

Conditioning and Release Strategies for the Golden Eagle: Techniques to Increase Survivorship and Mitigate Take



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Prepared By:

**John Goodell, Wildlife Biologist
Principal, Northwest Avian Resources
Portland, OR**

**Vickie Joseph, DVM, DIP. ABVP/Avian Specialist
President, California Foundation for Birds of Prey
Roseville, CA**

**Cordula Atkinson, BS, CLS (ASCP) Master Eagle Falconer & Raptor Rehabilitator
Vale, OR**

**Joe Atkinson, Master Eagle Falconer & Raptor Rehabilitator
Vale, OR**

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Introduction

Overview

The golden eagle (*Aquila chrysaetos*) rehabilitation program outlined in this document was developed by the California Foundation for Birds of Prey (CFBP), and its partners; including golden eagle rehabilitation experts, licensed golden eagle falconers, and raptor biologists with a shared interest in golden eagle conservation. Existing human-caused mortality rates and the need for new mitigation tools warrant an improved, standardized approach to eagle medical care, conditioning, and release strategies. The rehabilitation techniques and recommendations presented here are intended to increase post-release survival of rehabilitated eagles by addressing the unique physical and behavioral traits of golden eagles, and the common challenges inherent in the successful housing, conditioning, and release of suitable candidates. This document is intended for raptor rehabilitators, veterinarians, and agency staff charged with administering eagle rehabilitation permits and advising best practices in eagle rehab activities.

Background

There is growing concern within the raptor conservation community that current rates of human-caused golden eagle mortality may be unsustainable (Collopy et al. 2017, Millsap et al. 2013, Pagel et al. 2010, USFWS 2013, Tack et al. 2017). Best available science indicates the sources of eagle mortality are unusually diverse, including: car strikes, wind turbine strikes, electrocution, lead poisoning due to ingestion of shot carcasses, shooting, nest site disturbance and more (Collopy et al. 2017, Kochert & Steenhof 2002, Pagel et al. 2013, Russell & Franson, 2014, Stauber et al. 2010). Furthermore, shrub-steppe ecosystems across the West are increasingly impacted by energy development, habitat loss, and the spread of invasive plant species (Davies et al. 2011, Knick et al. 2003). These cumulative impacts have far-reaching consequences to eagles and their key prey species, such as ground squirrels (sciurid sp.) and jackrabbits (leporid sp.) still managed as nuisance wildlife in many Western states.

While raptor conservation professionals have regarded rehabilitation as necessary in the context of animal welfare, its usefulness to conserving wild populations is less understood due to limited data on survival of released raptors (Duke et al. 1981, Martell et al. 1991, Sweeney 1997). Specifically, no post-release mortality data (based on telemetry) exists for golden eagles. Also, rehabilitation operations vary widely in experience, adequate facilities and long-term funding; leaving few operations capable of effectively and reliably rehabilitating species with advanced husbandry requirements like the golden eagle. Nevertheless, the low reproductive strategy and high human-caused mortality rates seen in golden eagles provides an imperative to evaluate golden eagle rehabilitation as a mitigation tool in the context of take (Allison et al. 2017, Williams et al. 2013). Thus, there is a need to carefully evaluate and refine rehabilitation

techniques regarding this unique raptor, and support studies that assess rates of survival of released birds.

Golden Eagles vs. Bald Eagles in Rehab

Raptor rehabilitation professionals have limited reference material to use as guidance for eagle rehab. Specifically, commonly cited eagle rehab sources used by rehabilitators and agencies originate from facilities that primarily receive, treat, and release bald eagles (*Haliaeetus leucocephalus*) (Arent & Goggin 2001, Arent & Martell 1996, Chaplin et al. 1989, Servheen & English 1976, Wiemeyer 1981). However, golden eagle behavior, life history, and vulnerability to stress-induced illness differ significantly from bald eagles. Failure to address these differences in a rehabilitation context may significantly reduce post-rehabilitation survival in the wild.

A “Sea Eagle”, bald eagles are opportunistic hunters that subsist primarily on fish and are associated with seacoasts, rivers, lakes, wetlands and estuaries known for high species richness and abundance. Highly social, bald eagles are often found in small to large congregations of varying age classes, where scavenging and pirating food from each other is commonplace and adults display tolerance of immatures and sub-adults (Fischer 1985, Griffin 1981, Knight & Knight 1983). Although they will soar and ride thermals, bald eagles often initiate hunting flights from perches. Bald eagle individuals and breeding pairs generally exhibit moderate to high tolerance of human disturbance (Fraser et al. 1985, Mathisen 1968). Overall, bald eagle life history may be more favorable to the survival of released immature eagles rehabilitated using limited conditioning techniques such as flight pens and creance flights.

