1) private with some protection agreement or protective ojbective in ownership (e.g., The Nature Conservancy); (2) private without a protection agreement or protective objective in ownership; (3) State; (4) Federal; and (5) city. Figure 12 indicates the distribution of these ownership classes by state and overall.

Eight of the sites have ownership which can be characterized as protective in emphasis (private with protective agreement, state, or city). The one privately owned tract in this category is the Buck Creek (Iowa) site which was donated to The Nature Conservancy for protective purposes. Three of the state-owned sites have been designated as nature preserves (Bixby Park and White Pine Hollow, Iowa; Parfreys Glen, Wisconsin). All but one of the others in state ownership are in non-intensive use areas of state parks and forests. The city-owned site in Akron, Ohio, is likewise in a little-used area of a metropolitan park.

The federal government (specifically the U. S. Army Corps of Engineers) owns most of the large Kickapoo River Valley population in Wisconsin. Because the fate of the reservoir project for which the land was originally purchased has not yet been resolved, this site cannot be included in the protected category. Any of the proposed reservoir types would destroy portions of this monkshood locality. A study to assess the feasibility of a dry dam at La Farge was initiated in 1983.

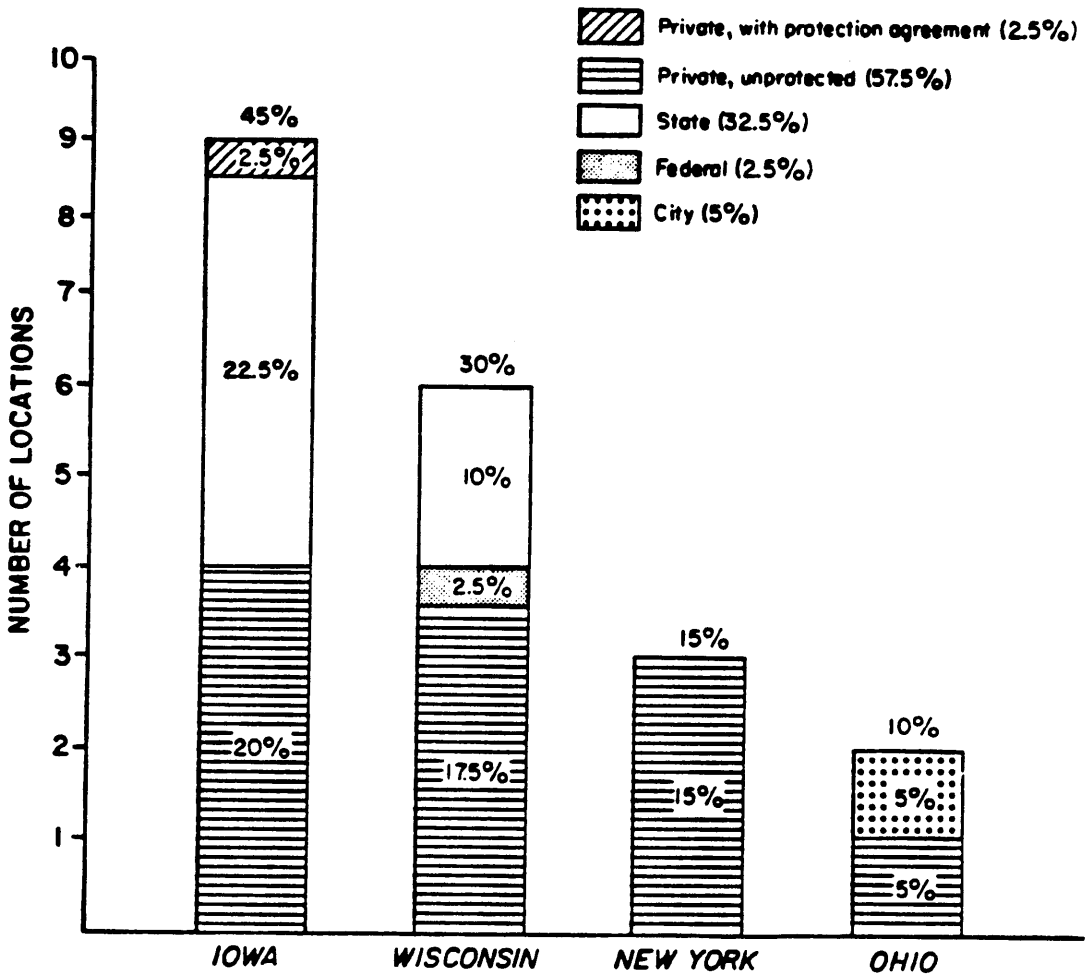


Figure 12. Number of extant monkshood populations by state and ownership type.

