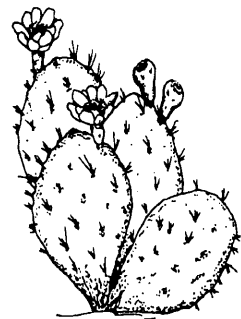
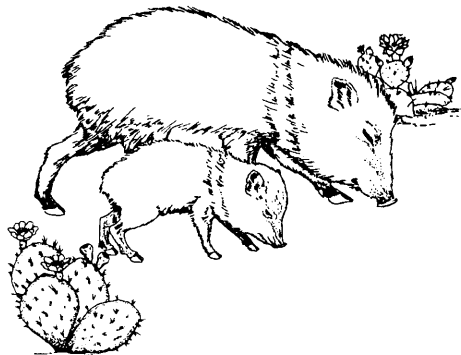


CREATING ATM SCHOOL HABITAT

**A Planning Guide
For Habitat Enhancement on
School Grounds in Texas**

APPENDICES For Southwest Texas

**Edwards Plateau, Blackland Prairies,
Post Oak Savannah, and
South Texas Plains
Ecological Regions**



Written by:

**Diana M. Foss, Urban Program, Texas Parks and Wildlife
Ronald K. Jones, U. S. Fish and Wildlife Service**

**Illustrations on pages A-15, A-17, A-21, and A-22 by:
Michele G. Foss**

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Texas Parks and Wildlife, Urban Program
U. S. Fish and Wildlife Service, Ecological Services**

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Additional copies of this manual may be obtained from the offices listed in the manual. Training workshops are offered periodically through the year in association with this manual.



Appendix A: Resource Professionals

**Texas Parks and Wildlife Department
Urban Program
134 Braniff Dr., San Antonio, TX 78216
(210) 348-6340
(800) 792-1112 (Austin Headquarters)**

**Texas Natural Resource Conservation Commission
P.O. Box 13087, Austin, TX 78711
(512)-239-1000
(210)-490-3096 (San Antonio)**

**Texas Agricultural Extension Service
Bexar County Extension Office
3427 Northeast Parkway, San Antonio, TX 78218
(210) 467-6575**

**Texas Forest Service
202 East Nueva, San Antonio, TX 78204
(210) 223-9963**

**San Antonio Water System
Conservation Department
1001 E. Market St.
P.O. Box 2449, San Antonio, TX 78298-2449
(210) 704-7323**

**San Antonio Botanical Garden
555 Funston, San Antonio, TX 78209
(210) 207-3264**

**Natural Resources Conservation Services
727 East Durango, Suite A-507
San Antonio, TX 78206
(210) 472-5527 ext. 113**

**Native Plant Society of Texas
Box 891, Georgetown, TX 78627
(512) 238-0695**

**Native Plant Society of Texas, San Antonio Chapter
c/o 5596 Hollyhock Rd., San Antonio, TX 78240-1606
(210) 696-0979**

**Ladybird Johnson Wildflower Research Center
4801 LaCrosse Ave., Austin, TX 78739-1702
(512) 292-4100**

Appendix B: Teacher Training Resources

**Project WILD and Aquatic WILD
Texas Parks and Wildlife Department
4200 Smith School Rd., Austin, TX 78744
(800) 792-1112
Web site—www.tpwd.state.tx.us**

**Project Learning Tree
Texas Forest Service
202 East Nueva, San Antonio, TX 78204
(210) 223-9963**

**National Wildlife Federation
Gulf States Natural Resource Center
44 East Ave., Suite 200
Austin, TX 78701
(512) 476-9805**

**Texas Master Naturalist
Statewide Program
113 Nagle Hall
The Texas A&M University System
College Station, TX 77843-2258**

**Texas Master Naturalist
Alamo Area Chapter
c/o Friedrich Wilderness Park
21396 Milisa, San Antonio, TX 78256
(210) 698-1057**

**Bexar County Master Gardeners
700 Garcia, San Antonio, TX 78203
(210) 225-5848**

ADDITIONAL RESOURCES:

Appendix C: Resources for Materials/ Supplies

This is only a partial list of plant vendors. Other nurseries may carry native species seasonally. Write in additional sources as you discover them.

NATIVE PLANTS:

Schumacher's Hill Country Gardens
588 FM 1863 (New Braunfels)
(830) 620-5149

Shades of Green
344 W. Sunset (San Antonio)
(210) 824-3772

The Grove
1319 Old Austin Hwy. (San Antonio)
(210) 822-6298

Rainbow Gardens
8516 Bandera Rd. (San Antonio)
(210) 680-2394
2585 Thousand Oaks (San Antonio)
(210) 494-6131

Landscape Marketplace
1031 Old Austin Hwy. (San Antonio)
(210) 822-1335

Southernwood Gardens
658 Landa Str. (New Braunfels)
(830) 608-9160



NOTE: When trying to locate mulch, compost, rocks, and other such materials, be sure to contact possible free sources first. Quite often, cities, utility companies, and tree trimming services have to trim trees. They frequently run the limbs through chipper/shredders and give away the mulch to school projects. In addition, many

cities are beginning to operate composting programs and will offer the finished product to the public. Rocks and gravel may be a different story. These materials may have to be purchased from local sand and gravel companies.

Milberger's Nursery
3920 NE Loop 1604 (San Antonio)
(210) 497-3760

The Antique Rose Emporium
7561 E. Evans Rd. (San Antonio)
(210) 651-4565

Natives of Texas
6520 Medina Hwy. (Kerrville)
(830) 896-2169

Medina Valley Greenhouse
1151 CR 477 (Castorville)
(830) 931-2298

SEED SOURCES:

Native American Seed
Junction, Texas
(800) 728-4043

Wildseed Farms
Eagle Lake, Texas
(800) 848-0078

OTHER MATERIALS:

Garden-Ville, Inc.
7561 East Evans (San Antonio)
(210) 651-6115
26807 N. Hwy 281 (San Antonio)
(830) 980-7645

Keller Material, Inc.
1920 S.E. Loop 410 (San Antonio)
(210) 648-4221

ADDITIONAL RESOURCES:

Appendix D: Reference Books

Also refer to books listed inside the Reference Boxes located at the end of various chapters.

STUDENT REFERENCES

FIELD GUIDES:

Peterson First Field Guides to:
Butterflies and Moths
Caterpillars
And others....

Gulf Publishing Field Guide Series -
Butterflies of Texas by Raymond Neck
Reptiles and Amphibians of Texas by
Garrett and Barker
Snakes of Texas by Alan Tennant

National Geographic Field Guide to Birds of North
America

Mammals of Texas by W. B. Davis and D. J.
Schmidly, University of Texas Press

Wildflowers of Texas by Geyata Ajilvsgi, Shearer
Publishing

A Guide to Freshwater Ecology by Christine Kolbe
and Mark Luedke, Texas Natural Resource
Conservation Commission, P. O. Box 13087,
Austin, TX 78711-2087

Forest Trees of Texas, How to Know Them, Bulletin
20, Texas Forest Service

Poisonous Snakes of Texas by Andrew Price, Texas
Parks & Wildlife Press

Birding for the Amateur Naturalist by Laura O'Biso
Socha, Acorn Naturalists, (800) 422-8886.

Growing Wild, Inviting Wildlife Into Your Yard,
(good for young children) by Constance Perenyi,
Beyond Words Publishing, 13950 NW Pumpkin
Ridge Road, Hillsboro, OR, 97123.

Habitats, Making Homes for Animals and Plants, by
Pamela Hickman, Acorn Naturalists, (800) 422-
8886.

TEACHER REFERENCES

Texas Wildscapes Gardening for Wildlife by Noreen
Damude and Kelly Conrad Bender, Texas Parks and
Wildlife Press

Native Texas Plants, Landscaping Region by Region
by Sally Wasowski, Gulf Publishing Company

How to Grow Native Plants of Texas and the
Southwest by Jill Nokes, Gulf Publishing Company

Creative Propagation, A Grower's Guide
by Peter Thompson, Timber Press, Portland, Oregon,

A Field Guide to Common South Texas Shrubs by
Richard Taylor, Jimmy Rutledge, and Joe Herrera,
Texas Parks and Wildlife Press

Trees, Shrubs, and Cacti of South Texas by James H.
Everitt and D. Lynn Drawe, Texas Tech University
Press

Wildflowers of the Texas Hill Country by Marshall
Enquist, Lone Star Botanical, Austin, Texas

Texas Trees, A Friendly Guide by Paul Cox and Patty
Leslie, Corona Publishing Company, San Antonio

Attracting Birds to Southern Gardens by Thomas
Pope, Neil Odenwald, and Charles Fryling, Jr., Taylor
Publishing Company, Dallas, Texas

Building Birdhouses and Feeders by Ortho Books,
Chevron Chemical Company, San Ramon, California

Schoolyard Sanctuaries, Houston Arboretum and
Nature Center, (713) 681-8433.

Worms Eat My Garbage, by Mary Appelhof, Flower
Press, Kalamazoo, Michigan.

Teaching Kids About Birds (and other booklets), Bird
Watcher's Digest, Pardson Corporation, 1-800-879-
2473.

Green Teacher magazine, \$27. per year, P. O. Box
1432, Lewiston, NY 14092.

Education Goes Outdoors, Addison-Wesley Publishing
Co., Acorn Naturalists, (800) 422-8886.

Educator's Activity Book About Bats, Bat
Conservation International, (800) 538-BATS.

Beyond the Classroom, Exploration of Schoolground
& Backyard, Acorn Naturalists, (800) 422-8886.

Bottle Biology, Kendall/Hunt Publishing Co., 4050
Westmark Dr., Dubuque, IA 52002. Also available
from Acorn Naturalists,
(800) 422-8886.

Texas Prairies - Relationships, for Grades 4-7,
The Botanical Research Institute of Texas, 509 Pecan
St., Ft. Worth, TX 76102-4060, (817) 332-4441.

Appendix E: Ecological Regions

by Noreen Damude, Texas Parks and Wildlife

Texas is divided into 10 ecological regions, according to the soil types, rainfall amounts, and vegetation. The greater San Antonio area contains four ecological areas: Edwards Plateau, Blackland Prairies, Post Oak Savannah, and South Texas Brush Country.

EDWARDS PLATEAU

Semi-arid, rocky, and beautifully rugged, the Edwards Plateau comprises nearly 24 million acres of land dominated by Ashe juniper, various oaks, and occasionally, honey mesquite (Winkler, 1982). Much of the region overlays a foundation of honeycombed Cretaceous limestone—and an immense underground reservoir called the Edwards Aquifer that spills out into many crystal clear springs. Caliche slopes, limestone escarpments, and thin clay soils are riddled with fossil remains of microscopic marine creatures, bearing testimony to the once massive sea that covered most of the state. Topography is generally rough with elevations ranging from slightly less than 1000 feet to over 3,000 feet and average annual rainfall varying from a meager 15 inches in the west to more than 33 inches in the east (Gould, 1975). Droughts can be prolonged, frequent, and often unpredictable. Sporadic flash floods can be devastating to those unaccustomed to their fury. Average temperatures range from 64° F to 67° F. Soils range from neutral to slightly acidic sands and sandy loams in the Llano Uplift, to thin, rocky highly calcareous clays and clay loams over the rest of the Plateau (Simpson, 1988).

Floristically, it is a region of great diversity, with 100 of the 400 Texas endemic plants occurring only here, including Texas snowbells, Bracted twist-flower, Texabama croton, Texas wildrice, and rock quillworts. Tucked away in protected valleys, are relict populations of Texas madrone, Texas smoke tree, witch hazel, and big tooth maples—trees normally found far to the northeast in Arkansas, to the west in the Trans-Pecos mountains or the south in the mountains of Mexico (Wasowski, 1988). The moist river corridors of the Colorado, Guadalupe,



Blanco and Nueces are lined with majestic baldcypress, pecan, hackberry and sycamores. And perhaps nowhere else are the spring wildflowers so spectacular as here, with undulation tapestries of bluebonnets, Indian paintbrush, gaillardia and golden-wave dazzling spectators come April.

