

# **THE NORTH AMERICAN BANDERS' MANUAL FOR RAPTOR BANDING TECHNIQUES**

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**A product of the  
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THE NORTH AMERICAN BANDERS' MANUAL FOR RAPTOR BANDING TECHNIQUES

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## PREFACE

The purpose of this manual is to provide for all banders of raptors in North America the basic information to safely and productively conduct banding. This manual is an integral part of several other publications, including a Banders' Study Guide, Trainer's Guide, and taxon-specific manuals (e.g., landbirds, hummingbirds, shorebirds, waterfowl, seabirds). While some of the material in the Banders' Study Guide was designed to apply more to certain taxa, the material was included if it applied to two or more of the taxa mentioned above. For instance, mist netting is used to capture most taxa and thus is discussed there, but skull pneumatization is used primarily for landbirds and therefore is discussed only in the landbird manual. Some judgments have been made; for instance, traps for catching landbirds are mentioned in that manual, although similar traps are used for shorebirds and waterfowl. The North American Banding Council felt, however, that the special adaptations required for capture of these quite different taxa merited separate treatment in the taxon-specific manuals, of which this Raptor Manual is one.

We trust that the Banders' Study Guide will be read by all banders and trainers. While guidelines used by various individual trainers and stations may differ slightly from the general guidelines set down in the manuals and guides, we and the North American Banding Council urge, at the least, that full consideration be given to the guidelines presented there, and that trainees be fully exposed to the full variety of opinions that are captured in these publications.

This is a truly cooperative venture, representing many hours of work by many individuals and their institutions. As such, it was necessarily an inclusive document covering, as much as possible, all responsible views of banding in North America. As can be imagined, this was at times an interesting effort. We trust that the final product is worthy of the effort that all have put into it, and of the birds that we study and cherish.

—The Publications Committee of the  
North American Banding Council  
C. John Ralph, Chair

## ACKNOWLEDGMENTS

The trapping methods described in this manual for migration trapping stations depend in large part on the experience of W. S. Clark at Cape May, New Jersey (Clark 1970). Many of the trapping techniques have been modified and are specific to the Golden Gate Raptor Observatory. They are included as examples of how particular problems have been solved and are not intended to be understood as the only valid methods.

We thank the following reviewers who provided helpful and thoughtful suggestions for improvements to early drafts of this manual: Ursula Banasch, Bill Clark, Ray Cromie, Brenda Dale, Allen Fish, Eric Feuss, Steve Gelman, Ed Henckel, Bob Hubert, Stuart Huston, Jerry Jackson, Greg Kaltenecker, Bob Lehman, Lucie Metras, Wayne Nelson, Hardy Pletz, Alexandra Rose, Bob

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—Buzz Hull and Pete Bloom

## 1. INTRODUCTION

This manual emphasizes the techniques and equipment in use at migration trapping stations while trapping and banding diurnal raptors. Although much of the trapping process discussed here is specific to such stations, the banding and processing techniques are common to many raptor banding studies. Short sections covering some non-migration raptor trapping and banding techniques and situations are included, but those are not exhaustive. The numbers of trap types and methods currently used in trapping raptors are so varied, and in some cases so specialized, that it is unrealistic to cover them all in detail in this manual.

Banding studies of migrating raptors have several purposes:

- (1) defining flight paths, wintering areas, and origins of migrating raptors;
- (2) defining seasonal timing of migration;
- (3) assessing health and condition of raptors;
- (4) defining morphometric characteristics of particular raptor species in the geographic areas involved; and
- (5) monitoring variations in all of the above over time.

Capture techniques involved in road trapping of specific individuals and the banding of nestlings allow for long-term studies of natal and breeding dispersal, survivorship, mate and territory fidelity, and the development of ageing methods.

Road-trapping techniques allow for more selectivity because the bander is moving from location to location in search of the desired species, age, or sex. Because the raptors usually are perched, they can be evaluated more closely prior to setting the trap. Road trapping can be used on migrating, wintering, and most importantly, resident raptors, whose long-term survival characteristics are more readily monitored than those of migratory individuals.

Banding of nestlings is accomplished by climbing to a nest box, other artificial structure, tree nest, or cliff ledge, although a few species nest on the ground. Some utility companies allow their poles to be climbed for raptor nestling banding or, more frequently, will provide their own professional personnel. Most building management staff permit access to roof tops for banding of raptor nestlings. These activities also provide a public relations opportunity.

## 2. THE BANDER'S CODE OF ETHICS

Bird banding is used around the world as a major research tool. When used properly and skillfully, it is both safe and effective. The safety of banding depends on the use of proper techniques and equipment and on the expertise, alertness, and thoughtfulness of the bander.

The Bander's Code of Ethics applies to every aspect of banding. The bander's primary responsibility is to the bird.

## *The Bander's Code of Ethics*

1. *Banders are primarily responsible for the safety and welfare of the birds they study so that stress and risks of injury or death are minimized. Some basic rules:*
  - **handle each bird carefully, gently, quietly, with respect, and in minimum time**
  - **capture and process only as many birds as you can safely handle**
  - **close traps or nets when predators are in the area**
  - **do not band in inclement weather**
  - **frequently assess the condition of traps and nets and repair them quickly**
  - **properly train and supervise students**
  - **check nets as frequently as conditions dictate**
  - **check traps as often as recommended for each trap type**
  - **properly close all traps and nets at the end of banding**
  - **do not leave traps or nets set and untended**
  - **use the correct band size and banding pliers for each bird**
  - **treat any bird injuries humanely**
2. *Continually assess your own work to ensure that it is beyond reproach.*
  - **reassess methods if an injury or mortality occurs**
  - **ask for and accept constructive criticism from other banders**
3. *Offer honest and constructive assessment of the work of others to help maintain the highest standards possible.*
  - **publish innovations in banding, capture, and handling techniques**
  - **educate prospective banders and trainers**
  - **report any mishandling of birds to the bander**
  - **if no improvement occurs, file a report with the Banding Office**
4. *Ensure that your data are accurate and complete.*
5. *Obtain prior permission to band on private property and on public lands where authorization is required.*

Nothing matters so much as the health and welfare of the birds you are studying. Every bander must strive to minimize stress placed upon birds and be prepared to accept advice or innovation that may help to achieve this goal.

Methods should be examined to ensure that the handling time and types of data to be collected are not prejudicial to the bird's welfare. Be prepared to streamline procedures of your banding operation, either in response to adverse weather conditions or to reduce a backlog of unprocessed birds. If necessary, birds should be released unbanded, or the trapping devices should be temporarily closed. Banders should not consider that some mortality is inevitable or acceptable in banding. Every injury or mortality should result in a reassessment of your

operation. Action is then needed to minimize the chance of repetition. The most salient responsibilities of a bander are summarized in the Bander's Code of Ethics; more details are found in Section 13 of the Banders' Study Guide.

Banders must ensure that their work is beyond reproach and assist fellow banders in maintaining the same high standards. Every bander has an obligation to upgrade standards by advising the Banding Offices of difficulties encountered and to report innovations.

Banders have other responsibilities too. They must submit banding data to the Banding Offices promptly, reply promptly to requests for information, and maintain an accurate inventory of their band stocks. Banders also have an educational and

scientific responsibility to assure that banding operations are explained carefully and are justified. Finally, banders banding on private property have a duty to obtain permission from landowners and make certain their concerns are addressed.

### 3. HANDLING RAPTORS

Handling either nocturnal or diurnal raptors can be an intimidating experience to the novice but can be done safely with training and practice. The safety and welfare of the raptor should remain uppermost in your mind at all times. By using recommended grips, you will be able to safely handle the raptor. Raptor banders accept occasional scratches and bites as part of the cost of banding these birds.

Most raptors use their feet as their main defensive weapons. Handling techniques are designed to protect the bander from injury caused by talons and, at the same time, protect the raptors' legs from injury. Most falcons and occasional individuals of other species also bite. Falcons are the only diurnal raptors below eagle size that are likely to do any real damage with their beaks. Some owl species also may inflict painful bites if given the opportunity.

Avoid wearing gloves during most raptor handling situations. Gloves can prevent the handler from sensing what the appropriate pressure should be. Too much pressure increases the chance of damaging the raptor, while too little pressure may allow wings or feet to slip free. When banding older nestlings of larger hawks or falcons, a light leather glove may be appropriate for a quick grab of the legs of a feisty or aggressive bird. After the raptor is secured, the glove should be removed.

A right-handed bander normally holds the raptor in the left hand, leaving the right hand free to record data and manipulate measuring and banding tools. Left-handers may feel more secure holding the bird in the right hand. All experienced banders are comfortable shifting birds from hand-to-hand and changing from one grip to another. Changing grips is often required for accurate, safe measurements and banding.

Most owls remain relatively calm during banding. Hoods can be used to calm raptors during banding, but the numbers of raptors routinely encountered at a migration banding station may make the use of hoods impractical.

#### 3.1. The Basic Leg Grip

Secure the legs and feet and control the talons. Raptors smaller than *buteos* must be gripped above the tarsal joint, as close to the raptor's body as possible to protect the thinner legs of these birds. Except for the initial control of some nestlings, gloves are not recommended for handling and banding raptors. Hold both legs securely in the same hand, with the index finger between the legs, and the thumb and third finger holding the legs. Keep the bird's wings gently closed with your other hand, or by holding the bird close to your body or your arm.

#### 3.2. The Cradle Hold

This hold is recommended for carrying a large raptor below the size of an eagle. The grip is used with the palm of the hand

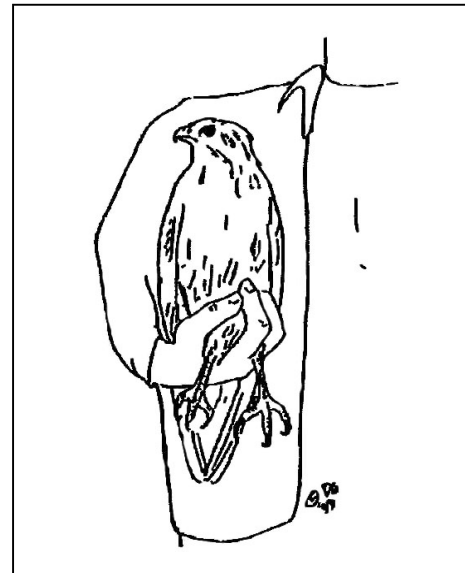


Figure 1. The Cradle Hold.

against the bird's belly and breast and the fingers pointing toward the head (Fig. 1). Keep the raptor close to your body with its back against your upper body and upper arm. Shield the bird from the wind with your body to help calm it. You may further calm an excitable raptor by draping a piece of cloth over its head to shield its eyes. This also can keep a biter from turning around and nipping while being cradled.

The Cradle Hold leaves one hand free to open a door, reset a trap, manipulate a band, and so on. If you need to hold a particular bird more securely, you may use the two-hand cradle by simply rotating the raptor onto its back in the crook of your other arm. This is done without changing the Basic Leg Grip.

#### 3.3. The Upright Hold

This is similar to the Cradle Hold, but instead of tucking the raptor back into your upper arm and body, you hold it in an upright position with its back firmly against your chest. This is a good hold for photographing the ventral plumage, particularly when the handler extends one wing to show the underwing plumage.

#### 3.4. The Backhand Hold

For this hold, reverse the Basic Leg Grip. Place your index finger between the bird's legs, with the thumb and third finger grasping the two legs and the fingers pointing toward the head (Fig. 2). Keep the back of your hand, not your palm, against the belly. This hold is sometimes called the "Knuckle Hold," because the handler's knuckles are against the raptor.

This is also a good hold for taking photographs because little plumage is obscured. The Backhand Hold allows slightly less control than the Cradle Hold. A good hold for showing leg feathers for a photo is the Upside-down Hold. The raptor is grasped by the feet and held head down. The raptor usually also extends its wings giving a good view of the wing plumage.

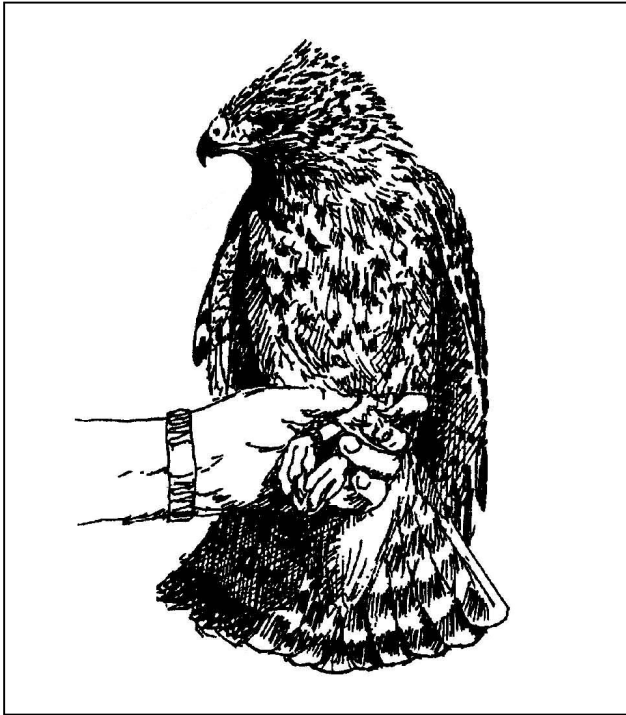


Figure 2. The Backhand or “Knuckle” Hold.