Golden Eagles on the other hand are primarily solitary raptors. While breeding pairs may hunt together and often remain on their territory year-round, they display aggressive territorial behavior to other golden eagles, and raptors generally. A highly aerial raptor, golden eagles will fly long distances while foraging and spend significant periods using ridge lift and thermals to migrate or locate prey (Katzner et al. 2012). Although they may initiate pursuits from a perch, they are often observed soaring at significant altitude and utilize their height to command more space, locate prey, and generate high speeds for pursuit (Katzner et al. 2015, Watson 2010).

Golden eagles may nest in forested habitats, but the majority of the western eagle breeding population occupies shrub-steppe and grassland ecosystems. Golden eagles are known to show high sensitivity to human disturbance (Watson, 2010, Richardson & Miller 1997). Unlike the bald eagle, they are strongly tied to jackrabbit and ground squirrel populations in shrub-steppe habitats (Bredrosian et al. 2017, Steenhof et al. 1997). Fledgling golden eagles are typically on their own when the breeding pair stops feeding them and offspring disperse from the territory at or before 5 months of age (Soutullo et al. 2006). The ability of post-fledglings to develop aerial skills and locate and capture prey is essential to their survival. Fledgling and/or post-fledgling (F/PF) aged

golden eagles rehabilitated using traditional techniques such as creance flights without soaring and hunting experience may have significantly reduced chances of survival.

Golden Eagle Rehabilitation

Preventative Medical Care for Releasable Eagles

Intake of golden eagles into rehabilitation facilities has been increasing in many western regions (California Foundation for Birds of Prey 2018, unpublished data). Concerns over the conservation status of the golden eagle suggest managers should evaluate existing rehab practices, and develop a standardized protocol to maximize successful outcomes.

Many eagles admitted to rehabilitation facilities have treatable injuries (Redig 1993), however, existing parasite loads and increased stress may act synergistically to increase their vulnerability to lethal infections. Specifically, golden eagles in captivity appear more vulnerable to aspergillus sp. infection (Joseph 2000) and West Nile virus has become prevalent in many Western communities.

Upon arrival and intake into rehabilitation/veterinary facilities, a standardized course of testing, vaccinations and treatment is recommended:

Initial Evaluations

1. Complete hematology and chemistry profiles (See Joseph 1999)
2. Parasite evaluation (fecal float, fecal smear).
3. Blood lead testing (LeadCare II for in house diagnostics and/or sample send out to a diagnostic laboratory) (Also see Redig & Arent 2008)
4. Whole body radiographs. (Usually performed under anesthesia to obtain a ventral, dorsal, and lateral view)
5. Some eagles will require further testing that might include West Nile Virus testing, bacterial or fungal culture evaluation.

Prophylactic Treatments & Vaccinations

West Nile Virus:

All eagles arriving at the center once pronounced medically healthy should receive two West Nile virus vaccines, given three weeks apart, as a preventative program.

Aspergillosis:

Golden eagles are very prone to Aspergillosis, a respiratory fungal infection often triggered by stress in captivity and/or low body condition from disease and/or starvation. (Joseph 2000, Redig & Ponder 2010, Beernaert et al. 2010) Specifically, prolonged stress results in increased cortisol levels, which depresses the immune system and increases their susceptibility to Aspergillus sp. infection.

Treatment for aspergillosis is complicated, time consuming and expensive. It is very important to start eagles on a preventative program upon arrival to the rehabilitation

facility, or any facility transfer. Three anti-fungal medications used for treatment and prevention are recommended below. Only one medication is necessary for preventative treatment, while combination anti-fungal medications may be used to treat an active infection.

Recommended Preventative Dosing for Aspergillus sp. (See Table 1.)

- Voriconazole (12.5 mg/Kg PO BID) for 14-30 days
- Itraconazole (10 mg/Kg PO SID-BID) for 14- 30 days
- Turbinafine* (10-15 mg/Kg Po SID-BID for 14 -30 days)

*Anecdotal evidence from DVM’s and falconers suggests the anti-fungal Turbinafine (Lamisil) is also a safe and effective prophylactic for aspergillus, however further clinical studies are needed (See **Table 1.**)

Table 1.

Recommendations for treating golden eagles with a prophylactic anti-fungal course

REHAB PHASE	WHEN TO INITIATE TREATMENT
INITIAL INTAKE & MED. TREATMENT	YES
TRANSFER TO FLIGHT PEN	NO
TRANSFER TO NEW FACILITY	YES
START OF FLIGHT CONDITIONING (FALCONER OR CREANCE)	YES

Creance Conditioning vs. Flight Pens

While creance conditioning is a common tool widely accepted and used in raptor rehabilitation (Redig & Ponder, 2010, Arent & Goggin 2001), it requires a repetitive sequence of capture and handling that may increase stress and have questionable value as a conditioning tool for more aerial species like the golden eagle. Given the golden eagle’s susceptibility to stress-induced disease, large rectangular flight pens or “round barn” pens may provide equivalent or superior conditioning outcomes with less stress and invasive handling (Greene et al. 2004). While eagles may spend considerable time perched in flight pens, they typically fly laps in early morning or when staff enter or approach the pen to feed or clean etc.

