United States Department of the Interior

FISH AND WILDLIFE SERVICE
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To: Chief, Division of Management Authority

From: Chief, Division of Scientific Authority /s/ Robert R. Gabel

Subject: Non-detriment finding on CITES export permit applications for wild and wild-simulated American ginseng harvested in 2006–2008

This document constitutes our non-detriment finding for the export of wild and wild-simulated American ginseng, *Panax quinquefolius*, to be harvested during the 2006–2008 seasons. American ginseng is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

We find that the export of wild and wild-simulated American ginseng roots harvested during the 2006–2008 harvest seasons in the States of Alabama, Arkansas, Georgia, Illinois, Indiana, Iowa, Kentucky, Maryland, Minnesota, Missouri, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin will not be detrimental to the survival of the species **provided that exported roots are from plants that were at least 5 years of age or older at the time of harvest** (i.e., with at least 4 bud-scale scars on the rhizome).

We note that we intend this non-detriment finding to remain in effect through the 2008 harvest season unless significant new information arises and compels us to modify the finding after the 2006 harvest season and sufficiently before either the 2007 or 2008 harvest begins, so that stakeholders can be consulted and notified.

We have determined that woodsgrown (woods-cultivated) American ginseng roots qualify as "artificially propagated" according to the criteria of CITES Resolution Conf.11.11 (Rev. CoP13) and, therefore, are covered in a separate finding.

BASIS FOR ADVICE

In the United States, more American ginseng (hereafter referred to as "ginseng") enters international trade than any other wild-collected native medicinal plant. To ensure that ginseng remains viable throughout its range in the United States and to determine whether the export of ginseng will not be detrimental to the survival of the species, the Division of Scientific Authority (DSA) annually reviews available information from published and unpublished literature as well

as other Federal and State agencies, industry representatives and associations, non-governmental organizations, scientific researchers, and the general public on the status and biology of the species. Therefore, this finding reflects the best available biological and trade information on the status of the species.

New information for the 2006 finding

1. Dr. Anne Lubbers (2006), Centre College, Kentucky, is conducting a 4-year study to examine the sexual reproductive characteristics of ginseng plants in eight populations located in western, central, and east-central Kentucky. The preliminary results indicate that seed production increases with plant size (larger plants produce more flowers and fruits), seed production varies among populations and among years, and seed production is much lower than its potential. Based on these preliminary results, Dr. Lubbers has concluded that diggers should leave a sufficient quantity of 3- and 4-leafed plants in place to ensure reproduction, and that some populations may need more protection than others.

2. Recent studies continue to demonstrate the significant positive effects that good stewardship through responsible harvest practices can have to ensure the sustainable use and long-term survival of ginseng. For example, Farrington (2006, discussed in detail later in this finding) demonstrated that if ginseng diggers harvest their ginseng after its fruit has ripened, limit their harvest to mature plants bearing ripe fruit, and plant the seeds at the optimal depth at the point of harvest, a harvest of as much as 50–60% of those mature plants is sustainable. The planting of seed by diggers can result in germination and recruitment rates far exceeding those achieved by natural dispersal, and can offset other pressures on ginseng, such as deer browsing. We have already begun to work with stakeholders who are producing outreach materials for distribution to diggers to encourage these good stewardship practices.

3. Emily Mooney (2006), University of West Virginia, is researching local adaptation and fitness of ginseng genotypes. Her research includes two field studies: a reciprocal transplant experiment and a breeding experiment. The reciprocal transplant study involves two populations in dissimilar habitats in West Virginia. Plants were removed from one population and were either exchanged between the populations or replanted in their original population. The preliminary results indicate a trend towards reduced seed production by plants transplanted into the new environment.

   The breeding study was designed to investigate the role of inbreeding and outbreeding in seedling germination and growth. A result of small population size is the occurrence of inbreeding, which can lead to a loss of fitness from lower heterozygosity, referred to as inbreeding depression. Inbreeding depression can be measured experimentally by comparing the fitness of progeny from artificially self- and cross-pollinated plants. Planting seeds from cultivated sources into wild populations can lead to outbreeding depression. Outbreeding depression refers to a reduction in fitness in the progeny, which is a reduction in performance due to either the introduction of new genes that are not adapted to local environmental conditions or the breakdown of gene complexes that combine to produce a genotype that is best adapted to local conditions.

To study the effects of inbreeding and outbreeding, Mooney self-pollinated or cross-pollinated by hand ginseng plants in three wild populations. Plants within populations were either self-pollinated or cross-pollinated with pollen from (a) plants located within 5 m (16.4 ft); (b) plants beyond 10 m (32.8 ft) in the same population; or (c) cultivated plants obtained from West Virginia and Wisconsin. The preliminary results indicate that self-pollinated flowers produced more seed than flowers crossed within the populations. There was a trend toward lower seed set, and lower germination of those seeds, by wild plants crossed with cultivated plants. Both of these studies will be continued through 2006 to better assess how local adaptation influences plant fitness in this long-lived species.

4. Cruse-Sanders et al. (2005) measured the effect of harvest on the genetic diversity of wild ginseng populations using a single-generation culling simulation program. For their work, they used genetic samples collected from 16 ginseng populations located in 6 protected sites in National Parks (no harvest allowed) and 10 unprotected sites (limited harvest allowed) (see genetic research section for further details). The simulation program modeled two harvest scenarios of a one-time harvest event: a random harvest across varying size-classes (levels); and a "legal limit" (i.e., minimum size of 3 leaves) random harvest. The researchers also compared the effects of the two models to a legal limit harvest of all the mature plants. The random harvest simulated a "choosy" harvester, whereas the harvest of all mature plants simulated a "busy" harvester. For the purposes of the study, 3- and 4-leafed plants were considered "mature" and of "legal" size, and the effects of the harvest scenarios were based on one generation.

   Results indicated that both protected and unprotected populations showed a similar decrease in genetic diversity in response to random harvest. The researchers found that random harvest at varying levels resulted in a significant loss of genetic diversity (lower heterozygosity), whereas the non-random harvest of mature plants resulted in a higher within-population genetic diversity. Genetic diversity, particularly allelic richness, decreased with increasing harvest pressure, and among-population genetic diversity increased with harvest pressure. Presumably, this is the result of a decrease in allelic richness due to the fixation of different alleles in different populations. The researchers showed that, when a harvester randomly left a portion of mature plants in populations, there was a smaller decrease in allelic richness and genetic diversity as well as a lower variation in the genetic diversity in the remaining populations after harvest. Conversely, the "busy" harvester, who removed all of the mature plants, caused a larger decrease in genetic diversity within populations and more genetic variation in the remaining populations after harvest. Therefore, the digger who does not harvest all of the mature plants in a population has less impact on the genetic diversity than a digger who does. The simulation work supported earlier findings by the researchers (see genetic research section), which indicated that the largest (oldest) plants in their study populations retained more genetic diversity, and therefore, by leaving a proportion of the mature plants, diggers would protect the reproductive fitness of the species.

   Based on the simulation results, the authors concluded that the current legal harvest rates for ginseng are high enough to significantly decrease genetic diversity within one generation. Due to the high price paid for wild roots, there is little incentive for diggers not to harvest all

3- and 4-leafed plants in populations at one time. However, to prevent the negative genetic effects of removing all legal-size plants, the authors recommended that diggers leave a proportion of the 3- and 4-leafed plants in each population. According to the authors, limiting harvest of 3- and 4-leafed plants to less than 16% of a population may reduce the genetic impacts of harvest (depending on the site-specific environmental conditions, population size, and distribution of allele frequencies in the population).

5. A predictive habitat model for ginseng for five States (Kentucky, Ohio, Tennessee, Virginia, and West Virginia) was developed by researchers from the U.S. Geological Survey–Biological Resources Discipline (USGS–BRD) (Thatcher et al. 2006). The primary objectives of the research were to develop and test a habitat model and to estimate the potential distribution of ginseng based on habitat suitability. The study area was approximately 44,016 miles^2, or 28,000,000 acres. Based on the predicted probability of the species' presence, the researchers determined that 43.9% of the study area contained suitable habitat for ginseng. In 2004, field personnel surveyed 273 plots on public lands where the model predicted ginseng to occur, of which 11% actually contained ginseng. In addition, they found 41 incidental sites containing ginseng en route to the plots. In 2005, they surveyed 78 additional plots with predicted occurrences of ginseng on public lands in Tennessee, with concentrated surveys in eastern Kentucky and southern West Virginia; 29% of the sites actually contained ginseng. In addition, 37 incidental sites containing ginseng were located. Combining data from both years, the maximum population size observed for ginseng was approximately 37 plants. The mean size-class for all site locations was 2.1 leaves per plant, with most plants in the 1- or 2-leaf class. According to the researchers, the rarity of older plants on the public lands in the study area "where harvest is prohibited makes this size-class distribution even more disturbing." Based on their work, the researchers estimated that 913–1,706 ginseng plants/km^2 (at a 95% confidence interval) could occur within the study area.

   The USGS–BRD researchers also compared their results to State harvest data (pounds/county) submitted to the Division of Management Authority (DMA) for four of the five States: 2000–2004 harvest data for Ohio, Virginia, and West Virginia; and 2002–2004 harvest data for Kentucky (Thatcher et al. 2006). County harvest data for Tennessee were not submitted for those years. Their analysis revealed that, in general, there was a strong relationship between the predicted county-level ginseng population abundances and the average annual harvest in pounds for those counties within the study area. However, they also noted that several counties, particularly those in the core range of ginseng, tended to have greater harvest amounts than expected based on their estimated population abundance and habitat suitability. Based on their analysis, the researchers recommended that States continue to collect and monitor annual harvest data by county.

   Possible explanations as to why certain counties had greater harvest amounts than predicted by the model may be a result of wild-simulated ginseng being grown and reported as wild and/or the presence of more ginseng buyers and/or diggers located in those particular counties.