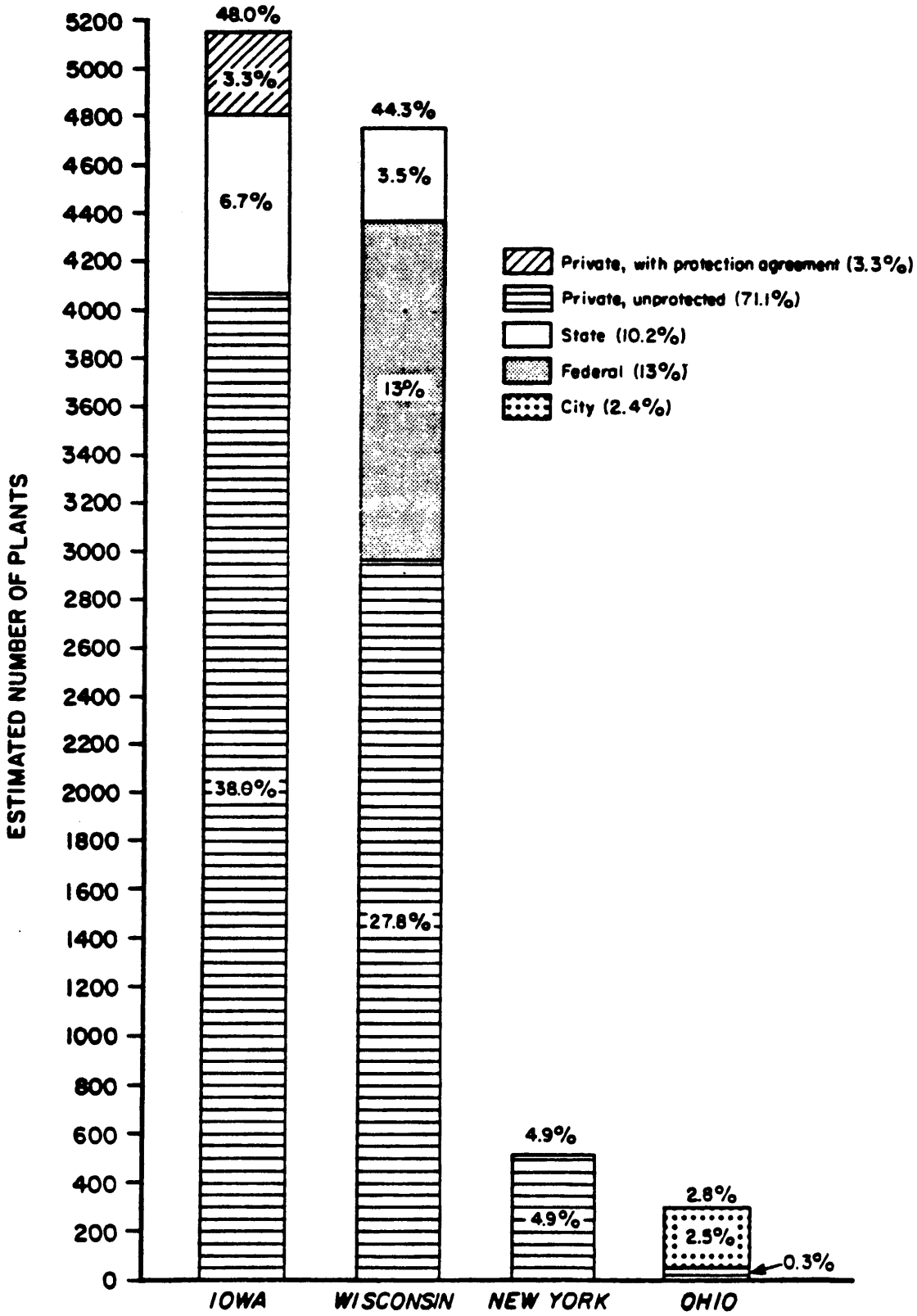


Figure 13. State and ownership distribution of estimated northern monkshood population.

Private ownership accounts for half of the presently known northern monkshood sites, including all sites in the State of New York. It should be emphasized that most of these private owners are aware of the presence of northern monkshood on their land, and if they are not sympathetically protective toward the species, they are no less than apathetic to it. Some private owners are proud of the fact that the land they own possesses something of special natural value. It appears that no northern monkshood site is threatened in the short-term due to its present private ownership.

Figure 13 shows the estimated population distribution of northern monkshood by ownership type in each state and overall. This is an additional way of evaluating the degree to which northern monkshood is protected under its present ownership configuration. Note, for example, that although only one of twenty sites is in Federal ownership (Figure 12), approximatley 13% of the world's population is contained in that single site. The eight sites under city, Nature Conservancy and state ownership cumulatively possess approximately 16% of the world population. Unprotected private ownerships, accounting for half of the 20 sites, contain together about 71% of the total number of plants.

This examination of the ownership distribution of locations and estimated population for northern monkshood suggests where further advances can be made in a recovery effort aimed at protective ownership. It should be cautioned that any efforts directed at bringing remaining privately owned sites into public ownerships needs to be evaluated in the context of improved short- and long-term protective management capabilities. In certain circumstances, enlightened private ownership may be a more effective protection alternative than public ownership where unlimited public users cannot be controlled.

Where possible, perhaps a mix of compatible, protective ownerships for the limited number of northern monkshood sites in each state is the best strategy for maximum protection of this species.

Statutory Protection

While many states have had wildflower protection laws in effect for years, it was not until the passage of the Federal Endangered Species Act that protective measures took on an emphasis of biological endangerment as the major criterion for listing. Protection of plant resources has always lagged somewhat behind that for vertebrate animals in most states, largely due to constitutional and legal interpretations of state versus private ownership rights of plants, but also because of general public attitudes regarding legal or other protection for wild plants.

TABLE 2. Plant Protection Laws and Federal Cooperative Agreement Status in States Within Northern Monkshood Range.

State	State Law	Cooperative Agreement	Remarks
Iowa	Chapter 109A - Management & Protection of Endangered Plants & Wildlife (1975). Statute prohibits taking, possessing, transporting, importing, exporting, processing, selling, buying or offering to buy any plant species on state or federal list.	No	Aconitum noveboracense on state list as Endangered (1979).
Ohio	Revised Code Chapter 1518 - An Act "to protect endangered species of native Ohio wild plants." Rules effective July, 1980 include preventing commercial taking of listed plants and prohibits collecting of listed plants without permission of the landowner or a permit from Department of Natural Resources.	Yes	Aconitum noveboracense on state list as Endangered (1980).
New York	New York Environmental Conservation Law 9-1503 prohibits picking, plucking, severing, removing or carrying away, without consent of the owner any protected plant (1974).	Yes	Aconitum noveboracense not a listed, protected plant under 1974 law. Monkshood listed in New York advisory publication as a declining species, vulnerable to commercial or private exploitation or imminent land development, and possessing scattered populations ("Rare and Endangered Vascular Plant Species in New York State," 1980).
Wisconsin	Statute (Section 29.415) prohibits removal or transport of any endangered or threatened wild plant away from its native habitat on public property or property which he or she does not own or lease, except in course of forestry or agricultural practices or in the construction operation maintenance of a utility facility. Commerce in listed species prohibited. State endangered species permit needed for most collections.	Yes	Aconitum noveboracense on state list as Threatened (1979).

Still, northern monkshood has received either advisory or legal protective notice in all four states in which it occurs. The level of protection afforded varies from state to state (Table 2). In general, these laws prohibit the sale of listed plants, and the removal of such plants from land without permission of the owner. There are substantial loopholes in these state laws (with the possible exception of Iowa) that allow the destruction of listed species without legal recourse. However, the mere recognition of a plant species as endangered or threatened often can be influential enough in itself to cause a modification in an action that would harm such a species. Supportive public opinion, sympathetic state governmental policy, and a company's public image have been as useful as strictly statutory methods in protecting rare plants on a state level.

The Federal Endangered Species Act has some much stronger provisions for the protection of endangered and threatened plants. Plants, like animals, are covered by Section 7 of the law which prohibits federal actions, authorizations, or funding of projects which jeopardize listed species. The section also establishes a consultation process between the U. S. Fish and Wildlife Service and the action agency designed to resolve endangered and threatened species conflicts with a proposed project. This consultation process has already been successfully used in the case of a northern monkshood population impacted by an Iowa state highway upgrading near Elkader in 1978-79 (Figures 14-16). The consultation between the Fish and Wildlife Service, Federal Highway Administration, and Iowa Department of Transportation resulted in a slight modification of the upgrading activities in the vicinity of the monkshood population so that a finding of "is likely to jeopardize" was avoided. Other than staff time required for the consultation, the solution did not add additional cost to the highway project.