### 3.5. The Ice-cream Cone Hold

This hold, although used by some raptor trappers, should be used only by experienced banders. This method is sometimes appropriate as a temporary hold while the handler is in the process of securing a small, struggling raptor. With the legs fully extended down the tail, the upper parts of the legs and tail and lower parts of the wings and body are clenched together in one fist as if you were holding an ice-cream cone. This hold decreases the feel that the handler has of the legs and can cause extensive bending to both wing and tail feathers. The usual argument is that it controls the wings, but we feel that this hold is ineffective for this. Often a little struggle by the bird can free its wings. This is especially true for accipiters with their short rounded wings and for large buteos if the handler has small hands. The handler is then left holding only the legs and somewhat slippery tail feathers. At this point the tendency by the handler is to squeeze tighter, which can further damage tail feathers. A raptor that has freed its wings from the grip can sometimes get one leg free with attendant danger to the handler from the talons, and danger to the raptor when it continues to twist and flap while being held by only one leg.

In most cases, the choice of hold depends upon the particular procedure being performed as well as the preference of the handler. The handler should use a hold with which he or she is comfortable. A relaxed confident handler often means a calmer, less-stressed raptor.

### 3.6. Alternate Holds for Larger Raptors

An eagle should be held by one person while a second person bands the bird. For instance, the handler would use one

hand to firmly grip each leg while the second person bands the eagle.

### 3.7. Storing Raptors

Raptors can be stored in tubes or cans for short periods prior to and during banding. Tubes for this purpose can be made from two cans joined to make a long tube with one end open, and one closed that is pierced by a number of ventilation holes for breathing (Fig. 3). Vent holes must be flattened or smoothed on the inside to avoid injuring birds. One method to keep the raptor from backing out of the tube is to use a Velcro strip that can be fastened across the open end.

After putting the raptor in a tube, place it in a cool, dark spot, away from the main activity of the banders, but within view and hearing. The tubed bird should always be placed in a horizontal position with its dorsal side up; never place a tubed raptor on its head for storage. When temperatures are extreme, holding a raptor for any length of time may endanger its life. Raptors cannot cool down in a tube. Never allow the tubed raptor to be placed in direct sunlight. Monitor all stored raptors for signs of stress by observing the tail pumping. Vigorous tail pumping and struggling indicate stress.

#### 3.7.1. Fit

Fit is crucial when storing a raptor in a tube. The fit must be snug but not so tight as to restrict breathing or abrade feathers. A range of tube sizes, adequate to properly fit the species and sexes that are likely to be captured, should always be on hand. If a proper fit cannot be achieved, the bird must be banded, processed immediately, and released. After the raptor is slipped into the tube, secure a Velcro strap across the back of the tube or place a small rock in the back of the can to keep the bird from backing out.

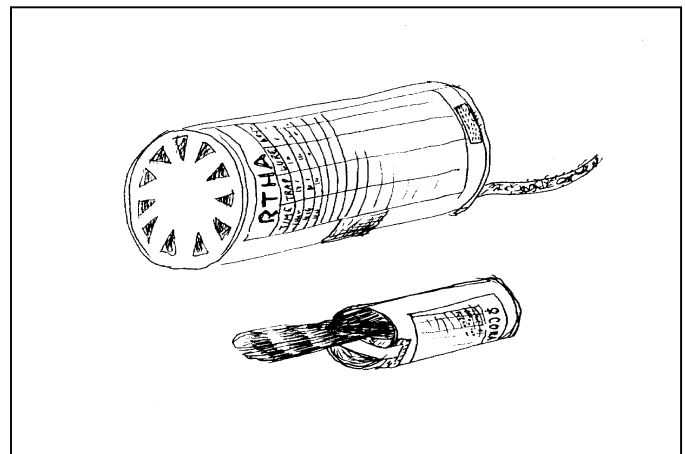


Figure 3. Storing a raptor in a can or tube. The top can is empty showing an open Velcro strap, air holes in the closed end, and the data sheet attached to the can. The bottom can shows the proper position for storage with a raptor on its ventral side and the Velcro strap fastened.

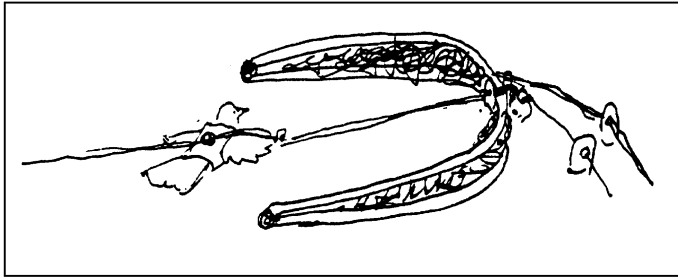


Figure 4. Bownet in the cocked position, with the lure at the center.

### 3.7.2. Crop

A full crop can cause several problems for a raptor in a tube. These include breathing and heat exchange problems. Before slipping a raptor into a tube, always check the crop. If the bird has an extremely full crop, consider banding and processing it outside the tube. Place the bird in the tube only for the few moments needed to weigh it.

### 3.7.3. Removing the raptor from the tube

Removing a raptor from a tube can be daunting, especially when the down feathers under the tail are fluffed, hiding the feet and talons. Peer into the tube, and if you can see the tarsal joints, grip them and gently begin to pull the bird out of the tube by its feet. You may have to tip the tube slightly and gently rotate it to move the bird closer to the opening. Be careful in pulling the feet out as the talons may hook on the lip of the tube. Some handlers prefer to pull gently on the tail feathers to begin the extraction process. If the bird immediately begins to move freely toward the opening, continue the gentle pull, and then switch your hold to the tarsi as soon as possible. If resistance occurs, stop pulling the tail feathers immediately. You will have to feel around in the tube for the legs.

After you grasp the legs, slide the raptor far enough out to grasp both legs in the Basic Leg Grip. Pull the raptor gently the rest of the way out of the tube, paying close attention to the condition of the feathers. Remember that as the raptor comes out into the light and can see you again, it may struggle vigorously for a moment or two. When you are about to remove the raptor from the tube, it may be helpful to alert others nearby to minimize noise and activity.

### 3.8. Releasing the Raptor

Hold the raptor in the Basic Leg Grip, face into the wind, and gently lift the raptor into the air as you release your grip on the legs. If the wind is especially strong, face at a right angle to the wind so the raptor will not have to maneuver around you. Always be sure that the most likely direction of flight will be clear of obstacles.

Frequently the raptor will perch immediately upon release and pick at the band.

## 4. CAPTURE TECHNIQUES AND TRAP TYPES

Several methods and kinds of equipment are used to capture raptors. The most common methods are discussed in this section. A more complete review of techniques can be found in Bloom (1987) and Bub (1991).

The selection of capture methods depends upon study objectives, species involved, season, and the study area. Traps in most widespread use will be described in this section.

Bownets, mist nets, and dho-gazas often are used effectively in combination at migration trapping stations to attract and capture the variety of raptors usually passing these locations.

### 4.1. Bownet

Bownets (Fig. 4) are effective for trapping diurnal raptors at migration trapping stations, wintering areas with high numbers, and on nesting territories. A typical bownet consists of two half-circles of light, tubular metal as rims, with netting material strung loosely between them. Nets with a 1.5-m (5-ft) diameter are useful for most situations. Hinges and springs connect the two half-circles at their ends. One half is staked to the ground. A trigger or release mechanism holds the moveable half of the trap cocked above the fixed half (Fig. 5). A line attached to the release mechanism is pulled by the trapper to spring the trap, or the trap is triggered by remote control. These traps are used with live lures or bait (e.g., carrion) to attract the raptors.

The manually operated bownet is the most common style, and is typically used at a station where migrating diurnal raptors are captured. The trapper sits in a blind located a short distance from the trap. A lure is used to attract flying hawks. This lure is most often a House Sparrow, European Starling, or Rock Dove wearing a protective leather jacket. The jacket is attached to a continuous loop line. One side of the loop passes through an eyed stake in the center of the bownet, under its frame, and then back into the blind. The other side of the loop is passed through eyelets at the top and the base of a 2- to 4-m (6- to 12-ft) tall pole, the "lure pole," and then back into the blind where it joins the first line. The trapper manipulates the lines to toss the

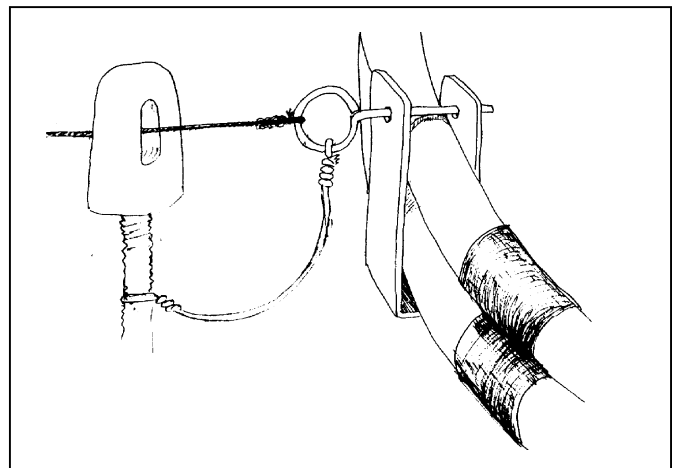


Figure 5. A bownet trigger mechanism for releasing the moveable half of the trap.



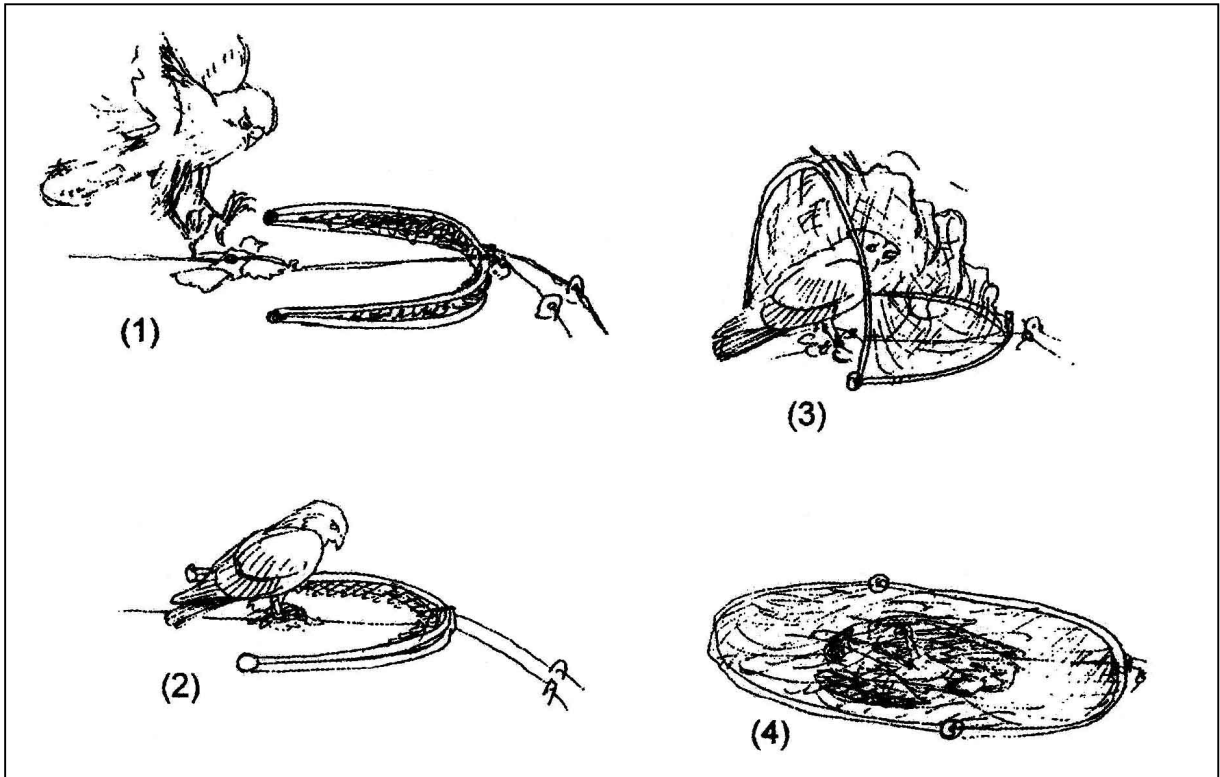


Figure 6. Sequence of actions in a bownet capture.

lure into the air, where it flutters briefly before being lowered to the ground.

If a passing hawk is attracted and initiates an attack on the lure, the lure is drawn back into the center of the trap using the appropriate line. If the hawk seizes the lure, holds on, and lands on the ground, the trapper then pulls the lure and raptor to the center of the bownet, waits for the raptor to fold its wings and settle, and then pulls sharply on the trigger line. This releases the moveable half-circle of the bownet to spring over the hawk, carrying the netting with it (Fig. 6).

