NRCS Natural Resources Conservation Service
Wildlife Habitat Management Institute

WILDLIFE HABITAT COUNCIL

Artificial Nesting Structures

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General Information

Artificial nesting structures can be used to increase wildlife reproductive success in areas where natural nest sites are unavailable or unsuitable. While artificial nesting structures cannot replace natural nesting habitats, they can increase the number of nesting sites available in an area.

Many types of wildlife use artificial nesting structures, including songbirds, woodpeckers, waterfowl, raptors, squirrels and bats. While structures are generally designed to meet the nesting requirements of certain species, they may also be used by nontarget animals and provide roosting and winter cover for a variety of birds and mammals. Nest boxes, bat houses, nesting platforms or shelves, and nesting baskets, culverts, and cylinders are some of the common types of artificial nesting structures.

The most effective artificial nesting structures are those installed in close proximity to brood-rearing habitat, adequate escape/concealment cover, a reliable source of food and water, and other elements of the habitat of target species. Predators, competitors, and territory sizes for individual species also influence the usefulness of nesting structures. Nest monitoring and maintenance actions can be taken to limit competing or undesirable species, assess reproductive success, and provide an opportunity for landowners and managers to observe wildlife.

Cavity-nesting wildlife

Birds and mammals that nest in tree cavities are likely to use nest boxes. Primary cavity-nesting species, such as members of the woodpecker family, excavate nesting cavities in live or standing dead trees (snags).

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Secondary cavity nesters (e.g., some passerine—or perching—birds, owls, waterfowl, and mammals) use cavities abandoned by primary excavators and those formed by fungus, knots, and trees subject to decay. The presence of snags in forested areas is directly related to the quality and quantity of nesting habitat for many cavity-nesting species. Fifty-five species of cavity-nesting birds in North America use snags, and invertebrates inhabiting the dead wood provide a rich food source. Optimal nesting opportunities for cavity-nesting wildlife are typically found on forested tracts that contain 10–12 small (<12-inch diameter at breast height—dbh) and 2–5 large (>12-inch dbh) standing dead trees per acre. Sloughing bark on snags is also used by roosting bats. Table 1 provides a list of North American cavity-nesting birds.

This leaflet is designed as an introduction to the use of artificial nesting structures to enhance wildlife habitats. When incorporated into comprehensive habitat management plans, artificial nesting structures can increase wildlife use in many areas. The success of any management strategy depends on targeting the habitat needs of the desired wildlife species, and

Table 1. North American cavity-nesting birds.

Primary (excavator)	Secondary (nonexcavator)	Secondary (nonexcavator)
Northern flicker*	Black-bellied whistling duck*	Violet-green swallow*
Pileated woodpecker*	Wood duck*	Tree swallow*
Red-bellied woodpecker	Common goldeneye*	Purple martin*
Gila woodpecker	Barrow's goldeneye*	Black-capped chickadee*
Red-headed woodpecker	Bufflehead*	Carolina chickadee*
Acorn woodpecker	Hooded merganser*	Boreal chickadee*
Lewis' woodpecker	Common merganser*	Chestnut-backed chickadee*
Yellow-bellied sapsucker	American kestrel*	Mountain chickadee*
Williamson's sapsucker	Barn owl*	Tufted titmouse*
Hairy woodpecker*	Eastern screech owl*	Plain titmouse*
Downy woodpecker	Western screech owl*	Bridled titmouse*
Red-cockaded woodpecker	Whiskered screech owl	White-breasted nuthatch*
Ladder-backed woodpecker	Northern hawk owl	Red-breasted nuthatch*
Nuttall's woodpecker	Barred owl*	Brown-headed nuthatch*
Strickland's woodpecker	Boreal owl*	Pygmy nuthatch
White-headed woodpecker	Northern saw-whet owl*	Brown creeper
Black-backed woodpecker	Spotted owl*	House wren*
Three-toed woodpecker	Flammulated owl*	Winter wren
Golden-fronted woodpecker*	Elf owl	Carolina wren*
Black-capped chickadee*	Ferruginous pygmy owl	Bewick's wren*
	Northern pygmy owl	Eastern bluebird*
	Brown-crested flycatcher*	Western bluebird*
	Great-crested flycatcher*	Mountain bluebird*
	Ash-throated flycatcher*	Prothonotary warbler*

**Species known to use nest boxes.*

C. Rewa

Natural cavities provide nesting sites for many species of birds and mammals.

assessing managed areas to ensure that the required habitat elements are present. Landowners and managers should be familiar with state and federally listed rare, threatened, or endangered plant and animal species to ensure their protection. Involvement of wildlife professionals in the identification of habitat management objectives and actions is encouraged.

Nesting Structure Basics

Besides overall habitat conditions, several factors influence the success of artificial nesting structures. These factors include construction materials used, structure design and placement, installation methods, use of predator guards, and monitoring and

Site fidelity.—Cavity-nesting waterfowl and other birds exhibit site fidelity, where nesting females return to the general area in which they were raised. When nest sites are destroyed by timber harvest, land development, and natural disturbances, returning females are forced to find other nesting cavities. Landowners and managers can supply artificial nesting structures to replace lost nest sites, and should limit the amount of disturbance during the nesting season.

Some cavity-nesting mammals in North America.

Yellow-pine chipmunk	Deer mouse
Northern flying squirrel	Common red-backed vole
Gray squirrel	Yellow-necked field mouse
Fox squirrel	Ermine
Red squirrel	Bats
Bushy-tailed wood rat	Raccoon

maintenance performed. Wildlife managers must consider all of these factors to maximize the usefulness of nesting structures. For example, the best-designed structures will be of little use if they are placed in the wrong habitat type or are easily accessed by predators. Likewise, a well-designed structure placed in suitable habitat may not be used if it is not properly attached or is easily detached from its support by wind or storms.

Construction materials

Structures made of wood are relatively inexpensive and easy to build. Wood seems to be the most weather-resistant, insulating material, and most wildlife species prefer wood to metal or plastic structures. For most nest boxes, 3/4-inch rough-cut boards are best used for construction. Since cavity-nesting waterfowl do not carry nesting material to the nest, 3–4 inches of coarse sawdust or wood chips should be placed inside the nest box. Nest boxes intended for use by woodpeckers can be tightly packed with sawdust to resemble decaying woody material. Old nesting material should be removed at the start of each nesting season and replaced with fresh materials.

Monsanto, Pensacola, FL

Great-crested flycatcher.

While many artificial nesting structures are designed for cavity-nesters, some provide nesting sites for other wildlife. Nesting platforms, baskets, and cylinders are used by waterfowl, raptors, and other species. If wire mesh is used as nest support material, the weave must be tight enough to prevent eggs and young from falling through the wire. Culverts are typically made of concrete, and some nesting baskets/boxes are made from plastic buckets or open metal tubs. Closed metal

Basic Nest Box Characteristics

- ✓ Should be made of wood; cedar (preferred, most weather-resistant), cypress, redwood, or pine.
- ✓ Box should open from the side or top for maintenance and cleaning.
- ✓ Sides of nest box should enclose the floorboard (recessed 1/4 inch) to prevent rain seepage.
- ✓ Nails, woodscrews, and hinges should be rustproof.
- ✓ Entrance hole dimensions should accommodate the desired bird species; hole should not be large enough to allow competitors and predators access.
- ✓ A double-thick entrance and extended roof to deter predators like squirrels and raccoons.
- ✓ Ventilation holes or slits at the top of both sides, just beneath the roof of the box.
- ✓ Drainage holes (four or five) drilled into the bottom of the nest box to allow for drainage.
- ✓ Songbird nest box should not have a perch, which increases predator access; native songbirds do not use perches.
- ✓ Nest box should not be treated with green-preservative—it is poisonous to birds.
- ✓ Nest box should not be painted on the inside or painted bright, unnatural colors on the outside (may attract predators or exotic species).

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Eastern bluebird.

boxes are generally not used, since they trap excessive heat which can kill eggs and young and stress adults. Artificial burrows have a solid, plywood top and are buried about six inches underground to prevent trampling by livestock. Milk cartons should not be used as nest boxes.

Structure design

A wide variety of artificial nesting structure designs have been developed over the years to accommodate cavity-nesting and other wildlife species. Designs range from simple platforms to complex, multicompartmented structures. Some of these designs are more successful than others, and most can be built or acquired from a variety of suppliers. Design schematics for a number of structures are provided throughout this leaflet.

Basic nest box designs can be modified to accommodate various species by altering dimensions or entrance hole sizes. The size of the entrance hole also influences the internal temperature of the box, predator accessibility, and use by competing nontarget species. Table 2 contains recommended nest box dimensions and entrance hole sizes for many cavity-nesting birds.

Placement

Habitat requirements of target wildlife species and available habitat greatly influences nesting structure

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Wood duck hens may lay eggs in the nests of others (dump nesting) where boxes are positioned in open areas.

Waterfowl.—Nest boxes for waterfowl should be placed in wooded areas close to or directly over water. Wood ducks, mergansers, buffleheads, and goldeneyes are tolerant of other nearby nesting species. Some waterfowl species exhibit a brood parasitism behavior known as dump nesting. Dump nesting occurs when a hen observes another female entering and exiting a nest box and is stimulated to lay her eggs in that nest. This behavior increases when several nest boxes are erected close to each other in highly visible areas. Studies show that hatching success decreases in areas with excessive dump nesting. It may be necessary to put a few nest boxes out in the open *initially* to attract nesting waterfowl. The nest boxes should be moved to more secluded spots along wooded edges close to water the season after nesting is observed. Once a female has successfully nested in a box, she is likely to return in following years.

Cavity-nesting waterfowl do not bring nesting materials to the nest. They use bark, decayed wood fibers, and other debris found in natural cavities and line the nest with down. Therefore, a 3- or 4-inch layer of coarse sawdust or wood chips should be added to boxes as nest building material.

C. Rewa

Wood duck nest box placed in wooded wetland setting.

placement. Some species seek secluded nesting sites, while others prefer to nest in more open areas. Species-specific nesting preferences should be considered when deciding where to install nesting structures. Table 3 provides habitat preferences and nest site characteristics for a variety of cavity-nesting birds.

Structures should be made available and ready for occupants before the breeding season begins. Since some bird species begin nest site selection as early as February, most nesting structures should be installed and/or made ready the previous fall or by late January.

Installation

When installing nest structures, landowners should consider height above the ground, orientation, predator guards, and preferred natural nesting sites. Woodpeckers and bats prefer nest boxes that face east, providing greater morning sun exposure. Most birds and mammals favor entrances that face away from prevailing winds. Landowners and mangers should learn which natural habitat conditions are favored by the desired wildlife species. Cavity-nesting waterfowl nest on or near the water and often prefer nesting structures that face open water and are clear of overhanging branches. Where beavers occur, landowners should avoid attaching nest structures to aspen or other tree species that are preferred beaver food sources.

Nest structures can be attached to poles, posts, or pipes on land or in the water. Nest boxes can also be attached to trees; however, it is hard to install predator guards on tree trunks. Supports should be sturdy enough to keep the structure from swaying or tipping over in high winds. Nest boxes can be attached to 4x4- or 4x6-inch treated wooden posts or trees by inserting a 4- to 6-inch lag bolt through a hole drilled in the back of the box, opposite the entrance hole. A large washer between the head of the lag bolt and the box should be used to secure the box to the support. The bolt should be checked each year and loosened as the tree grows. Wire should not be used to attach nest structures to live trees to avoid damaging the tree.

