

Release Criteria for Rehabilitated Wild Animals

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Abstract: The release of a rehabilitated wild animal carries with it the responsibilities of assuring the animal is physically and psychologically fit for release and is released at an appropriate time in an appropriate habitat.

INTRODUCTION

Upon release, the rehabilitated wild animal must be capable of much more than merely running, walking, or flying out of sight of the wildlife rehabilitator. It must be capable of recognizing, obtaining, and processing food; recognizing and evading or defending against predators; acquiring shelter; acquiring and defending territories; normal seasonal movements and dispersal; and, normal socialization with conspecifics.

This paper reviews the physical and psychological pre-release and release considerations that must be addressed for each patient in order to ensure successful and ethical releases. It is important to remember that the ultimate goal is the release of physically and psychologically fit animals in appropriate habitats at an appropriate time, not merely the release of an animal.

PHYSICAL CONSIDERATIONS

Recovery from Injury or Illness. While this subject would seem to be self-evident, there are three points to emphasize.

First, recovery, and consequently release, is delayed if primary and secondary problems are not discovered at the presentation of an animal or shortly thereafter, and appropriate action taken. Therefore,

go beyond the obvious when examining a patient. The use of basic diagnostic equipment and methods, such as radiographs, fecal analysis, and basic blood work, often are invaluable in making accurate diagnoses. The services of an experienced veterinarian should be sought for assistance with diagnosis, treatment, and necessary follow-up testing.

Second, recovery from injury or illness should not be assumed. Appropriate follow-up testing (blood, radiographs, etc.) should be performed whenever possible to quantify improvements in physical signs.

Third, watch for nosocomial (acquired in hospital) illnesses and injuries. Ideally, these should be prevented, but if they occur, they must be recognized and treated before release. Problems of this type often result from a failure to recognize illness (gapeworm, trichomoniasis, etc.) in one patient that later infects other in shared caging.

Functional Completeness/Handicaps. Despite the best care, it is common for some rehabilitated wildlife to be left with some sort of physical handicap due to the nature of their injuries. These handicaps can be minor or they can be serious enough to warrant euthanasia. A good working knowledge of the natural history of the species in question is essential to assess adequately the potential of release in a handicapped patient. Due to species-specific requirements, a handicap considered relatively minor for one species might be considered serious enough to prevent release for another species. For instance, an adult of a nonmigratory species that does not catch prey on the wing, such as a white-breasted nuthatch (*Sitta carolinensis*) with a slight flight deficiency, might still be releaseable, whereas a species that hunts on the wing or moves long distances, and therefore needs flawless flight capability, would be non-releaseable with the same handicap. An opossum (*Didelphis virginiana*) missing some toes on one front foot still might

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be releasable, while a badger (*Taxidea taxus*) with the same handicap may not be due to the problems it would have digging for prey and excavating burrows. Some specific guidelines regarding the release of handicapped animals of various species are in Specific Release Criteria section.

The ability of an individual animal to cope with a particular handicap should be tested whenever possible. Simple prerelease tests should be devised in order to observe how a handicap affects an individual. These tests should require a patient to demonstrate various abilities it will need to survive, such as locating, identifying and capturing prey (or foraging ability); processing food; identifying and avoiding/repelling predators; take-off and landing capabilities (birds, bats); maneuverability; preening/grooming capability; tree-climbing/descending ability; and, burrow excavation.

The potential for current handicaps to create new problems for an animal must be considered. For example, is a one-footed bird likely to develop bumblefoot or frostbite on the remaining foot? [*Editor's Note:* US Fish & Wildlife Service does not allow foot amputation in avian species.] The bottom line is the animal must have enough of the equipment and capabilities necessary to survive by means natural to its species if it is to be released.

Environmental Protection. A relatively thin layer of fur or feathers and fat reserves are all many animals have as protection from the potentially deadly effects of cold, wind, and water. The condition of this insulation layer at the time of release can be critical to an animal's survival. In cool or cold weather, birds and mammals lacking an intact layer (without missing patches) of feathers (contour feathers and down) or fur (under-fur and guard hairs) is not adequately insulated from the cold. For example, a fox treated for mange cannot be released in cold conditions until it has regrown a full coat of fur.

In all seasons, birds must have feathers that repel water. This is especially true for waterbirds, but applies to all other types of birds. It is useless to release a gull that has recovered from a fractured humerus if its feathers are not waterproof because it may drown or become hypothermic. Waterproofing can be checked easily by misting the bird with a fine spray of fresh water from a hand operated pump spray bottle. Larger species can be checked outside in warmer weather by misting lightly with a fine spray from a garden hose. When misting, allow the bird to stand or perch naturally and spray it from a distance comfortable for the bird. Swimming species can be checked by allowing

them to swim in a tub of clean water. Water beads-up on waterproof feathers. Feathers that are not waterproof become wet. Be sure to check the bird thoroughly since being only partly waterproof is not enough. Methods for maintaining or restoring waterproofing are described in the literature (Frink and Jones 1986; Holcomb 1985; Thorne 1986).