   In 2002, the National Park Service's (NPS) law enforcement program initiated the

Appalachian Chain Demonstration Project, a science-based landscape-level resource management protection project. As part of that project, the same researchers from USGS–BRD developed and tested a predictive habitat model for ginseng and three other plant species in the Blue Ridge Parkway (BRP), Great Smoky Mountains National Park (GSMNP), and the Shenandoah NP (SNP) (Young et al. 2003). Similar to the predictive habitat model developed for DSA, the model identified favorable habitats for ginseng in the Parks, information that the NPS personnel could use to focus their activities (e.g., permanently marking ginseng roots, establishing covert plots, and monitoring sites) and workforce. Field surveys based on the model's selection of favorable habitats were conducted for two consecutive years. In 2002, 142 sites were identified as favorable habitat for ginseng in the SNP and the northern portion of the BRP, which resulted in the identification of 40 new ginseng locations (28.2% of the sites). In 2003, surveys were conducted at 85 sites in the two Parks, of which 42 had ginseng (49.4%). Surveys were also conducted at 86 sites in the southern portion of the BRP and the GSMNP, of which 11 sites had ginseng (12.8%). The researchers reported that, where the model predicted favorable habitat conditions for ginseng, it was frequently absent, which they speculated was the result of excessive harvest pressure on ginseng (van Manen et al. 2005). Ginseng roots that were permanently marked in the Parks have since been identified in South Korea (van Manen et al. 2005).

According to the botanist at the GSMNP, due to years of poaching, ginseng populations in the Park are now composed of young plants with few mature plants (J. Rock, as reported by NatureServe 2006). The GSMNP is the largest Federally protected area for ginseng (512,000 acres).

6. The U.S. Forest Service (USFS) recently completed a comprehensive review of the ecology, biology, distribution, and status of ginseng in National Forests (NFs) in its Southern and Eastern Regions (Kauffman 2006). The report notes that since 1998, among NFs that issue harvest permits, there has been a decline in the number of permits issued on some. According to the author, "[I]t is uncertain if this decline in number of permits is reflective of population decline within the respective Forest since only one unit (two National Forests in North Carolina) has a representative monitoring system." He noted other factors that may influence the number of permits issued are the recent increase in the cost of harvest permits at some NFs, local and regional economic trends, general decline in the number of diggers harvesting ginseng, and local environmental conditions (e.g., hurricanes, drought years). The report indicates that, with the exception of NFs in North Carolina, the NFs that issue harvest permits do not yet have a comprehensive inventory and monitoring program upon which to base the issuance of harvest permits. "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" (Kauffman 2006). Furthermore, the NFs that allow ginseng harvest have experienced budget constraints and other workload demands, which limit their ability to monitor wild ginseng populations. Although the USFS has increased harvest restrictions, and some NFs no longer issue harvest permits, "the greatest impact to the long-term persistence of ginseng is inappropriate harvesting of the wild populations" (Kauffman 2006).

   In 2000, the Southern Region's Ozark–St. Francis NF in Arkansas instituted a 5-year

moratorium on issuance of harvest permits. Since then, 21 populations located across six Ranger Districts have been annually monitored. The monitoring results show that plants of larger size-classes are still scarce within the populations, and populations are either stabilizing following the illegal removal of larger-sized plants or are slightly declining in total population size (Kauffman 2006). The NF is currently evaluating the status of ginseng and the effectiveness of the moratorium, and anticipates a decision on whether to remove or continue the moratorium prior to the start of the 2006 season (Kauffman 2006).

For the 2006 harvest season, the Wayne National Forest (WNF) in Ohio has instituted several management actions. These include: (a) limiting harvest to one pound (green weight) per permittee; (b) using green weight instead of dry weight to quantify harvest; and (c) upon completion of harvest, requiring harvesters to return their permits to the WNF and to report how much ginseng they collected and where. The WNF has made return of permits and reporting of harvest information a condition for obtaining harvest permits in the future (C. Coons, WNF botanist, per. comm. 2006).

According to Maimon (2005) over-harvesting and poaching is now threatening the sustainability of ginseng in the Daniel Boone NF, and excessive poaching has threatened to all but eliminate ginseng at Mammoth Cave National Park (MCNP) in Kentucky.

7. Recently, the State Natural Heritage Programs in Kentucky and New York revised their rankings of ginseng in their States to "vulnerable–apparently secure" (S3S4) (NatureServe 2006). In 2005, the Kentucky Natural Heritage Program reviewed the species occurrence in the State and re-ranked ginseng from S4 (apparently secure) to S3 (vulnerable). Later that year, the ranking was reviewed again and changed to S3S4 (vulnerable–apparently secure). The current ranking of ginseng in Kentucky indicates that the species is still of concern and that its status will be watched by the State Program (D. White, Kentucky Natural Heritage Program botanist, pers. comm. 2006). In New York, ginseng's ranking was decreased from S4 (apparently secure) to the current lower ranking "vulnerable–apparently secure" (S3S4) based on the number of documented occurrences (fewer than 100 locations) in the State. According to the New York State Natural Heritage Program botanist, surveys are needed to provide ample evidence that the species meets the criteria for S4. The New York Natural Heritage Program anticipates working with the Division of Lands and Forests, the agency that regulates ginseng in New York, to initiate surveys for ginseng (S. Young, New York Natural Heritage Program botanist, pers. comm. 2006).

8. We have been informed that Kentucky does not currently have a mechanism in place to inspect harvested roots for certification. State inspection and certification ensures that wild-harvested roots meet our export requirement for roots to be at least 5 years of age while providing important documentation for those roots to the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA/APHIS) inspectors. This is of particular concern to us because of the recent change in the State ranking of ginseng to S3S4 (vulnerable–apparently secure), and the fact that Kentucky has the largest annual harvest of wild-harvested roots, according to the State harvest reports submitted to DMA. To obtain further clarification on this issue and to determine how the State might improve its monitoring and regulation of ginseng harvested, we will discuss these issues with the State

Department of Agriculture, which regulates ginseng in Kentucky.

9. Since 2000, the largest known ginseng population on Missouri State land has been monitored annually. The population increased from 231 plants in 2000, to 933 plants in 2004, and then decreased to 854 in 2005 (T. Smith, unpublished data 2006). Although the percentage of plants with fruits decreased from 58% in 2000 to 31% in 2005, the total number of fruits produced increased from 641 (889 seeds) to 1,409 (2,183 seeds), respectively. According to Smith, the population has not had any harvest in the last 6 years and deer herbivory is minimal (pers. comm. 2006). Similar to other field studies, the monitoring results indicate that ginseng populations can substantially rebound if harvest and deer pressures are removed.

10. According to Persons and Davis (2005) "[a]s wild ginseng becomes increasingly scarce, demand for wild-simulated and older woods-cultivated roots should increase..." In an attempt to quantify the extent of wild-simulated and woods-cultivated ginseng grown in the United States, Persons conducted a survey in 1994 and again in 2000 of knowledgeable people involved with ginseng in 22 States within its range, and 3 States outside of ginseng's range. According to the 2000 survey results, there are approximately 3,359 growers of wild-simulated ginseng (approximately 1,306 acres) in the 19 States with an approved ginseng export program. The authors estimated that an average of 160 pounds per acre of dried wild-simulated roots could be harvested after 9 years of growth (a typical wild-simulated harvest cycle). Therefore, in 2000, the 1,306 acres could potentially have produce 23,218 pounds annually. This indicates that as much as one-third of the ginseng reported annually as wild may actually be wild-simulated. This amount may actually be higher in 2006, if the acreage and/or numbers of growers have increased.

11. In the summer of 2005, Emily Mooney individually aged and sized 400 plants in the wild. According to McGraw (pers. comm. 2005), Mooney's results were the following: 1-leafed plants were 1–13 years old; 2-leafed plants were 3–23 years old; 3-leafed plants were 3–53 years old (McGraw noted that the low end is probably the result of human error); and 4-leafed plants were 10–24 years old). Anderson et al. (1993) also reported a variation in the age of wild roots and numbers of leaves: 1-leafed plants were 1–8 years in age; 2-leafed plants were 3–8 years in age; 3-leafed plants were 4–11 years in age; and 4-leafed plants were 8–11 years in age. Aging of wild plants by Kauffman (pers. comm. 2006) in North Carolina demonstrated that 3-leafed plants ranged from 9 to 25 years in age, with an average of 14.8 years. Lewis and Zenger (1982) in Missouri previously found that 3-leafed plants ranged from 4 to 17 years in age, but clustered between 6 and 10 years in age and were predominately 8 years in age.

Fish and Wildlife Service outreach efforts in 2006

12. The Service hosted a meeting with State ginseng program coordinators, other Federal agencies (USFS and USDA/APHIS), ginseng researchers, industry representatives, and the general public in Moon Township, Pennsylvania, January 31–February 2, 2006. Meeting participants discussed the status, conservation, management, and regulation of ginseng. The first day of the meeting, January 31, 2006, was open to the public and included a half-day symposium on recent research findings on ginseng by Federal and academic researchers,

a presentation by USDA/APHIS, and two presentations by industry representatives. Following the presentations, we held a half-day public meeting. The remaining day-and-a-half were devoted to a closed meeting with State and Federal personnel who manage and regulate ginseng. Issues discussed and recommendations developed during the closed meeting are listed in Table 1. (All tables are found at the end of this finding.)

We held three subsequent public meetings in Asheville, North Carolina (February 10, 2006); Indianapolis, Indiana (February 15, 2006); and Sutton, West Virginia (March 11, 2006). The purpose of the public meetings was to provide information on U.S. obligations under CITES related to the export of ginseng, and to obtain new information on the biological and trade status of the species. The information presented at the various meetings is reflected in this finding.

Over 200 people from 15 States attended the public meetings. Participants included diggers, growers, buyers and dealers, exporters, representatives of medicinal plant trade associations, and other people involved or interested in ginseng conservation, harvest, and trade. In addition, representatives from other State and Federal agencies, Congressional staff, and media representatives attended some of the meetings.

Ginseng diggers, buyers and dealers, and trade representatives shared a consensus view that the age requirement in place from 1999 to 2004 for wild ginseng roots, for roots to be 5 years of age or older for export, was an effective means of preventing harvest of young, immature plants. However, they advised that increasing the minimum age to 10 years placed even greater harvest pressure on older plants and undermined the transition to privately owned woodlot planting and management of ginseng (i.e., wild-simulated and woodsgrown) to replace the harvest of wild roots.