To ensure stability, the inside diameter of metal support poles should be at least two inches. Hex or carriage bolts can be used to attach structures to steel poles. Nest structures can be installed on or over water when it is iced over or when the water level is low. Nest boxes mounted over water should be four to six feet above the water surface to avoid flooding. A slight forward tilt can help drain the structure and keep out precipitation. A post driver can be used to drive wooden or metal posts into the substrate of ponds or wetlands. Utility or fire companies may be able to

Solutia, Inc.

Wood ducks readily use nest boxes.

Table 2. Nest box dimensions for some cavity-nesting birds (dimensions in inches).

Species	*Floor area*	*Cavity depth*	*Entrance height*	*Diameter of entrance hole*
Wood duck*	8x12	15	9 1/2	3x4 oval
Hooded merganser*	10x12	23	17	4x3 oval
American kestrel	8x8	12-15	9-12	3
Barn owl*	12x40	15	7	6x6
Barred owl*	13x13	22-28	14-18	6-8
Saw-whet owl*	6x6	10-12	8-10	2 1/2
Screech owl*	8x8	12-15	9-12	3
Northern flicker*	7x7	16-18	14-16	2 1/2
Downy woodpecker**	4x4	8-10	6-8	1 1/4
Hairy woodpecker**	6x6	12-15	9-12	1 1/2
Lewis' woodpecker**	7x7	16-18	14-16	2 1/2
Pileated woodpecker**	8x8	16-24	12-20	3x4
Ash-throated flycatcher	6x6	8-10	6-8	2
Great-crested flycatcher	6x6	8-10	6-8	1 3/4
Brown-headed nuthatch***	4x4	8-10	6-8	1 1/4
Pygmy nuthatch***	4x4	8-10	6-8	1 1/4
Red-breasted nuthatch***	4x4	8-10	6-8	1 1/4
White-breasted nuthatch***	4x4	8-10	6-8	1 3/8
Tree swallow	5x5	8	6	1 3/8
Violet-green swallow	5x5	6-8	4-6	1 1/2
Eastern bluebird	5x5	6	10	1 3/8
Mountain bluebird	5x5	8-12	6-10	1 9/16
Western bluebird	5x5	8-12	6-10	1 1/2
Bewick's wren	4x4	6-8	4-6	1 1/2
Carolina wren	4x4	6-8	4-6	1 1/2
House wren	4x4	6-8	4-6	1 1/8
Black-capped chickadee	4x4	9	7	1 1/8
Carolina chickadee	4x4	9	7	1 1/4
Tufted titmouse	4x4	9	7	1 1/4

** put four inches of wood chips or coarse sawdust in bottom of nest box*

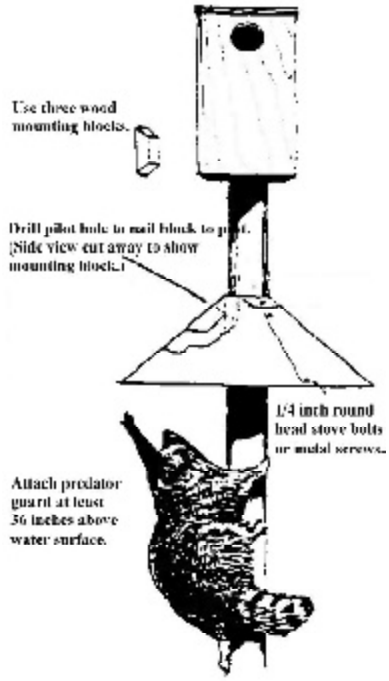
*** fill nest box tightly with sawdust, preferred if outer material is bark*

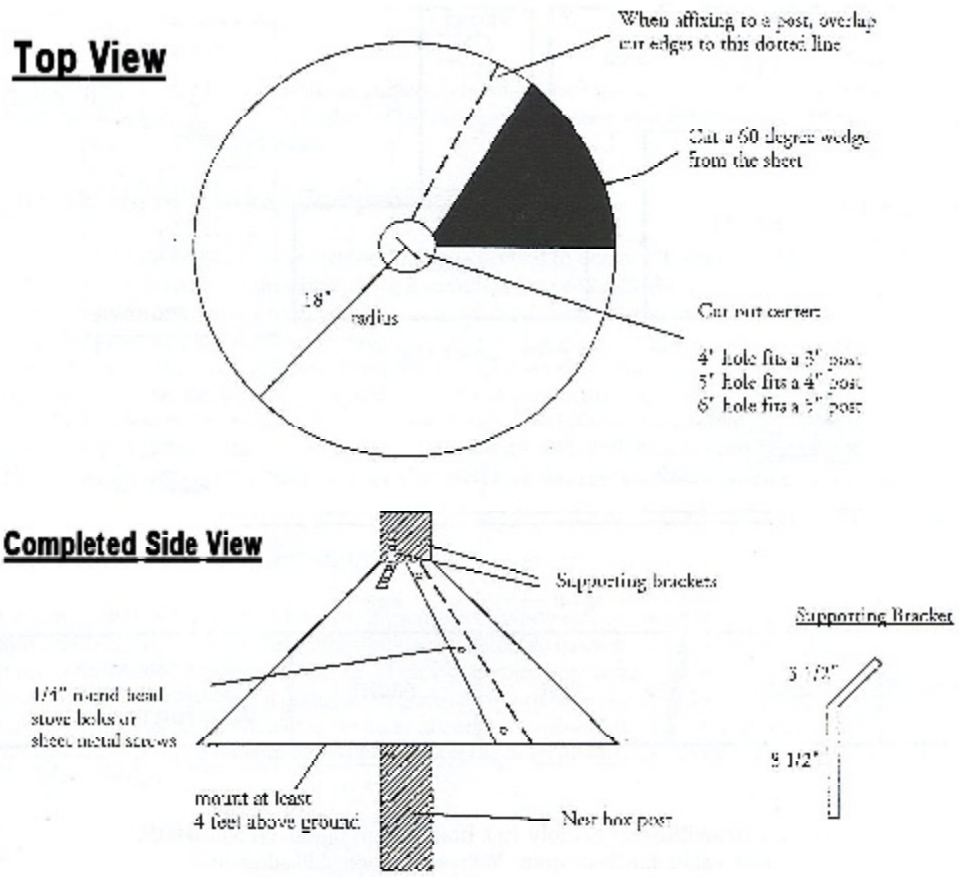
**** outer material should be bark*

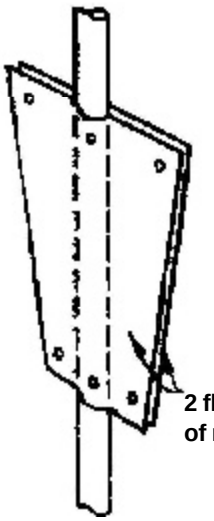
Conical predator guard

Below is a top-view layout for cutting a predator guard from a 3-foot x 3-foot sheet of 26-gauge galvanized metal. The first cut is to remove a 60-degree wedge from the sheet. The center hole is then cut.

The side view shows a guard affixed to a nest box post. This is done by overlapping the edges of the 60-degree wedge to the shown dotted line. Bolts or screws are then used to form the sheet into a cone. Fasten the guard to the post with supporting brackets. Note: Three wooden mounting blocks can also be placed on the underside of the guard to fasten it to the post. Fasten the blocks to the guard and post with screws. The predator guard should be placed on the post so the bottom of the guard is at least 4 feet from the ground.







The pipe, or sandwich guard (left) and the sheet metal band guard (right) provide alternatives to the conical predator guard. Heavy plastic, sheet metal, aluminum, and other materials can be used to make predator guards. Newspaper printers are good sources for large quantities of aluminum sheet metal, which is used in printing and then recycled.

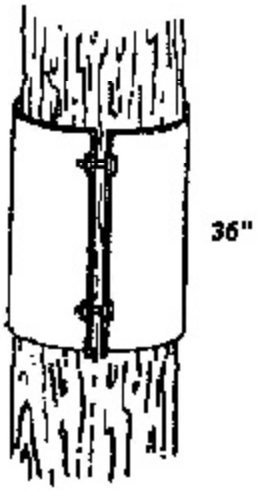


Table 3. Habitat requirements and nest box placement for some cavity-nesting birds.

Species	Nesting habitat and placement tips
Eastern bluebird Mountain bluebird Western bluebird	Open fields, meadows, backyards; old orchards; open rural country with scattered tree cover; place box 3-6 ft. above ground; entrance hole should face open areas, preferring east and north directions; Mountain and Western bluebirds may use some forest edge.
American kestrel	Pastures, fields, and open meadows with grazed or mowed vegetation; place boxes on solitary trees or posts in open fields or along edge of woodlots 10-30 ft. above ground.
Wood duck	Forested wetlands, swamps, ponds, lakes; place box in deciduous trees 6-30 ft. above ground, 30-100 ft. from nearest water source; space boxes 100 ft. apart.
Hooded merganser Common merganser	Prefer secluded wooded waterways, lakes, faster-moving rivers; place box on tree up to 6-30 ft. above ground, within 30-100 feet of water source.
Common goldeneye Barrow's goldeneye	Forested areas near permanent lakes and rivers and large, mature trees; place box in tree 6-30 ft. above ground, within 30-100 ft. of water source.
Screech owl	Forests, parks, woodland clearings, forest edges, especially in riparian areas; place box 10-30 ft. above ground facing north.
Great crested flycatcher	Deciduous or mixed deciduous-coniferous forests and forest edges, woodlands; place box on post or tree at forest edge, 3-20 ft. above ground.
Ash-throated flycatcher	Chaparral, mesquite thickets, savannas, deserts, and open deciduous and riparian woodlands; place box 3-20 ft. above ground.
Northern flicker	Pastures, woodlands, forest edges; place box 6-30 ft. above ground on pole or tree at forest edge or along fence rows.
Tree swallow	Open fields and other open habitats near riparian areas; place box on pole or post 5-15 ft. above ground with entrance hole facing east 30-100 ft. apart.
Violet-green swallow	Open or broken deciduous or mixed deciduous-coniferous forests, forest edge adjacent to open area; place box 9-15 ft. above ground.
White-breasted nuthatch	Deciduous, mixed deciduous-coniferous forests, woodlands, forest edges, with mature stands and decaying trees; place box 3-60 ft. above ground, entrance hole should face away from prevailing wind.
Red-breasted nuthatch	Coniferous and mixed deciduous-coniferous forests, aspen woodlands, mature stands with decaying trees; place box 5-40 ft. above ground, entrance hole should face away from prevailing wind.
Pygmy nuthatch	Ponderosa, yellow, and Jeffrey pine forests, pinyon-juniper woodlands; place box 6-60 ft. above ground.
Brown-headed nuthatch	Open stands of pines, mixed pine-hardwood woodland; place box 2-10 ft. above ground.
Black-capped chickadee Carolina chickadee	Forests, woodlots, and areas with mature hardwood trees, forest edges, and meadows; area should receive 40-60% sunlight and entrance hole should face away from prevailing wind.
Mountain chickadee	Montane coniferous forests; place box 5-15 ft. above ground, preferably in a snag; entrance hole should face away from prevailing wind.
Chestnut-backed chickadee	Coniferous and mixed deciduous-coniferous forests, usually near riparian areas; place box 2-15 ft. above ground; entrance hole facing away from prevailing wind.
Carolina wren	Open deciduous woodlands (especially with thick underbrush), backyards, parks, gardens with trees or shrubs; place box 0-10 ft. above ground.
Prothonotary warbler	Swampy lowland forests and river bottom woodlands subject to flooding; place box 2-10 ft. above or near water.

help landowners raise tall nesting structures, such as raptor and heron platforms.

