guideline

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GROWING PLANTS ON VIEW LANDSCAPES AND RECREATION AREAS

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Growing trees and shrubs to provide shade, screening, windbreaks, barriers to visitor traffic, and aesthetic value is a major problem on recreation sites that have been heavily used or that have not previously supported such plants. This is particularly true on the more arid lands of the Western United States where establishment of suitable plants may be inhibited by prolonged drought, extreme temperature fluctuations, shallow soils, nutrient deficient soils, competition from unwanted species or the short growing seasons associated with high elevations.

Problems of sparse vegetation are no longer limited to heavily impacted sites where vegetation losses have been high. Land use has spread from prime recreation sites onto lower quality areas that frequently have poor vegetative cover and less growth potential. Furthermore, the recreation developments and open spaces, desperately needed in and near rapidly growing cities, frequently lack adequate vegetative cover. Scenic management areas, roadsides through wildlands, and remote sections of the interstate highway systems are also frequently in need of plants to provide ground cover and aesthetic value. Extensive planting and maintenance programs are necessary if such lands are to be adequately embellished with vigorous plant materials. Such programs are also needed to provide screening and landscaping around military reservations, factories, and other sites that degrade the appearance of urban or rural environments.

Planting programs and subsequent maintenance require trained specialists and sound guides for plant selection, planting, and cultural techniques. In many situations, costs of long term maintenance programs are prohibitive. Consequently, proper plant selection and short term maintenance are essential for successful establishment of the desired plants at a reasonable cost.

Several examples of the problems we have defined presently exist in California. For instance, many Forest Service campgrounds have a dearth of natural understory vegetation or the trees and small shrubs have been eroded away during long periods of recreation use and inadequate protection from motor vehicles. Many shade trees have been lost because of overmaturity, disease, insect infestations, and recreational damage.

Re-establishment of plants is feasible if an area once supported more than the existing vegetation. Nevertheless, most efforts to revegetate depleted sites have failed due to faulty planting techniques, insufficient or poorly-timed maintenance, or lack of protection for new plants.

The problem may be different where there is no evidence of a previous vegetative cover. Many reservoirs, with increasing recreational value, are located in the foothills of California's Great Central Valley where shrubs and trees tend to be quite sparse. Little is known about species that may be most successful on such areas, how to establish them and the amount of maintenance they will require. Similarly high elevation sites (over 7,000 feet) presently not supporting trees or large shrubs are needed for campground development and expansion. Even though native plants grow nearby, growth rates are slow and the natives may not grow at the desired location.

In the situations mentioned, information has been inadequate to assure selection of proper planting sites, adaptable native and exotic species, correct planting methods, and proper cultural practices. As a means of

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developing effective solutions to problems of plant establishment and maintenence on difficult recreation sites, a substantial co-operative research program is underway in California. The program has drawn together the Department of Environmental Horticulture of the University of California at Davis, the Pacific Southwest Forest and Range Experiment Station of the U. S. Forest Service, the Environmental Resources Branch of the U.S. Army Corps of Engineers, the Recreation and Wildlife Branch of the U.S. Bureau of Reclamation, and the Western Service Center[1] of the National Park Service. Work for the National Park Service has been completed, and the results have been included in a report on direct seeding.[2]

As principal researchers, university scientists have completed a study of irrigation systems and water conservation at an old campground located in the San Bernardino Mountains of southern California (5,500-foot elevation). The study definitely demonstrated the benefits resulting from the mulching and shading of planted vegetation.

Further south, in the Laguna Mountains (6,000-foot elevation), clumps of California black oak were thinned and pruned to stimulate growth and improve tree form. Growth response to pruning was good the first season and tree form was improved, but there was little total visual improvement.

In a more complex study of lake Mendocino near Ukiah in northwestern California, an analysis was made concerning the influence of nitrogen-phosphorus-potassium fertilizer, sprinkler irrigation, chemical weed control, and mulching on more than twelve selected species. Over 100 different plants were evaluated for adaptation to the site.

