Conservation Assessment

For

American Ginseng (*Panax quinquefolius*) L.

USDA

Forest Service, Eastern Region

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Table of Contents

*** Attached Appendix due to size of images**

Acknowledgements
Ginseng is unlike any other rare or uncommon species I have had the pleasure of researching. Given its long history of harvest and use in this country numerous people have rich opinions on its status and needs. How many species can one carry down a dark city street late at night and have three perfect strangers passing by comment "nice ginseng"? Indeed, this may be the most well known herbaceous species in the eastern United States.

There are many individuals, too many to enumerate here, who I feel privileged to have discussed the ecological, botanical, social-economic, ethnobotanical and spiritual needs of the species. Data was gathered from harvesters still with a twinkle in their eye reminiscing about that "5-pronger" to old-time dealers spinning a tale on the rich cultural history surrounding ginseng. Additional info was gathered from the propagator who carefully explains how to successfully manipulate the plant, from researchers who can talk for hours on what we think we know, from the researcher who still yearns to see just one"5-pronger", from the historian who visually brings to life former harvesting and selling events, and finally from the numerous resource managers that want to learn more and wonder what really is happening to the species. I feel honored to have listened to a part of ginseng's legend and continuing story

I appreciate all the personnel in region 9, in particular regional office folks, who were gracious enough to bear with my long delay in completion of this assessment.

Executive Summary
This conservation assessment is a review of the distribution, ecology, and population biology of American ginseng (*Panax quinquefolius*) L., primarily across USFS lands in Region 8 and Region 9 but incorporates information known for other lands within its range across the eastern United States. *Panax quinquefolius* is perhaps the most well-known herbaceous in the Eastern United States. American ginseng is a slow-growing long-lived species that almost exclusively reproduces by seed. The species is known to occur within 33 states, throughout the eastern United States, and 2 Canadian provinces. *Panax quinquefolius* occurs in many plant communities but principally within those with mesic well drained soils with higher calcium content and a pH between 5 and 6. Mixed mesophytic forests most aptly define habitat characteristics for the species although it is also found in drier oak-hickory forest throughout its range and in northern hardwood forest at the northern extent of its range.

American ginseng has a long history of harvest, well over 200 years, of its roots for export as a medicinal plant to the Orient. Given the large harvest quantities, the species was placed on the Appendix II list of the Convention of International Trade in Endangered Species (CITES) in 1975. Currently the Office of Scientific Authority of the US Fish and Wildlife Service determines what criteria are needed to ensure sustainable harvest of the wild population. Nineteen states allow harvest of the species. Canada, where the North American harvest first started, includes *Panax quinquefolius* on its endangered species list and allows no wild harvest. The global rank was updated for

Panax quinquefolius in 2001 by the Nature Conservancy reclassifying it from "common" (G4) to "rare/common" (G3G4). The primary reason for status change was the continued large harvest rates coupled with relatively small population sizes in the wild.

Eleven states formally track the species as endangered, threatened, a species of concern or of conservation, or some other designation. Canada maintains the species on its federally endangered list. Those states that formally track American ginseng have the most reliable information on the number and quality of populations however even this information is often not current.

Within the National Forest system *Panax quinquefolius* is included on the Regional Forester Sensitive Species List for White Mountain NF, Green Mountain NF, Huron-Manistee NF, Ottawa NF, Hoosier NF, Shawnee NF, Allegheny NF, Chequamegon NF and Nicolet NF. These forests span seven states in Region 9. Two national forests in Region 9 permit the wild harvest of the species, the Wayne NF and the Monongahela NF. In Region 8, the following 5 units permit some harvest of wild ginseng; the George Washington and Jefferson National Forests, the Cherokee National Forest, the Nantahala and Pisgah National Forests, the Chattahoochee National Forest, and the Daniel Boone National Forest. These forests permitting harvest span 7 states.

The major harvest states have not varied dramatically during the past 15 years. The primary harvest is occurring within the following seven states: Kentucky, West Virginia, Tennessee, North Carolina, Indiana, Virginia, and Ohio. Within the last 15 years there has been a reduction in the annual US harvest (see table 1), however the general trend has been relatively constant from 1990 to 1997 (average of around 134,000 lbs.) with an almost 50% decline in harvest during the last seven years from 1998 to 2004 (average of around 67,500 lbs.). This decline in overall harvest generally equals a decline in the number of purchased permits within some respective USFS units, however not all of them. The annual number of permits per National Forest unit varies from less than 10 to 240.

It is uncertain if this decline in number of permits is reflective of population decline within the respective Forest since only one unit (National Forests in North Carolina) has a representative monitoring system. Other factors that may be reflective of the decline are recent increases in permit cost or local regional economic trends. An estimate of harvested individuals within the Forests ranges from under 1000 to more than 40,000 individuals. Costs for a wild ginseng permit varies from $20 per dried lb. to $30 per wet lb.

Other threats that may be impacting wild *Panax quinquefolius* populations include deer browse, poaching, genetic degradation, and vegetation management including logging, prescribed fire, and the urbanization of the landscape.

The National Forest Management Act and U.S. Forests Service policy require that forest service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of

reproductive individuals to ensure the continued existence of the species throughout its range within a given planning area (FSM 2670.5.22). There are inventory and monitoring information gaps within most of the national forests units that limit the ability to determine viability on the unit. For units issuing harvest permits, except for the National Forests in NC, there is lack of enough inventory and monitoring data to assess if the harvest level is sustainable.

The objectives for this conservation assessment are to assess all the information currently known for this species. This assessment will concentrate on any population data known for the species within those US Forest lands within region 9 and Region 8 to determine its status. It will provide background information needed to prepare a subsequent conservation strategy for the species on public lands.

Nomenclature & Taxonomy

Scientific Name: *Panax quinquefolius*
Common Name: Ginseng, American Ginseng, Sang, Seng, Five Finger Root, Little Person, Man Root, Ninsin, Panax, Redberry
Family: Araliaceae
Order: Apiales
Synonymy: *Panax quinquefolium* Linnaeus, *Panax quinquefolium* Linnaeus var. *americanum* Rafinesque, *Panax quinquefolium* Linnaeus var. *cuneatum* Rafinesque, *Panax quinquefolium* Linnaeus var. *obovatum* Rafinesque, *Aralia quinquefolia* Decaisne & Planchon, *Ginseng quinquefolium* Wood, *Panax americanum* Rafinesque, *Panax americanum* Rafinesque var. *elatum* Rafinesque, *Panax americanum* Rafinesque var. *obovatum* Rafinesque, *Panax cuneatum* Rafinesque, *Panax obovatum* Rafinesque,

Linnaeus first formally described American ginseng, *Panax quinquefolium*, in 1756 (Reveal 1991). Michael Sarrasin, the French King's physican to Canada, previously had documented the species in Montreal in 1716 (Duke 1989). The word *Panax* is derived from two Greek word elements; pan, meaning "all", and akos, referring to "cure"(Stearn 1992). Thus the original name for the genus alluded to its medicinal qualities, perhaps to its well know usage in the Orient.

There has been debate and inconsistency in which scientific name to use for American ginseng for the last century. Throughout most of the 21st century *Panax quinquefolium* was the norm for most floras (Robinson & Fernald 1908, Small 1933, Radford 1967, Fernald 1950, Brittion & Brown 1952, Gleason 1968) although there were exceptions to the unwritten rule (Jones 1950, Massey 1961, Strasbaugh & Core 1972). Prior to that *Aralia quinquefolia* was the accepted name (Grey 1887, Millspaugh 1902). Many of the more recent floras have *quinquefolius* as the specific epithet (Wofford 1989, Gleason & Cronquist 1991, Sorrie 1999, Kartesz 1999, Weakley 2001). However there does not appear to be any absolute consensus within the current literature. For instance the Vascular Tropicos nomenclatural database (2003) on the Missouri Botanical Garden website and the International Plant Name Project (2003)both indicate the specific epithet

as *quinquefolium*. A query for *P. quinquefolius* yields no results in both databases and it is not listed as a synonym *for P quinquefolium*. The University of Minnesota herbarium website, which also uses the scientific name P. quinquefolium, in fact indicates "quinquefolius is a persistent misspelling since the name was originally published by Linnaeus as –ium" (Cholewa 2002). International Rules of Botanical Nomenclature require gender agreement between genus and specific epithet. It has been argued these rules determine this Greek derived genus as masculine, thus requiring the specific epithet to end in "us" if standards are followed (Graham 1966). While there may never be agreement on the botanical name, it is important to search both names when investigating current or historical information on American ginseng.

The closest relative to *Panax quinquefolius* is *Panax ginseng* Mey, with a native range of China, Korea and Manchuria (Wen and Zimmer 1996). The species, although well known and utilized medicinally within the Orient for 5 centuries was only first described in the 1800's (Graham 1966). These species were thought to be similar enough at one time that *P. ginseng* was known as P. *quinquefolium* var. *ginseng*, P. *quinquefolium* var *coreenis* or *P. quinquefolia* var *ginseng*. The only other *Panax* species also aligned with P *quinquefolium* is variety *japonicum*, a native to Japan. It is no longer considered that similar to America ginseng and generally goes by the current accepted scientific name of Panax *pseudoginseng* var. *japonicus*.

The only other North American *Panax* species is P. *trifolius*, dwarf ginseng. While both North American Panax species are considered to be from a monophyletic source, *P. trifolius* is considered to be the most distantly related species of this genus (Wen and Zimmer 1996).

The common name is believed to be derived from Manchuria and refers to *Panax ginseng*. The species has been gathered and utilized there for more than 5 centuries (Veninga 1973). While numerous myths exist on the discovery of its medicinal properties, most refer to the human shape of the root. As a result it was named Jen-shen or man-root. Graham (1966) has a slightly different interpretation of the common name but also states that it refers to the human shape.

Life History

Panax quinquefolius is a slow growing long-lived species. It is uncertain how long ginseng can live. Some researchers indicate 50 plus years (Lewis and Zenger 1982) while others involved in the ginseng harvest trade attest to very long ages, even greater than several centuries (Heffern 1976, Pritts 1995). One researcher who examined a single population for many years suggests the upper age is 25-30 years old (Anderson et al. 1993). Recent work completed here in the southern Appalachians while completing an ongoing harvest study has documented roots greater than 45 years of age (G. Kauffman, pers. obs.).

Seeds exhibit morphophysiological dormancy requiring an alternating period of cold to –warm to cold temperatures prior to emergence 18-22 months following ripening (Baskin

and Baskin 1998, Lewis and Zenger 1982; Proctor and Bailey 1987). Lewis (1988) reported the presence of a seed bank at least 5 years in length, however the species is not believed to have a significant seed bank (Anderson et al. 1984; Charron and Gagnon 1991). Many factors can contribute to seed failure such as predation, disease, and drought (White 1988). Mortality rates as high as 90% in wild populations have been reported (Charron and Gagnon 1991).

McGraw (2003) has demonstrated much higher rates of germination when seeds are hand sown. Seeds germinated 8 times higher when sown at a depth of 2cm versus scattering the seed on the soil surface. Seed production is greater as a plant gradually continues to mature (Lewis and Zenger 1982). Generally 2-leafed plants have 2 fruits, 3-leafed plants have up to 9 fruits, and 4-leafed plants have as many as 15 fruits. Fruits can have up to 4 individual seed (Anderson et al. 1984; Schlessman 1985). Younger age classes tend to have single seeded fruits while larger 4-leafed plants have 2-3 seeds per fruit (Lewis and Zenger 1983).

Green fruits first appear in July and August, changing to pink and finally red at maturity in the fall (Charron and Gagnon 1991). The time of maturity can be variable across and within regions (MGraw et al. 2005). A fruit ripening study monitored 2,035 fruits on a total of 402 adult plants in 31 natural populations throughout eight U.S. States and one Province of Canada (Illinois, Kentucky, Maine, Missouri, North Carolina, Ohio, Virginia, West Virginia, and Quebec).

Ginseng fruits were monitored from mid-August until mid-September. Eighty % of all fruits within all the populations were still green on August 15, 44% on September 1, and 13% on September 15th. Seeds from red fruits germinated almost three times higher than seeds from green fruits. Variation in fruit ripening were observed within single populations and among populations in the same State. However, all populations had substantially more mature fruit by September 1 than in August.

Fruits typically falls within 6.5 feet of their parents (Lewis and Zenger 1982; Anderson et al. 1993; Cruse-Sanders and Hamrick 2004; Van der Voot 2005). Long distance seed dispersal of fruits is unknown although the red fruits suggest bird dispersal (Anderson et al. 2002). Fruits experimentally eaten by turkeys and grouse resulted in total seed maceration. Seed germination was not possible after passing through their digestive system (M. Furedi, pers. comm.).

The small flowers, arranged in an umbel, appear in late May to June. Individual plants can set seed in the absence of cross pollination since ginseng flowers are self compatible (Schlessman 1985). Cross pollination also occurs and is believed to result from generalist pollinators such as halictid species of *Dialictus* and *Erylaeus* and syrphid species of either *Toxomerus* or *Melanostomen* (Schlessman 1985, Lewis and Zenger 1983). Production of seed is not dependent on whether they were produced from a self-pollinated flower or from cross-fertilized flowers (Carpenter and Cottam 1982; Schlessman 1985). Genetic variation within and among ginseng populations is consistent with a predominant life-history strategy of self pollination (Grubbs and Case 2004).

Seedlings have a single leaflet when they emerge in late spring and may not have a trifoliate leaflet until the second season of growth. Mature one-leaved plants (1-prongs) have 5 palmately compound leaflets. As a ginseng individuals age, they sequentially develop more palmately compound leaves, typically up to five, although these are rare. In a broad sense the greater the number of leaves or prongs, the older the plant (Lewis and Zenger 1982; Charron and Gagnon 1991; Anderson et al. 1983; Lockard and Swanson 1998).

Ginseng roots have specialized underground vertical rhizomes about the thickened roots at their collar (Anderson et al. 2002). Harvesters often refer to the rhizome as the neck. A scar will form annually along the rhizome at the base of the abscised leaf petiole thereby allowing one to determine an individuals age (Lewis and Zenger 1982, Anderson 1983). Each year's growth adds to the length of the rhizomes growth (Anderson 2002).

Reproduction is primarily by seed. Asexual reproduction via fragmentation of the rhizome is thought to be a rarely present within wild populations although it has occasionally been observed (Lewis 1988; Charron and Gagnon 1991, Van der Voot et al.). Seed reproduction typically does not occur until a plant reaches 4 years of age.

Ginseng has a low reproductive potential due to delayed reproduction , typically not occurring until a plant reaches 4 years of age and with only limited seed (Carpenter and Cottam 1982; Lewis and Zenger 1983; Lewis 1988; Charron and Gagnon 1991, Anderson et al. 1983).

Different genetic studies have demonstrated variation between populations and from one region to another. Cruse-Sanders and Hamrick (2004a) examined 21 wild ginseng populations in four States (Georgia, Maryland, North Carolina, and West Virginia). They indicated that individuals have limited seed dispersal away from local microhabitats and concluded that populations are locally adapted. Another researcher showed the genetic structure of wild plants was distinct from plants in cultivation (Schlag, in litt. 2004). Schlag reported that native ginseng populations are potentially at risk of contamination through planting cultivated seed in the wild.

Grubbs and Case (2004) analyzed allozyme variation from 31 wild and 12 cultivated populations sampled from over ten U.S. States and one Province of Canada. Differences in the level of genetic variation between wild and cultivated populations, and in the amount of variation within wild populations and among wild populations, were observed. Wild populations had lower within (intra) population diversity, however contained they contained significantly higher levels of variation among (inter) populations. Wild ginseng exhibited over 2.5 times more genetic variation distributed among its populations than cultivated plants. Cultivated populations were more similar to each other than to wild populations. Grubbs and Case (2004) concluded that wild populations are influenced by high levels of genetic drift and low migration rates from prolonged small population sizes due to sustained harvest pressure, which has created successive severe genetic bottlenecks.

Boehm et al. (1999) also established that wild populations of ginseng in North Carolina, Pennsylvania, and Wisconsin were genetically distinct from cultivated specimens. Using random amplified polymorphic (RAPD) DNA genetic analysis, the researchers found that ginseng populations in the Great Smoky Mountains National Park (GSMNP) had a unique genetic identity. This was not the case in Pennsylvania, where they found that wild collections were not genetically diverse and were most similar to specimens of cultivated ginseng. Boehm et al. concluded that, in areas with a history of ginseng harvest, wild ecotypes and cultivated gene pools have most likely been mixed.

Stressful environmental conditions, such as drought (Gagnon 2002) or deer browse (Drees 2001, Furedi and McGraw 2004) can result in premature senescence. The early dormancy often stunts individuals resulting in reduction in size class after breaking the senescent period.

Habitat and Ecology

The primary habitat for ginseng is the eastern deciduous forest province as defined by Gleason & Cronquist (1964). American ginseng has a broad range traversing many provinces across the eastern half of the United States and its boundary with southeastern Canada (Figure 1). Throughout this broad range, *Panax quinquefolius* occurs primarily in mesic "rich" woods typified by mixed mesophytic forest within what the USFS has defined as the eastern broadleaf forest region (McNab and Avers 1994). This area closely resembles the zone Braun characterized as the mixed mesophytic forest region (1950). She centers her region within extreme southeastern Kentucky, which appears to be the heart of the species range if harvest data is representative of abundance.

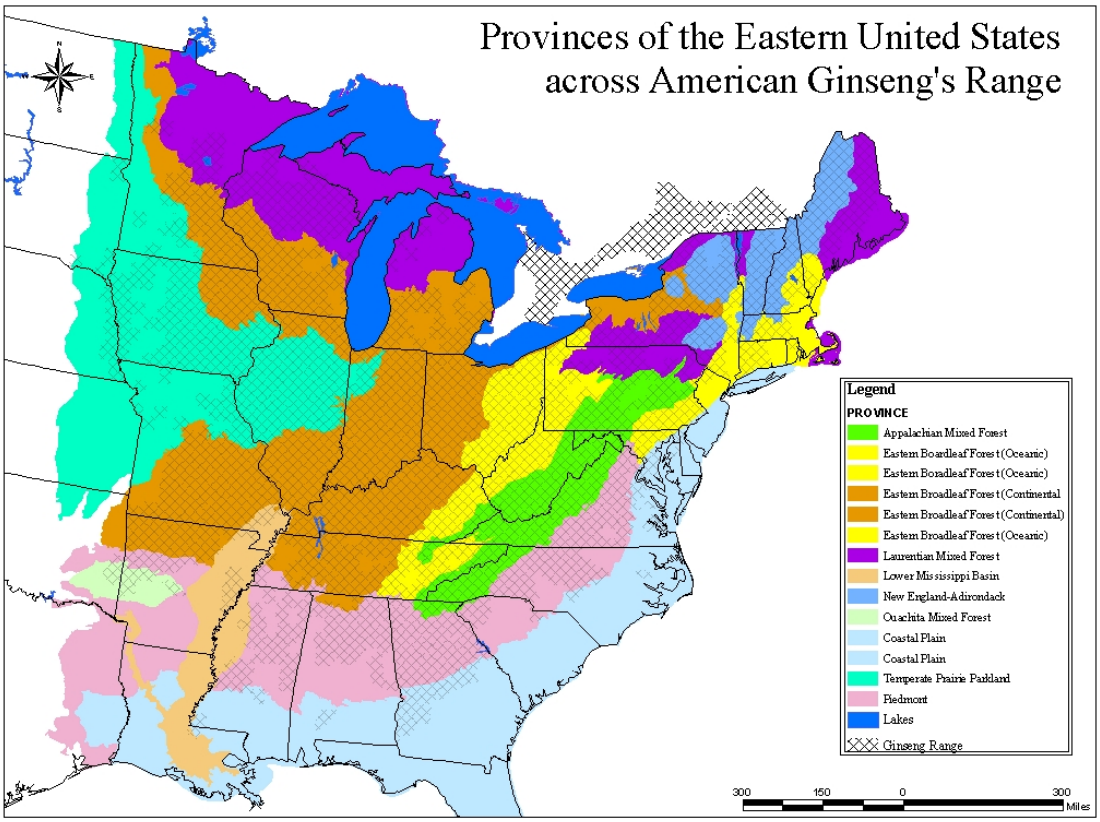

Figure 1. Eastern United States Provinces across *Panax quinquefolius* range.