Pelagic birds (ocean birds such as albatrosses, alcid, and petrels) without a functioning salt gland may dehydrate rapidly and die when returned to seawater. Holcomb (1987) describes techniques for maintaining or restoring salt gland function and lists the birds that must be reacclimated (salted) to salt water prior to release.

Animals protected from the elements during rehabilitation need to be acclimated to current weather conditions prior to release. This is especially true for hand-raised orphans and winter released animals. In winter, patients can be acclimated by moving them from heated quarters to an insulated outbuilding during a period of relatively warmer weather. After several days and in relatively mild weather the patient is moved to outdoor caging for exercise and further acclimation. This housing must be equipped with shelter (windbreaks, shelter boxes, etc.) appropriate for the species. Patients that have been in rehabilitation only a short time (a few days to a week or two) and are otherwise releasable can be taken from the outbuilding for release during relatively warm weather without spending time in outdoor caging.

Releases should be done during periods of current and forecasted mild, precipitation-free weather. This reduces the amount of environmental stress the released animal confronts as it readjusts to life in the wild.

Timing of Release. Mammals that hibernate should not be released in the fall if they have received long-term care and the timing of release prevents them from having enough time to prepare a den site for hibernation or to accumulate adequate body fat. Late season, captive-raised orphaned mammals, such as raccoons (*Procyon lotor*) and opossums may need to be overwintered. Late fall and winter in the northern latitudes is an extremely difficult time for these animals to learn basic survival skills. Wild-born raccoons born in late summer and fall usually spend winter with their mother, benefiting from her experience.

In northern latitudes, late season orphaned birds and birds that missed their normal migration may need to be overwintered or be transported south into their normal winter range for release. For many species, harsh weather conditions and food scarcity in late

fall and winter result in unnecessarily difficult conditions for a captive-raised orphan's first exposure to life in the wild. Food availability en route and the ability to survive weather conditions are important considerations when contemplating the release of a migratory bird that is delayed past its normal migration period. State or local ornithological societies often are able to supply the normal migration period for birds in your area. Be sure to contact your state wildlife department and the US Fish & Wildlife Service for permission before transporting birds across state lines.

Do not be too quick to release overwintered animals just because the calendar says spring is approaching or the weather is beginning to moderate. For most species, late winter and early spring are times of relative food scarcity. Food is in short supply and it is too early for new food supplies to be produced.

Releases should be timed to the animal's primary period of daily activity in all seasons. For example, a raccoon is more comfortable when released late in the afternoon or at night, when it is normally active. The authors prefer to release captive-raised diurnal birds in the morning so they have an entire day to explore and become acquainted with the release area before nightfall.

Conditioning. The relative inactivity forced upon recuperating wild animals often results in their loss of physical fitness. They may be mildly to profoundly out of condition (lacking muscle tone, endurance) at the end of their convalescence and, thereby, unfit for immediate release.

Criteria for assessing the behavioral and physiological readiness for release of birds of prey are described in the literature (Chaplin et al 1989; Martell and Redig 1985). However, very little information is available regarding specific measurable physiological parameters of release readiness for most other types of rehabilitated wild animals. Therefore, it is necessary to employ more subjective indicators for release fitness, such as willingness and ability to run/fly/walk/climb, ability to gain altitude (birds, bats), exercise endurance, and normal range of motion of legs and wings.

If an animal's condition is inadequate for release, it needs to be offered a greater opportunity to exercise at will (larger, properly equipped caging) and/or be placed on a mandatory exercise program. The later may include creance flying (raptors) or careful, gentle hazing of an animal in an enclosure in order to stimulate proper exercise. Such exercise programs must start out very slowly, with the amount of exercise gradually increasing as the patient regains fitness. Specific procedures for conditioning birds of prey for release are

described in the literature (Crawford 1984; Lee 1984, Newbauer and Fitzpatrick 1988; Schulz and Horowitz 1982).

Release Site Selection. Release site selection can be a critically important factor in post-release survival, especially for hand-raised animals, nonmigratory species, and species that lack the mobility to disperse from an area after release (amphibians, reptiles, many mammals, and some birds). Releasing a patient on a site that provides its needs (food, cover/shelter, water, space, and security) contributes to the ultimate survival of that animal. Release on a site that does not meet these needs can subject an animal to needless hardship and lessen its chances of survival.

