

MANAGEMENT OF NONRELEASABLE RAPTORS FOR CONSERVATION EDUCATION PROGRAMS

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ABSTRACT.—Nonreleasable raptors are utilized throughout the United States to enhance conservation education programs. Their management is often based on practices found in literature as well as through operational experience. Management practices must also comply with state and federal regulations. To document current management practices, we surveyed conservation education facilities throughout the United States regarding species and numbers of raptors utilized, sizes and types of enclosures, health problems, feeding regimes, and other aspects of management. We also mailed a similar survey to all facilities utilizing nonreleasable raptors in Georgia and we inspected a subset of the respondents and nonrespondents. This information was then combined with scientific literature, popular literature, and unpublished management methods to create a set of best management practices for nonreleasable raptors in Georgia, which comply both with Georgia Department of Natural Resources (GADNR) wildlife exhibition regulations and recent changes to United States Fish and Wildlife Service (USFWS) educational permit requirements. In most cases throughout the United States and in Georgia, the mean or median management practices exceeded those required by the USFWS. Less than 7% of all raptors housed under those management conditions experienced serious health problems. Results between the voluntary United States survey and the Georgia survey were similar, with most differences attributable to regional conditions. We discovered only minor discrepancies between survey results and inspections. An unexpected benefit from inspections was that operators appreciated GADNR taking an interest in their programs and most welcomed any advice provided regarding their facilities.

KEY WORDS: *captive raptors, captive raptor care, environmental education.*

Manejo de las aves rapaces no aptas para la liberación en programas de educación ambiental

RESUMEN.—Las aves rapaces no aptas para liberación son utilizadas a través de los Estados Unidos para realizar los programas de educación ambiental. Su manejo está basado en prácticas encontradas en la literatura como también a partir de la experiencia operativa. Las prácticas de manejo deben cumplir con las regulaciones estatales y federales. Con el fin de documentar las prácticas de manejo, investigamos los centros de educación ambiental a través de los Estados Unidos con relación al número de especies y rapaces utilizadas, tamaño y tipo de encierros, problemas de salud, dietas y otros aspectos de manejo. También enviamos un cuestionario similar a todos los centros que utilizan aves rapaces no aptas para liberación en Georgia, e inspeccionamos a los grupos que respondieron o no. Esta información fue confrontada con la literatura científica, la popular y con los métodos de manejo sin publicar para elaborar un juego apropiado de prácticas de manejo para rapaces no aptas para liberación en Georgia, que cumpliera con ambos requisitos: Los del Departamento de Recursos Naturales de Georgia (DRNG), con las regulaciones para la exhibición de la fauna silvestre y los cambios recientemente hechos por el Servicio de Pesca y Vida Silvestre (USFWS) a los permisos de educación Ambiental. En la mayoría de los casos a través de los Estados Unidos y en Georgia, la media o la mediana de las prácticas de manejo excedieron a los requerimientos del USFWS. Menos del 7% de todas las aves rapaces en cautiverio experimentaron serios problemas de salud entre las encuestas voluntarias de los Estados Unidos y los de Georgia fueron similares, la mayoría de las diferencias fueron atribuibles a condiciones regionales. Descubrimos unas pocas discrepancias menores entre los resultados y las inspecciones. Un beneficio

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inesperado de las inspecciones fue el agradecimiento hecho al DRNG por el interés mostrado en este tipo de programas y la bienvenida a cualquier tipo de sugerencia hecha con relación a su infraestructura.

[Traducción de César Márquez]

Environmental education centers throughout the United States often include wildlife classes in their curriculum. In order to enhance these classes, live animals, such as small mammals, snakes, and raptors are commonly utilized. Until recently, laws and regulations concerning the management of non-releasable raptors were vague (Official Code of Georgia Annotated OCGA § 27-2-13). Few states have regulations that apply specifically to non-releasable raptors. Some states, including Georgia, have provisions in their wildlife laws that allow the natural resource agency to determine appropriate management practices. Other states have no provisions at all. This often results in permit officers or other wildlife biologists making decisions on acceptable management practices.