The preferred habitat includes the rich cove forest in the protected landforms of the southern Appalachian Mountains, the northern mixed mesophytic forest of the central Appalachians, and the maple-hickory forests at the northern portion of the range (Gagnon 2000, Natureserve 2005, Schafale & Weakley 1990, Rock 1999). These forests with optimum ginseng habitat often have a diverse canopy with variable dominants, have an open or sparse shrub layer and a rich herb layer. Ginseng grows optimally at 70-90% shade throughout most of its range (Anderson et al. 2002). Populations have been located within mesic stands with 60% within the southern Appalachians (Rock 1999, Jim Corbin 1996) although Gagnon (1999) reports plants will begin to senesce prematurely from light levels of 50%. While soil characteristics may vary dramatically among ginseng populations, larger more robust populations of ginseng are typically found in well-drained humus rich soils with a pH between 5-6 and moderate to high calcium content (Nault et al. 1998; Rock et al. 1999, Corbin 1996, Das et al. 2001, Beyfuss 2000, Jones 2003). Under cultivation, ginseng grows very slowly with a soil pH less than 5 (Davis, pers. comm.). Most researchers report populations on north- and east-facing slopes (Anderson et al. 1984, Duke 1989, Persons 1994, Gagnon 1999, Fountain 1982, Thatcher et al. 2005). However the species can occur at the base of sheltered coves or “hollows” at many exposures within mountainous areas (Fountain 1996, Van der Voort, M.E. 1998). At the northern edge of its range in Canada the species typically is found on warmer exposures near the bottom of southeast to southwest-facing exposures (COSEWIC 2000).

American ginseng can found on slopes from 10% to 60% providing moisture is not limiting (Anderson et al. 1996). Thatcher et al. (2005) recently modeled habitat for American ginseng based on 72 field plots collected in portions of Kentucky, West Virginia, Virginia, Tennessee, and Ohio. Elevation, slope, Beers transformation of aspect, solar insolation, and percent deciduous forest were significantly correlated with ginseng. Simon et. al. modeled habitat for American ginseng within the southern Appalachians from ginseng occupied habitat (rich cove forest) over 300 plots. Important ecological variables to define the habitat included weighted landform index, elevation, length and steepness of slope, and high base geology. The following descriptions of regional plant associations indicate the diversity of sites where *Panax quinquefolius* can be located across its range.

- *Lake States*

At the northwestern portion of its range in Wisconsin the species is found in the richest northern hardwoods from mesic to dry-mesic site. Ginseng is often associated with canopy dominates of sugar maple (*Acer saccharum*) and American basswood (*Tilia americana*) (Anderson 1996, Sheehan, pers. comm.). Common herbaceous associates within these mesic sites included lopseed (*Phryma leptostachya*), cluster sanicle (*Sanicula gregaria*), zigzag goldenrod (*Solidago flexicaulis*), jack-in-the-pulpit (*Arisaema triphyllum*), sweet cicely (*Osmorhiza claytonii*), wild geranium (*Geranium maculatum*), aborted buttercup (*Ranunculus aborticus*), bloodroot (*Sanguinaria canadensis*), wild blue violet (*Viola sororia*), white snakeroot (*Ageratina altissima*), *Geum canadense*, maidenhair fern (*Adiantum pedatum*), rattlesnake fern (*Botrychium virginianum*), bulblet bladder fern (*Cystopteris bulbifera*), spinulose woodfern (*Dryopetris carthusiana*), and large-flowered bellwort (*Uvularia grandiflora*) (Anderson 1996). In Minnesota the species typically occurs within northern hardwood forest similar to sites located within Wisconsin (Smith, pers. comm.).

In Michigan the species is primarily found in mesic northern hardwood forests. Ginseng also occurs in forested dune hollows and leeward slopes along the Lake Michigan shoreline (Michigan Natural Features Inventory 1996). Common associates are very similar to those recorded from Swink and Wilhelm (1994) for the greater Chicago region (Penskar, personal communication). These species include sugar maple (*Acer saccharum*), white baneberry (*Actaea pachypoda*), maidenhair fern (*Adiantum pedatum*), rattlesnake fern (*Botrychium virginianum*), *Bromus pubescens*, *Carex albursina*, bitternut hickory (*Carya cordiformis*), blue cohosh (*Caulophyllum thalictroides*), toothwort (*Dentaria* spp.), Dutchman's breeches (*Dicentra cucullaria*), running strawberry bush (*Euonymus obovatus*), sharp-lobed hepatica (*Hepatica acutiloba*), red oak (*Quercus rubra*), bloodroot (*Sanguinaria canadensis*), false Solomon's seal (*Maianthemum racemosum*), basswood (*Tilia americana*), *Prunus virginiana*, and bellwort (*Uvularia grandiflora*). A Michigan ginseng collector also indicates the species grows under red maple (*Acer rubrum*) and white ash (*Fraxinus americana*) (Michigan Natural Features Inventory 1996).

- *Midwest*

Mixed mesophytic forests are characterized as species-rich forests occurring in protected slopes and ravines and well-drained bottomlands. (Martin 1992). Species composition can vary dramatically across the wide range of mixed mesophytic forest types however all types typically have an open shrub layer, albeit the composition of this layer can be quite diverse. Braun (1950) described mixed mesophytic forest primarily within the Appalachian Plateau of Ohio, southeastern West Virginia, southern Pennsylvania, Kentucky, middle Tennessee and North Alabama. For the purposes of the discussion here the type also extends into forested areas of Indiana and Illinois that were not formerly covered with prairie vegetation

A diverse canopy with numerous dominants characterizes these forests. Common tree species include tulip poplar (*Liriodendron tulipifera),* Appalachian basswood *(Tilia americana var. heterophylla),* White ash *(Fraxinus americana), Acer saccharum, Fagus grandifolia, Quercus alba, Quercus rubra,* Yellow buckeye (*Aesculus flava),* black cheery *(Prunus serotina), Acer rubrum* and eastern hemlock *(Tsuga canadensis).* (Braun 1950, Martin1992, Anderson et al. 1984, Burkhart 2004). *Magnolia acuminata* occurs locally. Frequent shrubs include pawpaw (*Asimina triloba),* hornbeam (*Carpinus caroliniana),* witch hazel (*Hamamelis virginiana*), spicebush (*Lindera benzoin),* bladdernut (*Staphylea trifolia),* and more locally, Umbrella magnolia (*Magnolia tripetala*) and white rosebay (*Rhododendron maximum*). Herbs are abundant in this type and often are characterized as spring wildflowers. Some of the common herbaceous associates include *Caulophyllum thalictroides,* black cohosh (*Actaea racemosa*), spring beauty *(Claytonia virginica*), squirrel corn (*Dicentra canadensis),* American trout lily (*Erythronium americanum), Sanguinaria canadensis,* foamflower (*Tiarella cordifolia*), bethroot *(Trillium erectum*), large-flowered Trillium (*Trillium grandiflorum),* and many others.

Two hundred thirty-nine previously recorded site occurrence records across Ohio were examined for habitat. Some of the records were dated prior to 1900. Many records were either vague with general habitat terms or gave no indication of the surrounding landscape. Of those that had better habitat descriptions the vast majority were mixed mesophytic forest. Seventy-one records were recorded within these forests, 25 were recorded within oak-maple forest, 16 within beech-maple forest, 6 within hemlock hardwood forest and 6 within oak dominated forest. *Lindera benzoin* was most frequently mentioned as an associate within these types.

- *Canada*

American ginseng generally grows in deciduous forests dominated by *Acer scacharum, Tilia americana, Fraxinus americana,* and *Carya cordiformis* in southern Quebec and Ontario at the north central edge of its' range (Charron and Gagnon 1991, COSEWIC 2000). It often is associated with morainal surficial material at the bottom of gentle slopes. The herb diversity within this layer is similar in composition and diversity to the mixed mesophytic forest described above.

- *New England States*

In the New England State at the northeastern edge of its range the species, American ginseng is known to occur within sheltered rich and typic northern hardwood forests, communities dominated within the canopy by *Acer saccharum*, yellow birch (*Betula allegheniensis*), and *Fraxinus americana* (Maine Dept. of Conservation 1999, New Hampshire Natural Heritage Inventory 1998). Tree species indicative of richer sites include butternut (*Juglans cinerea*), and shagbark hickory (*Carya ovata*). Often these sites occur on calcareous bedrock (R. Popp, pers. comm.). Associated herbaceous species include *Arisaema triphyllum, Uvularia grandiflora*, wild ramps (*Allium tricoccum*), showy orchid (*Orchis spectabilis*), *Dryopteris carthusiana*, Goldie's fern (*Dryopteris goldiana*), Dewey's sedge (*Carex deweyana*), *Adiantum pedatum* and *Trillium erectum (*Massachusetts Natural Heritage & Endangered Species Program 1994).

- *Appalachians*

At the northern portions of the Appalachians, American ginseng occurs within similar rich northern hardwood forests described for the New England States. At lower elevations within this area species composition resembles mixed mesophytic forest.
In the southern Appalachians, ginseng occurs primarily in protected mesic sites with an open understory, high diversity, and circumneutral soils (Whittaker 1956, Schafale and Weakley 1990). In the Great Smoky Mountains National Park ginseng is found most often on rich slopes from 880 feet to 4500 feet elevation (Rock et. al 1999). Within the Pisgah and Nantahala National Forests, *Panax quinquefolius* grows most frequently from 2500 to 4000 feet in elevation, although has been located as high as 5000 feet and as low as 900 feet (G. Kauffman, unpublished data). It has been located from high elevation red oak forest to montane alluvial forest, including rich cove forest, acidic cove forest, northern hardwood forest, and mesic oak-hickory forest (Schafale & Weakley, 1990; Patterson, 1994; Newell & Peet, 1995; Newell & Peet, 1996; Newell & Peet, 1997; Simon, 1995). While these represent a diverse variety of habitats, when occupied with *Panax quinquefolius* all have an absence of dense ericaceous cover and generally an open shrub understory. The herb layer typically has many of the same species described above for mixed mesophytic forest.

- *Ozarks*

In Arkansas near the southwestern edge of ginsengs range the species occurs primarily within colluvial areas with mesic hardwood forests. Fountain (1986) details the associated overstory species as *Quercus alba*, black oak (*Quercus velutina*), *Quercus rubra*, white ash (*Fraxinus americana*), mockernut hickory (*Carya alba*), *Fagus grandifolia*, and *Liriodendron tulipifera*. Understory woody vegetation included pawpaw (*Asimina triloba*), *Cornus florida*, *Magnolia acuminata* and hophornbeam (*Ostrya virginiana*). The herb layer was moderately diverse and includes false Solomon's seal (*Maianthemum racemosum*), *Botrychium virgianum*, bedstraw (*Galium* spp.), *Adiantum pedatum*, broad beech fern (*Phegopteris hexagonoptera*), wild yam (*Dioscorea quaternata*), as well as the more weedy species such as *Polystichum acrostichoides* and various *Desmodium* spp.

Lewis and Zenger (1982) describe study sites in Missouri dominated by *Acer scacharum* and *Tilia americana* with lesser dominance by slippery elm (*Ulmus rubra*). The open understory sites had a diversity of herb species including spring beauty (*Claytonia virginica*), bloodroot (*Sanguinaria canadensis*), dutchman's breeches (*Dicentra cucullaria*), large-flowering bellwort (*Uvullaria grandiflora*), rattlesnake fern (*Botrychium virginianum*), and Virginia creeper (*Parthenocissus quinquefolius*).
In Missouri ginseng also occurs within mesic oak-hickory forests with associated herb species such as *Asarum canadense, Arisaema atrorubens, and Hepatica nobilis*.

- *Southern Coastal Plain and Piedmont*

Within the Piedmont where ginseng is scattered the species occurs in mesic hardwood forests typically occurring in the most protected portions of the landscape. Common species within Mississippi include black walnut (*Juglans nigra),* water oak *(Quercus nigra),* white oak (*Quercus alba),* red oak *(Quercus rubra),* cucumber tree (*Magnolia acuminata*), American beech (*Fagus grandifolia*), tulip poplar *(Liriodendron tulipifera)* and red maple (*Acer rubrum*). (Denley, Bryson and Stewart 2002). The shrub layer is open and diverse with species such as wild hydrangea (*Hydrangea arborescens),* American holly (*Ilex opaca),* spicebush (*Lindera benzoin),* pawpaw *(Asimina triloba), Aesculus pavia, Carpinus caroliniana, Ostrya virginiana,* and *Cornus florida*. The herb layer is very similar to associated species collected in the Appalachians.

Only a few populations are known from the southern coastal plain province of Virginia, North Carolina, South Carolina, Georgia, Alabama, Louisiana, and Mississippi. Within these habitats it occurs within bottomland hardwoods or basic mesic forests (Schafale and Weakley 1990, Brown 1972). These habitats are typically dominated by *Fagus grandifolia, Quercus alba, Quercus rubra*, cheerybark oak (*Quercus pagoda*), and *Juglans nigra*. *Carpinus caroliniana* and *Asimina triloba* are often in the understory. Uncommon coastal plain herbaceous associates include *Sanguinaria canadensis, Asarum canadense, Dicentra cucullaria*, and columbine (*Aquilegia canadensis*)

Indicator Species

Many ginseng hunters refer to so-called indicator species that help them focus in on potential harvest sites (Beyfuss 2002, Apsley and Carroll 2004). Included in the description above of habitat are many of the indicator plants, such as *Arisaema triphyllum* and *Botrychium virginianum* that harvesters search for. An analysis of ginseng-associated species was undertaken in data collected in the southern Appalachian mountains of North Carolina and Tennessee. Species occurrence data was analyzed from 225 plots installed from 1992-1999. A suite of 10 species was found to be highly correlated with ginseng. The ten species are Maidenhair fern *(Adiantum pedatum),* Bloodroot *(Sanguinaria canadensis),* Yellow mandarin *(Prosartes lanuginosa),* Black cohosh *(Actaea racemosa),* Rattlesnake fern *(Botrychium virginianum),* Hairy Sweet Cicely *(Osmorhiza claytonii),* Blue cohosh (*Caulophyllum thalictroides),* Dutchman's Pipe (*Aristolochia macrophylla),* Bedstraw (*Galium triflorum),* and Canadian Violet *(Viola canadensis).* The presence of these species was used to determine ginseng habitat suitability for each of the 73 field plots examined in the rich cove model validation study.

There was much greater likelihood of detecting ginseng if at least 6 of these species were present (Figure 2).

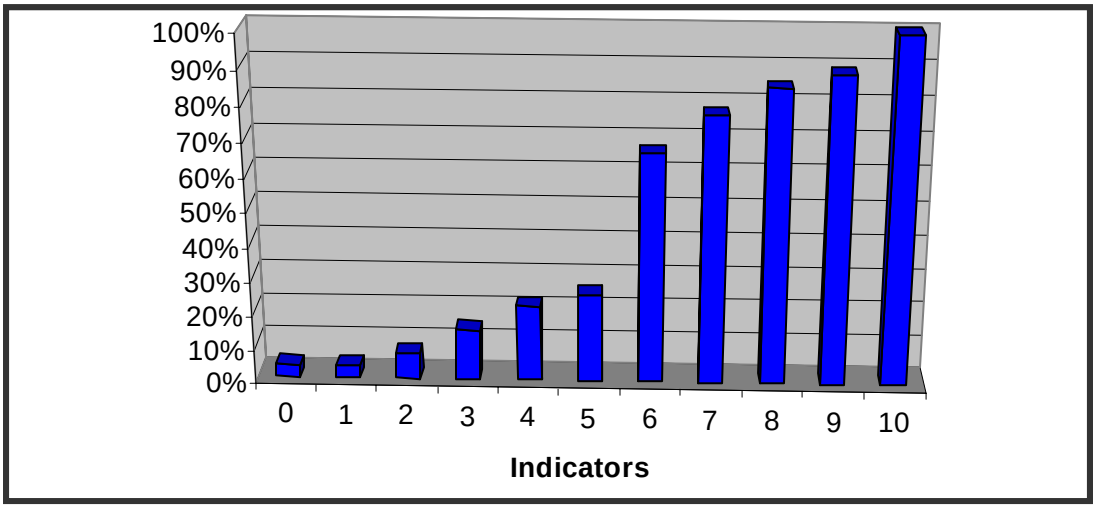

Figure 2. Percentage of plots occupied with ginseng based on the presence of other indicator species.

Thatcher et al. (2005) recently completed ordination analysis from 72 field plots with ginseng collected in portions of Kentucky, West Virginia, Virginia, Tennessee, and Ohio. They found that *Adiantum pedatum* was the strongest indicator across the range of their field plots. Other species with higher indicator values included *Trillium* spp. *Podophyllum peltatum, Caulophyllum thalictroides, Lindera benzoin, Arisaema triphyllum, Asimina triloba, Sanguinaria canadensis,* and *Asarum canadense*.

Historical Distribution and Abundance

There is little information on the historical abundance of American ginseng. Anecdotal information of former usage can provide some measure of the abundance of *Panax quinquefolius*. Native Americans utilized the root long before it became an economically valuable plant to the Orient. The Iroquois nation in upstate New York and southern Quebec called the plant garantoquen, which translates into “man’s thigh’s and legs separated” (Veninga 1973, Pritts 1995). The species was utilized in spiritual ceremonies as the plant was associated with old medicine man spirits (Veninga 1973). Numerous tribes detailed medicinal qualities. These included the Cherokee in the Southeast, the Creek in Georgia, the Houma in Louisiana, the Delaware on the east coast, the Meswaki in Iowa, the Mohegan in Connecticut, the Penobscots and Algonquins in New England, the Micmac in Nova Scotia and Prince Edward Island, the Pawnee in Missouri and both the Potawatomi and Menominee in present day Wisconsin (Moerman 1998, Veninga 1973, Foster 1991, Vogel 1970). It was utilized even on the edge of its range such as in

Oklahoma (Howard 1984). A few tribes such as the Pawnee and Seminole extracted love charms or potions from the root (Kindscher 1992, Moerman 1998).

It is unknown how extensively Native Americans harvested the American ginseng populations. Information can only be deduced from inferences. Prior to European occupation, the Cherokee traded for marine shells with coastal tribes, however it is unknown if American ginseng was one of their commodities (Duncan 1997). Both the Cherokee and the Chippewa (or Ojibwa) report American ginseng as a cash crop although again it is not known if this was the case prior to exportation to the far East (Moerman 1998). It is interesting that both tribes have recorded conservation harvest guidelines. Smith, in interviewing members of the Ojibwa tribe indicated roots were only harvested after the berries had matured (Foster 1991). James Mooney details Cherokee harvesting rituals (1900) involved only digging every fourth plant and performing a prayer prior and planting a bead in the hole after harvesting the first plant. There is no information on how extensive these guidelines were followed by tribe members. It is probably true that trade between early explorers and most of the tribes within its native range included the valuable ginseng plant. Indeed almost all of the early ginseng dealers were also fur dealers and a market economy already existed in that commodity with the Native Americans (Harding 1936, 1942, Gagnon 1999). It fact it is still not uncommon for both products to be traded by the same business, such as the Ohio River Ginseng & Fur Company, Lowe Herb and Fur in North Carolina, or the West Virginia Trappers Association.

Beyond the traditional medicinal and ceremonial usages in North American the inception of the ginseng trade solely resulted from a 1713 article published in the Philosophical Transactions of the Royal Society of London by Father Jartoux, a French Jesuit missionary and cartographer stationed in China (Pritts 1995). Father Jartoux detailed the substantial demand for *Panax ginseng* in China and Manchuria and its scarcity because of the collection for a substantial number of years. Furthermore he expounded on his personal experience on the efficacy of the plant reducing fatigue. He speculated if the species were to be found anywhere else in the world it would be within Canada, an area he considered very similar to the portion of China where *Panax ginseng* grew. Since many of the missionaries of that time period were also early explorers of the new continents, the original article sparked an interest in Father Francois Lafiteau, who was stationed in

American Ginseng Harvest Highlights

Pre-1715	Native American Medicinal Use
1716	American Ginseng recorded in Canada
1717-20	Canadian Trade Begins in Orient
1750	20,000-100000 lbs harvest in Canada
1752	Market Crash in Canada due to poor quality roots
1760's	Harvest established from Northeastern States
1773	55 tons exported from Boston harbor through European Middle Men
1770's	70 ton annual harvest
1782-84	Direct trade between American colonies & Orient
1821	Export of 180 tons
1800-50	Larger populations harvested across most of range, reports of harvest of 50-60 lbs/day by single harvesters
1850s	Ginseng Rush in Minnesota, Wisconsin, Illinois
1870's	Ginseng harvest reaching maximum of 210-225 tons per year
1870's	Ginseng becoming scare in portion of range, cultivation experimented by few initiates
1870	Intense Logging starting across Mixed Mesophytic Forest range
1900	Widespread reports on decline of Ginseng across range
1940-47	Japanese blockade of China, no ginseng trade
1975	Listing in Appendix II for CITES
1990's	Average annual wild harvest of 120,000 lbs

present day Canada. Three months after reading the article in 1916, he successfully relocated the American counterpart to Asian ginseng. The species was formally described by Michael Sarrasin, the French King's physician to Canada (Duke 1989). After Lafiteau sent some roots to China, the trade of American ginseng began overseas soon thereafter, although there are conflicting dates as to how soon it occurred with one report that commerce ensued as early as 1715 (Veninga 1973, Pritts 1995). What began as local collection of the American plant for export, quickly expanded to the whole Great Lakes area by the late 1710s (Gagnon, 1999). By 1720, the ginseng trade was only second to the fur trade in value (Goldstein 1975). The French Company of the West Indies formed as a result of this lucrative trade. Canadian Native Americans were soon employed as harvesters with the then lucrative sum of 0.25/lb. This resulted in few natives available to help with harvesting other crops (Veninga 1973). By the early 1750's the larger buyers were able to get as much as $5 per pound. The literature is inconclusive in annual harvest quantities. One source indicates over 20,000 lbs annually (Persons 1994), while another indicates over 100,000 lbs (Schorger 1969). Ginseng was being dug without any regard to sustainability or quality. Roots were dug throughout the season and improperly dried around campfires. The result was declining populations and burnt or scorched roots (Veninga 1973). The Chinese buyers were not interested in this inferior product; as a result trade dropped from a high of $100,000 in 1752 to less than $6500 in 1754 (Persons 1994, Gagnon 1999).