Several of the participants stated that many ginseng diggers traditionally removed and replanted the rhizomes ("root necks") of harvested roots. Bailey (1999) noted that diggers implemented this practice to improve their prospect of future harvests. However, we are aware of only limited research being conducted on this regeneration method, and proven techniques used to replant rhizomes are necessary to ensure that they actually become re-established and grow, and do not simply perish after planting. Although long-time diggers may have successfully used this technique in the past, it is not clear that persons recently taking up digging ginseng (a) know about this technique or (b) know the optimal way of planting rhizomes to ensure growth. In addition, counting the bud-scale scars on rhizomes provides the only mechanism, although imperfect, for aging ginseng roots for export. We are interested and will be exploring alternative methods for regulating exports of ginseng roots, as necessary and appropriate, and we will also be seeking additional information on the planting of rhizomes as a propagation method.

There was also acknowledgement at the public meetings that several State harvest seasons start too early, before ginseng fruits are mature, and that they need to be changed to when the fruits are mature (red). However, several participants and State ginseng coordinators did not favor a standardized harvest season for all exporting States due to regional variations in topography and environmental conditions that affect plant growth and fruit maturation.

McGraw (2003a and b) previously advocated a single harvest season starting September 1 for all States. According to the author, by having one universal start date diggers would be less likely to harvest in one State and sell their roots in a neighboring State. Additionally, it may improve the accuracy of State harvest data since there would be less likelihood of unintentional inclusion of roots harvested in a neighboring State. However, at the January 31 meeting, Dr. McGraw acknowledged regional, and in some cases within-State, variation in fruit maturation.

Several of the participants stated that wild ginseng populations are not in decline. However, none of the commenters provided actual field data or research results to support their belief that wild ginseng populations are not in decline.

We also discussed queries from participants regarding whether the Fish and Wildlife Service (Service) could consider a proposal to remove ginseng from CITES Appendix II. At this time, we would be reluctant to submit such a proposal to a meeting of the CITES Conference of the Parties (CoP) for two main reasons. First, we presently do not have sufficient information on the wild status of *Panax quinquefolius* to make a clear argument for delisting. Second, the other range country, Canada, would most likely oppose such a proposal because that country considers the species endangered within their borders. Furthermore, the CITES Parties are reluctant to have a species listed in one country and not another, so a proposal to delist the species only in the United States would face multiple obstacles.

Many of the participants expressed views on issues that need to be addressed at the State level and/or within the industry, not by the Service. These issues include (a) the over-abundance of white-tailed deer; (b) the poaching of ginseng on private lands; (c) the under-valuation of wild-simulated ginseng, (d) the impact of invasive species on ginseng; (e) the need to establish regional ginseng seed banks and nurseries; (f) loss of habitat; (g) timber harvest practices that adversely impact ginseng; (h) the need to allow salvage of ginseng plants that will be lost to logging and mining activities (especially mountain-top removal); and (i) the need to establish preserves or conservation areas for wild ginseng. Additionally, participants advocated a greater role for the ginseng industry in the conservation and sustainable harvest of ginseng.

Several of the participants, including exporters, also expressed views on the inspection of roots by USDA/APHIS inspectors at ports; in particular, there was concern that the inspection process was not standardized at all USDA ports, and that ports are variable in whether they strictly apply export restrictions or whether they are somewhat flexible.

Similar to the 2003 public meeting, there was a general recommendation that ginseng diggers need to be better informed of when and how much to harvest, and the correct planting depth for ginseng seeds. As a result of the input from the public meetings, DSA is working with the American Herbal Products Association and other stakeholders to produce a brochure to reach out to diggers to encourage good stewardship practices for harvesting wild ginseng, and to inform them of current State and Federal requirements. We will continue to investigate other avenues for working with stakeholders to improve harvest practices and

ensure the sustainable harvest of wild ginseng.

In addition to comments received at the four public meetings, we received comments via e-mail, mail, and telephone. Some commenters expressed concern about the negative effect of the 10-year requirement and the resulting economic impact on their livelihoods. Others stated their concerns about the status of ginseng in the wild, whereas others suggested we impose a moratorium on the export of wild ginseng, and some commenters recommended keeping the restriction on export at 10 years of age.

Species description and life history

13. Ginseng is a long-lived herbaceous perennial of the Araliaceae family. The species has a slow growth rate, a long pre-reproductive period (ca. 3–8 years), low fecundity, and high seed and seedling mortality (Carpenter and Cottam 1982; Lewis and Zenger 1982, 1983; Schlessman 1985; Charron and Gagnon 1991; Anderson et al. 1993; Dunwiddie and Anderson 1999; Schluter and Punja 2000).

14. Ginseng forms a special underground stem, known as a vertical rhizome, that sits on top of the main root and from which grows the single above-ground stem. The rhizome is characterized by alternating bud-scale scars that form as a result of the annual loss of the aerial stem. These annual stem scars can be counted to determine the approximate age of the plant (Lewis and Zenger 1982; Anderson et al. 1993; McGraw, unpublished data, 2005; Persons and Davis 2005; Kauffman 2006). The location where the rhizome and the root collar meet marks the first year's growth, and each subsequent year's growth is marked by a bud-scale scar (Carpenter and Cottam 1982; Lewis and Zenger 1982; Anderson et al. 1984, 1993, and 2002). Hence, the minimum age of a plant (root) can be determined as the number of bud-scale scars plus one. However, the chronological age of a plant may be greater because no scar forms in years when plants remain dormant (see below). It may also be difficult to count the exact number of bud-scale scars on some roots.

15. Reproduction is by seed. Although anecdotal information suggests that ginseng can regenerate by planting the rhizome of a plant, vegetative (asexual) propagation by rhizome or root fragmentation has been rarely observed to occur naturally in the wild (Lewis and Zenger 1982; Lewis 1988; Charron and Gagnon 1991). According to Burkhart and Jacobson (2004) this method of propagation is often less reliable than planting seeds.

    A limited field experiment indicated that intact rhizomes were capable of regenerating when planted. However, only 13% of the rhizome propagules were successful compared to 49% of the whole roots and root propagules planted (Van der Voort et al. 2003).

16. Ginseng has been typically grouped into four morphological classes (referred to as size- or stage-classes) based on the number of leaves, commonly referred to as "prongs." These classes are the following: 1-leafed, 2-leafed, 3-leafed, and 4-leafed plants. Although ginseng plants can produce up to 5 leaves, such plants are rarely encountered in the wild. Ginseng size-classes can be used to broadly estimate the age-class of individual plants and are a good indicator of root size (Lewis and Zenger 1982; Charron and Gagnon 1991; Anderson et al.

1993).

17. However, growth rate varies among individual plants due to biotic and abiotic factors (e.g., genetics, habitat quality, and environmental conditions), so plants with the same numbers of leaves and leaflets may be close in size, but not identical in age (Carpenter and Cottam 1982; Lewis and Zenger 1982; Anderson et al. 1983, 1993; Anderson 2002; McGraw, in litt. 2005). Field studies have shown that 3- and 4-leafed plants can subsequently regress in numbers of leaves the following year (e.g., 4-leafed plants to 3-leafed plants, or a 3- to 2-leafed plants, as well as other permutations) (Anderson et al. 2002; McGraw 2003 and unpublished data 2006; Van der Voort 2005; Farrington 2006). Plants can also produce the same number of leaves for multiple years (Van der Voort 2005). Furthermore, the leaves of ginseng can senesce (a natural die-back of the plant) due to drought or other factors during the growing season (Carpenter and Cottam 1982). Although not as common, true dormancy has also been observed in wild ginseng populations (McGraw and Furedi 2005; Farrington 2006); dormancy in plants for more than one growing season has also been documented in the wild (Farrington 2006).

18. Although wild 2-leafed ginseng plants (approximately 4 years of age) have been observed to reproduce (Carpenter and Cottam 1982; Lewis and Zenger 1982 and 1983; Anderson et al. 1993; Charron and Gagnon 1991; Dunwiddie and Anderson 1999), plants usually have 3 leaves (approximately 5–9 years of age) before producing fruit in any quantity (Charron and Gagnon 1991; Lewis and Zenger 1982; Anderson et al. 1993; Persons and Davis 2005). Fruit production is positively correlated with age and size of plant (leaf number and leaf area) and increases as plants age (Carpenter and Cottam 1982; Lewis and Zenger 1982; Anderson et al. 1984 and 1993; Schlessman 1985; Schluter and Punja 2000; Lubbers 2006).

19. Ginseng produces flowers in late May to June. The species has a mixed mating system (both self- and cross-pollination) (Carpenter and Cottam 1982; Schlessman 1985). Plants have been observed to be cross-pollinated by bees and flies in the families Halictidae and Syrphidae, respectively (Carpenter and Cottam 1982; Lewis and Zenger 1983; Schlessman 1985). The male (anthers) and female (stigma) parts of flowers are reported to mature at different times to allow cross-pollination to occur (Small and Catling 1999). Several field studies have shown that, in the wild, more flowers are produced than actually develop fruit, and seed production is much lower than its potential.

20. Although fruit maturity is variable across and within geographical regions (McGraw et al. 2005), green fruits first appear in July and August and reach maturity in the autumn, when they turn red (Anderson et al. 2002; McGraw et al. 2005). The berry-like fruit is typically two-seeded (Carpenter and Cottam 1982; Lewis and Zenger 1983; Anderson et al. 1984 and 1993; Dunwiddie and Anderson 1999), although three-seeded fruit is not uncommon (Schlessman 1985; Anderson et al. 2002). Dispersal is usually passive, and typically fruit fall within 2 m (6.5 ft) of parent plants (Lewis and Zenger 1983; Anderson et al. 1993; Cruse-Sanders and Hamrick 2004a; Van der Voot 2005).

21. Germination of seeds usually occurs 18–20 months after dispersal (Lewis and Zenger 1982; Anderson et al. 1993; Hackney and McGraw 2001). Although it may not be significant in

number of seeds (Anderson et al. 1984; Lewis 1988; Charron and Gagnon 1991), ginseng is reported to form a short-term seed bank of 5 years or less (Lewis 1988; Anderson et al. 2002; Van der Voot 2005).