A potential release site needs to be evaluated to determine if its features fulfill the specific requirements of the species to be released. This evaluation demands that the rehabilitator have knowledge of the requirements of the species. This information is available from discussion with other professionals and from natural history and wildlife rehabilitation books, periodicals, and symposia proceedings. Ludwig (1982) provides a good bibliography of some of these resources. Haufler (1985) discusses the habitat evaluation procedures of the US Fish & Wildlife Service as a source of information for some species.

Taking an 'animal's eye view' can be helpful in evaluating a release site. "If I were a fox [or whatever], would I like to live here?" But a release site also should be viewed with the rehabilitator in the role of a well-informed human investigator, able to uncover facts about the site of which an animal could not possibly be aware, such as water quality, future land uses, hunting and trapping pressure, contemporary or anticipated disease problems in resident animals, and the potential for negative interaction with humans.

Release Techniques. The release technique used can affect post-release survival of rehabilitated wild animals significantly. This is especially true for hand-raised orphans. Release techniques can be grouped into three major categories: quick or hard release or relocation; slow or soft release; and, hacking release.

Relocation, quick, or hard release involves simply liberating an animal in appropriate habitat. Generally, post-release support, such as food or shelter, is not offered. This technique is most appropriate for animals admitted as adults, since they have developed survival skills.

Slow, gradual, or soft release involves releasing captive-raised animals into the location in which they were raised (provided it is located on suitable release

habitat). The door to the animal's pre-release cage is opened and the animal is free to come and go at will. Food, water, and shelter continue to be provided in the pre-release caging. The animal can return to the cage as it desires to make use of provisions while its survival skills improve. This technique may allow hand-raised animals to be released at an earlier age than if they were quick released or hacked (Evans and Evans 1985; McGinnis and Wendt 1987).

Hacking or hacking out animals involves providing food and/or shelter at a release site. The terms slow release and hacking sometimes are used interchangeably, but hacking more often is used to describe the release of animals into a site other than the location in which they were raised. Often, the animals to be released are housed and fed in appropriate caging at the release site for a number of days prior to release. This helps them become familiar with the sights and sounds of the release site and, it is hoped, consider it a home base, which can be returned to as needed for food and shelter. Stewart (1987) discusses the technique as used with captive-raised raptors.

The amount and frequency of feedings are reduced and eventually eliminated as the released animals hone their survival skills and, consequently, return less often to the hack or slow release site. Some of the authors cited in Specific Release Criteria section give guidelines for the duration of post-release feeding.

Age. Age alone is not adequate as an indicator of release readiness in a hand-raised animal. Suggested release ages found in the literature, such as release at 12 weeks of age, should be considered the average time at which hand-raised individuals of a species can be expected to have reached a stage of physical and psychological/behavioral development suitable for release. However, the abilities to recognize, procure, and process natural foods; recognize and avoid predators; socialize with conspecifics; acquire or construct shelter; and, develop other survival skills, is more important in determining fitness for release. The Specific Release Criteria section contains release criteria for various species and is a compilation of criteria reported in the literature by wildlife rehabilitators. Inclusion in this section should not be construed to mean this paper's authors completely agree with the information given or that the information should be accepted as absolute fact.

PSYCHOLOGICAL/BEHAVIORAL CONSIDERATIONS

Migratory Function. In a study of captive-raised common yellowthroats (*Geothlypis trichas*), Beaver (1985) concluded that a clear view of the night sky during the second month of life appeared to be crucial for the development of normal functional migratory orientation. This precaution was recommended for this and other night-migrating species until more data is available. A similar study of captive-raised indigo buntings (*Passerina cyanea*), also a night migrator, concluded that young birds deprived of experience with day and night skies oriented less well than birds previously exposed to these cues (O'Conner 1984).

Most small birds, including most passerines, are night migrators. Most waterfowl and shorebirds migrate both at night and during the day. Raptors, several woodpeckers, swallows, several corvids, bluebirds, and blackbirds migrate during daylight hours.

Imprinted and Tame Animals. Imprinting is a process that occurs during a restricted period early in life during which an animal develops its species identification (Beaver 1984). Imprinting is believed to be irreversible and restricted primarily to birds (ducks, geese, swans, raptors, and cranes). After inappropriate imprinting, an animal directs behaviors normally directed at its own species (courtship) at the class of subjects upon which it is imprinted. An improperly imprinted animal lacks proper species identification abilities and, therefore, is unable to properly socialize with conspecifics.