The region also hosts a number of terrestrial vertebrates. Here the white-tailed deer is king. Other common denizens of the Hill Country include armadillo, black-tailed jackrabbit, opossum and Texas earless lizard. The purity and constant temperature of the waters provide ideal habitat for specialized spring dwellers such as the Clear Creek Gambusia, the San Marcos Gambusia, the Fountain Darter and the San Marcos Salamander. Within the larger rivers can be found the unique Guadalupe Bass and the Cagle's Map Turtle. Thousands of caves of all sizes harbor cave shrimp and blind salamanders which live only within the confines of these underground systems. Rare invertebrates like blind spiders, pseudoscorpions, mold beetles and harvestmen are also found in caves, as well as Mexican free-tailed bats which establish summer nursery colonies within several larger caves throughout the region. The Edwards Plateau also provides a meeting ground for birds typical of both eastern and western regions. The Green Kingfisher, Cave Swallow, Black-capped Vireo and Golden-cheeked Warbler nest more commonly here than in any other region in the state (Fisher, 1984).

BLACKLAND PRAIRIES

Taking the name from the fertile, dark clay soil, the Blackland Prairies constitute a true prairie ecosystem and have some of the richest, naturally fertile soils in the world. Characterized by gently rolling to nearly level topography, the land is well dissected and marked by rapid surface drainage. Pecan, cedar elm, various oaks, soapberry, honey locust, hackberry and Osage orange dot the landscape, with some mesquite invading from the south. A true tall-grass prairie, the dominant grass is little bluestem. Other important grasses include big bluestem, Indiangrass, eastern gammagrass, switchgrass and sideoats grama. While elevations from 300 to more than 800 feet match those of the Post Oak Savannah, the annual rainfall varies from 30 to 40 inches west to east, and the average annual temperatures range from approximately 66° F to 70° F. Described as “black velvet” when freshly plowed and moistened from a good rain, true blackland soils are deep, dark, calcareous deposits renowned for their high productivity (Wasowski, 1988). Scientists believe the richness of the prairie soils is derived from the abundant invertebrate fauna and fungal flora found in the soils themselves. The Blackland prairies are today almost entirely brought under the plow, with only 5,000 acres of the original 12 million remaining. For this reason, many authorities believe that the Blackland Prairies represent some of the rarest landscapes in Texas.

Like many of the prairie communities comprising the Great Plains of North America, the Blackland Prairies harbor few rare plants or animals. What is so special and unique about this ecosystem today, are the grassland communities themselves.

POST-OAK SAVANNAH

Lying immediately west of the East Texas Piney Woods, the Post Oak Savannah emerges almost imperceptibly, marked by subtle changes in soils and vegetation. Occupying approximately 8,500,000 acres, the area’s topography is gently rolling to hilly with elevations ranging from 300 to 800 feet, and rainfall averages from 35 to 45 inches per year from west to east. Annual average temperatures ranges from 65 F to 70 F. Soils of the Post Oak Savannah are interesting and complex. They are usually acidic, with sands and sandy loams occurring on the uplands, clay to clay loams on the bottomlands, with a dense clay pan underlying all

soil types. Because of this peculiarity, the Post Oak Savannah is sometimes referred to as the “Clay Pan Savannah” Clay pan soils are nearly impervious to water and underlie the surface layers of soil at depths of only a few feet. As a consequence, the moisture available for plant growth is limited making the habitat surprisingly arid at times. One curious exception the clay pan soils occurs in Bastrop County—home of the renowned Lost Pines. The Carrizo sands, a sandy inclusion of moist soils, harbor a unique community of loblolly pine, post oak and blackjack oak and is also home to sphagnum bogs with ferns and carnivorous pitcher plants.

The Post Oak Savannah is punctuated by scattered oaks—mainly post oaks, of course—and blackjack oaks (Wasowski, 1988). Black hickory may also be locally abundant. Widespread trees of lesser importance include cedar elm, sugarberry, eastern red cedar and common persimmon. Other important species of the region are Southern red oak, sassafras, flowering dogwood, yaupon, and winged elm. Some authorities believe that this regions was once predominantly a tall grass prairie, but that trees, mostly oaks, and brushy shrubs proliferated with the suppression of fires and the conversion of the land to farming and grazing. When fires were frequent, the land was not as it appears today. Historically, wide vistas of tall-grasses—little bluestem, Indiangrass, switchgrass and a myriad of wildflowers, broken only by the occasional motte of venerable “giants”, lent a park-like atmosphere to the landscape. Peat bogs, like the ones found in the Piney Woods, are also found here, mingled amongst stands of flowering dogwood, sassafras, bumelia and yaupon.

Early European settlers were especially attracted to the Post Oak Savannah because it was clearly transitional between woodland and prairies (Wasowski, 1988). Today, the Post Oak Savannah is used largely for improved pasture, with vast acreage seeded to introduced grasses such as Bahia Grass or Bermuda Grass (Simpson, 1988).

Mostly prairie animals with some woodland species abound in the Post Oak Savannah region. The distinctive sandy inclusion of the Lost Pines area also harbors one of the last refuges for the endangered Houston Toad.

SOUTH TEXAS PLAINS

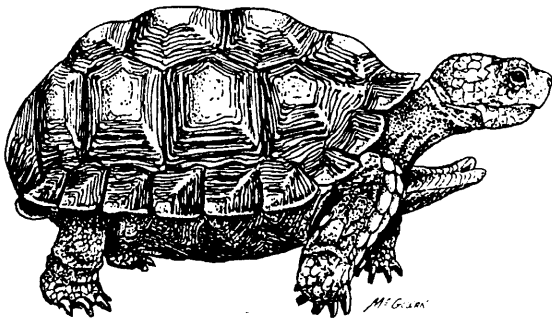
The South Texas Plains is also commonly referred to as the South Texas Brush Country. Bounded on the west by the Rio Grande and Mexico, and on the north by the Balcones Escarpment, the South Texas Plains is vast, serene, and unpopulated (Winkler, 1982). Elevation ranges from sea level to 1,000 feet and rainfall varies from 30 inches in the east to 16 inches in the west. Soils are varied and highly complex. Generally extremely basic to slightly acidic, they range from deep sands to tight clays and clay loams. With average annual temperatures around 73° F, the South Texas Plains boasts the longest growing season in Texas, lasting up to 365 days in some years at Brownsville (Simpson, 1988). This warm region is, however, a land of recurrent droughts, a factor which distinctly marks the landscape. Nearly everything that grows here is drought-tolerant, as rainfall is well below the amount needed for conventional forest trees (Wasowski, 1988). Sporadic rains, however, will trigger wildflowers to bloom unexpectedly at almost any time of year.

The South Texas region owes its diversity to the convergence of the Chihuahuan desert to the west, the Tamaulipan thornscrub and subtropical woodlands along the Rio Grande to the south and the coastal grasslands to the east. Essentially and gently rolling plain, the region is cut by arroyos and streams, and is blanketed with low-growing vegetation—mesquite, granjeno, huisache, catclaw, blackbrush, cenizo and guayacan. Wherever conditions are suitable, there is a dense understory of smaller trees and shrubs such as coyotillo, paloverde, Mexican olive, and various species of cacti. The woody vegetation of the South Texas

Plains is so distinctive that the area is also referred to as the “brush country”.

The Lower Rio Grande Valley is a highly distinctive subregion of the South Texas Plains. Usually defined as Cameron, Willacy, Hidalgo, and Starr counties, it contains the only subtropical area in Texas. Once supporting majestic groves of Texas palmetto, Montezuma cypress, tall ebony-anaqua woodlands, and jungle-like expanses of Tamaulipan thorny shrubs, today much of it has been bulldozed, plowed or paved. In fact, the once extensive groves of the native Sabal palm that used to flourish here are now reduced to only a few stands near Brownsville. Soils in this subtropical region range from sands to heavy clays. Clays and extremely poor drainage dominate the resaca areas (old meandering paths of the Rio Grande) (Wasowski, 1988).

Despite a history of land use that is the oldest in the state, the Rio Grande Plain harbors many rare species of plants and animals (Texas General Land Office, 1984). It is here that a few wild tropical cats—ocelots and jaguarundis—still take refuge. Other special animals include Ferruginous pygmy-owl, Green Jay, Elf owl, Texas tortoise, Indigo snake and Mexican burrowing toad. There are also a surprising number of plants that occur here and nowhere else, especially among the cactus family, like Albert’s black lace cactus, star cactus, and Runyon’s cory cactus.