Study results indicate that (1) plants mulched with bark were 12 to 114 percent taller than unmulched plants; (2) four of nine species were 14 to 69 percent taller when fertilized; (3) eight of nine were 18 to 675 percent larger in trunk size than unfertilized plants; (4) four of nine species showed 16 to 43 percent greater height growth when irrigated; and (5) five of nine species produced 19 to 450 percent greater trunk growth. A much larger number of plants have been evaluated to determine their environmental adaptability, resistance to wildlife damage, and ability to resist periodic flooding. On the basis of research data, 25 species were endorsed as outstanding for planting at Lake Mendocino, and about 75% of the species were deemed satisfactory.

(Continued)

Many campgrounds have bare soil surfaces and lack understory vegetation that is useful for screening, traffic control, and esthetic value.

Possibly the most exciting and potentially fruitful aspect of the cooperative research program concerns the evaluation of native and exotic species and their ecotypes. In many instances, landscape plants have been used with little knowledge of the environmental conditions under which a seed parent grew or how a new plant would respond to a new habitat. Gross assumptions were generally made regarding climatic comparability and the possible suitability of soils, but definitive studies were usually not made and seed source information was inadequate or entirely lacking.

Two additional U. S. Forest Service programs have materially aided plant selection research. The International Tree Seed Exchange in Washington, D.C., has supplied seeds of several Mediterranean conifers including Aleppo pine *(Pinus halepensis)* and erectcone Aleppo pine *(Pinus brutia)* from over 40 locations ranging from Morocco to the Caucasus Mountains in Russia. Also, about 15 selections of Canary Island pine *(Pinus canariensis)* seed were obtained at elevations ranging from near sea level to over 6,000 feet. In the other Forest Service program, the Institute of Forest Genetics, located at Placerville, California, has a collection of conifer seeds from around the world, and new aquisitions are continuing to be sent there for cataloging and storage. Seedlings for field experiments have been grown in the Institute nursery as well as at Davis.

Insight into the value of using seed from known sources to provide planting stock for recreation areas and landscaping can be gained by examining some recent findings. Originally, trees were planted which were grown from seed collected within the various California seed collection zones. The exact source of such seed was seldom known, only the general source area which may include several thousand square miles for each zone. Results showed that ponderosa pine seed which produced the fastest growing stock came from high elevation locations along the east side of the northern Coast Range and the southwest side of the Sierra Nevada Range. Surprisingly, seed collected from Jeffrey pine growing in southern California produced stock with the fastest growth rates. This was true even though it is the most difficult zone for establishment and growth wherein trees frequently appear unhealthy due to their continuing battle against a harsh semi-arid environment. Knowing that plants grown from seed found in a certain zone will grow better than other plants is of little value if seed cannot be collected from the parent trees.

Currently, seeds of promising native species are being collected from known sources. Results with Mediterranean pines are showing the value of this approach because ecotypic differences are identifiable by seed source. For example, the Aleppo pines of the same age and grown in the same nursery bed have demonstrated considerable variation in the following morphological and physiological characteristics:

- Dominant single leader to diffuse stem growth.
- Length of time to produce adult foliage.
- Foliar color varying from yellow-green to dark green.
- Size and density of roots and crowns.
- Frost hardiness.

Questions may be raised concerning the wisdom or desirability of using exotic species. Top priority will be given to suitable native plants with good growth rates and reasonable longevity. However, exotic species will be used whenever native species cannot provide a useful plant in a reasonable time. The advantage of nonnative species is evident in the following comparisons between natives and exotics. All plants were one year old at the time of planting, but the exotic species were planted a year later than the natives thus accounting for the age difference in the following table.