Trade with the continental United States picked up following the demise of the Canadian market starting in the northeastern states of New York, Massachusetts, and Vermont (Nash 1898, Pritts 1995, Persons 1994). Fifty-five tons of material was exported from Boston Harbor in 1773 (Williams 1957). Initially all the trade went by way of England, Holland and France, however several entrepreneurs soon realized the huge potential of a direct American to China market. In 1784, the Empress of China set sail from New York carrying almost 30 tons of ginseng in its hold. While the trip was long, over 6 months, the profit realized from this, over 30%, and other trips soon resulted

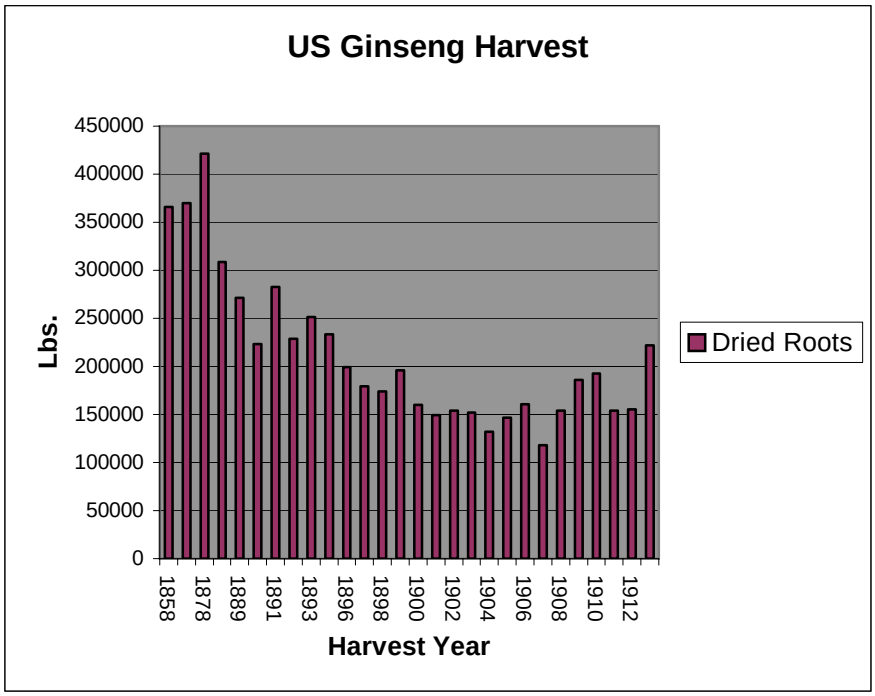

Figure 3. The average price of ginseng during the mid 1800's to early 1900's.

in a huge demand for dried roots. Apparently John Jacob Astor, founder of the American Fur Company, was an active trader in ginseng after realizing a $55,000 profit from a single trip in 1782 (William 1957). In fact it was eluded that ginseng gathering was more profitable than the fur trade in some parts of the Americas (Veninga 1973). Trade records are sparse during this period, however it is known that an average of 140,000 lbs were exported during the 1770's.

While nothing is known about precise quantities gathered from any one location anecdotal information reported throughout ginseng's range refer to its appeal as a readily sellable commodity during the late 1700's. George Washington in a trip to western Virginia in the late 1760's and in Pennsylvania in the 1780's refers to meeting "many mules and packs laden with ginseng going east…" (Washington 1978, Veninga 1973). In present day West Virginia and eastern Kentucky Daniel Boone harvested and purchased 12-14 tons of roots in 1787 only to have much of it ruined in a boating mishap while transporting these to the Philadelphia market (Hammond 1999). Not to be discouraged he collected almost as much the next year (Bakeless 1939). John Matthews, a surveyor for the Ohio Land Company in 1787, talked about camping in an area between Muskingum River and Short Creek for 5 days while digging the abundant ginseng population there (Pritts 1995). He indicated hardy men could dig 40 to 60 lbs per day. William Bartram in his travels through Cherokee Indian country in the Carolinas and Georgia during 1776 recorded the species as "appearing plentifully on the north exposure of the hill…." (Van Doren 1928).

Ginseng was gathered heavily in new territories with the westward migration of the new settlers. In western North Carolina and Kentucky Andre Michaux is believed to have instructed many settlers on the merits and economic benefits of American ginseng (Duncan 1997). Between 25-30,000 lbs. were collected from one watershed, the Toe River, in Yancey County, North Carolina in 1837 (Sheppard, 1935). By the mid 1850s the harvest of ginseng within that same county had drooped to 3500 wet lbs. (Sheppard, 1935). By the 1860's large quantities were dug in Indiana, Illinois, Minnesota and Wisconsin and quickly diminished in numbers (Nash 1895, Schorger 1969, Anderson et.al. 2003**).** After the Civil War in Randolph County, West Virginia harvesters gathered

$600 worth of roots from what they described as the largest population known (1898). Based on assumptions of market value at that time and the size of the plants it is likely the population was much greater than 10,000 individuals, probably closer to 20,000 individuals.

By the late 1850's trade in ginseng had increased to 366,000 lbs and continued to increase until the mid 1870's (figure 3). During that time it is reported that entire communities would collect ginseng for a day in the fall (Veninga 1973). A.R. Harding, a fur buyer and ginseng grower in southern Ohio, western Pennsylvania, West Virginia, and northern Kentucky noted single dealers handling from 20,000 to 100,000 lbs each during 1892-1897 (Harding 1908). He indicated during the earlier periods it was possible to find large patches with at least 100 lbs of roots. He noted that it was not unusual for

"sengers" to camp out and dig for the entire season in the 1800's. It is uncertain how much harvesting was completed during the entire season however there are indications that it was not restricted exclusively to the fall (Harding 1908).

By the late 1800's and early 1900's there were more and more reports of *Panax quinquefolius* becoming scarce and indeed by the 1900s the annual average harvest was less than 1/3 of that in the 1860's (Nash 1895, figure 4). During the mid 1800's to the early 1900's, lumbering operations were intensified across ginseng's range which undoubtedly intensified the impacts on native ginseng populations (Yarnell 1998, Gordon 1969, Martin 1992, Hinkle et. al. 1993). This beginning scarcity of ginseng in the wild is reflective of the relatively steep increase in price of the wild root during this period (figure 5). By the 1930's Harding speculates that ginseng had dropped to 10% of its former quantity in this area due to past heavy collection (Harding 1936). As ginseng became scarcer it resulted in less and less profit with harvesters making only a dollar or two per day in the early 1930's (Harding 1936).

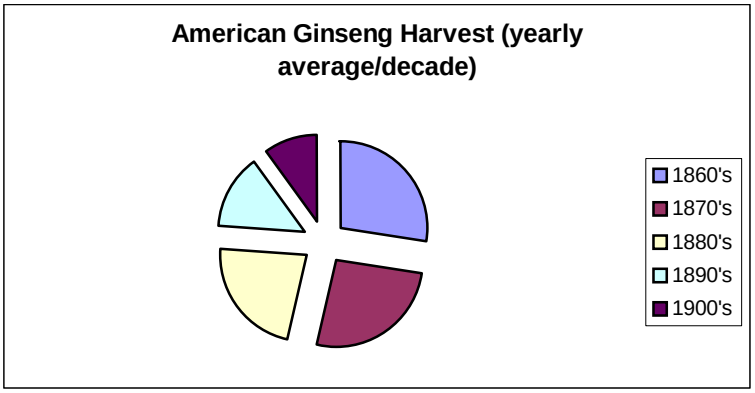

Figure 4. The average harvest of ginseng by decade during the mid 1800's to early 1900's**.**

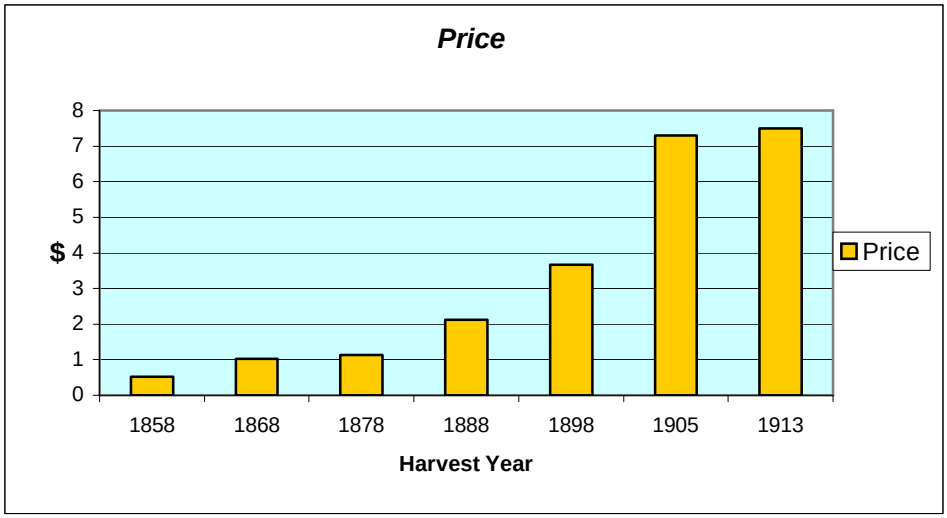

Figure 5. The average price of ginseng during the mid 1800's to early 1900's.

Regional floras also indicate the depletion of American ginseng populations. Millspaugh (1892) reports the species as becoming rare in North America. Britton and Brown in their Illustrated Flora of the Northern United States gave no indication on American ginseng's abundance in 1896 however had changed it to scarce in the 1913 edition. In the 1952 revision of the flora, Gleason treated it as rare. Taylor indicated the species was formerly abundant and now very rare in a wildflower manual in 1928. Small in 1933 states in his Manual of the Southeastern Flora the species "natural supply is being much depleted, the plant is now extensively cultivated". In the Flora of Indiana in 1940, Deam states "formerly common throughout state, now near extinction. In the 1948 published Wildflower Guide of the Northeastern and Midland United States, Wherry described ginseng's abundance as "occurring nearly throughout our area, it has been exterminated locally". By the 50's and beyond almost all the floras were indicating the scarcity of *Panax quinquefolius*.

During the 1900's there were gaps in mass collection of ginseng. Ginseng export was effectively stopped by the Japanese control of the Chinese ports during World War II. Commerce was stopped from 1940-1947 (Pritts 1995).

Given the continued uncertainty of the wild market, cultivation of ginseng was initiated in the late 1870's. Abraham Whisman of Virginia is credited as the first successful American ginseng cultivator however George Stanton of New York is widely attested as the father of commercial cultivation (Persons 1994). Apparently many growers started cultivating the plant across its range from 1880-1903, a period known as the "Ginseng Boom" (Persons 1994). A brief newspaper reference in *The Corydon Democrat* in December of 1904 indicated one local citizen of Corydon, Indiana had just sold his first crop of 4 to 5 year-old American ginseng roots. Stanton was producing as much as 100 lbs. dried root within a bed less than 100 square feet. By 1895 the USDA produced its first manual on cultivation of ginseng. There are no accurate figures indicating how much of the export market at that time included cultivated ginseng. Cultivated roots were getting as high or higher prices than wild roots during that period (Harding 1908).

Harvest root size also indicates a decline in the species over time. When the price was still 10 cents per pound there were accounts of large roots up to a single lb. (Arthur 1914). Based on price these individuals would have been harvested in the early 1800's. Today the number of roots is highly variable by state but typically 1 dried lb. ranges from 200-300 plants. These numbers indicate the harvested root size has declined and are thought to represent harvest of younger plants.

Given the lack of a systematic survey of the species across its range, *Panax quinquefolius* was placed in Appendix II of the Convention on the International Trade of Endangered Species (CITES) in 1973. (Robbins 1998, Patricia Ford, botanist, US Fish and Wildlife Service, Division of Scientific Authority, personal communication). The formal listing went into effect in 1975. The United States is the only exporter of wild American ginseng and implements the CITES listing by authorizing exports on a state-by-state, annual basis depending on the population status of the species and efficacy of management measures in these states. Canada does not allow any collection of its wild

populations. It was formally designated as federally threatened in Canada in 1988 (White 1988). Further review upgraded its status there to federally endangered in 2000 (Nault and White 1999, COSEWIC 2000).

The Office of Scientific Authority of the U.S. Fish & Wildlife Service assesses the current status of wild American ginseng and annually determines if the continued export will result in viability concerns to the species. A critical control to the continued export of the root is the inspections implemented by each of the 19 states currently exporting wild American ginseng. Each state registers its dealers, who record and quantify the harvest data by county from individual collectors. State inspectors certify the collections from the registered dealers and issue a permit essentially verifying the roots were collected legally based on the information they had. Each permit is valid for six months (Robbins, 1998). Most state inspectors also annually randomly count the number of roots constituting a dried pound. This information helps to quantify smaller roots, which typically indicates younger and younger plants being harvested. Large exporters typically buy the certified roots from the individual dealers and export it from the United States from one of the five ports designated for exporting *Panax quinquefolius*. The Animal and Plant Health Inspection Service (APHIS) under the U.S. Department of Agriculture is in charge of quantifying and inspecting the volume of plant material leaving the country at these ports. Currently 85-90% of the entire exported ginseng trade goes to Hong Kong (Robbins 1998).

Exports of cultivated American ginseng also requires a CITES certificate. The certificate stipulates and certifies the collection of the original parental stock did not result in a viability concern for the wild American ginseng (Robbins 1998). APHIS also inspects these exported roots. There are five official ports for ginseng export, Atlanta, Baltimore, Chicago, St Louis, and Milwaukee.

Recent regulations have resulted in some changes in the export of wild *Panax quinquefolius* from the United States (OSA finding 2005). In 1999, a minimum age of at least 5 year-old roots was stipulated, this past year the non-detriment finding changed to a 10 year-old minimum, as defined by the presence of 9 bud scale scars. Previously OSA came to a non-detriment finding for the continued persistence of the species regardless of all wild age classes being harvested. The finding in 1999 and 2005 detailed concerns about declines in wild ginseng populations and harvest in some parts of the country in the late 1990s. The finding in 1999 was followed in 2000 by further restricting the exported wild harvest to only those plants with at least 3 or more leaves.

Existing Range-Wide Distribution and Abundance

Panax quinquefolius is endemic to almost half of the United States and over a quarter of North America (figure 6). While primarily occurring across the eastern United States, it also occurs throughout the Midwest and in portions of the southeastern US. Ginseng has been reported and documented in 33 states, the District of Columbia, and 2 Canadian provinces (figure 7). Its range (see figure 3) is from southwestern Quebec, southern Ontario, south to Georgia, Alabama, Louisiana, Oklahoma, and Kansas (Natureserve 2003, USDA 2003, Gleason & Cronquist 2001, Kartesz 1999, Environment Canada

2003). The species has been referenced as presently occurring or having been extirpated within Florida in various scientific literature and older versions of websites (Natureserve 2001, Small 1933, Massey 1983, Ward 1979, Robbins 1998, Anderson 2003). However there has never been a documented occurrence of the species recorded within the state and the Florida Natural Heritage Program does not currently consider it be a native species there (L. Chafin, Florida Natural Areas Inventory senior botanist personal communication, web based Altas of Florida Vascular Plants 2003). It is speculated that Small included it in his 1933 *Manual of the Southeastern Flora* since it is known in a nearby Georgia County, Early, with a river drainage that also flows through North Florida (personal communication L. Chafin & Tom Patrick, Georgia Natural Heritage Program botanist). Undoubtedly as a result of Small's reference Ward stated in *The Rare and Endangered Biota of Florida: Plants* "Ginseng, *Panax quinquefolia* L., believed extirpated. Generally reported for northern Florida. Extensively collected northward for its medicinal root. No specimens seen and previous presence in Florida is in doubt." Within Canada the species is listed as occurring in Manitoba and an exotic in Saskatchewan (Fernald 1950, Natureserve 2003, Kartesz 1999). Manitoba was never known to be the natural range for *Panax quinquefolius* (Nash 1898, personal communication D. Gagnon). There are various personal communications of extirpated individual populations across its range, however American ginseng is not known to have been extirpated from any single state or province.

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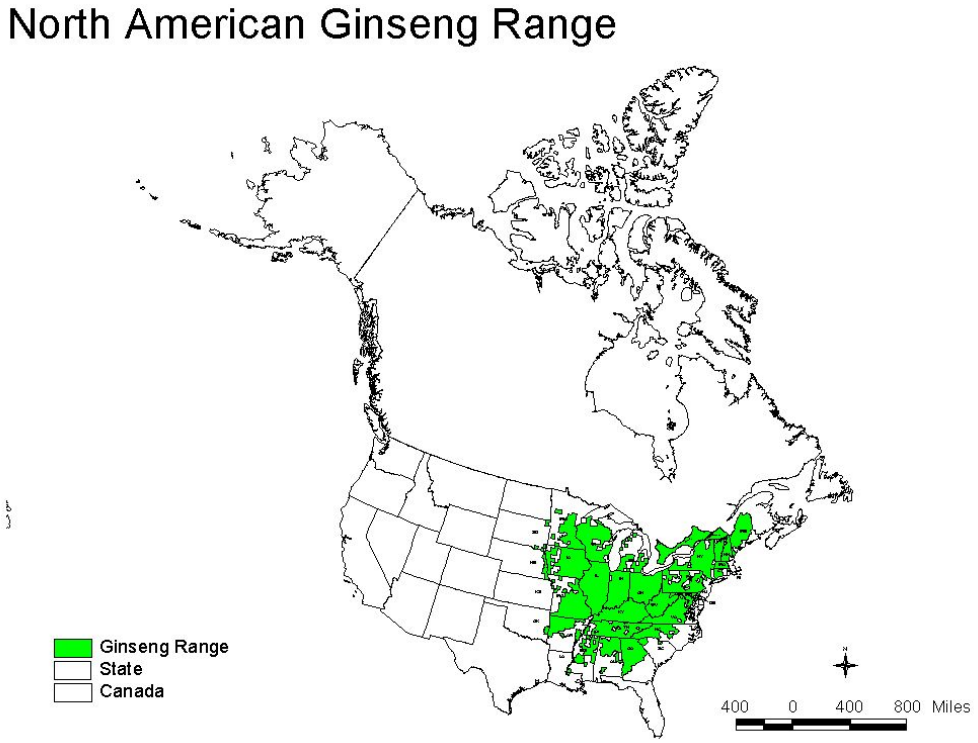

Figure 6. North American *Panax quinquefolius* distribution.

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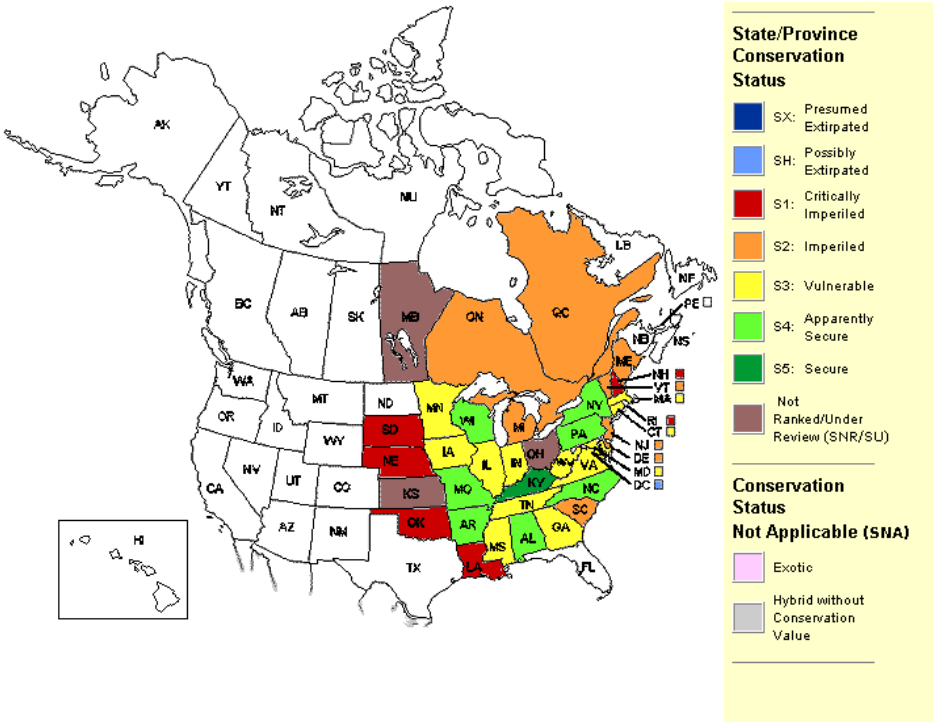

Figure 7. American ginseng state range map by S rank Natureserve 2005.

