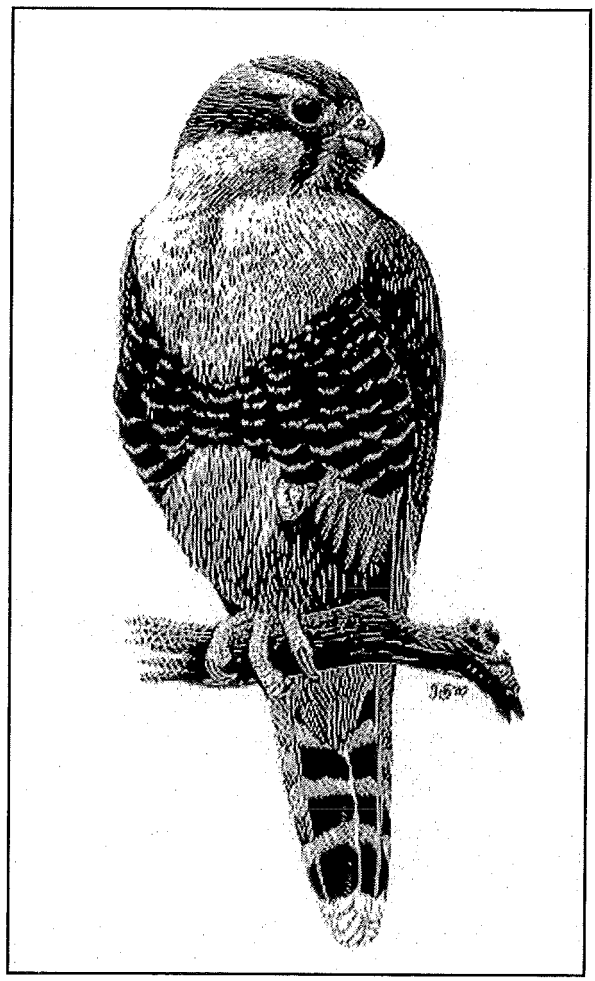
The Northern Aplomado Falcon: Biology, Restoration, and Hacking Procedures



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The Peregrine Fund
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ABSTRACT

At the beginning of the twentieth century the Northern Aplomado Falcon (*Falco femoralis septentrionalis*) was a common resident of the grasslands of southwestern North America, but by 1930 the falcon was mostly absent from all areas north of Mexico. [Causes unknown] Between 1978 and 1988 a total of 25 Aplomado Falcons were collected from nests in southern Mexico to establish a captive breeding program. A species restoration pilot project was accomplished between 1985 and 1989 and restoration on a larger scale began in 1993. Hacking procedures developed for Peregrine Falcon reintroduction were modified and utilized for the release of Aplomado Falcons. Although the captive propagation of this species has been challenging, 1,103 Aplomado Falcons have been produced and 1,004 released into Texas by the "hacking method." During the spring of 2004, 39 wild pairs of Aplomado Falcons were located in South Texas, 54 young fledged from 32 nests. Captive propagation and reintroduction by hacking large numbers of young are important management tools for the restoration of this and other endangered species. This species-specific Aplomado Falcon hacking manual is intended to provide project information and guidelines that will help guide Aplomado Falcon hack site attendants. An introduction to the natural history of this species and notes on the evolution of Aplomado Falcon restoration, and hacking procedures are included.

INTRODUCTION

Birds of prey are particularly sensitive to changes in both the quantity and quality of their habitats and as such are natural indicators of environmental change. Current ecological research also suggests that specialized predators existing at relatively low densities may play a role in maintaining the overall stability of their ecosystem (Greene 1988).

The Northern Aplomado Falcon once was widespread throughout the grasslands of the southwestern United States and Mexico. Fairly common at the beginning of the twentieth century, the species had all but disappeared from the United States' portion of its range by 1930 (Hector 1981).

Capturing insects and small-to-medium sized birds in fast chases, the beautiful Aplomado Falcon was formerly a fairly common species throughout the humid coastal savannas of Texas and Tamaulipas and the more xeric interior grasslands of the southwestern United States and adjacent northern Mexico. In southern Texas their population status was documented by more than 125 egg sets collected by Frank Armstrong between 1888 and 1915 (Hector 1981). However, like the Attwater's Prairie-Chicken (*Tympanuchus cupido*), the Aplomado Falcon was closely associated with the shrinking coastal savannas and began to disappear by the second decade of the twentieth century. The last known breeding of the Aplomado Falcon in the United States occurred near Deming, New Mexico in 1952. Today this falcon has become so rare that other than released falcons, only a few sightings are recorded each year in spite of the fact that it is one of the most sought after birds by American birdwatchers (Sandfort, 1994).

There remains some debate concerning the exact cause of the decline of the Aplomado Falcon throughout the southwestern United States and northern Mexico. Hypotheses implicating

habitat loss, pesticide use, climatic change, egg and skin collecting, disease, and others have been postulated. We may never understand the complex chain of events that lead to the virtual extirpation of this species throughout the northernmost portion of its range (Sandfort, 1994).

Unquestionably, the grassland savannas of the southwestern United States clearly underwent a tremendous physical change concurrent with the decline of the Aplomado Falcon. The humid grasslands of coastal Texas and Tamaulipas were once known as the "Wild Horse Prairie" and were maintained by naturally occurring range fires. By World War II much of the prairie had been tilled into crop land, and, with the control of range fires, what prairie remained soon became overgrown with brush species like Running Mesquite (*Prospis glandulosa*), Blackbrush Acacia (*Acacia rigidula*), Huisache (*Acacia smallii*), and Live Oak (*Quercus virginiana*) (Bogusch 1952).

The more xeric grasslands of west Texas, New Mexico, and Arizona were not only altered by the plow, but also by overgrazing (Hastings and Turner 1964). Overgrazing is believed to have effectively reduced the diversity of the native shortgrass prairie, enabling more aggressive exotic species to invade and become dominant. It seems likely that in time these grasslands became less productive, and they eventually may have been unable to support more sensitive species like the Aplomado Falcon.

Already greatly reduced in number and isolated through habitat loss, the remaining Aplomado Falcons were probably eliminated by the widespread use of chlorinated hydrocarbon insecticides developed during World War II. Although almost certainly extirpated as a breeding species within the United States since the mid-1900s, the Aplomado Falcon was not officially listed as "endangered" by the US Department of the Interior until 1986 [Fed. Register 51(37), February25, 1986, pp. 6686-6690].

A cooperative program was developed between The Peregrine Fund, the Mexican Government (SEDUE/SEDESOL), and the United States Fish and Wildlife Service (USFWS) in 1987 to reestablish the Aplomado Falcon in the southwestern United States and northern Mexico.

Fortunately, breeding populations of the Aplomado Falcon still occurred in portions of southeastern Mexico and northern Chihuahua. In 1977 and 1978 the Chihuahuan Desert Research Institute (CDRI) collected live young from nest sites in the Mexican states of Veracruz, Tabasco, and Chiapas for captive breeding. In 1987 and 1988 suitable habitat was surveyed in the Mexican states of Veracruz, Tabasco, Chiapas, and Campeche by Peregrine Fund researchers to assess the nesting population. Twenty-five territories were found in 43 days of field work. Two territories were located in Veracruz, 13 in Tabasco, nine in Chiapas, and one in Campeche. A total of 15 active nests were located, two in Veracruz, eight in Tabasco, and five in Chiapas. Nests were located in arboreal bromeliads or in small abandoned corvid and raptor (*Buteo spp.*) nests in the very top or at the extreme edges of large isolated trees. Climbing to the nests was difficult and often dangerous as the size of the limbs supporting the nests was extremely small and the trees themselves brittle. The mean brood size was 2.3 young per nest (n=10) with a range from one to four young. Nestling Aplomado Falcons were taken in both survey years, establishing the nucleus of The Peregrine Fund's captive breeding population. Of interest, all observed Aplomado Falcon territories were in close association with cattle ranching. It is possible that the ground cover morphology resulting from

carefully managed cattle grazing may be important in maintaining optimal nesting habitat for Aplomado Falcons (Sandfort, 1994).

Today the future looks brighter for the Aplomado Falcon due to current land use practices which employ prescribed burning as a means of brush control and a reduction in the use of persistent insecticides. Individual Aplomado Falcons are still occasionally observed in South Texas (now especially due to releases there), West Texas, and New Mexico. In 1992 Angel Montoya, a master's candidate at New Mexico State University, was able to document a small population of approximately 25 breeding pairs of Aplomado Falcons in the Mexican state of Chihuahua less than 160 km south of the New Mexico border. Although the observed reproductive success in this population was low (0.57 young fledged per nesting attempt) due to a high incidence of nest predation, the population appeared to be stable (Sandfort, 1994).