Species	Range of Mean Heights in Inches
Natives (*3 years* after planting)	
Pinus jeffreyi	6 - 12
Pinus ponderosa	7 - 16
Pinus coulteri	28 - 30
Exotics (*2 years* after planting)	
Pinus brutia *Pinus brutia* var. *pithyusa* *Pinus halepensis*	43 - 94
Pinus canariensis	55 - 67
Pinus pinaster	67 - 77
Cupressus lusitanica (Mexico)	95 - 108
X Cupressocyparis leylandii (*Cupressus macrocarpa* X *Chamaecyparis nootkatensis*)	112 - 140

Broad-leaved tree and shrub species showed equally spectacular growth. Three years after planting, the one year old stock of the following species had grown to the point where thinning and pruning was necessary to stop crowding. It is not known how much growth was inhibited due to crowding.

Species	Range of Means in Feet	
	Height	Spread
Eucalyptus spp. (7 spp.)	13 - 22	-
Acacia floribunda	9 - 10	6 - 8
Prunus ilicifolia	3 - 6	3 - 4

Some eucalyptus species have already survived one year without irrigation, and none are currently being irrigated. Fertilizers have not been applied to the plantings.

The whole picture is not one of sunshine and flowers. Obviously, some species will not qualify as landscape plants. The Siberian salttree *(Halimodendron halodendron)* from Russia has grown very well, in fact, too well. It is an extremely thorny plant (good for use as a barrier) with very small leaves and a strong tendency to produce root suckers. It is the latter feature that makes it undesirable. Vigorous root suckers have been observed three to four feet away from the original plantings. This plant appears to be spreading rapidly enough to become a noxious weed. Rapid growth and some ability to reproduce at a reasonable rate is desirable but excessive competitive growth patterns and rapid reproduction are not desirable. Salttree will be removed from consideration, and other introduced plants will be carefully screened to prevent introduction of potential weed species.

Research at several Corps of Engineers reservoirs is providing useful information regarding pruning and fertilization of native oaks and their resistance to flooding. At New Hogan Reservoir, east of Lodi, California, blue oak *(Quercus douglassi)* were pruned and fertilized to increase tree size and improve their appearance. Test trees, which were 3-6 inches in diameter and 20-25 feet tall, responded more to pruning than to fertilization.

Pruned but non-fertilized trees had 72 percent greater shoot growth than controls, and fertilized but non-pruned trees had 39 percent greater growth. Trees subject to both treatments produced less than those given a single treatment, but trees given both treatments produced 83 percent more growth than untreated plants. Therefore, pruning and fertilizing have been recommended to improve the vigor and appearance of blue oak.

Pruning increased shoot growth by 73 percent at a reservoir site in the foothills on the east side of California's central valley.

Three species of oak have been evaluated for susceptibility to flooding damage. Interior live oak *(Quercus wislizenii)* did not tolerate even very shallow flooding for periods as short as a week. However, valley oak *(Q. lobota)* showed a tolerance for flooding to depths of 12 feet for over 100 days. Whereas, blue oak would require removal from a flood zone only if depths attained 12 feet for 100 days or 25 feet for 80 days. Limbs of blue oak generally die if inundated for two weeks or more.

The cooperative research program is also concerned with direct seeding of landscapes to provide cover and aesthetic value to areas devoid of vegetation as a consequence of construction or concentrated use. Of particular concern are the more remote sites where regular maintenance programs are not economical. The more common examples are highway cuts and fills that occur in wildlands. Along such routes, direct seeding appears to be the best solution to minimize establishment and maintenance costs, provided that species are properly identified and coordinated with site characteristics and cultural practices. Under an agreement not involving the Forest Service, the University and the California Division of Highways collaborated to determine the feasibility of direct seeding along interstate highways. Information gained from these cooperative efforts have been freely exchanged to the extent that direct seeding studies have also been conducted for the National Park Service and the Corps of Engineers through an agreement with the Forest Service.

Plants considered for direct seeding must demonstrate an ability to establish from seed without subsequent maintenance on sites subject to severe environmental extremes. Seed dispersal has been hydromulching, range-land drill, and hand spotting. In 1968, hydromulched woody seeds showed scant success. It is possible that germinating seeds were not sufficiently covered by hydromulch to prevent dessication.