American ginseng's current abundance is variable and subject to change since it is a highly sought after commercial medicinal plant. Because of recent concerns raised due to declining populations of ginseng, the Nature Conservancy reevaluated the global rank reclassifying it from "common" (G4) to "rare/common" (G3G4) (Natureserve, 2001). Global ranking is done by consensus among scientific experts under the guidance of The Nature Conservancy. G4 ranked species generally have 100 to 1000 populations known while G3 species have from 21-100 populations known range wide. Ultimately the global rank considers other factors besides the number of occurrences. These include their population size and health to the extent known, the range, trend data if available, any known threats, and their fragility (Natureserve 2003). In the case of ginseng the fragility of populations due to harvest pressures greatly influenced the change in global rank. The global rank did not take into account that 9 states have a less rare state rank, in this case S4 and S5, than the final global rank. In the United States *Panax quinquefolius* has a national rank of N3N4. In Canada it is a federally listed species with a national rank of N2N3 (Natureserve 2003). It was formally designated as threatened by the Committee on the Status of Endangered Wildlife (COSEWIC) in Canada in 1988. The status was upgraded to endangered in 2000. In Canada it is rare and all natural populations are protected.

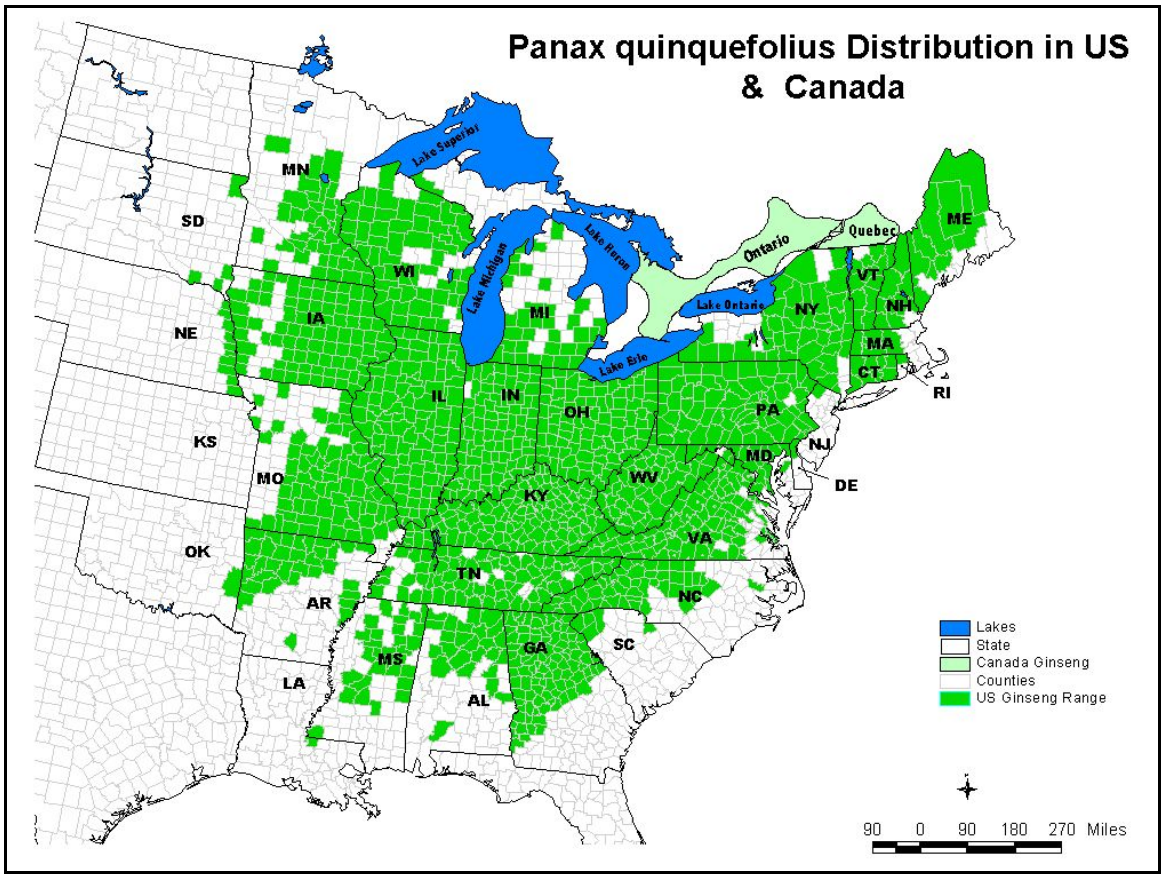

Figure 8. American ginseng county occurrence range in eastern North America.

Table 1 details the state ranks of *Panax quinquefolius* across its range. State ranks are often tied to numbers of populations as with global ranks but are also dependent on available population health or trend data. An estimate of each states number of populations was completed in table 1 either based on the state rank or known documented populations. Those states that formally track American ginseng have the most reliable information on the number and quality of populations however even this information is often not current (Michael Penskar, Michigan Natural Features Inventory Botany Program Leader, personal communication).

Country	State or Province	Status Rank*	State tracked	Estimated Populations based on status rank or tracked data	Percent of Counties with Ginseng	Estimated[aa] Individuals Harvested 2003
Unites States	Maine	S2	Endangered	26 extant, 9 historical	56%	
	Vermont	S2S3	Watch List	44 extant, 2 historical	93%	22,500
	New Hampshire	S2	Threatened	38 extant, 13 historical	90%	
	Connecticut	S3	Listed	21-100	100%	
	Massachusetts	S3	Listed	47	36%	
	Rhode Island	S1	Endangered	6-20	20%	
	New Jersey	S2	Species of Concern	6-20	5%	
	New York	S4	----		68%	101,000
	Delaware	S2	Species of Conservation	6-20	33%	

	Pennsylvania	S4	-----	101-1000	99%	176,000
	Maryland	S3	Watch List	21-100	63%	22,500
	Ohio	SNR	----	???	100%	1,403,000
	District of Columbia	SH	historical	Historical	100%	
	West Virginia	S3S4	---	20-500	99%	1,730,000
	Michigan	S2S3	Threatened	21-100	42%	
	Indiana	S3	---	21-100	99%	2,315,000
	Illinois	S3?	---	21-75	100%	715,000
	Iowa	S3	---	21-100	85%	68,500
	Wisconsin	S4	---	101-1000	79%	190,000
	Minnesota	S3	Watch List	21-100	45%	306,000
	South Dakota	S1	Listed	1-6	6%	
	Nebraska	S1	Threatened	1-6	11%	
	Kansas	SNR	---	?		
	Missouri	S4	---	101-1000	63%	499,000
	Arkansas	S4	---	101-1000	44%	555,000
	Oklahoma	S1	Watch List	1-6	1%	
	Louisiana	S1	Listed	1-6	2%	
	Mississippi	S3	Watch List	21-100	37%	
	Alabama	S4	----	101-1000	37%	193,000
	Tennessee	S3	Watch List	21-100	85%	3,166,000
	Georgia	S3	---	21-100	61%	95,000
	South Carolina	S2S3	Watch List	6-50	11%	
	North Carolina	S4	Watch List	101-1000	48%	2,390,000
	Virginia	S3S4	----	101-1000	70%	1,260,000
	Kentucky	S5	----	101-1000	100%	5,081,000
Canada	Ontario	S3	federally endangered	65 populations ~		
	Quebec	S2	federally endangered	74 populations ~11,000 individuals		

***State Ranks**

S1: Very rare, generally 1 to 5 occurrences believed to be extant and/or some factor(s) making it especially vulnerable to extirpation from the state

S2: Rare, generally 6 to 20 occurrences believed to be extant and/or some factor(s) making it vulnerable to extirpation in the state

S3: Uncommon, believed to be more than 20 occurrences and/or there is some threat to it in the state

S4: Apparently secure in state, often with more than 100 occurrences

SNR: State Not Reported or Rranked

aa Estimates based on 2003 state harvest figures and average number of dry roots/lb. The three states without dry roots/lb. data in 2003 were conservatively estimated based on previous counts or counts in adjacent states

Table 1: Status, Rank, and estimated number of populations of *Panax quinquefolius* across its range.

Panax quinquefolius is also informally tracked by 8 state heritage programs (table 1). These states are noted in table 1 with a watch list status. Each states individual informal category varies. For instance *Panax quinquefolius* is denoted as regional concern in South Carolina, as a watch class category in North Carolina, as commercially exploited in Tennessee, or it can be categorized as plant species of concern such as in Vermont or Maryland. (Amoroso 2002**,** Pope 2000, South Carolina Heritage Trust Program 2002, Lincicome 2001, Maryland Wildlife & Heritage Division 2001).

Characteristically those states with a watch list status are not actively tracking *Panax quinquefolius* in a standardized database. However, they are interested in information on

the species and typically keep hard copy files of these records. Other states keep active records on American ginseng sites. Typically these states either denote the species as endangered or threatened, however there are exceptions such as in Massachusetts where they track ginseng as a special concern plant (Connecticut Department of Environment Protection 2003, Massachusetts Natural Heritage & Endangered Species Program 2003). The states actively tracking the species are Delaware, New Jersey, Michigan, New Hampshire, Rhode Island, Maine, Massachusetts**,** Louisiana, and Nebraska (McAvoy 2003, New Jersey Office of Natural Lands Management. 2001, Nebraska Natural Heritage Program 2001, Louisiana Natural Heritage Program 1999, Maine Natural Areas Program 2002, Michigan Natural Features Inventory 1999, New Hampshire Natural Heritage Bureau 2003). A few states, such as Ohio, North Carolina, and Kentucky previously tracked *Panax quinquefolius* in either the late 1970's or early 1980's. Each of these states removed the species from the active list because of the numerous occurrence records.

It is difficult to get an accurate assessment of how abundant *Panax quinquefolius* is across its large range. There has not been a comprehensive survey for the species across its considerable range and with annual harvest within 19 US states the numbers undoubtedly fluctuate. A comparison of state ranks with existing harvest rates suggests the rankings are not consistently assessed across ginseng's range (figure 9). Kentucky consistently had the highest harvest rate during the past 15 years as well as in 2003. Logically it should have the highest state rank as is the case, however there was debate within the Kentucky Natural Heritage Program to assign *Panax quinquefolius* at a G3 rank versus a G4 rank (D. White, pers. comm.). Inconsistencies include the ranking of S4 by 6 states (Missouri, Wisconsin, Alabama, New York, Pennsylvania, and Arkansas) that typically have much lower harvest rates than 1 state ranked as S3 (Indiana) and 2 states ranked as S3S4 (Virginia and West Virginia).

A county occurrence map (figure 8) was generated from herbarium records, floras, county harvest records and communication with heritage botanists. It is most abundant in the central and southern Appalachian and Allegheny Plateau states of Kentucky, Ohio, West Virginia, Virginia, Tennessee, and North Carolina (Gagnon 1999). Within the extreme southern portion of its range (South Carolina and Georgia), ginseng is primarily restricted to the mountain physiographic region (USDA database 2005). Scattered populations occur within the piedmont of the southern states and a few rare occurrences are located within the coastal plains of Rhode Island, Pennsylvania, Virginia, North Carolina, Alabama, Mississippi and Louisiana (figure 1).

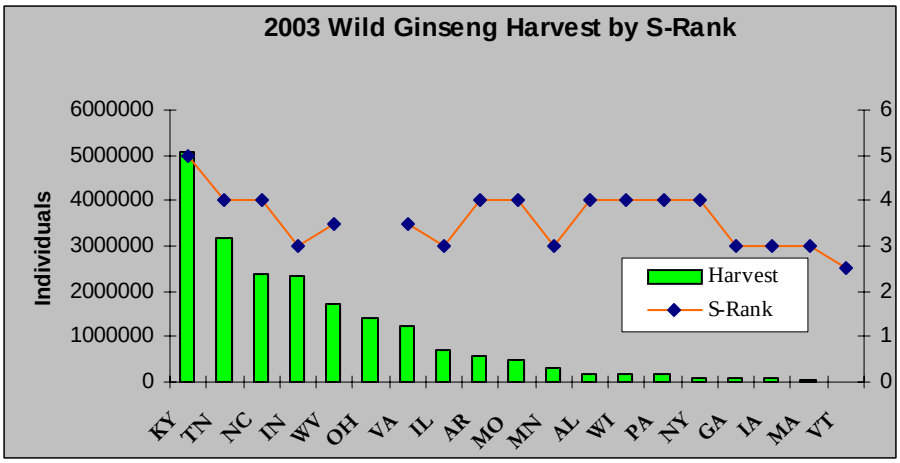

Figure 9. Comparison of state ranking (S-Rank) to recent harvest (2003 season).

Of the 33 states with *Panax quinquefolius* native populations, 19 currently export roots (figure 10). Within all of these states except Maryland there are national forest lands, although it is only a minor component within New York State. National Forest lands do not occur within 5 of the 14 other states with no wild harvested program. However of the other 9 states that do not allow wild harvesting, only 5 states have national forests with any appreciable acreage within American ginseng's range. These include the Sumter National Forest in South Carolina, the National Forests of Mississippi in Mississippi, the Ouachita and Ozark National Forests in Arkansas and a small portion of Oklahoma, the White Mountain National Forest in New Hampshire and a small portion of Maine, and finally the Ottawa and Manistee National Forests in Michigan (figure 10).

By examining the intensity of harvest for the past five years as well as during the 1990's decade, it appears that ginseng is most abundant within Kentucky and Tennessee with large quantities also within West Virginia, North Carolina, Virginia, Ohio, and Indiana (figure 11). Geographically all these states form the core or central *Panax quinquefolius* range. Within these states one might assume that ginseng is most abundant within Kentucky since the annual harvest for all of the 1990's there was almost twice that of the 2 next most abundant harvest states (figure 11, table 2). As one radiates from the central core it appears the group of states consisting of Illinois, Pennsylvania, Missouri, Wisconsin, and Minnesota have the next greatest number of ginseng populations. Iowa, Arkansas, New York, Alabama, and Georgia would have the next greatest harvest intensity. Of the 19 states with an annual harvest the two states that consistently harvest the least are Maryland and Vermont. State ranks were used to cluster the 2 remaining group of states with the least abundance of American ginseng in table 2. It should be noted and cautioned that the population abundance assumptions are all based on annual

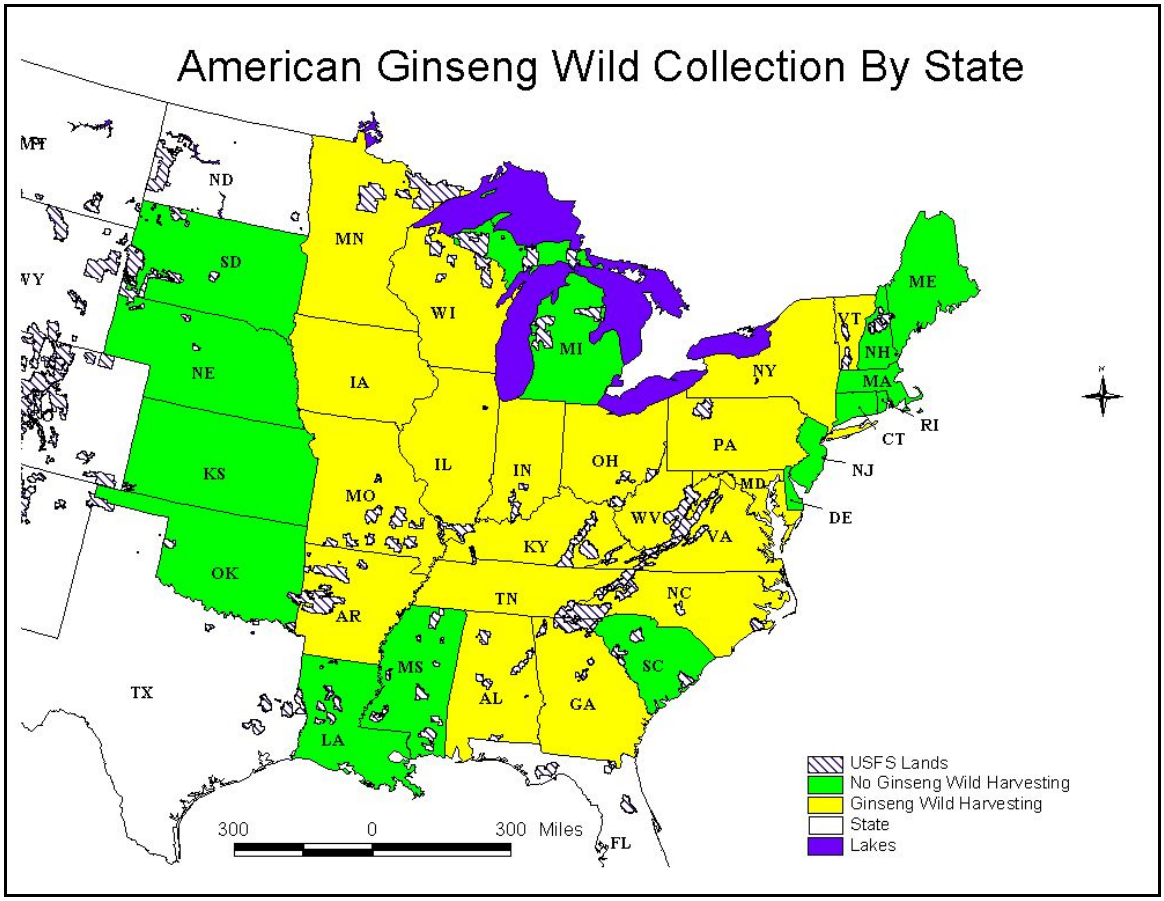

Figure 10. Legal collection of *Panax quinquefolius* by state.

collection data which can vary due to local social and economic circumstances as well as biological properties (Bailey 1999). How much of these quantities actually represent wild harvested ginseng is unknown. With a 10 to 20-fold price differential between wild and cultivated ginseng, some harvesters grow "woods grown" and "wild-simulated" ginseng in their own forest patches or even on tended patches on public land but sell and report it as wild. Woods grown is defined as ginseng grown in the forest where the soil has been mounded up to increase the yield of the crop. There is no tillage of the soil in wild-simulated ginseng; it is grown naturally at slightly higher densities under forest shade with minimal manipulation of competing vegetation (Hankins 2000, Beyfuss 1999, Burkhart 2004).

An attempt to assess the local abundance of American ginseng was completed by displaying the average county-wide harvest data for 2 years (1999 and 2000) across all 19 states (figure 12). These average figures were grouped into large harvest classes to account for possible inaccuracies in the data. The data suggest the highest harvest intensities in south central and southeastern Kentucky, followed by southwestern West

Virginia, western North Carolina, southern Indiana, southeastern Ohio and central West Virgina. As previously noted this data should be assessed with caution since county records may not be reflective of the county of collection due to poor data gathering by dealers or harvested material moving across state boundaries (T. Chisdock, pers. comm.).

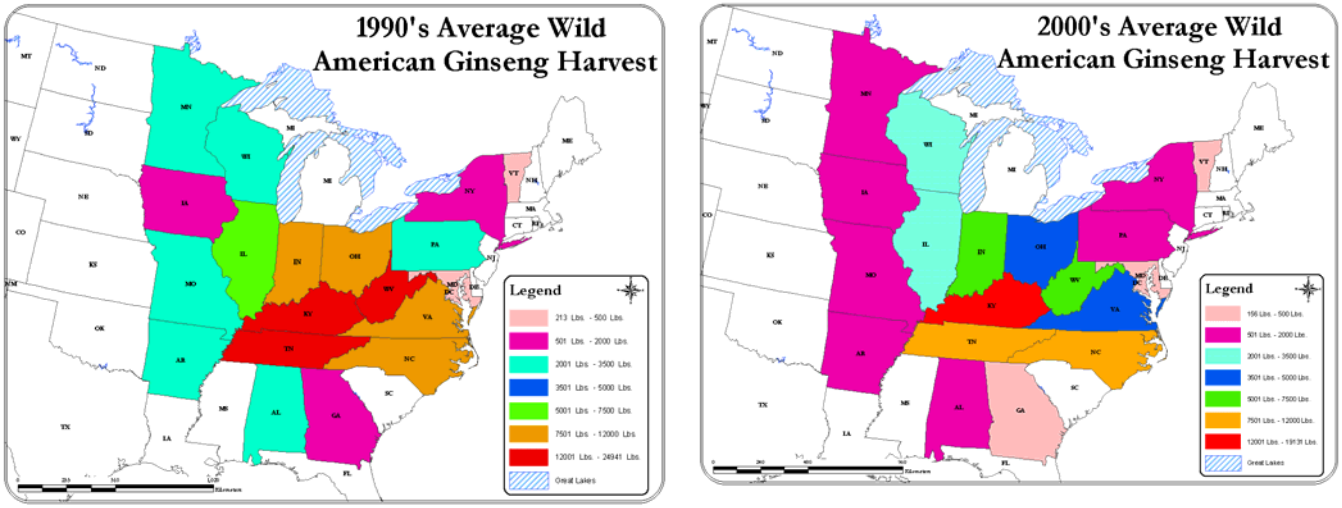

Figure 11. *Panax quinquefolius* Wild Harvest by state for 1990's decade and last 5 years.