FIGURES 14-16. The outcome of a Section 7 consultation involving an Iowa state highway up-grading in 1978 illustrates the value of the process in protecting listed species. In June, 1978, the sr. author of this report discovered a new locality for northern monkshood in the rather anomolous habitat of a roadcut of state highway 13 north of the city of Elkader, and reported the find to the Iowa Endangered Species Coordinator. It happened that this stretch of highway was scheduled for up-grading with Federal highway funds, and since the proposed alignment would obliterate the monkshood-containing roadcut, a Section 7 consultation was requested by the Federal Highway Administration. The result of the consultation is shown in the two photographs above. The old roadcut was avoided without costly realignment of the highway by decreasing the width of the paved shoulder in the vicinity of the monkshood. The left photograph shows northbound, uphill traffic at the point of the roadcut, and the caution markers announcing restriction in the road width. The right photograph, taken southward, shows the roadcut and monkshood being inspected in 1980, the second year after completed road work. While such consultations may have satisfactory endings, the

'Now we've run into something called an itty bitty pinky lilly'

derisive media coverage, such as the cartoon above which appeared in the DesMoines Register (July 6, 1978) in conjunction with this highway project, does not help promote in the public mind the value of protecting threatened and endangered species.

Threats to Northern Monkshood Populations

The range and habitat requisites for northern monkshood do put finite limits on the number of locations--currently known as well as unknown--in which the species exists. The cumulative historical search has yielded only 24 locations. Hundreds of other seemingly suitable habitats have been inspected and are known not to contain the species. Recent examination of most of the 24 localities have confirmed that all but two still contain northern monkshood. Whether the two have been destroyed since initial discovery or are simply elusive is difficult to determine. A number of threats have been identified at confirmed extant localities, some of which may adversely impact integrity of all or part of the population.

Dams and Reservoirs - The proximity of monkshood cliffs to water courses has sometimes put monkshood close to dams and their resultant reservoirs. In certain cases, the pre-existing condition of the reservoir basin as monkshood habitat is not known, so it is speculative to guess whether the reservoir did in fact inundate monkshood. However, the occurrence of reservoirs downstream from monkshood habitats does curtail seed dispersal via flowing water. Such is the case in one New York habitat (Peekamoose), and was historically the case in two Wisconsin sites (Loddes Mill Bluff and Parfreys Glen) where mill ponds (now defunct) may have impacted the monkshood population nearby.

The most significant reservoir threat to a northern monkshood population continues to be that posed by completion of the U. S. Army Corps of Engineers'

La Farge Reservoir project along the Kickapoo River in Wisconsin. A proposed 1,700-acre reservoir would inundate about 60% of the monkshood population outright, while more than 90% would be destroyed during flood water retention. The reservoir has yet to be created, despite completion of over 70% of the dam. The project was halted largely due to the poor water quality projected for the recreation-oriented lake. Impacts to a scenic, rural valley, and to rare cliff-dwelling biota were ancillary reasons for shelving the project in 1976. The Congressional authority for the project has not yet been withdrawn, so the possibility still exists that the project will be resurrected in its former scope or in a scaled-down version. A new feasibility study was initiated in 1983.

Road Construction and Maintenance Activities - On a number of occasions, road construction and maintenance activities have been implicated in threatening northern monkshood populations. Excessive use of deicing agents in winter and herbicides in summer are potential problems for one site in Iowa (Elkader), one site in New York (Peekamoose), and possibly one site in Ohio (Akron).

Road construction impacts on a small northern monkshood population were avoided during a state highway upgrading in 1978-79 near Elkader, Iowa (Figures 14-15). By a short narrowing of the paved shoulder in a road-cut containing this species, the rather anomalous habitat was spared. The only other northern monkshood population which may be affected by existing road maintenance activities is at the Peekamoose, New York, site where the roadside ravine habitat has been infringed upon in places by the placement of riprap in the right-of-way to stabilize the roadbed. Unless this practice is continued in other places along the stream and right-of-way, the habitat damage has been done already and no further infringement is expected.

Power Line Construction and Maintenance - The sizable and valuable northern monkshood population along the Yellow River, Iowa, has been crossed by two power line corridors which have destroyed habitat by clearing and maintenance activities. The main threat from in-place corridors is further habitat degradation from maintenance activities, especially herbicide drift from aerially dispersed weed retardants.

Logging Operations - All northern monkshood habitats are in wooded situations, and some of these sites may be subject to periodic logging operations. Destruction of the habitat may not be due only to logging machinery and skidding of logs, but also to modification of requisite light conditions caused by the removal of shade trees. Logging is difficult to accomplish in certain habitats due to steepness of slopes and inaccessibility, but woodland spring and streamside populations in New York's Catskill Mountains have been subject to logging in the past. Recent logging of canopy trees on one slope of the Chase Creek, Wisconsin, site has skirted the edge of the algific slope containing a major monkshood population. Certain habitats in Iowa and Wisconsin are subject not only to logging for commercial harvest, but they may be cleared of trees by girdling, cutting, and burning to create pasture on the otherwise non-productive farmland.

Quarrying Operations - The association of northern monkshood with cliffs and talus slopes sometimes makes the species susceptible to damage from quarrying. Such has been the case in the past at the Loddes Mill Bluff (Wisconsin) and Elkader (Iowa) locations. It is difficult to assess how much of the original populations were affected by the quarrying (if any), but their close proximity to the quarries indicates that there may have been impacts.

Grazing - Browsing by a number of animals, most commonly cattle and white-tailed deer, has been a problem at a number of sites, most notably at the Maquoketa and Pine Creek (Iowa) locations (accessible to cattle), Coon Valley and Chase Creek (Wisconsin) populations (cattle grazing), and the Akron (Ohio) site (white-tailed deer browsing). Before Federal acquisition, much of the Kickapoo River Valley (Wisconsin) population was accessible to cattle grazing. The major threats to a northern monkshood population caused by grazing animals are weakening of the plants by loss of their photosynthetic organs, loss of reproductive potential when flowers or fruits are consumed, and trampling of the plants, especially when grazing animals are at high density and the site is used as a pathway, resting place, or wallow.