This trap should be used only after thorough training. It employs powerful springs to close the net quickly enough to capture a raptor and has the potential for injury to both raptor and trapper if used improperly. One of its finer attributes is that the bownet is selective for the target species.

#### 4.2. Mist Net

Mist nets (Fig. 7) are effective for trapping raptors at migration stations and at or near nest sites where sufficient background vegetation exists to obscure the net and shelter it from the wind. A common mist net modification made by raptor trappers is the addition of a loop of elastic material at each trammel loop to act as a shock absorber. Mist nets are usually used in conjunction with a lure bird to attract passing raptors into the net, or with recorded playback of owl vocalizations. Mesh size is chosen with the target species in mind, most commonly 5.8 cm or 10.2 cm (stretched measurement).

Mist nets are used in a variety of lengths and mesh sizes. The taut horizontal cords, or trammels, support loose netting

between them. The loose material forms bags between adjacent trammels, entangling raptors that strike it (Fig. 8). Twelve-meter nets with four shelves and a stretched mesh size of 10.2 cm are the most useful for trapping raptors. At a migration station the net is set between a lure bird and the anticipated path taken by the raptor as it passes. A variety of sets can be used. These include placement either in front of or behind the lure; use of two nets, one on either side of the lure; or use of three nets in a triangle around the lure.

When a medium or small raptor is attracted to the station, the main lure, usually a Rock Dove, is lowered to the ground, and a European Starling or House Sparrow is raised and encouraged to flap. The approaching raptor is likely to divert its attention from the now quiet Rock Dove and begin an attack (stoop) on the smaller lure. If the mist nets have been properly placed, and the luring timed appropriately, the raptor will be intercepted by the net and tangled before touching the lure.

When netting owls on migration, or when netting owls or

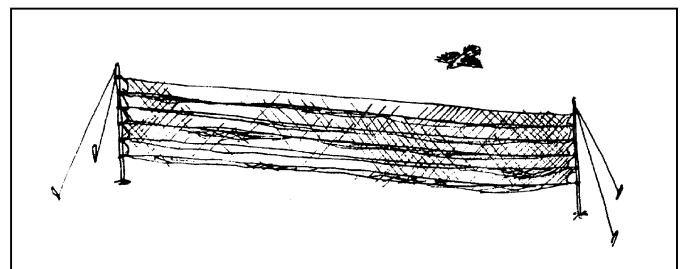


Figure 7. Mist net set for capture.

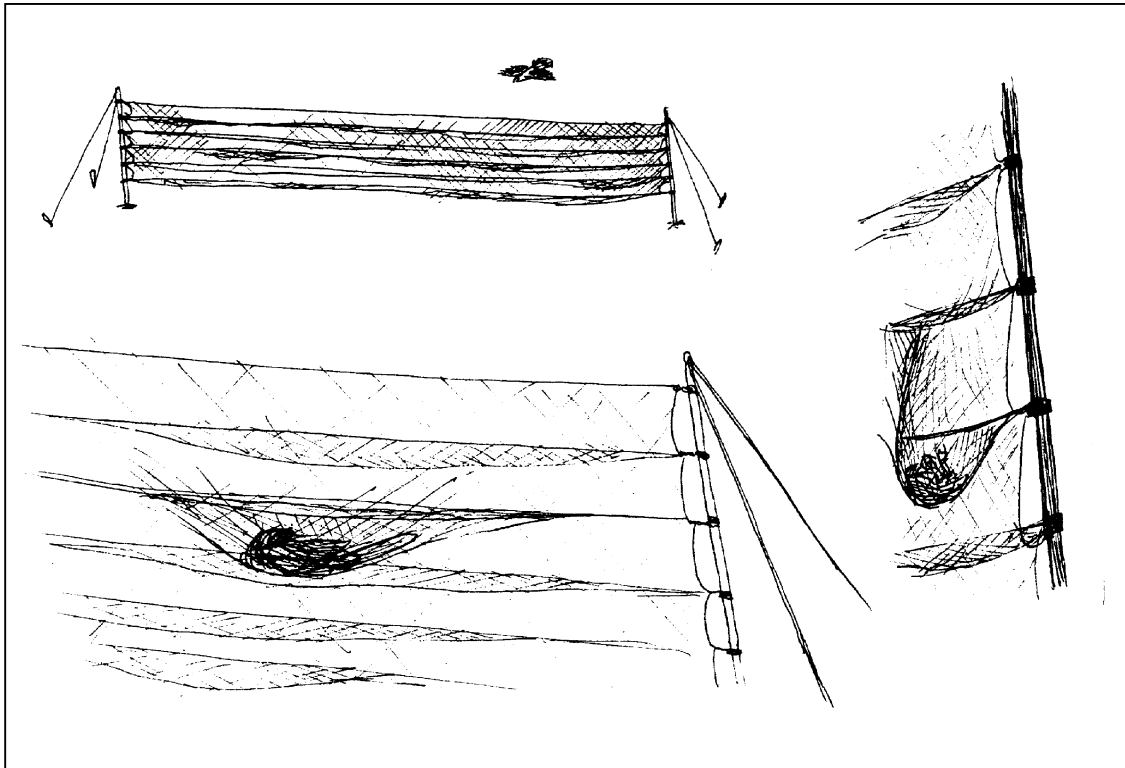


Figure 8. Mist net capturing a hawk.

woodland hawks on a breeding territory, as many as 10 to 20 nets may be set. These should be attended by 2-4 people, depending on the number of nets used. Recorded vocalizations may be used to attract raptors. Live lure animals are used less frequently than at raptor migration stations, although Great Horned Owls, either live birds or mounted specimens, are often used at diurnal raptor nest sites.

#### 4.3. Dho-gaza

Dho-gazas (Fig. 9) are used at migration stations, at or near nest sites, or near habitual perches. Like mist nets they require sufficient background to obscure the set. These consist of smaller panels of mist net material suspended between poles. The most common design allows the net to detach from the poles

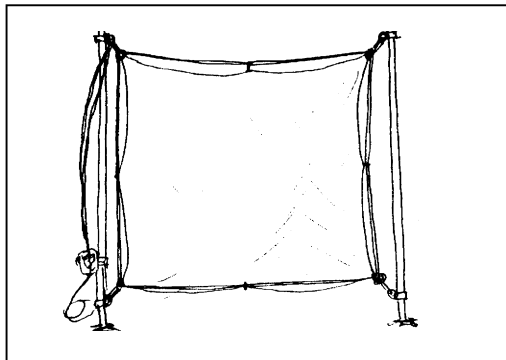


Figure 9. Dho-gaza set for capture.

when the raptor flies into the netting. A variety of panel sizes, mesh sizes, and release designs (Fig. 10) is used. An alternate design allows net and poles to collapse when hit by the raptor.

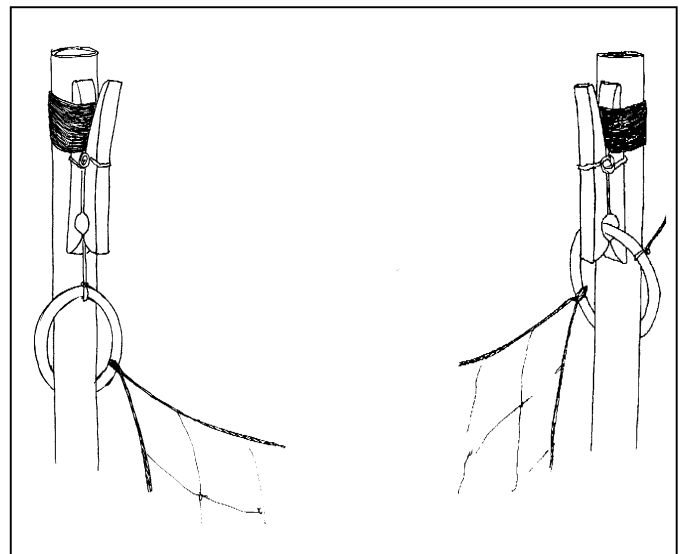


Figure 10. Dho-gaza release mechanism. The ring at the top of each of two poles is held in the “set” position by a clothespin that holds the tip of a short length of monofilament fishing line as illustrated by the left-hand drawing. When the raptor strikes the net, the rings are released and the net collapses around the raptor. The right-hand drawing shows the ring itself held in the jaws of the clothespin. In this position, the ring will not slide down the pole and repairs and adjustments can easily be made.

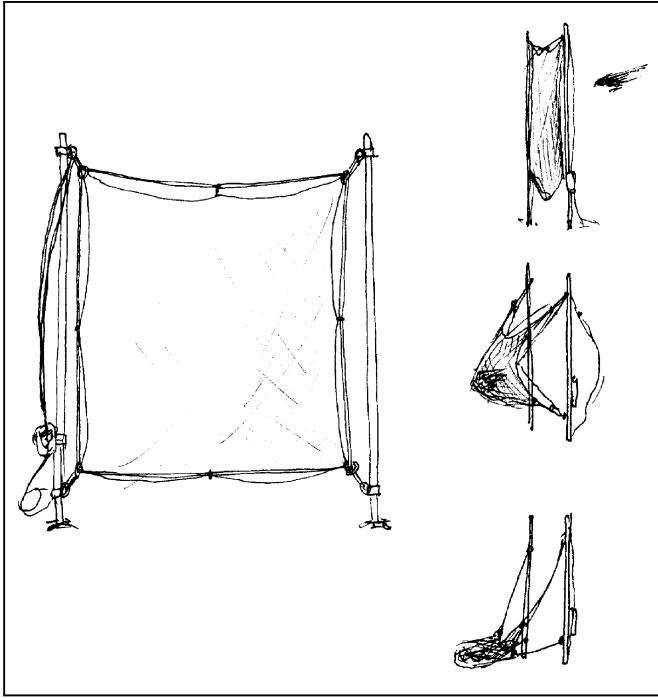


Figure 11. Dho-gaza in use.

Great Horned Owls, other large owls, non-native birds, or rodents are used as lures.

Dho-gazas are generally constructed of netting with the same thread diameter and mesh size as a mist net designed for capturing the same species. The dho-gaza differs in that it comes free of the poles, slides down the poles to the ground, or the poles and net collapse together when struck by a raptor, enfolding the raptor (Fig. 11). The debris picked up by the net can make extractions challenging.

Raptors are attracted into the dho-gaza using the same luring techniques as described for mist nets. Dho-gazas also can be used in conjunction with other lures when road-trapping, or with Great Horned Owls or similarly large-sized diurnal raptors as lures near nests during the breeding season. Those uses will be discussed in later sections. Both live Great Horned Owls and motorized or manually-rotated mounted specimens can be used successfully.

#### 4.4. Bal-chatri

Bal-chattris (Fig. 12) are most often used along roadsides or are preset at locations where a raptor is likely to perch hunting. These traps consist of wire cages with lure animals inside. Monofilament nooses are attached to the outside, and weights are attached to the bottom. Domestic house mice, black and Norway rats, European Starlings, House Sparrows, and Rock Doves often are used as lures.

Bal-chattris are generally ineffective when used at migration trapping stations unless many raptors perch near the station. The lure animals, generally mice, rats, or small birds, often become quiet a few minutes after the trap is placed and become much less attractive to raptors. Their use will be discussed in the section on road trapping.

## 5. STATION DESIGN AND OPERATION

Success at a migratory raptor banding station depends upon the site and the behavior and flight path of passing raptors. It is important to take advantage of vegetation that can provide a background to disguise the nets and provide camouflage or cover for the blinds. Position the blind to give good visibility in the most likely direction of the flight. Good visibility from the blind to the bownets, mist nets, and dho-gazas is essential.

Another feature of good station design, and one whose importance cannot be overemphasized, is the spatial relationship of the various traps, nets, and lures to each other, to the blind, and to the probable direction of the flight. Creating good lines of sight for the approaching raptor from the main lure to secondary lures should be a primary goal. When possible, avoid direct lines of sight from the approaching raptor through the main lure and into the blind.

Place mist nets and dho-gazas between the lure and the anticipated direction of the attacking raptors. Place the secondary lure so that it will be in front of a raptor that refuses the primary lure and continues its flight.

Be sure that trap-identifying signs are in place as required by the Banding Offices.

### 5.1. Setting Up

When you arrive at the station, open or set the nets and traps and check them for holes and debris. Inspect all bownet lines and test them for proper operation. Make needed repairs before starting. It is helpful to be completely set up before starting to lure so that you are ready to deal with a raptor in the hand.