Population Abundance	States
Greatest	Kentucky
	Tennessee, West Virginia, North Carolina, Virginia, Ohio, and Indiana
	Illinois, Pennsylvania, Missouri, Wisconsin, and Minnesota
	Iowa, Arkansas, New York, Alabama, and Georgia
	Maryland and Vermont
	New Hampshire, Maine, New Jersey, Delaware, South Carolina, Massachusetts, Connecticut, and Michigan
Least	South Dakota, Nebraska, Kansas?, Oklahoma, Louisiana, and Rhode Island

Table 2. Estimate of *Panax quinquefolius* abundance by state based on harvest records.

Other non-quantitative data can be gathered on the abundance of ginseng from current regional floras also. Weakley's draft for the Carolinas and Virginia indicates " has been reduced in most of its range to small populations of scattered individuals" (2005). Rhoades and Block in the Plants of Pennsylvania indicate it was formerly frequent but is now declining (2000). In both a 30-year old wildflower manual for Kentucky and a manual currently going to press, ginseng's abundance is described as rare (Wharton and Barton 1971, Thomas Barnes, University of Kentucky personal communication). *Panax quinquefolius* is listed as "rare, formerly more common" in throughout New England in 1969, although here is no mention on its abundance within the more recent Flora of the Northeast published in 1999 (Seymour 1969, Magee & Ahles 1999).

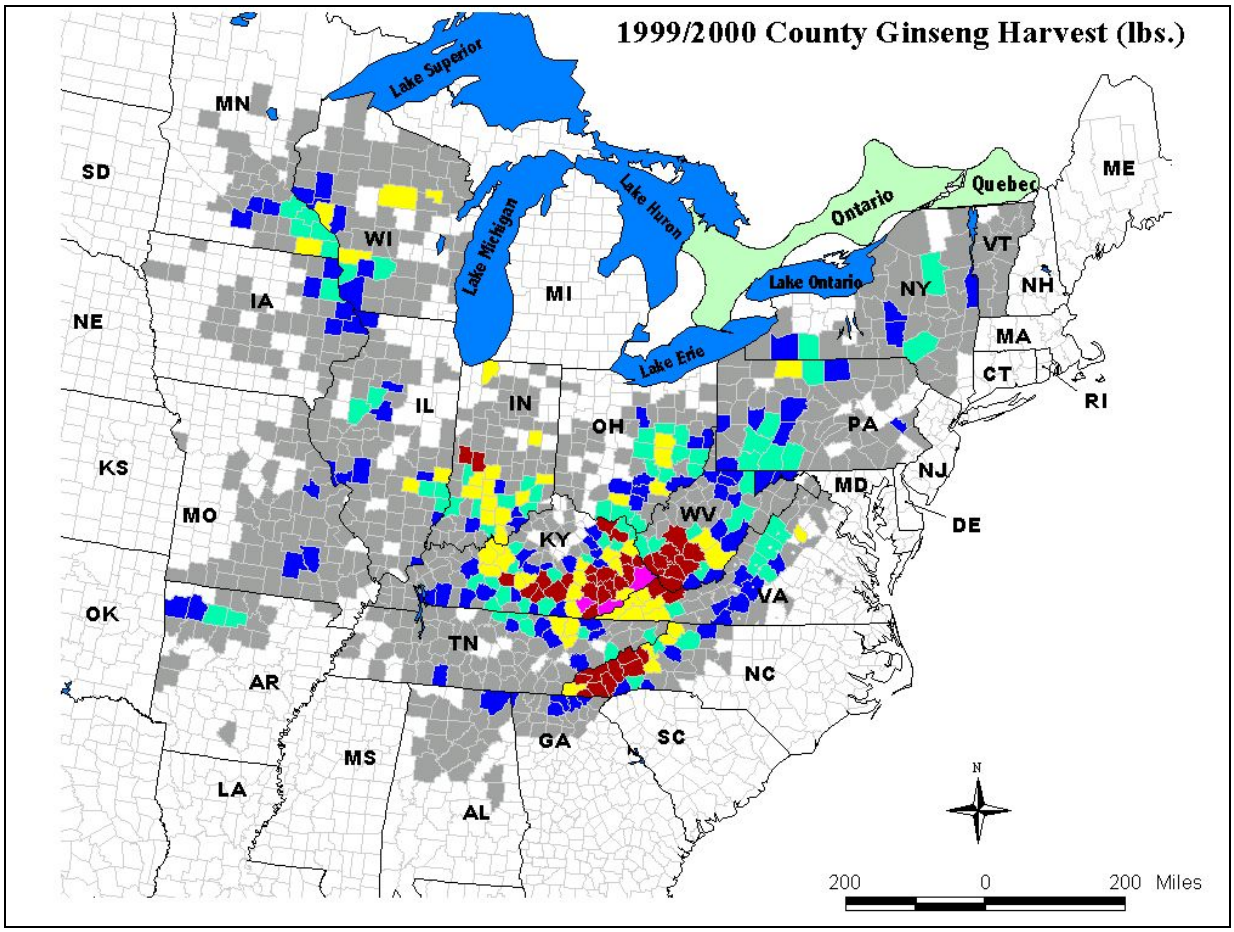

Figure 12. American ginseng harvest data by county averaged for 1999 and 2000. Shading of individual counties is delineated by white (no harvest), grey (1-50 lbs), blue (51-100 lbs.), green (101-200 lbs.), yellow (201-400 lbs.), red-brown (401-1000 lbs.), and pink (> 1000 lbs.).

USFS Distribution and Abundance

Many USFS units in Regions 8 and 9 occur across ginsengs' range (see figure 10). Except Iowa, a national forest unit occurs within each of the states that have a wild ginseng harvest program. A discussion will follow for each forest unit that currently has *Panax quinquefolius* populations. No national forest unit, except the National Forests in North Carolina, within states with an active ginseng collecting program has completed a comprehensive ginseng status review within their respective forest. Most units have site records, however these site records were often recorded while completing surveys for

other species or projects and may not reflect the complete population size for the species at that site.

Within Region 9 there are 10 states with National Forest units within or near ginsengs' range (table 3). The existing ginseng range does not extend into either the Superior or the Chippewa National Forest in northern Minnesota (figure 13). The nearest known occurrence is 21 miles to the south of the Chippewa NF (J. Greenlee pers. comm.). Neither forest has the species listed as rare on their respective forests although the Chippewa NF has their plant contractors search for American ginseng. It is highly unlikely the species could occur on the Superior NF given the boreal evergreen dominated vegetation present throughout.

Forest	State	Sensitive	Pops	Monitoring	Population Size
White Mountain	NH	Yes	16-18	No current data	Average <10, a few to 50 individuals
Green Mountain Finger Lakes	VT	Yes	9	No current data	5 or fewer individuals
Allegheny NF	PA	Yes	4	Recent monitoring	4-29 individuals
Monongahela	WV	No	15 +	Data from Dr. Jim McGraw Lab	Large populations 50-100 individuals, occasional 300 plus
Wayne	OH	No	10-15	No current data	From 10-50 individuals
Huron-Manistee Ottawa	MI	Yes	4	Recent monitoring	1 pop with 30, other 3 extirpated?
Hoosier	IN	Yes	25-30	No current data	Average 15-30 individuals, a few populations 100+
Shawnee	IL	Yes	?	No current data	Average 5-30 individuals, none more than 100
Chequamegon Nicolet	WI	Yes	2-5	Monitoring restoration sites	Typically < 25 individuals
Mark Twain	MO	No	?	No current data	Typically < 50 individuals, some 100+

Table 3. Status and monitoring of *Panax quinquefolius* populations within Region 9 National Forest units.

The native range of *Panax quinquefolius* extends into both the Chequamegon and the Nicolet National Forests in Wisconsin (figure 13), although the species is rarely encountered (L. Parker pers. comm.). Only a few natural populations are known within the Nicolet that were located prior to listing the species as Regional Sensitive in 2000 (S. Janke, pers. comm.). The previous documented populations were located incidental to other surveys and averaged less than 10 individuals in population size. Mesic northern hardwood forests are the most abundant ecosystem on the Nicolet NF and the second

most abundant ecosystem on the Chequamegon NF. This ecosystem provides potential habitat for reintroduction of native ginseng and native seed from a local grower was introduced to a few sites. These sites will be monitored in the future to determine the success rate.

The Mark Twain National Forest occurs within the heart of ginsengs range in Missouri (figure 14). Since the species is not listed as Regional Sensitive, there is no active effort to monitor (D. Moore pers. comm.). Little is known about the abundance of ginseng on the Mark Twain NF. Other researchers in the area indicate populations are scattered across Missouri, tend to be small in size, and are more abundant in state parks compared to the national forest (D. Drees & T. Smith, pers. comm.). Of the few populations located within the Marke Twain, they have been small, typically less than 10 individuals (P.

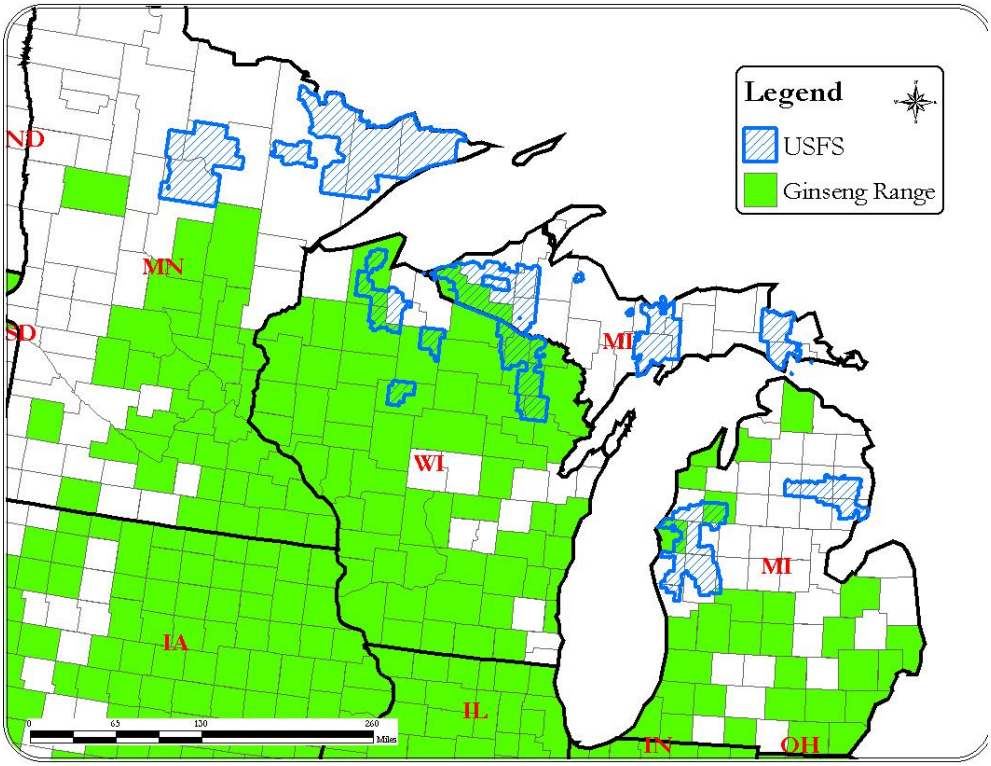

Figure 13. Range for *Panax quinquefolius* in National Forest units in Minnesota, Wisconsin, and Michigan.

Nelson, pers. comm.). Tim Smith, Missouri Dept of Conservation botanist, is tracking one population of approximately 300 plants. That population represents the largest population size suspected in Missouri. Dan Drees has been monitoring some populations within 6 larger populations with an average size of 92 plants (Drees 2002). Of these larger populations, less than 36% of the population was older in size classes with 3 or 4 leaves. The 4-leafed plants were less than 4% of the population total.

The Shawnee NF and the Hoosier NF are both completely within American ginseng's range (figure 14). While occurring throughout both states, American ginseng is believed to be more abundant in the southern counties that where not part of the former prairie

range (Anderson et al. 1993). Both the Shawnee and Hoosier National Forests occur within the southern portion of the two states. Within both forests, there has been no recent organized inventory of the distribution and abundance of American ginseng prior to the species becoming a Regional Sensitive species in 2000. Previous work on the Shawnee NF in the early 1990's located very few older reproductive plants. As a result of the scarcity and continued illegal collecting, the Shawnee NF prohibited harvesting of ginseng in 1991. Anecdotal evidence indicates the species has not recovered much such the elimination of ginseng permits. Beth Shimp recounts observing populations up to 100-120 plants in size, however in more recent times has only seen populations no more than 30 plants in total. Averge populations are small, only 10-15 plants in total. Mark Bassinger, who has conducted surveys across the state as well in the National Forest indicates recently, late 1990's and early part of this decade, he has not encountered any population larger than 100, most average between 10-20 individuals. A statewide assessments completed by Illinois State University within the early 1980's found a distinct difference between population size and age class in harvested vs. unharvested populations. Populations averaged were three times as dense and produced three times the number of fruits in protected sites in comparison to unprotected sites (Anderson et al. 1984).

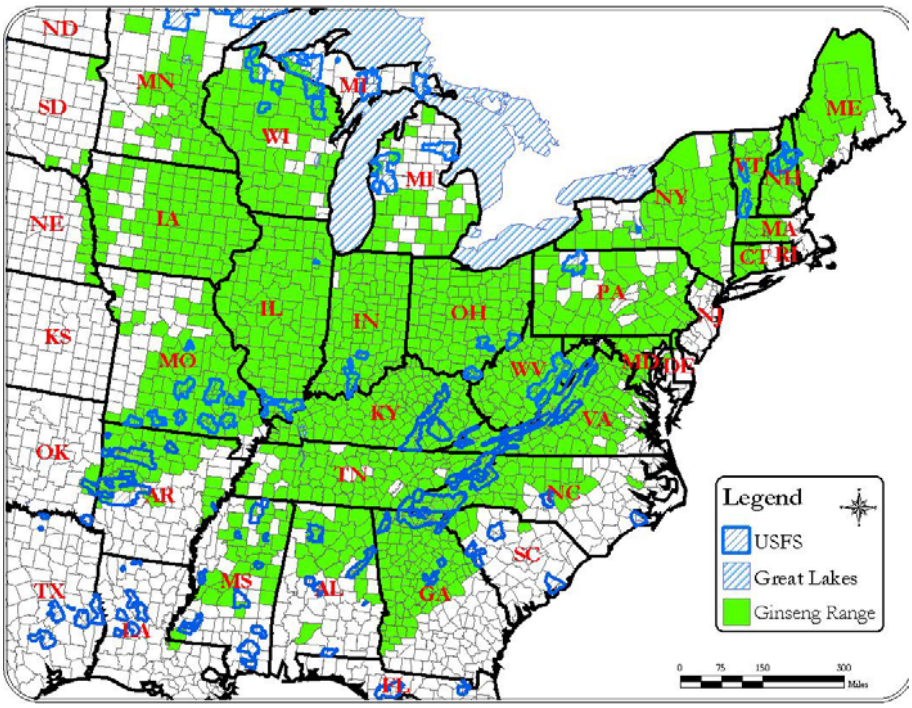

Figure 14. Range for *Panax quinquefolius* in National Forest units in the United States.

In Indiana there is no existing statewide ginseng inventory. Mike Hoyoma, botanist with the Indiana Divison of Nature Preserves, indicates average populations he sees are rarely more than a dozen individuals due to harvest pressures. In contrast a military base in the state has one large population with over 160 individuals including many 4-leafed (M.

Freudi, pers. comm.). As a result of concerns with dimminishing population sizes and continued poaching, the Hoosier NF banned all ginseng permits in 1997. Information in the early part of this decade indicated there were 22 populations recently documented on the Hoosier NF, all having small populations ranging from 1-12 individuals (S. Olson, pers. comm.). Brief surveys by the author and the Hoosier NF botanist and biologist located 7 populations in two days in 2001. Most were small in size, ranging from 3 to less than 30 individuals. Two larger ones had 45 and 108 individuals respectively. Five 4-pronged individuals were located, all except one of these occurred within the larger population. Sixty-five percent of these 6 smaller populations consisted of juveniles.

In Michigan two national forest units, the Ottawa and the Huron-Manistee are on the periphery of ginsengs' range (figure 13). The other USFS unit, the Hiawatha NF is not known to have any ginseng populations nor is it in the known range for ginseng (figure 13). Ginseng is formally tracked as a threatened species within the state. There are between 88 populations within the state, the majority of these occurring in the southern half of the state (Michigan Natural Areas Inventory 1996). Most of the records are historical or from obscure herbarium record, a status review is needed within the state (M. Penskar, pers. comm.). Only 19 have been either recorded or relocated within the last 20 years. These older records vary from ocurrences of less than a few individuals to as many as 300, however the majority have less than 10 individuals. Only 9 of the site records indicated more than 50 individuals present. Within the Ottawa National Forest there are 5 populations, 2 are known to be extant, the remaining 3 have not been relocated recently (J. Schultz, pers. comm.). These populations are all small, with less than 30 individuals.

White Mountain National Forest occurs in New Hampshire and a small portion of Maine in the Northwestern portion of ginsengs' range (figure 15). In both states ginseng is formally tracked as a threatened (New Hampshire) or endangered plant (Vermont). Population sizes within both states tend to be small, often less than 5 individuals (D. Sperduto, pers. comm.). In the White Mountain NF there are 16-19 extant occurrences in New Hampshire and 5 in Maine (Williams 2002, E. Larsen, pers. comm.). Three historical populations are also documented from New Hampshire. Most of the occurrences within the state that do not occur within the White Mountain NF occur nearby making the National Forest area the most optimal for this species within these two states. The five USFS populations in Maine vary from 3 to 50 plants with all except one less than 10 individuals. The New Hampshire USFS populations vary from 1 to 43 individuals. All except one population had less than 15 individuals.

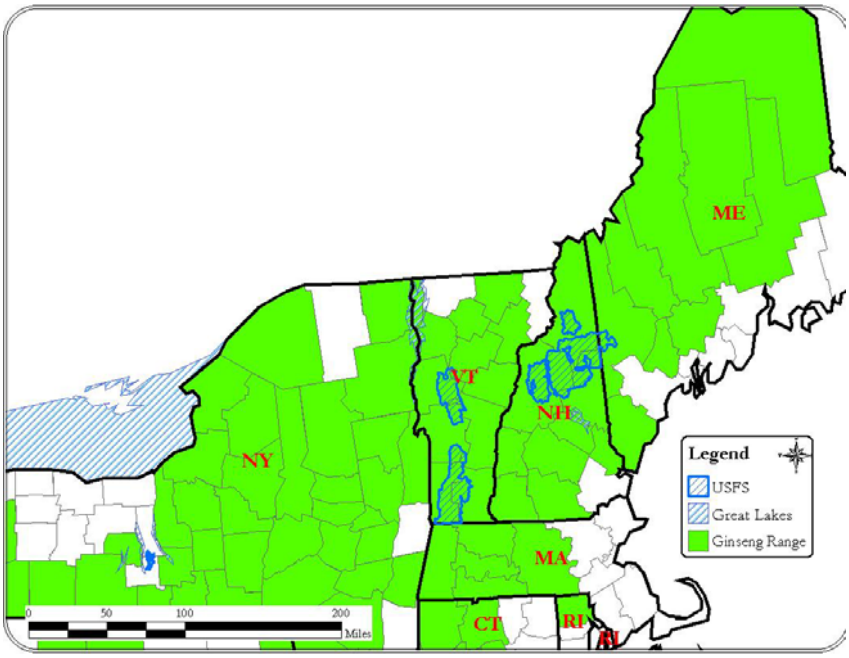

Figure 15. Range for *Panax quinquefolius* in National Forest units in Vermont, NewHampshire, and Maine.

The Green Mountain NF ginseng populations are similar to the White Mountain NF populations, although the forest is not known to occur within the heart of the species range in Vermont (Williams 2002). Nine extant occurrences are known in the national forest. Within Vermont, which informally tracks ginseng as a watch list species, there are 67 documented occurrences (R. Popp, pers. comm.). Most populations are small averaging around 10 individuals. Harvest is still permitted in the state. Of the nine populations known on the Green Mountain NF, all are small in extent, 5 or fewer individuals (M. Deller, pers. comm.).

The Allegheny National Forest occurs within American ginseng's range however it is not thought to be as abundant there as in southwestern Pennsylvania (S. Gund, pers. comm.). Gund considers a population size of 100 individuals large for Pennsylvania, most have many fewer individuals. Erik Burkhart, from the College of Agricultural Products at Pennsylvania State University, has been conducting an ongoing 3-year research project on ginseng's status within the state. His research includes an outreach program to growers and harvesters across Pennsylvania. Over 100 wild and wild-simulated plots are being studied. Burkhart contends populations are larger in extent, more than 100 individuals, it is rare to find populations less than 50 individuals. On the Allegheny NF, the total number of populations is not known although a few have recently been documented (A. Moore and C. Hydock, pers. comm.). Over 500 ecological typing plots (10 x 10 meter) distributed across the Allegheny NF failed to locate any ginseng individuals, thus the species does not appear to be well-distributed across the forest. The recently documented populations are small varying from 4-29 individuals with younger size classes including no 4-leafed individuals.