In 1998, the United States Fish and Wildlife Service (USFWS) modified their regulations regarding the care of captive raptors for education programs (USFWS Standard Conditions, Special Purposes-Possession/Education (Live Specimens), 50 CFR 21.27). These regulations specifically defined requirements for the use of captive raptors for conservation education programs. Criteria for housing and maintaining them were based on suggested guidelines of the University of Minnesota Raptor Center (Arent and Martell 1996). These new regulations provide specific, well-defined guidelines concerning the proper operation of captive raptor facilities but it is uncertain how these new regulations will affect the management practices at environmental education centers.

We began this study in 1996 to document and evaluate current nonreleasable raptor management practices in Georgia. The study was expanded to document practices throughout the United States to provide data with which to evaluate management practices in Georgia. We surveyed individuals and organizations in both Georgia and throughout the United States who utilize raptors in educational programs. In Georgia, the survey was followed up by on-site inspections and interviews with caretakers. We compared results from Georgia with results from centers outside Georgia and, when possible, with the current USFWS captive raptor regulations.

METHODS

The Sample. We sent a questionnaire to a sample of individuals and organizations possessing raptors used in environmental education programs in 1996. The Georgia sample was compiled from persons possessing Georgia Department of Natural Resources (GADNR) wildlife exhibition permits for raptors. The United States sample was compiled using two methods. A search was conducted using LYCOS®, YAHOO®, Infoseek®, and EXCITE® search engines during January 1998. Keywords included *raptor(s)*, *bird of prey*, *environmental education*, *rehabilitation*, and combinations of these. Links were examined at each site to locate additional related internet sites. A list of raptor centers throughout the United States which indicated that they rehabilitated raptors, used raptors in education, or maintained raptors in captivity was compiled from Internet web pages. Those persons indicating that they had E-mail were then sent a query to determine if raptors were used for educational programs and if they would participate in the survey. The survey was mailed to respondents providing a positive response.

The second method was to survey list-server users. Membership registers and messages were examined to determine how many members potentially had educational birds. E-mail inquiries were placed on two list servers for rehabilitators and one for falconers. The inquiry consisted of a message explaining the nature of the survey, time needed to complete the questionnaire, and purpose for the research. Respondents indicating they held nonreleasable raptors and used them for education programs were mailed a survey. Both methods were dependent upon the respondents owning a computer and having access to the world-wide web.

The Survey. Survey questions were based upon OCGA § 27-5-6 which contains the specifications for management of captive wild animals (Caudell and Riddleberger 2000). In general, the survey consisted of questions about the species and number of raptors possessed, facilities, space requirements, feeding, watering, sanitation, employees, separation of species, veterinary care, handling, and transportation. Questions were designed to obtain qualitative data for each of these areas. The United States survey was modified by removing questions regarding cleaning frequency and methods, pest control techniques, carrying cages, and program times to decrease the length of the instrument in order to increase the response rate (Caudell and Riddleberger 2000).

The Georgia surveys were mailed from the GADNR office in Social Circle, Georgia in late August 1997. Surveys were sent with a letter on official letterhead with return envelopes addressed to the GADNR office. A second survey was mailed to nonrespondents during the first week of January 1998 and reminders sent three weeks later. Request for United States participants were E-mailed from the last week of December 1997 through 20 February 1998. Surveys were mailed to United States participants on University of Georgia letterhead with re-

turn envelopes enclosed. Return envelopes were addressed to the university.

Respondents and nonrespondents in Georgia were randomly chosen from a stratified sample for on-site inspections in March and April 1998. Criteria of inspections were based on the Georgia survey. Questions regarding training procedures, past inspections, and educational programs were asked.

RESULTS

Sample Results. Twenty-three individuals and organizations that held Georgia permits for raptors used in environmental programs were sent the questionnaire. Seventeen surveys were returned. Of the five centers that did not return surveys, two reported that they did not have the time to answer, one did not believe that they used birds in programs in the manner specified in the instructions, and two did not respond. Nine centers (six respondents and three nonrespondents) were chosen for on-site inspections.