Taming is the socialization of an animal to humans as a response to habituation to positive stimuli, such as food. Tame animals usually direct species-specific behaviors at conspecifics if available. In rare cases, reversal may be achieved over time by eliminating the animal's exposure to human associated positive stimuli and allowing for socialization with conspecifics. Both tame and human imprinted animals are unsuitable for release because of the potential danger to humans (Beaver 1985; McKeever 1987; Moore 1988). After release, tame animals may seek the socialization or comforts to which they are accustomed to receiving from humans, or the lack of fear of humans may bring them into unusually close contact with people. The person approached is likely to misinterpret the animal's advances as due to an illness, such as rabies, and/or perceive it as a danger and may kill it or injure it in an attempt to drive it away. Game species may become easy prey for hunters or trappers. At sexual maturity, a bird imprinted on a human image may seek a human with which to mate. This can be

extremely dangerous for both parties if the bird happens to be a large raptor! Human imprinted or tame animals also may attempt to clear 'rivals' from the area around the person perceived to be its mate (McKeever 1987). Serious human injury may result from these attacks. These aggressive behaviors typically result in the animal being shot or trapped.

Exposure to conspecifics (visual and auditory) during the critical imprinting period can assure a normal imprinting experience. A substitute conspecific may include a foster parent(s) of the same or very similar species, an adult of the same species housed separately but visible to the imprintee (McKeever 1987), a hand puppet fashioned to look like an adult of the species, or a mounted bird skin made from an adult conspecific (Beaver et al 1986). Minimal human exposure helps prevent accidental imprinting on/habituation to humans.

Taming can be avoided by minimizing human contact, especially human-associated positive stimuli such as food. McGinnis and Wendt (1987) describe techniques for avoiding taming in orphaned white-tailed deer (*Odocoileus virginianus*). These general principles may be applicable to other species.

Food Recognition–Hunting/Foraging Skills.

Captive-raised animals should be introduced to a variety of the food types they will consume after release. Most of the authors listed in Specific Release Criteria section cite this as being important. This prior experience helps an animal recognize natural foods and simplifies the post-release transition to an all-natural foods diet. It also may prevent digestive upset, which can occur with a sudden drastic dietary change. To ensure nutritional completeness, Evans and Evans (1985) maintain captive-raised raccoons on commercial feed and supplement this with natural foods (up to 10% of the diet) one week prior to slow release. Martin et al (1951) is a valuable source of information on the dietary habits of many North American species in the wild.

Since bowls of dog food or mealworms are few and far between in the wild, captive-raised animals should be required to locate and process foods in a manner as close as possible to what will be required of them in the wild. For example, food can be hidden under stones or in logs to stimulate foraging behavior in raccoons; earthworms and insects can be offered on turf or in a shallow pan of soil for robins (*Turdus migratorius*); earthworms in a pan of soil also can be offered to woodcock (*Scolopax minor*); and, branches with berries can be offered to cedar waxwings (*Bombycilla cedrorum*).

While these exercises would seem to teach valuable lessons, they cannot simulate fully life in the wild. Therefore, release of gregarious birds such as chimney swifts (*Chaetura pelagica*) or cedar waxwings into a resident flock of conspecifics may help the hand-raised birds develop their food recognition and acquisition skills. For others, slow release or hacking can provide important support as they hone their foraging skills.

Predators must develop hunting skills before release. Due to the complex nature of prey recognition, pursuit, capture, dispatch, and processing, a predator released without thorough experience with these skills is likely to starve before they are learned. Releasing a captive-raised animal into an appropriate habitat where suitable food/prey can be found is likely to contribute to the survival of the animal. Carpenter (1984) states that young bald eagles (*Haliaeetus leucocephalus*) with little or no hunting experience require extensive training before release. Crawford (1984) mentions that other raptors may learn hunting skills by being housed with older, more experienced birds. McKeever (1987) recommends at least four weeks pre-release training with live prey for owls. The last two weeks, brown mice are used as these most closely resemble the bird's natural prey. Mammalian predators also must be given the opportunity to recognize and kill live prey. Knowledge of a species' natural prey and the techniques normally used in capturing it are essential in designing hunting exercises for captive-raised predators.

Predator Recognition and Avoidance. Little research has been done regarding the ontogeny (development) of predator recognition and avoidance in North American wild animals. Beaver (1985) demonstrated a significant intergroup difference in the development of antipredator behavior in American robins and mallards (*Anas platyrhynchos*) raised in view of a red fox (*Vulpes vulpes*) compared to those raised without view of the fox. Birds raised in view of the fox showed an appropriate antipredator response less often, suggesting that it is unwise to raise orphaned wild birds in sight of potential mammalian predators. Until more research is done, common sense dictates that young should not be raised within sight, sound, or smell of potential predators, including domestic cats and dogs. Under no circumstances should an orphaned wild animal being raised for release be allowed to play with or share close quarters with a dog or cat.