Field studies show that seeds of ginseng fruits (regardless of color) planted at the recommended depth of 2 cm (ca. 1 in) in soil have a germination rate 8 times greater than seed scattered on the soil surface or naturally dispersed by plants (McGraw 2003a). Planting seeds from harvested plants significantly contributes to population growth and the long-term survival of ginseng (McGraw 2003b; Van der Voot 2005; Farrington 2006). Moreover, seeds from red fruit germinate at nearly 3 times the rate of seeds from green fruits (McGraw et al. 2005).

Distribution, historical harvest, status, and population viability

22. Ginseng is native to eastern deciduous forests of North America, occurring from southern Canada (Ontario and Quebec), west to South Dakota and Oklahoma, and south to Georgia (Gleason and Cronquist 1963; NatureServe 2006). Although the species has a large geographic range, it occupies a narrow ecological niche, resulting in widely distributed populations across extensive areas (Lewis and Zenger 1983; Charron and Gagnon 1991; McGraw et al. 2003).

23. In 1716, Joseph Lafitau, a Jesuit priest, found ginseng growing near Montréal in eastern Canada (Carlson 1986; Small and Catling 1999). Trade with China was quickly established, and widespread harvest of ginseng went unchecked until the early 1750s, when the market crashed due to an over-abundance of small, poor-quality roots being shipped to China (Pritts 1995; Persons and Davies 2005; Taylor 2005; Kauffman 2006). Shortly thereafter, harvest of and trade in ginseng spread to the United States (Pritts 1995; Persons and Davies 2005; Kauffman 2006), where it was particularly important in the Appalachian region, Massachusetts, New York, and Vermont (Nash 1898; Carlson 1986). Abundant stands of ginseng that extended for acres allowed diggers to harvest for extended periods of time (Pritts 1995; Persons and Davies 2005; Taylor 2005; Kauffman 2006). Depending on habitat conditions and availability, accounts of daily harvests of 10– 60 pounds of ginseng per person were reported (Taylor 2005; Kauffman 2006). From 1821 to 1899, an average of 381,000 pounds of dried ginseng was exported annually (Carlson 1986). According to Carlson (1986) over 750,000 pounds of ginseng were exported in 1822, and over 600,000 pounds each for the years 1824, 1841, and 1862.

    Similar to the ginseng trade in Canada, in the United States there were reports that trade in ginseng was second only to the fur trade (Small and Catling 1999). By the late 1800s, ginseng had become scarce in many areas of its range due to over-harvest (Pritts 1995; Persons and Davies 2005). States concerned about declining wild populations enacted legislation to prohibit harvest in the spring and summer (Carlson 1986). It was also during the late 1800s that field cultivation of ginseng was becoming a popular alternative to declining wild stocks (USDA 1928; Williams 1957).

    During the mid to late 1800s, significant amounts of timber harvest occurred throughout

much of ginseng's range, which impacted already declining populations of wild ginseng. By 1920, timber logging had leveled off (USDA Forest Service 2002). Since the reforestation of the northeastern and southeastern United States, the amount of forested acreage has remained fairly constant (USDA Forest Service 2002). However, in some areas, ginseng populations have most likely been impacted due to timber harvest and loss of forest habitat.

As a result of over-harvest, in the late 1800s and early 1900s many botanists noted that ginseng was becoming uncommon (e.g., Millspaugh, Britton, Brown, Taylor), and that trend continued throughout much of the 20th Century (e.g., Dean, Gleason, Small, and Wherry). Today, many regional floras and Web-based plant databases report that ginseng was historically more abundant, but that it is now considered uncommon to rare, and occurs mostly in small scattered populations (e.g., Gleason and Cronquist 1963; Radford et al. 1981; Rhoads and Block 2000; Reed 2002; Weakley 2006). Diggers and dealers have also noted that ginseng is becoming increasingly harder to find, causing diggers to travel farther into forested and/or protected areas in search of ginseng (Greenfield and Davis 2003; Barringer 2005; Carmen et al. 2005; Kauffman 2006). However, anecdotal information also suggests that during the 20th Century ginseng seeds from various sources (e.g., wild, cultivated) were widely planted in the wild throughout much of the species' range.

24. More recently, in certain regions high densities of white-tailed deer are adversely affecting ginseng population growth rates by reducing seed production (McGraw and Furedi 2005; Farrington 2006). Repeated browsing of ginseng by deer can result in a decline in the percentage of mature plants that produce inflorescences (Drees 2003; McGraw and Furedi 2005; Farrington 2006). Furthermore, in some areas, age structure of ginseng populations is being affected by the selective browsing of adult plants over seedlings and juveniles (McGraw and Furedi 2005; Farrington 2006).

25. In certain States mining practices (surface mining and mountain-top removal) have resulted in loss and degradation of forest habitat (comments received at the 2006 public meetings).

26. NatureServe (2006) has ranked the global status (range wide) of *Panax quinquefolius* as "vulnerable–apparently secure" (G3G4), which they have rounded to vulnerable (G3). In Canada, where harvest and export of wild ginseng has been prohibited since 1989, the species was reclassified from threatened to endangered in 2000 (COSEWIC 2000). According to NatureServe (2006), ginseng is widely distributed with "hundreds if not thousands of occurrences primarily in the Appalachians and the Ozarks, but typically having very few plants per occurrence." However, NatureServe also noted that "many experienced field botanists in Appalachia report that they seldom if ever notice previously unreported populations of this species," whereas other "botanists felt there were a very large number of populations but did not have the ability to survey those populations to determine trends or viability" (P. J. Harmon, D. White, J. Townsend, and G. Kaufmann 2005, as reported by NatureServe 2006).

27. With the exception of Ohio, where the State Natural Heritage Program has not ranked the status of ginseng in the State since 2000, only 6 of the 19 States approved for export have a State status ranking of "apparently secure" and none of the States are ranked as "secure" by

their State Natural Heritage Programs (NHP) (Table 2). Since 2000, four States have lowered their conservation ranking of ginseng. Kentucky and New York (see new information section), and both Virginia and West Virginia re-ranked ginseng from S4 (apparently secure) to S3/S4 (vulnerable–apparently secure). The State NHP conservation status assessment of a species is based on eight factors: total number and condition of occurrences (i.e., populations); population size; range extent and area of occupancy; short- and long-term trends in the above factors; scope, severity, and immediacy of threats; number of protected and managed occurrences; intrinsic vulnerability; and environmental specificity (NatureServe 2006). State NHP botanists periodically review and, if necessary, re-rank the status of ginseng in their States. Rankings are based on the botanists' own experience combined with a review of data on species occurrence (which includes documented sites of ginseng that may occur on public and private lands), review of the literature, review of herbarium specimens, the experience of other biologists and botanists, and other sources of information such as any State harvest information for ginseng (Kat Maybury, lead botanist at NatureServe, pers. comm. 2006; Larry Master, chief zoologist at NatureServe, pers. comm. 2006).

Ideally, the State conservation status ranking "should reflect current conditions and understanding of that particular species" (NatureServe 2006). However, the amounts of wild-harvested ginseng reported annually by the States to DMA are not consistent with the numbers of plants and population sizes used for conservation rankings assigned by the State Natural Heritage Programs. The harvest levels generally exceed the amounts indicated by the conservation rankings. This is attributable to at least two factors. First, data are largely lacking on the occurrences of ginseng on private land. Second, much of what is exported as wild ginseng may in fact be some form of human-planted or -grown ginseng, such as wild-simulated. We have been informed by the ginseng industry that the amount of ginseng grown on private lands (i.e., wild-simulated) is much greater than we had previously considered (also, see earlier information cited from Persons and Davis 2005).

28. Empirical data have shown a decline in the species' abundance and distribution in protected (e.g., National Park Service lands) and unprotected areas (harvest with authorization). Studied populations are typically small with predominately young plants (2-leafed plants), and older seed-producing plants (3- and 4-leafed plants) are not abundant or are absent from many populations (Carpenter and Cottam 1982; Schlessman 1985; Rock et al. 1999; Spira, in litt. 1999; Charron and Gagnon 1991; Dunwiddie and Anderson 1999; Hackney and McGraw 2001; Gagnon 2003; Jones et al. 2003; Kauffman 2006; Cruse-Sanders and Hamrick 2004a; Furedi and McGraw 2004; Albrecht, unpublished data 2005; Thatcher et al. 2005 and 2006). However, the majority of field surveys and demographic studies have occurred on public lands and have documented the relatively low abundance of ginseng on those lands. Relatively few researchers have surveyed for ginseng on private property. Field surveys conducted by McGraw et al. (2003b) on three private forests in West Virginia revealed that there was approximately a "five-fold greater mean ginseng density" on those lands than on the public lands surveyed in Kentucky, Maryland, Ohio, Pennsylvania, and West Virginia.

29. Studies on minimum viable population (MVP) size for ginseng are limited. An MVP of 172 plants was estimated for the species in the most northern portion of its range (Canada)

(Nantel et al. 1996) and 510 to 800 plants in the southern portion of its range (Gagnon 2003; McGraw and Furedi 2005). The MVP of 172 was based on the species' high fecundity rates in Canada, and assumed that no more than 5% of 3- and 4-leafed plants were harvested annually, fruits were mature at time of harvest (although seeds were not planted), and random environmental catastrophic events did not occur. Gagnon (2003) calculated an MVP of 510 for populations in the Great Smoky Mountains National Park (GSMNP) because average population growth rates are lower, plants produce fewer fruits (seeds), and some large plants remain dormant or senesce. Dr. Gagnon speculated that an MVP of 510 in the GSMNP may also be related to droughts during the third and fourth years of the study, and that that the remaining populations of ginseng in the Park are located on marginal sites because poachers have extirpated ginseng from its preferred habitat (D. Gagnon, University of Quebec, pers. comm.). McGraw and Furedi (2005) calculated an MVP of 800 in West Virginia based on the negative effects of deer herbivory on ginseng populations.

Many ginseng researchers and individuals with practical experience with ginseng indicate that populations of 172–800 plants are rarely observed (Carpenter and Cottam 1982; Schlessman 1985; Van der Voot 1998; Charron and Gagnon 1991; McGraw 2000b; Kauffman 2006; public comments received at the 2006 public meetings). Therefore, it remains to be determined whether the MVP estimates that have been previously determined need further refinement for applicability to ginseng populations in other areas of the species' range and under different pressures (e.g., harvest, turkey predation, forest management practices, or other factors).