Jacket the lure birds you will use and set them out at the appropriate traps. You will normally set out a Rock Dove as the

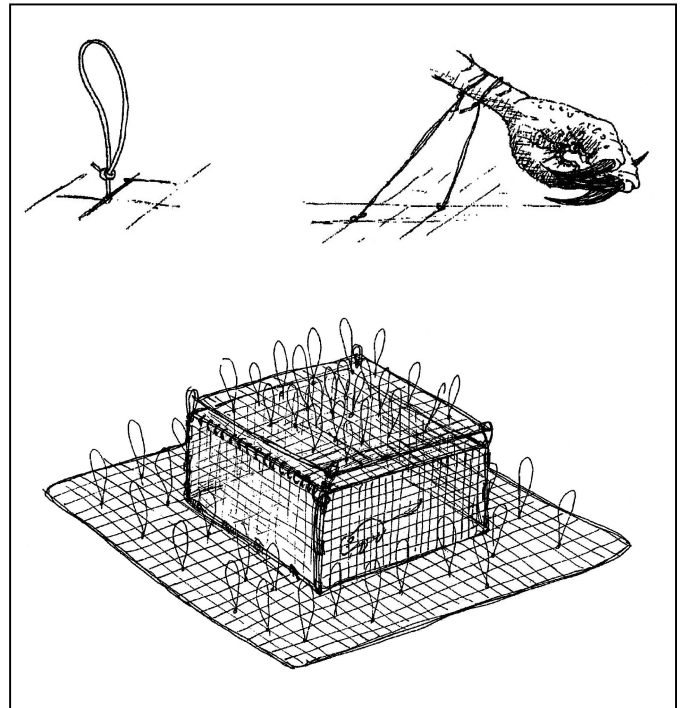


Figure 12. A typical Bal-chatri trap, a single loop, a captured raptor.

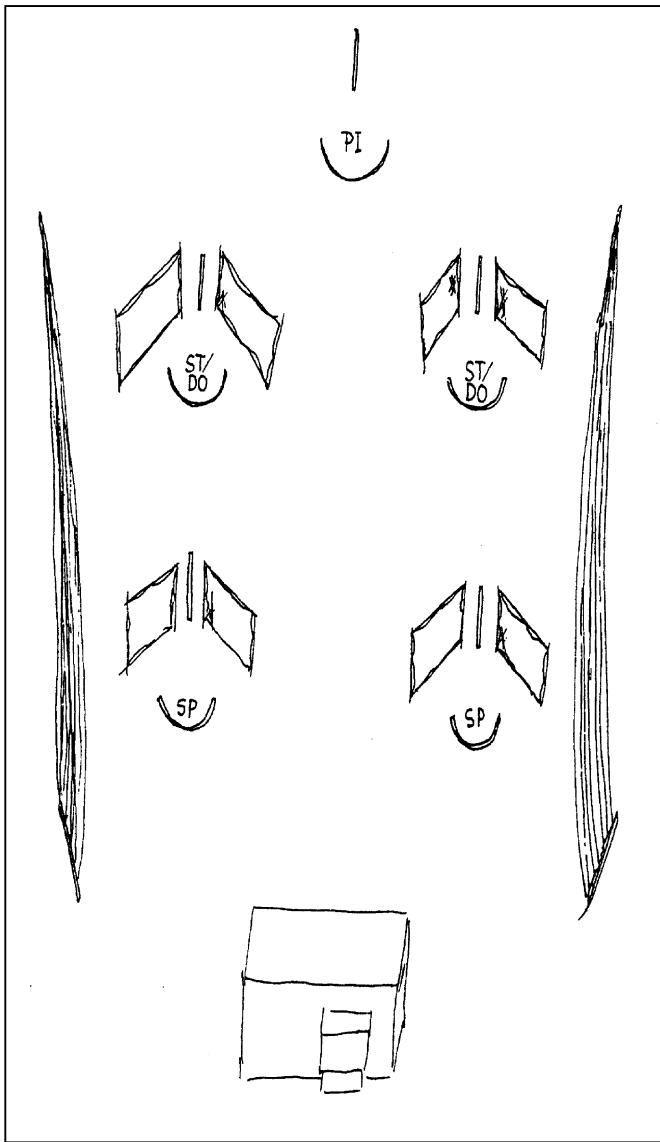


Figure 13. Raptor trapping station layout. Half circles represent bownets with their associated lure poles and lure bird species. Lure species are: PI = Rock Dove, ST=European Starling, DO = Ring-necked Dove, SP = House Sparrow. The rectangular panels at four of the bownets represent dho-gazas, and the lines at either side represent mist nets. The blind is at the bottom, facing toward the anticipated raptor flight path.

main attractor. This is usually the lure pole farthest from the blind in the direction of the anticipated flight. Set the smaller lures (starlings, doves, or sparrows) at the appropriate traps, usually behind dho-gazas or mist nets, and in the correct lines of sight for “handing off” (See Section 6).

Figure 13 shows the blind and generalized trap layouts. Each station will be different depending upon topography, vegetation, wind direction, and likely flight direction, as well as the target raptor species.

Be sure that all lures have food, water, and shade, both at the traps and in the cages. Check all needed supplies in the blind, including tools, data sheets, and lure animal food and water.

## 5.2. Closing the Station

At the end of the day, remove all lure birds from the lines, remove jackets, and place lures in holding cages. Examine each lure for injury and general condition. Any bird that has sustained an injury during the day, or has become exhausted due to overwork or extreme weather, should be returned to an extra rest cage so that it will have some recuperation time before being returned to field duty.

Examine all nets and traps for holes, worn lines, or other malfunctions. Make any repairs you can before closing the nets and traps for the night. Before leaving the station make notes on repairs that you are unable to accomplish. Pull the trigger lines on all bownets. Furl all mist nets and dho-gazas securely so that no bird can be caught accidentally during your absence.

Be sure that all tools are properly stored and that all holding tubes are nested and stacked. Set out empty food and water containers to be returned to the main supply area for restocking. Close and secure blind doors and windows. Be sure that all forms and data sheets are completed and that all data required by the Banding Offices have been included. Data sheets should not be left unattended in the banding blind unless they are protected from damage by weather, rodents, and vandalism.

## 6. LURING AND CAPTURE TECHNIQUES

Luring is the process of manipulating the lines attached to the jacket on the lure bird to make the bird flap. The motion of its flapping is the primary attractant for passing raptors. A technique that has been successful with Great Gray and Spotted owls is “cast luring.” A stuffed lure or toy mouse is attached to a fishing line and pulled slowly towards the operator by reeling in the line. When the lure and owl are close enough, a fish landing-net is placed over the owl. These two examples of luring suggest the range of techniques successfully used.

Although there are many ways to use the traps described here, the following sections describe their use to capture diurnal raptors at a hawk migration-trapping station. Modification of these techniques makes the traps effective in the many other situations where they are commonly used.

### 6.1. Luring

The trapper normally pulls sharply on the line running through eyelets on the lure pole to lift the lure bird into the air. The lure is likely to attempt to fly and will spend a couple of seconds flapping at or near the height of the top of the lure pole. The lure is then allowed to flutter gently to the ground. The trapper repeats the process a couple of times and then allows the lure to rest on the ground. After a short rest period, the trapper starts the luring cycle again.

### 6.2. Handing Off

When a raptor responds to the action of the main lure by changing direction or angle and starts toward the station, the trapper evaluates the situation again. At this point the trapper identifies the species and sex of the approaching raptor to determine whether a “hand-off” is appropriate.

The hand-off is the process of switching the approaching hawk's attention from one lure to another. The big, flashy movements of a pigeon lure are the main attractors for distant raptors. The trapper moves a smaller bird lure after identifying the approaching raptor as medium or small. Usually the trapper chooses a starling for the hand-off when the hawk is the size of a male Cooper's or a female Sharp-shinned hawk. If the approaching raptor is the size of a kestrel, male Sharp-shinned Hawk, or Merlin, the trapper probably will choose a sparrow for the secondary lure. It is important that the second lure be in a line both with the hawk and the first lure, and that the trapper initiates the hand-off before the hawk passes the second lure.

### 6.3. Passive Net Captures

This second lure will usually be behind either a dho-gaza or a mist net and the raptor becomes entangled in the net when it attacks or stoops. The trapper must moderate the vigor of the luring motion as the raptor gets closer. The trapper centers the lure behind the mist net or dho-gaza and keeps it close to the ground as the raptor gets close, with just enough movement to keep the raptor's interest. Wild flinging and flapping at this stage will most likely cause the raptor to slow down enough to avoid the net. It may flare off and lose interest, or it may maneuver over or around the net and settle on the lure. The trapper will then have to make a bownet capture with its attendant risk of injury to both the raptor and the lure. This small risk can be avoided through good luring technique, which will draw the raptor into a dho-gaza or mist net.

### 6.4. Bownet Captures

If the raptor successfully avoids the net and settles on the lure, the trapper can make safe bownet captures by following a few straightforward procedures.

First, the trapper should never take his or her eyes off what is happening with the raptor, trap, and lure. It is important for the trapper to learn by touch where all the lure and trigger lines are. When first sitting down at a specific trap, the trapper should practice feeling for all the lines until he or she can find them easily while looking out the window.

Second, the trapper never pulls a trigger on a bownet until it is certain that the raptor is centered, that its wings and tail are folded and clear of the bownet frame, and the raptor has settled. Because this may take some judgment and experience, the novice should never be allowed to operate a bownet without supervision.

An ideal bownet capture would involve the raptor settling on the lure after the trapper had already pulled the lure to the center of the bownet ("the peg"), the raptor folding its wings, and then the trapper pulling the trigger. It is important to hold the raptor and lure tightly at the center peg with one hand by pulling on the "down" line while pulling the trigger with the other hand.

In practice, captures are frequently not so by-the-book. Often the raptor will surprise the trapper and settle on the lure while both are still some distance from the bownet. In these cases the trapper uses a smooth, steady, hand-over-hand action on the lure line to pull the lure and raptor to the center of the trap. When a raptor and lure are centered at the peg, the raptor

usually takes a few seconds to fold its wings and settle, and then the trapper pulls the trigger.

Special problems occur when the raptor perches on a lure pole. Nothing will work all the time, but the greatest success in these situations is achieved by following the general guideline "less is more." This means that little or no movement of the lure yields more captures than even moderate luring action. The trapper should pull the lure to the peg and wait quietly for the raptor. The lure will be making small head and body movements that the raptor will see and will then usually decide to stoop off the pole onto the lure. Because the lure is already at the peg, the trapper will have to wait only for the raptor to fold its wings and settle before pulling the trigger.

## 7. EXTRACTION TECHNIQUES

Extraction of raptors from the various traps described in this manual is usually straightforward and easier than working with passerines. The same general procedures are used as for removing passerines from mist nets. The big difference is in handling, because raptors are larger than most passerines and the handler must take some steps for self-protection from the raptor's talons and beak.

### 7.1. Extraction from Mist Nets

Approach the raptor as quickly as possible from the same side it flew into the net. Secure its feet with one hand, usually working through the net for this first step. This may require distracting the raptor with one hand while grabbing its feet with the other. Grip the legs high enough to avoid injuring them, especially when handling a small raptor. Be alert for strands of net around the raptor's tongue; these should be carefully removed as soon as possible to avoid injury. Once the legs are secure, look for the space or hole between the legs and tail. Untangle the bird, starting with the legs and feet, then the tail, one wing, the head, and then the other wing.

If the legs and feet are badly tangled, it sometimes works better to leave them for last. Occasionally while the handler disentangles other parts of the raptor, it will relax its feet and the net will almost fall off of them. Remember to back the raptor out of the net from the side it entered.

### 7.2. Extraction from Dho-gazas

Removing a raptor from a dho-gaza is much like removing one from a mist net. The differences are because the raptor and net almost always end up on the ground. Trappers should watch dho-gaza captures closely so that they know from which side the raptor entered the net. Two things should be checked and managed before following the same procedures as for mist net extraction:

- (1) The raptor may have twisted the net about itself one or more times after landing on the ground. Look for twists, figure out which way the bird rotated with the net, and rotate the raptor and net in the opposite direction to untwist the net.

- (2) Twigs, small rocks, leaves, or other debris may be in the net. This material will often hold the net together in unexpected ways, making it almost impossible to decipher the logical sequence to follow in freeing the raptor. Remove any debris after rotating the raptor, but before trying to free it completely. Follow these first two steps carefully and the raptor may almost fall out of the net. Remember to secure the feet before starting any extraction procedure.

A very difficult extraction situation occurs when the momentum of the raptor carries both it and the dho-gaza into the lure bird, tangling it and the lure line in the dho-gaza along with the hawk. The best way to deal with this situation is to unclip the lure from the line, unclip the two sections of the lure line, extract the lure, and then re-clip lure and lines together.

### 7.3. Extraction from a Bownet

Usually bownet extractions are easy, seldom presenting any problems to the trapper. Because the raptor is on the ground under the net, this is also a situation in which the trapper can be a little more deliberate. Remember, after trapping a raptor in a bownet, that another raptor may be in the area; waiting a moment and moving a lure at another trap increases the likelihood of catching a second raptor. If, after waiting, no other raptor seems likely to be trapped, take a storage can from the blind and approach the bownet. Potential always exists for a second raptor to attack one already caught in a bownet. In this case, leave the blind immediately to scare off the attacker.

Initially work through the net. Bend close to the ground and immobilize the raptor by placing one hand on its back and gently but firmly holding it against the ground. If the raptor is on its back under the net, distract it with one hand while sliding the other hand underneath it and rolling it over so that it is firmly pinned to the ground.

Use the free hand to slide in from behind and under the raptor to grab its legs firmly. The trapper now should have a firm grip on the legs and will have some net material caught between the hand and the raptor's legs. The next step will be to get a grip on the legs without the net material.

While maintaining a secure grip on the legs, slowly lift the moveable half of the bow. The raptor will be entangled in the netting, so this step must be done slowly and carefully to ensure that the raptor's feathers or joints are not twisted to the point of injury. Lift the frame slowly, and start teasing the netting off the feathers.