Developments - Two types of developments have been noted to affect existing northern monkshood populations. Foot trail developments have affected or have the potential for affecting populations at Parfreys Glen (Wisconsin) and Beaverbrook (New York). At the former site, over 10,000 visitors pass through the scenic glen each year, creating a muddy path at the base of the cliff where northern monkshood occurs. No northern monkshood reproduction can be expected to take place at the cliff base due to the amount of foot traffic. At the Beaverbrook, New York, site a state trail crosses within a few meters of the monkshood population, and should this trail be redirected or expanded from its present course, a portion of the population could be adversely affected. Low density foot traffic occurs at the base of other cliffs containing northern monkshood (Bixby Park, Iowa; Nelson, Ohio; Akron, Ohio; Loddes Mill Bluff, Wisconsin; some of the Kickapoo, Wisconsin cliffs) but the level of traffic on these volunteer trails does not pose a threat to the species presently.

The other type of development having negative impact implications for northern monkshood is residential and urban development. Since most of the known populations of the species are in rural locations, urban/residential development poses a problem in only a few cases. The Akron, Ohio, site is in an urban setting and the small Nelson, Ohio, population is within a few hundred meters of surburban houses. It is reported, too, that the Chenango County, New York, site(s) is in a developed area, a factor which may have contributed to its presumed extirpation.

While such developments may not be directly placed on northern monkshood locations, the probability of various harmful activities increases with increased human presence, be it higher coincidental visitation, vandalism, or accidents. Also, higher land costs, taxes, and complex ownership patterns make preservation more difficult to accomplish in surburban and urban environments.

Scientific Overcollecting and Overvisitation - Over the course of several generations, scientific curiosity about a rare species may contribute to its demise, caused by too many people visiting the site (sometimes resulting in habitat degradation) and overcollecting (resulting in population depletion). This problem is suggested in the case of northern monkshood by the collection of plants from the small Parfreys Glen (Wisconsin) population on at least nine independent occasions in less than 45 years. Collectors often gather more than one plant so that duplicates can be distributed to the herbarium collections at various institutions. Together with collections housed in herbaria not seen in the preparation of this recovery report, total scientific collections from the Parfreys Glen site may account for a significant portion

of the population remaining today in the glen.

Scientific collecting was also mentioned as a threat to the Akron, Ohio, population by its property manager. He cited the time a few years ago when he led a professional botanist to the site, only to have him collect 25 specimens for comparative intra-population variation studies back in his lab. The property manager is now very wary of leading other biologists to the site.

The high scientific and public interest in endangered and threatened species also poses a threat to the species' welfare in some instances. With even a small number of visitations to certain northern monkshood sites each year, trampling of plants and surrounding vegetation, compaction of soil, and destruction of vulnerable spring seeps can become a problem. This has been true with habitats visited periodically in the course of these studies, and foot damage to a steep-slope habitat was noted at one other northern monkshood site in Iowa where the ecology of another rare cliff plant was being studied. The small number of northern monkshood populations, the fragile nature of many of their habitats, and the large number of people who would like to study, collect, photograph, or simply observe this rare plant make it susceptible to being "loved to death."

Natural Catastrophies - Of course, not all threats to the survival of northern monkshood originate from human activities. There are a number of natural events and factors which can adversely affect a population of monkshood. Such factors which were observed over the last six years with northern monkshood are drought, flooding, cliff failure, disease, and predation. With the exception of cliff failure, northern monkshood populations seem to be able to

rebound from these events, with only limited mortality or more often only a weakening or death of the present year's growth. Unless a particular monkshood population is subjected to a single or combination of damaging events over a sustained period of years, it is unlikely that any northern monkshood population will be lost due to the natural catastrophies to which the species was subjected periodically in its evolution.

Failure of the cliff face on which or over which the northern monkshood occurs is the one natural event which could almost totally eliminate a known population. All but three plants at the Nelson, Ohio, site are located in a small patch no larger than nine square feet in area, and are located at the base of a slightly overhanging cliff. Nearby, cliff failure has taken place, resulting in a rubble pile at the base of the cliff. Should failure occur in the cliff face above this small monkshood population, it would probably be lost.

PART II - NORTHERN MONKSHOOD RECOVERY PLAN

Goals of the Recovery Plan

Northern monkshood is a species that has always been known to possess a very limited range and habitat preference. It has been considered a threatened species on national and state levels because the small number of locations make it vulnerable to extinction. It was one such threat, the proposed La Farge Reservoir along the Kickapoo River in southwestern Wisconsin, which focused attention on the species leading to its listing as a threatened species at a national level.

The particular ecology and confined range of northern monkshood are factors which help direct goals of the recovery plan effort. The evidence presented in this plan suggests that northern monkshood is not primarily threatened due to historically documented destruction of habitats (although 2 or 3 of the 24 known sites may have become extirpated in historical times). The evidence also suggests that northern monkshood has such particular growing habits that we would not expect the species to ever become a common species through recovery plan efforts. The primary goal of this plan, therefore, is to provide a basis for consideration of delisting by providing security for all known northern monkshood locations against damage or destruction of the existing habitats. This goal can be achieved through a mix of actions, ranging from landowner contacts to land acquisition to strategic fencing. Two additional goals for the recovery effort are searches for new northern monkshood sites through surveys of all poorly known regions within its known range, and continued research into the controlled propagation of the species.

Specific Recovery Objectives

Following outline is a list of activities which singly and in combination should have a positive effect on the conservation of northern monkshood. In the subsequent section is a recommended priority and cost estiamte for the implementation of these proposed recovery actions.

Abbreviated Step-down Outline

1. First Order Recovery Tasks

    11. Habitat Protection

        111. Complete Started Acquisition

            1111. White Pine Hollow, Iowa

            1112. Buck Creek, Iowa

            1113. Loddes Mill Bluff, Wisconsin

        112. Landowner Awareness

            11201. Yellow River, Iowa

            11202. Maquoketa, Iowa

            11203. Miner's Creek, Iowa

            11204. Pine Creek, Iowa

            11205. Peekamoose, New York

            11206. Drybrook, New York

            11207. Beaverbrook, New York

            11208. Watson Hollow, New York

            11209. Nelson, Ohio

            11210. Chase Creek, Wisconsin

            11211. Coon Valley, Wisconsin

            11212. Pine River, Wisconsin

        113. Government Agreements

            1131. Yellow River, Iowa

            1132. Paint Creek, Iowa

            1133. Elkader, Iowa

            1134. Peekamoose, New York

            1135. Beaverbrook, New York

            1136. Kickapoo River, Wisconsin

12. Propagation Research

    121. Cary Aboretum, New York

    122. Other research organizations

13. Taxonomic Studies

14. Life History Research

15. Monitor Populations

16. Resolve La Farge Dam Project

17. Revise New York Law

2. Second Order Recovery Tasks

21. Field Surveys

    211. Northeast Iowa

    212. Catskill Mountains, New York

    213. Northeast Ohio

    214. Southwest Wisconsin

22. New Acquisition - all states

23. Protective Zoning

24. Scientific Awareness - Provide information on plants to all levels of the scientific community in order to enlist their aid in the recovery effort.