Recent harvest levels and research on sustainable harvest levels

30. From 1999 to 2004, exports of wild ginseng roots (which most likely included wild-simulated and possibly woodsgrown roots) amounted to 7.3% (412,129 pounds) of the total ginseng (5,608,741 pounds) exported from the United States (DMA 2005). During this period, the average annual export of wild roots was approximately 68,688 dried pounds. Using an average of 284 roots per pound for this period (weighted average for States and years for which roots/lb data are available), an average of over 19 million ginseng plants, reported as "wild" by the 19 approved States, were harvested annually.

31. The USGS–BRD modeling work, based on field surveys on public lands, estimated that 913 1,706 ginseng plants/km^2 may potentially occur within the 114,000-km^2 (44,016-miles^2) study area, composed of private and public lands, and covering five States. Using an average of 1,309 plants/km^2, potentially 1.49 million plants could be present. Three of the five States included in the study annually report the largest amounts of harvested roots to DMA (Kentucky, Tennessee, and West Virginia, respectively). From 1999 to 2004, average annual harvest for these three States was 33,017 dried pounds of wild ginseng roots, or approximately 9,376,828 ginseng plants (an average of 284 roots per pound). Given the amount of harvested roots annually reported by the 19 States, coupled with the amount of private versus public land ownership for those States, we conclude that either (a) wild-simulated roots make up a larger portion of the annual harvest than previously thought, or (b) ginseng densities on private land are much greater than on public lands, or both.

32. It has been noted that some ginseng diggers are harvesting younger plants to transplant to other locations, including their own property, for subsequent harvest or to sell as transplants, and that some diggers may have eradicated plants from optimal sites (McGraw 2001). Additionally, dealers frequently find small, pre-adult roots in batches they buy from harvesters (McGraw cited in Van der Voort 2005), and some amount of harvest, including on NFs, occurs out of season (Robbins 1998; E. Burkhart, in litt. 2005; D. Taylor, USFS, pers. comm. 2005).

33. Despite the commercial importance of ginseng, relatively little is known about sustainable rates of harvest. Few long-term field-based harvest studies on ginseng have been completed, yet researchers have reported that significantly more plants should be left for reproduction and population growth. The available studies suggest that harvest of older plants significantly decreases the population growth rate (Charron and Gagnon 1991; McGraw and Furedi 2005; Van der Voort 2005). Nantel et al. (1996) used transition matrices, based on demographic data collected from four populations in Canada, in a stochastic model to estimate a sustainable harvest of 5–8% of the 3- and 4-leafed plants in a population with ripe fruit; they assumed no seeds were planted.

34. Modeling work by Van der Voort (unpublished data 2005) strongly suggested that the sustainability of ginseng depends largely on good harvesting practices (i.e., harvesting only 25% of 3-leafed and larger plants with mature fruit and planting the seed at a depth of 2 cm (ca. 1 inch)). Based on demographic data from 6 populations located in north-central West Virginia, and drawing on known harvester behavior identified in previous studies (e.g., Bailey 1999), the researcher modeled three types of ginseng harvesters. The first type was the "noncompliant digger," who ignored the State harvest season and harvested 25% of 2-leafed plants and 3-leafed and larger plants in the population. The second type was the "compliant digger," who harvested only during the State's open harvest season (starting August 15) and removed 25% of 3-leafed and larger plants in the population. The compliant digger also scattered fruit from harvested plants, regardless of color, on the surface of the forest floor. The third type was the "steward digger," who delayed harvest until September 1st, so that fruits were more 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 cm (ca. 1 inch). According to Van der Voort, "the variability in harvester types devised for this study falls within the realm of possible behaviors for diggers…without being high or low."

    In the laboratory, Van der Voort (2005) used life table response experiments (LTREs) to model the three harvester types and a control of no harvest (ambient). Due to the high white-tailed deer densities in the study area, deer browse was accounted for in the simulations of compliant and steward diggers (9% and 15%, respectively). The significant findings of the research were the following: the non-compliant digger caused an average annual decline in the ginseng population of 15%; the compliant digger caused an average annual decline of 8%; and the steward digger, by planting ginseng seeds at 2 cm depth, caused an average annual increase in the population of 4% (Table 3). Increased seed germination from seeds planted at a depth of 2 cm accounted for 72% of the increase in population growth rate for the steward harvester. The control of no harvest also had an increase in population growth of nearly 4% per year.

35. Farrington (2006) used monitoring data collected annually since 1998 from six ginseng populations in east-central Missouri to study the effects of herbivory by white-tailed deer (*Odocoileus virginianus*), and to develop a simulation model based on two types of harvesters. Results from the deer study showed that deer browse disproportionately affected reproductive size-classes (2- to 4-leafed plants) more than smaller plants (1-leafed plants and seedlings). Plants totally browsed early in the growing season were more likely to regress in size than were unbrowsed plants, and smaller plants were more likely to die if totally browsed early in the season. Although ginseng did not appear to be a preferred browse species, it was negatively affected by high densities of deer. Ginseng populations were stable at 14 deer/km^2, and ginseng populations increased when deer populations were fewer than 14 deer/km^2. The research also indicated that it takes 33 seeds to produce one 7-year-old plant, based on an average recruitment rate (i.e., successful germination and establishment of seedlings) of 8.5% and a survival rate of 36% to 7 years of age. According to the author, at an average rate of 2.7 seeds produced annually, a 3-leafed plant would require approximately 10 years to produce 33 seeds.

    Harvest simulation models were developed to assess the effects of what the researcher described as a "responsible" harvester and an "irresponsible" harvester. The responsible harvester digs ginseng during Missouri's harvest season of September 1 to December 31 and plants the seeds of harvested plants at a depth of 2 cm (0.78 inch); the irresponsible harvester digs ginseng before September 1. Regarding the irresponsible harvester, the researcher included several scenarios: (a) plants are dug out of season before fruits are present; (b) fruits are present, but are removed from the site; and (c) a proportion of reproductive plants are not harvested, which subsequently set fruit and the seeds are dispersed naturally. The results revealed that, when the responsible harvester planted seed from harvested plants at a depth of 2 cm, an annual harvest of up to 53% of the 3- and 4-leafed plants in a population was sustainable, provided that there was no collateral mortality of smaller plants as a result of digging larger plants, even when subject to browsing by deer. With no deer herbivory, 62% of the plants could be harvested (maximum percent harvest possible to maintain the stochastic growth rate of ≥ 1.00). However, if no seeds were planted from harvested plants, only 8% of the 3- and 4-leafed plants could be harvested annually. By harvesting out of season, the irresponsible harvester negatively affected future recruitment, which resulted in declining populations in all models except one, which showed that up to 52% of 3-leafed plants in a population could be harvested every 10 years (growth rate ≥ 1.00).

    In addition, Farrington (2006) conducted field trials on depth of seed planting and germination success. The results revealed that seeds planted between 1 and 3 cm (0.39–1.18 inch) had the best germination rate (above 80%). These results are similar to earlier work by McGraw et al. (2003a and b) that showed the highest germination rates occurred when seeds were planted at a depth of 2 cm (0.78 inch).

    The differences between Van der Voort's and Farrington's results may be attributed to different assumptions each researcher used for their respective models and simulations, such as different deer densities, seedling mortality and adult survival rates of ginseng, and precipitation and other climatic factors that affect population growth rates.

Genetic research

36. Ginseng has always been considered to have a mixed mating system (both self- and cross-pollination) (Carpenter and Cottam 1982; Schlessman 1985). However, recent genetic research has shown that ginseng's genetic profile is consistent with a predominant life-history strategy of self-pollination (Grubbs and Case 2004), which results in low genetic variation and increased homozygosity within populations, but high genetic variation among populations (Grubbs and Case 2004; Cruse-Sanders and Hamrick 2004a).

37. Genetic research has also revealed that wild ginseng plants are distinct from cultivated plants, and that cultivated plants are more similar to each other (Boehm et al. 1999; Grubbs and Case 2004; Schlag, unpublished data 2005). The ability of a species to persist over time is related to fitness of plants within the population (i.e., survival and reproduction). The planting of cultivated and non-local genotypes into wild populations can reduce the fitness of progeny by diluting locally adapted gene pools, which over time may affect the long-term viability of the species (Anderson et al. 2002; Grubbs and Case 2004; McGraw, in litt. 2004; Schlag, unpublished data 2005; Mooney 2006).

38. Grubbs and Case (2004) analyzed genetic allozyme variation from 32 wild and 12 cultivated (established by humans in natural forests from a mixture of cultivated and wild seeds) populations collected from 35 counties in 13 U.S. States and one Province of Canada. The results showed substantial differences in the level of genetic variation between wild and cultivated populations, and in the amount of variation within and among wild populations. Wild populations were significantly lower in all within-population diversity measures. However, they contained significantly higher levels of variation among populations; cultivated populations were more similar to each other than to wild populations. Overall, wild ginseng had over 2.5 times more genetic variation distributed among its populations than did cultivated plants. The researchers 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.

39. Cruse-Sanders and Hamrick (2004a) analyzed the genetic diversity and population structure of 21 ginseng populations (1,317 plants) from 8 protected sites (no harvest allowed) and 13 unprotected sites (harvest allowed) in four states (Georgia, Maryland, North Carolina, and West Virginia). The researchers found significantly greater genetic diversity (higher heterozygosity), a greater proportion of older plants, and larger size-classes (stage-classes) of individuals within protected populations than within populations in which harvest had occurred, and that approximately half of the total genetic diversity occurred among populations. To measure the proportion of genetic diversity among populations, the genetic diversity statistic (G_{ST}) was calculated for each polymorphic locus, and then averaged over all polymorphic loci to obtain an overall estimate of population divergence. The G_{ST} was significantly greater among unprotected populations (G_{ST}= 0.491) than among protected populations (G_{ST}= 0.167). Based on their findings, the researchers speculated that harvest of the largest, most reproductive plants in unprotected populations has changed allele frequencies, thus creating genetic bottlenecks. As populations become smaller, plants lose genetic variation due to genetic drift caused by the fixation of different alleles in different populations. When populations are small and isolated from one another, such as is the case for many ginseng populations, genetic drift will have a dominant influence on population genetic structure and gene flow (Falk and Holsinger 1991).