BIOLOGY OF THE NORTHERN APLOMADO FALCON

Distribution

Three subspecies of the Aplomado Falcon are recognized, *F. f. femoralis, F. femoralis septentrionalis,* and *F. femoralis pichinchae.* The races differ somewhat in mensural characters and plumage. The species occurs from the southern tip of South America, Tierra del Fuego, to Venezuela and Ecuador. It occurs from sea level to 4000 meters or more in the Andes. The species formerly ranged through Middle America to the grassland and coastal prairies of Texas, New Mexico, and southeastern Arizona (Anthony 1892, Bailey 1928, Hector 1987, Ligon 1961, Johnson 1965 Phillips et al. 1964).

We are concerned with *septentrionalis* or the "Northern Aplomado Falcon." Its historical distribution, based on specimen collections, includes Arizona, New Mexico, Texas, and the Mexican States of Tamaulipas, Veracruz, Chiapas, Campache, Tabasco, Chihuahua, Coahuila, Sinaloa, Jalisco, Guerro, Yucatan, Oaxaca, and San Luis Potosi, and it occurs along the Pacific coast of Guatemala. Surprisingly, some authorities have suggested that the Aplomado Falcon of Belize and the Gulf-slope of Nicaragua belongs to the nominate race *F. f. femoralis,* which ranges over most of South America. However, a significant geographical separation exists (forests of western Colombia and Isthmus of Panama) between Belize/Nicaragua and South America while contiguous potential habitat occurs between Belize/Nicaragua and Mexico. Gene flow between Aplomado Falcons in Belize/Nicaragua and Mexico (*septentrionalis*) seems much more likely than with the South American race (*femoralis*). From a taxonomic standpoint, re-examination and evaluation of Aplomado Falcons in northern Latin America is desirable (Sandfort, 1994).

Habitat

Throughout its range, the Northern Aplomado Falcon is associated with grassland savannas. The structure of the habitat is consistent for populations inhabiting the moist coastal savannas of eastern Mexico and those inhabiting the xeric inland savannas of the Chihuahuan Desert. "From the standpoint of habitat structure or physiognomy, however, habitats inhabited by Aplomado Falcons are all semi-open associations containing rather widely scattered woody vegetation and relatively

little ground cover" (Hector 1981). The structural requirements of the falcon's habitat are no doubt related to presence and accessibility of prey. As mentioned above, Aplomado Falcons seemed to prefer nesting in areas where ground cover was moderately grazed by cattle. In Chiapas and Tabasco, several nest sites that had been active and grazed in 1987 were inactive and non-grazed in 1988. A well-managed cattle ranch with open grassland scattered with occasional large trees appeared to provide the most suitable nesting habitat (Sandfort, 1994).

Feeding Habits

The diet of the Aplomado Falcon consists principally of a variety of small- to medium-sized birds and large insects. A partial list of commonly observed prey species includes: Eastern Meadowlark (*Sturnella magna*), Common Nighthawk (*Chordeiles minor*), Mockingbird (*Mimus polyglottos*), Western Kingbird (*Tyrannus verticalis*), Brown-headed Cowbird (*Molothrus ater*), Mourning Dove (*Zenaida macroura*), White-winged Dove (*Zenaida asiatica*), Great-tailed Grackle (*Quiscalus mexicanus*), dragonflies (Odonata), cicadas (Homoptera), and grasshoppers (Orthoptera) (Hector1985, P. Jenny and A. Montoya, pers. observ.). Aplomado Falcons have been observed to hunt avian prey individually, as pairs, and in family groups before young disperse from nesting areas (P. Jenny, pers. observ. and C. Perez, pers. comm. 1994). They also pirate prey from other raptors (W. Heinrich, P. Jenny, A. Montoya, and B. Mutch pers. observs. Brown et al 2004). Cases of Aplomado Falcons hunting in front of grass fires are also well documented (Brook 1933).

Reproductive Biology

Unlike most birds of prey, falcons, including the Aplomado Falcon, do not build nests, but use the abandoned nests of other birds. We observed Aplomado Falcon nests (n=15) in eastern Mexico located in the abandoned nests of Gray Hawks (*Buteo nitidus*), Roadside Hawks (*Buteo magnirostris*), and Brown Jays (*Psilorhinus morio*) and at the base of palm fronds and atop arboreal bromeliads (Sandfort, 1994). In South Texas, Peregrine Fund biologists located 19 different pairs of adult and sub-adult Aplomado Falcons on territories during the spring of 1999. The majority of these falcons, identified by their bands, were birds released by us. One individual was identified as the young of a nesting pair of falcons released in 1996 while a second was unbanded (A. Montoya and B. Mutch, pers. comm., 1999). We have observed this recovering population of Aplomado Falcons in South Texas nesting in the abandoned nests of Chihuahuan Ravens (*Corvus cryptoleucus*), White-tailed Hawks (*Buteo albicaudatus*), White-tailed Kites (*Elanus leucurus*), and Crested Caracaras (*Polyborus plancus*), in yucca, mesquite (*Prosopis glandulosa*), Texas Ebony (*Pithecellobium ebano*), and Macartney Rose (*Rosa bractea*). Aplomado Falcons from this population have also nested in artificial nests on artificial structures (high tension power poles and microwave towers), and one pair was even found nesting directly on the ground. Due to the wide variety of nest structures utilized, Aplomado Falcons do not appear to be nest site limited. Nesting locations were from ground level to more than 20m above the ground. Some nests were very fragile and several were destroyed by windstorms (A. Montoya, and B. Mutch, pers. observ.). In Chihuahua, Aplomado Falcons have almost exclusively used the abandoned nests sites of Chihuahuan Ravens and other large *Buteo* species constructed in yucca (A. Montoya, pers. observ.).

Of particular interest in South Texas are the 13 pairs of Aplomado Falcons on Matagorda Island located by Peregrine Fund biologists. These are the first pairs to be discovered on barrier

islands and as far north as Matagorda. The principal motivation for releasing Aplomado Falcons on Matagorda Island was to avoid or reduce predation from Great-horned Owls (*Bubo virginianus*) during the highly vulnerable fledgling stage, but we expected the falcons would most likely disperse to the mainland to nest.

The best home range data for Aplomado Falcons have been collected by Montoya in Chihuahua. He calculated the average home range size as between 0.40 and 21.43 km by following the movements of 13 falcons (Montoya et al. 1994). The home range size of the Aplomado Falcon is no doubt dependent upon a variety of environmental factors, especially prey availability. In Tabasco active nests were observed less than one km apart (B. Mutch, pers. observ. and K. Sterner, pers. comm., 1988).

Aplomado Falcons appear to be non-migratory and adult pairs are found on their breeding territories throughout the year. The clutch size of wild Aplomado Falcons is normally two to four eggs (Hector 1987). In South Texas eggs were laid between 14 March and 26 May (n=29) with peak egg-laying occurring between 12 April and 26 April (n=15) (Bent 1937). These dates coincide closely with the recovering population of released Aplomado Falcons returning to nest in this same area (B. Heinrich, A. Montoya, B. Mutch, pers. observ.). In eastern Mexico, we observed a mean brood size of 2.3 young per nest (n=3) with a range of one to four young per nest (Jenny and Walton, 1988). In Chihuahua Montoya documented a clutch size of 2.6 eggs per nest (n=7) with a brood size of 1.57 young per nesting attempt. Fledging success was 0.57 young per nesting attempt (Montoya 1994). During the spring of 1999 Peregrine Fund biologists located 19 pairs of Aplomado Falcons on territories in South Texas. Of the 19 known pairs, 8 (42%) attempted to breed, and 4 (21%) successfully fledged a total of 12 young. An average of 1.5 young were fledged from pairs that attempted to nest. This fledging rate was much higher than the 0.57 young per breeding pair documented for the Chihuahuan population. Nevertheless, mortality at nest sites remains high in South Texas due to predation from other birds, mammals, and fire ants, in addition to structural failure of nests. To help reduce some of these failures and forms of mortality, we have erected a variety of artificial nesting structures with some success (Sandfort, 1994).

APLOMADO FALCON RELEASES

Hacking

Hacking is a process that has been used by falconers for ages to allow natural, physical conditioning of eyasses or young birds of prey taken from the nest before they can fly. Young falcons are placed on a conspicuous structure (shed or abandoned building) at fledging age and given their freedom. Food is provided by the falconer on this structure and is usually secured to a board called a "hackboard." The falcons develop gradually, flying free, but returning each day to feed from the hack structure. Eventually the falcons begin chasing prey, even making their own kills, and spending more and more time away from the hack site. At this point the falconer traps the falcons back and they are trained for hunting (Sherrod, et al. 1987).

The Peregrine Fund has adapted this technique for use in the release of Peregrine Falcons, Aplomado Falcons, California Condors, Harpy Eagles, and several other species with considerable success. The Peregrine Fund has released 1,004 Aplomado Falcons into Texas using this method. Numerous pairs of wild, adult Aplomado Falcons are now nesting in areas from which they had been completely extirpated as a breeding species. The details of hacking Aplomado Falcons, procedures, and information, comprise the main subject matter of this document.