25. Implement Management

251. Fencing Out Grazing Animals

2511. Maquoketa, Iowa

2512. Pine Creek, Iowa

2513. Akron, Ohio

252. Fencing Out People

2521. Beaverbrook, New York

2522. Nelson, Ohio

253. New Seedlings - Nelson, Ohio

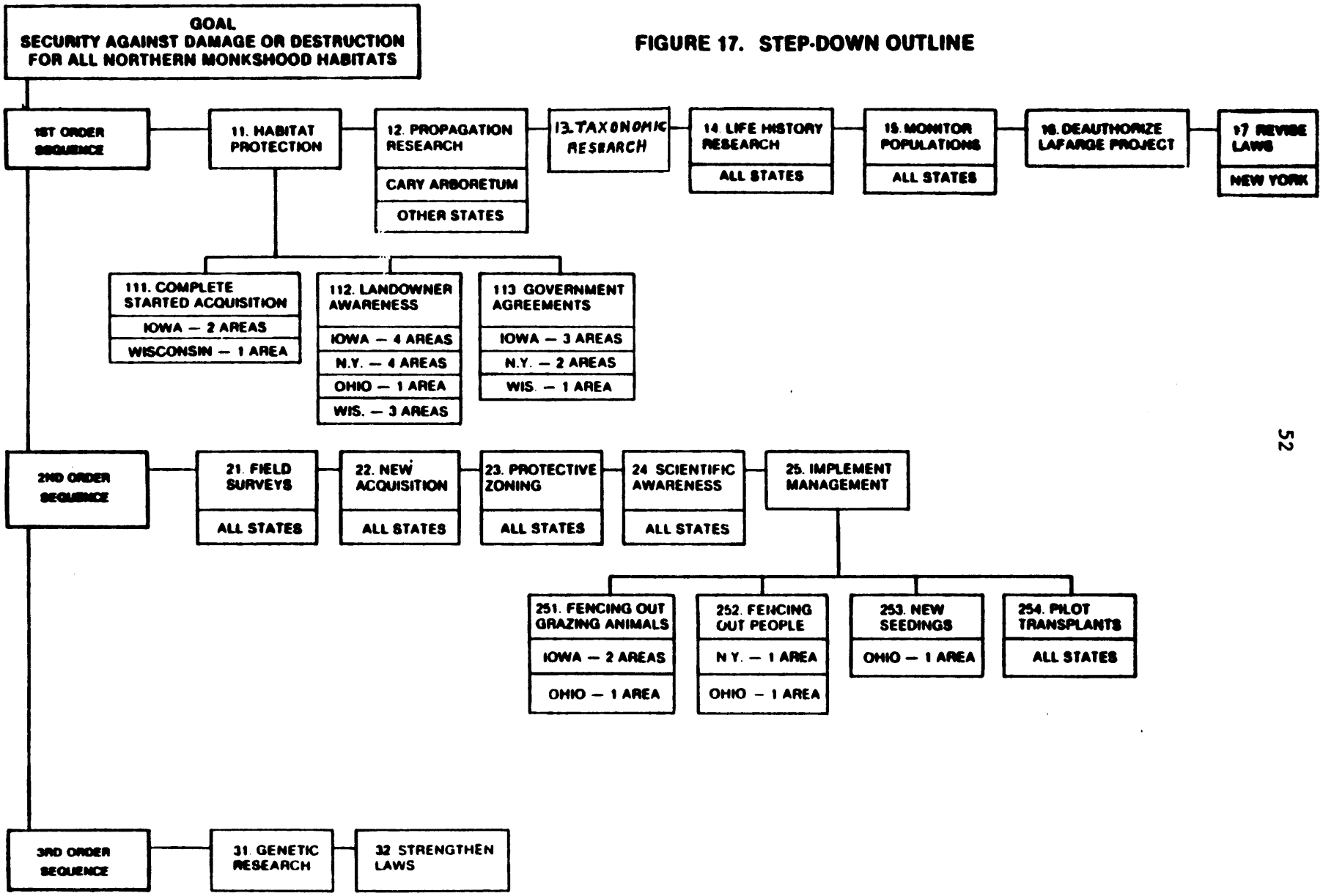
254. Pilot Transplant Program

3. Third-Order Recovery Tasks

31. Genetic Research - all states

32. Strengthen Laws - to protect plants on private lands.

FIGURE 17. STEP-DOWN OUTLINE



Recovery Plan Narrative

The tasks in this plan are divided into three groupings based upon the immediacy of the need to implement the task, and in certain cases, on the scope and duration of effort necessary to derive tangible results. Northern monkshood sites, to which the recovery effort should apply, are listed under the recommended action.

Also named with each activity is a suggested lead agency. Since often more than one organization is interested in the preservation of endangered and threatened species, recovery activities should be coordinated with other interested parties. Due to program stability, it is strongly suggested that the coordination be channeled through the state agency responsible for implementing the federal-state endangered species cooperative agreement (this being in all nortern monkshood-containing states the state natural resources agency). Initiative for recovery activities, however, may come from private groups or individuals as well as public agencies. The suggested lead agency is the one with the best capabilities for carrying out specific tasks, be it biological research, delicate land negotiations, biological surveys, etc.

Cost estimates to accomplish the recovery activity are given for all first-order and second-order tasks. These costs are those envisioned for a three year period, and as if the tasks were done independently of each other. Considerable cost savings should be achieved if some recovery tasks are combined, thus saving travel and staff costs. Only federal and state agency lead tasks are estimated, and only then if they have distinct end points. Land acquisition costs are not estimated due to volatility over time and the need to first ascertain adequate protection alternatives and boundaries.

1. First-order Recovery Tasks

11. Secure some level of protection for all known habitats. This may be accomplished by a variety of means, such as fee acquisition, easement, preserve designation, or simple landowner contact. The lead agency and type of preferable protective measure must be considered for site-by-site conditions, such as degree of threat, ability for adequate management by acquiring agency, need for controlled access, etc.