In subsequent trials, hydromulch seeding was successful for only three out of 17 species tested whereas 16 species were successful when seeded directly. Furthermore, it was determined that 13 to 200 times more seeds would be required to obtain the same number of plants for a given area by hydromulching as by direct seeding, and direct seeded plants grew faster. So far, more than 50 species of plants have been successfully established by direct seeding and without irrigation at more than 23 widely distributed test sites.[3]

Information is slowly being generated by the studies underway, but land managers urgently need help to solve immediate problems. Assistance in the form of a series of extension bulletins will present the "state of the art" concerning such topics as pruning and thinning, staking, site selection, species selection, planting, fertilization, and irrigation.

The first three bulletins, dealing with pruning landscape trees, staking landscape trees, and direct seeding woody plants, are published and available through the University of California Agricultural Extension Service.[4] Other bulletins are in various stages of preparation.

The merits of cooperative horticultural research are apparent. In the case discussed, the research is developing a valuable storehouse of information that can be effectively used by resource managers to establish and maintain vegetative cover on a variety of developed sites and visually sensitive areas. Many agencies do not have sufficient financing or staffing to generate the information or expertise they need to manage vegetation on their land. However, pooling funds and skills in a cooperative effort offers hope for solving these problems and developing a viable program for vegetation management.

Footnotes

1 Now the Denver Service Center.

2 Harris, R. W. *Establishment of Woody Plants by Direct Seeding in California.* Final Report. Dept. of Environmental Horticulture, University of California, Davis. 81 pp., illus. 1971.

3 *Op. cit.*, Harris, 1971

4 Harris, R. W., Hamilton, W. D., Davis, W. B., and Leiser, A.T. *Pruning Landscape Trees.* University of California Agricultural Extension Service, AXT-288. Berkeley, California. 28 pp., illus. 1969.

Harris, R.W., Leiser, A. T., and Davis, W.B. *Staking Landscape Trees.* University of California Agricultural Extension Service, AXT-311. Berkeley, California. 13 pp., illus. 1969.

Chan, F.J., Harris, R. W., and Leiser, A. T. *Direct Seeding Woody Plants in the Landscape.* University of California Agricultural Extension Service, AXT-n27. Berkeley, California. 12 pp., illus. 1972.

INTERPRETIVE TRAILS

This material was adapted from TRAIL PLANNING AND LAYOUT by Byron L. Ashbaugh and Raymond J. Kordish, National Audubon Society, 1971.

Trail Planning

The importance of good interpretive trail planning should never be underestimated. A nature trail is much more than a path through the woods. Careful planning by qualified personnel is essential. Here are four basic factors to consider:

1) Be thoroughly familiar with the site so that important features will not be overlooked.
2) Understand the educational objectives of the nature center and its programs and develop trails that will enhance these objectives.
3) Trails must be safe as well as exciting.
4) Every attempt should be made to protect the trail environment.

Trail Identification

A good interpreter can use his insight and imagination to take full advantage of all the features of a nature trail.

Although it is typical to assign an identifying name or label, rarely does a trail serve only one purpose. A name then is used for reference and also to inform prospective users of the major purpose of the trail or its most noteworthy feature. Trail identification, however, is usually more important to the visitor. A basic rule for planners to follow is to analyze its primary purpose and then select a name which best describes it and will generate visitor interest. The name should not be based on the subject of a walk as many different subjects can be taught on a single trail.

Types of Trails

Formal Teaching Trails

Formal teaching trails are those which emphasize interpretation. They can be guided or self-guided. Guided walks are usually given by a teacher-naturalist and almost exclusively involve groups on a scheduled basis. Self-guided walks leave the visitor by himself aided by interpretive leaflets or brochures keyed to trail markers or stations along the path.

Walking or Hiking Trails

Walking or hiking trails are longer and have few stations or brochures to guide the visitor. Trail specifications are less rigorous, thus the trail is more primitive and more exciting to those who use them.

