

Considerations and Plans for Indoor Cages for Squirrels

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Abstract: Rehabilitators need a variety of cages to appropriately and safely house squirrels of different species, sizes, ages, and health conditions while in rehabilitation. This paper provides a description of many of the essential considerations used with indoor cages for juvenile and recovering adult squirrels. Two cage plans are provided as examples of safe and effective indoor cages for juvenile squirrels, not outdoor pre-release cages. The plans result in cages that are inexpensive and portable, as well as easy and quick to construct, clean, and maintain. The basic construction process and plans also may be used to remodel purchased or donated cages as well as to build similar cages for other species.

Key words: Squirrel rehabilitation cages, cage design, cage plans, cage criteria, building wire cages, supplies and materials for rehabilitation cages, constructing rehabilitation cages, cage problems, cage features, cage considerations, using J-clips

INTRODUCTION

After medical treatment and proper nutrition, suitable enclosures are likely the third most important element of effective wildlife rehabilitation husbandry. Rehabilitators need a variety of cages for the different species, sizes, ages, and health conditions of squirrels in rehabilitation. Cages available for purchase in stores or online, or even donated, rarely meet the design and construction criteria needed for squirrels, especially for juveniles ready to climb and chew, as well as temporary housing for injured adults. This paper describes many of the essential design and construction criteria used with indoor cages for juvenile and recovering adult squirrels. Plans for two cages that have been used for 25 years by many rehabilitators are provided as examples. The plans result in cages that are inexpensive, generally costing less than \$20 in materials, as well as relatively quick and easy

to construct, often taking less than two hours to build after tools and materials are on site.

CAGE DESIGN AND CONSTRUCTION CONSIDERATIONS

There are many criteria to consider when designing and building suitable enclosures for wildlife in rehabilitation. While the *Minimum Standards for Wildlife Rehabilitation* (Miller 2000) provides some general construction and size guidelines, there are many other considerations as well. The following describes 20 criteria and associated questions that have proven essential in designing, constructing, and using indoor squirrel caging.

1. Natural History. Natural history is the foundation for many rehabilitation decisions, starting with the type of squirrel. Is it a tree or ground squirrel? Flying squirrel? What size and age? The following provides a few of the primary natural history considerations to factor into cage design.

The species, age, and size of the squirrel affects decisions such as shape and size of the overall enclosure, size, placement and number of doors, construction materials, and amount of space for cage furniture and nesting. The size of the squirrel head, body, and feet are important to consider in selecting welded wire size and shape. For example, the foot of a 200 g large tree squirrel (e.g., fox squirrel, eastern gray squirrel) may become stuck in the 0.5 x 1 in (1.3 x 2.5 cm) opening in welded wire and cause a sprain or fracture or damage the jaw, whereas the same size welded wire would be needed to safely contain a smaller squirrel (e.g., pine squirrel, Douglas squirrel, ground squirrel) that might squeeze out and escape from wire with larger openings. The younger pre-weaned squirrels that are less active and have fewer skills do not need as large a cage as those older, weaned, recovered from health problems, and preparing for transfer to larger outdoor pre-release enclosures.

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How does the squirrel move normally? Climb? Jump? Run? Is the cage a size the squirrel can move around in normally but not be at risk of injury from a fall? Is it large enough to exercise normal social and postural movements with litter- or cagemates? How does it try to escape predators? Does it climb to escape? Can it climb on the sides of the cage as well as freshly cut branches placed in the cage? What skills need to be developed and observed while inside this cage prior to assessed readiness for transfer to a larger cage? Are suitable materials for a small shelter/nest box provided where the squirrel would normally rest or hide? Are certain building materials avoided that can introduce unnecessary auditory stress, such as plastic or solid metal sides, that can be loud when bumped?

Rodents have very sharp and strong incisors and provided the opportunity, gradually chew through wood and plastic. Older squirrels may be able to chew through or bend thin or small gauge welded wire. This ability for vigorous chewing influences the thickness or gauge of welded wire and the placement of horizontal and vertical cage supports. For example, support pieces, such as those on cage edges and rims, should not be made using wood that can be chewed to create an exit. If wood is the only option, then any wood supports inside the cage should be tightly and completely wrapped with welded wire or the wood supports should be on the outside of the cage.

Knowledge of natural history also provides information on average size of litters, types of parasites and diseases, where time is spent playing, exploring, foraging, and resting, how the animals watch for and avoid predators, and causes of health problems and mortality factors. All of this knowledge is useful when designing cages. For example, both juvenile and adult tree squirrels commonly may sustain bruises, fractures, and head injuries in falls from trees. Cages that provide a smaller area of confinement that restricts climbing and movement are essential to allow for rest and recovery from such injuries. Much of these natural history considerations are available in published resources on squirrel natural history, observing squirrels in the wild, and discussions with other rehabilitators about their own cage designs, preferences, and ways found to be successful in preventing or reducing cage related problems.

2. Purpose of Cage. There are several questions to be addressed as to the overall purpose of the specific cage being designed. Will it house a single

young animal or a litter of young squirrels? Will it be used for older juveniles needing to develop skills and strength? Will it be used to confine the movement of an adult squirrel recovering from head trauma or a fracture? Will it be used to quarantine a newly arrived squirrel or litter? If the cage is for use both indoors and outdoors, will it be small and lightweight enough to pick up and move? If used for transporting one or more squirrels to a veterinarian, another rehabilitator, or to a release site, will it be easy to maneuver in and out of vehicles?

It is helpful to have cages that can serve multiple purposes, such as housing for juvenile squirrels, transport, or recovering adult animals. Additionally, designing cages that can serve multiple purposes allows the rehabilitator to appropriately meet the specific needs of a variety of animals and situations, minimizes economic investment in caging, as well reducing the overall storage space needed for cages when not in use.

3. Human/Animal Safety and Protection.

Generally, juvenile squirrels housed in cages described in this paper still are being handled on a regular basis for either feeding or treatment and observation. Therefore it is necessary the cages are safe for squirrels and people.

Many factors influence the safety of the cage. First, sharp or rough wire edges must be avoided because they easily can lacerate or puncture a fast-moving squirrel or person handling or reaching quickly into the cage. Also to be avoided is use of any cage material that allows the squirrel to chew through or is easily bent. Materials should be of sufficient structural strength to ensure cage stability and avoid causing injuries to the animals inside the cage from the cage falling over or collapsing. The material also should be strong enough to prevent the cage from collapsing when being moved.