SPECIFIC RELEASE CRITERIA FOR SELECTED NORTH AMERICAN WILDLIFE

Legend for abbreviations used in the following text:

HR = Hand-raised young

PCV = Packed cell volume

TP = Total protein

g/dl = grams per deciliter

Opossum (*Didelphis virginiana*). HR: Five months old; body length 7 to 10 in excluding tail; \geq two weeks pre-release in exercise cage. Should bare teeth and try to escape from humans. Acclimatize. Release site isolated, year-round open water. Release at dusk (Nave and Lacy 1983).

HR: Length excluding tail >12 in; well fed pre-release; acclimate to natural foods ≥ 10 days pre-release in outdoor cage. Release in forecasted good weather. Do not release near human habitation or roads. Provide temporary shelter and a food supply at release site (Adams and Johnson 1987).

Raccoon (*Procyon lotor*). HR: Release at five to seven months in small compatible groups; leave one-week supply of food (Lerman 1982).

HR: Familiarize with natural foods; wary of humans; difficult to catch for release. Ideally release two to three miles (3–5 km) from nearest road or human habitation with three days of good weather forecast. Leave dry dog food at release site in an A-frame shelter to keep it dry (Adams and Johnson 1987).

Adult and HR: Quick release least desirable release method; slow release or hacking preferred; minimum age for release 12 to 14 weeks. Introduce to natural foods (10% of diet) shortly before start of slow release program. Do not relocate near homes or farms. Release area should be close to water source, have variety of foods, area for daytime sleeping, and shelter. HR need access to large cage with branches and wading pool from weaning to release (Evans and Evans 1985).

Release area: food available in all seasons; mature deciduous woods near clean water source; available denning/sheltering sites; corridors to allow for dispersal from site if needed; assess numbers of resident conspecifics to prevent overpopulation; do not release near dumps, game farms, hunting or trapping areas, waterfowl or threatened or endangered wildlife breeding areas, roadways. Use areas with little human habitation and development. Slow release or hacking desirable for hand-raised animals (Stokhaug 1988).

River Otter (*Lutra canadensis*). HR: Allow for development of hunting skills by taking on outings in future release area after 22-weeks-old, or raise in large enclosure with minimal human contact following weaning. Padded traps connected to noise horns can provide aversion training. No positive contact with dogs; \geq two months water training pre-release. Select release area with great care; need large territory; not close to busy roads or areas that allow hunting or trapping; ideally, private nature preserve of several thousand acres with large lake or plenty of ponds and good food supply; \geq eight months old; slow release works well (Cain–Stage 1990).

Striped Skunk (*Mephitis mephitis*). HR: Housed outdoors and eats natural foods >10 days pre-release; well fed pre-release; release when \geq three days of good weather forecast (Adams and Johnson 1987).

Badger (*Taxidea taxus*). HR: Three-quarters grown; east mostly natural foods, catches live prey. Release away from people, farms, dogs, release when \geq three days of good weather forecast. Leave food in A-frame shelter to keep it dry at release site (Adams and Johnson 1987).

Gray Fox (*Urocyon cinereoargenteus*); **Red Fox** (*Vulpes vulpes*). HR: three to four months old; hunting live food consistently; slow release. Usually independent two to four weeks post-release; leave food until animal does not return for two weeks. Do not release near humans, roads, dogs, or hunting and trapping areas (Adams and Johnson 1987).

Woodchuck (*Marmota monax*). HR: two and a half months old; outside and eating natural foods ≥ 10 days pre-release; well fed pre-release; release away from human habitations and roads; \geq three days of good weather forecast (Adams and Johnson 1987).

Squirrels (*Spermophilus*, *Citellus*, *Sciurus*, *Tamiasciurus*, *Glaucomys Species*). HR: Pre-release exercise/climbing; acclimatization in large cage. Slow release if possible. If not possible, squirrels being fed natural foods diet can be released with food supply on good habitat with resident squirrel population. Generally, should be fully released by age 12 weeks (Adams and Johnson 1987).

Eastern Gray Squirrel (*Sciurus carolinensis*); **Fox Squirrel** (*Sciurus niger*). HR: Coat sleek and well-developed, tail thick and bushy; well-developed tail is necessary. In large outdoor cage with branches

two, preferably four weeks, pre-release. Ideally, provide backup food at release site for 4 to 5 days post-release and provide nest boxes ≥ 10 ft high in trees on site. Conspecifics should be present in area, but not too many. Release outside metropolitan areas (Hanes 1988).