    Similar to work by Grubbs and Case (2004), the researchers also found evidence of a recent genetic bottleneck: 3 of the 13 unprotected populations had indications of a recent genetic bottleneck, whereas no evidence of a genetic bottleneck was found among the protected populations. According to the researchers, the differences in the level and distribution of genetic diversity in these populations indicate that harvest reduces genetic diversity; therefore, to sustain genetic diversity, a proportion of the largest, most reproductive plants in each population should be maintained to provide for long-term genetic fitness and the evolutionary potential of the species (Cruse-Sanders and Hamrick 2004a). Additionally, the researchers noted that, since approximately 50% of the total genetic diversity occurred among populations, conserving five populations of ginseng throughout its southeastern range would protect 95% of the genetic diversity within the species (Cruse-Sanders and Hamrick 2004b). However, the researchers did not state what size the populations should be to maintain this level of genetic diversity.

40. Removing the largest plants from a population is of particular concern because research on the species indicates that small populations are vulnerable to the Allee effect (Hackney and McGraw 2001), which is a reduction in the fertility and survival of individuals once the population size descends below a critical threshold. As noted earlier in this finding, many wild ginseng populations are small in size and separated by distance. Small, isolated populations will result in loss of genetic variation (loss of alleles) due to genetic drift (Cruse-Sanders and Hamerick 2004a; Grubbs and Case 2004), which over time may reduce the species' resilience and ability to adapt to environmental change. Population size is also inversely proportional to the probability of extinction, because small populations are also more vulnerable to both environmental and genetic stochastic events.

U.S. Forest Service management of ginseng

41. Within the USFS Eastern Region, ginseng occurs on 12 NFs in 12 States. Two NFs in northern Minnesota (Superior and Chippewa) and one in northern Michigan (Hiawatha) are considered outside of ginseng's range (Kauffman 2006). Because ginseng is considered rare and populations are small on nine of the NFs, the species was listed as Sensitive on the Region's list of rare species (Regional Forester's Sensitive Species List) in 2000. However, due to concerns about the decline of ginseng from over-harvest, many of those NFs prohibited the harvest of ginseng years before it was listed as Sensitive (Kauffman 2006). Harvest is allowed through a permit system on only two NFs (Wayne in Ohio and Monongahela in West Virginia) in the Region. Ginseng is not listed as Sensitive on the Mark Twain NF in Missouri; however, harvest there is prohibited.

    Although harvest permits are sold without having baseline monitoring data to substantiate the issuance of such permits, the Wayne NF (WNF) in Ohio has issued permits "almost 3 times that of the annual harvest amounts reported by the State for the surrounding counties" (Kauffman 2006). However, for the 2006 harvest season, the WNF has reduced the amount of allowable harvest to one pound per permittee (see new information section). In addition, the Monongahela NF in West Virginia has issued permits for one-third and almost half of the county harvest amounts reported in 1999 and 2000, respectively (Kauffman 2006).

42. A study of the harvest of medicinal plants, including ginseng, on the WNF revealed that ginseng was uncommon, and that there is little oversight for permits issued (M. Albrecht, unpublished data 2005). Albrecht surveyed a total of 72 randomly placed transects in 17 mixed-hardwood forests 50 years of age or older. The forests were designated as protected (no harvest allowed) or unprotected (harvest with valid permits) (WNF Land and Resource Management Plan 1988). A total of 87 ginseng plants were located: 1-leafed plants represented 41% of the population, 2-leafed plants represented 29%, and 3-leafed plants represented 30%. The results indicated the density of ginseng on the NF to be 15 plants/ha (38.8 plants/acre). No significant difference in the frequency of plants was found in protected versus unprotected forests. Albrecht concluded that ginseng is unlikely to withstand the current harvest pressure on the WNF, and that more effective land management policies are needed if harvest activity continues. A limited survey by Kauffman (2006) in 2001 on the WNF located 10 small populations, ranging in size from 6 to 36 plants. A total of 101 plants were located, with 1- and 2-leafed plants representing 64% of the total plants.

43. Concerns about the over-harvest of ginseng have also prompted the USFS Southern Region to prohibit or restrict the issuance of ginseng permits on many of its NFs. Restrictions for some NFs include limiting the quantity of roots that may be harvested and the number of permits issued per person, whereas other NFs have increased the cost of harvest permits. Of the five NFs that continue to issue harvest permits in the Region, only two NFs (Nantahala and Pisgah) in North Carolina monitor the species (Kauffman 2006). Based on monitoring data collected from 300 plots (30 x 30 m) located on the two NFs in 2003, Kauffman estimated that, potentially, 1,450,000 3- and 4-leafed plants could occur on the two Forests (pers. comm. 2006). However, he emphasized that the estimated number of plants may be too excessive because of over-estimates of occupied habitat (i.e., fewer plants are present).

44. Management of the species varies on each NF that issues harvest permits, from no organized inventory to some recent monitoring of known locations (Kauffman 2006). Furthermore, once harvest permits are issued by a NF, there is little to no monitoring enforcement to ensure that permittees stay within the allowable harvest limits. Although the USFS Eastern and Southern Regions have implemented harvest restrictions, poaching of ginseng continues to be a problem, which has led to over-harvesting. Of particular concern are the NFs that have listed ginseng on the Regional Forester's Sensitive Species List and/or no longer allow ginseng harvest. As a result, FS officials continue to express concerns about the status and viability of the species on FS lands (Maimon 2005; Kauffman 2006).

State management of ginseng

45. In our 1999 non-detriment finding (and in subsequent years through 2004), we determined that wild roots for export must be 5 years of age or older based on concerns about declines in wild ginseng populations and harvest levels in some States in the late 1990s. At that time, only 5 of the 19 States (Illinois, Kentucky, Missouri, North Carolina, and Virginia) in the export program did not have State regulations designating a minimum age (i.e., 5 years) and/or a minimum number of leaves (i.e., 3 leaves or 3 prongs) for harvestable plants. Of those five States, only Kentucky required seeds of harvested plants to be planted. Since 1999, with the exception of Illinois, all States now have harvest regulations that include an aged-based restriction of 5 years of age and/or a minimum number of leaves (i.e., 3 leaves) (Table 4). Without a requirement for plants to have 3 or more leaves or be at least 5 years old, juvenile 2-leafed plants, which have been proven to be very valuable to population growth, may be harvested (Van der Voort unpublished data 2005; McGraw in litt. 2006).

46. Based on field monitoring of 31 populations in 9 States, McGraw et al. (2003) concluded, "[W]e found no biological basis for state-to-state differences in harvest seasons, and clear evidence that the harvest season is set too early in some states to ensure full berry ripening." Therefore, we strongly recommend that States that have harvest season start dates before September 1 (Georgia, Kentucky, Maryland, Tennessee, Virginia, and Vermont) monitor ginseng populations in their respective States to ensure that ginseng fruits are mature (red) by the start of their harvest season, and if necessary, revise their harvest season start dates as appropriate.

47. Several States specifically include language in their regulations that plants with green, unripe fruit should not be harvested (e.g., Alabama, Ohio, and Vermont), whereas other States require diggers to plant and not simply scatter seeds of harvested plants (e.g., Tennessee). Only three States, Illinois, Indiana, and Virginia, do not require diggers to plant the seeds of harvested plants. We strongly recommend that these three States adopt regulations that require diggers to plant seeds from harvested plants. Requiring diggers to plant seeds from harvested plants is one of the most important stewardship practices diggers can implement to increase population growth and help the long-term survival of ginseng.

48. We have previously asked Virginia to consider revising their regulations to require diggers to plant seeds from harvested plants and revise their harvest season start date, if appropriate, to allow seeds to ripen before harvest. However, we have been informed by the Virginia ginseng coordinator, who is the State Endangered Species Coordinator for the Virginia Department of Agriculture and Consumer Services (VDACS), that at this time it would be very difficult for the State to revise their regulations for ginseng because it would require action by the State legislature to amend the State's Endangered Plant and Insect Act; it is not merely a regulatory or administrative change. We have been informed that State personnel encourage diggers to delay the harvest of ginseng until after September 1 even though this is not codified in regulations.

49. The majority of the States have Web pages and/or brochures, handouts, etc. that include their regulations for the harvest, selling, and buying of ginseng, and also provide information on CITES and the Service's role in the export of ginseng. Additionally, most States provide information on good stewardship harvest practices (e.g., not to over-harvest, collect only from large populations, plant seeds of harvested plants).

50. In 2001, the States of Georgia, North Carolina, and Virginia reported concerns about the level of wild ginseng harvested in their respective States and the potential for negative impacts to the States' ginseng populations. In 2002, Georgia and North Carolina reported that the current levels of ginseng harvested in their States may have negatively affected wild populations to some degree, but that State information was lacking to estimate any trends or State-wide declines in ginseng abundance. In 2005, the Georgia Department of Natural Resources (GADNR) reported a strong relationship between the State counties where harvest occurred and the presence of USFS NFs (Chattahoochee and Oconee). According to the GADNR, there "appears to be a discrepancy between the amount harvested from the state (ca. 260 lbs) and the amount permitted by the US Forest Service" (GADNR ginseng harvest report 2005). In previous findings, DSA has made similar comparisons between the NFs in North Carolina and the proximity of counties in the State and the reported harvest levels. Kauffman (2006) has also reported on discrepancies between permits issued on NFs and harvest levels in surrounding counties.

    In 2002, Missouri assessed ginseng fruit maturation in the State in relationship to their harvest season start date of September 1. Based on State monitoring data, it was determined that most plants had mature fruit and frequently had yellow foliage or had withered completely by September 1. The State determined that the harvest season start was appropriate and did not change its start date.

    In 2003, Illinois, Ohio, and North Carolina revised their State regulations for ginseng. Illinois changed the start of the harvest season from the last Saturday in August to the first Saturday in September and prohibited the harvest of ginseng on State lands; however, the State still lacks an aged-based restriction. North Carolina required diggers to plant the seeds from harvested plants, and allowed ginseng on private property to be harvested outside of the State harvest season of September 1–April 1. We are concerned that North Carolina allows ginseng on private property to be harvested year around because it may encourage illegal harvest on State and Federal lands in the State and out-of-season harvest in neighboring

States. Additionally, diggers may sell their roots in a neighboring State which would decrease the accuracy of harvest data from North Carolina. Ohio changed the State harvest season start date from August 15 to September 1.