Another factor is the size, shape, and location of doors, which if improperly placed can result in injuries to toes, legs, and heads, as well as possible escapes. If the only access to the cage is a large door, there is a reasonable chance squirrels will seize the opportunity for escape almost every time the door is opened. If this is the case, a smaller door with an opening only large enough for a rehabilitator's hand, also should be retrofitted to the cage because it provides much more control over the open area when removing mobile squirrels for medical treatment. Doors designed to open and close easily and securely

also help prevent escapes. Additionally, opening a door on a cage with opaque or solid walls, such as a plastic pet kennel, where the rehabilitator cannot see the squirrel(s) easily increases chances of escape.

Proper selection of welded wire size used in cage construction reduces chance of a squirrel's head or foot becoming caught or injured and prevents escapes, which could result in injury to the squirrel, other squirrels, and people. Lastly, shape of the cage should be designed to allow the rehabilitator to safely reach a squirrel anywhere inside the cage without risk to squirrel or person. Achieving this may involve placement of several doors and access points depending on overall size of cage.

Cage design should include keeping the animal safe from other animals, domestic or wild. Cages used only in secured buildings may have larger wire openings and less substantial locks. However, cages designed for or used outdoors must have many more security features, such as locks on doors and smaller wire openings to prevent predators such as raccoons, snakes, and cats from accessing the cage.

If cages designed for indoor use, such as those with larger openings in the welded wire (1 x 2 in [2.5 x 5 cm]) are used outdoors, the cage should be securely locked and placed in a safe area like inside a larger pre-release cage or screened porch.

4. Space to Allow Normal Development and Movement. Cages need to be large enough for the squirrel to move around normally, climbing, jumping, running, or hanging upside down from a branch or cage top. That said, it is essential to consider age and health of the animal. Very young tree squirrels with limited climbing skills and strength should be in cages that are not as tall, such as 16 in (40.6 cm) in height, so they do not injure themselves when falling or missing a leap, which youngsters do fairly often. The same goes for a squirrel in weakened condition or recovering from an injury.

As the squirrels age and develop in size and ability, cage size should be large enough to provide opportunities for climbing, exploring, playing, hiding, and resting. If the squirrel is caged with others, such as littermates, the cage should provide sufficient room for normal socialization behavior.

While there are some general guidelines for cage sizes in the *Minimum Standards for Wildlife Rehabilitation* (Miller 2000), it must be emphasized that these are only guidelines and rehabilitators should use their knowledge of natural history and

needs of the species and specific animals to make caging decisions.

5. Cages for Various Ages. Review of hundreds of records from squirrel rehabilitators show that approximately 90 percent of tree and ground squirrels admitted to rehabilitation are juveniles (Casey and Casey 2005). Many are presented to rehabilitation in shock, dehydrated, or with injuries. These young squirrels need to be in gradually larger indoor cages until healthy, weaned, and of sufficient size to be placed in pre-release caging. Thus, rehabilitators need a variety of cages in graduated sizes.

Some squirrels admitted are adults—larger, stronger, and able to quickly chew through any cage not constructed with chew-proof materials. Adult squirrels in rehabilitation often have severe injuries, such as fractures and head trauma. Such squirrels need to be kept in cages that allow the animal to be comfortable, but limit movement and activity that could delay recovery or result in further injury.

6. Cages for Various Health Conditions.

Squirrels are admitted to rehabilitation with a wide variety of health conditions (Casey and Casey 2000b). Some squirrels are bruised, sore, and moving slowly. Some suffer from head trauma or fractures that require them to remain still, while others have collapsed and are barely able to move. Those that have recovered from health problems are likely active, fast, and agile. A rehabilitator needs cages to accommodate this full range of health conditions.

It is also important for the animals to be accessible easily but not allow escapes while medical care is provided. Cages used for animals with compromised health also need a way to provide supplemental heat in the nesting area. A variety of supplemental heat sources are used. For example, a heating pad on low may be placed under the cage bottom (not inside the cage), hot water bottle, well-sealed bottle or sealable plastic bag with warm water, or a SnuggleSafe® (Lenric C21 Ltd., West Sussex, UK). Look for a heating pad that does not have the common safety feature of automatic shutoff after a couple of hours. These are harder to find so obtain these items well in advance of when needed.

7. Quarantine. Squirrels, like other wild animals, may have diseases and parasites that are transmissible to other animals, including *Bordetella*, *E. coli.*, mange mites, fleas, coccidia, and giardia. It is critical to have

cages that can be cleaned and disinfected effectively before use with other animals. It also is essential to have enough cages to quarantine new arrivals. Equally important is to have an area that has strict quarantine protocols and is physically separate from the area where animals classified as 'no longer in quarantine' are housed.

8. Escape Prevention. Eyes-closed squirrels generally do not try to escape, most other squirrels in good health may try to leave the confinement of a cage. While it is often possible to recapture a squirrel that gets out of a rehabilitation cage indoors, the normal and vigorous running, climbing, and jumping can cause a variety of problems. Cages, supplies, food, formula, and other items may be knocked over, spilled, or damaged. The squirrel and other animals may be stressed. The squirrel could be injured or have its health compromised during a romp through the facility or during capture. Time is lost when a person has to recapture the squirrel. The rehabilitator and other caregivers can receive scratches or bites, as well as inadvertently injuring the squirrel. Other animals may be exposed to disease and parasites.

There are more complications if the squirrel exits the rehabilitation facility or escapes from an outdoor cage. Those animals may not have recovered from the health problems or be old enough to survive on their own. They may not be in appropriate habitat. The location may be inappropriate for release and cause problems for the animal, rehabilitator, and others. They could spread a disease or parasites to local wild populations. It can be quite difficult, if not impossible, to recapture squirrels that escape outdoors.

It is far better to prevent cage escapes whether the squirrel is indoors or outdoors. When designing and building a cage, consider how a squirrel might escape and work to prevent it. For example, a small plastic cage is acceptable for squirrels not able to chew out. An older squirrel, however, may chew through a plastic cage quickly and easily. Similarly, a large opening may be acceptable for very small, eyes-closed infant squirrels that sleep except for feeding, but unacceptable for older, more agile, and stronger squirrels that can run or jump through a door.

A small door or two allows one to add food or remove a squirrel while blocking the escape of others. Large doors or openings are used when cleaning cages, setting up new cage contents, and so forth. Using a small door that can be blocked quickly and closed with a single hand can reduce escapes signifi-

cantly. When placing a small cage in a pre-release enclosure to acclimate squirrels to the outdoors, it is helpful for the enclosure to have a double door entry that is fully secured to reduce chance of escape.

Squirrels also can escape if the welded wire is weak, flimsy, or damaged, or if it has holes. Wire, support structures, and openings that are not firmly secured allow escapes.

It usually is possible to retrofit and adjust door size or to add small doors to reduce escape possibilities. It also is imperative to keep the cage in good repair. Keep cage doors closed and securely latched or locked when not in use. Again, think through and visualize how a squirrel may try to escape and adjust the cage and how cage is used to prevent this.