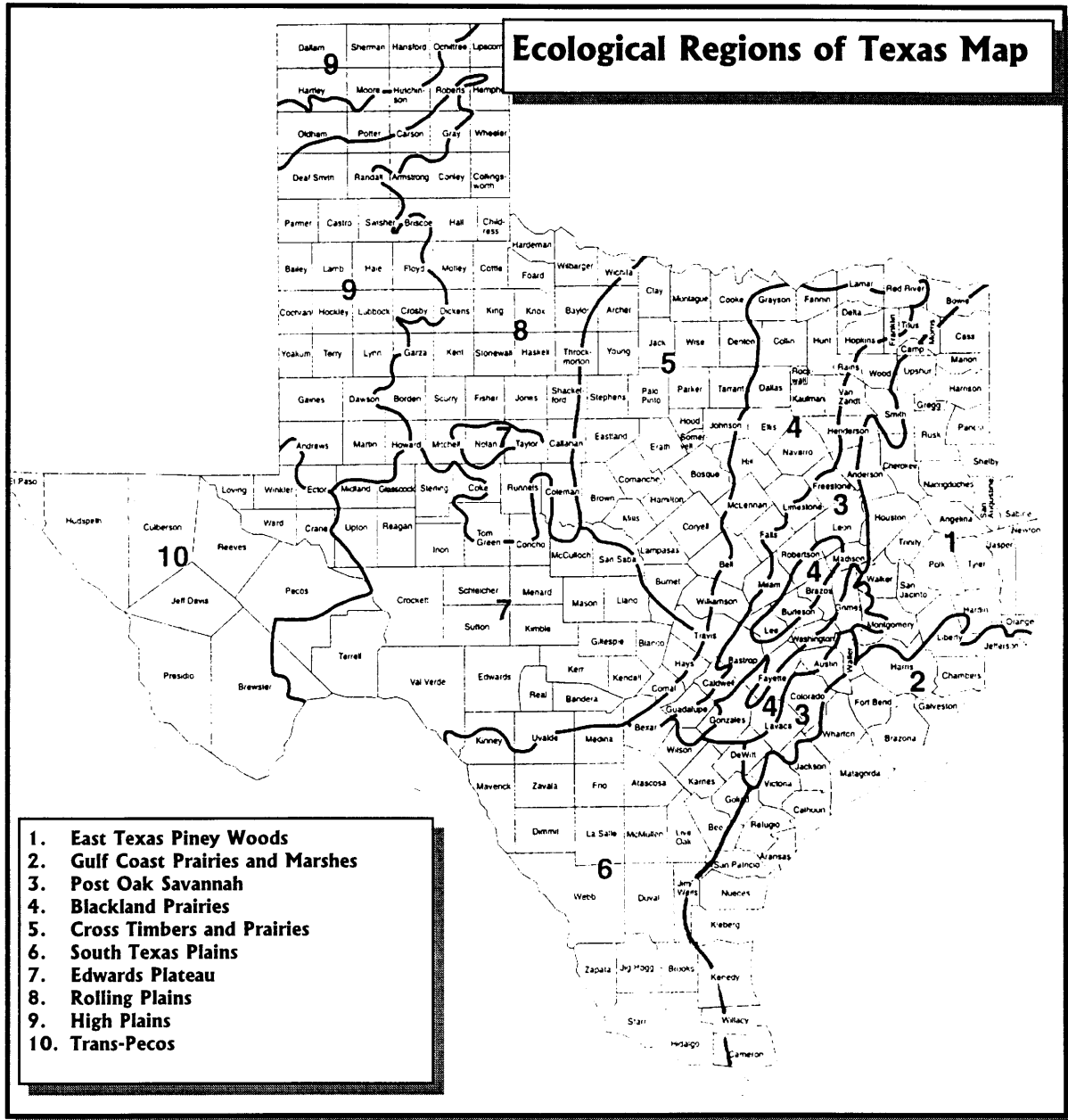


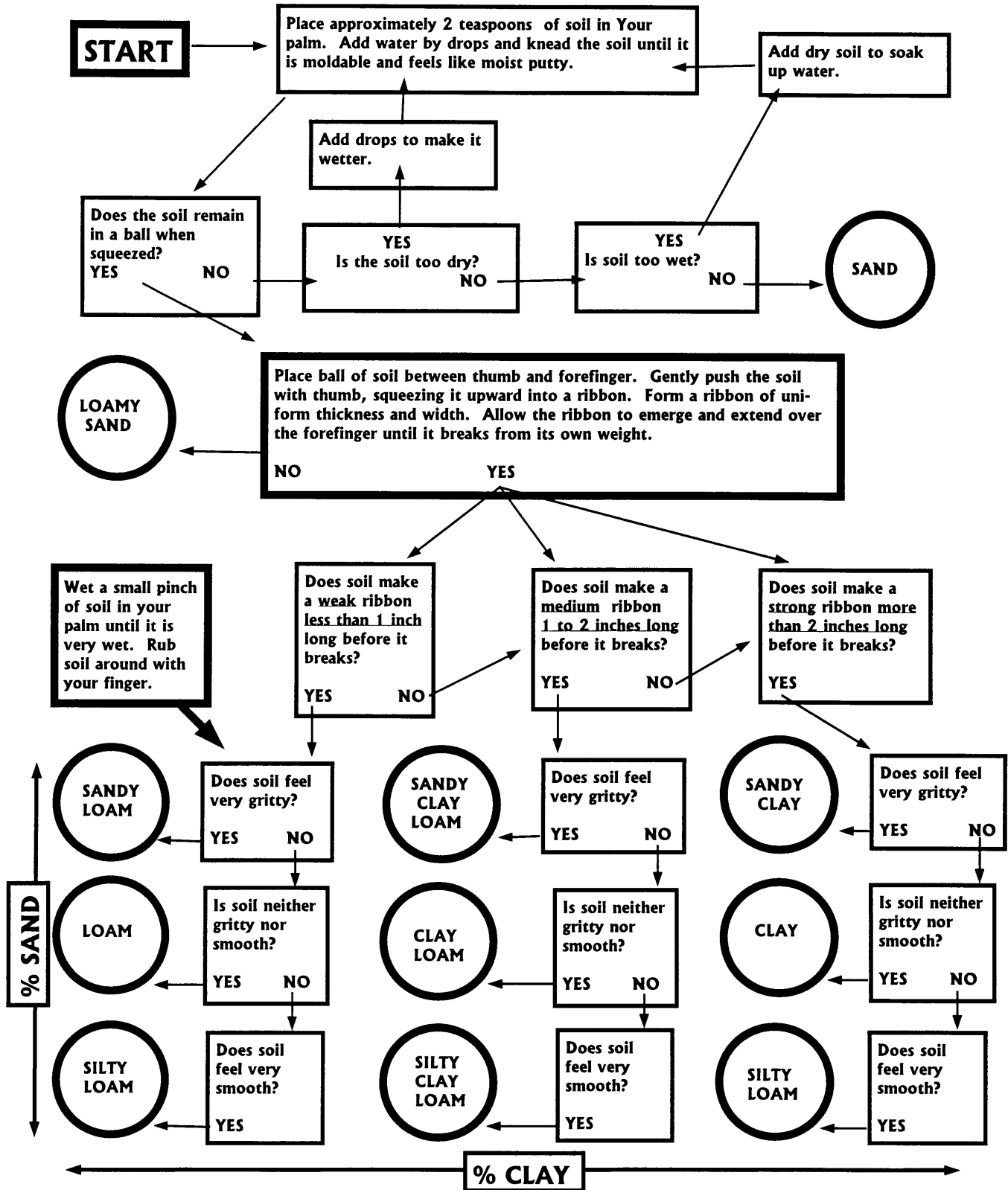
Figure (29). Map of the Ecoregions of Texas. (Source: Map adapted from F. W. Gould, G. O. Hoffman, and C. A. Rechenhth, *Vegetational Areas of Texas*, Texas A&M University leaflet 494.

Appendix G: Common Wildlife Foods

	Turkey	Deer	Squirrel	Rabbit	Quail	Bluebirds	Wood Duck	Hawks	Foxes	Beaver	Owls	Shrews	Snakes	Woodpeckers	Raccoons	Bats	River Otter	Turtles	Salamanders	Frogs
Spiders	X				X	X	X							X	X			X		X
Acorns	X	X	X				X							X	X					
Nuts	X		X				X							X						
Mushrooms		X	X																	
Seeds	X		X		X	X	X		X					X	X					
Fruit	X	X	X	X	X	X	X		X					X	X			X		
Tubers, Roots	X													X						
Greens	X	X			X					X				X				X		
Insects	X				X	X	X	X	X		X	X	X	X	X	X		X	X	X
Snails	X				X	X	X					X		X	X				X	X
Leaves, Twigs	X	X								X										
Lichens		X																		
Ferns		X																		
Buds		X	X																	
Grain	X	X	X		X	X	X							X						
Bark					X					X										
Fish						X	X	X			X			X	X		X	X		
Frogs & Salamanders							X	X						X			X		X	X
Snakes							X				X			X						
Crayfish	X						X	X												
Birds							X				X			X						
Small Mammals							X	X	X		X	X		X						
Aquatic Plants							X		X									X		
Carrion										X										
Earthworms									X			X						X		
Eggs													X						X	
Mussels							X											X		

Appendix H: “Key to Soil Texture by Feel” Chart

Fig. (31). This key was adapted from a flow chart by Steve Thiem, 1979, source unknown.



Appendix I: Cost Estimate Worksheet, Page 1

PROJECT DESCRIPTION – ITEM	AMOUNT NEEDED	COST PER ITEM	TOTAL COST
POND AREA:			
Backhoe rental with operator			
Pond Liner			
PVC Water Pipe to extend Water Line			
PVC Pipe Fittings			
15 gal. plants			
5 gal. plants			
1 gal. plants			
DECK/ STUDY PLATFORM:			
Boards -			
Boards -			
Boards -			
Nails -			
Concrete -			
PATHWAYS:			
Material -			
Edging -			
Lawn Roller Rental?			

Cost Estimate Worksheet, Page 2

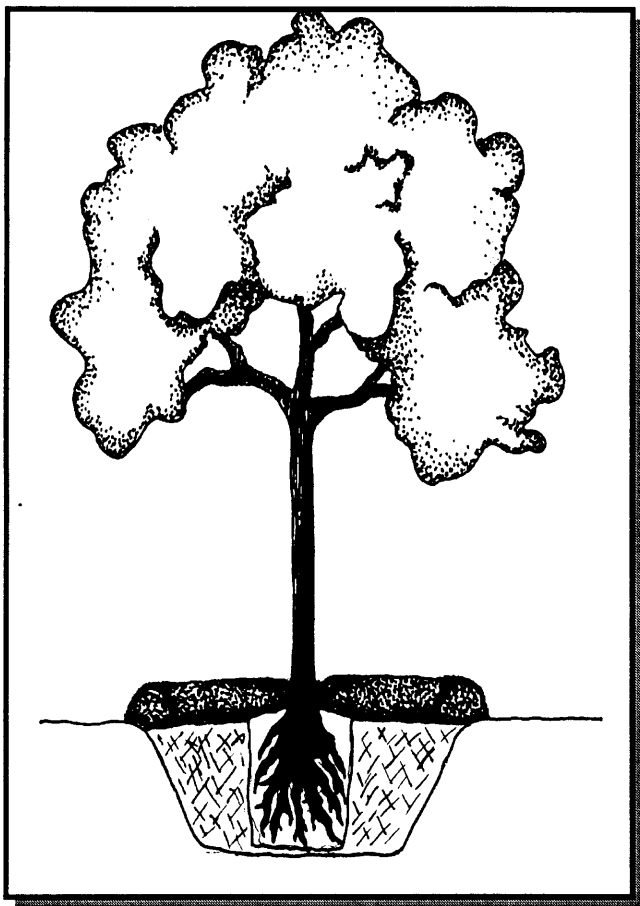
PROJECT DESCRIPTION – ITEM	AMOUNT NEEDED	COST PER ITEM	TOTAL COST
WILDFLOWER / PRAIRIE AREA:			
Tiller Rental			
Herbicide			
Wildflower/ Prairie Seed			
OTHER:			
15 gal. plants			
5 gal. plants			
1 gal. plants			
Plants – other			
Mulch			
Tools –			
Wheelbarrow			
6' X 8' Tool Storage Building			
Chain Link Fencing			
Chain Link Double Gate			
Chain Link Single Gate			

Appendix K: Tips on Planting Trees and Shrubs

from The Houston Area Urban Forestry Council

Trees do wonderful things. They create shade around buildings which decreases summer electric bills. Their cool, green leaves create a peaceful setting, clean and cool the air, buffer wind and noise, protect water quality, prevent soil erosion, screen unsightly areas, and provide food and cover for wildlife. For all the benefits trees provide, it is worth the extra effort to give them a good start.

PROPERLY PLANTED TREE



PLANTING TIME:

Generally, mid-November to late February is the best time to plant trees. Planting in late fall or winter will allow roots to become established before moisture demanding summer sets in. Most shade and ornamental trees sold in the nursery trade are either balled and burlapped or container grown.

6 STEPS TO PLANTING A TREE:

1. PLANTING A CONTAINER GROWN TREE –

Do not remove tree from container until you are ready to place into planting hole. Fine roots dry out rapidly when exposed to air.

2. HOLE SIZE - Loosen the soil in your planting site to a depth of 12 inches using a shovel or tiller. Dig a hole 2 to 3 times wider than the root ball and slightly shallower. The tree should be planted slightly above the original soil level. (This is especially important in heavy clay soils to aid in drainage.) When the hole is ready, gently remove the tree while lightly pressing against the sides of the container. If necessary, cut the container vertically to dislodge the root ball.

3. PLACING THE TREE IN HOLE - Set tree gently into hold, lifting by the root ball. When removing a tree from its container, take care to avoid breaking the root ball. Tree should be centered and level. Hold tree in place while backfilling around the root ball. Tamp soil lightly to eliminate air pockets. Large dirt clods should be broken apart before backfilling.

Figure (32). Properly Planted Tree. Dig the hole at least 2 to 3 times wider than the root ball. Slope sides of the planting hole. Gently place root ball into hole. Backfill with original soil. Build a ring of 3 to 4 inches of mulch around the tree with an indented saucer over root ball. Illustration by Michele G. Foss.

4. MULCHING - Remove any grass or weeds within a 3 foot minimum diameter circle around the tree. Create a slightly indented watering saucer. Cover with 3 – 4 inches of mulch composed of bark, woodchips, compost, or pine needles. Do not use fresh grass clippings. Do not place bark directly against tree bark.

5. WATERING - Adequate water is essential at planting time. Place water hose at base of tree and allow water to slowly trickle until the soil is saturated.

6. CARE OF NEWLY PLANTED TREE -

After watering, add mulch to compensate for any settling. If your tree needs additional support, use two or three six-foot stakes pounded into the ground outside the root ball. Attach the tree to the stakes with wide nylon webbing. The tree should have enough freedom to sway in the wind to develop strength. The stakes should be removed after the first growing season.



TREE PLANTING TIPS

- Loosen the soil far beyond the drip line of the tree.
- Brace the tree only if it will not remain upright in a moderate wind.
- Brace with broad, belt-like material that will not injure the bark. Remove after one growing season.
- Cover root ball with mulch, but keep trunk exposed.
- Keep soil moist, but not water-logged.
- Remove dead, diseased and damaged branches.
- If planting a balled and burlapped tree, check with your local resource professionals for advice on proper methods for your area.

MISTAKES TO AVOID

- Do not plant too deep.
- Do not wrap trees.
- Do not amend the soil, unless the soil is very unhealthy.
- Do not brace the tree so tightly that the tree cannot sway.
- Do not leave the bracing material on for more than one growing season.
- Remind students to remove the container before placing the plant in the ground.