Special Use Trails

Equestrian. Try to avoid combining equestrian and hiking trails. Horses tend to force walkers off trails and can cause undesirable or muddy conditions.

Bicycle. Bicycle paths and trails in cities and parks are becoming more and more popular. According to the Bicycle Touring League of America, a bicycle trail should meet the following requirements:

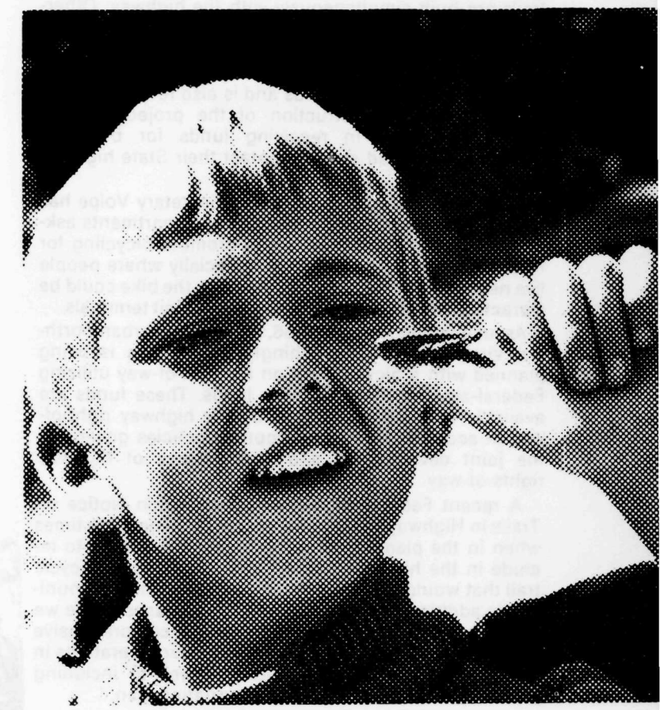
1. Be wide enough for at least two riders to pedal side by side.
2. Be long enough, at least five miles, to make the ride interesting.
3. Be hard-surfaced to avoid tire damage. Cinders, sand, gravel and shells are unsuitable as surface material.
4. Avoid motor crossings wherever possible.
5. Should run through points of scenic or historic interest.
6. Be as far away as possible from motor highways. Noise and Exhaust fumes are not conducive to a pleasant and relaxing ride.
7. Be nearly level, but a few rolling hills make a ride more interesting. A trail can be planned along a lake, river, ocean front, an old canal towpath, or along an abandoned railroad right-of-way.
8. Have shade trees for more pleasurable summer cycling.
9. Have a bicycle-rental station. Rental from the concession provides funds for the maintenance of the path.
10. Be clear of debris, glass and sand. Grading should prevent water puddles from forming.

Underwater. Underwater trails are now in operation in the Trunk Bay area of the Virgin Islands National Park, St. John, Virgin Islands, and in the John Pennekamp Coral Reef State Park just offshore Key Largo, Florida. Both trails are in shallow water (6 - 10 feet deep). Visitors tour the area with snorkeling equipment. Basic water safety rules must be followed.

Canoe or Boat. Water trails can be used in several types of watery environments. Marshes, both freshwater and saltwater, lend themselves well to boat use and interpretation. Sometimes channels have to be created or periodically cleared when vegetation clogs the right-of-way. In most instances, careful exploration will reveal natural watercourses which can be suitably developed into water trails with little maintenance. This is especially true in swamps, large bogs, and recently inundated wet areas.

Trails for the Handicapped. Interpretation and nature education are the primary aspects of trails for the handicapped. The aged, mentally afflicted, partially and totally blind and deaf and otherwise physically handicapped require special facilities. Trails should be wide enough to accommodate wheelchairs, have a hard surface, level topography, and include curbs or rope lines to guide blind visitors. Paths should be no longer than one-eighth of a mile and should form a close loop. Significant interpretive features should be marked by Braille labels of weather-resistant material. Printed labels need also be included for sighted visitors.