Inventory and Selection of Potential Release Sites

The Peregrine Fund chose South Texas for the focus of its initial reintroduction effort for the Aplomado Falcon because: (1) some of the last known United States breeding attempts of the species occurred in this area, (2) the highest known nesting density historically occurred in this area, (3) wild Aplomado Falcons were still being seen in and along the South Texas coast, and, especially, (4) there appeared to be extensive suitable but unoccupied habitat for reestablishing a wild population. Habitat along the Gulf Coast was surveyed by light aircraft from Sergeant's Beach, Texas, south to San Fernando in the Mexican state of Tamaulipas. In addition, the Aransas National Wildlife Refuge, Attwater Prairie Chicken Refuge, Laguna Atascosa National Wildlife Refuge, Welder Wildlife Foundation, and three divisions of the King Ranch were visited and their comparative merits for potential release sites analyzed. Primary consideration for release site selection includes habitat structure, prey availability, nesting structures, potential threats from predators, logistics to work the site, and extent and proximity to other suitable habitat. Laguna Atascosa National Wildlife Refuge was selected for the initial release of Aplomado Falcons due to habitat, logistical support, and its strategic position between extensive areas of suitable habitats both to the north and south (Sandfort, 1994).

Since the first releases at Laguna Atascosa, restoration has continued on other refuges and on neighboring, privately owned cattle ranches. Releases have occurred along the Laguna Madre as far north as Matagorda Island and Sea Drift, Texas, and inland as far west as the Welder Wildlife Foundation near Sinton, Texas. Releases will continue at many of these same locations until breeding pairs of Aplomado Falcons are established, and then moved to other suitable habitat of surrounding locations.

In 2002, The Peregrine Fund was able to expand its Safe Harbor* permit to enable the development of release sites in West Texas. The Peregrine Fund is working with a variety of private, state, and federal entities in New Mexico in an effort to develop a future release program in that state. These xeric grasslands, once home to breeding Aplomado Falcons, will provide extensive habitat for their reintroduction and would provide a second, disjunct wild population from South Texas. This habitat seems to be intact, but has lacked nesting Aplomado Falcons for almost 50 years.

**Safe Harbor. A significant component of this reintroduction program was the development of a program under section 10(a)(1)(B) of the Endangered Species Act (Act) that encourages the release of Aplomado Falcons on private lands in return for their protection-- a "Safe Harbor"-- from any additional future liabilities under the Act. The Peregrine Fund is the formal permittee under the requested Section 10(a)(1)(B) permit.*

With the expansion of the Safe Harbor Agreement, the first release sites in West Texas were identified in 2002. Two release sites, located on large private ranches supported the release of 36 falcons of which 27 successfully reached independence. In 2003, 48 Aplomado Falcons were released on three ranches, and in 2004, 81 Aplomado Falcons were released on a total of four ranches. The project in West Texas continues to move forward with additional release sites being identified each season.

PILOT STUDY

Between 1984 and 1989 a pilot study was accomplished to evaluate the feasibility of a species restoration project. The first captive breeding of the Aplomado Falcon was accomplished under the direction of Grainger Hunt by the Chihuahuan Desert Research Institute (CDRI) from eight nestlings collected in Mexico in 1977 and 1978. John Langford succeeded in propagating the first two young in 1982. In 1983 all of the CDRI Aplomado Falcons were transferred to The Peregrine Fund and held by the Santa Cruz Predatory Bird Research Group (SCPBRG), Santa Cruz, California, under Brian Walton's direction.

In 1984 SCPBRG propagated their first two young which were retained for breeding. The following year four young were raised, and the first release attempt accomplished. The falcons were released from a tower, similar to ones used for Peregrine Falcon (*Falco peregrinus*) releases, on the King Ranch in South Texas. Apparently, all four young were lost. Over the next four years an additional 20 captive-bred Aplomado Falcons were released on the Laguna Atascosa National Wildlife Refuge and on adjacent Buena Vista Ranch to test the suitability of South Texas for the reintroduction of the species and to develop release techniques. Sixteen of the young survived at least to independence of human care, 21 days or longer after release. Three pairs of Aplomado Falcons were transferred from Santa Cruz to The Peregrine Fund headquarters at the World Center for Birds of Prey (WCBP), Boise, Idaho in 1989, and the remainder, except for one behaviorally imprinted female, were moved in the following year (Sandfort, 1994).

The pilot study, accomplished by Brian Walton and his co-workers at the SCPBRG in cooperation with The Peregrine Fund, yielded information critical in preparing for implementation of a species restoration project. They proved that predictable captive propagation results were

possible given suitable breeding stock and facilities. Also proven was that captive-bred Aplomado Falcons could be released using techniques similar to those already developed for Peregrine Falcons. The high survival of released Aplomado Falcons is an indication of the viability of this effort in South Texas. Based on these results, The Peregrine Fund and potential project supporters gained the confidence to commit to restoration of the species in its former range in the southwestern United States and northern Mexico.

Release Results and Analysis from Pilot Study: 1984 - 1989

Twenty-four captive-bred Aplomado Falcons were released in South Texas between 1984 and 1989 as part of a pilot study to determine the feasibility of developing a full-scale restoration program for this species. These preliminary efforts indicated that suitable habitat for the release of captive-bred Aplomado Falcons exists along the southern Gulf Coast of Texas and northern Mexico. The effort also resulted in the development of release techniques for this species which continue to evolve, maximizing the success of the young falcons (Sandfort, et al. 1994).

In 1989, The Peregrine Fund, in cooperation with the USFWS, State of Texas, and other cooperators, began a full-scale effort to reestablish a self-sustaining population in a suitable habitat in the southwestern United States and northern Mexico where the species was extirpated. This action was based upon experience gained during the pilot study. The first priority was to build up the captive breeding population to at least 30 pairs so that a sufficient number of young (50/year) could be produced for release to initiate restoration. To accomplish this goal, all young produced during the 1990, 1991, and 1992 breeding seasons were retained for breeding. The goal of 30 pairs of captive Aplomado Falcons was achieved in 1992. Additional young have been retained in most following years to enhance the genetic diversity of this captive population and decrease the mean age/breeding pair. The World Center for Birds of Prey currently houses 36 pairs of Aplomado Falcons. During the breeding seasons of 1997, 1998, and 1999 the goal of at least 50 young/year was greatly exceeded with over 100 young produced during each of those three seasons. Large scale reintroduction of this species is now possible and ongoing.

HACK SITE PROCEDURES: CARE OF THE FALCONS PRE-RELEASE

In addition to an introduction of this species, historical information, and our future plans, the following important hacking procedures will give attendants an idea of what to expect day to day while working at a release site. In conjunction with verbal instructions from on-site supervisors, this will help ensure and maximize the success of young falcons at the release site. The procedures that follow are all techniques that have been successfully employed in recent years. However, captive propagation and reintroduction of any species is dynamic; we must continue to be flexible and modify these procedures when necessary to increase the success of the young falcons at our release sites.

Hatching and Raising

In all cases so far, our young Aplomado Falcons have been artificially hatched and brooded (Sandfort, pers. observ.). Newly hatched falcon chicks are fed by hand in sibling groups for up to

25 days. They are then raised in sibling groups with minimal human exposure until their transportation to a release site at 32-37 days of age.

Number and Sex of Young at a Hack Site

Although the Aplomado Falcon is smaller than the Peregrine Falcon and therefore more vulnerable to predation, we have found them to be much easier in some respects to release successfully to the wild. The Aplomado Falcon is far more gregarious than the Peregrine Falcon, both among the same age class and with returning adults. This characteristic has important implications for reintroduction because more birds can be released at a single location at one time. We have sequentially released up to six different groups of Aplomado Falcons at one site, a total of 35 falcons. This adds weeks to the duration of the release. Unfortunately, we have learned that the longer a release site continues, the higher the mortality rate of the young falcons. A release site essentially becomes a feeding station for not only the released falcons, but to other wildlife as well, particularly species like Turkey Vultures (*Cathartes aura*), Black Vultures (*Coragyps atratus*), Crested Caracaras, Great-Horned Owls, Chihuahuan Ravens, raccoons (*Procyon lotor*), and coyotes (*Canis latrans*). These non-target species can not only greatly increase the amount of food required to support a falcon release, but also represent a direct threat to the falcons' survival. However, releasing two or three groups of from five to seven falcons per group seems to have successful results. We need to maximize the number of young released from the limited, but successful release sites we are able to find and use each year. Also, falcons from second- and third-group releases seem to develop much more rapidly, learning important behavior from the older group of falcons.