9. Lighting. Squirrels, with the exception of flying squirrels, are active during the day. There needs to be light for them to see. However, there are certain conditions when a low-light environment is desirable, such as when an animal is recovering from shock, head trauma, or a disease that may include painful symptoms of photophobia, such as West Nile virus. Also, maintaining a lower light level in the room, and thus in the cage for a day or two after admission, may reduce stress and activity level and help accelerate recovery and healing. Lower light levels may be achieved by having lighting dimmed in the room or by partially covering the cage.

Light inside a rehabilitation building is generally from artificial lights or sunlight from a window or skylight. Since animals need full spectrum lighting that is not available from most light bulbs or through normal window glass, use of full spectrum light for at least a short time each day is advisable. The beneficial distance between the animal and full spectrum lights can vary by product, manufacturer, lumens, etc., so follow the manufacturer's information and recommendation.

10. Stress Minimization. Squirrels, like other wild animals, can stress easily when in a captive environment. Stress causes a variety of health and behavioral problems in squirrels and in some cases can be fatal. The design, construction, and placement of a cage can reduce stress from the surrounding environment. For example, tree squirrels climb to escape predators. So if the tree squirrel is healthy and old enough to climb, having a cage that allows at least some climbing above the level of the cage floor can reduce stress. Having a cage for juveniles or injured

adults on a table instead of the floor means the caregiver may be able to better access the cage from the side or slightly above the cage, and not by standing directly over the squirrels like a predator. Partially covering the top and sides of a cage may reduce visual distractions and allow animals to feel less exposed and vulnerable. Having shelter in which to hide in a cage can reduce stress.

Another stressor for squirrels and other wild animals is how they are captured for routine handling. A well-designed and constructed cage and effective bedding materials can help reduce the stress. For example, a rehabilitator may reach into a small cage to restrain a squirrel while it is safely huddled in a pile of bedding then wrap it securely, quickly removing it for feeding or medical care. The squirrel then can be returned without a chase in the cage. Similarly, it may be possible to temporarily confine a squirrel in an easy-to-reach and removable nest box, which can be moved to another cage during cleaning or even transferred to another, larger cage as the squirrel develops and grows.

11. Temperature and Weather. It is important for squirrels to maintain a healthy and comfortable temperature. Young squirrels or those with any number of health conditions, with rare exception, need supplemental heat, thus it is beneficial for these squirrels to be kept in a smaller cage.

There are many ways to ensure temperature in a cage is comfortable. For example, cages with young squirrels are kept inside a building at or near normal room temperature (60–80° F [16–27° C]) until they have developed pelage and are old enough to be active in a cool or cold outdoor environment. On the flip side, squirrels outdoors in very hot weather need to have shade from the cage roof, trees, awnings, and so forth. Some rehabilitators place commercial misters near outdoor cages in extremely hot weather (over 100° F [38° C]) to help reduce the ambient temperature.

Squirrels in outdoor pre-release cages are adjusting to temperature range and weather, including wind, rain, snow, and sleet. However, shelter from weather extremes and a comfortable, dry, warm, and secure place to sleep is essential.

Juvenile or recovering adult squirrels benefit from time to adjust from indoor temperatures to outdoor temperatures and weather. Many rehabilitators accomplish this by moving a larger cage normally used indoors to an outdoor location for a few hours

daily over several days as the squirrel gradually acclimates to the temperature and weather, as well as becomes accustomed to sounds, odors, and activity of the outdoors.

12. Shelter and Bedding. Natural history of squirrels indicates the primary nesting and bedding areas usually contain soft materials, such as fresh green leaves, shredded dry grass, and moss. Opportunistically and while not optimal, some species also utilize human produced items such as cloth, rags, and home insulating material. The mother squirrel constructs the nest interior to remain dry, relatively clean, and parasite free. Similarly, squirrel cages used in rehabilitation also need to have a dry, clean, and parasite free nesting area where the animals can rest, sleep, and even hide. Instead of using leaves, rehabilitators most often use soft fabrics, such as knits, fleece, or flannels. Use of such cloths in a white or very light color helps to easily show signs of parasites, blood, soft stool, or diarrhea. Since squirrels often chew and shred most fabrics, it is important to monitor the bedding to ensure it does not have holes that can trap a head or leg. Avoid using terrycloth as bedding since the very small loops in the material can trap and injure toes. Avoiding fabrics that ravel easily or have loose thread reduces risk of injury or ingestion.

13. Water Sources. Natural history studies show young juvenile squirrels with eyes closed do not drink water. Depending on species, the molars erupt about 1 to 3 weeks after squirrels open the eyes (Casey and Casey 2003). When squirrels start chewing and eating solids, they also start drinking water and need access to a supplemental water source. Weaned and adult squirrels also need a water source.

Many rehabilitators hang a plastic or glass water bottle on the outside of a wire cage—especially for juvenile squirrels. The bottle is hung so the wire or metal nozzle of bottle is directed inside cage and positioned so the nozzle tip is about the height of a squirrel when standing relatively upright on its back legs. If the water bottle is too high or low, it is difficult for a squirrel to drink properly. A piece of 0.25 in (0.64 cm) hardware cloth placed between the water bottle and outside wall of cage prevents squirrels from reaching the plastic bottle and chewing a hole in it. Plastic water bottles are available at most retail pet supply stores and it is a good idea when purchasing to ask salesperson to let you fill the bottle with water,

attach top, invert, and check for leaks. Water bottles used on an outdoor cage should be monitored in cold weather for freezing. Remember the metal nozzle can be frozen solid even if water inside the bottle has not yet frozen or is only slushy. Squirrels that have used a water bottle adjust quickly to surface water sources in the wild upon release or a water bowl may be provided the last few days before release to accustom them to drinking from surface water.

Water bowls are another option. Bowls should be sturdy, stable with a broad base, and rather shallow, so less likely to tip over and spill water when bumped or jumped on by squirrels. Since injured adult squirrels are unfamiliar with a water bottle, use a water bowl in their cage. However water needs to be monitored closely to ensure it has not spilled and caused the squirrel to become wet and cold or has adequate liquid. Water in a bowl also may evaporate, especially in hot temperatures. Since it is more difficult to assess amount of water being consumed from a bowl, one needs to monitor an animal's hydration closely and initiate rehydration protocols if needed. Water in bowls may be contaminated by feces and food and is susceptible to insects. Regardless of type of water source, water always should be clean and accessible.