Floating nest platforms are usually held in place by anchor chains, weights, or buoys. They should be anchored at least 25 feet from shore, in water at least 18 inches deep. Floating platforms should be removed before the first major freeze to prevent damage from ice action and fluctuating water levels.

Predator guards

Predators (both native and introduced) can limit the reproductive success of wildlife using natural nest sites and artificial nesting structures. The rough surface of wooden posts and trees makes climbing easy for terrestrial predators such as snakes, raccoons, and domestic cats.

Artificial nesting structures, especially those close to water, should be fitted with predator guards to reduce the likelihood of nest predation. Heavy plastic, aluminum sheet metal, and other materials can be used to construct predator guards. Newspaper printers are good sources for large quantities of discarded aluminum sheet metal. Metal poles are more difficult to climb, but should at least be covered with repeated applications of axle grease where effective predator guards are difficult to install.

There are three basic types of predator guards: the conical guard, the pipe (sandwich) guard, and sheet metal tree band guard (see illustrations on page 7). Other structures such as coarse wire mesh extending out from around the nest box entrance hole may be used to prevent raccoons and other predators from reaching into the nest box.

In addition to installing predator guards to discourage ground-dwelling predators, overhanging or low branches near nesting structure should be removed to discourage access by arboreal predators.

C. Rewa

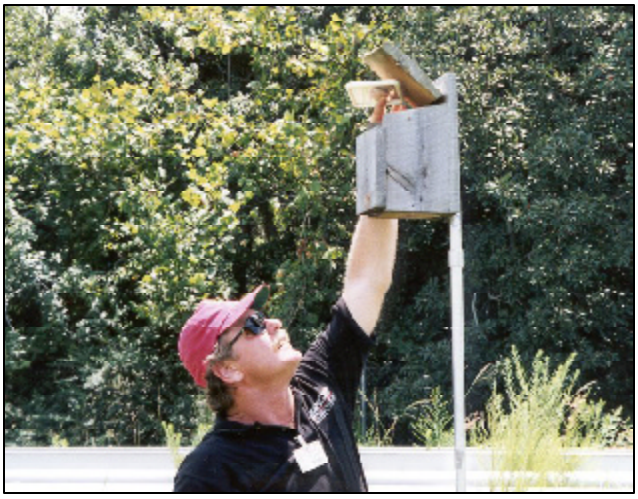
Predator guards help reduce loss of eggs and young to predation.

Monitoring and maintenance

Nesting structures can be monitored throughout the nesting season to track use and nest success, remove undesirable exotic species, and to clean the structure after young are fledged to make it available for late and second nesting attempts. Some birds and mammals tolerate limited levels of human disturbance, such as occasional (once a week or once every ten days) nest checks, but others do not. Nest checks should be completed quickly to minimize stress on parent birds and young. Intrusive monitoring of sensitive species (e.g., ferruginous hawks, ospreys, barn owls) should be limited to prevent nest abandonment.

Parasites cause problems for some nesting birds. To check for blowfly larvae, mites, and other pests, gently lift the nest off the box floor and tap it lightly. After the pests drop to the box floor, sweep them out of the box. Since birds have a poor sense of smell, adults do not generally abandon nests that have been handled in this manner.

Woodpeckers.—Many woodpecker species will take advantage of nest boxes if mature trees and snags in which to excavate cavities are not available. Boxes should be tightly packed with sawdust to simulate decaying wood inside snags and dead limbs. Woodpeckers prefer boxes with bark exteriors, placed on the south or east side of trees (to maximize exposure to the sun).



Monsanto, Pensacola, FFL

Monitoring and maintenance can help ensure success of bluebird boxes and other nesting structures.

Well-built nesting structures can last 10–15 years if properly maintained. After a brood has left the structure, the old nesting material should be cleaned out to make room for a second clutch. Nest structures should be checked at least once per year before the breeding season starts to remove old nesting materials, mouse nests, insects, and other debris. Place fresh wood chips, shavings, or sawdust in nest boxes, if appropriate. Replacement parts and other repairs can be made to nest structures during annual maintenance checks. Nest monitoring results can be used by local birding organizations and state and federal government agencies to keep track of reproductive success and wildlife population trends.

Competitors

Competition for nest sites is often high among cavity-nesting wildlife species. Birds, small mammals, and insects compete for suitable sites. Deer mice and squirrels often inhabit nest structures during the winter months, and their nests should be removed during annual maintenance inspections if they are not the target species.

House sparrows and European starlings are not native to North America but thrive in backyard and suburban areas, frequently taking over nest sites used by native songbirds. House sparrows will kill the parents and young of bluebirds, chickadees, house wrens, and other native birds. An entrance hole diameter of less than 1¼ inches can preclude house sparrows from using nest boxes, but also excludes some native cavity-nesting birds. European starlings can be excluded by entrance hole diameters of no greater than 1½ inches. Special starling guards are available to protect entrance holes of purple martin houses and other nesting structures.

If a house sparrow or starling nest is found during routine nest monitoring, the nest and its contents should be removed. These two introduced species are often persistent nesters and are not protected by federal law. Live trapping and humane destruction may be necessary in areas highly populated by house sparrows and starlings (traps are available at bird specialty stores). Local authorities can help landowners dispose of the birds properly. Frozen birds can be donated for scientific use, and to academic institutions or raptor rehabilitation centers.

Wasps and bees also build nests in birdhouses. These insects can be discouraged by soaping the inside top of nest boxes. If insects such as paper wasps establish a nest in a vacant box, a low toxicity insecticide can be sprayed inside the box in the early morning (when the insects are still cold and sluggish) and the nest can be removed. Annual maintenance and monitoring help detect colonies of wasps and bees.

K. Klimkiewicz

Non-native house sparrows aggressively compete for nest sites with native species.

Vulcan, Brooksville, FL

Screech owl young in nest box.

C. Rewa

Owl nest boxes can be attached to the side of buildings.

Types of Artificial Nesting Structures

Nest box

Nest boxes are probably the most common and easily recognized artificial nesting structures used today. Over 50 species of birds including waterfowl, raptors, songbirds, and woodpeckers are known to use nest boxes. A variety of nest box designs are provided throughout this leaflet, and box dimensions for various species are listed in Table 2. Some government and nonprofit organizations may supply nest boxes and/or building materials at no charge or at a reduced rate. Local community groups like scouts and ornithological society chapters can help landowners construct and erect nest boxes.

Like natural nesting cavities, nest boxes should not have perches mounted at the entrance hole. Box construction should limit the amount of light and precipitation that can enter the box. During construction, four ¼-inch holes should be drilled in the bottom of the nest box for drainage, and ventilation slits should be provided on both sides just under the roof overhang. Hardware cloth attached to the inside front of waterfowl nest boxes serves as exit ladders for ducklings.

Great Horned Owl and Great Gray Owl Nesting Platforms

Great horned owls and great gray owls do not build their own nests. Both species typically use nests abandoned by red-tailed hawks, goshawks, eagles, and other large raptors. Artificial nesting platforms and cones are also used.

Great horned owls prefer platforms lodged in mature hardwood trees 15 to 50 feet above the ground. Nest sites should be relatively free from human disturbance, and foraging habitat should be available nearby. Platforms in quiet woodlot edges, shelterbelts with mature trees, and windbreaks are examples of suitable nesting sites.

Great gray owls prefer nest sites located in the interior of coniferous forests. Nesting platforms should be placed in mature trees at least 15 feet above the ground.

Monsanto, Pensacola, FL

Owl nest boxes ready for deployment.


Paul Jung

Purple Martin Housing Standards

Today, purple martins depend on humans to supply them with suitable nest sites. For more detailed information about purple martins, helpful management tips, and housing specifications and diagrams contact the Purple Martin Conservation Association (PMCA) at the Edinboro University of Pennsylvania at 814-734-4420 or visit the PMCA Web site at http://www.purplemartin.org.

The PMCA has developed a set of biologically sound housing (for compartment or gourd system) standards for purple martins. Listed below are some purple martin housing basics. These birds have additional housing needs, and PMCA literature addresses those issues.

Housing materials: Although aluminum housing is often preferred for its ease of maintenance and accessibility, untreated wood apartments are also commonly used. Cypress and cedar are recommended, but pine and redwood are also used. The exterior of the apartments should be painted white. The interior should have no treatment, stain, or paint. Wood floors with a rough surface prevent nestlings from developing splayed legs. If the housing is made of plastic, the exterior should be a light color or white. The plastic should be opaque. Translucent plastic overheats quickly, killing the eggs and nestlings, or stressing the incubating parent martin. Gourds are also used as purple martin apartments.

Compartment size: A martin house contains at least four to six compartments, and the minimum size for each compartment is 6x6x6 inches. Larger compartments offer better protection from weather and predators.

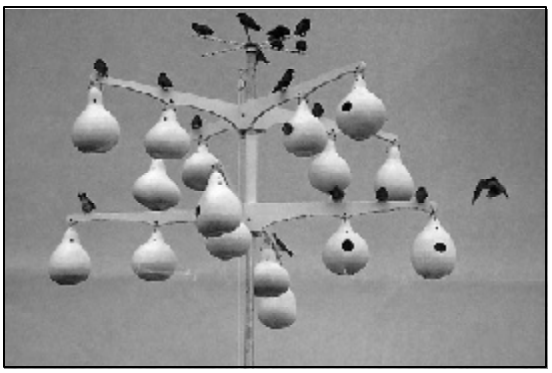
Entrance hole: Purple martins use round entrance holes with diameters ranging from 1¾ to 2¼ inches. Most housing features 2?-inch diameter entrance holes. Door plugs should be used in the winter to close compartments to house sparrows, starlings, and other winter occupants. The entrance hole should be 1 to 1½ inches above the floor of the compartment.

Height and placement of housing: Housing should be erected 12–20 feet above the ground on a metal pole or pressure-treated wood post set into the ground with concrete. The house should not sway or tip in high winds. The house should be placed in an open area at least 40 feet away from trees, but within 100 feet of human activity (home, marina, etc.).

Other considerations: Landlords should install a pole predator guard to discourage terrestrial predators. The compartments should have ventilation holes under the roof overhang and drainage holes in the compartment floor. Porch railings are desirable.

The martin housing must be able to be lowered and raised vertically in order to perform routine maintenance, cleaning, and nest monitoring. Housing on a winch or lanyard system or on a telescoping pole is highly recommended. House sparrows and European starlings frequently take over housing, so the landlord must check for nests, eggs, or occupants on a regular basis. Perches are not recommended since they attract these exotic species.


Aluminum purple martin house. Dave Holmes


Purple martins on gourd housing structure. WHC

Amoco

Many floating platform designs are used to provide suitable waterfowl nesting sites.

Nest Shelf

Nest shelves are used by American robins, eastern phoebes, and barn swallows. Since these species use mud in nest construction, nearby mud puddles or other water sources may enhance the attractiveness of nest shelves. Some birds prefer shelves placed under building overhangs or eaves, adjacent to open areas. Old nesting material should be removed after the breeding season is complete. A design for a typical nest shelf is provided on page 19.