Facilities rehabilitating golden eagles without a large flight pen ([See Recommended Flight Pen Design](#)) should consider transferring post-treatment eagles to facilities with appropriate flight pens when possible. The time spent in the flight pen will vary for each eagle, depending on the medical problem or injury. Time in the flight pen may range from two weeks, to two months.

While adult and sub-adult eagles (age when admitted to rehab) may be conditioned in a flight pen and released, fledgling and post-fledgling (F/PF) eagles admitted to rehab facilities before learning to soar and hunt, may require more advanced techniques in

combination with flight pen time (See [Age Class and Its Implications to Conditioning & Release Strategies](#), also see [Falconry Techniques to Condition Fledgling/Post Fledgling Eagles](#)).

(Regulators should note that many facilities recommending creance conditioning cannot use flight pens for large raptor species due to climate considerations such as snow loading, and/or cannot afford to construct these facilities. In situations where large flight pens are not an option, creance flight conditioning has been an acceptable alternative for many raptor species.)

Recommended Flight Pen Design

Flight pen structure will vary with location and climate. The minimum size for a rectangular golden eagle flight chamber should be ~4000 square feet; 25ft. tall and at least 100ft. long and 40ft. wide. The forty foot width allows the eagle to bank and turn without landing, thus this minimum width is an important design consideration. Aviary netting should be used on the top and partial sides. This allows maximum airflow especially in the hot summers and provides a cushion upon impact with the sides if the eagle flies into it. When left undisturbed, the eagles can be seen flying laps in the flight chamber without touching the sides. A swinging perch is placed at one or both ends to encourage muscle development as they land and reduce impact and related foot bruising that could lead to foot injury such as bumblefoot (Rodriguez-Lainz et al. 1997).

Round barns may be a preferable alternative to rectangular pens as they provide more usable flight space, and promote continuous flight. Round barns should be at least 200ft in diameter. The perimeter walls are 16-20ft. high and typically constructed with steel posts installed every 10-12ft., tied together with steel purlins. Metal barn siding may be fastened to the interior side of the wall to reduce feather abrasion, however shade cloth may be preferable to promote airflow and cushion possible impacts. A large steel post, 25-30ft. high, is installed in the center and cables are strung from the top of the center pole, to the top of each perimeter post. Netting material is then draped over the entire roof area. Perches are fastened to the center pole and limited swinging perches are installed on the perimeter.

Age Class and Its Implications to Conditioning & Release Strategies

Nestlings and Fledglings (little to no medical issue on arrival)

Occasionally golden eagle nestlings or fledglings are brought into rehabilitation facilities with minor underlying medical issues such as internal parasites and low body mass. These individuals may require simple treatments and short-term feeding regimens to raise their weight, but can be 1) promptly returned to the natal nest site (if feasible), 2) fostered to other active wild eagle nesting pairs, or 3) hacked at suitable release sites (see [Fostering and Hacking Methods](#)). However most F/PF eagles require treatment that prolongs release dates past the seasonal window

where fostering or hacking is possible (California Foundation for Birds of Prey 2018).

Fledgling/Post-Fledgling Eagles

The majority of eagles admitted to rehab facilities are F/PF eagles that require weeks or months of medical care due to starvation, lead poisoning, parasites, orthopedic injury, or other. These young eagles often cannot be fostered or hacked due to hospitalization, testing and treatments (California Foundation for Birds of Prey 2018). Such individuals have missed the critical developmental window afforded by wild adults, who would provision them over the spring and summer months, while they learn aerial skills.

Successful wild post-fledglings learn to locate and negotiate thermals and ridge lift (orographic lift), understand the value of increased altitude for locating prey, and develop the confidence to use this height to stoop at great speeds toward fleeing prey. Anecdotal observations indicate this developmental phase may take longer than most diurnal raptors. Notably, many experienced eagle falconers observe young eagles struggling to understand soaring techniques, seem uncertain of how to descend at speed, and surprisingly, exhibit notable muscle fatigue from early soaring attempts.

Learning to Soar

Soaring is likely one of the most important skills inexperienced eagles must learn to survive in the wild. The significance of soaring to wild eagle movements was recently documented through telemetry data (Katzner et al. 2012 & 2015).

There are two distinct soaring strategies golden eagles use to move large distances: ridge lift (orographic lift) and thermals (Katzner et al. 2015). *Ridge lift* occurs when airflow coming up the side of a hill creates lift and raptors ride this updraft much like a surfer rides a wave. This is an energetically inexpensive way to hunt and migrate. Eagles can course back and forth over the length of the hill looking for prey or use ridge lift to cover large distances in fall and spring migration (Katzner 2012). If ridge lifts ends during a migratory movement, the eagle will need to relocate by flying great distances. Powered flying in search of new hunting ground is energetically expensive and may be especially difficult in high temperatures. In these conditions eagles may use *thermal soaring* to great advantage. Thermal soaring involves finding rising columns of air to gain altitude. Once at altitude in a thermal, eagles eventually leave the air column to cover horizontal distance, locate a new thermal and so forth - in a “stair-step” pattern.