Be careful of the bird's eyes, head, and mouth at this stage. It is easy to get the net caught on the tongue if the net is lifted from the raptor too quickly. As soon as enough slack exists in the net, prop the frame against your arm or leg and shift hands, now gripping the legs without holding any net.

Whenever changing grip or hands, slide the free hand between the raptor's body and the hand holding the legs. This will help keep your hands close to the raptor's body and avoid the risk of injury to the raptor that may result from holding the legs too near the toes.

After changing grips to eliminate the netting from the hand holding the raptor, finish pulling the netting off the tail, wings,

and feet.

Some raptors clench their feet together under the net, often holding a generous measure of the net tangled between the talons. It may be counterproductive to start trying to pull the netting free at this point, as pulling at the feet may cause the bird to clench even tighter. Continue freeing the other parts of the raptor first. Sometimes the bird will relax its grip as the extraction proceeds, allowing the net to fall away from the talons.

Once the raptor is completely free of the net, reset the net and examine the lure bird before returning to the blind. Slip the raptor into a storage can, freeing both hands to reset the net. (The raptor will later be carried back to the blind in this can.) Throughout this process, protect the raptor, the lure bird, and yourself from accidentally being hit by the frame of the bownet. If the lure bird needs attention, either call for help from someone in the blind, or return and take care of the lure as soon as practical.

## 8. BANDING AND PROCESSING

Banding raptors differs in several important ways from banding many other birds. First, most raptors are capable of inflicting painful and sometimes serious injuries with talons and beak. The bander must use handling techniques during the banding and measuring process that protect both the bander and the raptor from injury. Second, because a large raptor can remove a butt-end band with its powerful beak, special lock-on bands with folding tabs are used. To apply properly, these bands require techniques slightly different from butt-end bands. Rivet bands are recommended for eagles and larger owls.

All banding, restraint, and processing should be done without wearing gloves. Proper handling techniques will protect the bander and the raptors from injury. Gloves cause a loss of sensitivity in handling, which puts the raptor at risk of injury, particularly to the legs. As suggested in Section 1, gloves may be appropriate in initial restraint of nestlings.

Banding and measurement of the legs, feet, and tail should be done while the raptor is still in the can, also reducing chance of injury to the bander and at the same time reducing stress to the raptor.

### 8.1. Fitting the Band

Recommended band sizes are found in the "Raptor Age-Sex Keys" in *North American Bird Banding Techniques: Volume II* (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977:Part 6). Proper fit is obtained using a leg gauge (Fig. 14). Although recommendations of the Bird Banding Lab for proper band size usually are correct, each individual should be checked with a leg gauge (Fig. 14) to determine the best fit.

Pull one leg out of the can and hold it firmly to examine for lesions or injuries. Do not band a leg that has lesions or is swollen. Slip the slot in the leg gauge over the tarsus, slide it up and down the tarsus, and rotate it to be sure that the fit is correct. Start with the slot corresponding to the recommended size; trying two or three slots will usually pinpoint the correct fit. A band must slide up and down and rotate but not have much extra

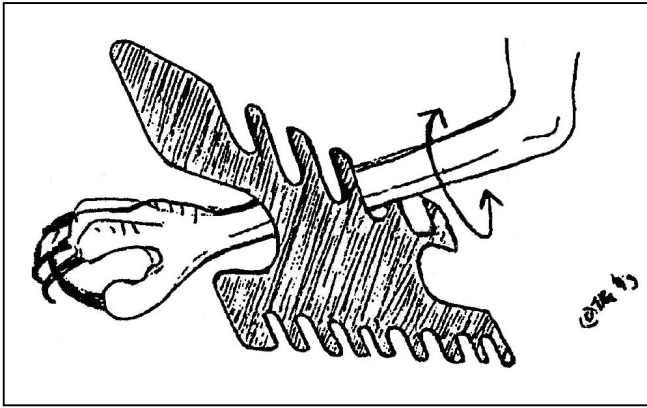


Figure 14. Leg gauge in use.

space between tarsus and band. If the band is too tight, it may constrict the leg and cause injury. If it is too loose, it can slide down over the toes and interfere with normal foot movements. If the leg falls right between band sizes, it is better to use a band that is slightly larger rather than one that is slightly smaller.

Always use banding pliers with holes to apply and close butt-end bands (Fig. 15). These pliers generally have either two holes (sizes 2 and 3) or one hole (sizes 3B or 3A) for closing the band. Open the band using the split post on the pliers. Insert the opened band into the correct slot in the pliers and, using the pliers to hold the band, slip it over the raptor's leg. Squeeze the band closed, rotate it 90 degrees, and squeeze it again to make sure that the ends are tightly closed and along its entire length, with no projecting corners or edges. Be sure that the band is round. Make a final check of the fit by sliding the band up and down the tarsus and rotating it. Never use needle-nosed pliers or forceps to close butt-end bands because of the danger of overlapping the band or damaging the band number.

### 8.2. Applying and Closing Lock-on Bands

For raptors requiring band size 4 or larger, use only lock-on bands (Fig. 16). Lock-on bands have a tab at each end of the band that is at right angles from the curvature. The tip of the longer tab is to be bent over the tip of the shorter tab. When squeezed tightly in place, or crimped, the raptor cannot remove

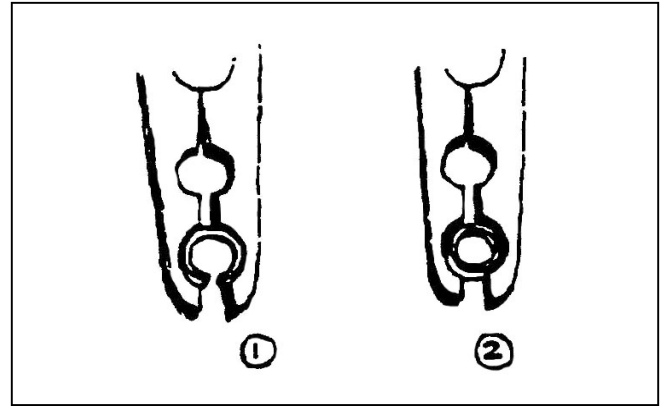


Figure 15. Banding pliers closing a butt-end band.

the band. After determining the proper fit with the leg gauge, place the band around the raptor's tarsus and gently squeeze it shut with the fingers or needle-nosed pliers. Check the fit with the band closed, but not crimped, by turning it and sliding it as you would a butt-end band. If the fit is correct, squeeze the tip of the longer tab over the other shorter tab as tightly as possible, using either pliers or a vice-grip. Using the needle-nosed pliers to adjust any projection, be sure that the ends are even and that no sharp corner extends above or below the crimped tab.

### 8.3. Removing a Band

A band that is too tight or too loose must be removed. Occasionally a band is damaged, overlapped, or forced out of round in the process of applying it and must be removed. The removal of a band is a delicate process requiring the bander to protect the raptor's tarsus throughout the process.

The best method for removing a large band involves the use of two pairs of small vice-grip pliers. Adjust the gape of each pliers so that it will lock onto the band from the top edge to the bottom edge. Lock one pair on either side of the opening in the butt-end band and, with one pliers in each hand, gently rotate the pliers away from each other, opening the band as the pliers rotate. This must be done slowly and carefully, putting pressure only on the pliers and the band, never on the raptor's tarsus. This is a two-handed operation and can be done safely with the

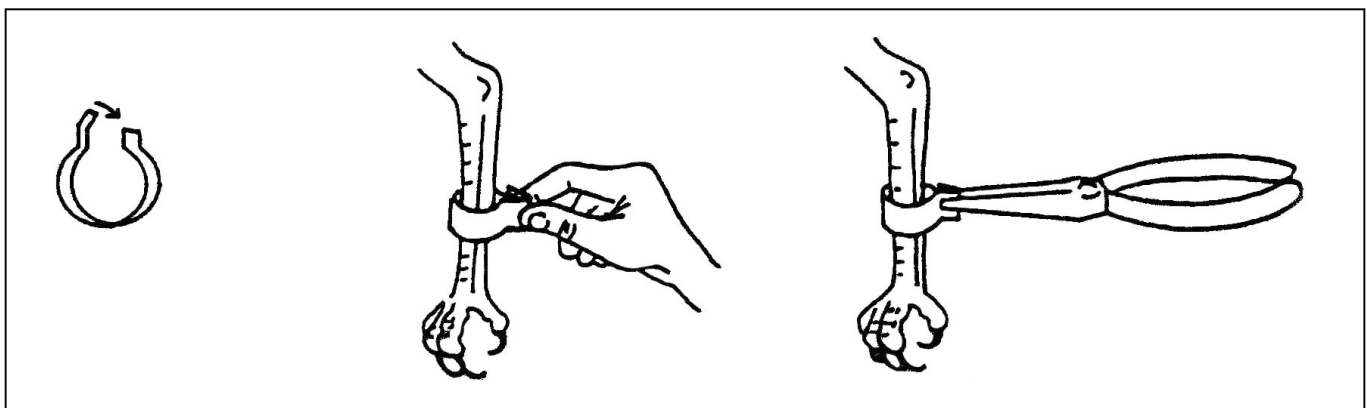


Figure 16. Applying a lock-on band.

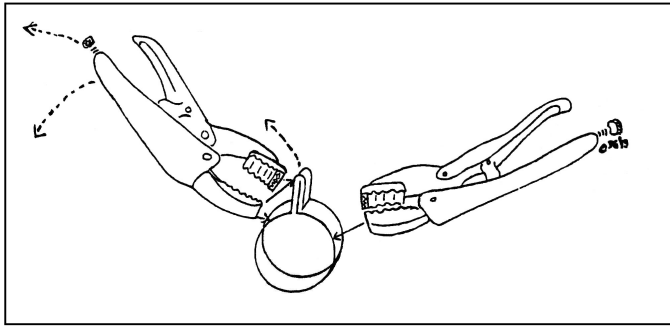


Figure 17. Removing of a lock-on band.

raptor in a can with only the leg extended, or it may be done with a second handler holding the bird and protecting the tarsus from any pressure. With the lock-on band, the vice-grips are locked onto the band on either side of the crimped tab, but not quite touching it (Fig. 17). The rotation of the two pliers is still away from each other; the end of the band slips out of the tab quite easily when this rotation is correct.

#### 8.4. Record Keeping

Accurate record keeping is of utmost importance in any banding operation. Meticulous records must be kept at the time of banding and must be checked and corrected as near the time of banding as possible. Every band issued by the Bird Banding Laboratory or the Canadian Bird Banding Office must be accounted for with data for the bird on which it was placed, or with the appropriate code to explain its loss or destruction.

Minimal data required by the Bird Banding Offices include band number, alpha code for species, status code, age and sex, region and location of banding, and date. Each individual project will have specialized data-gathering requirements in addition to those of the Bird Banding Offices. Data-recording forms may be variable but must include spaces to record data for the respective Bird Banding Offices.

Many data sheets have space for all 100 bands in a string entered in consecutive order as they are used. This means that you will have a different data sheet for each band size. Organizing your data recording sheets in this way has the advantage of making it relatively easy to account for each band as it is used, as well as making the data easy to transcribe to the Banding Office's schedules. Some banders reserve a string of bands for a single species and sometimes even for sex. This expedites accurate and efficient reporting to the Banding Offices. When banding nestlings or road trapping, a bound notebook may be more desirable, because multiple locations may be involved and other data (such as local habitat information) may be recorded.

#### 8.5. Processing the Raptor—Commonly Used Measurements

It is possible to determine sex of some raptors through plumage characteristics and/or a combination of weight and wing-chord measurements. Different investigators at different locations have taken a variety of measurements; by repeating some of these standardized procedures, populations in different

geographical areas can be compared. Tarsus, hallux claw, tail (rectrices), and weight can all be measured while the raptor is still in the can.

##### 8.5.1. Tarsus depth (or thickness)

This is a measurement of the thickness of the raptor's lower leg and is taken at the narrowest point of the tarsus (tarsometatarsus in Figure 18), but in the maximum direction at that point (Fig. 19). Because the tarsus is usually oval or slightly flattened laterally, not round, the caliper is adjusted to this maximum thickness at the thinnest point on the tarsus usually in the front-to-back direction or angled off to one side. Close the caliper until it contacts the tarsus on both sides at this point, and then attempt to slide it up and down. When the caliper is at the correct spot on the leg, slight resistance to this up-and-down movement will occur and you can record the measurement.

##### 8.5.2. Hallux claw

The hallux is the hind or rear digit on the raptor's foot (Fig. 18). Measure only the chord of the claw or talon. Place the point of the fixed leg of the caliper on the anterior surface of the claw where it meets the skin of the toe (Fig. 20). Adjust the calipers so the point of the moveable leg is at the very tip of the claw. Record the result as the Hallux Claw measurement.

##### 8.5.3. Standard tail

A standard tail measurement is taken with a thin plastic or metal metric ruler that begins at "0"—that is, it has measurement increments that begin precisely at the beginning end of the ruler. Start the procedure by counting tail feathers in from each side to locate the two central rectrices. These are the #1 rectrices. Insert the ruler between the #1 rectrices to the point of their emergence from the skin and record the measurement to the tip of the longest rectrix (Fig. 21). This may or may not be rectrix #1 (e.g., it is not for the Swallow-tailed Kite).