In Ohio there is no statewide ginseng inventory. *Panax quinquefolius* was tracked as a rare plant species until 1987 (Butch Grieszmer, ecological analyst, Division of Natural Areas & Preserves, personal communication). It was removed from the list when there were enough records to indicate a presence within each county. Two hundred thirty-nine previously recorded site occurrence records across Ohio were examined for abundance. Ginseng is documented more frequently within the southeastern portion of the state and least abundant in the northwestern portion of the state where it borders Michigan. The largest recorded population was 198 individuals. A few populations were recorded with 50 individuals. Most had fewer than 10 individuals. Care should be taken interpreting these numbers since the records give no indication of survey intensity. Recent observations of population sizes range from 5 to 300 individuals, with the majority under 50 individuals (E. Larsen, Dr. P. Cantino, M. Ortt, C. Carroll, and G. Duskey, pers. comm.).

A medicinal plant study, including ginseng, across 72 randomly located transects in appropriate habitat in the Wayne NF yielded 87 ginseng plants (M. Albrecht, pers. comm.) The size classes located favored younger individuals with 1-leafed plants representing 41% of the ginseng population, 2-leafed plants represented 29 % of the population, and 3-leafed plants represented 30% of the population. No 4-leafed plants were located within the field plots. The results indicated American ginseng density on the Wayne NF was 15 plants/ha (38.8 plants/acre). A brief survey by the author in 2001 located 10 small populations, ranging in size from 6 to 36 individuals. As Albrecht's assessment most of the 101 plants were 1 and 2-leaved representing 64% of the individuals located. Only one 4-leaved individual was located.

Within the Monongahela National Forest, there appears to be less optimal ginseng habitat compared to the Wayne National. This is based on personal observation and discussions with botanists from West Virginia University and the Nature Conservancy. The best suitable habitat for the species within West Virginia is in its southeastern portion bordering Kentucky. McGraw (2003b) developed an estimate for the state at a population density of 14 plants/hectare (5.6 plants/acre). In her master's study on the Monongahela National Forest, Dr. Martha Van der Voort located 43 populations (Van der Voort, 1998). They varied in size from 1 to 348 individuals with a mean of 21.5. Only 2 populations had more than 100 individuals. Some survey work by the author and the Monongahela NF botanist in 2001, J. Garrett, located 11 populations within the national forest. One population included 62 individuals, all the remaining populations had less than 11 individuals. One and two-leafed individuals represented 57% of all the individuals that were located

One other recent study by the U.S. Geological Survey–Biological Resources Division, including a ginseng predictive habitat study across Ohio, West Virginia, Kentucky, Tennessee, surveyed some plots within each respective national forest unit (Thatcher et al. 2005). Thirty-six percent of the study area, encompassing over 11,000,000 hectares (28,000,000 acres) was determined to be suitable habitat for ginseng. A validation study of 273 plots (30 by 30 meter) located ginseng in 11% of the plots. The maximum

population size was 37 plants with the majority of the individuals in the 2-leafed size class. Two percent of the surveyed individuals were larger 4-leafed plants. The mean population size was 5.8 plants. Preliminary population density estimates across the study area was 1783 ginseng plants/km2 (7.2 plants/acre).

Another multi-state study establishing 27 demographic monitoring plots across West Virginia, Kentucky, Virginia, and Indiana (one site) was initiated in 2001 (McGraw 2003a). Population sizes among the study area varied from an average of 128 in West Virginia, 145 in Indiana, 162 in Kentucky, and 76 in Virginia. A ginseng density of 18 plants/ha (46.6 plants/acre) was derived. Most of the populations were small and consistently reproductive individuals, 3 and 4-leafed plants, were not common or completely absent in most of the plots. The populations within West Virginia, Virginia, and Indiana averaged a 2% decline during the 3-year study. In contrast, the populations in Kentucky were increasing at a rate of 8%.

Within Region 8, there are 11 states with National Forest units within or near ginsengs' range (table 4). *Panax quinquefolius* is not considered a Regional Foresters Sensitive Species in the southern region. Within the southwestern periphery of ginsengs' range there are 4 states that all have national forest units (figure 16). The Kisatchie NF in Lousiana may have a small historical ginseng population extending the county range (P. Hyatt, pers. comm.). While the National Forests in Mississippi overlap the known range

Forest	**State**	**Monitoring**	**Populations**
Chattahoochee	GA	No current data	Typically 20-50 individuals, 1 historic population 618 individuals
Cherokee	TN	4 populations	Typical < 50 individuals
Daniel Boone	KY	No current data	Typically 10-50 individuals
Nantahala Pisgah	NC	2 demographic 7 Long term 45 short term	Averaging 50-100 individuals, occasional 200+, forest wide population model 4,000,000 plants
George Washington Jefferson	VA	No current data	Typically 10-50 individuals
Sumter	SC	37 populations	Variable ranging from 3-56 individuals
Ozark St. Francis	ARK	21 populations	Variable ranging from 5-30 individuals
Ouachita	ARK, OK	No current data	Typically < 25 individuals, a few populations 100-150
NFs in Alabama	ALA	5 populations	Most < 20 ndividuals, one with 40 plants
Nfs in Mississippi	MS	No data	May occur
Kisatchie	LA	No data	1 historic population < 10 individuals

Table 4. Status and monitoring of *Panax quinquefolius* populations within Region 8 National Forest units.

for ginseng, there are no populations documented in the national forest. In Alabama, the species is known to occur although there has been no extensive inventory across the national forest land (R. Stewart, pers. comm.). Most populations documented within the state have less than 20 individuals. Five populations on the forest, ranging in size from 10-40 individuals have been periodically monitored (every 3 years) during the past 8 years. All the populations have remained relatively stable, one population doubled in size from one sampling period to the next.

Within Arkansas, there is no extensive inventory across the state. American ginseng is still collected within the state. Because of difficulty of locating extant ginseng populations or only documenting small populations within the Ozark –St. Francis NFs during the 1998 and 1999 season, the forest instituted a 5-year moratorium on issuance of all ginseng permits (S. Best & R. Odegard, pers. comm.). As a condition of the moratorium, the forest developed a monitoring protocol of establishing 21 monitoring plots distributed across 6 ranger districts. The monitoring plots have been annually reviewed during the past 5 years with mixed results. Some of the plots had to be reestablished due to harvesting pressure eliminating all the individuals.

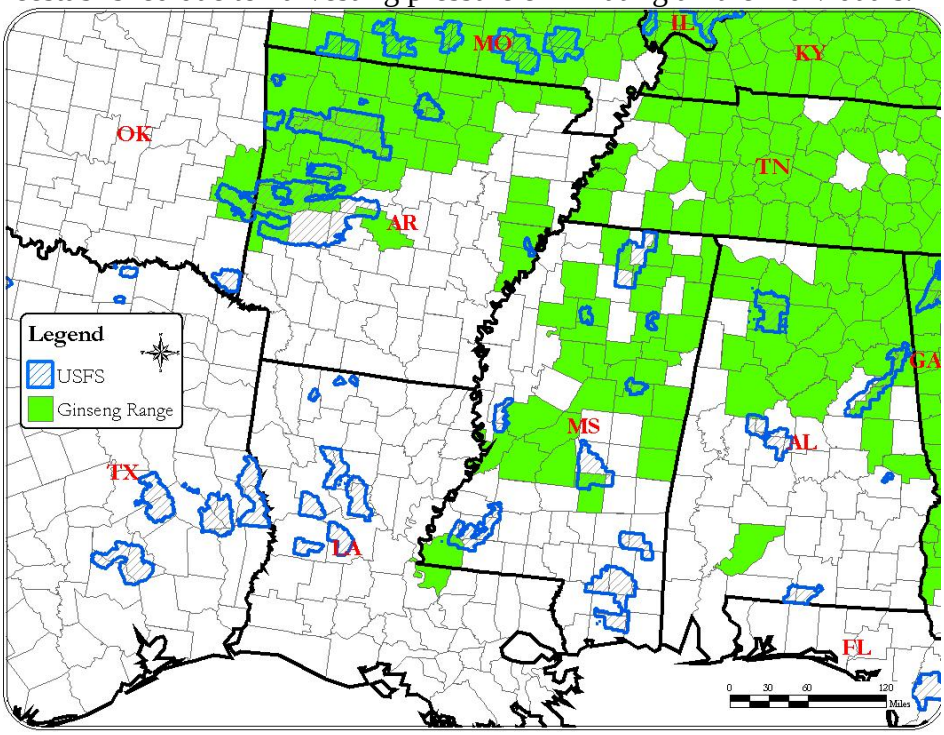

Figure 16. Range for *Panax quinquefolius* in National Forest units in Arkansas, Louisiana, Mississippi, and Alabama.

After 5 years the populations are either stabilizing following illegal harvest activity or are slightly declining in total population size. As previously documented larger size classes are still scarce within the plots suggesting continuing harvest pressure within the monitor sites. The Ozark –St. Francis NFs is currently evaluating the renewal of the permit moratorium; a decision will be made prior to the start of the 2006 season. The Ozark –St.

Francis NFs currently treat ginseng as a Management Indicator Species (MIS) to assess trends within mesic hardwood forests, however the draft land management plan currently undergoing review proposes to eliminate it from a MIS list. Even though it may no longer be on the MIS list, the Ozark –St. Francis NFs plan to continue to periodically monitor the 21 established plots.

The state of Georgia is one of the southernmost states that allow collection of wild ginseng. In the mid 1980's to mid 1990's a set of 20 monitoring plots (5 by 5 meters) were established (T. Patrick, pers. comm.). Fifteen of the plots were located within the Chattahoochee NF. Most of the population sizes were small, ranging from 1-5 individuals. One unique population had 618 plants. The study was abandoned by 1995 since most of the populations disappeared. The Chattahoochee NF does not currently monitor populations. Some of data collected by Jenny Cruise for a genetic study within the forest in 2000 located populations up to 50 individuals.

South Carolina is on the southeastern periphery of ginseng's range (figure 14). There is no formal monitoring program established within South Carolina for ginseng. The state heritage program informally tracks it as a watch list species. Little research has been gathered on this species within the state. Dr. Tim Spira, a Clemson University professor, gathered demographic data (2000) on 3 populations within an old-growth forest in a municipal watershed closed to the public for 70 years. The three populations of 308 individuals primarily consisted of 1 and 2-leafed plants. Three-leafed individuals varying from 13-35% of the populations. There were no 4-leafed plants. An age assessment of all the plants derived young average ages of the three populations, 2.8, 5.0 and 5.6 years. Thirty-seven populations are known within the Sumter NF in South Carolina (R. Mackie, pers. comm.). Most of the populations are small with 1 to 4 individuals in the southern Appalachian area of the Forest. The fewer populations within the adjacent South Carolina Piedmont have larger sizes, up to 180 individuals. These piedmont populations may be larger because there is not a deep cultural history of harvesting within this area of the Forest (R. Mackie, pers. comm.).

The state of North Carolina has no formal ginseng monitoring program. Plots established both on public and private land in 1979 and 1980 were abandoned in the mid 1980's due to funding difficulties (Sutter and Kauffman 2000). Eight of these plots on national forest land were resampled from 1999 to 2003. The mean size of these populations decreased during the time period and two of the populations were locally extirpated. There has been a significant decrease in the mean number of reproductive individuals present within these populations during this period (figure 17).

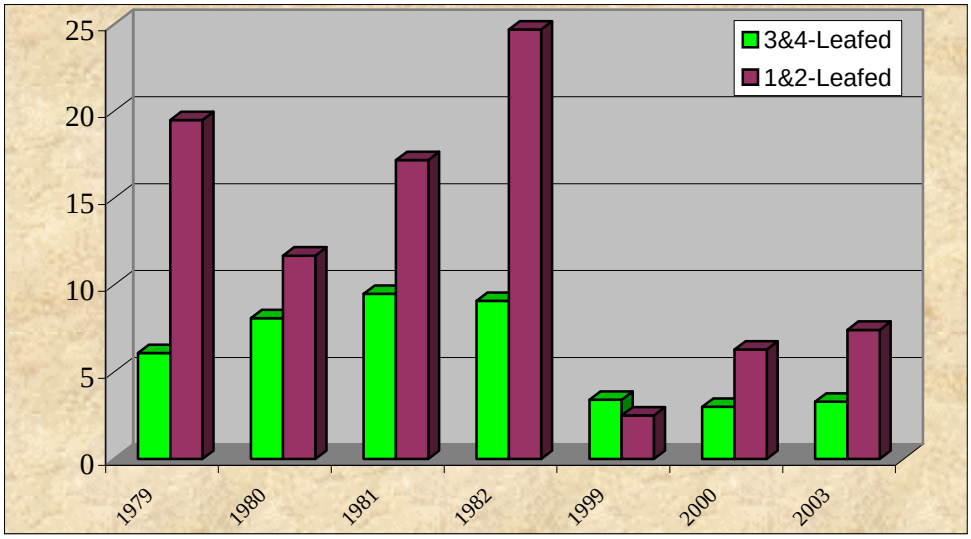

Figure 17. Mean of size class groups in 8 ginseng populations sampled from 1979-2003.

A predictive model of optimal suitable habitat for American ginseng within the southern Appalachians was developed from an analysis of continuous and discrete environmental variables present within more than 300 plots occupied with American ginseng. In 2000 and 2003 randomly selected plots (30 by 30 meter) were field checked to validate the model and quantify the presence of ginseng by size class. An estimate of ginseng's density across the Nantahala and Pisgah NFs in 2000 was 18.5 plants/hectare (45.6 individuals/acre (figure 18). By extrapolating the average number of all individuals counted, it was estimated there were slightly over 5,000,000 roots on the 2 national forest units, about 1,925,000 individuals of which were harvestable age, or a 3 or 4-leafed individual. A reassessment in 2003 found a slightly higher average number of ginseng plants per plot than in 2000, although a slightly smaller number of 3 and 4-leaved plants.

The state of Tennessee does not actively monitor its ginseng population in field plots. A model of ginseng habitat within the Great Smoky Mountain National Park (GSMNP) was developed (Rock et al. 1999). An estimate of 212,559 ginseng plants was derived for the park, which occurs within Tennessee and North Carolina. Four long-term monitor plots were recently established on the southern and northern half of the Cherokee NF (M. Pistrang, pers. comm.). Another 75 populations have been documented on the Cherokee NF during the last 10 years. These occurrences range in population size from 1-50 individuals. Less than 10 populations had more than 10 individuals.

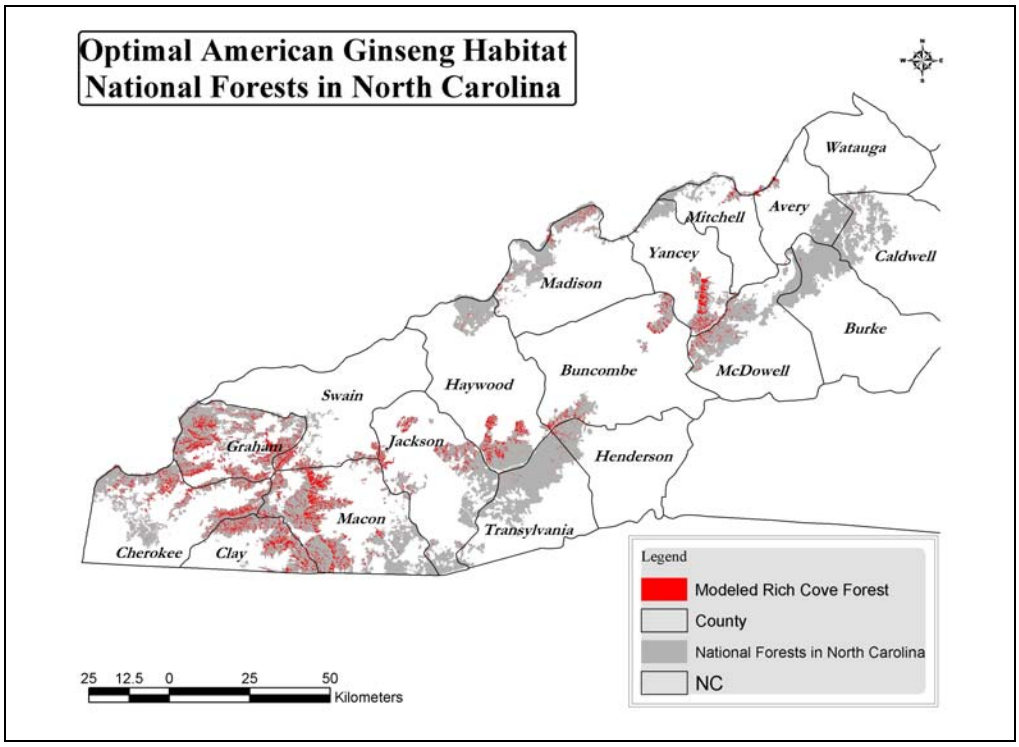

Figure 18. Potential distribution of optimal habitat for ginseng across the Nantahala and Pisgah National Forests.

Within the National Forests in North Carolina populations are not uncommon but tend to be small. Careful counts with randomly observed clumps will often locate 50-100 individuals, however larger populations are rare (G. Kauffman, pers. obs.). One has been documented to contain more than 1000 individuals.

Kentucky has consistently had the largest quantities of wild ginseng harvested for the last 15 years. The Kentucky Department of Agriculture initiated development of a series of one-acre monitoring plots across each of the 102 counties in 1978 (Jones et al. 2003). Plots were resampled approximately every 5 years. Correlation analysis of the 115 plots over the 25-year period determined that 39 populations (34%) increased in size, 16 populations (14%) were declining, and that 60 populations were relatively stable. The same patterns were generally observed when examining size class distinctions. Five of the plots are located within the Daniel Boone NF. The population trends across the state are similar for the Daniel Boone NF (T. Jones, pers. comm.). There is no monitoring program on the Daniel Boone NF. Small ginseng populations, up to 25 plants, are known to be scattered across the forest and more abundant in the eastern districts (D. Taylor, pers comm.).

Virginia does not have a series of ginseng monitoring plots. While biologists within Virginia and the national forests do not consider the plants common, they do find small populations at widespread locations (G. Fleming, F. Huber, C. Thomas, & L. Boggs, pers

comm.). The species was encountered within 27 of the almost 3000 plant community plots established across Virginia (G. Fleming, pers. comm.).

Population Biology and Viability

Most national forests and heritage programs that evaluate the status of ginseng within their respective state or forest indicate extensive harvesting is the single greatest threat to the species and thereby could affect its viability. In New England at the northeastern periphery of its range, experts think it has reduced population sizes from hundreds to dozens (SVE Panel 2002). Even some dealers and growers such as Larry Harding of Harding's Ginseng Farm in western Maryland acknowledge "overharvesting has almost driven wild ginseng to extinction. Most wild ginseng hunters make a practice of planting the seeds of the plant after digging up the root. Even so, the wild variety is scarce and difficult to find".

An analysis of 915 herbarium specimens (gathered during a span of 186 years) revealed a reduction in plant size for those specimens collected from the heart of ginsengs' range, the Midwest and further south (McGraw 2001). McGraw concluded the reduction was the influence of the long-term harvest of the largest plants. This reduction in size was not observed from specimens of closely related species placed in herbaria during the last 100 years (Ford 2005). Other research that suggests greater impacts in those regions with greater harvest intensity includes a study of 950 commercially harvested wild ginseng roots ranging in age from 1-39 (Anderson et al 2002). The data suggested harvest pressure is greater in the southern portion of its range since there was a linear decrease in root weight with a decrease in latitude plus the southern states had a younger mean age.

Charron and Gagnon (1991) demonstrated the harvest of 3- and 4-leafed plants, with the reduction of fruit in the future, had the greatest impact on the populations. Cruse-Sanders and Hamrick (2004) looked at 21 ginseng populations in four States (Georgia, Maryland, North Carolina, and West Virginia) to assess whether harvest pressures were affecting genetic diversity. They found significantly greater genetic diversity (higher heterozygosity), more older plants, and a larger age class for those protected populations in comparison to unprotected populations. They indicated that harvest reduced the genetic diversity due to loss of rare alleles that resulted from bottlenecks and genetic drift. This effect could ultimately reduce the growth rate for affected ginseng populations.

An unpublished study of infrequent and frequent harvested sites in North Carolina found similar results regarding the age class structure. There was a distinctive population shift toward a greater density of 3 and 4-leafed individuals (average of 6.5 individuals to average of 32.8 individuals) in frequently harvested populations to infrequently harvested populations. The infrequently harvested plots averaged 3 times the density of ginseng as infrequently harvested plots (figure 19). An age assessment of reproductively viable plants for a subsample of these plots demonstrated both 3 and 4-leafed plants were older in the infrequently harvested plots.