Attendants who worked at one of our Laguna Atascosa hack sites during the summer of 1999 actually forced this positive mentor behavior of the older group upon the younger Aplomados prior to their release. *"After we'd released our Group I birds and had Group II in the hack box, we would tie quail to the roof hack-board and slowly slide it out a little ways onto the front corner of the tower deck - so that the birds in the box would be able to observe their "mentors" feeding. Our hope was that the falcons inside the box would adopt the Group I birds' behavior right away in terms of feeding on the tower deck before fledging. In our estimation, the more activity on the part of the already released birds - in front of the box, where the still-captive birds await their release - the better. We were really impressed with how well the mentoring worked. Our Group II birds seemed mature in flight skill and aggressive behavior much faster than the birds from Group I, and we think it largely had to do with the fact that, while still in the box, the Group II birds were able to often observe the behavior of the Group I birds"* (Dana Doherty and Mark Menlove, pers. comm., 1999)

The ability to release 12-18 or more falcons, from a single release site, also reduces costs associated with additional release sites, while increasing chances of establishing an adult breeding pair of Aplomado Falcons.

We have alleviated many of the problems of attracting and feeding non-target species at the release site by an innovative covered hack-board, and several other important procedures which will be discussed later under the topic of Feeding.

We do not pay much attention to the sex of falcons sent to a particular release site. It is more important to place a group of young falcons at a release site similar in age, ideally at or within three days of the same age. Aplomado Falcons fledge naturally at approximately 39-41 days of age, with males generally maturing and fledging first. A group of falcons with ages separated by more than five days, especially when males are the oldest, is avoided as these oldest falcons may have such a strong urge to fledge that they may simply disperse from the hack site or fly so far they become lost. The youngest falcons in this group fledge and possibly wind up on the ground, vulnerable to predation. Throughout the course of any reintroduction season, especially when over 100 Aplomado Falcons are available for release, the sex ratio tends toward 50:50, as with most species. Even if 12 males are released from one site in a single season, falcons from other release sites in the area disperse back and forth. Returning sub-adults from previous releases now occur every year at most release sites. Young falcons have dispersed more than 200 miles during their first year. This means Aplomado Falcons from virtually any one of our South Texas release sites could find others to pair with.

Transporting to the Hack Site

At 28 days of age young Aplomado Falcons can tear their own food. If scheduling would necessitate, the young could be transported to the hack site at this age. It is preferable, however, to wait until the young are older, 32-36 days, before transporting and placement into the hack box. These extra days ensure that the young falcons are eating on their own. The ages given here are simply guidelines we like to follow when possible. There is considerable variation in the physical development between males and females of the same age and even between individuals of the same age and sex. Regardless of the age of transfer to the hack site, it is at this time that we place federal bands and alpha/numeric color bands on the birds.

The transportation of Aplomado Falcons has been challenging; moving over 100 young falcons during the hot summer months from Boise, Idaho to their release sites in Texas. Because of recent heat restriction regulations enacted by the Airlines, we are no longer to fly the falcons commercially. Instead, we are using air charter services, and flights provided by our board members and cooperators.

The falcons are shipped in airline-approved containers (kennels) with clean straw or hay as substrate to sit on. Three to four young are shipped in each box or kennel. When falcons for three different hack sites are shipped at once, there can be as many as 21 falcons arriving in seven containers. Our field supervisors meet the arriving aircraft, pick up the falcons, and drive them to the hack site.

Placement and Care of the Falcons in the Hack Box

Before placing the young falcons in the hack box, we usually skin and provide a half quail per falcon. These are spread around the box so each falcon has the opportunity to feed on its own quail undisturbed by a possibly more aggressive bird. The falcons are provided with some quail for food during their transportation in the event a flight is delayed. A delayed flight has occurred most every year and falcons have even been held overnight with no adverse effects. Upon opening the kennels after these delays, we have noted the food provided for the falcons in their containers has

always been eaten. In this case we may hold back on some of the food provided the day we place the falcons in the hack box. We try to keep odors to a minimum; an over-abundance of quail in a hack box in the heat and humidity of a Texas summer produces a strong odor, attracting scavengers and predators, and producing an unhealthy environment for the young falcons. When the falcons are over-fed on their first day, the amount of wasted quail continues to build up over the next four to seven days the falcons remain in the box prior to their release. It is possible a hack box may have to be cleaned of excess quail. **IT IS EXTREMELY IMPORTANT THAT ATTENDANTS HAVE CLEAN HANDS WHENEVER HANDLING QUAIL. INSECT REPELLENT, SUN SCREEN, ETC. SHOULD ALWAYS BE WASHED OFF BEFORE THE QUAIL ARE TOUCHED.** (Discussed under Feeding.)

With the help of the hack site attendants, the young falcons are individually removed from the shipping containers and placed in the hack box by our field supervisors. Care must be taken not to let them grab the other falcons while removing them from the kennels and upon placing them in the hack box. High winds are a common occurrence and provide additional challenges. Extreme caution must be taken with the kennel containing the young falcons while on the tower. Also the hack box door must be guarded at all times, held tightly open and closed as falcons are placed in the box. It may take a few hours for the falcons to settle down and begin eating, depending on how long it has been since their last meal or on their individual "personalities." The young falcons' personalities are variable from docile and tame acting to extremely wild and defiant or even very shy. These different personalities affect the falcons' behavior, often the entire time in the box and even after release. Individual behaviors should be noted during daily observations. Hack site attendants have become very proficient at accurately identifying the different falcons after release by noting these different personalities and behaviors while observing the falcons in the hack box.

Observations - Pre-Release

Upon arrival of the hack site attendants, the hack site location will have been selected with release towers, shade blind, and hack box construction completed. A freezer location and a freezer filled with food (quail) for the falcons will be located near attendant housing. The falcons will arrive within a day or two after the attendants. At this point the duties of the attendants include the daily responsibilities of feeding and observing the young Aplomado Falcons while they remain in the hack box, as well as their release.

Between the time that the birds are placed in the hack box and the time they are released, attendants should spend at least an hour with the falcons after feeding them each morning and again for an hour in the afternoon or evening. Peepholes are drilled in three sides of the hack box which offer a limited view of most of the hack box and the falcons inside. The front of the hack box is built with vertical conduit barring and half-inch wire, which provides the falcons an open air view in that direction. The attendants should never go in front of the box, and any visitors to the site should be given these same instructions. While making observations attendants should sit absolutely motionless because the young falcons are keenly aware of any noise outside the box. Attendants should make certain that all the birds are feeding and that each appears to be in good shape. If the attendant suspects that one of the birds has some abnormality, he/she should call us immediately to discuss the problem. It is normal for falcons to spend time lying on their stomachs.

The attendant should use the days prior to release to observe any potential threats to the falcons. Late evening hours, even after dark, are important times to look and listen for Great-horned Owls which have been the greatest threat to the young falcons' survival. Owls will often perch on and hunt directly from our release towers. Attendants should look for signs that owls, raccoons, coyotes, and other species are using the area, on, or directly around, the hack tower regardless of what is seen or heard. Molted feathers, pellets, and droppings give us information as to what is visiting the towers during the night when no attendants are present. Any of these observations should be relayed immediately to the field supervisors.

Vultures, caracaras, or other species may use the tower either as a perch, or key into the odors from the hack box, seeking food. We would like to know this information prior to the falcons' release so we can take precautions that will help the falcons from being flushed on release day. A successful release generally requires the falcons leaving the tower on their own, not being scared and flushed into flight by vultures or some other species hovering down to land and feed from the tower. Fledging falcons commonly fly too great a distance when scared into flight, becoming disoriented, lost, and unable to find their way back to the tower and food.

Attendants have also found it useful while the falcons remain in the hack box to note differences in plumages, no matter how slight. The small alpha-numeric color bands, identifying each individual falcon, are often very difficult to identify once the falcons have been released. Feather patterns, especially on the chest and head, show variations among the different falcons. Also, some falcons may show an overall very dark appearance while others are much lighter. These variations can be valuable identifying markings which attendants have used successfully. Some even go so far as to sketch the feather patterns on separate sheets. These sheets include their different personalities and any other distinguishing characteristics for a type of quick glance, identification page. Anything that can help to identify the individual falcons throughout the release is useful. These small details should be noted prior to release when the falcons can be observed closely. The ability to identify all individual falcons that successfully survive to independence (21 days or more after their release) is very important and the only means we have to report the success of each release site.

Feeding - Pre-Release

As mentioned above, attendants' duties include the care and especially the feeding of the young falcons. The following are detailed procedures which should be closely followed unless instructed otherwise by Peregrine Fund supervisors.

Located near each of our release sites will be at least one small freezer filled with Coturnix Quail (*Coturnix coturnix*) to be used as food for the falcons. Depending on the number of falcons being fed at each particular hack site, the freezer may or may not have to be stocked with additional quail to complete the release site. Quail are raised and shipped from Peregrine Fund headquarters in Boise, Idaho. In recent years we have taken greater care to feed the falcons all they need, while still trying to be conservative with the amount of food needed and used at each site.