Understandably, it is impossible to promote this nuanced development and achieve the specific needs of these less experienced individuals with brief creance conditioning or even time in large flight pens. While fostering or hacking is preferable when possible (See [Fostering and Hacking Methods](#)), eagle rehabilitators are increasingly looking to falconry techniques to address the unique conditioning/learning needs of eagles that cannot be fostered or hacked (See [Falconry Techniques to Condition Fledgling/Post Fledgling Eagles](#)).

Sub-adults & Adults

Adult golden eagles, and sub-adults (including 1st year immatures more than 5 months old when found) have learned aerial skills in the wild and been successful capturing prey. These individuals do well in a large flight pen for pre-release conditioning (See [Recommended Flight Pen Design](#)). Time in the flight pen allows birds to regain body mass in a stress-free environment, break up scar tissue from surgeries, while also allowing sustained flight to build conditioning. Captive eagles in large flight pens are often observed flying for extended periods.

Falconry Techniques to Condition Fledgling/Post Fledgling Eagles

Eagle Falconry and its Applications for Rehab

Golden eagle falconry has been practiced throughout Eurasia for thousands of years, with a notably strong tradition in Germany, Czech Republic, Slovak Republic, Hungary, and Mongolia. In North America, a small, but growing core of eagle falconers are gradually increasing interest within the general falconry community. By-in-large this group is strongly interested in conservation and willing to donate time and resources to eagle rehabilitation.

While the rehabilitation community offers expertise in medical evaluation, hospitalization, and treatment; the falconry community provides expertise in advanced husbandry, preventative care, behavior modification, physical conditioning, and the development of hunting skills. Furthermore, the USFWS permit rules require eagle falconer candidates undergo significant vetting. Initially, prospective falconers must pass a state test, a facilities inspection, and complete a two year apprenticeship, then practice falconry for an additional 8 years to matriculate to Master level. Only then can a prospective eagle falconer apprentice under another permitted eagle falconer for two more years before receiving an eagle falconry permit.

In order to identify and retain qualified falconers to assist rehab, The California Foundation for Bird of Prey (CFBP) has developed a rigorous vetting program where falconers are carefully evaluated and must sign a contract (See [Falconer Requirements to Conduct Eagle Rehab](#)). An effective golden eagle rehabilitation program should include a similar formal vetting process.

What is Habituation? Understanding Imprinting vs. Manning

Habituation

Raptor rehabilitators are expected to minimize human exposure to injured birds to reduce human-food associations and habituation to people. Habituation is a diminishing physiological or emotional response to a frequently repeated stimulus. Habituation may be temporary, and most common when combined with a positive reinforce like food. In other cases, habituation may be permanent due to imprinting (See *Imprinting*). For example, wild raptors exhibit habituation to moving traffic because power pole perches

along road-sides offer excellent hunting perches – a form of positive reinforcement. In rehab, habituation in adult birds is rare due to the negative reinforcement of invasive medical evaluations, testing and treatment. However habituation is more possible with nestlings and fledglings due to potential for permanent imprinting to humans. Furthermore some concerns exist over the potential of falconry techniques to habituate releasable raptors.

Imprinting

Nestlings and fledgling raptors are vulnerable to imprinting to human handlers in a rehab or falconry setting. Imprinting is an important development phase, during which, a recently hatched bird identifies its parents (and siblings), forms attachments, and develops a concept of its own identity. Imprinting to parents and siblings also results in reduced fear to individuals of the same species. With the absence of fear, nestling, fledgling and post-fledgling raptors often exhibit aggression toward parents and siblings over food competition. Later in life this con-specific aggression is also triggered by territoriality.

When imprinted to humans during rehab or falconry handling, raptors may develop aggressive behavior toward their handlers or other humans. Imprinted eagles are of heightened concern to public safety therefore more scrutiny of techniques used to condition juvenile eagles is warranted. While most juvenile eagles are recovered after the natural imprinting phase has passed, placing F/PF eagles in flight pens with other eagles *before* falconry training is an importance step in preventing partial imprinting to humans.

Creance conditioning and other invasive handling techniques are often interpreted as a tool to prevent imprinting or habituation. However, imprinting is a formative, genetically predetermined developmental process where an individual forms a permanent concept of identity. If hazed with negative reinforcement like capture/creance flights, imprinted raptors remain imprinted, but learn fear or aggression toward certain people or objects used in that negative episode. For example, one facility tried to avoid imprinting a nestling eagle that displayed possible imprint behavior, by chasing it with a broom. The eagle remained imprinted to people, but was terrified by the site of a broom (J. Atkinson, personal communication, 2018).