14. Ventilation. Squirrels need fresh air in the cages for breathing and general health. Good ventilation also helps moderate temperature, reduce accumulation of bacteria, and any odors that may otherwise be generated by the occupants. While good ventilation is necessary, rehabilitators may choose to partially cover a cage to reduce or protect from wind and drafts, rain and snow, excessive sunlight, or visual stressors.

15. Substrate of Cage. For small welded wire cages described in the accompanying plans, substrate of the cage is actually placed on top of the wire cage floor. The bottom of cage is lined with several layers of newspaper and then covered by a cut-to-fit piece of plastic artificial turf with the stiff jute backing, which drains quickly unlike other turf-type products with a solid rubber backing. The artificial turf prevents squirrels from getting to newspaper and shredding it, avoiding the accompanying mess, while still allowing urine or water to soak through to newspaper, keeping cage and occupants dry. Artificial turf cleans very easily after soaking in hot water and should be disinfected with a scent-free germicide or common household bleach diluted and used according

to standard cleaning protocols. After cleaning, rinse, hang to dry and aerate in sunlight for a day or two.

Other bedding such as cotton fabric free of any buttons, zippers, or holes, also can be used but these tend to produce a soiled and wet cage floor after a short time, requiring frequent changing and cage cleaning. Plus squirrels have free access to the cloth and will chew, shred, and rearrange, leaving areas of wire exposed on the cage floor.

16. Cleaning and Disinfecting. Most welded wire is galvanized and resists noticeable rusting or discoloring if kept dry. Washing wire with hot, soapy water and a stiff brush removes any dirt or debris, then sanitize cage with a disinfectant product, and air dry in direct sunlight. Frequency of cleaning is determined by size of the cage and number and health of occupants. Unless there are noticeable gastrointestinal issues present in the cage, the nesting area or nest box usually stays clean, except for solid, dry food such as rodent chow that may be taken inside for chewing and shredding. Use of a dry food product such as a good quality, full life cycle rodent chow, while avoiding fresh, wet foods such as fruit, helps maintain a clean and dry environment.

Healthy squirrels by nature are fastidiously clean animals. So while it is important to keep the cage clean, too frequent cleaning can introduce unnecessary stress. If the nest box is clean and free of odor, it does not need to be cleaned or disturbed. If the turf/newspaper method described above is used, these products do need to be changed and cleaned regularly, with frequency determined by age and number of cage occupants. If gastrointestinal issues develop, the cage likely becomes soiled with a noticeable odor and requires more frequent cleaning, as well as the need to address the gastrointestinal issue source.

17. State Regulations. While some states have specific regulations for rehabilitation cages, most do not get into the level of detail described in this paper. It is essential for cages to meet or exceed state specifications, or explain reasons for not doing so and obtain a written exception from the state agency that issues and oversees wildlife rehabilitation permits. These issues should be handled during the design phase of a caging project, so time and resources are not invested in cages that fail to meet regulatory requirements.

18. Cost. While rehabilitators would appreciate having unlimited funds for rehabilitation activities, that is rarely the case. Most rehabilitators are on strict budgets and have to leverage financial resources and use money wisely. So it is helpful to have an appropriate number of effective and safe cages that can be used in multiple ways and that are cost effective and relatively inexpensive to build and maintain.

Some cages used for other animals or purposes are donated to rehabilitators. While donated cages help the budget, many need to be modified or remodeled to be effective, safe, and meet the needs of squirrels in rehabilitation. A donated cage that does not meet the needs of squirrels and cannot be retrofitted to meet the design criteria described in this paper should not be used, even if the cage is free. Such cages may be donated for other species or purposes.

19. Repair and Remodel. There are times when even cages that have been constructed and used successfully for a number of seasons need repair or remodeling to incorporate new features, such as different sized doors. In addition, there are times when cages need to be repurposed. While this may be easy with small portable cages, it can be very challenging with larger cages whether used indoors or outdoors. Considering how a cage might later need to be modified or moved when in the design phase can make it easier when time to repair or remodel the cage or to move it to a new location.

20. Size and Stability vs. Moving the Cage. The more structurally sound a cage is constructed, the more likely it will last longer and not be subject to accidental disassembly or collapse. However, stability also can come with more cage weight. Simply moving a cage within the facility can become a real chore if it is excessively heavy. For small cages, use of a heavy gauge welded wire often provides necessary structural integrity to hold cage together and support weight and movement of occupants, without adding unnecessary weight. This decision is made by each rehabilitator, balancing structural integrity of the design with ease of cage movement.

WIRE CAGE BUILDING SUPPLIES

With the small cages included in this paper, there are three basic materials needed for construction. The first is the welded wire. The amount, size, and gauge of wire obviously depend upon the cage being built.

Local hardware and home improvement stores are generally the most economical source for wire, but make sure wire is straight and has a good galvanized finish. Otherwise, look elsewhere, such as wire suppliers listed at the end of this paper. Additionally required are J-clips for construction and spring locks to secure doors. These items often are available from local hardware, pet supply, and feed stores, but also may need to be ordered from the listed suppliers. As mentioned previously, these particular plans may be considered as indoor cages for juvenile or recovering injured adult squirrels, such as fox squirrels and eastern gray squirrels. These specific cage plans are *not* appropriate for free-standing, outdoor pre-release caging due to size, construction materials, wire mesh size, and security.

Tools Needed. There are basic tools needed for material preparation and final assembly of cages in this paper. Required tools include:

1. Measuring tape or ruler;
2. Set of wire cutters with sufficient strength to cut the gauge of welded wire being used;
3. J-clips and J-clip pliers (Figures 1, 2, and 3); and,
4. Flat metal file or grinding wheel that fits a hand-held electric power drill.

Plastic safety glasses, work gloves, and a set of standard pliers also are helpful. Though not required, if a number of cages are being built, the work is made much easier with the addition of a set of J-clip removal pliers (Figure 4) and an electric bench grinder.

Follow basic safety protocols. Wear gloves and sturdy shoes. Use eye protection. Work on a flat surface uncluttered by tools, wires, and supplies. If using electric tools, consider earplugs. While one person can construct most small squirrel cages, the process is often faster and easier when assisted by another person.

PLAN A: CAGE FOR JUVENILE SQUIRRELS

An example of a cage designed specifically for pre-weaned tree squirrels, except for pine squirrels follows. Overall dimensions of the cage are 36 in (3 ft, 0.9 m) length by 16 in (40.6 cm) depth by 16 in (40.6 cm) height (Figure 5). The cage weighs approximately 6 lb (2.7 kg). The cage has two doors, one at each end. The large door allows for an opening



Figure 1. A basic set of crimping pliers with a handful of metal J-clips.