Nesting platform

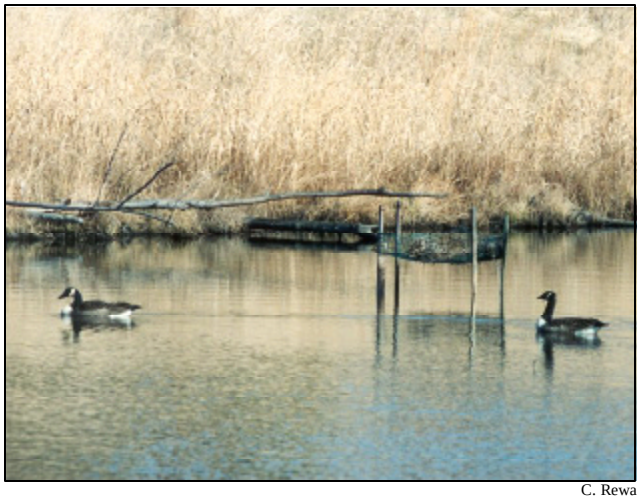
Ospreys, ferruginous hawks, golden eagles, great horned owls, great gray owls, great blue herons, black-capped night herons, double-crested cormorants, egrets, and occasionally bald eagles have been known to nest on platforms when suitable natural nest sites are limited or unavailable. Sticks are frequently wired to the platform to simulate previous use, which is attractive to these species. Nest platforms can be mounted on a single pole, a solid base such as a tree or tripod, or for species that nest along coastal or inland waterways, marine navigational structures. One nesting platform design is provided on page 24.

Floating platform

Many waterfowl species choose natural nesting sites on islands or along shorelines of lakes, ponds, rivers, and streams. Most waterfowl favor sites sheltered from prevailing winds, and preferred nesting cover varies with species. Floating platforms offer alternative nesting sites that provide protection from many predators. Floating platforms are used by common loons and Canada geese in areas where water levels fluctuate. Mallards, black ducks, pintails, blue-winged teal, and canvasbacks may also use floating platforms. Aquatic vegetation such as rushes and cattails can be secured to floating platforms in northern lakes to attract nesting loons. Canada geese prefer platforms covered with grass, straw, or hay. Nest material can be wired to the bottom of the platform to prevent it from blowing off. Other waterfowl species and turtles may use floating platforms for loafing. A floating nesting platform design is provided on page 22.

Nesting baskets, cylinders, and culverts

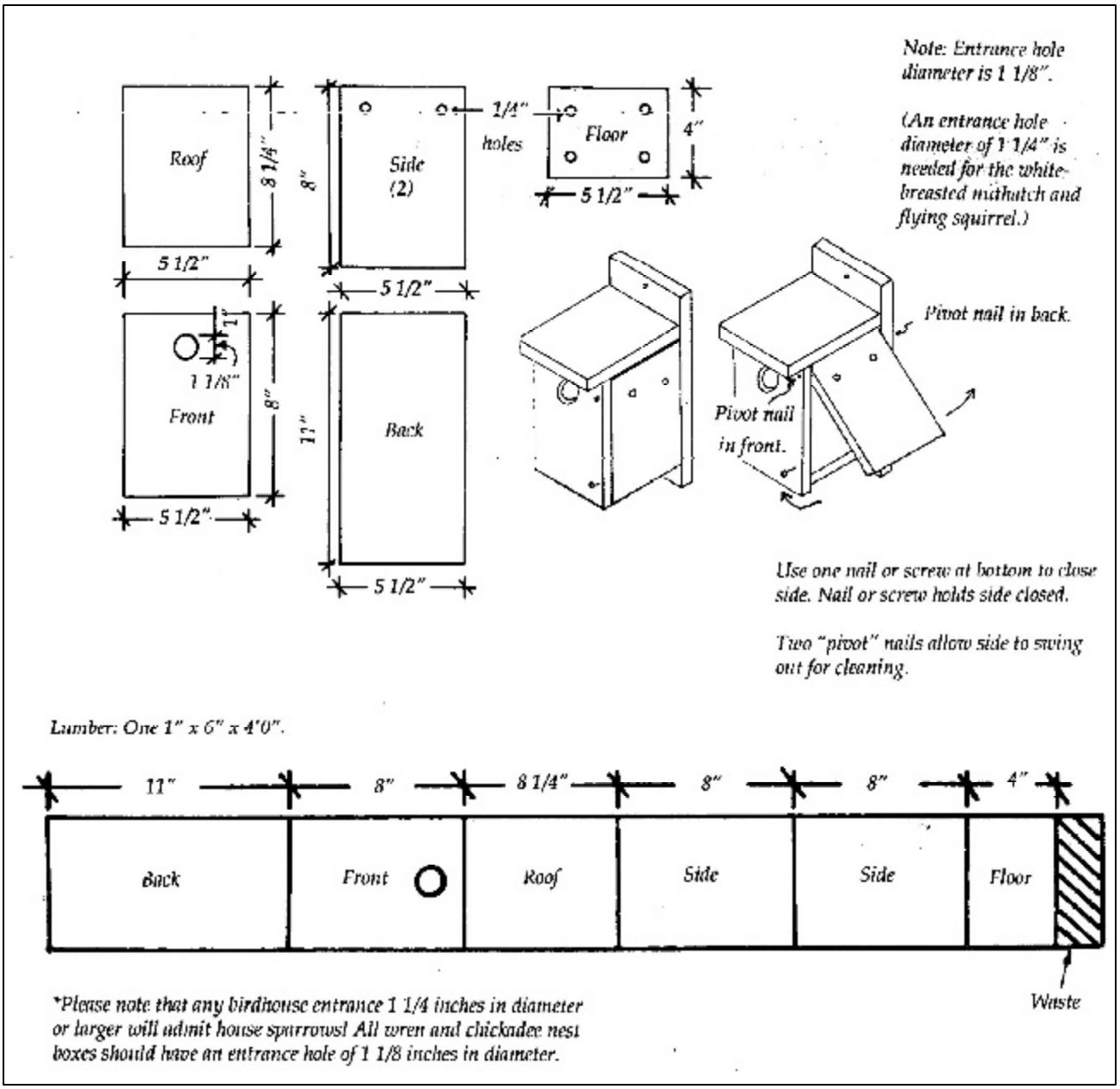
Nesting baskets and tubs (both metal and fiberglass) are used by ducks (primarily mallards) and geese. Mallard nest baskets should be installed over water at least ten feet from the land. Baskets or tubs attached to wood or metal supports should be at least three feet above the surface of the water to prevent flooding. Straw, hay, or grass nesting material should be replaced annually. About 10 drainage holes must be punched into the bottom of the tub. A 6x4-inch escape notch should be cut out of the side of the tub to allow goslings and ducklings to exit. The tub may be painted a natural earth tone (brown, gray, or dark green). If the tub is attached to a floating platform, the platform must be



C. Rewa

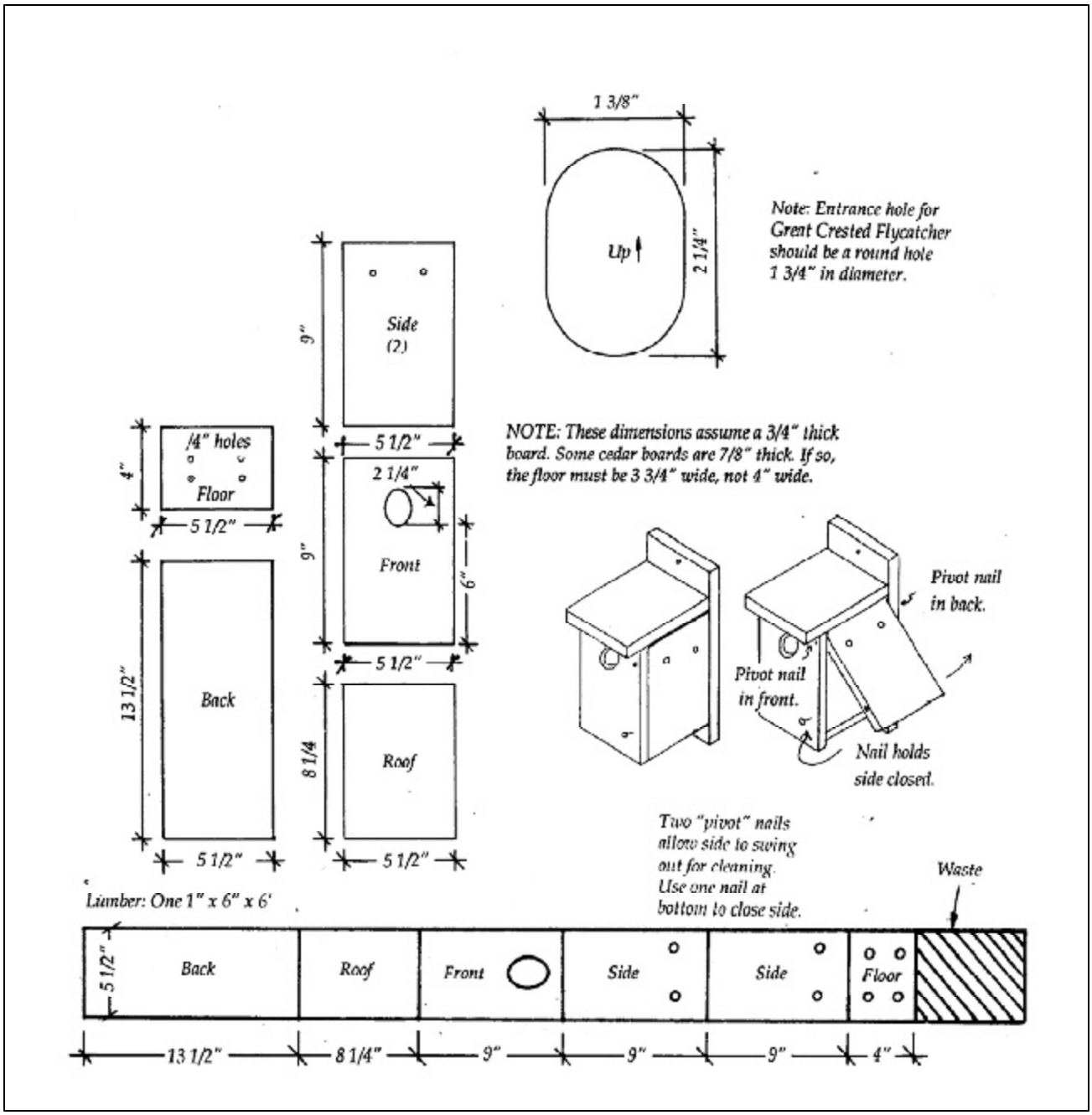
Baskets provide nesting sites attractive to waterfowl.

Nest box diagram for black-capped chickadee, house wren, prothonotary warbler, white-breasted nuthatch, flying squirrel, deer mouse and white-footed mouse.