The food consumption per day for one Aplomado Falcon varies during the course of the release sequence. When the falcons remain in the hack box, we know that only the young falcons

are eating what we are providing, one half quail per falcon is often more than enough. A group of six Aplomado Falcons will be fed three quail each morning. These quail will be cut in half so each falcon can feed from its own portion. How and where to cut the quail in half will be demonstrated by supervisory personnel upon arrival of the falcons. As the falcons mature following release, their appetites increase due in part to their greater activity. After release as the falcons travel longer distances, it is not uncommon to see a falcon eat a whole quail or more. **It is important that the amount of food provided for them is then adjusted for these increased appetites.**

When falcons arrive particularly young, less than 32 days of age, it may be necessary to cut the food into smaller pieces and feed them twice a day during the first few days they are in the box. This will be an added inducement to get them eating on their own. Later, after the falcons are stronger and eating well, the quail can be fed just in the morning and only cut in half. This will retard spoilage, moisture loss, and fly infestation. The falcons will usually discard most of the entrails, but it is best to leave these organs with the quail. Studies conducted for us have shown that if the entrails are removed prior to feeding, the nutritional value of the food is reduced and even deficient in some vitamins and minerals essential for proper growth and development (Sherrod, et al. 1987).

We ask our attendants to try and observe each falcon feeding each day. While the falcons remain in the hack box, attendants drop a pre-determined amount of food only through a food chute located on the roof of the hack box. The door through which the young falcons were placed into the box should never be opened prior to release except by Peregrine Fund supervisors. We have never lost a falcon that escaped during handling or while cleaning a box, NOR SHOULD WE. The falcons must be fed prior to release in this manner and observed feeding only through the peep-holes drilled in the hack box.

Often falcons are aware they are being watched no matter how careful and quiet attendants are. Some falcons simply don't mind the disturbance and noises of people carefully moving around the tower platform, while others are upset at the slightest noises and may sit motionless for hours. If this is the case, we ask attendants to feed the falcons, then watch for 15-20 minutes, leave the tower for 20-30 minutes, and return to look for signs that all birds might have fed in their absence. As falcons eat, their food passes first to their crop, located high on their chest under the throat. This will become visibly distended the more the falcon eats. Another sign that a falcon probably has been eating is either, or both, the appearance of blood and feathers stuck to upper or lower mandibles and possibly on their feet.

If a group of falcons which is very young arrives at the release site and requires a longer period of time in the hack box, the birds will need to be watched very closely for feeding and, in addition, their box may need to be cleaned prior to release. Attendants who are extremely conscious and aware as to how much their falcons are eating may still over-feed quail to the falcons when they must be left in the box for more than six days. It is better to err in excess than deprive them of food. So, as a rule, we will always clean a hack box if the falcons must spend seven or more days inside the box. This will be performed by one of our supervisors with the help of the attendants.

We ask attendants to begin a morning feeding schedule for the young falcons while they remain in the hack box. As mentioned before, if the falcons are very young, feeding smaller portions

twice a day is best, then switching to larger portions once a day within a few days. Getting the falcons on a regular feeding schedule will be useful later when the birds are wandering out of sight. During this later period an observer will be more likely to see the birds near the box at feeding time.

Attendants are responsible for removing the amount of quail needed each day from their freezers. These quail need to be thawed when fed to the falcons but the colder and fresher the better as quail quickly spoil after being placed in the hack box. Placing quail from the freezer into a refrigerator for 12 hours is generally sufficient time to thaw a quail while still keeping them fresh for the falcons. Frozen quail or quail that have been left out too long, held over from previous days, should not be fed to the falcons. It will be the responsibility of our attendants to figure out a schedule that works best at each particular site for getting the best quality food to their falcons.

Questions have been asked in past years about feeding various species of birds, found dead or dying, to the falcons. We DO NOT ever provide this kind of food. First, without salvage permits it is illegal to pick up most species of birds even when they are found dead or dying, and second, the cause of death can often not be easily determined. It is risky to feed the falcons birds that have been poisoned, contain lead shot, or suffer from one of many avian diseases. It is simply best to provide them with a known food source which is legal and safe, at least while they remain in our care.

In preparation for release, the falcons are not fed the day prior to their release. This procedure helps ensure that the falcons will come out of the box a little hungry on release day, and be preoccupied with food, and not just flying away from the tower. Falcons that come out of the box and feed before making any flights tend to be more successful at returning from their first flights. Taking the time to look around and orient to their surroundings outside the box and the release tower seems to be important steps to a successful release. Falcons that simply come out of the opened door, ignoring the food, spending no time looking around, then flying from the tower, are often never seen again. Any factor that slows or delays the fledging process on release day is important. Feeding, for a young falcon, is a fairly slow process. A falcon that has just been released and takes the time to feed is often distracted long enough to help it settle into its new environment outside of the hack box. A slow-paced release in which the falcons do not fly much at all on their entire first day is much better than falcons becoming scattered all around the release site. We do everything we can to try and keep the falcons at ease and from wanting to disperse too far away. Other release day procedures which help us to accomplish this will be discussed under Release.

FREE FLYING FALCONS

Release

Between 39 and 42 days of age the young Aplomado Falcons are old enough to be released. Just prior to this time, attendants may witness a lot of activity by the falcons inside the hack box. The birds may try to climb the bars, repeatedly fly at the bars and the walls of the hack box, and vigorously flap their wings while holding onto one of the perches. This is all normal behavior and part of a pre-flight restlessness. In the wild the young often leave the nest on foot and "branch" to different limbs and perches outside of the nest, but may not fly for several days thereafter (A.

Montoya, pers. comm., 1999). The exact age of release can vary according to individual rates of development, or upon the sexes among the group of falcons. Some individuals seem to grow slightly faster than others. Males are usually ready to fly a day or two before the larger females, but it is necessary to keep them inside the box until the rest of the young have developed to the stage for release.

Prior to release, and even prior to the arrival of the falcons, perches of limbs pruned from mesquite trees are nailed to each corner on the top of the tower platform, to each corner and center of the X-bracing below the tower platform, and to the hack box itself for the released falcons to perch on. Also, pole perches are set at several locations around the tower at various distances from the tower. These are also "decorated" with native greenery for the falcons to perch on. These particular perches are important when the young falcons fledge and wind up landing on the ground. These perches encourage them to leave the ground where they are more susceptible to predation. Besides being just a safer location to perch, they allow them a better location from which they can see the tower and attempt a flight back to it. The perches we provide on the tower also give the falcons something to hold on to during windy conditions, helping them to fledge when they are ready, not by being blown from the tower into forced flight.

Mesquite perches also help to provide some cover for the falcons during the night, helping to camouflage their silhouettes. When falcons choose to roost on the tower, they become highly vulnerable to predation by Great-horned Owls. Aplomado Falcons learn very quickly about a safe roost, and often their first night out of the box is spent in the safety of a yucca. Unfortunately, some falcons spend several nights roosting on the hack tower. The perches we provide afford them some protection as cover from owls. These perches are important and must be provided at each site prior to release. They also make good feeding platforms, and when constructed close to the observation blind, falcons can be forced to feed from them, offering attendants a better look at their bands and other identifying characteristics.

The actual release process may be the single most critical aspect of the hacking procedure. Since these birds are wild, the presence of a human having to perform the release process greatly upsets them. We take every care to reduce our exposure to the falcons and perform the release activities as quickly and efficiently as possible.

If conditions over which we have no control do not permit an early morning release, we may delay it until later in the day or even until the following day. Release days are carefully chosen with regard to the age of each falcon in the group, and we try very hard to release them on these pre-scheduled days. At times, we have delayed a release due to very high winds, fog, and even once due to a large group of vultures that habitually returned to a particular hack site to roost upon it around 10:30 each morning. Generally, however, we are able to release the falcons as scheduled.

On the day of release both hack site attendants, and at least one of our field supervisors, will meet at the hack site at a pre-determined time to perform the release. Attendants are responsible for bringing a three day supply of quail which will be placed on the tower and hack box, leaving the falcons alone to fledge and feed undisturbed during the first three days following release. Both attendants should plan on spending the entire day at the site, early morning until dark, during this time.

Hack site attendants should be prepared for these long, hot days with plenty of cold drinks and food for the day. When all of the falcons have fledged and are accounted for, usually by the fourth day following release, attendants are able to take a break from the site during the heat in the middle of the day, when the falcons are also very inactive. (Discussed in more detail under Post Release Observations.)