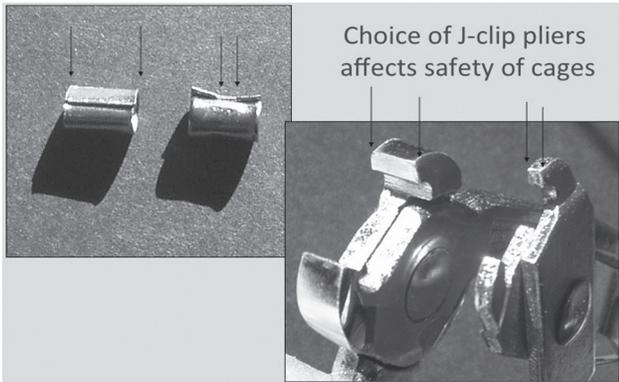


Figure 2. Crimping pliers with a wider set of teeth provide a more complete closure of J-clip to avoid sharp edges.

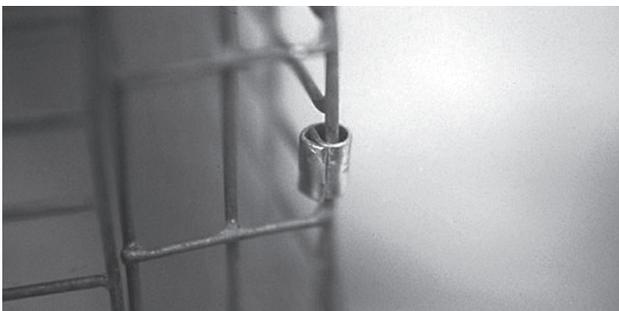


Figure 3. A J-clip that has been crimped around a piece of welded wire.



Figure 4. J-clip removal pliers easily remove a seated J-clip with a simple twist.

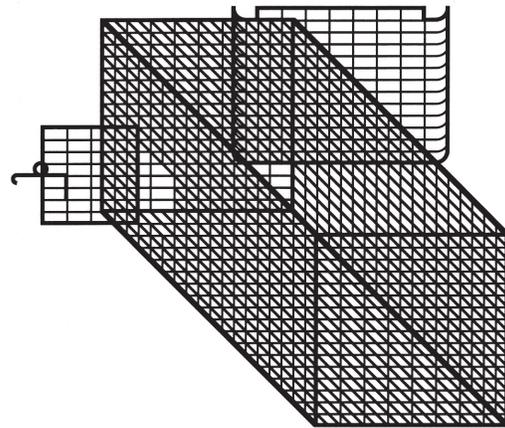


Figure 5. Plan A—Fully assembled cage.

big enough (12 x 16 in [30.5 x 40.6 cm]) to facilitate cleaning, as well as placement and removal of a nesting box or hammock and small tree limbs or other natural habitat material. The small door provides an easily controlled opening (6 x 6 in [15.2 x 15.2 cm]) to prevent escapes while taking out one squirrel at a time for feeding. The cage costs about \$20 to build and can be constructed in less than two hours when materials and tools are onsite.

Primary materials required are 1 x 2 in (2.5 x 5 cm) 14 ga galvanized welded wire 8 x 3 ft (2.4 x 0.9 m) and J-clips.

Figure 6 shows where to cut wire, including large and small openings for the doors. Be very careful with sharp edges of newly cut wire. Gloves and safety glasses are always recommended. Once all of the wire is cut, sharp edges should be filed down until smooth. This is a tedious job, but reduces future scratches on animals and rehabilitators.

When edges are smooth, fold the 64 in (1.6 m) piece of wire at 16 in (40.6 cm) intervals as shown by arrows in the cutting diagram. Try to get these folds as close to a 90° angle as possible. Then fasten the two ends together just below the small door opening with J-clips, as shown in Figure 7. Space the J-clips about every 5 to 6 in (12–15 cm) apart. Before assembly, bend the wire with your hands to 'square-off' all sides, removing any wavy areas. Next, attach the two end pieces with J-clips.

The last assembly steps involve attaching the two doors. The small door uses a spring lock to hold door closed. The lock attaches to the 8 by 8 in (20.3 x 20.3 cm) piece of wire with J-clips. Then, the door itself is attached to cage as shown in Figure 8, with

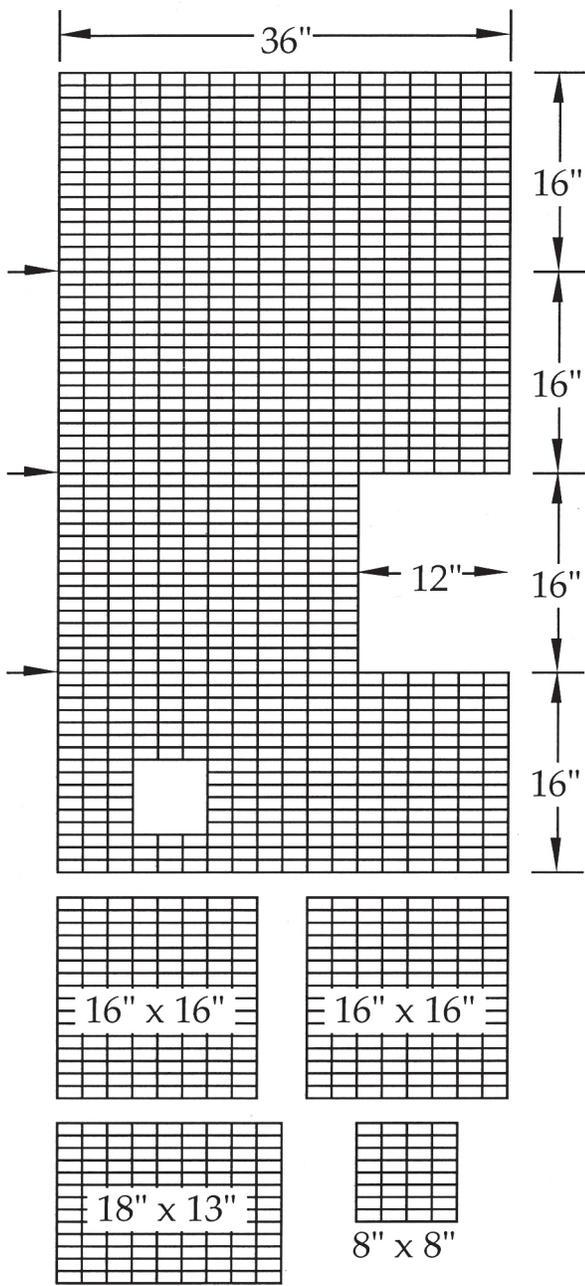


Figure 6. Plan A-Wire dimensions and cutting diagram.