Manning

Manning is a falconry term describing the process of behaviorally conditioning a wild-taken raptor (post-fledgling age or greater) to accept a falconer in close proximity. This behavioral modification is achieved using weight management, positive reinforcement using food and careful handling to establish trust. While imprinting occurs in nestlings and is often a permanent behavioral state, manning (post-fledgling and older) is temporary and does not appear to result in permanent habituation. Moreover, wild-origin golden eagles in falconry appear to show a heightened recognition of individual

falconers, yet display a healthy fear of other humans even when being flown in falconry conditions.

The take of “passage” wild raptors for falconry is practiced across North America by licensed falconers. The majority of these birds are lost or released yet no evidence exists to suggest their time in falconry resulted in permanent habituation.

Recommended Falconer Requirements to Conduct Eagle Rehabilitation

(Qualifications currently required by the California Foundation for Birds of Prey [CFPB] for falconers to participate in eagle rehabilitation)

To qualify, prospective falconer-sub-permittee candidates should meet the following criteria:

- Master Falconer permit holder in good standing
- Provide four qualified master falconer references
- Resides in an area suitable for free flight and abundance of game for eagles to hunt.
- Fly and hunt the eagle consistent with flight-conditioning training program.
- Provide timely updates on eagle’s progress
- Submit to facility inspections by CFBP and if required, state or federal regulatory agencies.
- The eagle will not be exposed to the public and maintained in private during the training process
- All eagles entering the program remain under the permit of CFBP. They are not transferred to the falconer’s license.
- In the event that a falconer does not follow the required training protocol or has acted in a way not deemed to be in the best interest of the eagle, the falconer’s sub-permittee designation will be terminated and the eagle will be removed from the falconer’s care.
- The final decision to place an eagle with a falconer will be made by the program director and the CFBP Eagle Committee
- The falconer will sign a memorandum of understanding with CFBP acknowledging the above mentioned criteria and stipulations.

Equipment & Facilities for Falconry Flight Conditioning

- The dimensions for the building are 12ft x 12ft x 12ft with a 3ft solid screen perch 3ft from the rear of the building. The floor is covered with ½ inch thick, heavy rubber horse stall mats with a thinner ¼ inch thick mat on top, which is removable for cleaning. A tarp is tacked behind the perch and attached to the wall behind the perch to catch feces and is also removable for cleaning. There is a vent in each wall and a fan is mounted above the door to move air on warmer days. There is one window that allows light and also more airflow into the chamber.

- This building is for training only, with the eagle tethered to the screen perch, not free lofted (at liberty to fly loose in the building), to keep stress to a minimum during the training process. Preventing the eagle from seeing outside stressors like people, dogs, cars and the like, is critical to the well-being of the eagle. Once the door is closed they settle down very quickly.
- Clean water must be available at all times.

Falconry Conditioning Program

Flight Pen

This free flight conditioning program is designed for fledgling to post-fledgling age (F/PF) eagles with limited free-flight experience and no hunting experience. Following the medical treatment phase, these eagles are placed in the eagle flight pen to social them with other eagles before flight training begins, in order to avoid possible imprinting or habituation issues and allow young eagles time to learn appropriate behavior with other eagles. The time spent in the flight chamber with other eagles may range from 2-4 months, depending on their injuries and response to treatment. (See [Recommended Flight Pen Design](#))

Manning the Eagle

The traditional method of ‘manning’ a raptor entails “flooding”, a method where the falconer incrementally exposes a wild bird to new stimuli while on the glove until it overcomes its fear. While many raptors respond quickly to this technique, golden eagles are difficult to “man” on the glove due to their size and strength, and most exhibit high stress to this approach, making them vulnerable to Aspergillosis.

The manning process (taming for glove handling and free-flight) described herein is a low stress method that does not require any initial handling of the eagle, but should only be conducted by an experienced eagle falconer. The eagle is placed in a specially designed mews, where light is controlled and the bird is tethered on the screen perch to restrict its movement. It is tethered using anklets, jesses, jess extender, swivel and leash. The leash length is long enough to allow the eagle to jump down and reach the floor on both sides of the screen perch. The rubber horse mats on the floor reduce traction when bating, causing the eagle to quickly stop bating and, as a result, foot injuries are eliminated. This also serves to reduce feather damage while in this captive setting. Restricting the eagle’s movement is imperative to insure the eagle’s safety. Initially, the eagle is provided food with no human presence. The door is opened, food is tossed in, the door is closed and the trainer leaves.

In a few days, the eagle starts to anticipate the trainer’s arrival, as it means food. When this occurs the trainer starts the process of manning. At first, the eagle’s perception of people is negative, brought on by all the previous handling in the context of medical treatment. As the days go by, the trainer waits outside with the door partially open,

peeking inside, and watching the eagle feed in their presence. Each day, the trainer moves further into the chamber until they are sitting at the far end of the screen perch as the eagle feeds. The trainer always approaches from the left side of the perch, establishing the right side as the eagle's 'safe zone', which should never be encroached upon.

