BACKGROUNDER

About Local Propagation

June 2011

The Earth Sangha's Wild Plant Nursery is designed to help preserve the native flora of the greater Washington, DC, area. We propagate a broad range of native plants for use in local restoration projects—and we propagate all our plants from local, wild populations. We never propagate from street trees or other types of managed plantings.

In our region, this type of propagation is still uncommon, at least on the scale at which we practice it. Nevertheless, it is the standard best practice in ecological restoration. That's because restoration projects are usually designed to err on the side of caution.

To play it safe, restorationists generally assume that the local, wild populations of a species are likely to have acquired, over the course of many generations, a genetic make-up that works well under local conditions. (When ecologists discuss this kind of local adaptation, they refer to such populations as "ecotypes" or sometimes, "genotypes," although the latter term can be confusing because it has other meanings too.) Restorationists usually make a second assumption as well: that the genetics of the local ecotype may in some measure determine the species' ecological role in the area—how effectively it competes against various other plants, how much water and nutrient it absorbs, how palatable it is to browsing animals, and so forth.

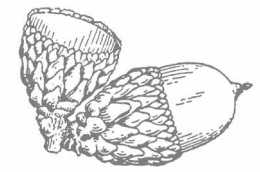
The advantage of planting local stock is that it minimizes the risk of changing these factors—it is not likely to interfere with local genetic fitness or local ecological function.

People sometimes wonder whether planting local stock could cause "in-breeding depression," loss of fitness resulting from the interbreeding of close relatives. This phenomenon can threaten small, isolated populations of both plants and animals. But in large plant populations—populations containing thousands of individuals—the risk of in-breeding depression is virtually nil. At present, in-breeding depression is not a concern in our own restoration work, because all the species that we currently propagate occur in large, local populations.

It's also worth noting that, even when a species occurs only in small, isolated populations, planting local stock does not inevitably lead to a loss of fitness—nor does the introduction of extraneous stock inevitably preserve fitness. Extraneous stock can sometimes cause "out-breeding depression," loss of fitness through hybridization with other varieties.[1]

Local, wild stock is definitely not the best choice for every type of planting. In parks that are managed primarily for recreational or esthetic purposes, for example, cultivars are often much better choices than wild plants, because the care requirements and growth habits of cultivars can be reliably predicted. ("Cultivar" is a contraction of "cultivated variety," a plant variety maintained by people.) Even in "semi-wild" areas, a good case can often be made for choosing stock that is not local, at least if the areas in question are relatively small. In such cases, many considerations may influence the choice of planting stock—cost, availability, site conditions, proximity to more-or-less undisturbed areas, and so forth.

These and other issues may also weigh on the choice of stock in ecological restoration projects. But where the objective is to restore a plant community to something resembling its wild state, there is a strong professional consensus in favor of planting local material—barring some very good reason for doing otherwise. Nine well-informed perspectives on the issue follow.[2]



"Clearly, the horticultural practice of propagating and moving plants to any location where they will survive creates problems for restoration efforts. Among the environmental problems it poses is to threaten subspecies diversity by eliminating the level of isolation between populations. The subspecies level of biodiversity is the least understood and the most endangered. So to retain these often very localized plants, the restorationist will need a new kind of nursery centered on local diversity."

Leslie Jones Sauer and Andropogon Associates, *The Once and Future Forest: A Guide to Forest Restoration Strategies* (Washington, DC: Island Press, 1998), p. 62. Leslie Jones Sauer is a field ecologist, founder and former principal landscape architect (now retired) for the Philadelphia-based environmental design firm, Andropogon Associates, and now a consulting landscape architect.

"One of the most difficult problems for the landscape restorationist is obtaining locally indigenous species and subspecies for use. Unfortunately, the economics of plant production has resulted in large centralized growing facilities that serve very extensive regional markets. 'Superior' native varieties, like non-natives, are propagated vegetatively and distributed widely. These are often significantly different from local native varieties and, in places, may jeopardize indigenous species. There is no seed production nursery for native grasses and wildflowers in the East, so even when we try to plant a native meadow in New York or New Jersey, we cannot use local subspecies unless we have collected local seed. The differences are often strikingly apparent. To cite just one example, Indian grass grown from midwestern seed dwarfs its eastern counterpart. These plants may persist and/or hybridize with native subspecies and become a problem for restoration."

Ibid., p. 174.