In 2005, West Virginia revised their State regulations, which included changing the start of their harvest season from August 15 to September 1. Other changes in West Virginia included the initiation of a State certification program for wild-simulated and woodsgrown ginseng growers, and the requirement that diggers obtain and carry a digger's permit with them.

Pennsylvania is currently revising its harvest season start date of August 1 to September 1. The Pennsylvania Department of Conservation and Natural Resources anticipates having the change in place possibly in 2007 or in 2008.

51. Thirteen of the 19 States in the export program prohibit the harvest of ginseng on State lands (Table 4), and most States that do allow harvest require diggers to obtain a permit (Table 4). With the exception of Minnesota, the total acreage of forested private land ownership in the 19 approved States exceeds the total acreage of forested public lands. Public forested acres (State and Federal lands) account for approximately 20% of the total forested acres (private and industrial forests) in the 19 States (USDA Forest Service 2002). (Total acres may include unsuitable forest habitat or forested land harvested after 2001.) Although the amount of public forested acreage is significantly less than private land holdings, those forests may have higher-quality habitat.

52. The issue of whether diggers should be licensed by the States to harvest wild ginseng came up several times during our public meetings held earlier this year. Participants expressed divergent views on this issue: some stated that States need to license diggers to improve legal control and document the origin of ginseng roots, whereas other individuals opposed the idea due to concerns about the cost of such a license to diggers, the potential for burdensome paperwork, or a perceived infringement on personal freedom. Private landowners expressed their desire to ensure that diggers were legally obtaining ginseng and not poaching it, especially on their land. Currently, only four States, Illinois, Maryland, West Virginia, and Wisconsin, require diggers to obtain a permit or license. One commenter suggested that States could annually issue a no-cost "hip card" to diggers, which could be carried by diggers and returned to the State after the harvest season. Accordingly, this would allow States to collect ginseng population and other pertinent information from diggers, similar to existing State animal hunting programs, and some suggested that diggers who did not return a card in one year should not be provided a card or allowed to legally harvest ginseng the following year.

The licensing of harvest is a State issue. At this time, there is no particular decision for States to begin licensing, although we may continue to discuss with the State ginseng coordinators, and with other stakeholders, how a licensing system might work to reduce the illegal collection of ginseng from both public and private lands while improving our ability to collect information on the status of ginseng and the impact of harvest on the species. Meanwhile, the ginseng industry itself has indicated its willingness to promote better self-

regulation by discouraging buyers and dealers from purchasing under-age roots or roots of unknown origin.

53. We will continue to request that all States report harvest data by county, and to include dry-roots-per-pound averages in their annual harvest reports, so that we can continue to evaluate these data as an indicator of the impact of harvest on wild ginseng populations, and to monitor regional fluctuations in harvest. We also recommend that States annually review and monitor their harvest data for fluctuations in harvest amounts, and to determine trends and areas for monitoring populations.

Wild-simulated ginseng

54. Although in 2005, we allowed roots declared as wild-simulated to be exported at 5 years of age, and thus did not directly affect the export of those roots. We recognize that by having two separate age classifications for wild-simulated and wild ginseng (5 and 10 years, respectively), we may have allowed the export of wild roots as wild-simulated, while simultaneously creating confusion among growers and dealers regarding our regulation of ginseng exports. Wild-simulated roots are typically visually indistinguishable from truly wild ginseng roots, and diggers often get prices for wild-simulated roots that are comparable to the prices for truly wild roots.

55. With the exception of West Virginia, which is the only State to institute regulations to certify growers of wild-simulated ginseng, States do not have a mechanism or regulations in place to accurately track and report wild-simulated roots separate from wild roots. In fact, many States do not recognize wild-simulated ginseng as distinct from wild ginseng in their regulations, and include the planting of ginseng seed and/or transplants in the wild "from other areas" in their definition of wild ginseng (e.g., Alabama, Georgia, Illinois, Indiana, and Tennessee).

56. During our public meetings, we were informed that many former diggers of wild ginseng have shifted to growing wild-simulated ginseng and that the number of persons digging truly wild ginseng is declining due to various factors (e.g., diggers aging, low hourly return). Lockard (2003) reported that the 5-year age requirement and the decline in the number of diggers today have resulted in an increase in wild-simulated ginseng being grown.

57. We recognize that the production of wild-simulated ginseng promotes an alternative source of ginseng to the export market that may actually alleviate harvest pressure on wild ginseng populations. Wild-simulated growing techniques are widely practiced and heavily promoted through State extension offices, land-grant universities, local community organizations, and ginseng growers' associations. Persons and Davis (2005) report that, although woodland production of ginseng (i.e., wild-simulated and woods-cultivated) remains quite limited in terms of both land planted and dried pounds harvested, "there is a consensus among ginseng buyers that some significant portion" of wild-simulated roots are being sold as wild. However, the authors conclude that the amount of wild-simulated roots sold as wild "has had no noticeable effect on the total amount of wild root exported."

We know that the amount of harvested roots reported by many States as "wild" is actually a mixture of wild and wild-simulated ginseng. Our inability to quantify the amount of wild-simulated ginseng reported as "wild" may lead us to falsely conclude that wild populations are not declining because of relatively stable harvest trends. We may also fail to detect a decline in harvest pressure on wild populations due to replacement with wild-simulated roots. Therefore, to improve our analysis, we strongly recommend that States adopt measures for differentiating the amount of wild-simulated roots produced in within their States so that it can be considered separately from truly wild roots in trade.

Conclusions

Based on our concerns about the possibility of over-exploitation of wild ginseng, in our 2005 non-detriment finding, we increased the minimum age of wild roots for export from 5 to 10 years. At the time, we determined that this change in minimum age was necessary to ensure that ginseng plants remain in the wild until after they have an opportunity to reproduce and contribute to future recruitment. We also had information indicating that 10 years was the next age at which plants could be distinguished from younger age-classes. Although ginseng is a widely distributed species that persists throughout much of its historic range, we are concerned that populations that have been subject to study are small and show both demographic and genetic changes as a result of harvest pressures, among other potential factors (e.g., excessive browsing due to high deer densities in some areas).

Feedback on our 2005 finding informed us that some of our information and conclusions may have been incorrect. Therefore, we conducted an extensive outreach effort in early 2006 by hosting a series of public meetings as well as a symposium on current research findings on ginseng and a closed meeting with other Federal agencies and State ginseng coordinators. Based on these consultations and a review of the most recent information available on ginseng, we have concluded that the 10-year age restriction imposed in 2005 may undermine current trends toward increased cultivation of ginseng, especially the production of "wild-simulated" ginseng, which may reduce harvest pressure on wild ginseng.

Greater populations of ginseng may occur on private land than occur on public lands (Federal and State), although populations on private lands are less studied and therefore not quantified. It may be that ginseng on private land has been more intensively managed and manipulated by landowners to produce a sustainable crop of ginseng for export, although this has not been formally demonstrated through research. It also may be, however, that ginseng populations on private lands have been subject to greater genetic alteration due to the planting of non-native seed or other propagules to enhance production. These areas need further study. The amounts of wild ginseng roots exported each year seem to be inconsistent with the estimated abundance from observations on public lands, and perhaps discrepancies are not fully explained by the production of wild-simulated ginseng.

Furthermore, recent research indicates that allowing ginseng harvest can actually contribute to population growth and recovery of ginseng populations when harvesters delay harvest until seeds are ripe, do not harvest under-age plants (i.e., those with fewer than 3

leaves), harvest only a portion of the mature plants (i.e., with 3 or 4 leaves), and plant ripe seed from harvested plants at an appropriate depth at the point of harvest. These good stewardship practices, as applied to ginseng harvest, can actually overcome other adverse impacts on ginseng populations, such as excessive deer browsing, and can achieve improved germination and recruitment of young plants than would be achieved under natural conditions of no harvest. Based on recent research results summarized in this finding, ginseng is generally characterized by small wild populations, which some research suggests are below minimum viable population levels. Given that good stewardship practices have the potential to increase recruitment into such populations, and further recognizing that some proportion of ginseng diggers harvest responsibly and replant seeds to replace the roots they dig, restrictions that reduce harvester effort may potentially have adverse effects on wild ginseng populations by preventing these activities that augment wild production.

We have concluded that the exports of wild and wild-simulated ginseng harvested in 2006–2008 and certified by the States listed on page one of this finding will not be detrimental to the survival of the species, if the following **CONDITION** is met:

All wild and wild-simulated roots must be from plants at least 5 years of age or older (i.e., with at least 4 or more bud-scale scars on the rhizome) at the time of harvest. (Minimum age of ginseng roots at the time of harvest can be determined by counting the number of annual bud-scale scars on the rhizome. Except for the first year, after germination, single scar is produced after abscission of the plant's aerial stem each year, except in years where the plant remains dormant. As a general guideline, although subject to variation, plants with at least 3 leaves at the time of harvest are likely to be at least 5 years old.)