Appendix L: Sample Butterfly & Hummingbird Garden

- GARDEN CHECKLIST:**
- For Hummingbirds**
- _____ Open space for flying
 - _____ Tubular, nectar-rich flowers
 - _____ Twig perches nearby
 - _____ Source of small insects, such as gnats
- For Butterflies:**
- _____ Open spaces in full sun for fluttering
 - _____ Away from strong winds or provide windbreak
 - _____ Masses of color (pink, purple, yellow, orange)
 - _____ Fragrant, nectar-rich flowers
 - _____ Larval food plants
 - _____ Puddling area

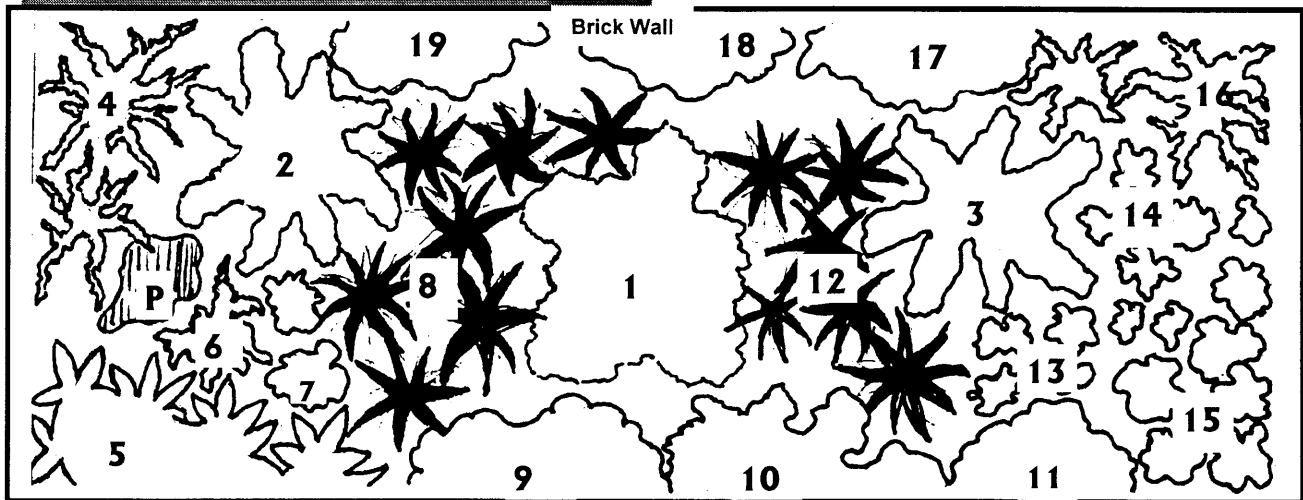


Figure (33). Sample design for a simple 10 foot by 28 foot butterfly and hummingbird garden. The garden is located in full sun against a brick wall. The design includes nectar sources for hummingbirds and butterflies, as well as a few larval host plants for caterpillars. Larger shrubs and vines could be planted nearby. The map scale is 1 inch equals 4 feet. Illustration by Michele G. Foss.

MAP KEY:

- | | | |
|------------|-------------------------|-----------------------------------|
| 1 | Hummingbird Bush | (<i>Hamelia patens</i>) |
| 2, 3 | Butterfly Bush | (<i>Buddleia sp.</i>) |
| 4 | Mexican Bush Sage | (<i>Salvia leucantha</i>) |
| 5 | Purple Coneflower | (<i>Echinacea purpurea</i>) |
| 6 | Mealy Blue Sage | (<i>Salvia farinacea</i>) |
| 7 | Dill | (<i>Anethum graveolens</i>) |
| 8, 12 | Milkweed | (<i>Asclepias sp.</i>) |
| 9 | Purple Asters + Winecup | |
| 10 | New Gold Lantana | (<i>Lantana sp.</i>) |
| 11 | Prairie Verbena | (<i>Verbena bipinnatifida</i>) |
| 13 | Fennel | (<i>Foeniculum vulgare</i>) |
| 14 | Penstemon | (<i>Penstemon spp.</i>) |
| 15 | White Mistflower | (<i>Eupatorium wrightii</i>) |
| 16 | Scarlet sage | (<i>Salvia coccinea</i>) |
| 17, 18, 19 | Maximilian Sunflower | (<i>Helianthus maximiliani</i>) |
| P | Puddling area | |

REFERENCE MATERIALS

The Hummingbird Book by Donald and Lillian Stokes, Little, Brown and Company publishers.

The Butterfly Book by Donald and Lillian Stokes, Little, Brown and Company publishers.

How to Attract Hummingbirds & Butterflies, Ortho Books, Chevron Chemical Company, Consumer Products Division, Box 5047, San Ramon, CA 94583.

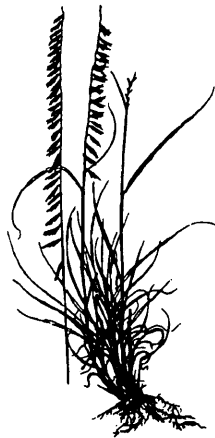
Butterfly Gardening for the South by Geyata Ajilvsgi, Taylor Publishing Company.

Native Texas Plants, Landscaping Region by Region by Sally Wasowski, Gulf Publishing Company.

Appendix M: Establishing a Prairie and Wildflower Area

Your school habitat will likely attract more birds and insects than any other wildlife. Both of these wildlife groups can provide many opportunities for observation. Insects not only attract birds to your habitat, but also offer life cycle observations that can be conducted outdoors or moved into the classroom. Herbaceous vegetation in the form of forbs (i.e., wildflowers) and grasses is more likely to attract insect species, including butterflies, than any other type of vegetation.

Schools often want to plant wildflowers for their aesthetics, and it is often seen as an inexpensive and easy project to do with children. Wildflowers alone do not constitute a habitat type. Mixed with native grasses, these areas will resemble the native prairie (see Appendix E) that once covered much of the state. To maximize your ability to attract insects, it is necessary to provide a mix of forbs and grasses that will provide both food and cover for a wide variety of species. This bit of habitat may also provide food and cover for some bird species.



The establishment, maintenance and sustainability of these areas can be one of the most difficult phases of your school habitat projects. The area may also draw the most comments, both positive and negative.



The establishment of a prairie/wildflower area is divided into 3 phases:

1. Site preparation
2. Planting
3. Maintenance

1. SITE PREPARATION

Site preparation may be the most important aspect of this project. The successful establishment of desired species is directly related to how well you remove and control undesirable competitors, many of which are exotic plant species. Complete elimination of this vegetation should be your goal. There are several techniques available to achieve this goal. Choose a technique or combination of techniques suitable for your site and appropriate for your skill level and available resources.

Methods for Removing Vegetation:

Cultivation

This method includes such techniques as plowing, tilling, rototilling, and scarifying. Cultivation serves to kill undesirable plants and their germinating seeds. This process can be effective but labor intensive and requires the use of machinery. Repetition will probably be required to kill plants that germinate from dormant seeds brought to the surface. Many perennial weeds may not be destroyed by this process, and may, in fact, be spread and increased. This is not an appropriate technique for erosion prone sites. Repeated cultivation may be detrimental to the soil structure.

Herbicide Treatment

If this method is chosen, use a low toxicity, non-persistent herbicide, such as Round-up or Kleenup and follow the manufacturer's instructions carefully. Apply the chemical to green, actively growing vegetation. Wait two weeks and apply again, if necessary.

If your site contains a lot of rank or previous year's growth, it will probably be necessary to mow and rake up the cuttings. After cleaning up, allow the regrowth to reach 6-8 inches tall before applying

preparation may bring dormant seed to the surface, resulting in the need for an additional treatment with herbicide or additional tilling for control. This treatment is an effective technique for weed removal and works well on erosion prone sites. Remember that school districts may restrict the use of herbicides or require the spraying be conducted by a licensed applicator.

Solarization Method

Solarization is the process of trapping heat generated by sunlight to kill plants and sterilize the soil. This method involves wetting the soil surface and covering it with clear or black plastic sheeting. Some studies indicate that clear plastic is more effective than the black. The material will have to be anchored down to keep it in place. In our climate, ultraviolet light tends to break the plastic down within one season. To be totally effective, the plastic should remain in place for an entire year to allow for the control of both cool and warm season plant species. While this is a safe process, it can be expensive and impractical for a large area. Some of the tougher plant species may still persist after this treatment.

Your site may require a combination of these methods to achieve the best results. You will find that your efforts will be rewarded by higher survival of your desired species.

Seedbed Preparation

For the most part, seedbed preparation should only consist of lightly tilling or discing of the soil. The goal is to prepare the soil to enable good seed contact with the soil. Tilling or discing should be restricted to the top one or two inches of the soil. By tilling deeper, you encourage undesirable dormant seeds to germinate.

2. PLANTING

The planting process provides another good opportunity to involve students. Students can do everything from selecting the proper plant species for your site to doing the actual installation.

Plant Selection

Select species native to this area. Choose species that match your site conditions. Remember that most of the plants in a prairie wildflower area

prefer full sunlight. Select a mixture with approximately 60% grass species and 40% forbs. You may find that emphasizing perennial species will result in a more successful project. Prepared seed mixes available on the market tend to have a high percentage of annual species. Purchase seeds from a reputable source. [Avoid purchasing seed mixes or “seed mats” that don’t list the flower species on their packaging. These mixes are usually designed for cooler climates and cannot handle our summer heat.] If you collect seeds from the wild, make sure you obtain the permission of the landowner. Never collect more than 50% of the seed available in that wild spot. By leaving half the available seed, this will leave seeds to germinate in the wild next year. Rescuing plants from an area that will be developed, with the landowner’s permission, would be the exception to the collection rule.

Seeding Rates

The seeding rate is the amount of seed applied to a given area, usually shown as lbs./acre or ozs./ 1000 sq. ft.. Seeding rate is based on the PLS (pure live seed) content of your mixture. Seed purchased from a reputable dealer will have the PLS content indicated on the packaging, as well as the recommended seeding rate. You will not know the PLS content for seeds you hand collect from the wild and planting rates may be difficult to calculate. For calculating seeding rates for collected seed, use the rates recommended by seed dealers and then err to the excessive.

Planting Technique

Many of the seeds you will be working with are very small. Several thousand seeds per one ounce is not uncommon. To evenly distribute such tiny seed on your site, it is necessary to dilute them by mixing them with a suitable material, such as dampened sand or sawdust. Use a volume of sand or sawdust equal to or greater than the volume of your seeds.

The more you dilute your seed mixture, the more students you can involve in the planting activity. Divide the mixture in half. Distribute one half of the mixture between the students and have them broadcast it gradually while walking across the site. Distribute the second half of the seed and broadcast it while walking perpendicular to your first path. This process will allow for a more even distribution

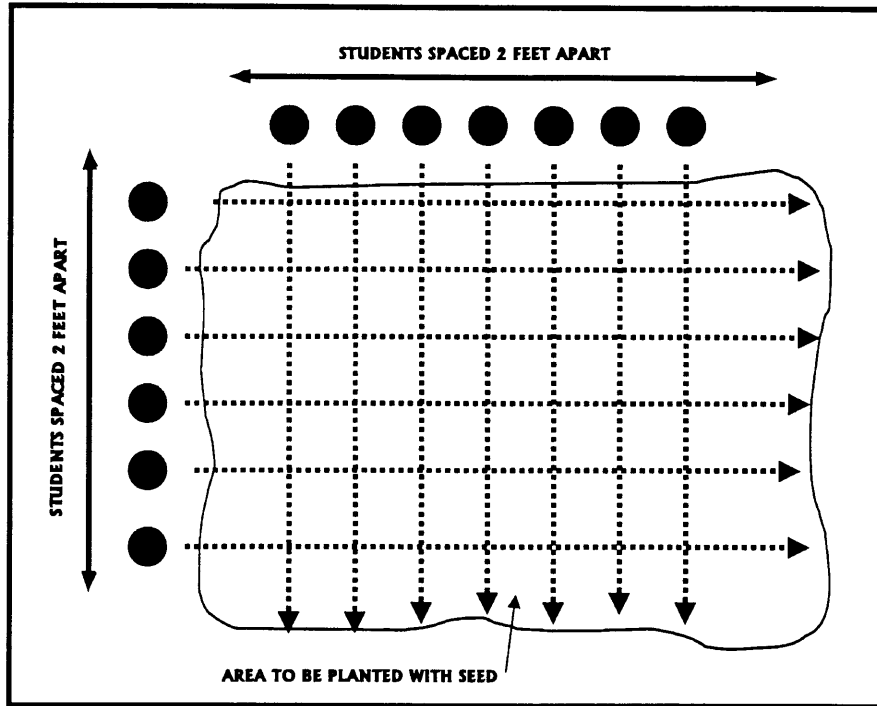


Figure (34). Student Seed Planting Activity. Students line up on two sides of the site to be planted with seed. Students on one side walk in straight lines from their side to the opposite side, gently releasing seed all along their path. Then students from the other side walk in lines perpendicular to the original students' paths. This process results in a fairly even distribution of the seeds.

of the seed mixture. Lightly rake the soil surface. Have the students walk back and forth across the site or rent a lawn roller to gently push the seed mixture into the soil surface. Good soil contact is important for germination success. **Burying the seed is not your goal.** Many of these seeds require light to germinate. Watering after planting may not be necessary and may actually favor the germination of weed seeds. Late summer through fall is the best time to plant warm season grasses and spring or summer blooming wildflowers. Late winter into early spring is the best time to plant fall-blooming wildflowers.