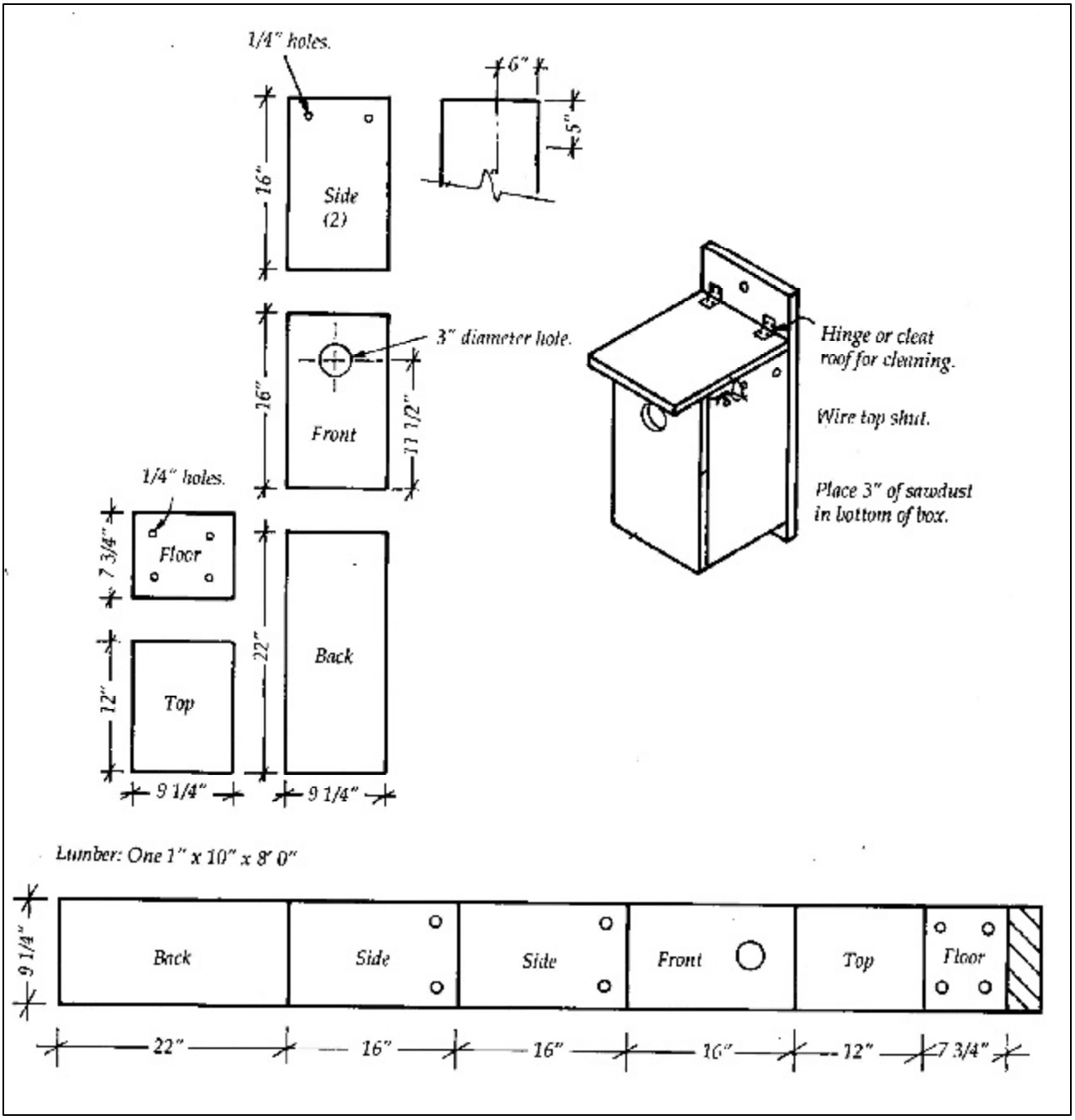
Minnesota Department of Natural Resources

Nest box diagram for eastern bluebird, great-crested flycatcher, and tree swallow.



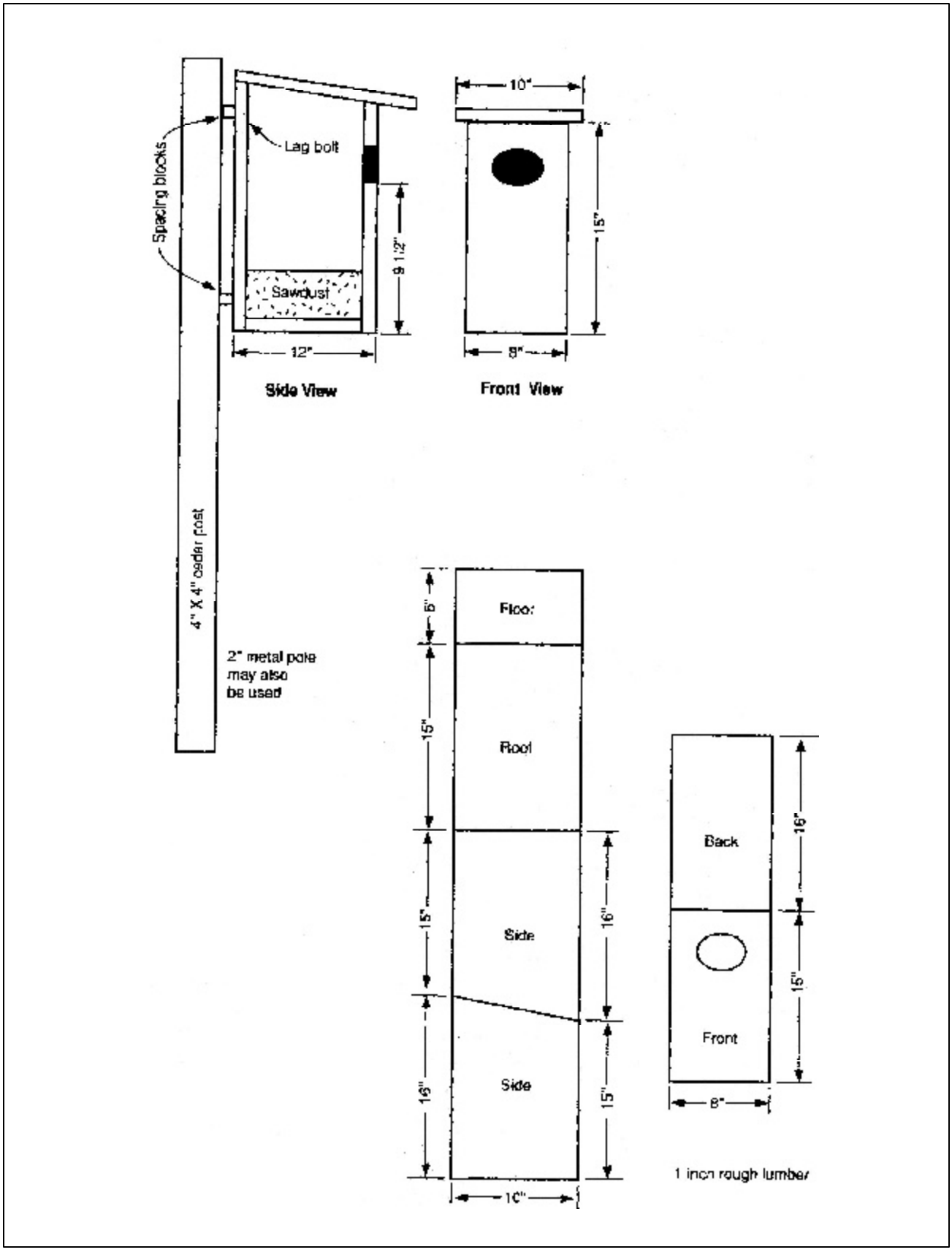
Minnesota Department of Natural Resources

Nest box diagram for American kestrel, boreal owl, northern saw-whet owl, screech owl, fox squirrel, gray squirrel and red squirrel.

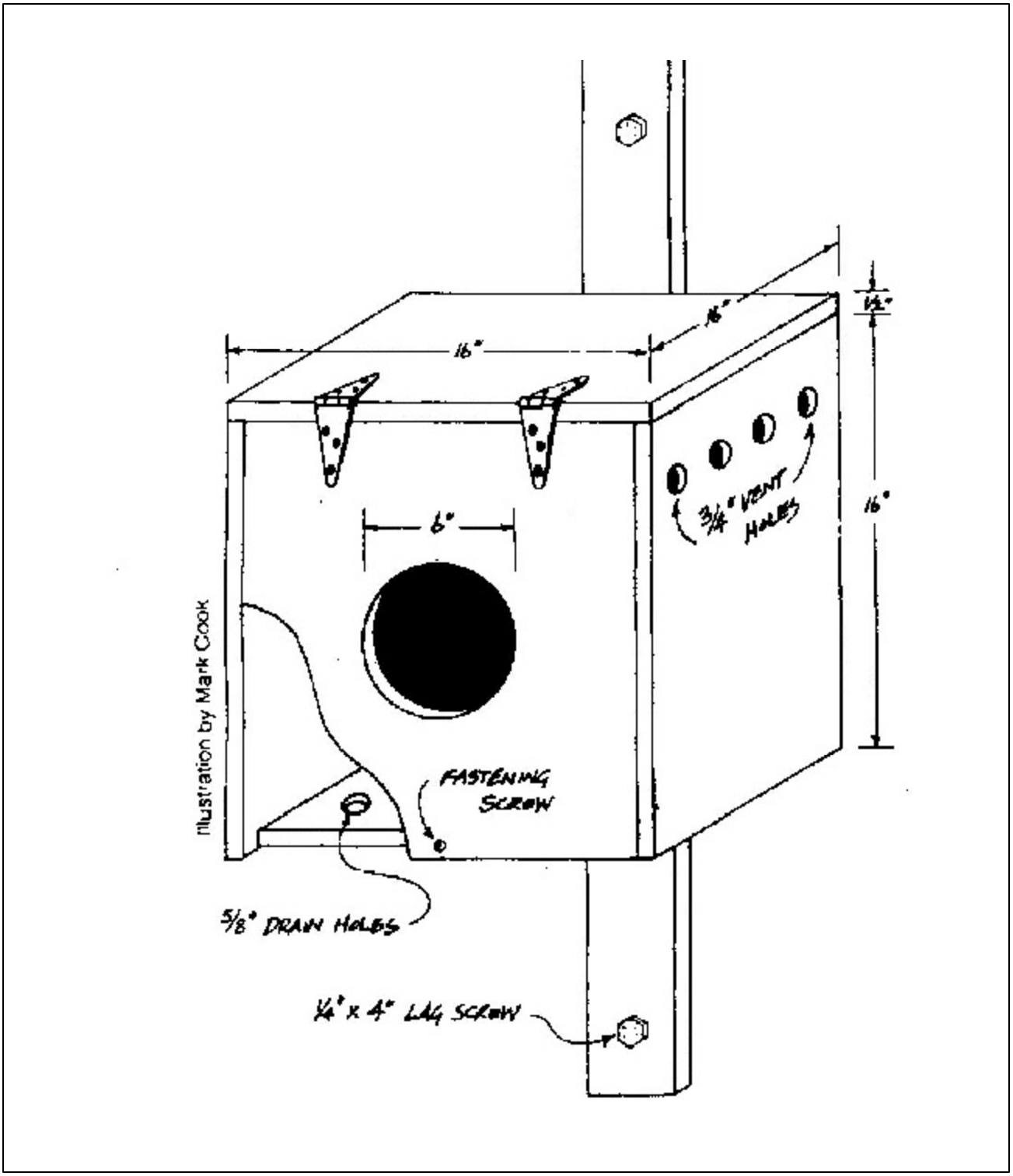


Minnesota Department of Natural Resources

Wood duck nest box diagram.