Peregrine Fund field supervisors will perform the actual release and bring all necessary equipment to carry out this procedure. Assistance will be provided by at least one of the attendants. Prior to, and during release, duties are performed in the following order:

- Organize the shade blind with chairs, scope, and tripod setup to observe the release
- Inventory all necessary equipment needed to perform the release:
  a. Three days worth of quail (generally 14-18 quail is adequate)
  b. Tie wraps to secure quail to covered hackboards
  c. Side cutters for cutting excess tabs on tie wraps
  d. Game shears for cutting quail in half
  e. Cardboard to cover hack box door (appx. 32"x 36")
  f. Water spray bottle, filled
  g. Makita cordless drill
  h. (4) 2" - 2 ½" decking screws
- One quail is provided on each of the pole perches (fastened with a tie wrap)
- Attendant(s) and supervisor walk to tower and quietly place ladder behind the box and climb to platform
- Quail are secured to each screw eye provided on covered hackboards
- Both attendants return to shade blind to observe the release with scope and binoculars
- Supervisor will open the hack box door and wet the falcons with the spray bottle; performed to slow fledging and calm the falcons
- Door opening is covered with the cardboard
- Door is fastened opened with cordless drill and screws
- Cardboard is slowly removed and the falcons are wet down again
- Supervisor carefully retreats down the ladder and ladder is removed
- Falcons are observed CAREFULLY identifying each individual exiting the box, feeding, fledging, etc., recording this and all other important information

Once the falcons have been released it is critical to watch the box door closely with the spotting scope. Individual falcons should be identified as they come out of the box and continually while they remain on the tower platform. We like to record actual fledging times for each falcon when possible. Obviously, this is a difficult task requiring very diligent observations. It is helpful if one attendant observes through the scope while the other takes notes and watches with binoculars. Good binoculars are important as they provide a broader view of the release site, allowing a better view of a larger area. They do not, however, allow identification of the color bands. This is often difficult even with the spotting scope. Observations need not be limited to just the shade blind. Attendants should move around to provide a better view, when possible, away from the shade blind. Care must be taken not to disturb any falcon by getting too close. The falcons will frequent favorite perch sites away from the tower and the blind which will require a different position from which to

observe. Observing from various locations around the release site becomes more important as the falcons begin to travel greater distances. The shade blind is centrally located for a base of operations and often a good location for observations, but DO NOT limit observations to this location.

After the release, some of the young may come out of the hack box within seconds, while others may stay in the box for hours. The falcons often advance to the food and begin eating. Their feeding may be distracted by the new and strange surroundings outside of the hack box. If a falcon does come out of the box and immediately fledge, it should be watched carefully. It may return after simply circling the tower, but often it will wind up some distance from the tower and on the ground. This location should be watched from a distance to see that the falcon eventually makes it to a perch off of the ground. The falcon will probably return, sometimes very quickly or later that day. We have even had birds fledge on release day, fly a great distance, and not return for four or more days. If they can, they will try to return to the hack box. The vast majority of the falcons stay, eat, and spend a considerable amount of time observing their surroundings, flapping, and sleeping rather than immediately bolting from the box.

Frequently photographers and media personnel want to get good close-up photos of the birds coming out of the box. At the time of release this is just not possible because it is too risky. The falcons are too easily frightened and may fly out of the release area. It is not worth disturbing them and potentially jeopardizing a bird's survival. Photos can be safely taken later when the birds are flying well and repeatedly returning to the hack box, a week or more after release.

The time for the first flight of an individual falcon is completely unpredictable. If released at the suggested ages, most birds will be flying within two days. In very rare instances, a falcon may still not have fledged when it is time to begin daily feedings, the fourth morning after release. An Aplomado Falcon that does not fledge for four days could be cause for concern. If a falcon must be forced to fledge it should be watched carefully to see that it does not land at some unsuitable location and also carefully watched to confirm that it appears healthy. If forced to flush, do so when other falcons are in the vicinity, this helps to keep the flushed bird from going too far.

On the fourth morning attendants should begin a daily feeding schedule again. In some circumstances, when all the falcons have fledged the first day, and all are returning easily to feed, we often begin daily feedings on the third morning. The longer the excessive amount of food placed on the tower during release is allowed to stay there, the greater chance we have of attracting unwanted visitors such as vultures. We want to avoid feeding any species other than Aplomado Falcons at the release site.

Feeding - Post-Release

Daily feedings begin after release on the third morning if all the birds fledge and are returning to the box by the first or second day. By the fourth morning, we begin feeding even if a bird still has not fledged. Most of the food provided on release day will have been eaten at this point and the remaining food items will be spoiled. Attendants should remove any remaining quail, as the falcons need to be fed fresh food.

Attendants should feed the falcons each morning. Observations are made during early morning hours at sunrise or earlier. When arriving at the hack site each morning, attendants should first try to identify any falcons visible on the tower or on surrounding perches prior to placing any food. The falcons are flushed when placing food on perches and the tower, and, if not identified beforehand, it is a missed opportunity.

After feeding, attendants should observe the birds during the next five hours. When attendants leave for their midday break, all food placed that morning should be removed. When food is left out, while attendants are not present, the hack site can become a feeding station for many avian species, and this problem only escalates throughout the duration of a release sequence. We urge our attendants to take every precaution that no species other than Aplomado Falcons ever successfully feeds at the hack site, and this avoids problems with other avian species. The saying "an ounce of prevention is worth a pound of cure" applies perfectly here. The problem that can, and has been created, especially by vultures becoming habituated to feeding from our release sites, is very discouraging, difficult to cure, and potentially causes the loss of falcons. Simply removing all food when no attendants are present is one easy step that has greatly reduced this problem.

Attendants returning from their midday break provide additional quail for evening observations, replacing fresh quail for those removed that morning. This schedule of removing all food around 1130 hours then replacing it at 1530 hours should be followed closely. Unless there are falcons roosting on the tower, the food provided during the afternoon/evening observations should be removed prior to leaving the site as we do not want to attract predators to the site. If falcons begin to roost on the tower, please discuss options with your supervisor. This routine continues for the duration of the hack site. Sometimes the amount of food provided during morning and evening feedings will need to be adjusted. Some site attendants have observed their falcons changing their feeding habits by feeding less during the morning and increasing during the evening, or visa-versa.

The food we provide is always fastened in place with plastic cable ties (tie wraps) around one or both wings or legs to screw eyes on the hackboard. This is to ensure that falcons do not simply fly into the site, grab a quail, then fly off with it. A feeding falcon often spends at least five to ten minutes eating. This provides a good opportunity to identify individual falcons' bands while they are preoccupied at one location feeding. Aplomado Falcons can be very active and do not often offer a very good look at their bands. Therefore, we also provide the food where it will be easily visible to the attendants with spotting scopes. Food which is tied in place is also more difficult for avian species to fly in and try to quickly "snatch" from the tower or perches.

Food is provided at several different locations, both on the tower and on several perch sites strategically located near the observation blind. Another method we have used successfully to discourage other species from successfully taking quail from the release site is constructing covered hackboards. Quail are fastened to screw eyes in the center of a board which has a roof over it approximately eight inches in height. The falcons can easily see the food and become comfortable with walking under this roof to feed unmolested, in the shade provided. Vultures, caracaras, and ravens cannot see the food, and even when/if they perch on the tower, they find it difficult to reach the food, and seem apprehensive even to try to take food from this structure. They quickly lose interest in the site as a food source, never successfully feeding from it, and after the frequent

harassment (clapping hands, vocalizing, approaching the vulture) from our attendants while trying to steal food, lose interest in the site altogether.

Other than the day prior to release day, when no food is provided, and on release day when we provide three days worth of quail, the falcons will be fed every day until the week prior to closing the hack site. During the last week the falcons are fed every other day. For instance, if a hack site were only to receive one group of falcons, they would be placed in the box and remain there for about a week and be fed daily except for the day before the release when they are not fed at all. On release day we provide enough food to last three days. Two or three days after the release the falcons are fed daily again for five weeks, counting from the day of release. During the sixth week we alternate feedings; the falcons are fed every other day. At the end of the sixth week the site is then closed. However, since we always release at least two groups from each site, feedings are not alternated until the last group released has been out for five weeks.

The extra quail which are not eaten and is removed twice daily from each hack site should be disposed of a mile or more away from the release site. Simply removing the quail and pitching them near the site defeats the purpose and the trouble we take to perform these special feeding procedures. Predators and/or scavengers, including both avian and mammal species, will be attracted to any food remains left lying around the site.

Attendants who have completed a hack site have suggested we recommend to others they include supplies for hand-washing. Biodegradable soap, water, and hand towels are useful after handling quail, especially when removing and discarding the older quail from the hack site. Some have even recommended tongs and gloves when handling and discarding the old quail and having a plastic sack to transport them from the hack site.

Special feeding instructions will be given verbally at virtually every release site by our supervisors. Each site seems to have its own unique challenges and each group of falcons show variations with respect to feeding that require slightly different procedures. The above information is very important and provides a framework which can be adapted to fit the needs of each particular hack site.

Behavior of Young Falcons on the Wing

Aerial behavior by the young birds varies according to the age of the birds at release, their sex, physical properties of the site, and level of activity of the individual falcon. Males are nearly always more adept at aerial activities than females. Older birds seem to exhibit certain types of behavior sooner than younger birds that have been flying for the same amount of time (Sherrod, et al. 1987).