From the Internet search, 43 sites were located that possibly had nonreleasable raptors used in educational programs. Of these, 11 facility managers indicated that they possessed birds and would participate in the survey. From the list-server search, 42 facilities were identified that possibly had nonreleasable raptors and 29 responded that they had birds and would participate in the survey. Forty surveys were mailed. Nine surveys were returned from the Internet search and 27 were returned from the list-server search. Response rate from the combined groups was 90%.

The two samples were not mutually exclusive. Four centers used in the United States sample also possessed raptors in Georgia. These four centers were selected because they voluntarily returned the survey and had Internet access. The distribution of the surveys was spread throughout the continental United States based on the current USFWS regions (Arent and Martell 1996). Eleven surveys were returned from centers in Region 4, nine surveys were returned from Region 1, five surveys were returned from Region 3, four surveys were returned from Regions 2 and 5, and three surveys were returned from centers in Region 6. We did not receive any surveys from centers in Region 7.

Survey Results. Sixteen Georgia facilities reported housing 98 raptors used in educational programs. Thirty-six facilities throughout the United States reported housing 428 raptors. Education centers throughout the United States and Georgia utilized *Buteo* spp. most frequently (Table 1). *Accip-*

iter (*Accipiter* spp.), Ospreys (*Pandion haliaetus*), Mississippi Kites (*Ictinia mississippiensis*), and Ferruginous Pygmy-Owls (*Glaucidium brasilianum*) were rarely used. American Kestrels (*Falco sparverius*) were used infrequently in Georgia, but were commonly used throughout the rest of the United States.

Enclosure sizes varied as did the types of materials used in their construction. There were no major differences between the median enclosure size found in Georgia and those reported throughout the United States (Table 2). Median cage size areas were greater than or equal to current USFWS requirements for nonflighted birds (Arent and Martell 1996).

The two most commonly-used perch materials were artificial turf and tree branches. Throughout the United States, 27% of facilities used tree branches and 25% used artificial turf. In Georgia, 39% of facilities used tree branches and 22% used artificial turf. Other perch materials used by facilities included rope (12% in Georgia, 11% throughout the United States), stumps or logs (17% in both Georgia and the United States), large stones (3% in Georgia, 6% throughout the United States), and wood blocks (6% in both Georgia and the United States). Perch material selection was not mutually exclusive. In 93% of the facilities, more than one type of perch material was used. None of the materials used in perches throughout the United States or in Georgia were considered unacceptable by USFWS standards.

Throughout the United States, round river rock was utilized by 24% of facilities as floor substrate while only 12% of facilities in Georgia utilized this material. The two most commonly used substrates in Georgia were pine needles (19%) and crushed gravel (19%). Throughout the United States, 7% and 13% of facilities used pine needles and crushed gravel, respectively. Other commonly used substrates included dirt or no substrate (15% in Georgia, 13% throughout the United States), sand (8% in Georgia, 10% throughout the United States), grass (4% in Georgia, 13% throughout the United States), concrete floors (8% in Georgia, 5% throughout the United States), and newspaper (8% in Georgia, 3% throughout the United States). Fifteen percent of floor coverings throughout the United States were considered unacceptable by current USFWS standards. In Georgia, 27% of the materials used as floor covering would be

Table 1. Numbers and relative frequencies of nonreleasable raptors used in environmental education programs in the United States and Georgia.

SPECIES OF RAPTOR	U.S. SURVEY		GEORGIA SURVEY	
	TOTAL NUMBER	RELATIVE FREQUENCY	TOTAL NUMBER	RELATIVE FREQUENCY
<i>Buteo</i> spp.	84	19.6	27	28.1
<i>Otus</i> spp.	45	10.5	15	15.6
<i>Falco sparverius</i>	43	10.1	1	1
<i>Bubo virginianus</i>	41	9.6	15	15.7
<i>Strix varia</i>	29	6.8	19	19.8
<i>Falco</i> sp.	29	6.8	0	0
<i>Haliaeetus leucocephalus</i>	28	6.5	1	1
<i>Tyto alba</i>	25	5.8	10	10.4
<i>Aquila chrysaetos</i>	17	4	0	0
<i>Cathartes aura</i>	14	3.3	5	5.2
<i>Asio</i> spp.	13	3	0	0
<i>Aegolius funereus</i>	11	2.6	0	0
<i>Accipiter</i> spp.	10	2.3	0	0
<i>Parabuteo unicinctus</i>	10	2.3	1	1
<i>Coragyps atratus</i>	10	2.3	0	0
<i>Circus cyaneus</i>	5	1.2	0	0
<i>Pandion haliaetus</i>	5	1.7	2	2.1
<i>Ictinia mississippiensis</i>	3	0.7	0	0
<i>Polyborus plancus</i>	2	0.5	0	0
<i>Athene cunicularia</i>	2	0.5	0	0
<i>Glaucidium</i> spp.	1	0.2	0	0
<i>Nyctea scandiaca</i>	1	0.2	0	0