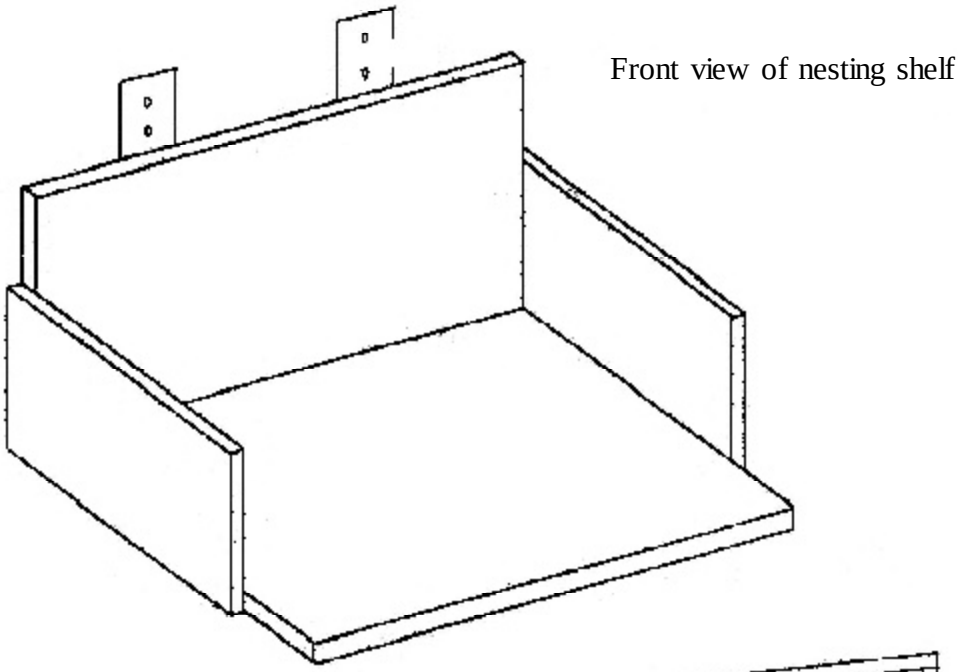


One type of barn owl nest box.

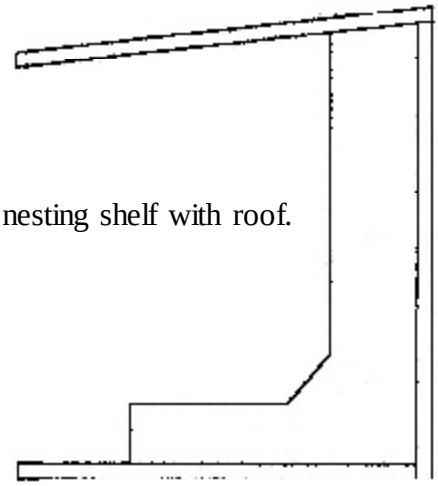


A barn owl nest box based on design in T. Hoffman, Using Barn Owls for Rodent Control (see on-line references). The 24-inch cube requires 1 1/2 sheets of 1/2-inch plywood.

Nesting shelf diagrams for American robin, eastern phoebe, and barn swallow.



Front view of nesting shelf without roof.

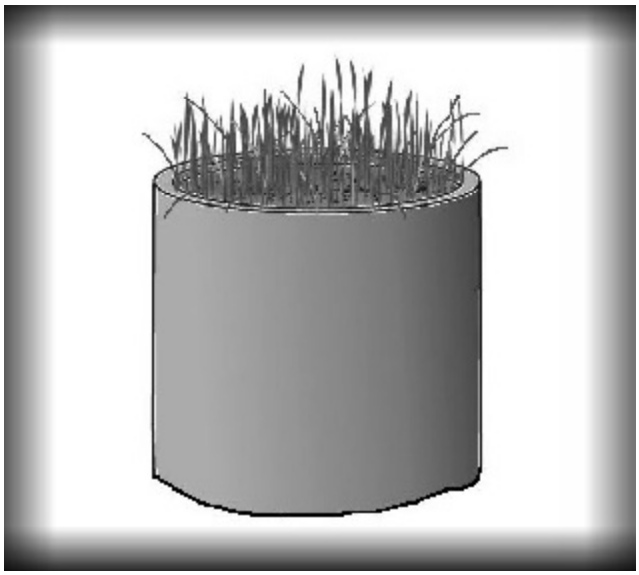


Side view of nesting shelf with roof.

Nesting shelf dimensions and mounting height.

Bird Bird species	Floor dimensions (in.)	Front height (in.)	Mounting height (ft.)
American robin	6x8	8	6 to 15
Eastern phoebe	6x6	6	8 to 12
Barn swallow	6x6	6	8 to 12

Place shelf on side of building with vertical or horizontal brackets.



Concrete waterfowl nesting culvert.

C. Rewa

Waterfowl nesting cylinder, or "hen house."

anchored to the bottom at opposite ends in two to four feet of water. Floating structures and nesting baskets should be installed in areas where view of other similar structures is obstructed.

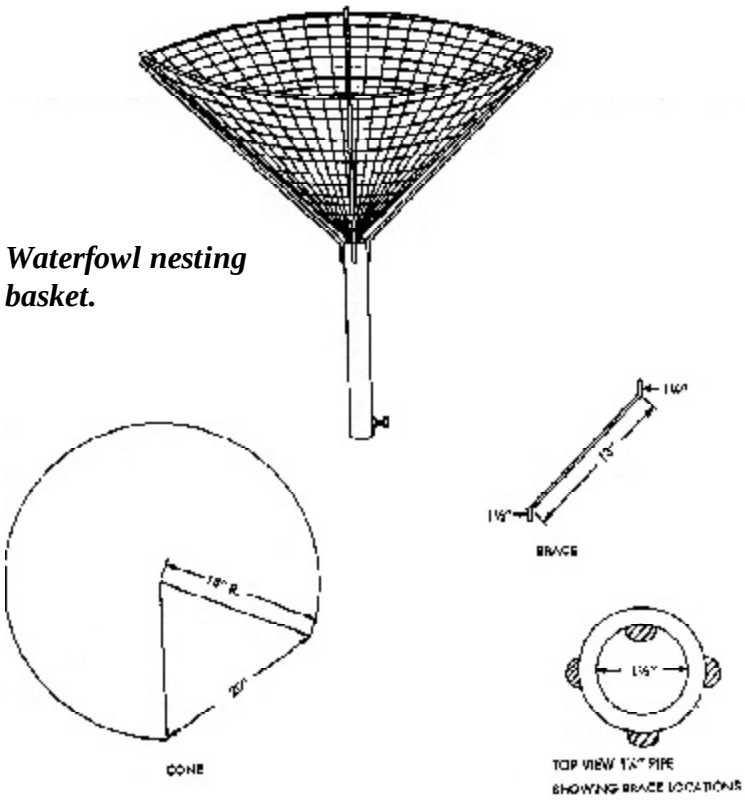
Hen houses, or nesting cylinders, are suitable nest sites for waterfowl species that favor overhead nesting cover. The house is basically a 3-ft. long cylinder made of rolled fencing wire and hay, dried grass or other vegetation. Cylinders can be mounted on wooden boards attached to poles protruding from the water. Pipes or poles supporting the hen house should extend at least three feet above the surface of the water to prevent flooding.

Basic designs for nesting baskets and cylinders are provided on page 21. Concrete culverts can be used to make suitable nesting structures for some ducks and geese. To construct a nesting structure, the culvert is to be set on end and filled with soil. Vegetation preferred by the target species should be planted in the top layer of soil. Culverts require little annual maintenance and are usually installed in about 18 inches of water along shorelines of lakes, ponds, and wetlands. The culvert should extend far enough above the water to prevent flooding or easy predator access. It may take one or two years before there is adequate vegetation cover to attract nesting waterfowl.

Bat box

Forty percent of bat species in the United States are rapidly declining or endangered because of habitat loss and destruction of roosts and hibernacula. Bats are nocturnal mammals that depend on roosts in natural tree cavities, caves, hollow trees and sloughing tree bark, and manmade structures such as attics, mines, and bridges. Daytime roosts are used for migrating and bachelor colonies, as well as summer maternity (or nursery) colonies. Artificial roosting structures,

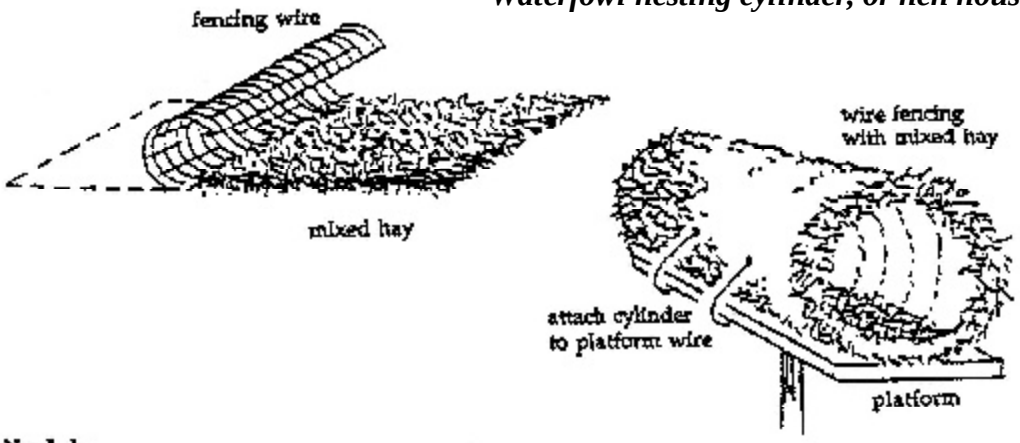
C. Rewa



Waterfowl nesting basket.

Add straw or hay nesting material before the nesting season.