For more detailed information on trail design, construction, maintenance, special trailside interpretive features, signs, labels and guides, you can order a copy of TRAIL PLANNING AND LAYOUT by writing to the Nature Center Planning Division, National Audubon Society, 950 Third Avenue, New York, New York 10022. Price is $3.00.



Federal Assistance for Bike Trails

(Information in this section is reprinted from a joint publication of the U.S. Departments of Interior and Transportation entitled "Bicycling for Recreation and Commuting.")

The Department of Transportation is concerned with the commuting aspects of bicycling. It provides the States, through its Federal Highway Administration, with Highway Trust Fund moneys. These funds are for construction and improvement of roads included in Federal-aid highway systems.

These funds may be used for constructing bicycle paths when they are built in conjunction with a Federal-aid highway project. The money for the trails is available on the same basis as money for other Federal-aid projects. In the case of Interstates, it is 90 percent Federal money matched by 10 percent State funds when the trails are built simultaneously with the highway. Otherwise it is on a 50 percent basis. For all other Federal-aid projects, it is also on a 50 percent basis.

In such cases, the State highway department makes the request for Federal funds and is also responsible for the design and construction of the project. Citizen groups interested in receiving funds for bikeways through Federal-aid should contact their State highway departments.

As an aid to bicycle enthusiasts, Secretary Volpe has written to the heads of State highway departments asking them to do what they can to promote bicycling for recreation and for commuting, especially where people live near their jobs or schools, or where the bike could be a practical link with the bus and rapid transit terminals.

As an example, Interstate 66, through suburban northern Virginia and the Washington, D.C. area is being planned with a bicycle path on its right-of-way utilizing Federal-aid and State highway funds. These funds are available for facilities located on the highway right-of-way in accordance with appropriate policies governing the joint development and multiple use of highway rights-of-way.

A recent Federal Highway Administration Notice on Trails in Highway Rights-of-Way, states, "There are times when in the planning of a highway it is possible to include in the highway right-of-way a walking or bicycle trail that would be of significant benefit to the community." In addition, the Notice urges, "In all cases where we have 3-C (continuous, coordinated, comprehensive transportation planning process) planning operations in progress, consideration should be given to including trails as part of the areawide transportation plan."

Other Grants to Investigate

Public spirited groups may wish to investigate through their State's appropriate agency, the availability of funds for bike paths from various Federal agencies.

Land and Water Conservation Fund grants, under the President's "Legacy of Parks" program, are administered by the Bureau of Outdoor Recreation, Department of the Interior. These grants provide funds to states and their political subdivisions for acquisition and development incidental to outdoor recreation areas and facilities, including bike trails. Priority is given to projects serving urban populations. Application is made through the appropriate State liaison agency. All grants are on a 50-50 matching basis and can be for very small amounts or in the hundreds of thousands of dollars, depending upon the scope of the project, ie: cost of land and development.

Two grant programs under Community Development, Department of Housing and Urban Development, contain funds applicable to land use for recreation. First, an Urban Renewal Project program to provide assistance for the rehabilitation or redevelopment of slums and blighted areas makes possible the acquisition of land and installation of public improvements including streets and sidewalks and incidental recreational areas. Plans can include bike facilities. Application is made through a State or local renewal or housing agency. Range of grants—$800,000 to $40,000,000, and they are for 2/3 or 3/4 of project costs.

Second, HUD under its Open Space Land Programs helps communities meet rapidly growing urban recreational needs by assisting in acquiring and developing land for permanent open space use. Roadways, signs and landscaping are included in this program. Its application to bikeways should be investigated with the State authority handling the Open Space Land program. Grants range from $4,900 to $2.5 million, and they are made for 50 percent of total acquisition and development costs.

Another Federal assistance program suggested for investigation is the Appalachian Regional Development Act of 1965. This legislation promotes the economic development of the 13 states in this region. (Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia.) This includes development and creation of outdoor recreational opportunities.