With any measurement of feathers, it is important that you examine the feathers, making note of excessive wear or broken tips. Whenever feathers are excessively worn or broken, make a comment on the data sheet about feather condition, but do not take the measurement. This caution applies to wing chord and flat wing measurements as well.

##### 8.5.4. Weight

First, check the zero point on the scale and adjust as necessary. Lay the can on the scale and weigh to the nearest 0.1 g. Next weigh the empty can. Subtract the tare from the gross to get the net weight of the bird. If you use an electronic scale, put the raptor on the scale, tare it to zero, then remove the bird from the can and replace the can on the scale. The resulting number will be the (negative) weight of the raptor. If you weigh a raptor with food in its crop, always record this fact on the data sheet.

##### 8.5.5. Exposed culmen length

Exposed culmen length for raptors is the cord distance between the tip of the beak and the midpoint of the culmen where the cere meets the beak (Fig. 22). This measurement and the two wing measurements are done with the raptor out of the



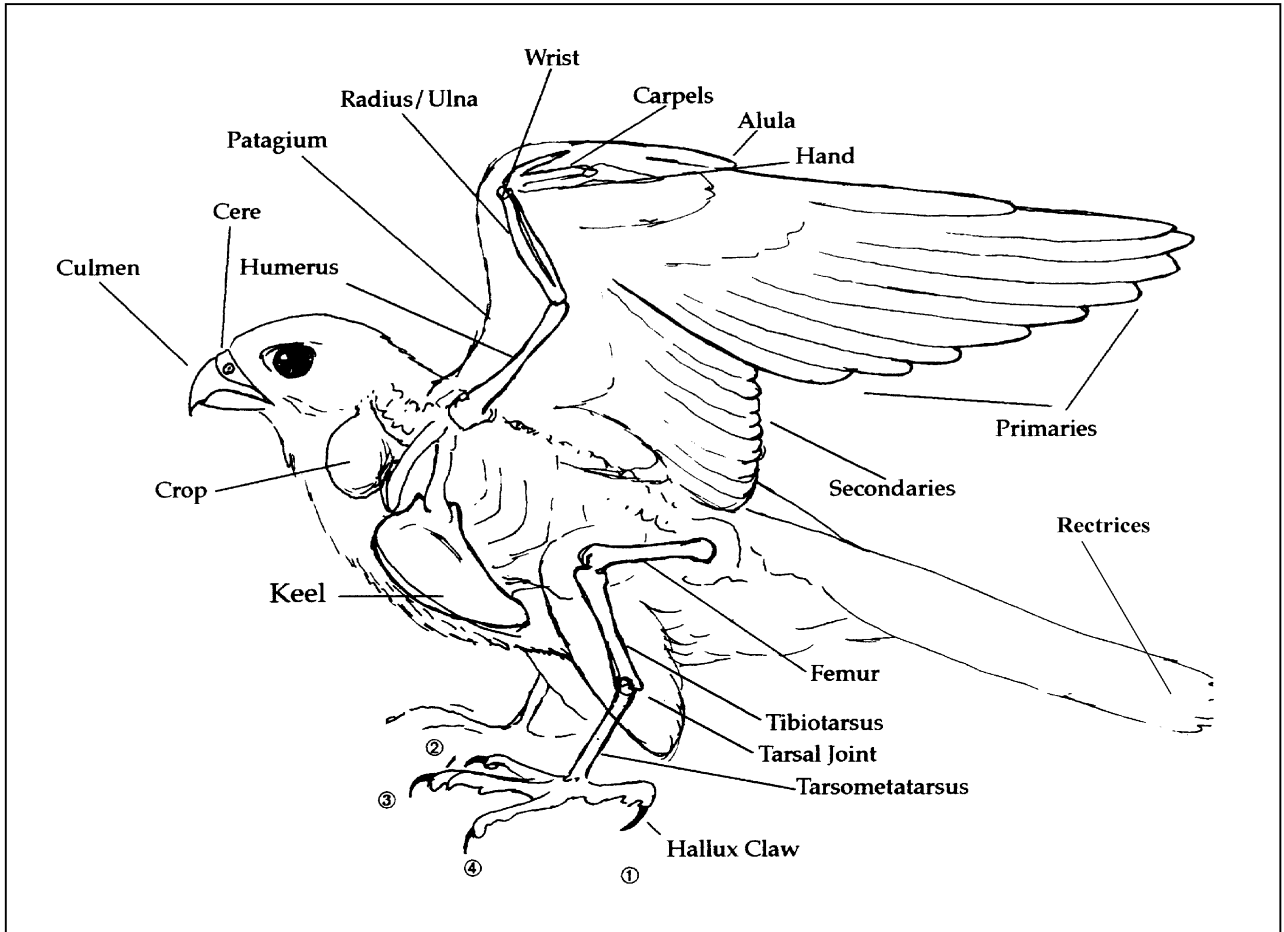


Figure 18. Selected raptor topography.

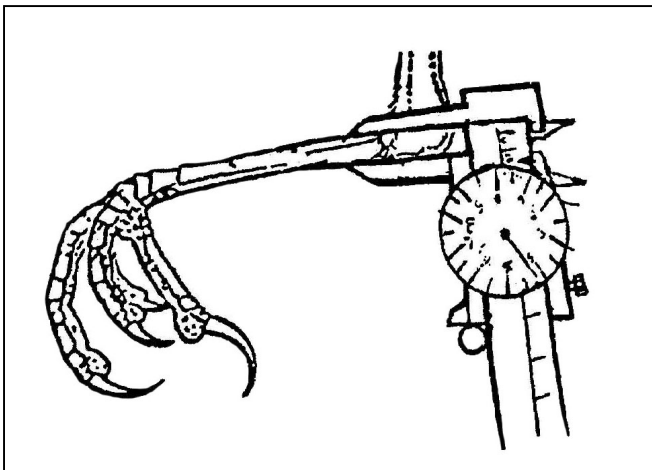


Figure 19. Tarsus depth measurement.

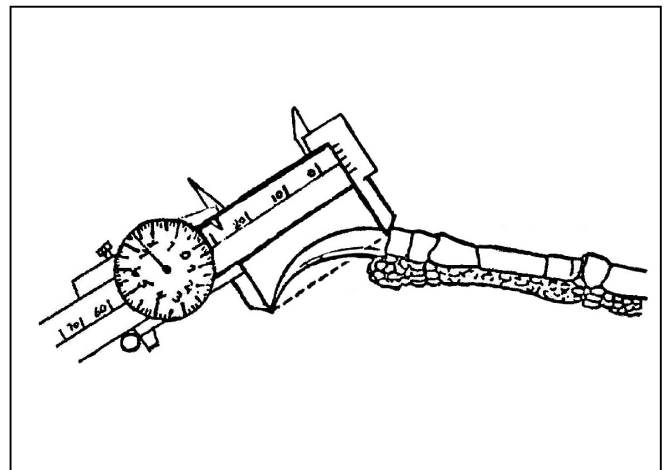


Figure 20. Hallux claw measurement.

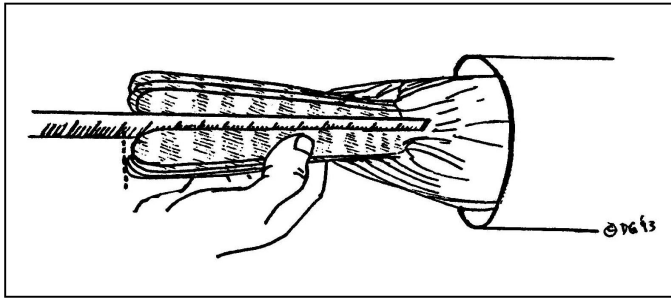


Figure 21. Standard tail length.

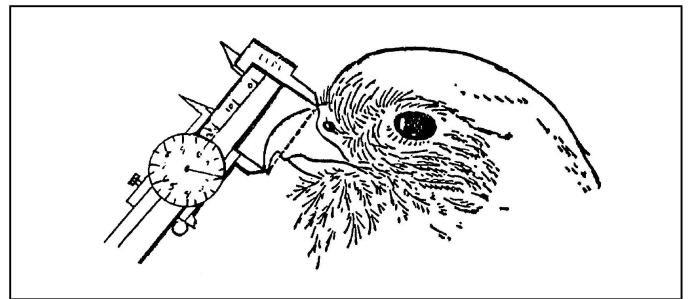


Figure 22. Exposed culmen measurement.

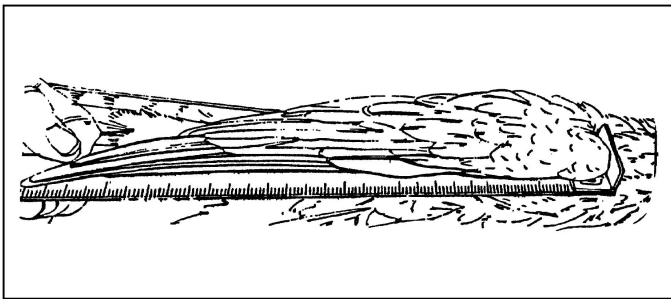


Figure 23. Wing chord measurement.

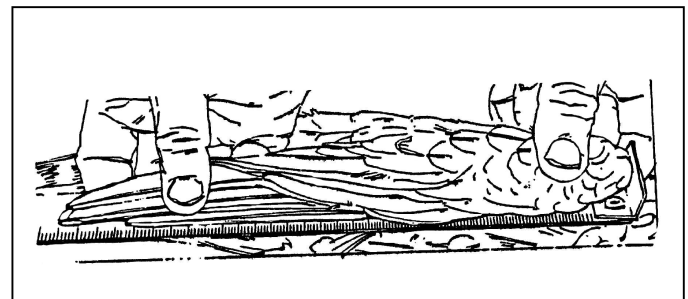


Figure 24. Flat wing measurement.

can. The palm hold is a convenient hold to use while doing these procedures. Other holds can be used if they are secure and safe for the raptor.

Place the point of the fixed leg of the caliper on the middle of the beak at the line where the cere meets the beak. Adjust the caliper so that the tip of the moveable leg is at the exact point of the tip of the beak. Record the measurement to the nearest 0.1 mm.

#### 8.5.6. Wing chord

Slip the ruler with the angle stop under the wing and, while keeping the folded wing as close to the raptor's body as practical, place the angle stop firmly against the carpal joint (Fig. 23). Allow the wing to retain its natural curve while just barely touching the tip of the longest primary to the ruler. Record this measurement to the nearest mm.

#### 8.5.7. Flat wing (flattened wing)

This measurement is much like the wing chord but with the natural curve flattened against the ruler. Place the angle stop of the ruler against the carpal joint and flatten the wing against the surface of the ruler (Fig. 24). This measurement will always be longer than the wing chord. Record the result to the nearest mm.

#### 8.5.8. Physical examination

Any special physical characteristics that are to be recorded should be performed after banding and measurements. General and molt condition, presence or absence of ectoparasites, specific comments on injuries or lesions, and abnormalities may be checked and recorded before release.

#### 8.5.9. Final data check and release

Just before releasing the raptor, check over the data sheet to be sure that all data required by the Banding Offices and by the individual project have been taken and accurately recorded. This is also a good time to do any photo documentation of plumage or unusual species. Finally, compare the number of the band on the raptor to the number recorded on the data sheet. Release the raptor into the wind and away from all nets, lures poles, blinds, and natural hazards.

## 9. CARE OF THE LURE ANIMAL

The use of live lure animals is standard practice among raptor banders. It is of utmost importance to treat any living animals within your care in a thoughtful humane manner at all times. Good animal-care practices must be followed with regard to adequate shelter, cleanliness of cages, diet, and overall health.

In the field, the lure animals should be provided with food and water, shelter from extreme weather, and some protection from the raptor's talons and beaks. The aim of the trapper should always be to minimize injury and stress to the lure animals, as much as possible in the context of capturing raptors.

Be sure to alternate days in the field with rest days for the lures. The smaller lure animals may require more than one day of rest between field days. A system of alternate date cages prevents exhaustion of the lures.

#### 9.1. Morning Care of Lure Birds

Each morning give all lure animals clean food and water, clean their cages, and examine individual animals for health and

vigor before selecting them for field use. Any that needs extra rest should be put into a recuperation cage. If at all possible, all food and water containers should be washed and disinfected daily. An efficient way to accomplish this is to maintain two sets of containers. As part of the daily routine, discard any food left from the previous day and wash and disinfect the containers. These can be left to air dry for use the next day. The containers washed and disinfected the previous day are used for food and water for the current day. Scrape clean all perches daily, rake the sand or litter used on the cage floor, and discard soiled litter.

Birds should be given an opportunity to bathe at least every other day. This should be done after removing the birds for field use. Birds that have bathed should not be used in the field while their plumage is still wet. Do not leave baths in the cages for more than an hour or so. Wash and disinfect bath containers along with the food containers. Do not provide bath water when the weather is extremely cold or stormy.