considered unacceptable by current USFWS standards.

Wooden slats and solid wood were the most common building materials used. In wall construction, 56% of facilities throughout the United States and 26% of facilities in Georgia used wood. To cover enclosures, 30% of facilities throughout the United States and 15% of facilities in Georgia used wood.

Plastic mesh was the next most widely used material followed by netting, galvanized hardware cloth, and polyvinyl chloride bars. The choices for the sides and roof materials were not mutually exclusive. Two percent of materials utilized in raptor enclosures throughout the United States were considered unacceptable by current USFWS standards, primarily chicken wire. In Georgia, 4% of the ma-

Table 2. Enclosure dimensions of captive raptors from throughout the United States.

SPECIES	N	LENGTH (m)		WIDTH (m)		HEIGHT (m)		AREA (m ²)	
		MEAN ± SE ¹	MEDIAN	MEAN ± SE	MEDIAN	MEAN ± SE	MEDIAN	MEAN ± SE	MEDIAN
Hawk	31	5.0 ± 0.5	4.2	3.2 ± 0.2	2.4	2.9 ± 0.1	2.4	19.9 ± 3.1	11.8
Large owl	34	4.8 ± 0.5	3.7	3.1 ± 0.3	2.4	2.6 ± 0.1	2.4	19.1 ± 4.3	9.6
Small owl	27	2.2 ± 0.1	2.4	1.7 ± 0.2	1.4	1.9 ± 0.1	2.0	4.0 ± 0.5	3.2
Large falcon	13	3.3 ± 0.2	2.4	2.6 ± 0.1	2.4	3.2 ± 0.2	2.4	9.2 ± 1.0	7.4
Small falcon	21	3.3 ± 0.2	3.1	5.6 ± 0.2	2.4	2.3 ± 0.1	2.4	9.9 ± 1.6	5.8
Eagle	12	5.3 ± 0.2	5.4	4.2 ± 0.3	3.7	2.8 ± 0.1	2.8	24.0 ± 2.3	16.7
Vulture	5	6.9 ± 0.5	4.9	2.8 ± 0.1	2.4	2.8 ± 0.1	2.4	21.0 ± 2.3	11.8

¹ SE = standard error.

terials utilized would be considered unacceptable by the USFWS standards.

The average number of employees working in facilities in Georgia was 4.5 ± 1.3 (\pm SE) and ranged from 1–20. The average number of employees working in facilities throughout the United States was 14.8 ± 3.6 and ranged from 1–83. The amount of formal training provided to employees or volunteers ranged from a few hours to months. The mean number of years of the primary caretaker's experience reported in Georgia and throughout the United States was 12.2 ± 2.1 and 13.5 ± 1.4 yr, respectively. The level of training ranged from having no formal training to veterinary technician certification. In Georgia, three caretakers reported having rehabilitation experience and three reported having a wildlife-related degree. Approximately 33% of the caretakers surveyed throughout the United States had rehabilitation experience and only one reported having a degree in wildlife or a related field.

Questions regarding cleaning frequency and methods, pest control techniques, carrying cages, and program times were asked only on the Georgia survey. The frequency of cleaning water bowls and food dishes ranged from once per day to once per week. The frequency of cleaning cages and substrate ranged from once per day to once per month. Commonly used disinfectants and cleaning solutions included chlorine bleach, other disinfectants, and soap and water. Twenty-seven percent of centers have an established pest control program for external parasites, internal parasites, or predators. Most facilities (88%) had at least one transport cage per bird. All facilities provided a rest break between performances that was at least as long as the performance period.