Establishing your habitat with containerized plants rather than from seed will give you quicker results. However, you may find the cost prohibitive and that not as many species are available in containers. An alternative would be to have students raise the plants from seed and transplant them to the habitat. You may choose to use this alternative method for those plant species that are difficult to germinate in the field and then have your students intersperse the seedlings with those that were seeded directly into the ground.

3. Maintenance

Most seeds will germinate the first year. If optimum conditions do not exist the first year, some seeds may lie dormant and then germinate the second year. Many of the grasses concentrate on establishing root systems the first year and as a result, do not produce much top growth. The second year these grasses will produce more top growth and may bloom.

This several year process aids in prairie management. Many unwanted weeds are annuals that will grow taller than your desired prairie species. Therefore, to maintain the prairie, you can cut down the taller annual weeds without damaging your new grass or wildflower seedlings. The goal is to cut the undesirable annuals before they produce and distribute their seed. During the second or third years, you may want to reseed any bare spots or add transplants to increase your plant diversity.

Controlling Invasive Species

Controlling Invasive Species

You will probably discover that spot applications of herbicide and hand weeding are necessary. If used, a herbicide should be applied to a specific problem plant only, called spot treatment, rather than sprayed widely over the area. Be persistent in controlling invaders, such as bermuda grass and johnson grass. If these tough, invasive grasses persist while your project becomes established, it will be extremely difficult to control them. After these invaders wind their way among your desired plants, spot treatment with herbicide can be almost impossible. Without control, they will eventually outcompete the natives and become the dominate plants in your site.

Prairies benefit from occasionally being burned. In most cases, this is not practical on a school site. An annual mowing in late winter will be your best substitute. However, do not mow your entire site at one time. Instead, mow in small sections at a time, or in a mosaic of strips with unmowed sections in between. As the prairie wildflower area matures, it will provide wintering areas for various insects. Leaving some of it untouched each year assures that some winter cover remains available for wildlife.

ROOT SYSTEMS IN A PRAIRIE

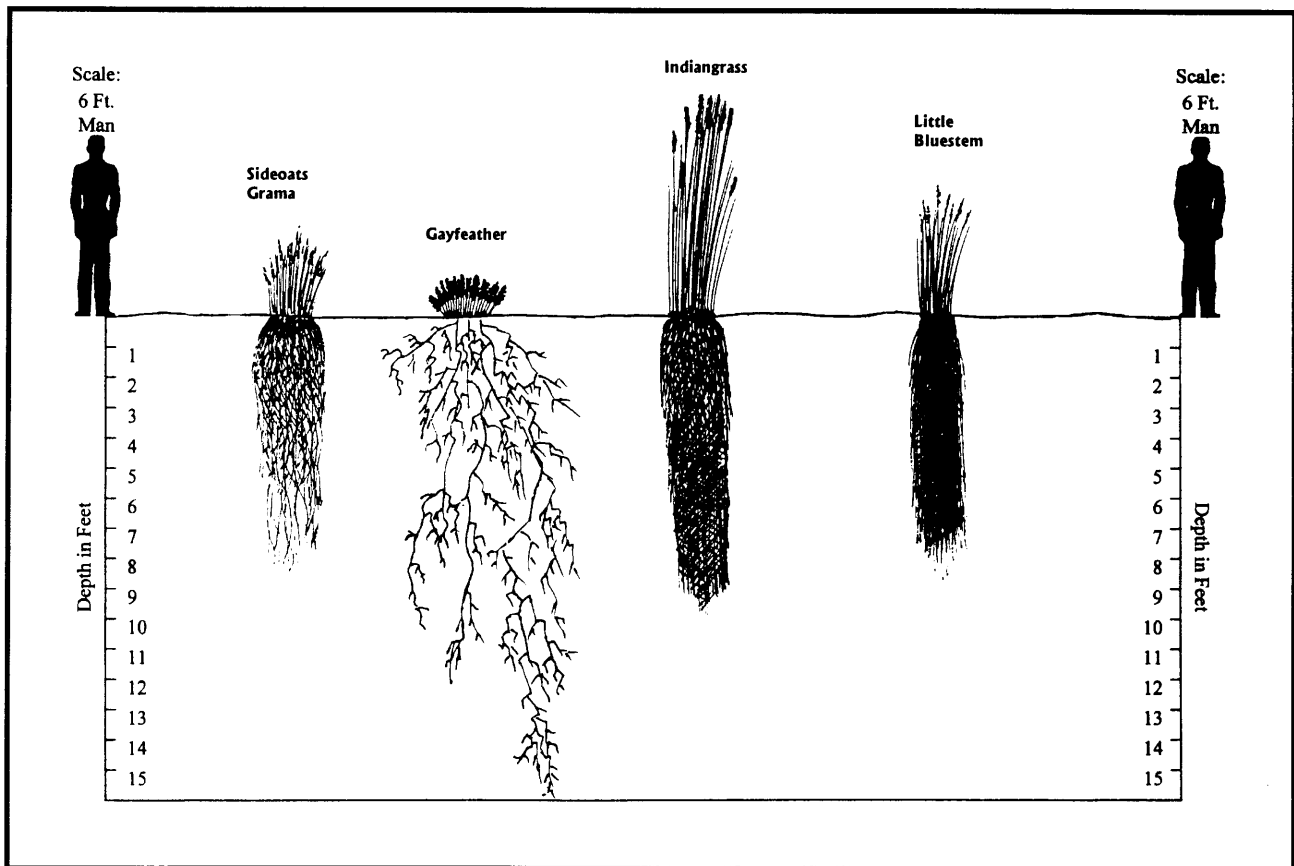
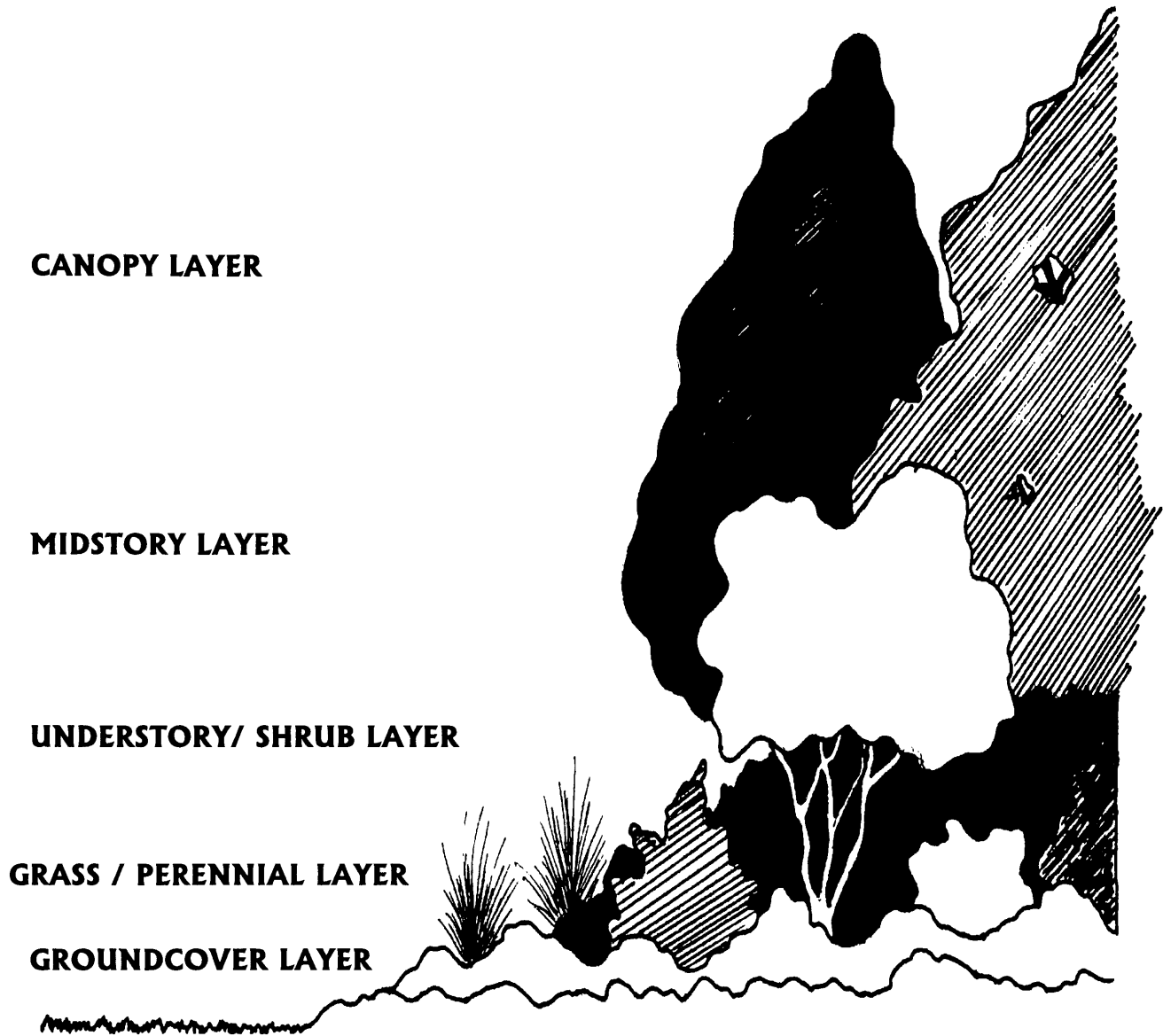