Animals that appear sick or exhausted should be isolated from the main population and given quiet, warm spaces in which to recuperate. Any seriously ill or injured animals should be given first aid or taken to a rehabilitation center. When such care is impractical, the animal should be euthanized in as humane a manner as possible. The currently accepted guidelines for humane euthanization of birds can be found in Gaunt and Oring (1999), *Guidelines on the Use of Wild Birds in Research*, published by the Ornithological Council. To receive a copy, contact the Ornithological Council at 1725 K Street, Suite 212, Washington, D.C. 20006-1401, or at their web site: <http://www.nmnh.si.edu/BIRDNET>.

### **9.2. Care at the Trapping Site**

Trappers should be aware of the condition of their lure animals at all times while in the field. This includes assuring that they have access to food, water, and shelter both in the holding cages and at the traps.

Select the birds to use and dress them in protective jackets. Be sure that jackets have no rough or sharp edges and that they are large enough to allow the birds free movement for both breathing and flapping. Clip a lure bird onto the line at the ring and be sure that it can reach its shelter. Scatter a small amount of food on the ground where the bird can reach it. Fill the water container near the shelter with clean water.

Healthy lure birds can be used for 1-2 hours of active luring in moderate weather. Extreme heat is especially hard on lure animals, requiring extra attention and care by the trapper. If any lure bird becomes less vigorous, replace it at once. After contact between a raptor and a lure, examine the lure at once and replace it if injuries are noticed.

### **9.3. At the End of the Day**

After removing lure birds and returning them to the transport cages, examine each bird for signs of injury or exhaustion. Make a mental note of any needing to be moved into rest cages for recuperation.

At the main cage area, return all lure birds to their cages. As birds are returned to the cages, check each one again for signs of

stress, exhaustion, or injury. Place any that needs extra rest into recuperation cages. Check all cages for food and water and add as needed. The lure birds that were in the field may not have taken food or water during the day, so it is very important that they have that opportunity as soon as possible.

## **10. ROAD TRAPPING AND OTHER TRAPPING TECHNIQUES**

The fundamental difference between road trapping and station trapping is that station trapping involves luring migrating raptors to a fixed location where several traps of varying designs are located. Road trapping can be accomplished year round and involves driving some distance, locating a hawk or owl, and placing the trap in a location close enough for the raptor to see the lure animals. The trap is then monitored until the bird is captured, or the bird's behavior suggests that it has no interest in the offering. Typical lure animals involve non-native species such as the house mouse, black rat, gerbil, House Sparrow, European Starling, and Rock Dove. These should be exchanged about every 4 hours. The most frequently used trap designs when road trapping are the bal-chatri, small dho-gaza, and harnessed lure. Each trap is best used on particular species and each can be used more effectively in certain situations. Drawings and detailed descriptions of their use are provided in Bloom (1987) and Bub (1991)

### **10.1. Road Trapping**

Bal-chattris are the most frequently used trap when trapping from roads. The bal-chatri is a small cage made from hardware or aviary cloth (Fig. 12). Mesh size depends upon the lure animal to be used and should be no smaller than necessary to keep the animal from escaping. The most common cages are dome-shaped, conical, or square, with nooses 3.8-6.4 cm (1.5-2.5 inches) tall. The noose size is determined by the target species. Nooses are placed on the upper surface of the cage (and sometimes the sides or on an apron) to provide the best chance of entanglement. The strength of the noose material is chosen with the target species in mind and varies from 4.5- to 11.3-kg (10- to 25-lb) test. The lower strength monofilament is best used on raptors the size of American Kestrels and Burrowing Owls, and 9-kg (20-lb) test is standard for raptors the size of Red-shouldered Hawks and Great Horned Owls. The trap is weighted enough to keep the raptor from flying away with it, but light enough to be dragged a short distance to reduce the likelihood of the noose breaking. See Bloom (1987) for a more detailed discussion of the bal-chatri and use of other trap types for road trapping.

Bal-chattris are most often used for capturing kestrels, buteos, accipiters, and owls but may be used with more limited success on other species and groups as well. A hawk or owl is first located, and the weighted trap is then dropped along the roadside near the target bird. The trap is placed as far from the road edge as feasible, which provides added safety for the raptor from oncoming vehicles and ensures that the bird will not be disturbed prior to entanglement in the nooses. Ideally, a small,

infrequently used dirt road allows placement of the trap at a greater distance from the road edge. In some cases, it may be prudent to walk a trap 50-150 m out into a field. The trick is in knowing at what distance the bird is likely to flush, as raptors tend to be more cautious of people than they are of vehicles.

The small dho-gaza consists of a section of 10-cm-mesh (4-inch-mesh) mist net about 1.5 m (5 ft) long and 1 m (3 ft) tall strung between two small vertical rods. Release tabs are located at each corner and usually held by a paper clip. The net detaches when a falcon or hawk in pursuit of a tethered House Sparrow or European Starling blunders into it. The net is attached to a small weight that acts as a drag when the falcon passes through. Because falcons stoop on the lure at low angles, and when captured carry the net several yards, small dho-gazas can be used only on country roads or in fields adjacent to well-traveled roads.

The harnessed lure is a protective leather jacket fitted to a Rock Dove with 9-kg (20-lb) test monofilament nooses placed across the top. The lure is weighted to the ground with a small drag weight and placed within sight of the raptor, well away from the road. Harnessed lures are used mainly on large falcons, buteos, and accipiters.

Some species (American Kestrel, Cooper's Hawk, and Red-shouldered Hawk) are very responsive to bal-chatris and may be on the trap within 1 min of placement. Other species, such as Ferruginous and Rough-legged hawks, often require 30 min and usually do not respond at all. Small dho-gazas and harnessed lures are used in a similar fashion but are most frequently used on large falcons and Red-tailed Hawks. If a falcon is going to attack, usually it will do so within 5 min. Many raptors have previous experience with traps from both the banding and falconry communities. As a result, most individuals already recognize traps and avoid them. Older age classes of all species tend to be less responsive than are juveniles.

A notable variation on road trapping involves pre-placement of 5-20 bal-chatris and/or Verbal traps (traps atop a perch) and mist nets at regularly-used hunting locations, before the raptors have arrived. If needed, time may be spent camouflaging traps to conceal them from trap-wary birds. Traps are then monitored continuously via motion detectors (trap transmitters). Trap transmitters are small radio transmitters, set to different frequencies, which are activated when the trap is moved by a snared raptor. This method is very effective on owls and hawks in forested areas and on most raptors adjacent to utility poles and snags. Dry leaves placed inside bal-chatris increase capture success, particularly for owls. Large mesh mist nets may be used simultaneously, but must be checked frequently. Frequency of trap checks is dependent upon the specific situation. Human interference, potential predation of trapped hawks, and public relations concerns should all be considered when determining how frequently various trap types are checked.

## **10.2. Other Trapping Techniques**

A large variety of traps is available to the researcher. Knowing when, where, the type of lure, and what raptor species to use them with is the foundation of successful trapping. It is not our goal to describe every trap type, nor the details of their

various uses, nor how to build them. Instead, we simply want to make the reader aware of their existence and provide the relevant summary literature (Bloom 1987, Bub 1991) that encompass a broad spectrum of traps, their uses, and the references within. Since publication of the above references, a number of variations on the same trap types have been created, and a few new traps have been developed.

Several very different traps are available for capturing vultures and eagles, and are only superficially dealt with here. These include leg-holds, walk-ins, rocket and cannon nets, pit traps, and noose carpets. These traps are unique and most require direct prior experience before operating.

Eagles and vultures regularly use their beak to defend themselves, and eagles also use their talons and can inflict serious injuries. Eagles should be hooded immediately after capture and their toes taped closed. After vomiting, a vulture can be calmed by placing a dark sock over its head, but should be monitored to ensure that it is not choking. Turkey and Black vultures can be marked with patagial tags or transmitters but cannot be banded because fecal material builds up on their legs, which seals band to leg.

### **10.2.1. Leg-hold traps**

Leg-holds are used in the capture of eagles and vultures and involve the use of traps whose jaws have been padded and springs weakened. A light drag is attached to the trap. Several traps are placed around a carcass and monitored from a great distance. The pressure needed to trigger the trap must be carefully adjusted so that small nontarget birds such as ravens and magpies are not injured. Care should be taken to ensure that pet animals and coyotes are not captured. The use of leg-hold traps is illegal in some states, such as California.

### **10.2.2. Rocket and cannon nets**

Rocket and cannon nets also are used in capturing eagles and vultures. Both require use of explosives, so they are dangerous. With proper instruction use of these traps can be done without injury to the researcher or birds. These traps are superior to others in having the advantage of being selective and capable of capturing multiple birds with one firing. The most important consideration before firing the cannons and rockets is the location of all the birds. The projectiles are heavy and will kill or injure anything that they strike.

Special federal permits are needed before using these traps in both Canada and the United States. Regulations may require state or provincial permits for these traps. Contact state or provincial authorities to determine permit requirements in a specific study area.

### **10.2.3. Walk-in traps**

Walk-ins are relatively large compartment traps used with great success on Turkey and Black vultures. Each bird can be dealt with slowly because the remaining birds are safe within a spacious trap.

#### **10.2.4. Pit traps**

The pit trap is a hole dug in the ground from which eagles, condors, vultures, and ravens can be grabbed by hand. This method is highly selective and effective for eagles.

#### **10.2.5. Noose carpets**

Noose carpets consist of relatively tall nooses attached to hardware or aviary cloth that can be placed on known perches, at nests, in burrows, or surrounding carrion.

#### **10.2.6. The Verball**

The Verball trap is a perch trap that requires no lure animal, although it can be used in tandem with live animals.

#### **10.2.7. Mist nets**

Mist nets are most effective for capturing small owls but also can be used with good success on woodland raptors. Small owls are captured in mist nets by the hundreds each year at migration stations, particularly in eastern North America. They are best caught in 6- or 10-cm-mesh (2.4- or 4-inch-mesh) nets. Ten-cm- and 4-denier-mesh nets should be used for large raptors, such as Great Horned Owls and Northern Goshawks. Only 10-cm-mesh nets should be used for diurnal netting operations, as this reduces the number of nonraptors captured. Using 12- and 20-m (42- and 60-ft) nets maximizes net coverage. Diurnal and nocturnal nets should be checked hourly, except when temperatures fall below 4E C (40E F) when they should be monitored at no greater than half-hour intervals.

### **11. BANDING NESTLING RAPTORS**

Banding studies of nestling raptors are often designed to address questions different from those of interest in studies of migrating or wintering raptors. Since the natal area is known, studies of nest-site fidelity, natal dispersal, and related topics can be undertaken.

Compared to trapping raptors, banding young raptors in the nest presents a different set of problems to consider. These include the safety of the bander, who should be experienced with climbing, and behavioral responses of various raptor species to human intruders. Each species, and often different individuals within a species, respond differently to nest intrusions. The typical response of a Golden Eagle to a nest visit by a human is to leave the area quietly, whereas Bald Eagles respond with vociferous attacks that occasionally result in a climber being struck. Barn Owls are usually very timid during diurnal hours, but are often aggressive at night, when they will strike the intruder. Great Horned Owls are known for aggressive physical attacks on the climber, even during the day. At night these attacks are more frequent.

Raptors, while sensitive to human disturbance at the nest, are tolerant as long as the disturbance interval is short and timing of the visit is appropriate. Climbing to the nest structure and banding of the young should be accomplished as quickly as possible. Both can usually be done in less than half an hour.

Chicks should be banded in the nest and not lowered to the ground, as this only increases the time at the nest. Attachment of color-marking devices, transmitters, taking blood samples, and increased safety for both the nestling and the bander are some of the few valid reasons for lowering young birds to the ground.

Researchers should be familiar with the nesting phenology of the species to be banded. Most raptors can be banded at the age of 2 weeks but ideally are banded when half grown. Half-grown chicks can be sexed more easily and the potential for chicks to jump from the nest is near zero. Females of most raptors are up to a third larger than males and in some species require 1-2 band sizes larger. This is most apparent in large falcons and accipiters. The banding of female young with bands designed for the male of the species is terminal for the chick. Banding very young raptors in stick nests should be avoided because, under rare circumstances, a stick may become wedged between the band and tarsus and cause fatal leg deformities.

Before attempting any climb, safety requirements should be met. A safety harness should be worn and a second individual should be present for climber safety as well as to retrieve any nestling that jumps from the nest.

Ideally nests should be assessed first from the ground or air and stage of development of the young confirmed. Depending upon species, climbing the nest tree or cliff, either when eggs are present or the young are too small, can cause nest failures (Fyfe and Olendorff 1976). If nothing else, the nest structure will have to be climbed again along with the attendant disturbance to the nesting pair. A nest structure climbed when the young are near fledging predictably results in prematurely fledged young and, on rare occasions, the death of young. The young of most raptor species, when confronted by a climber, begin jumping from the nest when about three-quarters developed. Special planning is necessary before climbing to a nest if there is a reasonable chance of the young departing. This should include placement of several people with two-way radios at strategic locations to confirm where fledglings land.