The next step is to place the food closer and closer to the trainer on the perch, giving the eagle the choice to move closer to take the food or retreat back to its safe zone. Once the eagle will walk over to get the food, the next step is to place the glove on the perch next to the food. When the eagle is comfortable coming over to the glove for food, the trainer moves closer with the food in the glove and lets the eagle take it out of the glove. Finally, the trainer places their gloved hand on the perch with the food in the glove but, this time, when the eagle grabs the food, the trainer holds on and doesn't let the eagle take it away. This leaves the eagle no choice but to eat the food out of the gloved hand.

Once this takes place, training moves along quickly and it is not long before the eagle is feeding on the fist. All of this was accomplished on the eagle's own terms, nothing was forced, thereby keeping the stress level to a bare minimum. The trainer has changed the eagle's perception of the trainer from something scary to a food provider, to the point that they look forward to their arrival.

In general, this stage usually takes two weeks. The goal is to allow the eagle to track along with the training and the falconer at its own pace. When training is rushed or moves along too rapidly for the eagle to understand, setbacks occur and fear comes back into the eagle's mind. This process cannot be rushed, as it is building the trust and foundation for all the training to come.

The length of time required can vary with each individual eagle and its background. How and why it came into the rehabilitation center and how it was previously handled are big factors affecting training. Eagles that have been repeatedly netted for examination and medication, or have poor feather quality due to disease or housing issues, present setbacks for the falconer to overcome and may prolong training time and this initial trust building stage.

Lure Training & First Free Flight

Once the new eagle is comfortably feeding on the glove the trainer introduces the lure, which will be the main callback method. Calling a rehab eagle to the fist is not recommended as it increases the dependency of the eagle toward the falconer and promotes an unnecessary food-association with people. Raptors that have been trained to come back to the glove for small pieces of food are not looking for moving prey; they are trying to figure out how to get the falconer to put food on the glove. By having the eagle looking for the lure, it is looking away from the trainer, and starting to learn to hunt. Further along in the training, the eagle is shown the lure to recall it after an

unsuccessful chase or flight. The eagle is then given a suitable amount of food to entice it to step up on the fist for another flight.

Once the trainer has introduced the lure, training picks up speed quickly and free flying is only a few days away. Each time the eagle is flown to the lure the trainer increases the distance. In short order, the creance is removed and the eagle is free flying. Generally, it takes five to six weeks to reach this point in the training process. This can vary with each individual eagle.

Beginning Soaring

Once flying, the trainer should continue to lengthen the distance until the eagle is flying a quarter mile 2-4 times in a training session. Then the trainer introduces terrain by moving into natural habitats to lure train. The trainer continues to call the eagle from distance but now over and across valleys, ridges and other desert landscapes. It is at this point, when the eagle is on its way, flying to the lure, the trainer will hide the lure as the eagle closes in, causing the eagle to flare up and begin to circle. This is the first step to get the eagle to soar. Just as distance was increased, now the number of times the eagle is allowed to circle before being called to the lure is increased, with the eagle eventually going to significant heights.

With the eagle now circling overhead the trainer can begin the hunting phase of the training. All raptors will react to the sight of game and in the case of eagles, they seem to have a natural interest in jackrabbits. However their ability to maneuver and capture a running jackrabbit may take time. Descending from a soar at 150mph toward a running jackrabbit takes practice. This falconry-based conditioning method allows the eagle time to practice and make mistakes without the pressure of finding their next meal at the same time, just as their parents would do for them in the wild. (See video narrative of training techniques [here](#))

Training during the Molt

As in all birds, raptor molt timing and sequence coincides with their breeding season – the most physiologically demanding period in their life history, when breeding pairs must not only feed themselves but provision nestlings. During this period, birds molt in a sequential and symmetrical pattern to allow new feather growth while not undermining flight ability as they defend the nest site and provision young. In many cases, wild raptors (especially males) delay their molt while their provisioning rates climb; then finish in the fall after young have dispersed.

Molt timing is also connected to photoperiod and physiological changes including hormone shifts that stimulate birds to migrate. In falconry conditions, flying during the molt often results in incomplete molts – while normal in the wild, it is less desirable to falconers who strive for a near complete flight feather molt. As a result, falconers put their birds into mews in spring, raise their body weight, often include UVB lighting, with the goal of artificially initiating and accelerating the molt during the summer months.

In most state falconry regulations, the take of game species in falconry is prohibited from April to August. Thus molting during this time avoids losing birds due to hormonal shifts and readies their birds for the start of legal hunting seasons on September 1st. The goal of rehabilitation, however, is not to prepare birds for the fall game hunting seasons, but to release it as soon as possible. Thus molting has less relevance to flight training, unless flight feathers are notably damaged.