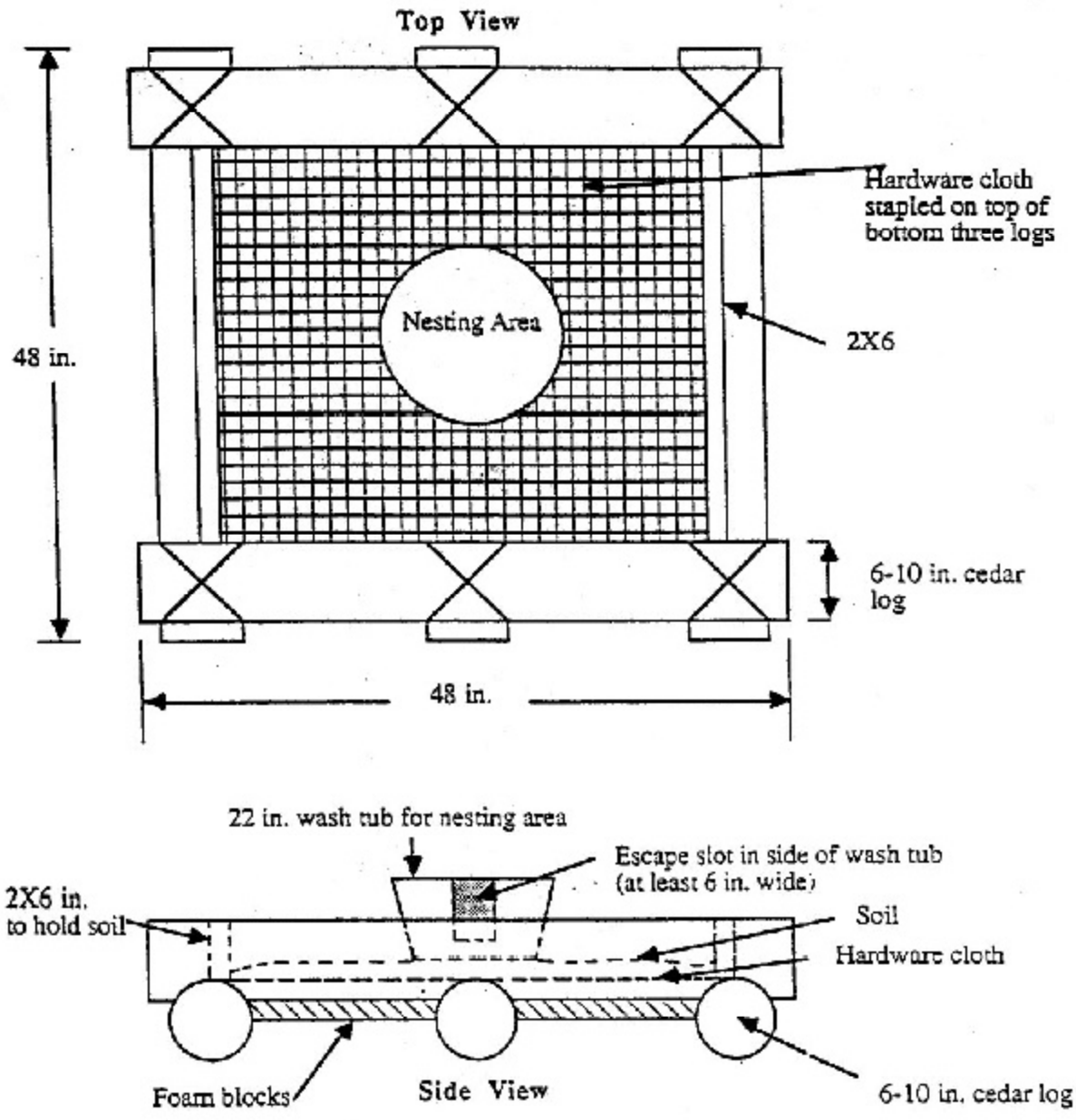
Waterfowl nesting cylinder, or hen house.



Materials Needed:

- 7 foot piece of 2" x2" mesh-welded plastic coated garden fencing. 36" wide.
- 1" x 6" x 3 ft. treated board.
- Pipe flange attached to the bottom center of the board which is driven into the marsh to stand 3 feet above the water.
- 4' x 1" steel pipe screwed into the flange.
- Marsh hay. If marsh hay is not available when rolling the wire into a cylinder, use 'ditch grass' or 'horse hay' such as a timothy orchard grass mixture. DO NOT USE STRAW.
- When wire is rolled, a cylinder which is 36" long by approximately 12" in diameter should be produced.

Floating platform diagram for common loon, Canada goose, and other waterfowl.



Construction Notes:

Fill the spaces between the logs on top of the hardware cloth with soil or peat (3 to 4 inches) and plant with sedges, rushes or marsh fern.

Place an armful of hay in the center nesting area on top of soil to form nest. A 22-inch diameter washtub can be used as a nesting area, provided a 6-inch square hole is cut in the side to facilitate escape of goslings.

C. Rewa

Osprey nesting platform.

referred to as bat houses or bat boxes, can serve as effective roosts and nursery areas. Pairing two or more bat houses back-to-back or on the same building provides a variety of temperatures for different roosting needs. Pivot-pole systems are the easiest method to raise or lower single or paired boxes for maintenance.

Diagrams for building bat houses are provided on page 26 and 27. For additional information on bat biology, conservation, and research, see Fish and Wildlife Habitat Management Leaflet No. 5, *Bats*, or go to Bat Conservation International's website at *www.batcon.org*.

Osprey Nesting Platforms

Ospreys need nesting platforms placed over or close to a good quality water source that supports abundant fish, the main component of the osprey diet. Platforms should be placed in areas free from human activity such as along secluded wetlands and river segments. Platforms should rise above the elevation of surrounding vegetation and landscape features. Osprey platforms should be located at least 1,000 feet apart and away from nests and perches of other large raptors. Pressure-treated wood posts should be at least 25 feet tall. Some sticks should be placed on the platform to simulate previous use by ospreys.

Artificial burrows

Artificial burrows are used by a variety of ground-dwelling animals. Most artificial burrows are built of plywood and buried at least six inches below the ground surface. For a more natural appearance, a small mound of soil should be built up around the entrance hole to simulate natural excavation by some other animal. Artificial burrows are generally constructed of wood. Plastic tubing at least eight inches in diameter can also be used. The burrow should be placed on a relatively high, well-drained location and checked annually for repairs.

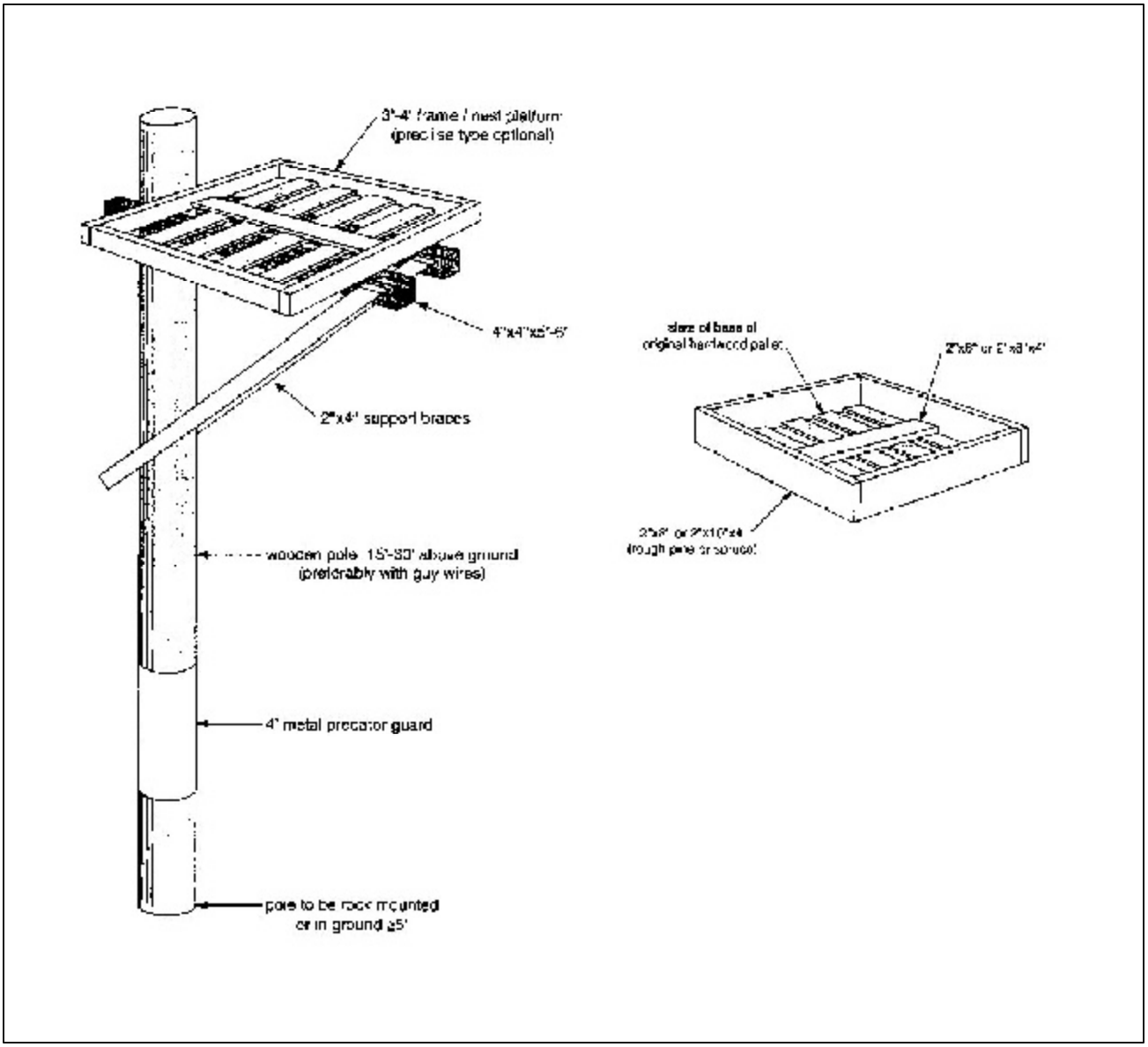
Burrowing owl.—Shortgrass prairies with good visibility are the preferred habitats of burrowing owls. Ungrazed mixed grass prairies are also used for nesting. The owls inhabit burrows abandoned by ground squirrels, prairie dogs, foxes, coyotes, and badgers. Since much of the burrowing owl's natural habitat has been lost to farming and ranching, artificial nesting burrows can help stabilize declining populations.

U.S. Fish and Wildlife Service

Burrowing owls.

Unimin-Emmett

Osprey nesting platform diagram.



Bat Conservation International

Bat Box Placement

Install bat houses two to six weeks before spring or before bats are evicted from an attic, barn, etc. Bat boxes should be installed on a 4x4- or 4x6-inch pressure-treated wooden post or a metal pole with an inside diameter greater than two inches (for stability). Boxes should be installed in open woodlots, old orchards, farmlands, or backyards within one-quarter mile of a lake, pond, stream, or wetland.

Bat houses placed on poles, under building overhangs or on the side of buildings are occupied more successfully than those boxes mounted on trees. The bottom of the house should be 12 to 15 feet above the ground and located in ample sunlight. Northern and eastern bat boxes should receive at least eight hours of direct sunlight per day and face south or southeast for the maximum amount of solar radiation. Warmer climates should receive six or more hours of direct sunlight and face east or southeast. In the hottest climates, four or five hours is acceptable.