111. Complete acquisitions of northern monkshood habitats that have already been started.

1111. White Pine Hollow (Iowa). It has recently been reported that part of the northern monkshood population may extend beyond presently state-owned land. This needs to be checked and an adequate protection boundary determined.

Lead Agency: Iowa Conservation Commission

Estimated Cost: $500, for field analysis, ownership determination, and preservation boundary description.

1112. Buck Creek (Iowa). Complete preserve acquisition, especially provision for legal access.

Lead Agency: The Nature Conservancy

1113. Loddes Mill Bluff (Wisconsin). Complete acquisition of adjacent property that contains the majority of northern monkshood.

Lead Agency: Wisconsin Department of Natural Resources, or alternatively The Nature Conservancy as an advance for the State.

Estimated Cost: $500, for field analysis, ownership determination, and preserve boundary description.

112. Make owners of all privately held northern monkshood sites aware of their special resource, long-term protection needs, and options available to assure long-term protection.

Lead Agency: Depends on the history and effectiveness of prior contacts.

Estimated Cost: $300 per site for staff and travel time and expenses, a summary report, and a follow-up letter.

11201. Yellow River (Iowa)

11202. Maquoketa (Iowa)

11203. Miner's Creek (Iowa)

11204. Pine Creek (Iowa)

11205. Peekamoose (New York)

11206. Drybrook (New York)

11207. Beaverbrook (New York)

11208. Watson Hollow (New York)

11209. Nelson (Ohio)

11210. Chase Creek (Wisconsin)

11211. Coon Valley (Wisconsin)

11212. Pine River (Wisconsin)

113. Make contacts leading to protective agreements with natural resource and transportation agencies, and public utility staffs whose activities have the greatest likelihood of impacting certain northern monkshood populations.

1131. Yellow River (Iowa). Contact utilities whose transmission lines pass through site.

Lead Agency: Iowa Conservation Commission

Estimated Cost: $300, for initial contact, field analysis with utility representative, and follow-up letter.

1132. Paint Creek (Iowa). Inform state forest forester and superintendent of northern monkshood location and discuss protection strategies.

Lead Agency: Iowa Conservation Commission

Estimated Cost: $200, for staff and travel expenses for field conference with forester and superintendent.

1133. Elkader (Iowa). Consult highway maintenance personnel with the goal of marking roadside northern monkshood population to avoid damaging maintenance activities (e.g., herbicide, deicing agents).

Lead Agency: Iowa Conservation Commission.

Estimated Cost: $300, for initial contact, field analysis with transportation department respresentatives, and follow-up.

1134. Peekamoose (New York). Consult with transportation officials and maintenance personnel with the goal of marking road segment near northern monkshood population against damaging road maintenance activities (e.g., riprap material, herbicides, deicing agents).

Lead Agency: New York Department of Environmental Conservation.

Estimated Cost: $300, for initial contacts, field analysis with transportation department representatives and follow-up.

1135. Beaverbrook (New York). Consult with Department of Environmental Conservation trail maintenance staff with the goal of placing trail marker guides in the vicinity of the northern monkshood population closely skirted by a state foot trail.

Lead Agency: New York Department of Environmental Conservation.

Estimated Cost: $300, for intra-department consultation, field analysis, and follow-up.

1136. Kickapoo River (Wisconsin). Meet with the U. S. Army Corps of Engineers representatives and property manager, with the goal of keeping them informed on the location of the northern monkshood on federal property.

Lead Agency: Wisconsin Department of Natural Resources.

Estimated Cost: $400, for staff and travel expense costs for initial contact, field analysis, and follow-up report and consultation.

12. Continue research on the propagation of northern monkshood under greenhouse and garden conditions. The goal of this research should be the production under controlled conditions of northern monkshood from seed to the survival of first generation plants through seed production. This would supply a demand for seed by horticulturists and the establishment of experimental colonies on which to develop management techniques, and enhance life history knowledge.

Lead Agency: Cary Aboretum, Millbrook, New York, and other research organizations.

Estimated Cost: $5,000 per year for three years per agency.

Special Note: If results in early trials seem encouraging, it is recommended that seed from the very small and vulnerable population at Nelson, Ohio, be used, with the goal of saving this genetic stock if the natural population should be destroyed.

13. Taxonomic studies are needed to solve the dispute over the specific validity of *noveboracense*.

14. Conduct life history research on northern monkshood in native habitats to determine such factors as breeding (pollination) systems, dispersal mechanisms, predation, juvenile mortality, adult longevity, and habitat requisites.

Lead Agency: Request for Proposal

Estimated Cost: Three year study at $10,000 per year.

15. Initiate northern monkshood population monitoring effort in each state, with the goal of an early warning system to indicate population declines, threats, and land use or ownership changes.

Lead Agency: Lead agency should be the state program responsible for endangered and threatened species or their designate. Alternate arrangements should take into consideration long-term stability of program, and staff commitment to maintaining a monitoring program.

Estimated Cost: $300 per site, based on one inspection of each population every three years for the purpose of monitoring. The cost per site includes staff salary and travel expenses, and a follow-up report. This cost may be decreased substantially and the efficiency increased by the creation of a volunteer monitoring network using trustworthy, interested residents living in proximity to a site.

16. Resolve La Farge Reservoir Flood Control Project issue in Wisconsin. The completion of this flood control project along the Kickapoo River, in any one of its several alternatives, poses the single largest threat to northern monkshood numbers anywhere. The project was halted in 1977 due to the projection of poor water quality in its conservation reservoir, lack of flood control for an adequate distance downstream, and impacts to the scenic valley and its biota. Despite these problems, the projects may be reactivated unless it is deauthorized by Congress. It would be prudent to have the issue of the La Farge Reservoir resolved.

Lead Agency: Wisconsin Department of Natural Resources, U. S. Congress.

17. Revise New York Endangered Species Law to include protection of northern monkshood.

Lead Agencies: New York Department of Environmental Conservation and New York State Museum (State Botanist), as legislation sponsors.

2. Second-Order Priority Tasks

21. Complete field surveys for additional northern monkshood habitats. It is probable that all northern monkshood locations have not yet been found. State surveys to search for additional northern monkshood populations should be initiated or completed. Exhaustive searches should also be made of old, as yet unverified sites.

211. Iowa.

Northeastern Iowa has the most unsearched potential habitat within the range of the species. A two-year, intensive survey should allow for the investigation of most suitable habitats and leads.