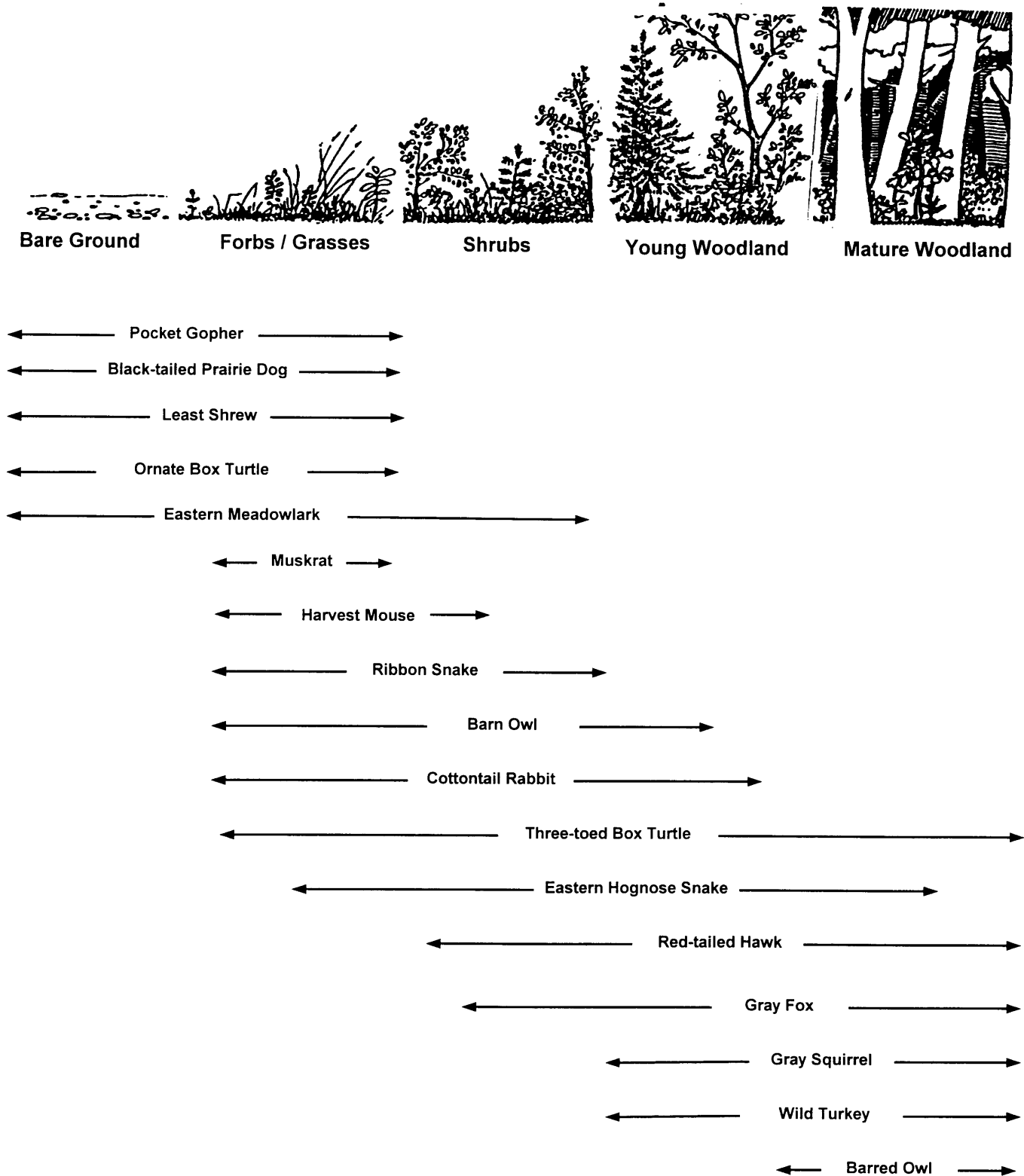
Figure (35). Prairie Root Systems. Extensive root systems are essential for vigorous growth, even during unfavorable weather conditions. The roots hold the plant in place and absorb soil water and nutrients. Perennial plant roots function as surplus food storage centers. Most of the plant root material is concentrated within the top 12 inches of soil; however, as illustrated, many desirable species have deep, vigorous feeding root systems. Illustration by Michele G. Foss.

Appendix N: Vertical Layering in a Habitat



Layers in a habitat. Try to reproduce the many vegetation diversity and layers in a natural habitat in your school habitat. The majority of wildlife species utilize the lower two thirds of a habitat. Illustration by Michele G. Foss.

Appendix O: Stages of Plant Succession and Associated Wildlife Species



Stages of Plant Succession and Associated Wildlife Species. Modified from Homes for Wildlife, published by the New Hampshire Fish and Game Department.

Appendix P: Constructing Raised Beds

If you are constructing raised beds for planting annuals or perennials, delineation and preparation of your beds should be done prior to planting.

1. Kill or remove the grass from the bed area. There are several methods you may choose.

- One method involves using herbicides, such as Roundup, to kill the grass. Remember that most general herbicides kill all plant material they touch, so spray on windless days.
- Another method, called smothering, involves placing black plastic, 3 to 7 layers of newspaper, or cardboard over the grass to deprive it of light. A variation is to place plastic down with a layer of mulch on top. The cover must remain in place for approximately 3 months. When ready to plant, you may remove the cover completely, or simply cut holes through the plastic to plant. The dead grass layer may be left in place to decompose, thus forming a weed barrier and providing nutrients for the soil.
- Another alternative is to dig out the grass layer by hand. Simply tilling the grass, especially Bermuda grass, into the ground without killing it first is a mistake. The grass usually re-seeds or re-sprouts and grows up through your newly planted bed, requiring you to dig it out by hand.

2. Estimate the amount of soil, mulch, sand, or compost you need. To do this, determine the number of square feet of garden bed you need to fill. Then decide how deep (in inches) you want your soil. Remember that fluffy soil will eventually settle, so plan to add a little extra. Use the Soil Estimation Formula (Figure 33) to determine the number of cubic yards of soil you need. (Example: Your planting area measures 10 feet long by 12 feet wide. You want the soil in a raised bed 4 inches deep. Multiply 10 feet by 12 feet by 4 inches. Divide by 324. You will need to order 1.5 cubic yards of soil for your area.).

3. Add any soil amendments at this time to correct deficiencies in the soil. (See Soil Health) Till or mix the soil by shovel. Water the soil and allow the area to settle for a week.

4. Use garden hose, rope, string, stakes, lines of flour, or spray paint to temporarily delineate bed edges. Add edging, if desired.

SOIL ESTIMATION FORMULA

$$\text{Volume of Soil (cubic yards)} = \frac{\text{Length of Area (feet)} \times \text{Width of Area (feet)} \times \text{Depth of Area (inches)}}{324}$$

Figure (36). This formula determines the amount of soil, compost, or mulch, in cubic yards, that you will need to order. Pay close attention to the units of measurement when using the formula. Do NOT convert so that all the units are the same.

SOIL HEALTH

Good soil health insures plant health. Soil should be loose, fluffy, and fairly well-drained. If your soil resembles hard packed cement, then you need to add some ingredients to amend the soil, such as compost, mulch, leaves, or sand. By mixing in the appropriate ingredients, you return needed nutrients to the soil and improve its ability to drain water.

- **Simply add small amounts of compost and dead leaves to the soil and till them in. Over a long period, these additions will gradually improve the soil.**
- **For a quicker solution, order a larger amount of compost or topsoil and add this regularly to your topsoil.**

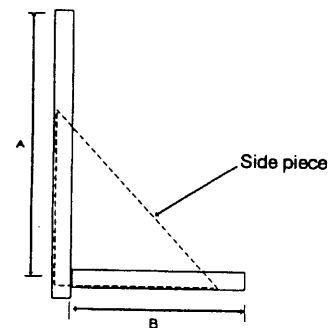
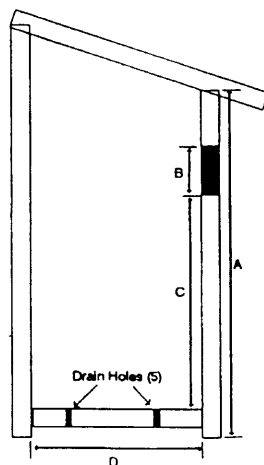
Appendix Q: Nest Box Specifications

Species	Floor of Nest Box (inches)	Depth of Nest Box (inches)	Entrance above Floor (inches)	Diameter of Entrance (inches)	Height above Ground (feet)	Success Potential for Urban Areas
Eastern Bluebird	5 X 5	8	6	1 1/2	5 – 10	Fair ¹
American Robin	6 X 8	8	(2)	(2)	6 – 15	Fair
Barn Swallow	6 X 6	6	(2)	(2)	8 – 12	Good
Eastern Phoebe	6 X 6	6	(2)	(2)	8 – 12	Fair
Carolina Chickadee	4 X 4	8 – 10	6 – 8	1 1/8	6 – 15	Good
Tufted Titmouse	4 X 4	8 – 10	6 – 8	1 1/8	6 – 15	Excellent
Bewick's Wren	4 X 4	8 – 10	6 – 8	1 – 1 1/4	6 – 15	Excellent
Carolina Wren	4 X 4	8 – 10	6 – 8	1 1/2	6 – 15	Excellent
Purple Martin	6 X 6	6	1	2 1/2	15 – 20	Excellent
Prothonotary Warbler	6 X 6	6	4	1 1/2	2 – 4	Fair ³
Great-crested Flycatcher	6 X 6	8 – 10	6 – 8	1 9/16	8 – 20	Good
Ash-throated Flycatcher	6 X 6	8 – 10	6 – 8	1 1/2	8 – 20	Fair
Golden-fronted Woodpecker	6 X 6	12 – 15	9 – 12	2	12 – 20	Excellent
Ladder-backed Woodpecker	6 X 6	12 – 15	9 – 12	1 1/2	12 – 20	Good
Downy Woodpecker	4 X 4	9 – 12	6 – 8	1 1/4	6 – 20	Fair
Eastern Screech Owl	8 X 8	12 – 15	9 – 12	3	10 – 30	Good
Wood Duck	10 – 18	10 – 24	12 – 16	4(w) X 3(h)	10 – 20	Fair ³
Black-bellied Whistling Duck	10 X 18	10 – 24	12 – 16	4	10 – 20	Good ³

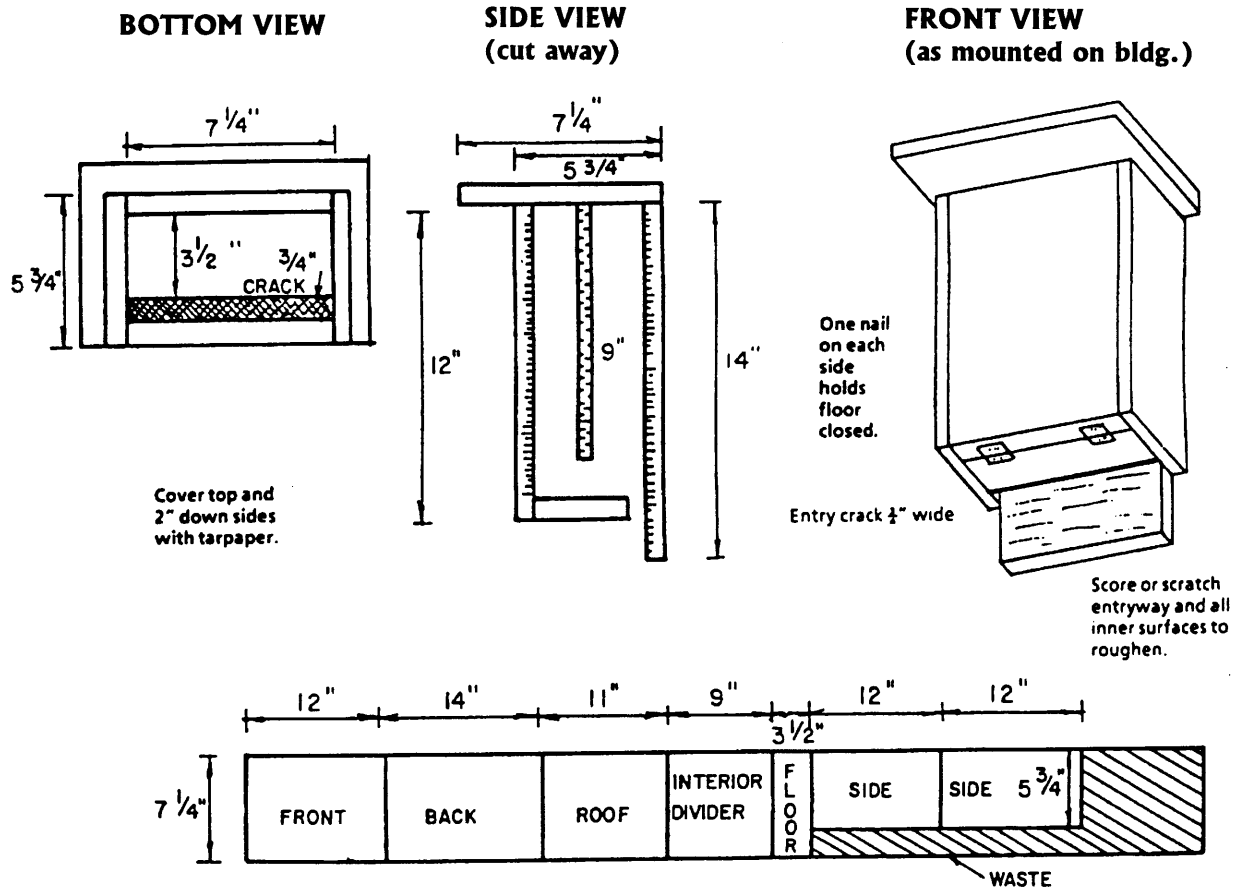
¹ Requires habitat to include open areas, such as fields or meadows.

² Two or more sides need to be open (nesting shelf).

³ Requires habitat to include wetland type areas, such as ponds, lakes, or streams.