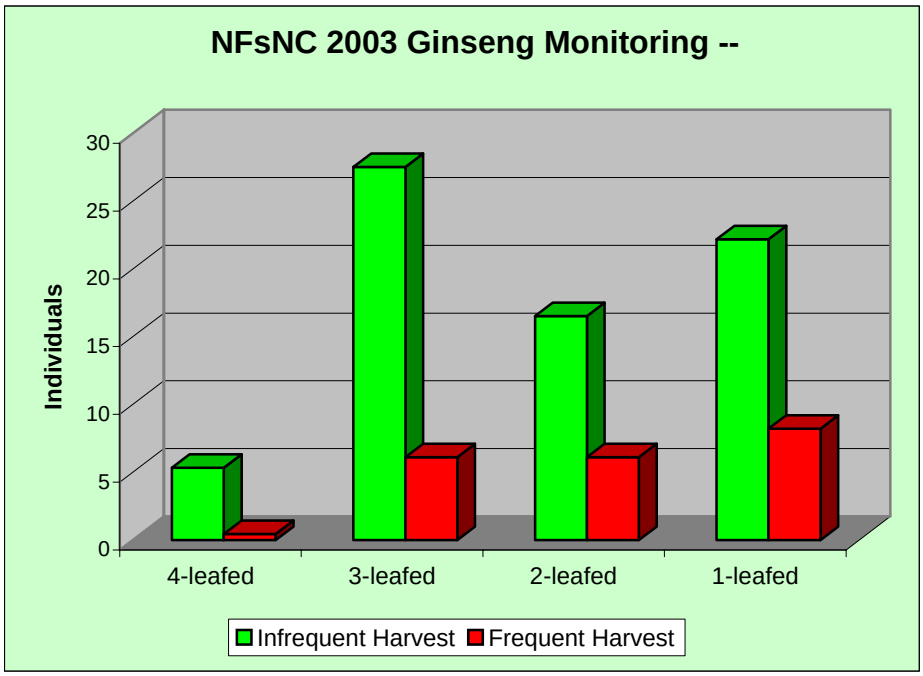

Figure 19. Ginseng population size class differences at frequently harvested sites compared to infrequently harvested sites sampled across the Nantahala and Pisgah NFs.

Different researchers have established long-term demographic plots to determine the minimum viable population (MVP) size for a few areas in ginsengs' range. MVP is defined as a 95% probability of persistence for 100 years (Soule 1987). In Canada the MVP population size is 172 individuals (Nantel et al. 1996), however in the GSMNP the number was 510 individuals (Gagnon 2002). Another study (McGraw and Freudi 2005) completed across Kentucky, Indiana, West Virginia, and Virginia determined a MVP size of at least 800 individuals was necessary if deer browse was a significant threat as it was within the study plots. The discrepancy in the MVPs were a result of different average growth rates (3% average rate in southern Quebec versus a slight decline in the Smokies), variable fruit production, the presence of dormant plants, and herbivory by white-tailed deer (*Odocoileus virginianus*).

Few harvest studies have been completed on ginseng. Some sustainable harvest rates have been calculated based on demographic data. Nantel et al. (1996) determined a harvest rate of 5–8% of a population, spread over each size class of plants would be sustainable. McGraw (2003b) recommended 5% would be a sustainable harvest within the heart of ginsengs' range. He indicated the importance of not harvesting fruiting individuals prior to ripening of the fruit, thereby not affecting the seed production for that season. Harvest of individuals prior to fruit ripening resulted in a decline in growth rate below a steady state level.

Van der Voort (2005) modeled 3 separate harvesting strategies based on demographic data on 6 West Virginia populations. Three harvester scenarios were identified. The noncompliant digger disregarded state harvest seasons, harvested 25% of 2-leafed plants and 3-leafed and larger plants in the population. The compliant digger harvested only during the state's open harvest season, harvesting 25% of 3-leafed and larger plants in the population, and scattered fruit, regardless of color, on the forest floor. The steward digger delayed harvest until fruits were mature, harvested only 25% of 3-leafed and larger plants with fruit in the population, and planted the fruit, regardless of color, at a depth of 2 centimeters. Van der Voort (2005) used life table response experiments to model the three harvester types plus a no-harvest control.

Neither the compliant or non-compliant harvester were able to compensate for the loss of seed, which was the single parameter that was the most responsive to population changes. The non-compliant harvester model was expected to result in a decline in the population at an average rate of 15% per year. The compliant harvester was not able ensure the sustainability of harvested populations with an expected decline of 8% per year. In contrast the steward scenario was expected to increase the population at a 4% rate. The authors concluded population growth rates were most responsive to mature seed production and carefully planting seeds at a depth of 2 cm. The harvest dates of some states currently do not always ensure the ripening of fruits, particularly those states that initiate the harvest season August 15 (McGraw et al. 2003). An on-going harvest study of a modified steward harvest methodology has been initiated in NC for the past 3 years. This study involves a 1-time harvest of all mature fruiting individuals with the careful sowing of all ripe seed at a 2 cm depth. The initial harvest included 90% of all 4-leafed plants and 71% of all 3-leafed plants. After 2 years the population size has recovered to pre-harvest levels (168 plants), however there has been a large change in size class frequencies. The 3 and 4-leafed individuals declined from 36% of the population to less than 7% of the population while the 1-leafed individuals have increased from 45%-71%. (G. Kauffman, unpublished data).

Clearly it appears the greatest impact to the long-term persistence of ginseng is inappropriate harvesting of the wild populations. However, most states or national forests do not have an active monitoring program on wild ginseng populations nor do they have an accurate assessment of average population sizes. The greatest long-term data for the species across its range continues to be the annual harvest counts (see attached Appendix 1). However, the ability to accurately assess population trends can be questionable as well as the completeness and accuracy of the location data. Annual harvest quantities can fluctuate with fluctuating regional economies and adverse weather. Most dealers indicate they have no way to validate the accuracy of the origin of the ginseng they purchase. In areas with nearby adjacent states, harvesters may dig in one state and sell in an adjacent state for premium prices or to sell earlier if there is a difference in the start of the harvest season. The frequency of this activity is unknown, however the ensuing transactions will not accurately reflect where the wild ginseng was collected

The data can be assessed for some broader trends. Within the last 15 years there has been a reduction in the annual US harvest (figure 20), however the general trend has been relatively constant from 1990 to 1997 (average of around 134,000 lbs.) with an almost 50% decline in harvest during the last seven years from 1998 to 2004 (average of around 67,500 lbs.). It is uncertain what resulted in the large drop but it does appear that the annual US harvest has been relatively stable for the past 7 years. The primary harvest has occurred within the following 7 states for the last 15 years: Kentucky, West Virginia, Tennessee, North Carolina, Indiana, Virginia, and Ohio. Not surprising, the respective National Forest system within each of these states except for Indiana still sell permits for collection of wild ginseng. The only remaining National Forest system that allows harvest within states with lower annual ginseng harvests is the Chattahoochee NF in Georgia.

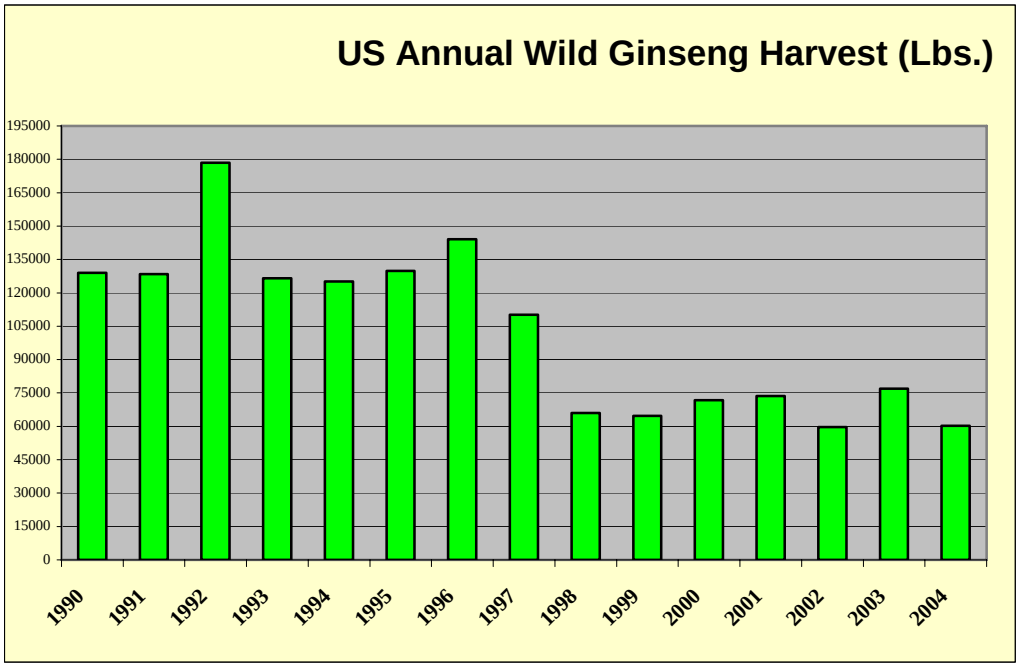

Figure 20. Total annual harvest of wild American ginseng from 1990-2004.

This decline in overall harvest in the later half of the 1990's has generally equaled a decline in the number of purchased permits within each respective USFS units that issues ginseng permits (figure 21). The decline of USFS American ginseng permits has continued to decline for most units within the later half as well. The annual number of permits in 2003 per National Forest unit varies from less than 10 to 250. Collection within the USFS units in North Carolina has been consistently higher than any other USFS unit. Within Region 9, the Wayne NF has the highest allowable number of permits. Not all the permits are issued at a consistent price or at a consistent quantity (table 5 & 6). Four units currently sell permits for 1 dried lb., the remaining 3 issue a permit for 1 wet lb. Permit costs vary from $20 for a dried lb. to $30 for a wet lb. The latter figure when corrected for dried wet would be approximately equivalent to $90 a dried lb. Ginseng harvesters buying permits have typically responded negatively with a change in permit costs. Often it has resulted in a reduction of the number of permits. For instance, the Wayne NF doubled the cost from $10-20 in 2002. There was a reduction

from 236 to 138 permits from 2001-2002. There was a reduction in the harvest of wild ginseng in Ohio during this same time period, however not at the steep rate in the decline of the number of permits.

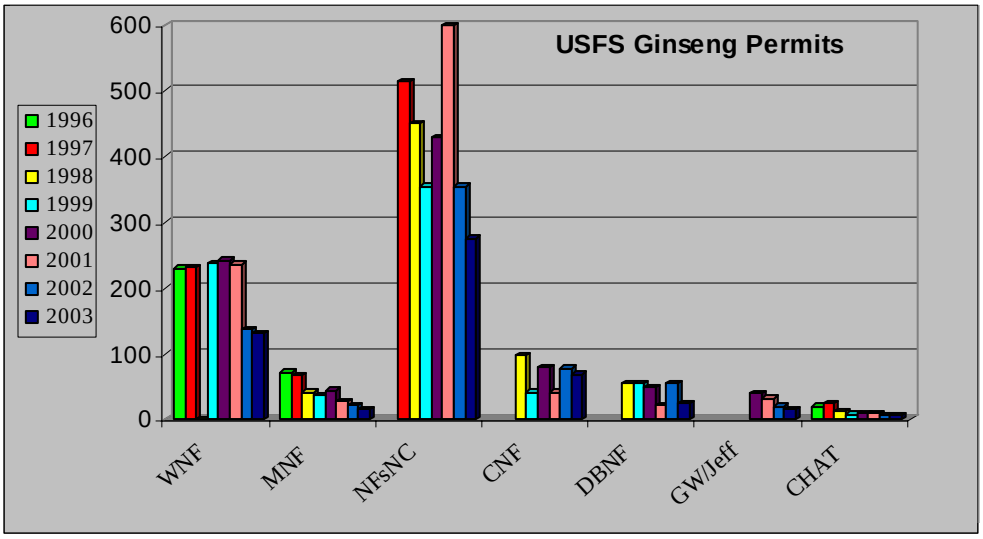

Figure 21. Annual Ginseng permits issued across seven national forest units from 1996 to 2003. WNF = Wayne National Forest, MNF = Monongahela National Forest, NFsNC = Nantahala and Pisgah National Forests, CNF = Cherokee National Forest, GW/Jeff = George Washington and Jefferson National Forests, CHAT = Chattahoochee National Forest.

USFS	Permits	Sold Dried/Wet	roots/lb	Dried Lbs.	Individuals Harvested	Pops/50	Pops/100
Wayne	130	Dried	308	130	40040	801	400
Monongahela	10	Dried	241	10	2410	48	24
Nantahala/Pisgah	240	Wet	365	80	29200	584	292
Cherokee	102	Dried	335	100	33500	670	335
Daniel Boone	35	Wet	250	10	2500	50	25
George Washington/Jefferson	15	Dried	269	15	4035	81	40
Chattahoochee	10	Wet	224	3	672	13	7

Table 5. Potential roots harvested and number of harvested populations if harvest either 50 or 100 individuals from dug populations.

Table 5 also indicates the average number of individuals reflective of the permit quantities sold for the past few years. An estimate of the number of ginseng individuals annually harvested can be derived simply by multiplying the average number of roots that weigh a dried lb by the number of dried lbs sold. The average number of roots is annually tabulated by respective state ginseng inspectors from a random selection of dealer's harvested roots. Of the seven forests still selling permits, the harvest varies from less than 1000 individuals too slightly greater than 40,000 individuals. Since it is difficult to determine how large an area these number of harvested individuals may occur

within, it is helpful to determine the number of populations that would be harvested if they had either 50 or 100 harvestable individuals (at least 3 leaved or at least 10 years of age based on the 2005 finding). Potential harvest within populations with a size of 50 and 100 individuals was analyzed since these are the sizes many interviewees across these states indicated was a large population. It should be indicated these harvest populations should be almost twice their harvested individual size if one also counts 1-leafed and 2-leafed individuals.

Since the Wayne and Cherokee National Forests sell the greatest number of individuals, the potential number of populations harvested from National Forest land could exceed 800 on the Wayne and 670 on the Cherokee NF. Are these permitted harvest rates sustainable? Only the National Forests in NC have completed a sustainable harvest assessment based on the estimated number of wild ginseng individuals derived from modeled suitable habitat. These rates are just under what both McGraw and Gagnon have determined could be the upper harvest rates for a sustainable yield. However, these estimates do not consider the rate of poaching.

Year	Permits	Harvested Individuals	Forest Estimate	Harvest Estimate
1997	514	48800	1500000	3%
1998	450	43500	1500000	3%
1999	355	34700	1500000	2%
2000	429	47,000	1500000	3%
2001	600	73,000	1500000	5%
2002	355	42000	1500000	3%
2003	276	32000	1450000	2%
2004	240	28500	1450000	2%

Table 6. Potential rate of wild ginseng harvest on the Nantahala and Pisgah National Forests based on the issued permits.

If significant, it could result in a potential unsustainable harvest. Since over 95% of all the permitted harvesters only purchase one permit for a single wet lb. while the average transaction weight with dealers in North Carolina is greater than 1.5 lbs., there is a strong suspicion that the harvest numbers on the national Forest could be much higher.

By assuming that ginseng collection on USFS land is proportional to ownership within the surrounding county, an estimate of potential harvest, including the illegally harvest, is obtained. These area based USFS county harvest estimates for the National Forests in North Carolina for the last eight years indicate the purchased permits only represent from 10-20% of the anticipated harvest. Similar poaching analysis completed for both the Monongahela NF and the Wayne NF in 1999 and 2000 does not provide a consistent intensity of illegal harvest. For instance during the 2 year time period the Wayne NF sold permits almost at 3 times the harvesting intensity within the surrounding counties. In contrast, the Monongahela NF sold 1/3 of the proportional county harvest rate in 1999 and almost 50% in 2000. Assuming a proportional intensity of harvest on national forest

land as on the surrounding private land may lead to inaccurate assessments. Unfortunately, the rate and intensity of illegal harvest can typically only be speculated.

However, the countywide harvest data can highlight where potential harvest intensity within the national forest unit may be particularly high (figure 22). Some units, such as the Daniel Boone and the National Forests in NC, occur within the center of the states highest harvest rate (figure 22). The numbers of permits issued may not be reflective of the harvest rates on the national forest unit. The remaining five permitting units also have generally higher harvest rates than most of the remainder of the respective state.

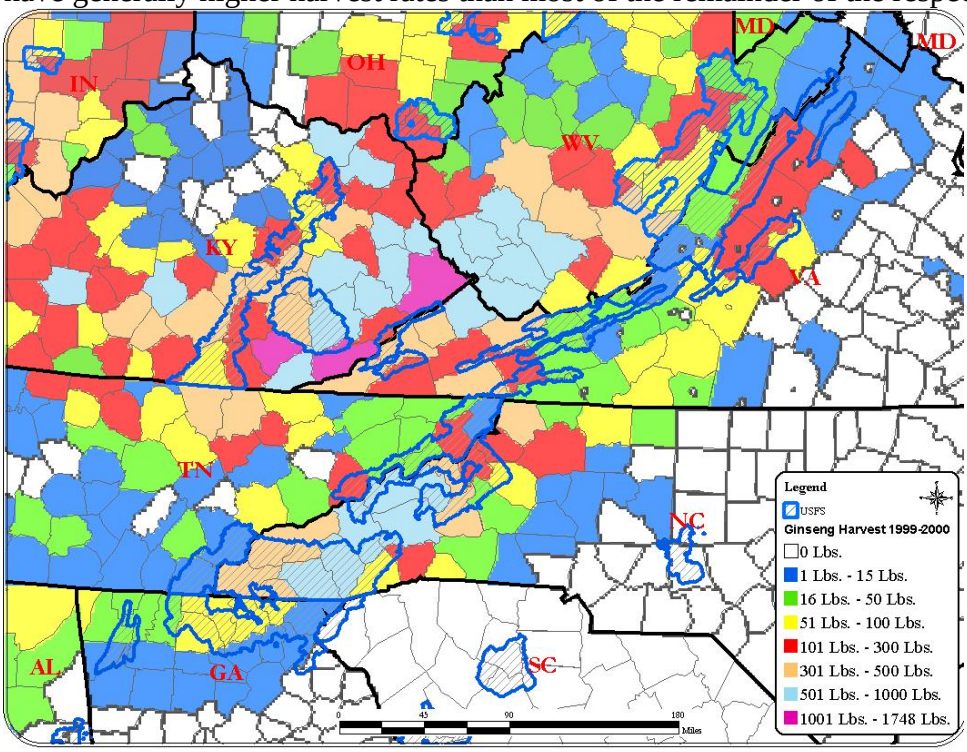

Figure 22. Average county harvest rate (dried lbs) of wild ginseng within the Mid-Atlantic States for the 1999 and 2000 season.

Poaching is recognized as a problem both within national forest units, national parks, state lands, and on private lands. It is unknown how significant an effect the illegal harvest is having on native ginseng populations. The illegal harvest is occurring both with legally collected areas (diggers with no permits) and within protected areas such as wilderness. The Great Smoky Mountains National Park (GRSMNP) is tracking poaching more than any other state or federal agency within American ginseng's range. Over 10,150 plants were seized between 1991 and 2000 (Rock et al. 1999), although they indicate they have no idea what percentage of illegal activity they are quantifying. John Garrison, in charge of law enforcement activities during a portion of this period within the GRSMNP indicated " the number of poachers you catch is directly proportional to the interest of the rangers". Most National Forest botanists interviewed for this assessment indicated poaching was a problem irregardless if ginseng harvest was permitted or not. Most forests have evidence of some poaching but are uncertain how extensive the

problem is. A few National Forests, such as the piedmont portion of the Sumter NF, at the periphery of ginsengs' range do not appear to have any detectable illegal harvest. This may be the result of low ginseng population density as well as the absence of a history of sustained harvest within the region.