Lead Agency: Iowa Conservation Commission (Iowa Preserves Board Staff).

Estimated Cost: $20,000 per year for 2 years, to cover staff, travel, materials, report costs.

212. New York.

Remote, high elevation sites in and around the Catskill Mountains should be searched, and the old Chenango County location(s) should be reinvestigated again.

Lead Agency: New York State Museum (State Botanist).
Estimated Cost: $20,000 for a one-year effort, covering staff, travel, materials and report costs.

213. Ohio.

A small number of sites in the northeastern part of the state possessing the requisite geological formation should be investigated. The survey should include an estimation of the suitability of all habitats for the introduction of northern monkshood.

Lead Agency: Ohio Department of Natural Resources
Estimated Cost: $5,000 for a one year effort covering staff, travel, materials and report costs.

214. Wisconsin.

Investigation of inaccessible areas of the unglaciated region in the southwest portion of the state should be completed.

Lead Agency: Wisconsin Department of Natural Resources.
Estimated Cost: $10,000 for a one year effort, covering staff, travel, materials and report costs.

22. Pursue acquisition of properties that are found to be available on a willing-seller basis. The goal of this activity is to prepare an acquisition plan for all properties found to be available as a result of landowner contacts (I.A.2.).

Lead Agency: Follow-up of agency involved in landowner contacts, or delegation to a new lead agency.

Estimated Cost: $500 per site for development of acquisition plan to include preserve boundary, acquisition plan, probable cost, management plan.

23. Pursue land-use zoning and/or nature preserve designation where appropriate to the enhancement of habitat protection. The goal of this task is an analysis of zoning or designation categories that would be compatible with a particular population's preservation. Evaluation of zoning should be especially stressed on state, city and federal properties where master planning can often put sensitive areas into protective categories without divulging the identity of the specific resource being protected.

Lead Agency: State agency responsible for endangered and threatened species, or designs.

Estimated Costs: Inter-agency cooperation costs should be covered under existing duties. Analysis and follow-through for land use zoning of private properties, or designation procedures on any site (nature preserve, scientific area, critical habitat) may exceed

$1,000 per site in staff expenses alone. Currently, two sites in Iowa (publicly owned), three sites in New York (privately owned), two sites in Wisconsin (publicly owned), and one site in Ohio (privately owned) may benefit from zoning or designation analysis.

24. Initiate an educational effort with the scientific community, requesting their cooperation in not collecting or conducting student field trips at northern monkshood populations. The goal of this activity is to heighten the scientific community's awareness of the damaging results of overcollecting and trampling, and how they can participate in recovery activities.

Lead Agency: State Endangered Species Coordinator.
Estimated Cost: $500 for each state and adjoining state, to cover cost of preparation and oral presentation at an appropriate state forum (state academy of science meeting, state/county/local botanical club meetings, etc.) and/or preparation of a brochure.

25. Implement most important management activities.

251. Fence populations from grazing animals.

2511. Maquoketa (Iowa). Fence northern monkshood population from cattle, with permission of owner.

Lead Agency: Iowa Conservation Commission.
Estimated Cost: $600, covering material and labor.

2512. Pine Creek (Iowa). Fence northern monkshood population from cattle, with permission of owner.

Lead Agency: Iowa Conservation Commission.

Estimated Cost: $1,000 covering material and labor.

Special note: Limitations on the use of public money for expenditures on private land may necessitate an alternative lead agency and source of funds to accomplish this.

2513. Akron (Ohio). Fence northern monkshood population from browsing by the protected herd of deer in the metropolitan park.

Lead Agency: City of Akron, with cooperation of Ohio Department of Natural Resources.

Estimated Cost: $2,500 for materials and labor.

252. Cordon-off northern monkshood populations susceptible to damage from trampling by people.

2521. Beaverbrook (New York). Construct trail-funneling rails in vicinity of nearby monkshood population.

Lead Agency: New York Department of Environmental Conservation.

Estimated Cost: $1,000 for materials and labor for construction of 50-foot wooden hand rail along state trail.

2522. Nelson (Ohio). Fence-off small population to protect it from foot traffic on nearby volunteer trail.

Lead Agency: Ohio Department of Natural Resources.

Estimated Cost: $50-$100 in materials and labor. Inexpensive snow-fence and wood-post railing would be sufficient. See special note also applying here under 2511 above.

253. Set-up seeded plots at Nelson, Ohio. Collect seeds at small, vulnerable Nelson site and sow in nearby marked plots, with the goal of increasing population jeopardizing established plants.

Lead Agency: Ohio Department of Natural Resources, with cooperation of private landowners.

Estimated Cost: $500, for staff time to collect and sow seeds, mark plots, keep records and monitor success.

254. Pilot Transplants. Conduct a pilot transplant program. with the exception of the Nelson, Ohio, population, no northern monkshood population appears in imminent danger of extirpation. Early transplantation results have had mixed success results, and until propagation research can deliver experimental material, any further transplant work would be at the expense of native populations. Conservation of these habitats must take a higher priority at the present time.

3. <u>Third-Order Priority Recovery Tasks (without lead agency designations and cost estimates.</u>

31. Conduct a research program to develop tissue culture techniques for the propagation of northern monkshood. This activity is not recommended at this time because northern monkshood population levels are not critically low enough to warrant such research. The creation of genetic clones is not conducive to maintenance of genetic diversity now existing in out-crossing, native populations. Research aimed at growth of northern monkshood through seeds--which most plants produce copious numbers--should have a higher research priority, however, if population size drops to a critical level tissue culture would be the last chance for survival.

32. Strengthening protection laws for plant species at the state and federal level. It may be argued that legislative protection for endangered species has reached a plateau, based on several years of experience with existing laws. Constitutional restraints, regularity backlash, and enforcement limitations may have determined the limits of further legislative initiatives toward protection of endangered and threatened plants. The present level of recognition of endangered resource conservation may be adequate to be effective for plants in most cases. The one exception for the need of further legislation is in the state of New York, where northern monkshood (as well as other biologically endangered and threatened state species) should be added to the statutorily protected list of plants.

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Andreas, B. 1980. Flora of Portage, Stark, Summit and Wayne Counties, Ohio. Ph.D. Thesis, Kent State Univ. 664 pp.

[Contemporary occurrence of northern monkshood in Ohio is discussed, as well as the geology and ecology in this part of its range.]

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Cooperrider, Tom S. 1962. The flora of north-facing slopes compared to that of the surrounding area in eastern Iowa. American Midland Naturalist 67 (2): 369-372.