Future Actions and Recommendations

In preparation for making our non-detriment finding on exports of wild ginseng in 2009 and beyond, we will assess whether further progress has been made by State and Federal agencies to improve the conservation and management of the species, particularly through changes to harvest regulations, increased enforcement, increased monitoring of ginseng populations, or other actions. We will also consider the results of our outreach efforts and those of other stakeholders to improve digger compliance with good harvest practices, whether currently required by a given State or not. We will seek up-to-date information on the status of the species, including the results of any field surveys and additional protections afforded to it, and will discuss and recommend, as appropriate, specific additional measures that may contribute to the conservation of the species and sustainable harvest of ginseng for export. Following are other specific actions and recommendations:

- We will urge States to consider and implement measures for differentiating wild-simulated ginseng from wild ginseng, such as certification programs for growers of wild-simulated ginseng, although we are not imposing a specific requirement on any State. (We note that, at this time, West Virginia has developed the most advanced program for this purpose.)
- We will continue to discuss with both government and non-government stakeholders the best approach for ensuring that illegally obtained ginseng roots, from both public and private land, do not enter into trade. Although determining the legality of roots is a separate finding for the issuance of CITES permits, made by the Division of Management Authority, we also note that the illegal harvest of roots also undermines regulatory programs intended to ensure the sustainability of the ginseng harvest and prevent detriment to wild populations.
- To prevent the harvest of plants with fewer than 3 leaves and to ensure the long-term survival of ginseng in the wild, we will continue to urge Illinois to adopt a minimum-age or -size requirement for the harvest of ginseng, which is consistent with the minimum-age requirement for export and with other States and best harvest practices. We will also continue to urge Illinois, Indiana, and Virginia to require diggers to plant the seeds of harvested ginseng plants at the point of harvest.
- We strongly recommend that Georgia, Kentucky, Maryland, Tennessee, Vermont, and Virginia field monitor ginseng populations in their respective States to ensure that fruits are mature (red) by the start of its harvest season, and if necessary, revise their respective start dates as appropriate. We will also work with Kentucky to ensure that harvested roots are properly certified by the State.
- We will continue to work with Federal, State, and private-sector stakeholders to investigate means for expanding efforts to monitor the status of ginseng in the wild and ensure that harvest levels are sustainable for both the short and long terms. At our meeting with State ginseng program coordinators earlier this year, several program coordinators expressed interest in using monitoring data to assess population status and trends, and less emphasis on recording harvest levels. We will be discussing in more detail with the States how to facilitate improved monitoring of ginseng.
- We will continue to discuss with the States and industry the use of non-local or "commercial" seed for replanting of ginseng in the wild. We support and recommend the planting of wild ginseng seeds from wild plants where they are harvested. However, based on scientific findings, we do not support the planting of "commercial" or non-local seed to augment and/or restore native wild populations. As noted in this finding, there are important genetic distinctions between wild and cultivated populations. Therefore, we remain concerned about the origin of ginseng seeds used for restoration purposes and the impact of non-local seed on local gene pools of wild populations, and also the threat of disease introduction. This is of particular concern where the species is less common, and where random planting of non-local seed may have an even greater adverse effect on ginseng populations and the evolutionary capability of this species.
- Following from their "Conservation Assessment for American ginseng," USFS will prepare a conservation strategy for ginseng in the Eastern Region. We will continue to discuss with the USFS additional conservation measures that may be implemented to ensure the long-term survival of ginseng, particularly on NFs that issue harvest permits.

- We will discuss with the scientific community the possibility of conducting field trails with replanted ginseng rhizomes to study this alternative regeneration method. Additionally, further studies are needed to determine appropriate minimum viable population levels for the species in the United States, or possibly in different regions of the species' range.

Table 1. Results of the FWS-State ginseng workshop, Moon Township, Pennsylvania, February 1-2, 2006.

Status and Management Issues	**Recommendations**
Status of ginseng on State lands: Currently, only six States implement some type of monitoring. States recognized the importance of monitoring. Need a standardized monitoring protocol and funding mechanism to implement State monitoring programs.	FWS/States to develop a standardized monitoring protocol that all 19 States can implement. Program-wide State monitoring may eventually reduce the FWS reporting requirements.
Age-based restrictions and possible alternatives: Discussed various options and restrictions (e.g., root diameter, root length, rhizome "neck" length), including the option of planting rhizomes versus keeping them attached to roots for aging purposes.	Further evaluate approaches to regulating and monitoring ginseng harvest and trade. Need biological studies to determine viable and practical alternative methods to implement.
Production system categories: Do State definitions for wild and cultivated meet CITES definitions of wild and artificially propagated. Most States do not have definitions for wild-simulated or woodsgrown ginseng.	Woodsgrown ginseng meets the CITES criteria for "artificially propagated" plants (Resolution Conf. 11.11 (Rev. CoP13)). Wild-simulated ginseng was defined as ginseng grown from non-local seed (e.g., cultivated seed) that is planted by humans in native habitat with minimal manipulation of the site. The definition of wild-simulated does not meet the CITES criteria for "artificially propagated" plants. The FWS is working within CITES on an intermediate category for plants that are not wild or artificially propagated.
State-level management	
Uniform program-wide harvest season.	Impractical to standardize because of variability across the 19 States. However, standardized season would prevent harvest of ginseng before a State's starting date and movement of such ginseng across State lines. Further evaluate establishing regional harvest seasons (e.g., south, central, and north).
Uniform program-wide selling/buying season.	Further evaluate establishing a uniform start selling/buying date.

Table 1. Results of the FWS-State ginseng workshop, Moon Township, Pennsylvania, February 1-2, 2006.

Law enforcement: States need to provide effective enforcement and sentencing of violators.	Raise profile of law of enforcement efforts and sentencing problems to the State judiciary-level. Need to improve within-State communication/coordination between regulatory and enforcement agencies.
Required State reporting: Information required by FWS.	FWS to evaluate State reporting requirements.
Industry stakeholders: Need more integrity within the ginseng industry and their cooperation with the States and FWS.	Work with the ginseng industry to actively promote best management and good stewardship practices within the industry.

Table 2. 2000 and 2006 State status ranking of ginseng. Changes in State rankings are in bold.

State	2000 Status rank[1]	2006 Status rank[1]	Classification under Sate law or regulation
Alabama	S4	S4	None
Arkansas	S4	S4	None
Connecticut	S3	S3	Special Concern
Delaware	S2	S2	Species of Conservation
District of Columbia	SH	SH	Historical (possibly extirpated)
Georgia	S3	S3	Special Concern
Illinois	S3	S3?	None
Indiana	S3	S3	None
Iowa	S3	S3	None
Kansas	SNR	SNR	None
Kentucky	**S4**	**S3S4**	None
Louisiana	S1	S1	Rare
Maine	S2	S2	Endangered
Maryland	S3	S3	Watch List
Massachusetts	S3	S3	Special Concern
Michigan	S2/S3	S2S3	Threatened
Minnesota	S3	S3	Special Concern
Mississippi	S3	S3	Watch List
Missouri	S4	S4	None
Nebraska	S1	S1	Threatened
New Hampshire	S2	S2	Threatened
New Jersey	S2	S2	Species of Concern
New York	**S4**	**S3S4**	Exploitable Vulnerable
North Carolina	S4	S4	Special of Concern
Ohio	**S4**	**SNR**	None
Oklahoma	S1	S1	Watch List
Pennsylvania	S4	S4	Vulnerable
Rhode Island	S1	S1	Endangered
South Carolina	S2/S3	S2/S3	None
South Dakota	S1	S1	Rare
Tennessee	S3S4	S3S4	Special Concern, Commercially Exploited
Vermont	S2S3	S2S3	Watch List
Virginia	**S4**	**S3S4**	Threatened
West Virginia	**S4**	**S3S4**	None
Wisconsin	S4	S4	None

[1] Explanation of NatureServe ranking system is the following. Critically imperiled (S1): often 5 or fewer occurrences. Imperiled (S2): very few populations, often 20 or fewer occurrences. Vulnerable (S3): relatively few populations, often 80 or fewer. Apparently secure (S4): Uncommon but not rare; some cause for long-term concern due to declines or other factors. SNR: State conservation status not yet assessed. SH: Species occurred historically and there is some possibility that it may be rediscovered. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.6. NatureServe, Arlington, Virginia. Available: http://www.natureserve.org/. Accessed February 28, 2006). State ranking for CT, ME, MA, MI, NH, NY, NC, PA, RI, and TN: URL: http://plants.usda.gov/ Accessed March 20, 2006; State ranking for GA, NC, SC, and SC: URL: http://herbarium.unc.edu/weakleysflora.pdf. Accessed March 29, 2006.

Table 3 Results of the LTRE model simulations (Van der Voort 2005).

Simulation type	Percent of large adult plant mortality	Seeds planted	Population growth per year	Population growth rate (lambda)
Control (ambient)	2%	No	Increased 4%	1.0389
Noncompliant	27%	No	Decreased 15%	0.8522
Compliant	25%	No	Decreased 8%	0.9236
Steward	17%	Yes	Increased 4%	1.0412

Table 4. Current State ginseng regulations.

State	Harvest Season	Harvest permitted on State lands	Monitoring ginseng on State lands	Require seeds to be planted at site	Minimum age and/or number of leaves/prongs required for harvested plants
Alabama	Sept 1–Dec 13	yes, with permit	no	yes	3 prongs
Arkansas	Sept 1–Dec 1	no	no	yes	5 years, 3 prongs
Georgia	Aug 15–Dec 31	no	no	yes	3 prongs
Illinois	first Saturday in Sept. - Nov 1	no	no	no	no requirement
Indiana	Sept 1–Dec 31	no	no	no	3 prongs, a flowering or fruiting stalk, or 4 internodes on root
Iowa	Sept 1–Oct 31	no in State parks or preserves; yes in State forest and wildlife areas	no	yes	3 prongs
Kentucky	Aug 15–Nov 30	yes in State forests; no in State parks	yes, long-term permanent plots	yes	5 years, 3 prongs
Maryland	Aug 20–Dec 1	yes in State forests; no in State parks	yes, ongoing research	yes	5 years, 3 prongs
Minnesota	Sept 1–Dec 31	yes in some State forests	no	yes	3 prongs

Table 4. Current State ginseng regulations.

State	Harvest season	Harvest permitted on State lands	Monitoring ginseng on State lands	Require seeds to be planted at site	Minimum age (number of leaves/prongs) required for harvested plants
Missouri	Sept 1–Dec 31	No	yes, permanent plots	yes	3 prongs or plants with fruiting stems
New York	Sept 1–Nov 30	No	no	yes	3 prongs
North Carolina	Sept 1 – April 1; however, ginseng on private property can be harvested outside of season	No	no	yes	5 years, 3 prongs
Ohio	Sept 1–Dec 31	No	no	yes	3 prongs
Pennsylvania	Aug 1–Nov 30	No	yes, ongoing research	yes	3 prongs
Tennessee	Aug 15–Dec 31	only on Royal Blue Wildlife Management Area	no	yes	5 years, 3 prongs
Vermont	Aug 20–Oct 10	no	no	yes	5 years, 3 prongs
Virginia	Aug 15–Dec 31	yes	yes	no	3 prongs
West Virginia	Sept 1–Nov 30	no	yes, ongoing research	yes	3 prongs
Wisconsin	Sept 1–Nov 1	no	yes, periodically	yes	3 prongs

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