All facilities in Georgia and throughout the United States used the same veterinarian on a regular basis. Of the veterinarians used in Georgia and throughout the United States, 75% and 86%, respectively, reported having prior experience treating raptors. Visits to raptor facilities by veterinarians in Georgia ranged from none to weekly. Throughout the United States, visits to raptor facilities by veterinarians ranged from none to daily. Of the 98 nonreleasable raptors reported being housed in Georgia, only 10 problems were reported in 1996. Of the 428 raptors housed in the United States, 62 problems were reported. Physical injuries, bumblefoot, and problems related to old age were most frequently reported. There was no

obvious relationship between occurrences of problems and the number of routine visits by veterinarians to the facilities or routine checkups.

Raptors were fed a variety of food items (Table 3). Few birds were fed a single type of food item. The most common food item among all birds was mice or rats. The most notable exceptions were bald eagles (*Haliaeetus leucocephalus*) and accipiters which were fed mostly fish and fledgling domestic chickens, respectively. Nutrient supplements were used by 60% of the facilities. None of the foods utilized in either Georgia or throughout the United States were considered unacceptable by current USFWS standards.

Based upon qualitative observations, there did not appear to be any major discrepancies or misrepresentation between our inspections and the responses to the survey. The most noticeable differences were due to acquisition of new birds and new construction. Food items, food supplements, construction materials, cage substrate, and perch materials used were nearly identical to reported practices.

DISCUSSION

Although it was stated in the instructions that responses from Georgia were voluntary, mailing the survey from the GADNR Special Permit Unit could have affected the responses in several ways. Fear of not receiving permit renewal may have influenced persons to return surveys or persons may have refused to participate due to animosities with GADNR. They may have also misrepresented their center's management practices due to anxiety over permit renewal. However, this did not appear to be the case based on our inspections. The primary sample bias from throughout the United States was that most respondents were probably from the better centers (i.e., those with enough funds for Internet access and computers and those willing to provide details about their center's operations). Management practices of nonrespondents in Georgia did not appear to differ from respondents. However, this observation was based upon qualitative assessment rather than quantitative measures due to the small sample size of only three nonrespondents inspected and the lack of randomness in the sampling method. To further validate the responses, additional nonrespondents throughout the United States should be sampled in conjunction with random, voluntary surveys.

Species abundance at education centers reflects

Table 3. Food items (mean \pm SE) fed to captive raptors in environmental education programs throughout the United States and in Georgia.