Fox Squirrel (*Sciurus niger*). Adult and HR: Species territorial, resident conspecifics may chase newly introduced squirrels. Consider seasonal food supply, water, proximity to crops, which could result in animal being trapped, shot, or poisoned. Do not release into areas where western gray squirrel (*S. griseus*) resides and fox squirrels are absent. HR: Fully acclimated; eating natural foods, able to crack whole walnut; shy of people. Adequate pre-release exercise. Release at weight >350 g; normal PCV 40 percent, TP 5.0g/dl. Release during day (Stone and Fender 1985).

Northern Flying Squirrel (*Glaucomys sabrinus*); **Southern Flying Squirrel** (*Glaucomys volans*). HR: Release at 12 to 14 weeks; weight >60 g; familiar with native foods. Release at dusk from nest box placed ≥ 10 ft in tree. Desirable to leave food post-release (Wasserman 1988).

Beaver (*Castor canadensis*). HR: Acclimatize. Release prior to cold weather near streams or river systems with supply of trees, vegetation; at dusk, in vicinity of, but not directly by beaver colony (Marcum 1982).

Muskrat (*Ondatra zibethicus*). HR: By five weeks eating total natural diet, swimming. One week in outdoor cage, eating well pre-release; should be well fed pre-release. Slow release, in evening with \geq three days good weather forecast. Release site: Consider number of conspecifics in area, possible trapping activity, motorboat activity, water depth, availability of feeding and nesting sites (Adams and Johnson 1987).

Deer mouse (*Peromyscus maniculatus*). HR: Fully furred; "half-grown;" eating seeds and other natural foods. Release in thick grasses and shrubs where there is food and shelter. Leave small pile of seeds and nuts at release site (Adams and Johnson 1987).

Black-tailed Jackrabbit/Hare (*Lepus californicus*). HR: Acclimated; recognize and eat natural foods; should have ample opportunity for exercise pre-release; minimal pre-release human handling (Fender and Stone 1984).

Cottontail Rabbit (*Sylvilagus floridanus*). HR: Weaned; recognize and eat natural food items; four to seven weeks old; weight 100 to 200 g. Should shun human contact. Acclimatize to outdoors for \geq one week pre-release. Release in early evening in warm, clear weather; food such as rabbit pellets can be left at release site (Hiss 1988).

HR: Approximately three to five weeks old, do not retain longer than five weeks. Acclimatized. Release away from humans, dogs, cats. Probably will not return to release site (Adams and Johnson 1987).

White-tailed Deer (*Odocoileus virginianus*). HR: Slow release from pen situated on appropriate deer habitat. Fawns are conditioned pre-release to respond to nonhuman associated bottle-feeding signal; release pre-weaning when have reached maximum bottle-feeding volume of 24 oz (720 ml) three times per day. Fawns return to pen for feeding in response to bottle-feeding signal (McGinnis and Wendt 1987).

HR: Raised without associating with humans for food. Minimal exposure to humans pre-release. Weaned; familiarized with native foods. Release in area of extensive good habitat, few humans (Forness 1984).

HR: Minimal human contact while raising. Release after weaning, no later than three and a half to four months old if healthy. Slow release if possible away from people, especially farms, roads, and hunters. (Adams and Johnson 1987).

Moose (*Alces alces*). HR: Release of HR orphans not recommended due to difficulty in avoiding socialization with humans and resulting potentially dangerous post-release interaction with humans (Moore 1988).

Nine-banded Armadillo (*Dasybus novemcinctus*). HR: Acclimatize. Release at dusk; avoid marshy areas (Marcum 1983).

Reptile. Adult and HR: Return to original capture site (within 8 km). Proper release sites are needed because reptiles have a lower dispersal rate than most vertebrates, thus limited gene pools. Release \geq two weeks prior to normal hibernation date. Young born to recovering adult should be released immediately at the parental site (Moriarty 1985).

Reptile and Amphibian. Adult and HR: Upon presentation, immediately release healthy animals at original collection site; consider the continued possible presence of threats. Immediately release

neonates (except crocodylians) at parental collection site. Maintain natural diets in captivity. Allow sufficient time to re-acclimate prior to hibernation time. Acclimatize outside a few days pre-release. Release when weather is forecast to be stable (Heinrich 1987).

Hérons, Cranes, and Bitterns. HR: Fly well. Release when fuzz has begun disappearing from head. Condition in outdoor cage \geq two to three weeks pre-release. Slow release/hack out. Stop feeding when food is untouched for four to five days (Adams and Johnson 1987).

Wood Duck (*Aix sponsa*). HR: Recommended soft release in which birds are held for several months in a semi-wild situation before release (Pichner 1985).