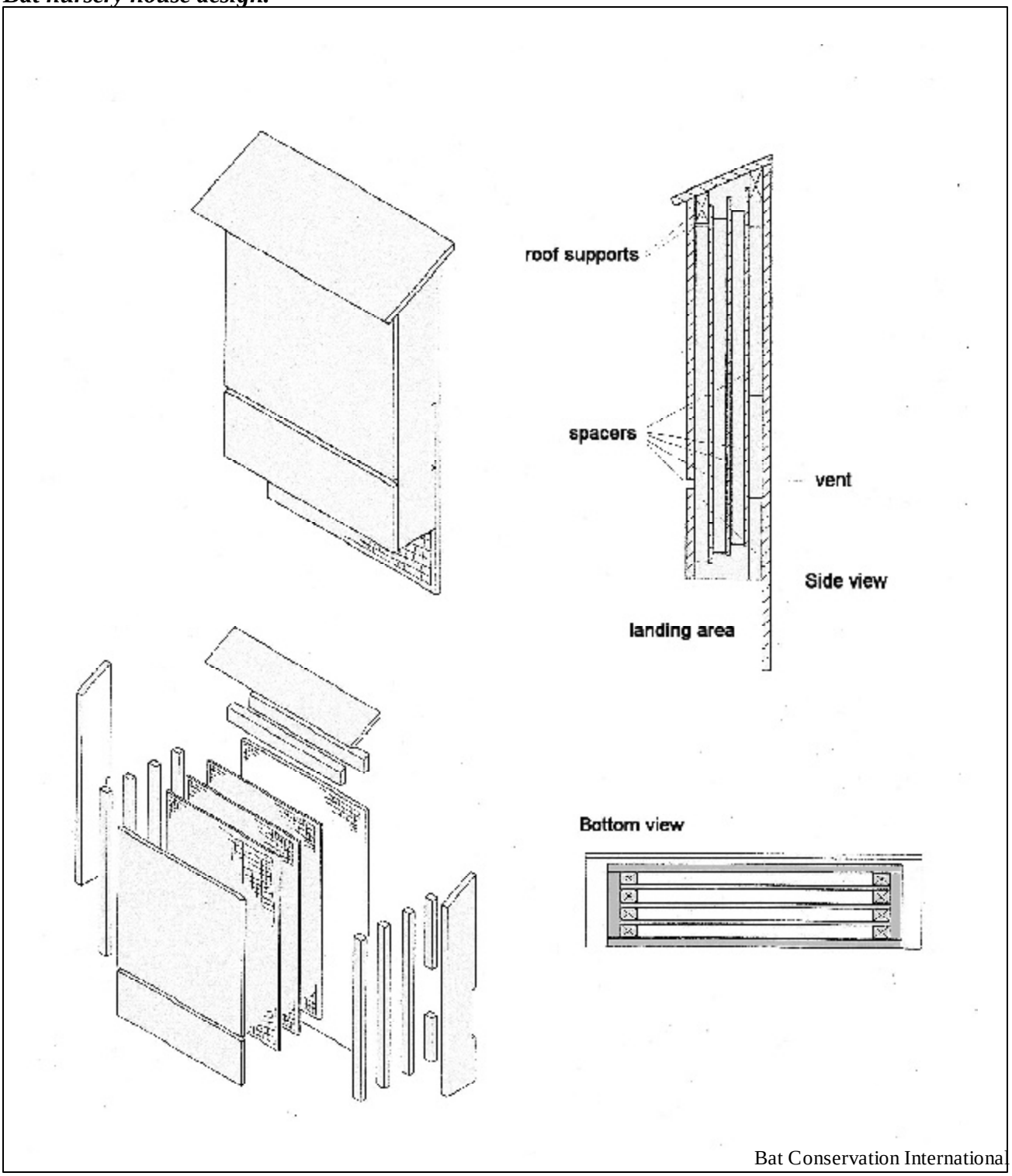
Basics of Bat House Design

Most bat houses, or bat boxes, are made of wood. Typically exterior-grade plywood that has not been pressure-treated is used. Listed below are some basic guidelines for building bat boxes. For more detailed information, contact Bat Conservation International (BCI) or visit their website at http://www.batcon.org.

- Internal roosting partitions should be properly spaced, 3/4 to 1 inch apart for bat species in the U.S., to conserve heat.
- Internal roosting partitions should be roughened with a saw or chisel to create footholds for bats. Use 1/8- to ¼-inch plastic mesh as a substitute.
- For boxes in regions where average July temperatures exceed 85 degrees Fahrenheit, include vents six inches from the bottom of the box. Front vents should be as long as the box is wide; side vents should be 6x1/2 inch.
- A partial bottom can be added to boxes in colder, northern climates to increase the internal temperature of the box. The bottom should be angled at 45 degrees or greater to allow guano to fall out of the box. Attach the bottom with rust-proof hinges and secure with a hook-and-eye latch for easy maintenance.
- Apply three layers of a dark colored exterior paint to the outside of the bat house; dark brown or black for boxes in the north and east, medium to light brown for boxes in the south and southwest. An aluminum roof may need to be installed (for shade) over boxes in regions with high summer temperatures.
- All exterior surfaces should be caulked and sealed to prevent heat loss from inside the box and prevent precipitation from leaking into the box.
- Perform routine, annual maintenance on the bat box such as caulking, painting, and general repairs.

Bat Conservation International

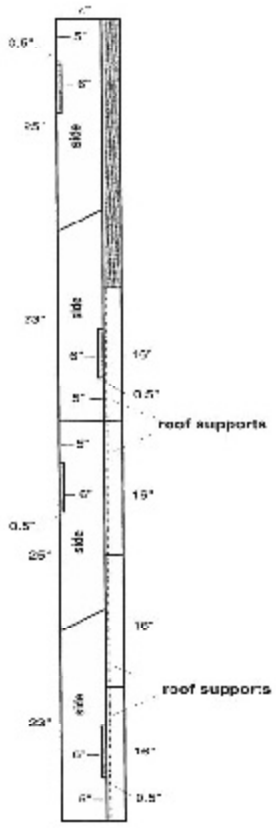
Bat nursery house design.



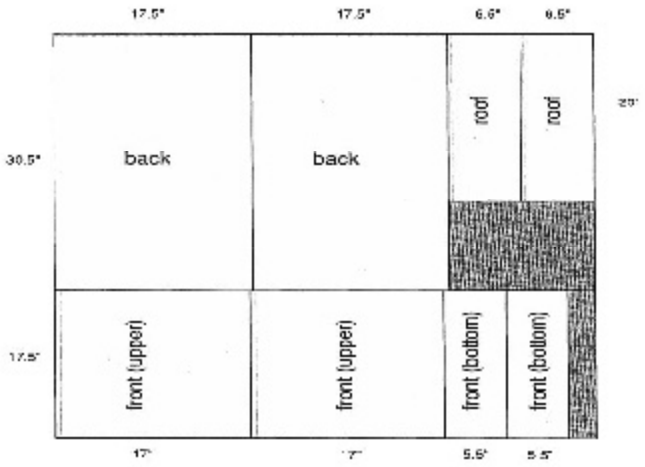
Bat Conservation International

1. Measure and mark all wood as per cutting diagrams on page 27. Cut out all parts.
2. Cut six pieces of netting14"x21". Staple to partitions.
3. Screw back to sides, caulking first. Be sure top angles match.
4. Cut a piece of netting16"x30" and staple to inside surface of back. Be sure netting lies flat and does not pucker.
5. Construct house as per drawings above. Place spacers on partitions, screw top front piece to sides, then screw bottom front piece to sides to create a 1/2" vent between the two pieces. Attach supports, attach roof.
6. Caulk between roof and sides, sides and front pieces, and sides and back pieces to seal the nursery house tight.

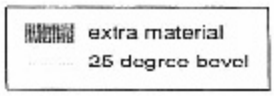
Bat nursery house sawing diagrams.

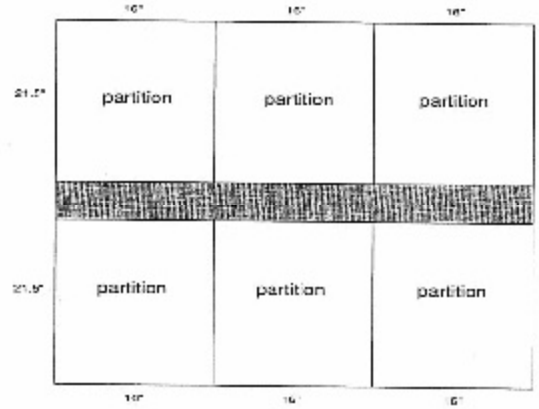


1" x 6" x 8' sheeting

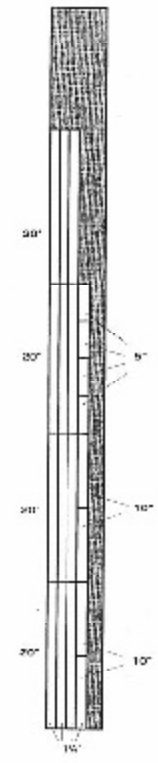


4' x 4' x 1/2" plywood





4' x 4' x 1/4" plywood



spacers:
5" spacers = back bottom
10" spacers = back top
20" spacers = others

1" x 6" x 8' sheeting

Bat Box Monitoring

Bat boxes should be checked at least twice a month in the summer with a flashlight in daylight hours to count adult bats and young. Boxes should be checked at least once during the fall and once during the winter to check for migrating and overwintering bats. Bats are sensitive to excessive human disturbance. For large colonies, count the bats as they emerge from the box at dusk.

To determine if a box contains a nursery colony (late May through June), check the box 45 minutes after sundown after the adults have left to feed. The young are pink and flightless and cling to the insides of the box.

Bat Conservation International

Monitoring bat boxes during daylight hours minimizes disturbance to roosting bats.

Landowner Assistance

There are a variety of private and public organizations that provide technical and/or financial assistance to landowners and managers that want to enhance existing wildlife habitats by erecting artificial nesting structures. Local chapters of ornithological societies, such as local Audubon chapters or birding clubs, can help landowners construct and install the appropriate nesting structures. State wildlife agencies can also help landowners identify wildlife needs and assess available habitat. Local hardware stores, home improvement stores, lumberyards, or pipe manufacturers may be willing to donate materials needed to construct a large quantity of nesting structures. Boy Scout and Girl Scout troops may wish to help land managers build and install artificial nesting structures. Local utility companies may also be willing to assist landowners erect raptor and heron platforms or other tall, hard to install nest structures.

There are numerous groups and organizations that supply information about the biology of specific species, as well as detailed instructions for building nesting structures to attract the desired species.

Conclusion

Artificial nesting structures are not meant to replace suitable habitat, but rather to enhance existing habitat and increase the nesting success of a particular species.

Basic habitat management techniques for improving habitat for a variety of wildlife species and groups are provided in other habitat management leaflets in this series. These leaflets contain information about specific species that use artificial nesting structures, such as the wood duck (*No. 1*), eastern bluebird (*No. 2*), and American kestrel (*No. 3*). These leaflets are available at www.whmi.nrcs.usda.gov and at www.wildlifehc.org.

Landowners and managers must be patient when attempting to attract wildlife to artificial nesting structures. It can take a year or two for the desired species to take notice of new nesting structures. Human activities that disturb nesting activities should be restricted in the vicinity of structures during the breeding season.

Quality of construction is important. The type of materials used, entrance hole dimensions (if applicable), attachments, and predator guards contribute to the effectiveness and longevity of the structure and the reproductive success of the targeted wildlife species.

Groups and organizations that design artificial nesting structures for specific wildlife species.

Group name	Contact information	Website address
Bat Conservation International (BCI)	P.O. Box 162603 Austin, Texas 78716-2603 tel: 512-327-9721 fax: 512-327-9724	www.batcon.org
Purple Martin Conservation Association (PMCA)	Edinboro University of Pennsylvania Edinboro, Pennsylvania 16444 tel: 814-734-4420	www.purplemartin.org
North American Bluebird Society (NABS)	P.O. Box 74 Darlington, Wisconsin 53530-0074	www.nabluebirdsociety.org
The Eagle Institute	P.O. Box 182 Barryville, New York 12719 tel: 914-557-6162	www.eagleinstitute.org
National Audubon Society	700 Broadway New York, New York tel: 212-979-3000 fax: 212-979-3188	www.audubon.org

By considering the biology and habitat requirements of the desired species, landowners and managers can maximize the benefits of using artificial nesting structures for wildlife.

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