Recommendations for Release

Fostering and Hacking Methods

Fostering

Eagle eggs and nestlings may be successfully fostered by wild golden eagle pairs actively incubating or raising nestlings of their own (Fyfe et al. 1978, Temple 1978). Eggs or nestlings, or even fledglings (not older than 10 weeks) may be placed in or near the nest of an active golden eagle pair. In some cases where nestlings or fledglings require treatment, rehab facilities should consider applying the minimal course of treatment necessary if fostering is possible. However, data suggests most eagle rehab candidates require hospitalization and treatment that prohibits fostering within the appropriate developmental window (California Foundation for Birds of Prey 2018). Also, fostered nestlings or wild nestlings may be vulnerable to siblicide especially with mixed age nestlings. Therefore, fostering requires the coordination with regional biologists to select the most appropriate nesting pair.

We recommend rehab facilities conducting golden eagle rehab, establish an Eagle Rehab Response Network in their region. This network would consist of agency eagle biologists and experienced climbers who would identify appropriate nest sites and coordinate fostering with an experienced climber. Furthermore we suggest placing animal carcasses near the nest site of the fostering pair for extended periods to increase post-fledgling survival.

Hacking

Hacking is a soft-release method used to release and/or reintroduce nestling raptors and increase their rates of survival (See Sherrod et al. 1982 for a detailed description of hacking). Hacking golden eagles has proven successful in many regions throughout North America. In some cases where nestlings or fledglings require treatment, rehab facilities should consider applying the minimal course of treatment necessary if hacking is possible. For example, a hacking candidate is better off gaining body mass at hack vs. in holding.

We recommend hacking options should also be coordinated by an Eagle Rehab Response Network in their region. This network would consist of agency biologists and rehabilitators, identify suitable hacking sites based on knowledge of surrounding eagle

territories and available prey base. Furthermore we suggest placing animal carcasses within hack sites for extended periods when possible, to increase post-fledgling survival.

Adult and Sub-Adult Eagles

Large Flight Pen Performance:

Adult or sub-adult eagles (age when first admitted) already know how to soar and hunt. Therefore these individuals may be sufficiently conditioned for release in large flight pens with swinging perches (See [Recommended Flight Pen Design](#)). We suggest candidate eagles should be observed flying the length of the flight pen and regaining the tallest perch in one continuous flight without landing on the ground and hopping to the tallest perches. Preferably, eagles should be observed making multiple laps within the flight chamber.

Fledgling and Post-Fledgling Eagles

Hunting Performance:

The regular pursuit of wild game is one of the key steps in preparing eagles for life in the wild. The trainer's goal is to have each eagle catching at least 6-12 head of wild game prior to release.

Soaring Performance:

Sustaining soaring flight for 1-2 hours or more is the minimum requirement before release.

Timing Release: Seasonal and Ecoregional Considerations

Seasonal Timing

Within the rehabilitation community, it is commonly understood that releasing less experienced predatory animals during the seasonal peak abundance of their prey is preferable. In effect this allows for a "soft release", whereby a predator that is likely not in optimal wild condition or has not gained experience hunting, is given access to abundant prey comprised of high proportion of the young of the year. These juvenile prey animals typically are present in higher abundance and densities, are easier to find, and capture; and allow the predator time to gain condition and confidence before periods of prey scarcity develop in the winter months.

This release strategy parallels the reproductive strategies of the golden eagle, where early courtship and nesting (relative to other diurnal raptors) in-turn produce fledgling dates that coincide with the emergence of young ground squirrels and/or jackrabbits in May and June (Steenhoff et al. 1997). This strategy provides juvenile eagles with at least 6 months before winter conditions limit prey availability.

Furthermore, it is well known that adult golden eagles are exceptionally territorial toward other eagles and diurnal raptors and this behavior is particularly intense during the courtship phase in mid to late winter through nestling phase (Burgo 1987). As is the case with other raptors, as fledglings leave the nest area, adult territorial behavior eases

as adults show more tolerance to immature eagles within their territory; as an instinctive behavior to protect possible young as they gain independence. By fall or early winter, adult pairs re-assert their territory and may display less tolerance to immature eagles.

As a result, releasing F/PF eagles during the approximate April-October seasonal window of reduced territoriality and increased prey abundance, should maximize their survivability. This may require requesting extensions from the USFWS.

Ecoregional Approach

The timing of eagle release in northern latitudes should be considered more carefully than southern areas within the golden eagle range. For example, in the southern range of the black-tailed jackrabbit (i.e. Mojave and Sonora Basin and Range, Central California Valley and others), reproduction can occur year-round and fossorial sciurids may be above ground nearly year-round except for estivation periods in late summer. In contrast, jackrabbit reproduction in northern regions (i.e. Columbia Plateau, Wyoming Basin, Snake River Plain and others) may span only three months in the spring and summer and fossorial sciurids may appear in March and April, and return underground by mid-July to estivate during the remaining summer heat (Davis 1976, French et al. 1965).