Some national forest units that no longer issue ginseng permits, such as the Hoosier NF, may still be experiencing significant poaching pressure. The Hoosier NF occurs in southern Indiana that traditionally has the highest wild ginseng harvest rate (figure 23). While surveying native ginseng populations on the Hoosier NF and the Wayne NF in 2001, I completed a quick assessment on the ease of finding extant populations. Theoretically, the Hoosier NF should have populations that are recovering from the former harvest pressure while the Wayne NF should have populations with size class

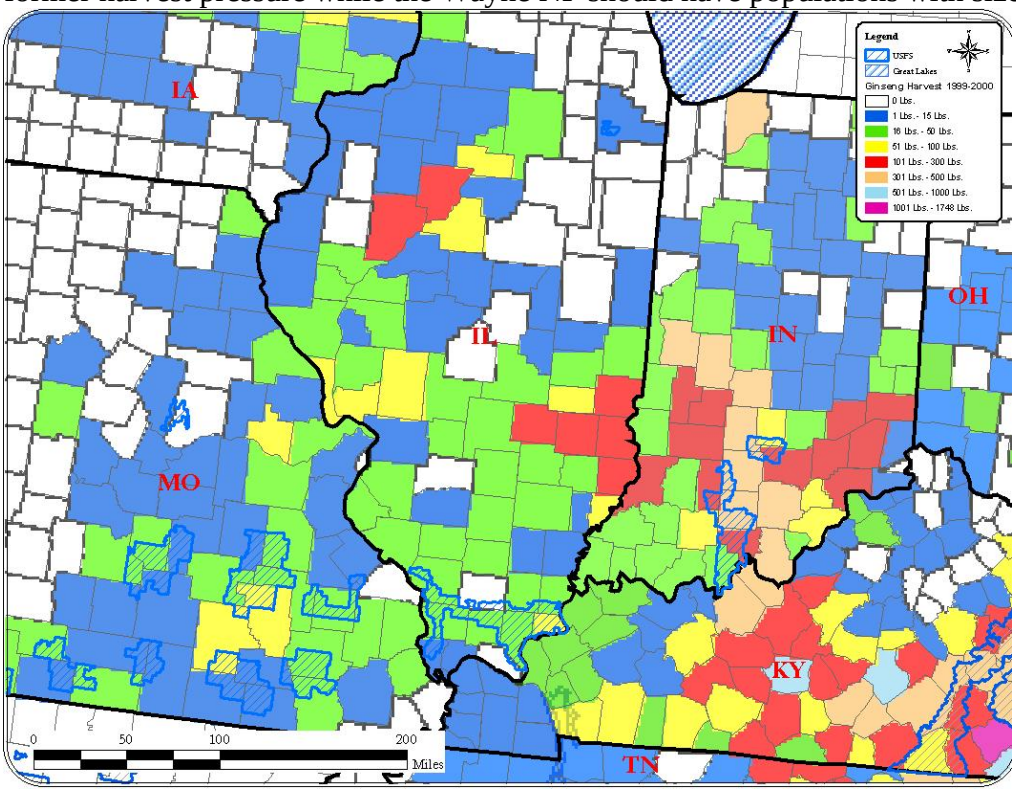

Figure 23. Average county harvest rate (dried lbs) of wild ginseng within the Midwest for the 1999 and 2000 season.

structure and total numbers indicative of populations with more frequent harvest. Both forests have similar habitats for ginseng and both have very fragmented lands. The surveys targeted areas where ginseng had been either known to occur before or where knowledgeable people indicated the potential was likely to encounter the species or suitable habitat. The survey time was recorded for each site. Eleven occurrences were located on the Wayne NF at a detection rate of 6.2 individuals per hour. In comparison, eight occurrences were located on the Hoosier NF at a rate of 8.2 individuals/hour. One site on the Hoosier NF included a protected area with higher base content and other rare plants. It was very different in terms of population size and size class structure from any of the remaining occurrences. If this site were excluded from the survey the rate of

encountering ginseng drops to 6.4 individuals/hour. The overall comparison of 3 and 4-leafed size classes was comparable, 37% on the Wayne NF and 35% on the Hoosier NF. This quick assessment does not indicate the Hoosier NF wild ginseng populations are free from harvest pressures.

Poaching is occurring within all land management designated land types including wilderness and natural areas. Two demographic plots in two separate wilderness areas on the Nantahala and Pisgah National Forests were harvested following the initial plot establishment. In areas where the Wayne NF abuts state park lands, which do not permit any ginseng harvest, harvesters are digging on the state lands providing the excuse they were unaware of the boundary when stopped by state park officials. The patchy land base on this Forest has its boundaries typically only marked at corners (C. Coon and D. Taylor, pers. comm.) thereby making it difficult to successfully ticket and fine poachers.

Fines levied on poachers within individual states are highly variable and appear to depend on how well informed the judge is regarding the market value of the root. For instance in Missouri, a reporter in the early 2000's while backpacking on the Ozark Trail on the Mark Twain NF encountered two ginseng poachers on an all terrain vehicle. The out-of-season harvesters were not averse to recording their names and appeared to have no reserve about illegally harvested the roots (D. Drees, pers. comm.). Approximately 200 poachers are caught annually within Ohio, which appears to have the most law intensive program. In Ohio in 2000, 2 men who dug ginseng out of season were each fined $2000, given 5 years probation with no legal collection of ginseng, and required to perform 6 months of community service. The two men were arrested with 4500 roots in their possession, which is probably close to 18 lbs. and may have had a market value for that season as high as $6000. It is difficult to track the incidence of fined ginseng poachers caught on National Forests lands since offenses are typically not specifically tracked for ginseng. Often they are either consolidated with other offenses involving botanical products. Most law enforcement officers within the National Forests units are covering very large areas, up to 150,000 acres. Consequently, ginseng poachers are rarely apprehended.

Since 1993 the GRSMNP in cooperation with the North Carolina Department of Agriculture (NCDA) initiated a constantly evolving ginseng marking program from steel ribbons, silicon chips to phosphorescent dyes (Corbin 2002). In 2001 the NCDA begun to train a K-9 unit to help detect illegally collected marked roots in the field both with a phosphorescent dye and a scent. The tagging program has been primarily implemented within the GRSMNP, the Shenandoah National Park, and the Blue Ridge Parkway although some other state and federal parks have also incorporated the tagging program. As of 2005, over 25,000 plants had been marked in the GRSMNP. Ginseng roots have also been marked on two National Forests, the Nantahala and Pisgah NFs in North Carolina. The marked roots are within managed Wilderness areas and natural areas where harvesting is prohibited. This tagging program is only successful if local natural resource law enforcement personnel and state ginseng inspectors are adequately trained and motivated to detect the marked roots. According to J. Corbin, the tagging program has resulted in successful prosecutions of poachers and deterred the incidence of poaching. It

is impossible to detect the lower incidence of poaching since there is no data on how prevalent poaching was historically and is currently. However empirical data indicates there is less poaching on public lands since ginseng population counts within the GRSMNP are higher than 10 years ago and marked roots are not being detected when inspecting wild ginseng bought by local dealers (Corbin, pers. comm.) Dealers have been discouraged from buying marked roots since they are likely to be seized by inspectors with an associated loss in profits.

Given the sparse inventory data there is insufficient information available to determine sustainable harvest levels within most national forest units that still permit ginseng collections. Budget and time constraints limit the ability of the respective forest units to adequately monitor the activity. In 2005, the USFS was given the authority for retention of receipts for special forest products at the issuing Forest or district. This revenue is to be utilized administrative, monitoring, and law enforcement costs associated with the special forest products program. Based on recent permit values the potential revenue across the seven units currently permitting wild ginseng varies from $200 to slightly more than $7200 (table 6). Only two Forest units, the National Forests in NC and the Wayne NF, would potentially have more than $2000 available. Most units would have less than $1000 available. As such, the development of any meaningful monitoring program will be difficult. As previously mentioned most Forests are not currently monitoring any ginseng populations. Given the recent availability of the funds, most forests have not yet decided on where the funds will be utilized. The Wayne NF will specifically be utilizing their funds to initiate a ginseng monitoring program this coming season (C. Coon, pers. comm.). Individuals ranger districts within the Nantahala and Pisgah NFs will receive the funds relative to the cost of the permits issued. There has been no discussion to utilize some of the funds to continue to monitor ginseng populations.

USFS	Permit Cost	Sold Dried/Wet	Permits	Potential Revenue
Wayne	20	Dried	130	$2600
Monongahela	20	Dried	10	$200
Nantahala/Pisgah	30	Wet	240	$7200
Cherokee	20	Dried	100	$2000
Daniel Boone	25	Wet	35	$875
George Washington/Jefferson	30	Dried	15	$450
Chattahoochee	30	Wet	10	$300

Table 6. Potential revenue generated from ginseng permits available for management of the program.

Maintaining larger populations with representation of older reproductive age classes are two important parameters to ensure the persistence of this species within any specific area of the country. There is insufficient information on the majority of the USFS forest units regarding population sizes. Harvest pressures are still occurring within national forest units even if they are not issuing ginseng permits. Are populations large enough to maintain viability considering the larger MVP sizes, ranging from 172-800,

determined from Canada to North Carolina? Populations that persist on the periphery of its range within the national forest units in the states of Michigan, New Hampshire, Vermont, Wisconsin, South Carolina, Alabama, possibly Louisiana, and Oklahoma are reported to be small and generally isolated. The Allegheny NF only has a few populations although it occurs closer to the heart of ginsengs' range. The continued viability of these peripheral populations within national forest units appear to be important in maintaining genetic diversity for the species. Those forests in Region 9 with designation as a Regional Sensitive species may be able to more easily address impacts to the species with a consistent policy compared to forests that do address impacts to the species. *Panax quinquefolius* is included on the Regional Forester Sensitive Species List for White Mountain NF, Green Mountain NF, Huron-Manistee and Ottawa NFs, Hoosier NF, Shawnee NF, Allegheny NF and Chequamegon and Nicolet NFs. The small number of populations documented for these units are protected from project impacts that either avoid populations with buffers excluding occupied sites. There are known potential threats from genetic degradation (see below) with re-seeding of forested areas with seed where the provenance is not known. Given the large range of the species, the abundant habitat still available, the previous extirpation of sites from over-harvesting there is great potential for the species to recolonize sites it may have been extirpated from due to local harvest pressures.

Potential Threats

Root harvesting is generally recognized as the greatest impact on ginseng populations within national forests units (see population viability and viability). Other impacts that can have long-term effects on populations include vegetation management, including canopy manipulation and prescribed fire, landscape urbanization, deer browse, and

- *Canopy Manipulation*

American Ginseng probably was first impacted by mass scale logging in the middle of the 1800's. The intense logging of the primary forest occurred across its range for the next 60-80 years. Within the heart of E.L. Braun's Mixed Mesophytic Forest region logging began in earnest in the 1870's with a boom lasting for the next 40-50 years (Hinkle et. al. 1993). Demand typically was only for the highest-grade trees. As a result most trees less than 24 inches in diameter were cut and burned. Intense concentrated logging progressed from one area to the next after exhausting the existing resource within the first area. Apparently the coming of the railroad was integral to increasing the logging intensity (Caudill 1963). More than 700 full train carloads per year were removed from an area during the height of logging the primary forest there (Hinkle et. al. 1993). By the 1910's with the ready use of railroads, logging increased in intensity in the Cumberlands (Caudill 1963).

Pre-harvest site preparation, prescribed burning, thinning, shelterwood harvest treatments, clearcutting, and treatment of competing vegetation using herbicide and slashing are the primary management activities that occur in sites suitable for ginseng in areas selected for timber production. Logging indirectly affects *Panax quinquefolius* with a rapid increase in light levels and temperatures at the forest floor as well as lower

ambient relative humidity. Other impacts can be a stimulus to forest invasive species. Few natural resource managers indicated a significant impact from invasive exotic plants, however some plots within the southern Appalachians are known to have been impacted by an increase in oriental bittersweet (*Celastrus orbiculatus*). No specific monitoring has been implemented within the following harvest activities. *Panax quinquefolius* grows in plant communities with at least 50% shade, although preferring 70-80% shade. Gagnon (1999) observed premature senescence of individuals in forest canopies of 50% cover. The immediate effects on ginseng plants within a recent harvest area may vary depending on the age of the individuals. Anecdotal information suggests that mature individuals are able to persist in the harvest areas while seedlings and juveniles die out (J. Corbin, personal comm. and personal observation). An Ohio Heritage Program has a record of two individuals observed in July in an open logged area. There is no indication on the long-term abundance at this site. Scott Bailey, a research ecologist at Hubbard Brook Experimental Forest indicated a population increased in size following a storm event that substantially reduced the forest canopy. A population in Ontario that experienced an ice storm is currently being monitored (D. Gagnon, pers. comm.). There are recurrent accounts of harvesters indicating they find larger ginseng population sizes within forest stands that have been recently harvested (10-20 years of age). The respite from harvest pressure within the logged stand may gradually allow the population to quickly recover. There is a lack of any detailed study following ginseng populations following timber harvest. It is suspected either thinning or single tree selection prescriptions may favor ginseng by maintaining a persistent canopy but increasing incidental light to the forest floor.

- *Urbanization of the landscape*

Across the United States 2450 acres of open space are developed every day. The continued urbanization of the landscape is impacting the availability of American ginseng habitat. While this does not directly affect National Forest lands, there may be an indirect affect from harvesters that traditionally gathered on private acres that no longer are available. The only outlet for harvesting may be on public lands. In addition, the increased growth may result in an increase in nearby accessibility to the National Forests or smaller private woodlots. It appears there continues to be a reduction in small isolated fragments across the original mesophytic forests within the Midwest (Brothers 1993).

Within the last 20 years, significant changes have occurred across the Southern Appalachians. Tourism, secondary home development, and county population numbers have increased dramatically and are projected to continue to rise. Use within the National Forests has changed as a result. A greater number of forest users are accessing what previously were inaccessible portions of the national forest. Since 1950, recreational use of forest roads has increased over 13 fold. This greater recreational use can result in more localized collection pressure.

- *Prescribed Fire*

During the past five years there has been a greater emphasis on the use of prescribed fire as a management tool across a large portion of Regions 8 and 9 national forest units. This increase in prescribed burning should have little effect on ginseng since mesic forest

communities typically are not targeted in a fire but only included in larger landscape burns. Within individual mesic hardwood forest, the result is primarily a low-intensity, low-severity fire. Little research of the effect of fire on ginseng has been undertaken. Preliminary results in Missouri indicate an impact to 1-prong plants from a hot fire (Drees, 2001). Mature reproductive plants and more than half of the juveniles, defined as 1-leafed plants survived the hot fire. In personal observations in recently burned areas both in Ohio and North Carolina, ginseng individuals were located the year following the burn. Neither of these sites had previous documented complete baseline data on ginseng individuals.

- *Deer Browse*

In a 6-year study in Missouri state Parks, Drees (2001-2003) an impact on up to 41% of reduction in seed production of previously flowering individuals. He found that deer browse pressure was partially tied to drought stress, the greater the drought, the greater the likelihood of deer visiting mesic forests. Seed germination trials of those seeds produced on plants with all the leaves browsed indicate very low percentages even thought the embryos appeared viable when collected. Drees found that plants entering dormancy because of browse pressure decline in vigor and typically take 4 years in terms of seed production to return to their previous reproductive age.

In the same study when the deer population was reduced, the reproductive success of ginseng improved. Drees reported that repeated deer browse could stress ginseng populations and result in a substantial decline in the percentage of mature plants that produce fruit. Farrington (in Ford 2005) evaluated different deer herd densities at the study site in Missouri. A three to 7% population growth rate was noted after the herd was reduced from 36 deer per square mile to 6 deer per square mile.

Furedi and McGraw (2004) have been studying the effects of deer browse in West Virginia for the last 5 years. They found it was critical to census a population 3 times during the year to detect browse pressure since browsed plants may go dormant as in late spring. She detected deer pressure greatest in spring or during a drought. They found deer preferred larger plants and therefore tend to have a greater impact on potential seed production. Annual browse rates varied across the 7 studied populations from 19-42% and appeared to be localized since the variation occurred more widely between populations than from year to year. As Drees, the researchers noted a decline in vigor of plants undergoing dormancy. The average decline of all 7 populations was 2.7% per year. An ex-situ controlled feeding study of 16,800 ginseng fruits provided to 8 white-tailed deer did not locate any intact seed in the deer's fecal pellets. They concluded that white-tailed deer actively browse ginseng fruit, but do not dispense any seed.

Deer herds are known to be large within local areas of West Virginia, Illinois, Ohio, Indiana, Kentucky, Minnesota and Pennsylvania (Webster and Parker 2000, Pederson and Wallis 2004, Frankland and Nelson 2003, Anderson et al 2002). Furedi (pers. comm.) has seen evidence of deer browse in Indiana as severe as her West Virginia plots, and also noted some in Kentucky and Virginia although believes the impacts are less evident. Ginseng populations within these areas could be currently affected. Deer populations in

West Virginia are estimated to be 2-5 times presently than during pre-settlement times (M. Furedi, pers. comm.). A recent analysis of deer herds within the counties surrounding the Daniel Boone NF indicates they are 3 times more plentiful than 40 years ago (D. Taylor, pers. comm.).

- *Genetic Degradation*

Small, isolated populations, loose genetic diversity due to genetic drift and inbreeding depression which can impact their long-term survival capabilities. Different researchers have concluded that wild ginseng populations are subject to high levels of genetic drift due to low population sizes and low migration rates resulting in possible bottlenecks (Cruise-Sanders & Hamrick 2004b, Grubbs and Case 2004). Boehm et al (1999) concluded that cultivated seed planted within wild populations results in lower genetic diversity within these populations, thereby potentially putting the populations at risk if some environmental change or disease pressure increases.

There is no complete historical data available on where and to what extent wild ginseng populations have been supplemented with cultivated seed. Many harvesters and dealers speculate that all populations have been mixed over the last 100 years since cultivation was first initiated. Separate genetic studies do not support this view across ginsengs' range, particularly where populations are in remote locations. Wild-simulated techniques are being heavily promoted throughout ginsengs' range (Burkhardt 2004, Carroll and Apsley 2004, Hankins 2000). These techniques have the potential to greatly increase ginseng populations, however there has been no organized effort to develop local regional genetic seed nurseries. Much of the seed currently available or previously planted originated from either the large cultivated centers of either southern Ontario or Marathon County, Wisconsin. Other seed producers do not know the original provenance of their seed (S. Persons, pers. comm.). Many harvesters and dealers are not convinced there is any need to develop regional genetic selections (R. Beyfuss, pers. comm.). History indicates that some growers recognized regional phenotypic differentiation in the early 1900's (Harding 1908). In Vermont, ginseng enthusiasts are planting ginseng in communities where it does not normally grow (Williams 2002). It is unknown if these plantings are originally derived from native New England ginseng. The prevalent views of many within the ginseng industry and the availability of cheaper Wisconsin or Canadian grown seed has the potential to impact local wild gene pools.

Research & Monitoring

Many references are available on research with ginseng. Two excellent reviews of current research are contained within Annex 1 (Ford 2005) of the recent Division of Scientific Authority finding for the export of wild ginseng in 2005 and an overview of the species for Native Plants Journal (Anderson et al. 2003). Research and monitoring needs to further help in conservation of American ginseng are briefly stated below:

- All forests need to develop a monitoring system that will remain useful and yet be achievable given current funding shortfalls. The most critical forest in need of inventory and monitoring information are those that currently sell ginseng permits: the Wayne NF, the Monongahela NF, the George Washington and Jefferson NF districts that still issue permits, the Cherokee NF, the Daniel Boone NF, the Chattahoochee NF. The National Forests in NC needs to continue to periodically monitor its established plots. Other forests with information needs based on perceived poaching pressures include the Hoosier NF, the Shawnee NF, and the Mark Twain NF.

- A national or regional strategy needs to be developed for the collection, production, redistribution, and recollection of locally gathered wild seed. Currently there are a few projects, like the one developed by Eric Burkhart in Pennsylvania, encouraging the production of regional germplasm. There are other seed producers that have both locally collected germplasm and other germplasm that are unsure on the provenance. The development of local seed nurseries will help to disperse this seed on both public and private lands.

- Experimental harvest studies need to be initiated across ginseng's range and across sites with different population sizes. There is a lack of information on how this affects size classes, fruit production, and persistence. Harvesters need to consulted to develop some harvesting methodology based on their frequency and intensity of harvest. Basic research is needed to determine the impacts of management activities on this widespread species. Anecdotal evidence indicates the species can survive and persist in timber harvest areas even though most of the recorded literature indicates the species prefers 70-80% shade. There may be selective management techniques that may benefit the species.

- Monitor a larger portion of ginseng's range (beyond West Virginia and Missouri) to assess impacts from white-tailed deer. This should be a critical information need within those USFS units at the periphery of its range with only a small number of populations. If grazing pressure is demonstrated, it may be necessary to install some exclusion fence if deer herds can not be reduced/

- State ginseng certification programs do not consistently track ginseng transactions to aid in apprehension of ginseng poachers. Two states, Wisconsin and Maryland, require all harvesters to obtain a license. Ohio is currently trying to pass this change through their state legislature. Other states, such as Tennessee, require all harvesters to sign their name with identification when they sell to certified dealers. Finally some states, such as North Carolina, only require a harvester to state their name when they sell their roots to the dealer. The later system makes it impossible to track the chain of custody for ginseng roots.

- Educate ginseng harvesters stressing the importance of harvesting plants only after the berries have ripened (turned red) even if the harvest season has already started and carefully planting the seed at a 2 cm soil depth.

- There is a lack of information on any dispersal agents for ginseng fruits. Most researchers have only documented fruits depositing less than 2 meters from their parent plants Cruise Sanders et al. 2004, Van der Voort 1998).

- Establish ginseng preserves where ginseng is prohibited and initiate a marking program to aid law enforcement officials in apprehending illegal harvesters. The success of these areas as reserves will depend entirely on enforcement, since the larger, protected ginseng populations will continue to lure collectors. It will be critical to educate law enforcement officials, state ginseng inspectors, members of the judicial system, dealers, and the public to ensure the success of the program.

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