HR: 70 to 75 days old. Raise with access to swimming facilities, consequently waterproof. Quick release; pond with marshy area, adequate low vegetation on banks, surrounded by good wooded area is ideal (Carson 1990).

Black-necked Stilt (*Himantopus mexicanus*). HR: Acclimatize; normal flight capability; waterproof. Release in AM, day with little wind, near other stilts. In flight caging a few days pre-release. Acclimatize to saltwater if released near saltwater habitat. Study noted release weights of 131 to 167 g; average 149 g (Johnson 1986).

Precocial Birds (Waterfowl, Shorebirds, Gallinaceous Birds). HR: In outdoor flight caging \geq two weeks pre-release. Fully feathered; flying; eating natural foods; waterproof. Release in appropriate habitat (Adams and Johnson 1987).

Killdeer (*Charadrius vociferous*). HR: Basic flight skills. HR and adult: Waterproof; release during day; weight 60 g if fledgling (5 weeks), >75 g if adult. Release where food and water occur; be aware of migration in or out of release area (White 1983).

Raptors. Adult and HR: Fully functional appendages; good visual capability; good athletic ability; appropriate social conditioning; knowledge of survival skills. PCV 40 to 50 percent; plasma protein 3.4 to 4.5 g/dl; total white cell count <12,000 cells/mm³. Effects of missing digits (D) on releasability: unilateral loss of DII, DIII, or DIV = good release candidate; unilateral loss of DIII and DIV or unilateral loss of hallux (DI) = marginal release candidate; unilateral loss of hallux and DII or bilateral loss of hallux = nonreleaseable (Martell and Redig 1985).

HR: Killing prey \geq one week pre-release. House in outdoor aviary pre-release. Hack out; not in urban or suburban areas. Keep feeding until birds do not return for two weeks. release hatching year birds in July or August (Adams and Johnson 1987).

HR and adult: Conditions rendering a raptor nonreleaseable until resolved: for a male, <80 percent of normal vision; for a female, <60 percent normal vision; for a male, < full use of first and second digits (D) of both feet, and some use of DIII and DIV; for female < full use of DI and DII of both feet; inability to stretch both wings to full extension and fold to near normal flexed position; inability to fly directly upwards from ground to overhead perch—female snowy owl (*Nyctea scandiaca*) is possible exception due to heavy wing loading. Unable to maintain flight or other activity involving both wings \geq two minutes without signs of respiratory distress; especially in owls, hearing loss or impairment that results in inability to accurately strike unseen prey by hearing alone; questionable social orientation (McKeever 1987).

American Kestrel (*Falco sparverius*). HR: have basic flight skills; good physical flying condition, ability to sustain extended flights; waterproof; pre-release opportunities to kill live prey. Release during day. Male should weigh 105+ g; female 120+ g (White 1983).

Common Barn Owl (*Tyto alba*). HR: Housed in flight caging pre-release. Release away from highways, at end of day or in evening; plentiful prey rodents and some conspecifics in release area. Body weight >400 g; occasional lighter birds should be well-fleshed. PCV >40 percent, prefer about 45 percent; TP >2.5; preferably 3.0 to 4.0 g/dl (White 1984).

HR: Consistent proficiency at catching, killing, and eating live mice; total independence from humans; perfect flying ability (Lyons 1982).

HR: Four weeks pre-release in flight caging. Trained to kill live prey (mice). Release from nest-box type hack station. Mice are left at entrance of hack box each night until no longer eaten (Schulz 1986).

Mourning Dove (*Zenaidura macroura*). HR: Fully acclimated; one to two weeks in outside aviary pre-release. Self-feeding; good weight (>90 g); fly well; PVC \geq 45 percent. Few or no broken primaries or retrices; waterproof. Release in area frequented by conspecifics, early in day during period of sustained good weather. If possible, release in pairs if cannot release into flock (Brain 1985).

Chimney Swift (*Chaetura pelagica*). HR: Pre-release exercise in flight cage. Should be able to maneuver, turn sharply, hover; should act restless. While at rest, wings should cross at least 25 mm (~1 in). Wing chord approximately 127 mm (5 in). Release in AM in calm weather into flying group of swifts \geq two weeks prior to normal migration time. Toss into air as other swifts fly overhead, or place above damper in chimney where other swifts are living. Check periodically to make sure they are not in distress and have exited the chimney. If released where raised, some birds may return for a few days post-release (Kyle and Kyle 1986).

HR: Fully feathered; flying well on own. Release from cage. May return for one to two weeks; hand feed until no longer return (Adams and Johnson 1987).