The first type of flight behavior that usually occurs is simple flight from one perch to another (perch to perch flights) and perch to ground and back to another perch. Aplomado Falcons spend a lot of time on the ground. Little or no interaction is observed among the falcons during these first flights. Within a few days the birds may begin chasing each other in a type of sibling pursuit or mock combat. One bird or more will fly above, behind, or alongside another. The siblings will repeatedly extend their legs with opened feet while grasping toward each other, rolling over, and

diving together. Sometimes the falcons will actually grab each other's feet. All of this activity is usually accompanied by a lot of vocalization.

Soon the falcons begin grasping at inanimate objects. Aplomado Falcons will fly by and grab leaves blowing in the wind, clumps of grass, and anything else that catches their attention. Often, young Aplomados will hang upside down from a branch or fly in circles while holding on to the leaves or branches of a tree or shrub. The falcons begin to catch all sorts of airborne insects and fiddler crabs which are common on the mud flats surrounding many release sites. Some of these are eaten, while others are merely discarded.

The young Aplomados also begin to pursue other birds and even a few mammals. Some of the species pursued are appropriate prey for the falcons while others are completely inappropriate. For example, Aplomado Falcons have been observed pursuing and harassing White-tailed Deer (*Odocoileus virginianus*). The young falcons are stimulated to pursue almost anything that moves. They seem to chase with greatest frequency those species that are most obvious in the direct vicinity of the hack site. There is a lot of individual variation among the falcons in this respect. Initially, small birds will quickly outfly the young Aplomados, as will larger species, although to a lesser extent. Often other birds will reciprocate and begin aggressively pursuing the Aplomados during the initial chases by young falcons. Soon the Aplomados will be able to keep up with larger birds such as gulls, herons, or kites and although the falcons can easily grab these species, they do not. Most of these chases are not of a serious nature, and the falcon will simply follow along behind without even dropping its feet. Sometimes the falcon will tap the other bird with its feet or hover above it once the bird has landed. Gradually the Aplomados will be able to keep up with the more maneuverable, small birds that are flying in the area and these smaller birds will eventually become prey for the Aplomado Falcons. These chases become more and more aggressive until finally the young falcons begin making kills on their own. Kills on flying birds have been witnessed at Aplomado release sites as soon as 14 days after the release. Generally, the falcons are older and have been flying for four weeks or more before attempting, and successfully taking other birds from the air (A. Montoya, B. Mutch, pers. observ., 1999). Although an observer will probably see the young falcons chasing other birds at a hack site, it is rare to witness an actual kill (Sherrod, et al. 1987).

Most wild falcons transfer birds to their young in the air and even drop both dead and live prey to their offspring. This type of parental behavior, however, is not necessary to stimulate a young falcon to pursue or capture avian prey. Young falcons are programmed genetically to exhibit both types of behavior even if parental influence does not exist. Similarly, it is not necessary to cut back on the food supply in order to stimulate young Aplomados to pursue or capture prey species. In fact, research has shown that a cutback of food within about the first ten days to two weeks of flying caused a decrease in the pursuit of vertebrates by young falcons (Sherrod, 1982). Young falcons treated in this way returned to the hack site where they sat and screamed, waiting for food. Within a few days of resumed feeding, the falcons were eagerly chasing prey again (Sherrod, 1982). Frequently, the young falcons at a hack site are seen chasing and even catching prey, even when they have a full crop.

Sherrod found that hacked falcons that were intermittently deprived of food began killing between two and four days on the wing sooner than falcons that were fed all they could eat; however, 71 percent of all the observed kills by males and 55 percent of the observed kills by females were

made during the periods when the falcons were receiving all the food they wanted. The birds which had not already made earlier kills began killing during the sixth week of hack when the food supply was provided on alternate days only. A six week long hack period is based on the minimum period of flying dependence that wild falcon fledglings enjoy (Sherrod, 1982). We feel that a falcon that builds up a natural supply of fat during the dependency period and that kills from its own instincts has a better chance of surviving after independence than one which is "starved" into killing (Sherrod, et al. 1987). By the sixth week of hack the falcons have developed enough aerial skill so that they can easily catch prey and, in fact, readily do so almost immediately when the food supply is only slightly reduced. If the food supply is reduced when the falcons have been flying for only two to three weeks, some birds may be successful at killing, while others may starve to death (Sherrod, 1982).

Dispersal

Even though the Aplomados are ranging from the hack site and may be only returning to the box only once every day or so does not mean that they are independent or are dispersing. This is simply a natural part of their exploratory nature which exposes them to prey sources, other raptors, and sometimes even fatal experiences. It can be rather boring/slow for the hack site attendant who only gets to see the falcons for a few minutes each day during this period. However, it is still important for the attendants to maintain their vigil and to identify a falcon for the few minutes when it returns to the site to feed. Confirmation of individual falcons returning to feed provides the best measure of the success of the survival to independence by the falcons at each site. Falcons observed 21 days or longer after their release are counted as successfully reaching independence. Food is still provided, however, for all falcons at a release site until the end of their sixth week.

Observations - Post-Release

Attendants are given the opportunity to participate in this very successful restoration program of an endangered species. Most past hack site attendants finish the season with a great sense of accomplishment and feel the experience was extremely rewarding, although many long, hot days were spent caring for and making observations on the progress of a group of from 12-20 Aplomado Falcons. Their activity and progress may seem, and often is, very slow. Aplomado habitat is hot, humid, and can harbor a very robust insect population. Working conditions can be and are difficult. However, valuable experience is gained; attendants truly get out of this field work what they put into it. We cannot stress enough the importance of our hack site attendants' observations at the release site. The success, or at least the improved success, of a particular hack site is greatly dependent upon the diligence of our attendants. The falcons' well-being and their care is our number one responsibility. They are entirely dependent upon us for their survival until the site closes. Attendants have identified and solved many problems, and directly rescued falcons from water, injuries, and predators, increasing the success of their site. This was accomplished by simply being at the site, making observations and good decisions.

We ask attendants to make observations during the hours when the falcons will be the most active. The periods of highest activity are the first two hours of daylight and the last couple hours prior to dark. Variable degrees of activity occur during the hours after and prior to these times. Attendants should plan on spending the hours from 0630 - 1130, and again from 1530 until dark,

observing the falcons. This should amount to approximately eight to ten hours of observations daily. During the hot, midday hours from about 1130 - 1530 hours, falcons are inactive and seek shade, roosting for hours. There will be some flexibility that can be worked into the observation schedule based on individual site characteristics and the timing of releases. This can be discussed with your supervisor.

Information we suggest recording are the following details:

- Description of hack site (location, habitat, vegetation, etc.)
- Pre-release details (information on the birds in the hack box, problems, predators/scavengers observed, feeding activity)
- Release details (personnel present, time, falcons' activity, i.e., time out of the box, time to fledge, time to return to the box, problems)
- Significant flights, hunting flights
- Problems and concerns with particular falcons and identification of the concern/problem
- Feeding observations (record date, time, and number of falcons observed feeding, or same for falcons when a band color/number/letter is identified while feeding)
- Date and time when a band is identified, always
- Roosting behavior
- General evaluation of the falcons
- Unusual incidents (i.e. falcons visiting from other hack sites, adults/sub-adults from past years, intense weather)
- All visitors to the hack site

Everything recorded should help attendants to complete two reports: An operation report and an internal report. The operation report is a brief summary of the entire release site. This is included in The Peregrine Fund's annual publication of all projects worldwide and sent to agencies, board members, and other cooperators. The internal report is for Peregrine Fund species restoration personnel only. This provides us with helpful suggestions such as problems experienced, better equipment lists for future attendants, or anything else, positive or negative.

Attendants should work in pairs throughout the entire period spent at the release site. It is much better to have two pairs of eyes and minds at work watching for predators, making observations, and taking notes. At times, attendants may need to take shifts with one working in the morning and the other during the evening. This can work when absolutely necessary but we strongly recommend working together most all of the time.

Closing the Hack Site

When the hacking period is completed and it is time to close down the hack site, there are a few chores that need to be accomplished.

It is satisfying to know that a group of Aplomado Falcons has successfully reached independence. This is just one step towards our final achievement of establishing a breeding pair of Aplomado Falcons in the area. We may need to use a release site several years to achieve this

goal. Therefore, we want to leave the site in the proper condition for its reactivation the following season.

All food scraps should be cleaned out of the box and hauled away to discard. The door from which the falcons are released needs to be closed and latched securely. An open hack box provides a very favorable nesting structure for Great-horned Owls. It is a good idea to give the outside of the box a coat of white paint. This increases the number of seasons we are able to use each box before having to replace them. The ladders can be stored at the tower, but should be up off the ground where cattle will not destroy them. The canvas tarps we provide at each shade blind should be taken down and rolled up for storage. Any chairs, trash or other obvious material foreign to the site needs to be picked up and stored.