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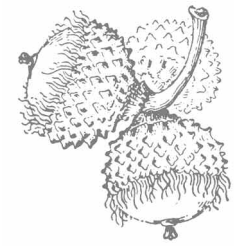
[1]For a review of in-breeding and out-breeding depression, see Spencer C.H. Barrett and Joshua R. Kohn, "Genetic and Evolutionary Consequences of Small Population Size in Plants: Implications for Conservation," in *Genetics and Conservation of Rare Plants*, ed. Donald A. Falk and Kent E. Holsinger (New York: Oxford University Press, 1991), pp. 3-30.

[2]Boldfacing in the excerpts is not present in the original texts.

"Propagule source is a concern to many native plant enthusiasts because of the natural variation in so many traits within a species over large geographical ranges. A simple example of this variation and its importance is the failure of marginally cold hardy species to survive at their limits of cold hardiness when that individual has come from southernmost sources. Ideally, one should be able to purchase native plants propagated from local sources, but such idealism is rarely reality."

Donald J. Leopold, *Native Plants of the Northeast: A Guide for Gardening and Conservation* (Portland, OR: Timber Press, 2005), p. 27. Donald Leopold is a forest ecologist and a professor at the College of Environmental Science and Forestry, State University of New York at Syracuse.



"There is no generic answer to the question 'How local is local?' Patterns of genetic variation generated by spatial differences may be small or large scale, clinal or abrupt, static or changing. The extent to which a species will respond to such differences varies enormously between species depending on their size, range, population structure, breeding system [for example, whether a species is self-fertile or out-crossing], history and behaviour.

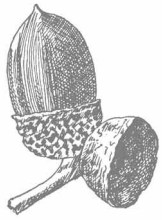
"Nevertheless, in the absence of appropriate data for each species, the approach of restorationists has been to take a local or, perhaps more accurately, regional perspective when choosing sources of germplasm. There are at least three good reasons for this."

In brief, the reasons cited are that the use of local genotypes (1) increases the chances of successful establishment, (2) maintains the genetic integrity of local populations, and (3) avoids the possibility of introducing invasive genotypes that alter ecosystem function or diversity.

Alan J. Gray, "The Evolutionary Context: A Species Perspective," in *Handbook of Ecological Restoration*, ed. Martin R. Perrow and Anthony J. Davy (Cambridge, UK: Cambridge University Press, 2002), vol. 1, pp. 68-70. Alan Gray, a plant ecologist and geneticist, retired as director of the UK Natural Environment Research Council's Dorset Centre for Ecology and Hydrology in 2003. He is president of the Estuarine and Coastal Sciences Association and a former vice president of the British Ecological Society.

"Although there are nurseries (both state operated and privately owned) that produce native seedlings for reforestation projects, a community-based plant propagation program is an excellent way to preserve the ecotypes and genetic variation in local plant populations. It is also a great way to bring community members together to help their local environment. The rewards from a seed propagation program are great if volunteer involvement is strong, access to substantial quantities of seed is adequate, and space for growing seedlings is available."

Chesapeake Bay Foundation (CBF), *Community Forest Buffer Guide* (Annapolis, MD: CBF in conjunction with the Maryland Department of Natural Resources, the Maryland Cooperative Extension, and the USDA Natural Resources Conservation Service, 2001), p. 5.



"Local genotypes are best suited to restore sites where the degree of disturbance has been low. . . . Although close correspondence between environment and genotype argues for the use of local genotypes in restoration . . . , soils of seriously disturbed sites bear little resemblance to those with which natives evolved. Traits found in dissimilar populations may be needed for adaptation to highly novel or stressful conditions. Local genotypes are also desirable when the size of the disturbance is large because they will have no adverse effect on the integrity of local gene pools. . . ."

A loose, plain-English translation: Use local stock on relatively undisturbed sites. In general, local stock is likely to be the best fit for local conditions, but the soils of badly disturbed sites may be so degraded that the local stock is no longer adapted to them; in such cases, consider looking elsewhere for stock that might work better. But if your project is large, you should probably use local stock anyway, to reduce the possibility of interfering with local gene pools.

Peter Lesica and Fred W. Allendorf, "Ecological Genetics and the Restoration of Plant Communities: Mix or Match?" *Restoration Ecology* 7.1 (March 1999), pp. 45-46. The authors are professors of biology at the University of Montana. *(Note: Only references to figures and bibliographical citations have been removed from the quotation; no text has been removed.)*

One of the authors' five concluding guidelines puts it more succinctly:

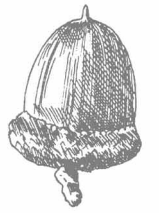
"Use local genotypes when feasible, especially for large sites."

Ibid., p. 47.