J-clips serving as hinges. Use 4 to 5 J-clips for hinges. Once attached, the door should overlap the opening by 1 in on top and bottom, and by 2 in on side with the spring lock. The large door is made by taking the 13 x 18 in (33 x 45.7 cm) piece of wire and notching the upper corners (Figure 9). The upper edge and two side edges then are bent over in order to form a lip on the door, to prevent escapes when door is closed (Figure 9). Metal snaps or locks then are used to hold this large door firmly in place.

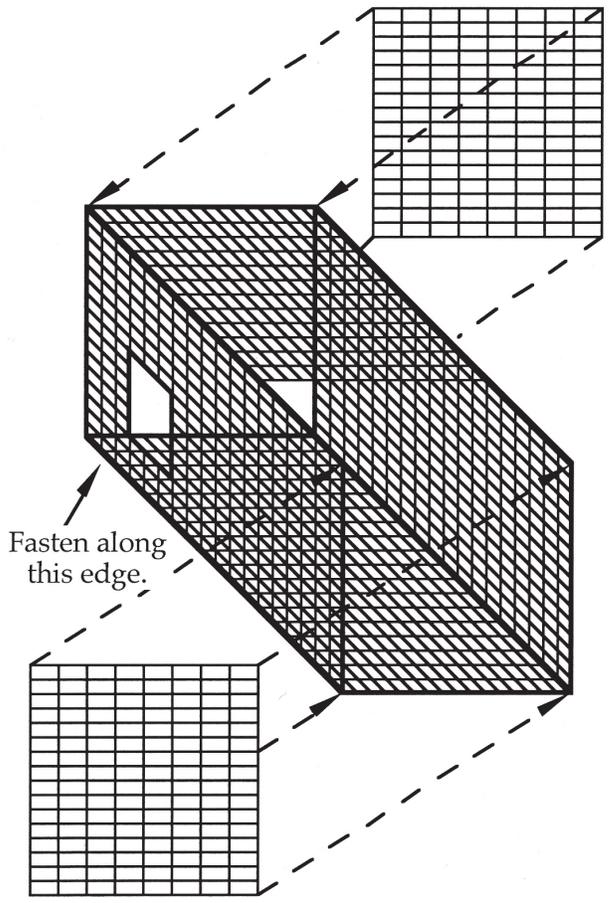


Figure 7. Plan A-Placement for attaching end pieces to main body of cage.

The bottom of cage can be lined with newspaper and covered by the cut-to-fit piece of artificial turf with the stiff jute backing since it drains quickly, unlike other turf-type products with a solid rubber backing.

For juvenile squirrels, a nesting box made from wood can be placed inside the cage, or a cloth hammock made from a T-shirt or flannel can be draped from top of cage, with the four corners of cloth tied to top of cage. Small branches can be added for chewing and to develop climbing skills. The cage easily can be totally or partially covered with a blanket or cloth bed sheet to provide a visual barrier to reduce stress. This is especially helpful if the cage is used for transport to a release site.

This cage is not recommended for unattended outdoor use, as the 1 x 2 in (2.5 x 5 cm) opening size wire does not prevent entry from certain predators. It is best used in an indoor facility or in a secured outdoor area, such as inside a pre-release cage or

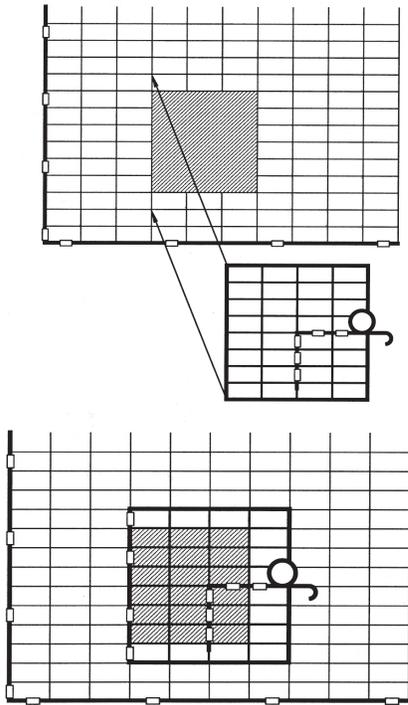
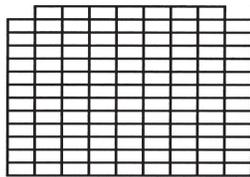


Figure 8. Plan A—Placement of spring lock on small feeding door and placement of door on cage.

A. Notch upper corners.



B. Side view.



C. Top view

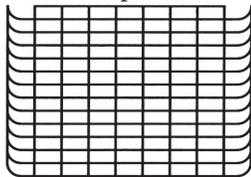


Figure 9. Plan A—Notching and wire bending diagram for large cage door.

screened porch.

The cage can be constructed with other size wire, such as 1" x 1", but loses overall structural strength if wire smaller than 14 ga is used. The 1/2" x 1" wire is acceptable for pine or large ground squirrels but not for

juvenile tree squirrels since this can injure feet and legs.

This cage is relatively quick and easy to build and should fit within most budgets. It is also an excellent way to learn how to use J-clips to build small mammal caging. A video tutorial demonstrating the cage construction process also is available at http://web.me.com/stratlink/CagePlan/Tools_%26_Materials.html.

PLAN B: CAGE FOR PRE-WEANED JUVENILE SQUIRRELS

The design and plans for this cage yield a small cage well-suited for small mammals such as pre-weaned squirrels. It is constructed with 1 x 2 in (2.5 x 5 cm) welded wire using J-clips as fasteners. It has two doors for ease of entry and access to the full cage, with the larger opening is on top of the cage. The smaller door is used to access the squirrel. Cost for this cage is approximately \$15, depending on price of the welded wire.

Start with a piece of 1" x 2" welded wire 36 in (3 ft, 0.9 m) wide and 56 in (1.4 m) long. Then cut the wire as shown in Figure 10. After cutting, file down sharp points of wire using a bench grinder, a hand held drill with a grinding wheel, or a hand held metal flat file. This helps prevent lacerations to humans as well as to the animals.

Next, take the two longer pieces and fold them in half to form a 90° angle as shown in Figure 11. Use the edge of a workbench or table as a guide to help support the wire when folding. Then attach these two bent pieces together with J-clips to form the four sides of the cage (Figure 12). Space J-clips approximately 4 to 5 in (10–13 cm) apart along the cage seam. Use J-clip pliers to ensure a secure and tight crimp on J-clips. This helps to prevent small claws from getting caught in the closed J-clip.

Once sides are together, attach the bottom of cage next (Figure 13). Start at one corner and attach one J-clip. Then go to the opposite diagonal corner and attach another J-clip. Finish the remaining corners. Once the bottom is "squared-up" with the sides, finish seams with J-clips, again with spacing of about every 4 to 5 in (10–13 cm).