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[Fassett describes northern monkshood in and adjacent to the midwestern "driftless area" as the distinct variety quasiciliatum.]

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[A discussion of the relic plants occurring in the midwestern Driftless Area.]

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[Northern monkshood is known from four sites in Wisconsin at this time: Parfreys Glen, Coon Valley, Loddes Mill Bluff, and Pewit's Nest.]

Fernald, M. L. 1950. Gray's Manual of Botany. 8th Ed. American Book Co., N.Y. 1632 pp.

[Northern monkshood is listed as occurring in "rich woods, shaded ravines, and damp slopes, local, se. N.Y. to Wisc. and Ia."]

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[An account of northern monkshood at the Beaverbrook site, New York.]

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[Northern Monkshood's habitat and range is listed as "rich woods; Catskill Mts., ne. O., and the unglaciated parts of Io. and Wis."]

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[Hardin describes northern monkshood as a subspecies of the mainly Appalachian-ranging Aconitum uncinatum.]

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[This thesis, and the summarized version in the citation following, lists northern monkshood from the Yellow River (Iowa), Buck Creek (Iowa), Bixby Park (Iowa), White Pine Hollow (Iowa), Loddes Mill Bluff (Wisconsin), Pewit's Nest (Wisconsin), and the Coon Valley (Wisconsin) sites. Habitats are listed as "moist sandstone cliffs and on cold, mossy, north-facing talus slopes; rare."]

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Schaffner, J. H. 1932. Revised Catalog of Ohio Vascular Plants. Ohio State Univ. Bull. 25.

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[Northern monkshood is listed from this long known and sole Dubuque County, Iowa site.]

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[Account of northern monkshood near the summit of this Catskill Mountain peak; part of Drybrook population of this report.]

Zimmerman, J. H. and H. H. Iltis. 1961. Conservation of rare plants and animals. Wis. Acad. Rev., winter: 7-11.

[Northern monkshood is briefly discussed and partial range-map shown.]

PART III - NORTHERN MONKSHOOD IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY FWS REGION	RESPONSIBLE AGENCY FWS PROGRAM	RESPONSIBLE AGENCY OTHER*	FISCAL YEAR COSTS (EST.) FY 83	FY 84	FY 85	COMMENTS/NOTES
A	White Pine Hollow, IA	1111	2	1 yr	3		ICC	$ 500			
A	Buck Creek, IA	1112	2	1 yr	3		TNC				
A	Loddes Mill Bluff, WI	1113	2	1 yr	3		WDNR	500			
OI	Yellow River, IA	11201	2	1 yr	3		ICC	300			
OI	Maquoketa, IA	11202	2	1 yr	3		ICC	300			
OI	Miner's Creek, IA	11203	2	1 yr	3		ICC	300			
OI	Pine Creek, IA	11204	2	1 yr	3		ICC	300			
OI	Peekamoose, NY	11205	2	1 yr	5		NYEC	300			
OI	Drybrook, NY	11206	2	1 yr	5		NYEC	300			
OI	Beaverbrook, NY	11207	2	1 yr	5		NYEC	300			
OI	Watson Hollow, NY	11208	2	1 yr	5		NYEC	300			
OI	Nelson, OH	11209	2	1 yr	5		OUNR	300			
OI	Chase Creek, WI	11210	2	1 yr	3		WDNR	300			
OI	Coon Valley, WI	11211	2	1 yr	3		WDNR	300			
OI	Pine River, WI	11212	2	1 yr	3		WDNR	300			
A3	Yellow River, IA	1131	2	1 yr	3		ICC	300			
A3	Paint Creek, IA	1132	2	1 yr	3		ICC	200			
A3	Elkader, IA	1133	2	1 yr	3		ICC	300			
A3	Peekamoose, NY	1134	2	1 yr	5		NYEC	300			
A3	Beaverbrook, NY	1135	2	1 yr	5		NYEC	300			
A3	Kickapoo River, WI	1136	2	2 yr	3		WDNR	400	400		
R7	Cary Arboretum, NY	121	2	3 yr	5		Cary	5,000	5,000	5,000	
R7	Other Research	122	2	3 yr	3&5			5,000	5,000	5,000	private & governmental
R5	Taxonomic studies	13	1	1 yr	9						
R	Life History Research	14	2		3&5		states	10,000	10,000	10,000	

PART III - NORTHERN MONKSHOOD IMPLEMENTATION SCHEDULE (cont.)

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY FWS REGION	RESPONSIBLE AGENCY FWS PROGRAM	RESPONSIBLE AGENCY OTHER*	FISCAL YEAR COSTS (EST.) FY 83	FISCAL YEAR COSTS (EST.) FY 84	FISCAL YEAR COSTS (EST.) FY 85	COMMENTS/NOTES
R1	Monitor Populations	15	2	3 yr	3&5		states	$ 6,000	$ 6,000	$ 6,000	
04	Deauthorize Project	16	2	2 yr	9		WDNR, US Congress				
03	Revise NY Law	17	2	2 yr	5		NYEC				
R6	Northeast IA	211	2	2 yr	3		ICC	20,000	20,000		
R6	Catskills, NY	212	2	1 yr	5		NYSM	10,000			
R6	Northeast OH	213	2	1 yr	5		ODNR	5,000			
R6	Southwest WI	214	2	1 yr	3		WDNR	10,000			
A	New Acquisition	22	2	1 yr	3&5		state	500/site			
03	Protective Zoning	23	2	1 yr	3&5		states	8,000			
01	Scientific Awareness	24	2	1 yr	3&5		states	2,000			
M4	Maquoketa, IA	2511	2	1 yr	3		ICC	600			
M4	Pine Creek, IA	2512	2		3		ICC				
M4	Akron, OH	2513	2	1 yr	5		City of Akron	2,500			
M4	Beaverbrook, NY	2521	2	1 yr	5		NYEC	1,000			
M4	Nelson, OH	2522	2	1 yr	5		ODNR	100			
M1	New Seedings	253	2	1 yr	5		ODNR	500			
M2	Pilot Transplants	254	2	3 yr	3&5		states				
R14	Genetic Research	31	3	3 yr	3&5		states				
04	Strengthen Laws	32	3	1 yr	3&5		states				

* ICC - Iowa Conservation Commission
NYEC - New York Department of Environmental Conservation
NYSM - New York State Museum (State Botanist)
ODNR - Ohio Department of Natural Resources
TNC - The Nature Conservancy
WDNR - Wisconsin Department of Natural Resources

PART IV - APPENDIX

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