Appendix R: Bat House Plan (Small)

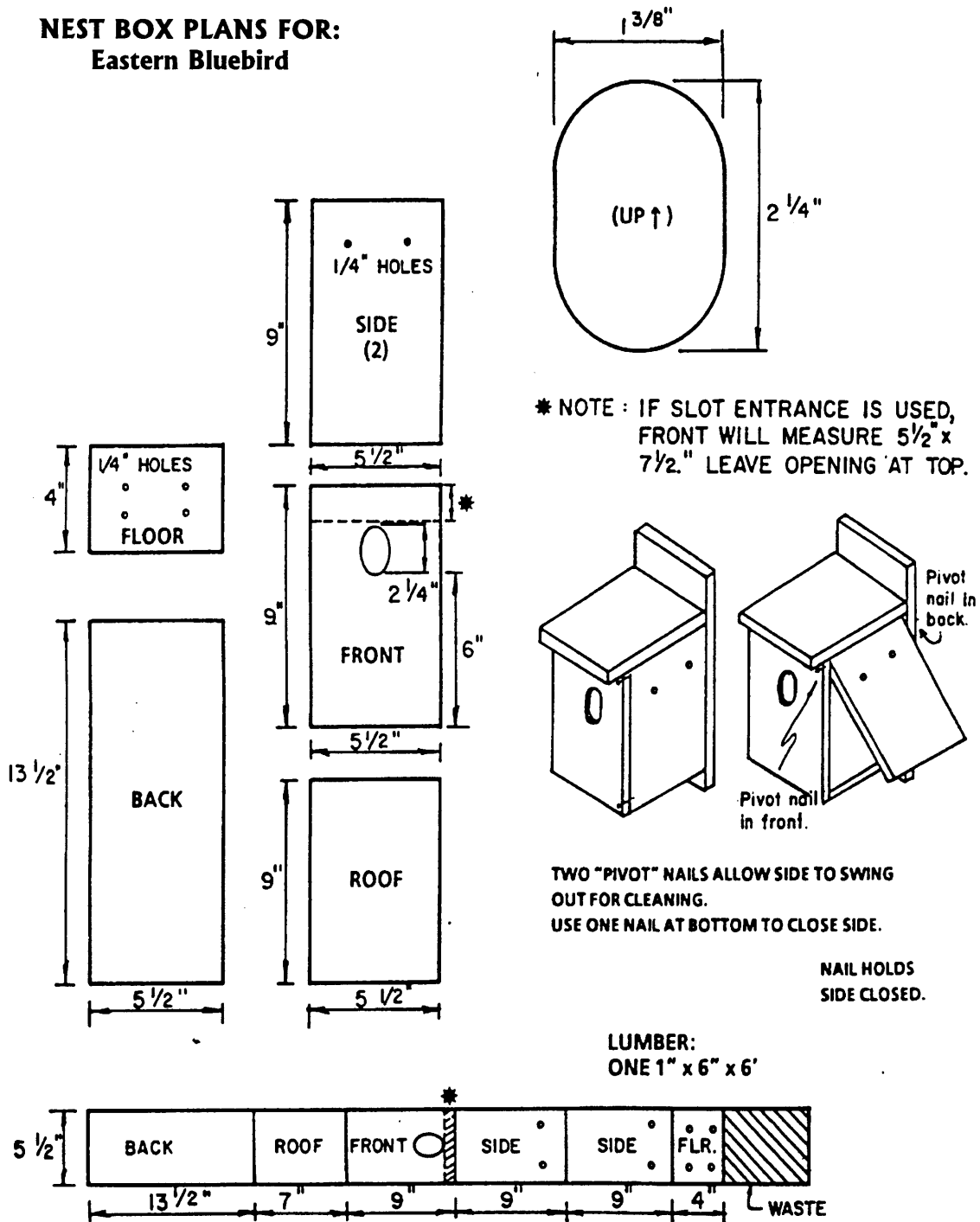


LUMBER: 1 inch X 8 inch X 8 feet

Plans for a small bat house. Reprinted from Woodworking for Wildlife, Minnesota Department of Natural Resources.

Appendix S: Small Nest Box Plan

NEST BOX PLANS FOR: Eastern Bluebird



Plans for bluebird nest box. Reprinted from Woodworking for Wildlife, Minnesota Department of Natural Resources.

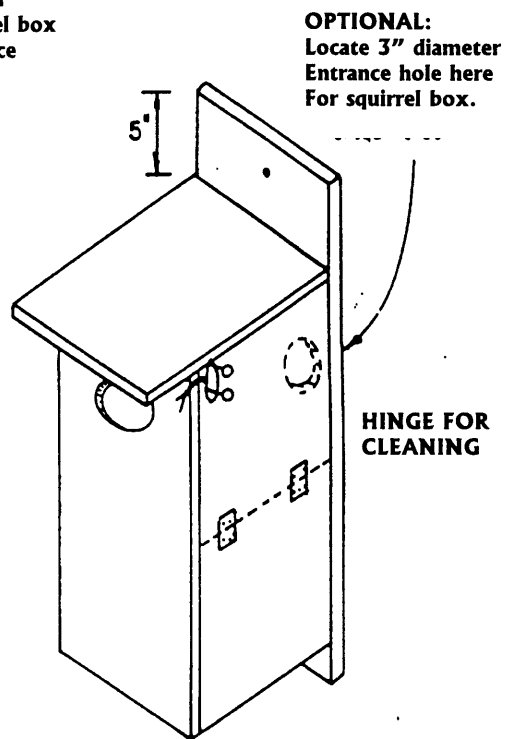
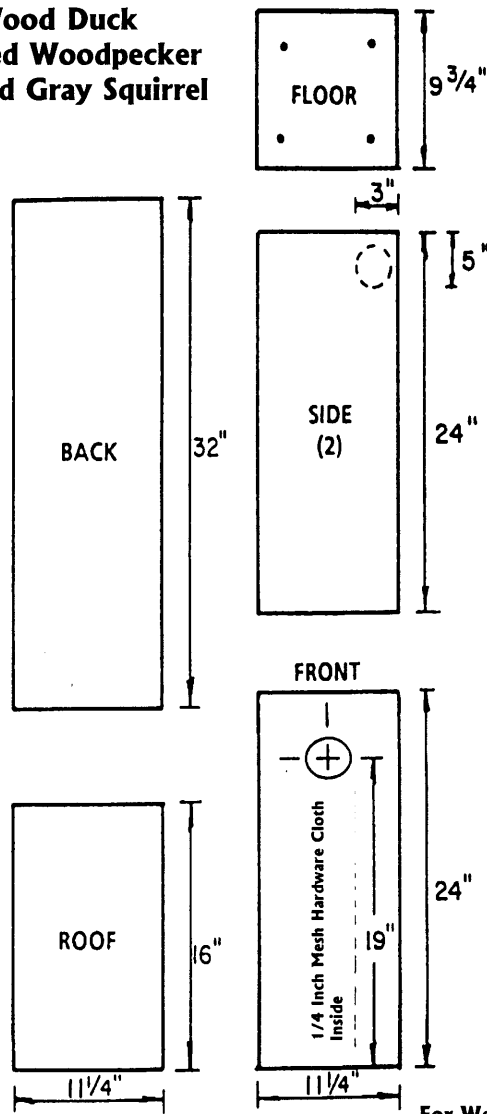
Appendix T: Large Nest Box Plan

NEST BOX PLANS FOR:

**Wood Duck
Pileated Woodpecker
Fox and Gray Squirrel**

Wood Duck 3" high & 4" wide oval
Fox and Gray Squirrel 3" diameter round
Pileated Woodpecker 4" diameter round

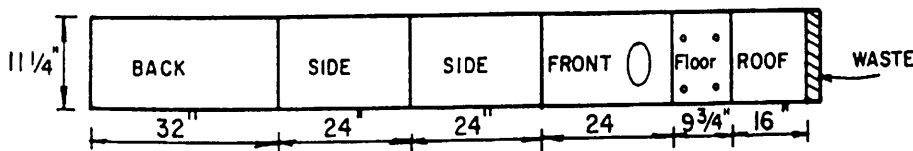
*Please note that the pileated woodpecker is not common in this part of the state.



Lumber
One 1 inch X 12 inch X 12 foot

For Wood Duck House:
Place 3 to 4 inches of Wood chips in bottom of box.

For Pileated Woodpecker House:
Fill box to top with sawdust.



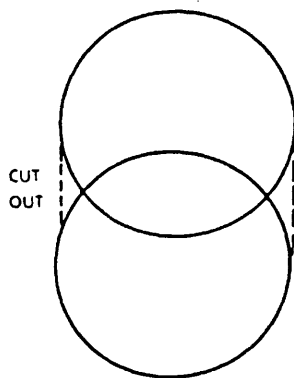
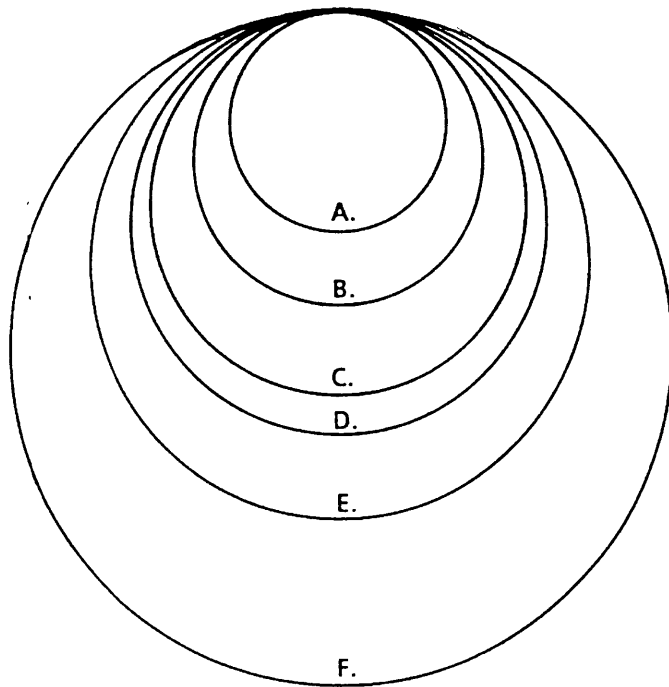
Note: Pileated Woodpecker box should be constructed from One 2 inch X 12 inch X 12 foot cedar. Floor must be 8 1/4 inches Long instead of 9 3/4 inches.

Plans for wood duck, squirrel, pileated woodpecker, and raccoon nest box. Printed from the Woodworking for Wildlife, Minnesota Department of Natural Resources. Please note that the pileated woodpecker is not common to this area.

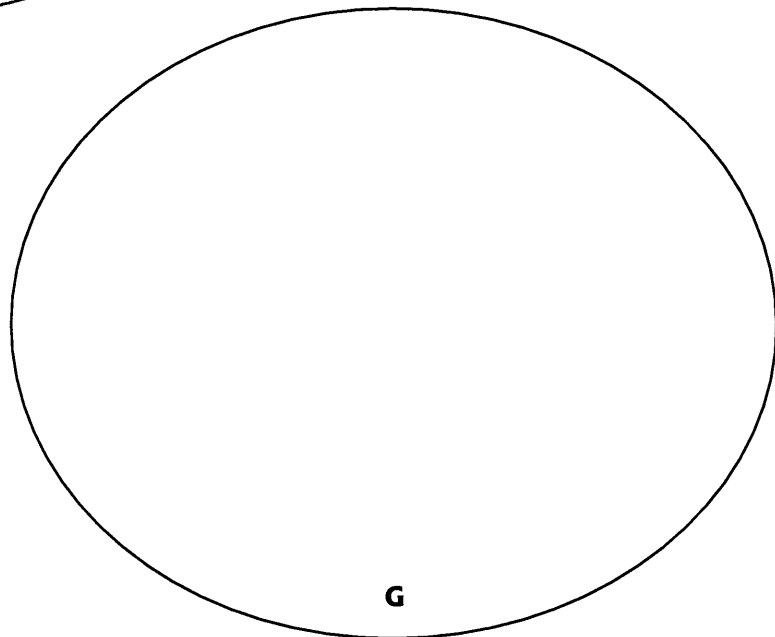
Nest Box Entrance Hole Sizes

TRACE ONTO WOOD WITH
CARBON PAPER.