The next step is to attach the stationary part of top. This piece of wire is cut to 12 x 20 in (30.5 x 50.8 cm). Fasten with J-clips according to Figure 14.

The last step is to attach the two doors. The top door piece is hinged with J-clips and has a lip to form a secure seal around the top door opening. To construct this lip, notch the two upper corners of

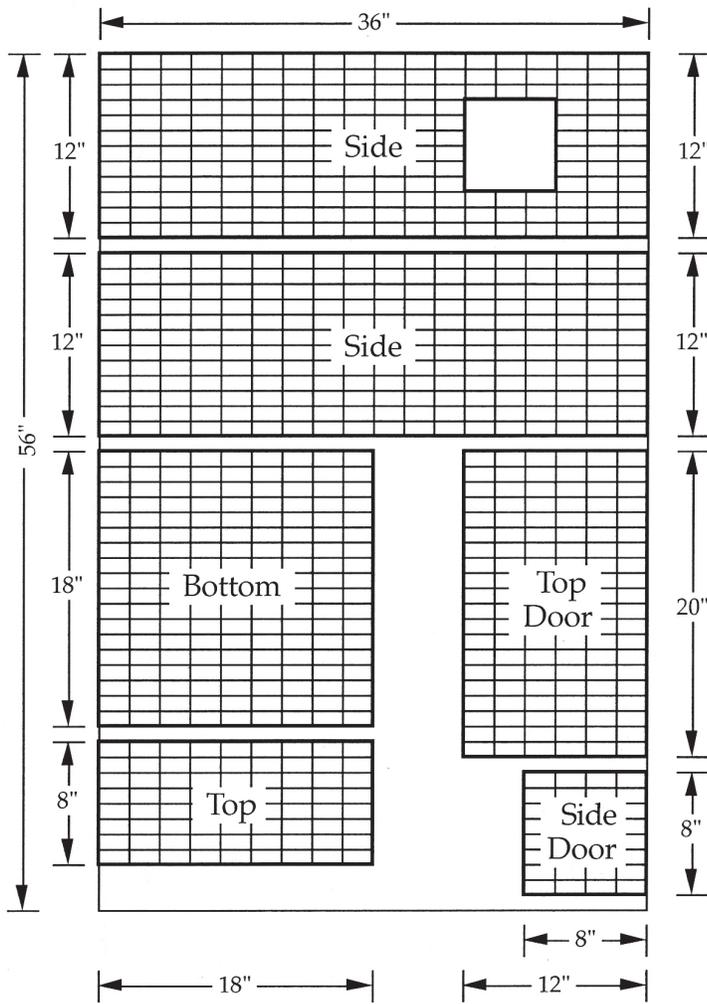


Figure 10. Plan B-Wire dimensions and cutting diagram.

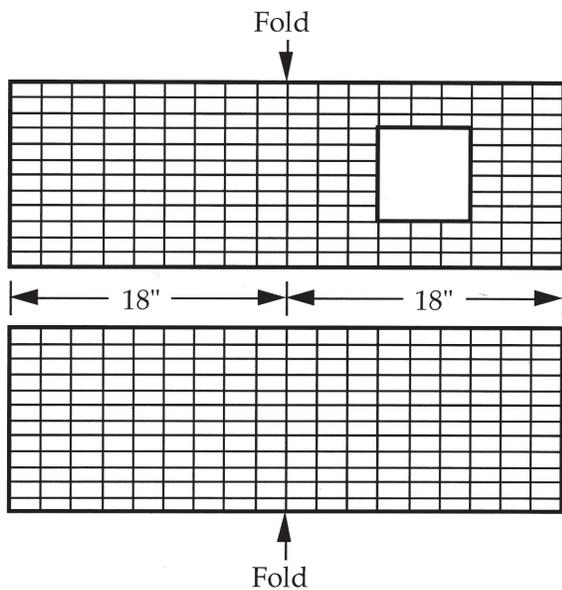


Figure 11. Plan B-Folding diagram for two main cage side pieces.

the door by removing the outer wire as shown in Figure 15 inset. Bend front of the top door and the two sides to form a rounded lip as shown (Figure 15). Once these three overlaps are formed, attach the door to top of cage with J-clips acting as hinges. The overhangs from the top door should form an escape-proof seal around the top of cage. This top door is held securely in place during use with 2 to 3 metal snaps or small bungee cords. The smaller side door is first fitted with the door clasp, generally available where J-clips are sold. This clasp is attached to the door with J-clips and door is attached to side of cage also using J-clips as hinges.

CAGE ACCESSORIES

In addition to using the cage as constructed, there are a number of cage 'accessories' that are very useful and help to properly outfit a cage prior to occupancy. For older juvenile squirrels that are recovered from injuries, a wooden nesting box that is easily and quickly opened can be placed inside the cage, or a cloth hammock made from a T-shirt or flannel can be hung down from the top of the cage, with the four corners of the cloth tied to the top of the cage. Consider using a pile of soft bedding, such as tee shirts, for squirrels that still have compromised health and need to be on supplemental heat and/or regularly examined, instead of using a nest box for these

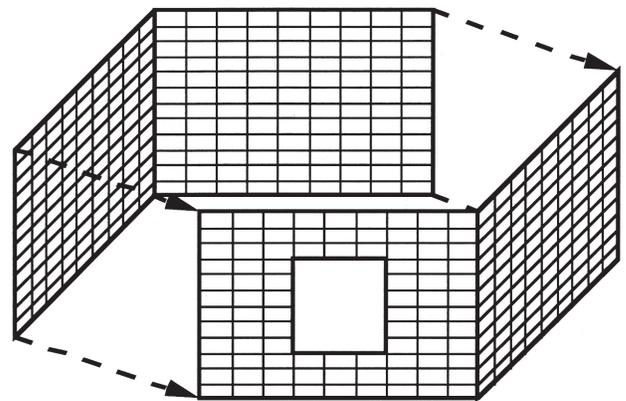


Figure 12. Plan B-Assembly of two cage side pieces to form main body of cage.

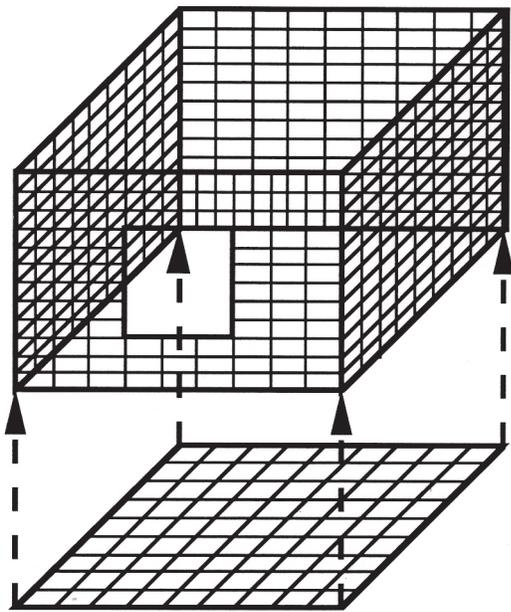


Figure 13. Plan B—Placement of bottom piece to main body of cage.