Golden Eagle Rehab as a Mitigation Tool

Evaluating Post-release Mortality Rates

Golden eagle rehabilitation may be a viable mitigation tool in the context of industry take, however there is a need to assess of post-release survival rates in rehabilitated golden eagles. In North America, few studies have attempted to evaluate survival rates in rehabilitated raptors, and none have attempted to experimentally test the effects of varied rehabilitation techniques on post-release survival. Specifically, two studies in North America have evaluated post release mortality rates in rehabilitated raptors using band returns and incidental observations (Duke et al. 198, Sweeney 1997) and two other studies used VHF radio telemetry techniques (Hamilton et al. 1988, Martell et al. 1991). Currently no data exists regarding the post-release survival of golden eagles using telemetry.

Satellite transmitter technology has enabled researchers to accurately estimate juvenile golden eagle mortality in the wild (Murphy et al. 2017, McIntyre et al. 2006). Using this telemetry technology, we suggest an evaluation of post-release mortality should aim to 1) assess rates of mortality for all post-release golden eagles across all age classes, and 2) compare post-release mortality for F/PF eagles (age when first admitted for treatment) conditioned using the falconry-based techniques proposed here vs. standard creance and/or flight pen methods currently in use by most rehabilitators. Currently the

USFWS is in the early stages of designing such a study; however there is no funding available (Milsap, B. Pers. Comm).

Estimating Costs

Accurate rehabilitation cost estimates are essential to developing rehab as a mitigation tool. The following is an estimate of per-eagle costs associated with medical treatment and post-treatment rehabilitation and release (See [Table 2.](#)). Golden eagles admitted to veterinary and/or rehabilitation facilities exhibit a wide range of injuries and symptoms. The resulting treatment may require short or long hospitalization and treatment. While some DVM's and rehab centers are able to donate services, direct medical and rehabilitation costs may range from a low of approximately \$2,000.00, to a high of approximately \$5,600.00 per eagle – from intake to release.

This cost estimate is based on recommended standards for medical evaluation, testing, treatment and conditioning. Currently, many facilities undertaking eagle rehab may not have the necessary resources to follow these standards. By developing eagle rehab as a mitigation tool, rigorous evaluation, testing, treatment and conditioning could be applied to most, if not all, releasable golden eagles admitted to rehab facilities. As a result, more rehabilitated eagles will be returned to the breeding population.

Table 2.
Estimated Medical and Rehab Costs Per/Eagle*

DESCRIPTION	LOW QTY	HIGH QTY	COST	LOW EST	HIGH EST
Intake and Evaluation					
NON-PROFIT EXAM	1	1	\$10.00	\$10.00	\$10.00
BRIEF ANESTHESIA	1	1	\$80.00	\$80.00	\$80.00
ANESTHETIC TECH/MONITORING (15MIN)	1	1	\$35.00	\$35.00	\$35.00
DIGITAL RADIOGRAPHS 4 VIEW STUDY	1	1	\$240.00	\$240.00	\$240.00
AVIAN COMPREHENSIVE BLOOD PROFILE	1	2	\$170.00	\$170.00	\$340.00
LEAD (PB) TEST (IN-HOUSE LEADCARE II)	1	2	\$70.00	\$70.00	\$140.00
FECAL EXAM; FECAL FLOATATION	1	2	\$35.00	\$35.00	\$70.00
Hospitalization and Treatment					
HOSPITALIZATION	3	14	\$60.00	\$180.00	\$840.00
FLUID THERAPY	1	2	\$55.00	\$55.00	\$110.00
INJECTIONS MULTIPLE	3	5	\$30.00	\$90.00	\$150.00
IN-HOSPITAL TREATMENTS	1	5	\$10.00	\$10.00	\$50.00
NEBULIZATION BID	1	1	\$55.00	\$55.00	\$55.00
VORICONIZOLE 50MG TABLET	4	8	\$18.00	\$72.00	\$144.00
IN-HOSPITAL MEDICATIONS	1	3	\$15.00	\$15.00	\$45.00
FEEDING (COTURNIX QUAIL)	30	60	\$2.00	\$60.00	\$120.00
Flight Pen Conditioning					
FEEDING (COTURNIX QUAIL)	60	240	\$2.00	\$120.00	\$480.00
REHABILITATION STAFF TIME	10	50	\$25.00	\$250.00	\$1,250.00
Falconry Training & Release					
FEEDING (COTURNIX QUAIL)	240	720	\$2.00	\$480.00	\$1,440.00
				Low	High
			Total	\$2,027.00	\$5,599.00

*Estimates based on cost data from the California Foundation for Birds of Prey and other input from regional DVM's. These cost estimates reflect a recommended standardized approach to eagle evaluation, initial testing, treatment, and preventative care.

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