SPECIES	N	FOOD ITEMS									
		MICE	RATS	POULTS	BOP ^a DIET	ROAD KILL	QUAIL	INSECTS	OTHER		
<i>Accipiter</i> spp.	3	9.7 \pm 2.5	9.7 \pm 2.5	4.7 \pm 1.2	0.0 \pm 0.0	0.0 \pm 0.0	66.7 \pm 8.6	0.0 \pm 0.0	9.3 \pm 2.4		
<i>Agolius</i> spp.	3	83.3 \pm 4.3	0.0 \pm 0.0	13.3 \pm 3.4	0.0 \pm 0.0	3.3 \pm 0.9	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0		
<i>Aquila chrysaetos</i>	10	3.9 \pm 1.4	51.9 \pm 5.0	8.7 \pm 3.6	0.0 \pm 0.0	7.9 \pm 2.5	10.5 \pm 2.3	0.0 \pm 0.0	15.1 \pm 3.5		
<i>Asio</i> spp.	2	100.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0		
<i>Buteo</i> spp., <i>Parabuteo</i> sp.	34	31.9 \pm 4.6	29.3 \pm 4.4	12.5 \pm 2.9	7.8 \pm 3.5	1.0 \pm 0.4	7.0 \pm 2.2	0.9 \pm 0.8	9.4 \pm 3.2		
<i>Bubo virginianus</i>	23	45.6 \pm 5.0	23.4 \pm 3.7	11.5 \pm 3.6	3.9 \pm 2.8	0.9 \pm 0.4	5.0 \pm 2.7	0.0 \pm 0.0	8.7 \pm 3.5		
	10 ^b	7.5 \pm 2.0	42.5 \pm 7.5	36.1 \pm 7.8	7.1 \pm 3.1	3.0 \pm 1.3	4.0 \pm 1.6	0.0 \pm 0.0	0.0 \pm 0.0		
<i>Cathartes</i> sp., <i>Coragyps</i> sp.	10	26.8 \pm 3.2	47.0 \pm 5.6	7.1 \pm 1.2	0.0 \pm 0.0	1.0 \pm 0.5	2.0 \pm 0.9	0.0 \pm 0.0	16.1 \pm 2.5		
	4 ^b	0.0 \pm 0.0	57.5 \pm 8.4	5.0 \pm 1.9	0.3 \pm 0.1	25.0 \pm 9.6	12.5 \pm 4.8	0.0 \pm 0.0	0.0 \pm 0.0		
<i>Falco sparverius</i>	24	69.8 \pm 4.5	1.7 \pm 0.8	12.2 \pm 2.8	0.4 \pm 0.3	0.2 \pm 0.2	9.4 \pm 3.0	1.0 \pm 0.6	3.6 \pm 1.1		
<i>Falco</i> spp.	7	20.7 \pm 2.9	1.4 \pm 0.6	10.0 \pm 2.7	0.0 \pm 0.0	0.0 \pm 0.0	38.6 \pm 5.6	0.0 \pm 0.0	29.3 \pm 7.2		
<i>Haliaeetus leucocephalus</i>	12	1.3 \pm 0.5	24.9 \pm 2.8	11.3 \pm 3.9	0.0 \pm 0.0	2.7 \pm 1.3	10.8 \pm 3.4	0.0 \pm 0.0	49.9 \pm 3.3		
	4 ^b	10.0 \pm 2.4	16.3 \pm 3.8	25.0 \pm 8.4	10.0 \pm 3.8	0.0 \pm 0.0	10.0 \pm 3.8	0.0 \pm 0.0	24.0 \pm 6.8		
<i>Ictinia mississippiensis</i>	2	50.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	2.5 \pm 0.5	47.5 \pm 0.5	0.0 \pm 0.0		
<i>Otus</i> spp.	24	75.2 \pm 4.8	1.3 \pm 0.7	18.9 \pm 4.6	0.4 \pm 0.3	0.2 \pm 0.2	1.7 \pm 0.9	1.0 \pm 0.6	1.4 \pm 0.6		
	10 ^b	42.0 \pm 7.7	6.0 \pm 2.6	37.5 \pm 8.2	5.0 \pm 3.0	2.0 \pm 1.2	5.0 \pm 3.0	0.0 \pm 0.0	2.0 \pm 1.2		
<i>Sirix varia</i>	15	45.5 \pm 5.7	24.0 \pm 5.0	21.8 \pm 5.1	0.0 \pm 0.0	1.7 \pm 0.7	6.0 \pm 2.9	0.0 \pm 0.0	1.0 \pm 0.4		
	13 ^b	16.9 \pm 4.6	28.5 \pm 7.4	28.8 \pm 7.5	19.7 \pm 6.8	2.7 \pm 1.2	3.1 \pm 1.4	0.0 \pm 0.0	0.0 \pm 0.0		
<i>Tyto alba</i>	14	38.9 \pm 4.3	21.4 \pm 3.8	28.6 \pm 4.6	0.0 \pm 0.0	1.1 \pm 0.4	2.9 \pm 1.0	0.0 \pm 0.0	6.4 \pm 2.2		
	7 ^b	22.1 \pm 6.9	32.1 \pm 7.4	33.6 \pm 8.2	7.1 \pm 3.6	0.7 \pm 0.4	2.9 \pm 1.5	0.0 \pm 0.0	0.0 \pm 0.0		

^a BOP = commercial bird of prey diet.^b Data from Georgia survey.