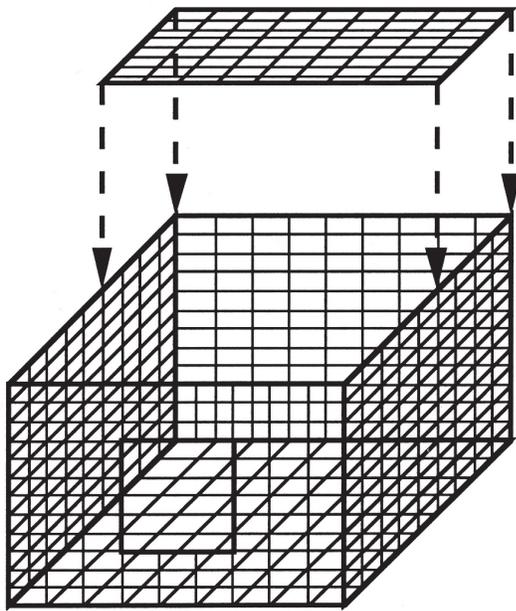


Figure 14. Plan B—Placement of stationary wire piece on top of cage.

animals.

Small branches can be added for chewing and to develop climbing skills. The cage easily can be covered totally or partially with a blanket or cloth bed sheet to provide a visual barrier to reduce stress. This is especially helpful if the cage is used for transport into a release site.

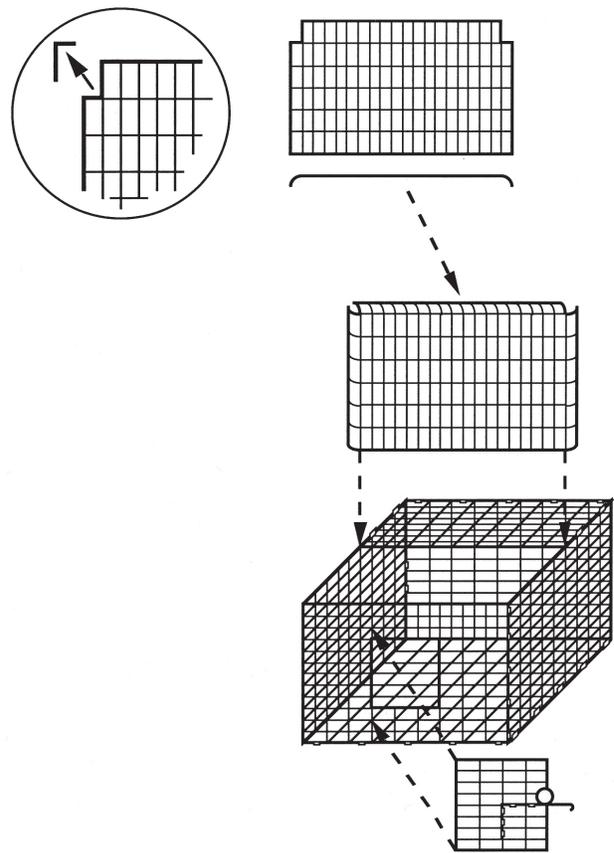


Figure 15. Plan B—Diagram for notching and wire bending for large cage door attached to top of cage and placement of small feeding door on side of cage.

CAGE SETUP

Once again, squirrel natural history offers tips on where cages should be placed. Squirrel survival is dependent on all of the senses, as well as their agility and speed. Squirrels are very sensitive to sounds, odors, and activities. Occupied squirrel cages should be kept in a place that is relatively quiet, free of strong odors, including cleaning agents, cigarette smoke, and very close distractions such as small children, pets, or livestock.

The cage should not be near animals that could be considered predators, whether domestic or wild mammals, birds, or snakes. The cages should be in an area separate from busy human activity or other distracting or potentially stressful activity. Keep the squirrels in areas away from people and possible predators to help reduce stress and the chance of habituation to these species.

Cages should be on a level surface and placed in such a way as to reduce risk of cage tipping or falling

over. As mentioned earlier, many predators approach a squirrel from above, so it is helpful to place the cage at a level where caregiver is not significantly higher.

While rehabilitators often focus on cages when they are in use, there are times of the year when at least some of the cages are empty. So it is helpful to consider the amount of space needed to store cages. Cages that can be easily stacked or nested in each other can help reduce the amount of storage space.

EVALUATING CAGES

The design criteria described above can be used easily as a starter checklist when evaluating any cage to be used for juvenile squirrels. The more the various design criteria fully can be met, the more likely the cage will be successful. This checklist can be used when designing a rehabilitator's basic set of cages. Additionally, it can be used to evaluate commercially available cages as well as any cages that may be donated or contributed by a member of the public or another rehabilitator. If a cage fails to meet a number of the criteria, the next consideration is retrofitting. If the cage can be retrofitted to better meet the criteria, then it may serve just as a useful cage. If criteria cannot be met, it is better to seek other cages than to compromise the health and well-being of both animals and caregiver.

CONCLUSION

While medical and diet considerations are appropriately the focus of many rehabilitators and rehabilitation publications, caging deserves similar attention to detail. As this paper discusses, effective caging is much more than simply trying to use a cage designed for other purposes. Thoughtful, informed, and thorough consideration of caging criteria, design, and use of newly constructed cages, as well as appropriate retrofitting of purchased or donated cages, can make a significant difference for the early, formative development and overall well-being of squirrels in rehabilitation, as well as provide safety for the squirrels and their caregivers.

SUPPLY SOURCES

Bass Equipment Co. P.O. Box 352, Monett, MO 65708 (800-798-0150). The heavy duty J-clip pliers provide a tight crimp (\$12). J-clips are about \$3 per pound and spring door locks are \$ 0.65 each. The J-clip remover pliers are \$20, but worth every penny for cage builders. <www.bassequipment.com>.

Da-Mar's Equipment Co. 14468 Industrial Parkway, South Beloit, IL 61080 (800-95BUNNY) No website. Excellent printed catalog of supplies, including J-clip pliers, J-clips, water bottles, other caging supplies, and an extensive selection of welded wire sizes, gauges, galvanized, either before or after welding, and even vinyl coated wire.

KW Cages. 9565 Pathway Street, Santee, CA 92071 (619-596-4000). They sell cages as well as welded wire mesh in a variety of sizes. <www.kwcages.com>.

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