Anna's Hummingbird (*Calypte anna*). HR: Usually ready for release at seven weeks. Have good flight skills, hover effortlessly. Can be trained to artificial feeder and shown location of same pre-release. HR and adult: Waterproof. Release during day. Do not release if half or more of 10th primary is missing, or as little as one-third missing if 9th primary is broken as well; if so, retain until primaries are molted (Prill 1985).

Belted Kingfisher (*Ceryle alcyon*). HR: Fully feathered; self-feeding; proficient fisher from pool in flight cage. Pre-release condition in flight cage. Ability to fly full speed, land on perch without slowing down, stop in mid-flight to change direction, hover for extended period. Waterproofing is critical. Behaviorally: Should raise crest, bob head and/or tail, and call in moments of danger (human presence) (Torsey 1989).

HR: Pre-release housing in flight caging. Should be catching live fish. Release in area where originally found or from pre-release housing if in appropriate location (Adams and Johnson 1987).

Woodpeckers (*Picidea family*). Adult and HR: Basic flight skills; ability to maintain short to medium ranged flights at ambient temperature without panting. Waterproof. Release during day in habitat with ample supplies of insects and utilized tree types. HR: Minimal human contact in outdoor flight caging pre-release, usually 7 to 10 days. All should have body weight above minimum for species in *Body Weights of 686 Species of North American Birds*, Monograph 1 by John B. Dunning, Jr. (1984) (Nave and Stone 1984).

Altricial Birds. HR: Outdoors in release/flight cage one to two weeks pre-release. Flying well; self-feeding; have adult feathers. Slow release/hack out; fresh food in or on top of cage daily. Feed until birds have not returned for five to seven days. Release during three to four day period of forecasted good weather (Adams and Johnson 1987).

Carolina Wren (*Thryothorus ludovicianus*) and **Bewick's Wren** (*Thryomanes bewickii*). HR: Self-feeding; release at seven to eight weeks old. Carolina: Weight 15 g; wing chord 55 mm (2.2 in). Bewick's: Weight 11 g; wing chord 50 mm (2 in). Release where conspecifics reside but population density is low. Supply food approximately two weeks post-release (Kyle and Kyle 1986).

American Robin (*Turdus Migratorius*). HR: \geq five weeks old; self-feeding on variety of foods; feathers in good condition; sustain short to medium range flights without panting; waterproof; weight \geq 70 g; PVC 40 to 45 percent; TP 3.0 g/dl. Fearful of humans and pets. \geq seven days pre-release in outdoor flight cage. Release early in day during forecasted good weather; conspecifics on release site (Johnson 1986).

Northern Mockingbird (*Mimus polyglottos*). HR: Body weight $>$ 42 g; waterproof; basic flight skills; ability to maintain short to medium range flights at average ambient temperatures without panting. Does not approach people; release during day in area with ample fruit, insects, and water (Richter and Stone 1984).

American Goldfinch (*Carduelis tristis*), **Lesser Goldfinch** (*Carduelis psaltria*), and **Lawrence's Goldfinch** (*Carduelis lawrencei*). HR: Approximately eight weeks old; feathers in good condition; acclimatized to outside conditions; completely self-feeding, recognize natural foods; ample fat reserves; body weight 9 to 10 g. Several weeks pre-release in flight cage; at least one week pre-release in outdoor enclosure. Release midmorning in area frequented by other goldfinches (Stone and Granados 1985).

House Finch (*Carpodacus mexicanus*). HR: three weeks old; self-feeding; clean, waterproof feathers; weight \geq 18 g; PVC 45 to 50 percent; TP 2.5 to 4.9 g/dl. Acclimatized to outdoor flight cage 7 to 10 days pre-release (Shaw 1989).


CONCLUSION

Pre-release conditioning and training, release area selection, and timing of release are as important as proper medical management of injuries and illnesses to the long-term survival of rehabilitated wild animals after release. Further research regarding the ontogeny of predator recognition, food recognition, communication skills, and the efficacy of pre-release training regimens in increasing post-release survival and quality of life will help wildlife rehabilitators improve pre-release training and conditioning. This will lead to the betterment of animals entrusted to our care.

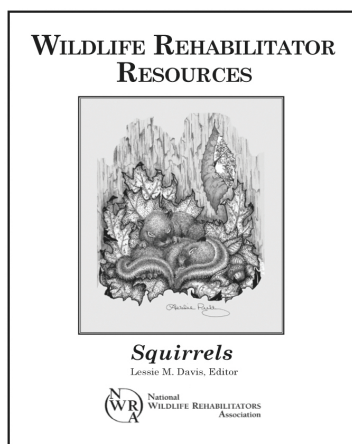
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