All Peregrine Fund equipment, spotting scopes, chairs, coolers, game shears, side-cutters, canvas tarps, hackboards, and other equipment should be stored in a waterproof storage box provided for each site. This can be left with the Peregrine Fund quail freezer unless another location was selected or other instructions given by your supervisors.

When housing is provided by The Peregrine Fund or one of our cooperators, it should be left in the condition it was found, or better. Housing is always provided for our South Texas release sites as camping conditions are rugged at best, (owing to the heat, humidity, insects, tropical storms, etc.). In the past, at Peregrine release sites, our attendants were able to camp very near the release sites. These sites were located on national forests, national parks, and other very favorable camping locations in the Rocky Mountain region.

Color Marking

During many seasons of field work, we have tried a number of marking techniques to try to best identify individual falcons. Unfortunately, no permanent marker has proven to be ideal. The problem arises from the fact that nearly all markers which are safe for the birds are hardly visible. This is especially true of Aplomado Falcons due to their small size.

The best color identification bands on the market today are purchased from ACraft Manufacturing Company in Canada. Their bands are easy to apply, safe, permanent, and have the best colors with alphanumeric codes available.

An Aplomado Falcon cannot safely carry a very large band. Females wear a band only 9 mm in width while males' are just 7 mm. We use seven different colors which we feel are most discernible from each other. One symbol, either a silver letter or a number, is etched on these bands. The bands are made of high grade silver aircraft aluminum. The aluminum is anodized in an acid wash to produce the different colors. Therefore, we have no control over the color of the silver letter or number etched into the band. Attendants have requested the possibility of black numbers or letters on the lighter colors of bands. This is a good suggestion, as they would be easier to read, but would simply have to be marked over the silver symbol with a permanent ink marker, which experiments have shown to be not very permanent in Texas heat, humidity, and rain.

The color band on our released falcons is always placed on the right leg. The left leg receives the federal band. Fortunately, we have come up with a method to identify females from males very quickly. Female federal bands are anodized black while males are left their natural silver. These black bands on the females are highly discernible; females have either letters or numbers only on the color band while males have the opposite. This banding sequence has proven to be extremely helpful; by identifying a black or silver band on the left leg, this limits the choices of what to look for on the color banded right leg. Wild young are all banded with the USFWS band on the right leg in order to help differentiate them from the captive produced birds.

Marking techniques have and will continue to be one of the shortcomings as we place much importance on our attendants being able to identify each individual falcon throughout the hacking process. This area has been the number one complaint by hack site attendants and is one which we have not been able to completely correct. One method which has helped is to furnish higher quality optical gear (spotting scopes). Unfortunately, high quality spotting scopes are very expensive, and the demanding use they receive is rather punishing, shortening their useful years. However, a good spotting scope is an essential tool when trying to identify a color band or even read a small letter or number on the color band. Thus, we are slowly replacing our older scopes with better, high quality scopes.

Conclusion

We hope that this document will help to answer some questions and stimulate others while providing a brief background on the evolution of events leading to the restoration of the Aplomado Falcon in the southwestern United States. This information should help our hack site attendants understand what to expect and what they will be responsible for while working for The Peregrine Fund at an Aplomado Falcon release site. These are guidelines that should be followed with additional information provided verbally by our field supervisors.

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APPENDIX I - Care of Injured Falcon

There is always the possibility that one of the birds at the hack site will be injured and need special care. Hack site attendants should immediately get in touch with field supervisors who are working in the area and explain the problem. It may be necessary for the attendant to hold the bird for observation. It is best to place the bird in a large cardboard box or, if possible, simply place the falcon back into the hack box and secure the door. If placed in a cardboard box some type of substrate needs to cover the bottom such as long grass or other soft, absorbent material for the falcon to sit on. If the falcon is transported any distance the box should be held very stable so as not to jar the injured falcon inside. If the bird is moved from the site, it should be kept at a cool, quiet, and dark location. Hack site attendants should immediately get in touch with field supervisors who are working in the area and explain the problem. The bird may need medical attention and have to be driven or flown to care.

After falcons have been released and are ranging farther and farther from the release site for greater periods of time, their tendency to injure themselves becomes higher. There seems to be a high frequency of observed injuries during the last couple of weeks of a hack site. The most common injuries we have noticed are sprained or broken toes and legs. These probably occur as the result of collisions with fences and power lines while hunting. Attendants need to be aware at all times of the overall condition and appearance of each falcon. Any concerns with a particular individual should be noted; record the bands, the suspected problem, and keep an eye on it for improvement or deterioration. Sometimes a bird must be trapped to treat an injury.

APPENDIX II - Reminder Sheet

Hack Site Attendants Duties

Before Release:

- Read Hacking Procedures
- Make sure all birds are feeding daily. Observe for one hour in morning and another hour during the afternoon or evening.
- Spend several evenings up to an hour after dark listening for Great-horned Owls.
- Note the presence of any predators/scavengers using the tower or vicinity.
- Feed thawed quail (one half quail/falcon/day) between 0700 and 0900 every morning. EXCEPTION: Do not feed the day before release.
- If the falcons are not leaving any food uneaten each day, feed more until they do so.
- They should leave one half quail uneaten or a little more. Do not let large numbers of quail accumulate in the box.
- Let supervisors know if quail are accumulating in the box. WE will clean the box when the falcons must be held for more than six days prior to their release.
- Have three quail per bird ready to feed on the day of release. Attendants will bring these on the morning of the release.
- Never let birds associate you with food. Do not let birds see or hear you near the box (this is difficult or impossible after release). Travel to the box out of view of the birds, and never stand in front of the box, either on the tower platform or while on the ground.
- If attendants are concerned about the health of any falcon, identify its band, watch it closely, and call our field supervisors immediately.

After Release:

- Re-read Hacking Procedures
- Be able to account for every bird, and be sure that each one has returned to the tower to eat. Use the shade blind and other locations to account for every falcon daily. Be certain that all birds are feeding after the first four days.
- If all birds fledge and return to the tower to feed on the first or second day, begin daily feedings on the third day. Otherwise, feed on the fourth day (count release day as day one). Always remove any old quail when new quail are provided and always dispose of old quail well away from the hack site.
- Call your supervisor at least twice a week and update them on progress at the release site.
- If a falcon is not observed during a 24 hour period notify your supervisor immediately. If you are unable to contact your supervisor, contact Bill Heinrich at 1-800-377-3716.
- To make sure the falcons are provided with enough food, one or two quail halves should be left each day.
- All quail are fastened to one of the covered hackboards provided on the tower and on perches.
- Try to place food out when the falcons are away from the box.

- Be sure only the Aplomado Falcons are eating the food. Pull all remaining food when leaving for midday break, replacing it with fresh quail in the afternoon.
- At the end of week five, for the last group which was released at the site, feed one daily ration every other day (alternate feeding). Release day is counted as day one.

At the end of the hacking period, ask supervisors for advice and specifics about closing down the site. This will also be discussed during an orientation for each hack site attendant at the beginning of the season.

APPENDIX III - Safety

Please Read Carefully

We have found that most of our hack site attendants are more than willing to tackle almost anything that we ask of them. At the same time, the willing enthusiasm of the attendants is not always accompanied by the experience or caution that should be shown with regard to a certain task. Below are a few notes about safety hazards that we want you to read even though you are probably already familiar with the information (Sherrod, et al.1987).

Snakes

Rattlesnakes are common throughout South Texas and are likely to be found if you stray off the trails into tall grass or brush, or are walking at night. Please use extreme caution and always use a flashlight to look at the ground while walking at night. Some recommend always carrying a snake bite kit made by Sawyer Products, P.0. Box 17127, Tampa, Florida 33682, telephone 1-800-940-4464. Sawyer kits can be found at most sporting goods stores, or in the sports departments of many department stores. In the unlikely event that someone should be bitten we recommend following the instructions provided with the kit and going immediately for help.

Lightening

Several of our hack towers have been struck by lightning, and it is advisable to stay off of them during thunderstorms or threatening weather. As you probably know, it is not wise to stand under trees during thunderstorms (Sherrod, et al. 1987). SEVERE lightening storms occur commonly at our West Texas release locations. DO NOT remain at the blind or on the tower while these storms move through the area! They tend to pass quickly and normal duties are allowed to resume generally within the hour.

Hurricanes

Please be advised to take all hurricane warnings seriously and do not hesitate to evacuate the area if that is what the weather service recommends. The falcons should be fine and can go without eating for several days if an emergency situation should develop.

Sunburn

The Texas sun is hot and intense. You should always be prepared for hot days. Wear a hat, use sun screen, and be sure to always have plenty of water. By not taking the risk of sun burn seriously you may seriously jeopardize your health and ruin your summer.

Insects

Chiggers, ticks, and mosquitoes can be a problem in some areas. We recommend having a supply of insect repellant, and even using a mosquito net headset during periods of high mosquito concentrations. Again, always remember to remove any sun screen and insectrepellant from your hands before handling the falcon's food.