"An ecosystem containing genetically fit populations is one that is not only adapted to the current environmental regime, but possesses some "genetic redundancy," whereby the gene pool contains a diversity of alleles [an allele is a particular form of a gene] that may be selected in response to environmental change. Under normal circumstances, the reintroduction of local ecotypes is sufficient to maintain genetic fitness. Nevertheless, in sites that have suffered substantial damage and consequent alteration to their physical environment, the introduction of diverse genetic stock may be the preferred strategy, thereby allowing recombination and the eventual development of novel, more adaptive ecotypes."

Translation: To be genetically fit, a plant population should contain enough genetic diversity to thrive under current conditions and to adapt when those conditions change. Normally, if you plant with local stock, you don't have to worry about genetic fitness. But if you are restoring badly degraded sites, where you can't be sure the local material will thrive, you may be able to improve the chances of success by including a variety of material from elsewhere. Over time, the increased diversity might allow the population to adapt to the site.

Society for Ecological Restoration International, Science and Policy Working Group, *The SER International Primer on Ecological Restoration* (Tucson, AZ: SER International, 2004), p. 6.



"Several decades of ecological research have demonstrated the existence of genetic adaptation and ecotypic differentiation in local populations of many plant species, often over short distances and historical time periods. . . . Consequently, it has been argued that these local adaptations need to be recognized and preserved when propagating plants for use in ecological restoration. . . . For example, it has been suggested that herbaceous [non-woody] plant material should be collected 328-3,280 feet (100-1,000 meters) from the intended restoration planting site. . . ."

Philip J. Burton and Carla M. Burton, "Promoting Genetic Diversity in the Production of Large Quantities of Native Plant Seed," *Ecological Restoration* 20.2 (June 2002), p. 118. The Burtons are independent ecological consultants working in British Columbia, Canada. *(Note: Only bibliographical citations have been removed from the quotation; no text has been removed.)*

Given this very strict definition of "local," it would be hard to disagree with the Burtons' conclusion, at least in most cases:

"We believe, as do a number of other researchers, that inclusion of genetic material beyond local populations ensures that the genetic diversity and vigor required for native species to respond to climate change and other stresses will remain in place."

Ibid., p. 119.

"Restoration practitioners have long been faced with a dichotomous choice of native versus introduced plant material confounded by a general lack of consensus concerning what constitutes being native. The 'restoration gene pool' concept [proposed in this article] assigns plant materials to one of four restoration gene pools (primary to quaternary) in order of declining genetic correspondence to the target population."

Briefly, in this system, the primary Restoration Gene Pool (RGP) is the population growing in the area to be restored; the secondary RGP is drawn from populations of the same species on other sites; the tertiary RGP is from closely related species on other sites; and the quaternary RGP is from distantly related species on other sites.

T.A. Jones, "The Restoration Gene Pool Concept: Beyond the Native Versus Non-Native Debate," *Restoration Ecology* 11.3 (September 2003), p. 281. Tom Jones is a rangeland ecologist at Utah State University in Logan.

Jones goes on to specify local stock as the first resort:

"Primary RGP material is preferred when it is available and when the ecological function of the target site has not been fundamentally altered in a manner that makes such material no longer adapted. But when either of these two conditions do not hold, materials from higher order RGPs may be substituted. In practice, secondary RGP material will be most commonly substituted when primary RGP material is simply unavailable. Tertiary or quaternary RGP materials will be substituted under the more challenging circumstances of major disruption of ecosystem function."

Ibid., p. 282.

About Local Propagation

"From a strict environmental viewpoint, the use of local ecotype plant stock is preferable to imported stock under the assumption that locally propagated material would exhibit a higher survivability rate and be better adapted to northern Virginia's climate, native soils, and growing conditions. Cultivars, bred to favor limited characteristics, normally express less genetic variation than local native stock. However, the availability of locally propagated stock is very limited at the present time."

Rod Simmons and Greg Zell, *Keeping It Natural! A Guide to the Use of Native Plants for Natural Land Restorations and Post-disturbance Project Plantings within Natural Woodland Sites, Riparian Buffers, and Forest-edges in Arlington County and the City of Alexandria, Virginia* (January 2010), p.5.

"Avoid the use of cultivars—the use of cultivars is well established within the nursery industry and has long been considered acceptable for plantings on private property or in cultural landscape settings, but is not appropriate in natural settings. The long-term affects of cross-pollination between cultivars and natural trees and shrubs is unknown, not worth the risk of unintended consequences, and is contradictory to the objectives of preservation."

Ibid., p. 6.

For more information, contact:
Chris Bright, President
Earth Sangha
10123 Commonwealth Blvd. (703) 764-4830
Fairfax, VA 22032-2707 cbright@earthsangha.org