If a cliff has a large area of talus rocks below the nest, in the flight path of older young, the nest should not be visited. Likewise, if a nest containing well-developed young is on top of a tall tree or cliff and on a large promontory, the nest should not be visited, as the young may glide great distances and not be retrievable. Similarly, special preparations such as a boat may be required in the case of raptor nests containing large young that are located adjacent to water.

When rappelling into cliff nests, adult raptors should be alerted to the presence of climbers before initiating the climb as some adults may knock small young to the ground in their haste to confront intruders. Climbers should also position themselves to one side of the nest so that loose rocks do not fall in the nest.

Climbing during the day to stick or cliff owl nests that contain eggs or young less than 1.5 weeks old should not be done because it is likely to cause reduced nest success or nest failure. When uncertain as to whether eggs or young are present, climb to the nest at dusk or dark. If the nest belongs to a large owl, extra precautions, including a helmet, protective eye wear, and rope, may be prudent. Even some small owls, such as the

Northern Hawk Owl, are capable of violent defense of the nest with attendant risk to the climber's eyes.

## 12. PERMITS REQUIRED

### 12.1. Federal Banding Permit

Before any raptor is banded, you must obtain a Federal Bird Marking and Salvage Permit and a state or provincial permit. Currently two levels and types of permits are available.

#### 12.1.1. Master permit

This permit is issued either to an organization with a responsible person named on the permit, or to a person for a specific research project. In the case of an organization, it is generally issued when an ongoing project will be carried out under its mission.

#### 12.1.2. Subpermit

This permit is issued to banders who work under the direction of the individual responsible for an organization's Master Permit, or under the supervision of a Master Permit holder.

The above permits are obtained by requesting a permit or subpermit application from either the Canadian Wildlife Service or the Bird Banding Laboratory.

#### *Canada:*

Bird Banding Office  
Canadian Wildlife Service  
National Wildlife Research Centre  
100 Gamelin  
Hull, Quebec, Canada  
K1A 0H3

#### *United States:*

U. S. Geological Survey  
Bird Banding Laboratory  
12100 Beech Forest Road, STE-4037  
Laurel, MD 20708-4037

### 12.2. State or Provincial Banding Permits

Rules for state permits for banding vary from state to state in the U.S. In California, as an example, a Scientific Collecting Permit is required but is only the first step for banding raptors. After obtaining the collecting permit, it is then necessary to obtain a Memorandum of Understanding (MOU) for banding raptors, because they are all listed as exceptions on the California Scientific Collecting Permit. Rules may vary from state to state, and the state agency responsible for fish and game or wildlife issues will be the appropriate agency to contact for further information.

In Canada, in addition to the banding permit, banders must obtain a provincial or territorial permit or permission prior to capture of any raptor species. Banders should contact the Banding Office for more complete information.

## 13. ORGANIZATIONS AND ASSOCIATIONS

### 13.1. Banding Associations

- (1) **Western Bird Banding Association**, Kenneth Burton, P.O. Box 716, Inverness, CA 94937. E-mail: [kmburton@svn.net](mailto:kmburton@svn.net). Web site: <http://thecity.sfsu.edu/snfc/western.htm>
- (2) **Inland Bird Banding Association**, Tom Bartlett, 1833 South Winfield Drive, Tiffin, OH 44883. E-mail: [Tom\\_Bartlett@Tiffin.k12.oh.us](mailto:Tom_Bartlett@Tiffin.k12.oh.us). Web site: <http://aves.net/inlandbba>.
- (3) **Eastern Bird Banding Association**, Elaine Mease, 2366 Springtown Hill, Hellertown, PA 18055. E-mail: [measede@enter.net](mailto:measede@enter.net). Web site: <http://www.pronetisp.net/~bpbird>.
- (4) **Ontario Bird Banding Association**, 1320 Mississauga Valley Blvd, Suite 804, Mississauga, Ontario, Canada L5A 3S9. Web site: <http://sites.netscape.net/tntcomm-obba/OBBA.htm>

### 13.2. Professional Ornithological Societies

Membership inquiries for the following five organizations should be addressed to: **Ornithological Societies of North America (OSNA)**, P.O. Box 1897, Lawrence, KS 66044-8897, E-mail: [osna@allenpress.com](mailto:osna@allenpress.com). Web site: <http://www.nmnh.si.edu/BIRDNET/OSNA/index.html>.

Members in any of these also receive the bi-monthly *Ornithological Newsletter*, which can be viewed online at <http://www.ornith.cornell.edu/OSNA/ornnewsl.htm>, and the biennial membership directory, *The Flock*. Web pages for the following organizations can be reached from the OSNA web site.

- (1) **Raptor Research Foundation**. Publication: *The Journal of Raptor Research*
- (2) **Association of Field Ornithologists**. Publication: *The Journal of Field Ornithology*
- (3) **Cooper Ornithological Society**. Publication: *The Condor*
- (4) **Wilson Ornithological Society**. Publication: *The Wilson Bulletin*
- (5) **American Ornithologists' Union**. Publication: *The Auk*

An organization dealing specifically with migration of diurnal raptors is: **Hawk Migration Association of North America (HMANA)**. Publication: *Hawk Migration Studies*. Web site: <http://www.hmana.org/>.

### 13.3. Raptor Banding Stations

- (1) **Cape May, New Jersey**. Bill Clark, 7800 Dasset Court, Apt 101, Annandale, VA 22003
- (2) **Hawk Ridge, Duluth, Minnesota**. Dave Evans, 2928 Greysolon Road, Duluth, MN 55812. E-mail: [mail@hawkridge.org](mailto:mail@hawkridge.org). Web site: <http://www.hawkridge.org/>.
- (3) **Hawk Cliff, Ontario, Canada**. c/o Russ Chantler, 8 Taylor Crescent, St. Thomas, Ontario, Canada N5R 5J4
- (4) **Cedar Grove, Wisconsin**. Dan Berger, 1806 Grevelia Street, S. Pasadena, CA 91030.
- (5) **HawkWatch International**. Jeff Smith, P.O. Box 660, Salt Lake City, UT 84110. E-mail: [hwi@hawkwatch.org](mailto:hwi@hawkwatch.org).

Web site: <http://www.hawkwatch.org>

- (6) **Golden Gate Raptor Observatory, San Francisco, California.** Buzz Hull, Building 1064, Fort Cronkhite, Sausalito, CA 94965. E-mail: [ggro@ggnpa.org](mailto:ggro@ggnpa.org). Web site: <http://www.ggro.org/>.
- (7) **Idaho Bird Observatory, Boise, Idaho.** Greg Kaltenecker, 1413 Rand, Boise, ID 83709. E-mail: [gkalten@internetoutlet.net](mailto:gkalten@internetoutlet.net). Web site: <http://www.idbsu.edu/biology/ibo>.

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- Gaunt, A.S. and L.W. Oring (eds.). 1999.** *Guidelines to the Use of Wild Birds in Research (2nd edition)*. Ornithological Council, 1725 K Street, Suite 212, Washington, D.C. 20006-1401.

## APPENDIX A. RAPTOR BANDER'S SKILLS CHECKLIST

This checklist details skills needed to band raptors. The list should be used by both trainer and trainee to monitor learning progress. Starred items are required skills for certification at the Assistant level. All items should be thoroughly mastered for certification at the Bander level.

	Required Item	Trainer's Initial		
<b>PROCESSING</b>			<b>Net Operation and Extraction</b>	
<b>Handling</b>			Judge conditions under which nets will be effective	___ ___
Use the Basic Leg Grip correctly	*	___	Correctly set dho-gaza for existing wind condition	___ ___
Use the Cradle Hold correctly	*	___	Demonstrate standard extraction technique	___ ___
Use the Upright Hold correctly	___	___	Deal proficiently with unusual or difficult situations	___ ___
Use the Backhand Hold correctly	___	___	Recognize nets in poor condition	___ ___
<b>Banding</b>			Demonstrate basic repair techniques for holes and perimeter lines	___ ___
Select correct band size	*	___	<b>BOWNETS</b>	
Read and record band numbers correctly	*	___	<b>Set up and Operation</b>	
Correctly apply butt-end band	*	___	Choose an appropriate location for bownetting	___ ___
Correctly apply lock-on band	*	___	Correctly set up bownet and lines	___ ___
Know how and when to correct an incorrectly applied band	*	___	Set net demonstrating knowledge of safe procedures around bownets	* ___
Know when and how to remove a band safely	*	___	Safely trap and extract raptor from bownet	* ___
<b>Carrying and Storing Hawks</b>			Recognize bownets that are in poor condition	___ ___
Know how to select correct size storage can	___	___	Demonstrate knowledge of basic bownet repair	___ ___
Safely remove a hawk from a can	*	___	<b>TRAPS</b>	
Correctly position the hawk in the can for storage	___	___	Has knowledge of traps and appropriate uses	___ ___
Correctly position the can with the hawk for storage	___	___	Operates traps properly and safely	___ ___
Know the signs of stress to be monitored for a raptor in a can	*	___	<b>LURE ANIMAL CARE</b>	
Know when not to store a raptor in a can	*	___	<b>Husbandry</b>	
<b>Field Data Collection</b>			Know and practice basic lure animal care (cleaning, feeding, minor first aid)	* ___
Record all required data items clearly and legibly	*	___	Recognize signs of stress, injury, poor health	* ___
Recognize when a measurement is inappropriate and make notation	*	___	Recognize when euthanasia is appropriate	* ___
Recognize and take photos or notes of unusual plumages	*	___	Demonstrate preferred technique for euthanasia when appropriate	* ___
<b>Biometrics</b>			<b>Care in the Field</b>	
Correctly use and read wing rule, tail rule, balance, calipers	*	___	Demonstrate proper handling and jacketing of various lure birds	* ___
Correctly measure various anatomical features	*	___	Demonstrate proper lure care at the trap	* ___
Accurately assess and record molt	___	___	Demonstrate proper lure care in the holding cages	* ___
Complete molt chart correctly	___	___	Recognize stress, injury, and exhaustion and take correct action	* ___
<b>Ageing and Sexing</b>			Recognize when conditions are too extreme for lure use	* ___
Correctly use guides for ageing and sexing	*	___	<b>NESTLINGS</b>	
Correctly use molt and plumage for age, sex determination	*	___	Follow species and age guidelines in the banding manual	___ ___
Understand and assign correct age codes	*	___	Know and follow safe climbing procedure	___ ___
<b>MIST NET AND DHO-GAZA USE</b>			Approach nests responsibly	___ ___
<b>Set-up, Opening, and Closing Nets</b>			Know proper precautions against mammalian predators	___ ___
Know how to choose an appropriate site and size of net	___	___	Handle, band and replace nestlings safely	___ ___
Correctly set up a net	___	___	Know how to assess risk of premature fledging and methods to prevent this	___ ___
Correctly furl and unfurl nets	___	___		
Correctly take down and store nets and accessory equipment	___	___		



**ETHICS AND INJURIES**

Know and practice the Bander's Code of Ethics	*	___
Show excellent awareness of injury prevention	*	___
Show familiarity with most common injuries and their causes	*	___
Know signs of stress and what actions to take to ameliorate these	*	___
Record details of all injuries and casualties	___	___

**HEALTH AND SAFETY OF BANDERS**

Know the potential causes for banders to be injured by raptors	*	___
Know the ways to avoid raptor caused injuries	*	___
Know the potential for infection caused by lure animals	*	___

Know the proper preventive measures to avoid infection	*	___
Know the physical hazards in the banding area and how to avoid injury from them	*	___

**DATA MANAGEMENT**

Proof and correct banding sheets	*	___
Complete banding schedules properly without assistance	___	___
Complete other paperwork completely and correctly	___	___

**PUBLIC RELATIONS**

Communicate effectively with the public about banding	*	___
Communicate effectively using banding data (reports, articles, etc)	___	___

**APPENDIX B. THE NORTH AMERICAN BANDING COUNCIL**

The mission of the North American Banding Council (NABC) is to promote sound and ethical principles and techniques of bird banding in North America. Skill levels of banders will be increased by the preparation and dissemination of standardized training and study materials and the establishment of standards of competence and ethics for banders and trainers.

The immediate objectives are:

- (1) to develop a certification and evaluation program by setting standards for experience, knowledge, and skills that must be attained at each level (Assistant, Bander, and Trainer);
- (2) to produce and update training materials such as manuals and perhaps videos;
- (3) to identify and certify an initial pool of trainers; and
- (4) to encourage cooperative efforts in the use of banding in the study and conservation of North American birds.

The NABC consists of 18 to 20 voting members, including

one representative appointed by each of the following organizations: American Ornithologists' Union, Association of Field Ornithologists, Cooper Ornithological Society, Colonial Waterbird Society, Eastern Bird Banding Association, Inland Bird Banding Association, Ontario Bird Banding Association, The Pacific Seabird Group, Raptor Research Foundation, Society of Canadian Ornithologists, Western Bird Banding Association, Western Hemisphere Shorebird Reserve Network, and Wilson Ornithological Society; and two representatives appointed by the International Association of Fish and Wildlife Agencies (one from Canada and one from the United States). Other groups have been invited to become affiliated. The NABC also designates from four to six additional members. The directors of the Canadian and U. S. Bird Banding Offices are nonvoting members of the NABC. The NABC was incorporated as a non-profit, California corporation in 1998.