- A. House Wren, Chickadee,
Titmouse, Prothonotary
Warbler
- B. Great Crested Flycatcher
- C. Purple Martin
- D. Common Flicker
- E. Squirrel, Screech Owl, Kestrel
- F. Pileated Woodpecker (not common)
- G. Wood Duck



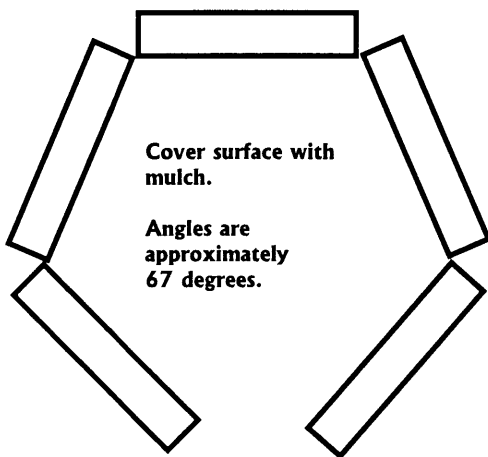
**EASTERN BLUEBIRD &
TREE SWALLOW
(DRILL 2 HOLES 1 3/8"
DIAMETER. CENTERED 7/8"
APART.)**



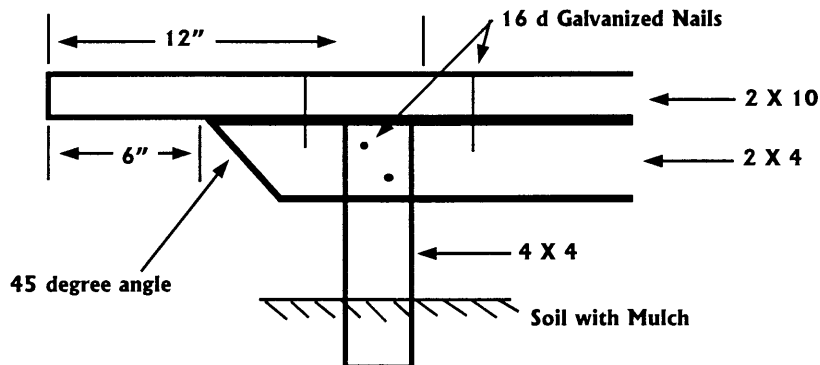
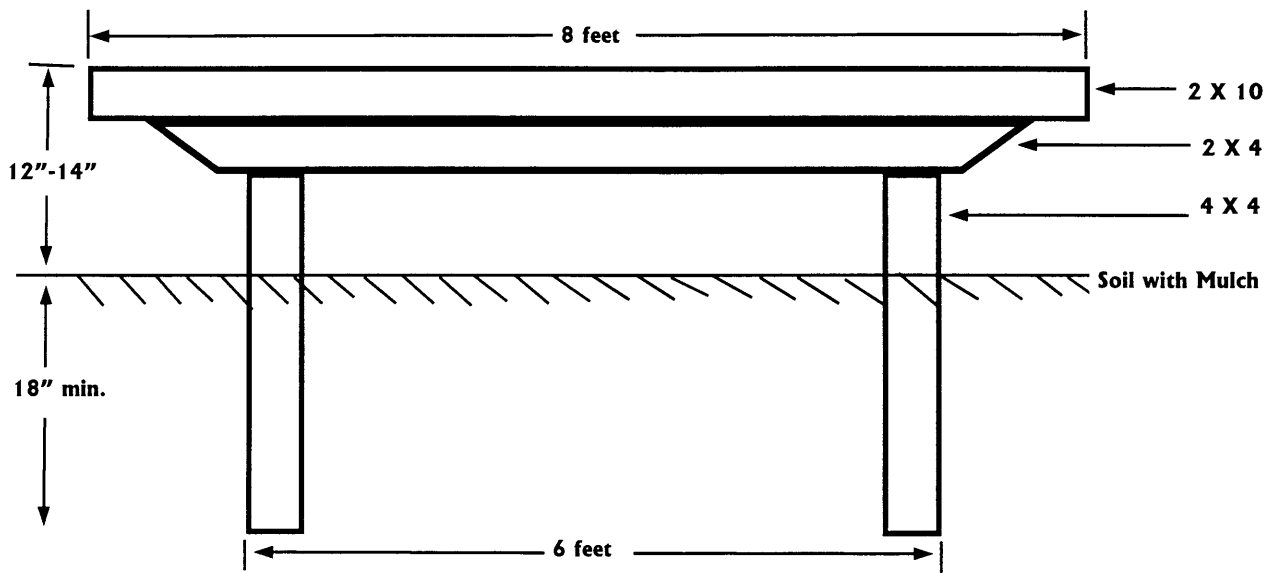
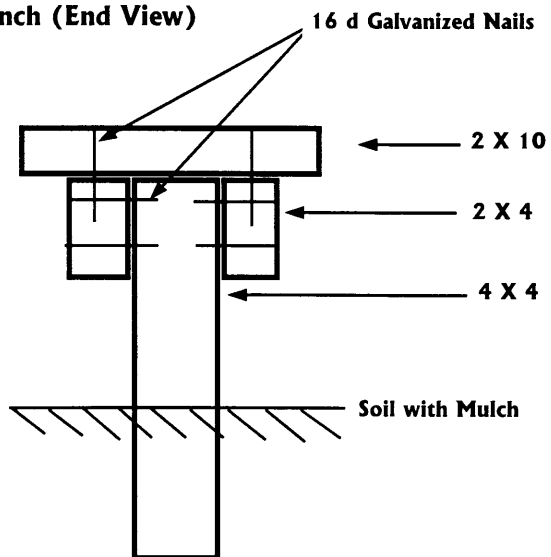
Each species prefers a specific hole size in their in their nest box. Use the illustration above to trace the correct hole shape and size onto the wood. Please note that the pileated woodpecker is not common to this area.

Appendix U: Sample Bench Design

Bench Configuration



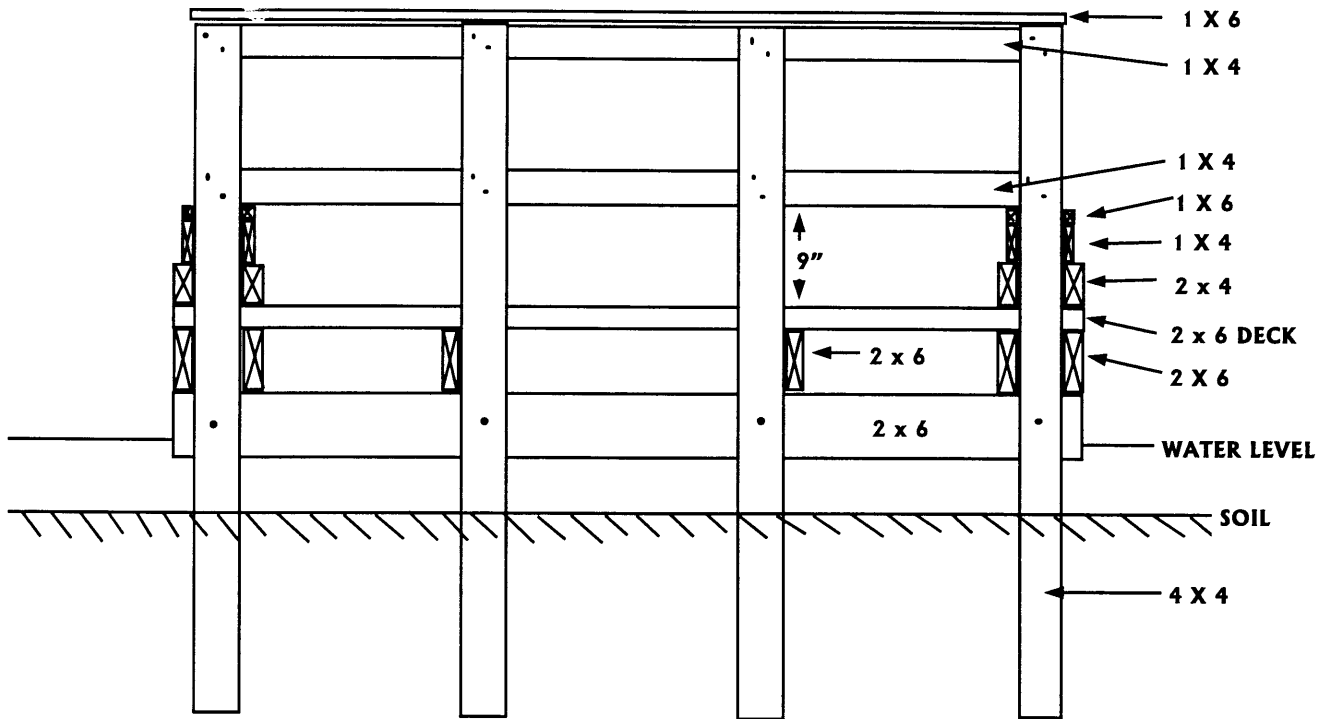
Bench (End View)



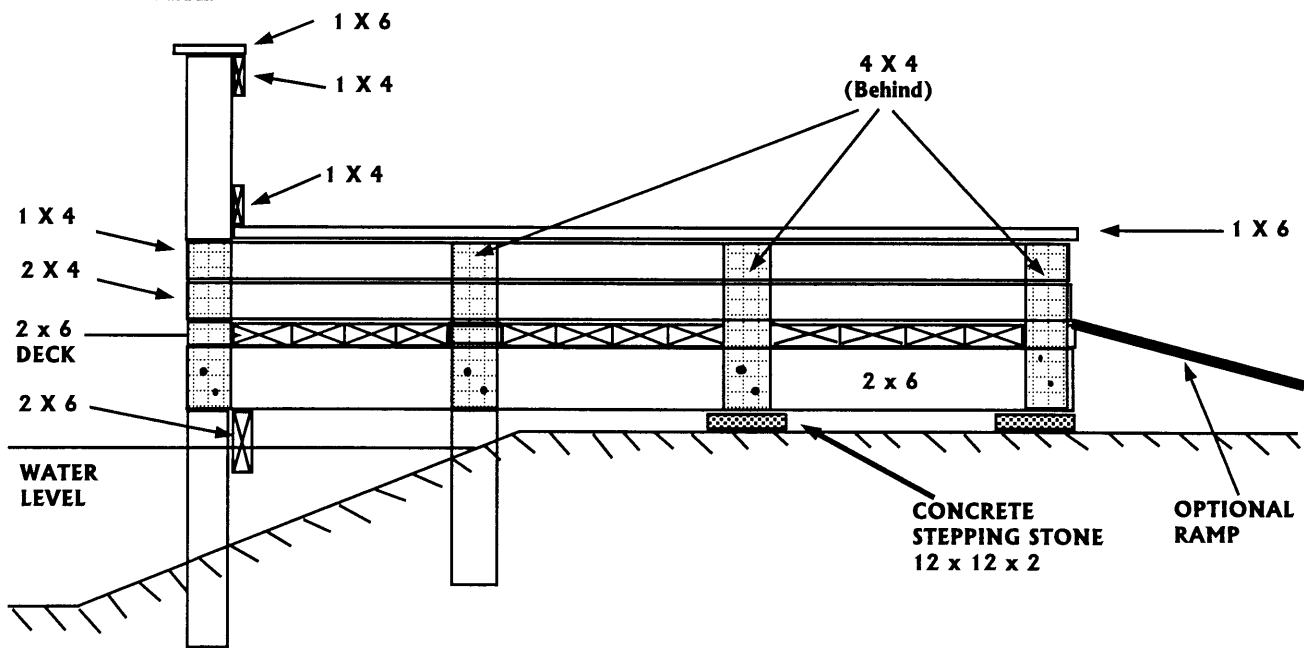
Typical outdoor bench design. Note that all lumber is pressure treated yellow pine. Nails are 16 penny galvanized screw or ring shank. Landscape timbers may be substituted for the 4 X 4 material. Nails are spaced 12 inches apart off center. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.

Appendix V: Sample Study Platform/Deck Design

FRONT POND VIEW



SIDE VIEW



Concept design for Study Platform to provide student access to water features. Style and dimensions of the platform may vary with need, construction techniques, site modifications, etc. Note that all wood is pressure treated. All fasteners are galvanized. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.

Appendix W: Plant Tables