popular and published beliefs about generalization of certain species' behavior. Accipiters are generally considered nervous birds that are difficult to keep in captivity and undesirable as educational birds (Arent and Martell 1996). Therefore, they are not a commonly utilized species. Most hawks, such as Red-tailed Hawks (*Buteo jamaicensis*), are regarded by falconers as a "beginner's bird" and are recommended as educational birds (Parry-Jones 1994, Arent and Martell 1996). American Kestrels and owls are other birds that adapt well to captivity and use in educational programs. Golden Eagles (*Aquila chrysaetos*), Bald Eagles, Peregrine Falcons (*Falco peregrinus*), and Prairie Falcons (*F. mexicanus*) are recommended for experienced handlers only. Ospreys are considered to be one of the most difficult raptors to maintain in captivity (Arent and Martell 1996). Despite these generalizations, each bird should be evaluated individually.

Differences between species used in Georgia and throughout the United States can, in many cases, be attributed to regional species abundance. Since many birds used in educational programs are injured migrants or resident species, a disparity of species used between regions of the United States was expected. Even though American Kestrels are Georgia residents and considered to be excellent program birds (Arent and Martell 1996), they are rarely used in environmental education programs in Georgia.

When deciding upon the minimum recommended enclosure sizes, median enclosure areas may be of more use than mean enclosure areas. Several centers reported having enclosures much larger than the mean enclosure area, which caused the mean to be skewed toward larger cages. This may be due in part to large numbers of birds being housed together, though this was not determined through the survey. Centers with birds used for display only were asked to participate if these birds were part of educational programs, such as walk-by lectures, which may account for some of the variation. From on-site inspections made in Georgia, larger enclosures were often used as static displays rather than for housing birds that are routinely "manned" (held on a glove during programs) for educational programs. These larger enclosures often held multiple birds.

Providing additional width or length may be more important in nonreleasable raptor housing than providing additional height. Many nonreleasable raptors have damaged wings or reduced vision

and do not need tall cages. Perches set high in a tall cage may injure a raptor with an amputated wing if the bird falls (Gibson 1996). Nonreleasable raptors used for educational programs must also be accessible while providing the bird with a non-stressful environment. A bird can be difficult to retrieve if the cage is much higher than a person's head. The space above the caretaker's reach is either wasted or utilized by the bird to escape the caretaker. The highest perch should be no higher than the caretaker can comfortably reach to capture the bird (Arent and Martell 1996). Gibson (1996) recommends that perches be set no higher than 1.2 m for amputee birds. Texas Parks and Wildlife Department's 1998 regulations regarding captive raptors (69.305-d-1) require a minimum height of 3.7 m, which, based on current USFWS regulations and surveyed management practices, is too high to efficiently retrieve flightless raptors utilized for educational programs. Not only does it make it difficult to retrieve birds, but a high ceiling may cause stress to a bird if the perch is set far below it, as would be necessary with amputee birds (Gibson 1996).

Perhaps the most serious deviation from accepted management practices and current USFWS regulations is the use of pine needles and similar substrates for floor covering. Floor substrates that appear to give the birds a natural setting are aesthetically pleasing to visitors at facilities. In Georgia, pine needles are abundant and can often be obtained for little or no cost. Unfortunately, pine needles and other unacceptable floor substrates may pose health hazards to birds. Pine needles and similar materials are hard to clean on a daily basis and are ideal growth media for fungi, such as *Aspergillus fumigatus*, the causative agent of aspergillosis (Parry-Jones 1994, Gibson 1996). Brushed concrete floors can injure the raptors' feet when landing or pacing. Birds with reduced flight capability seem to be especially prone to this type of injury (B. Kessner pers. comm.). However, improper substrate can be easily changed with little impact to facilities. From our inspections and consultations in Georgia, caretakers did not seem to mind making minor changes, such as using different substrates. Often, they did not know of the potential health risk to their birds or their staff from using pine needles or similar substrate. Most caretakers were receptive to changes where benefits to the birds were apparent and the cost to the facility was minor.

Few medical problems were reported. Since many raptor facilities have few or infrequent visits from veterinarians, problems that are difficult to diagnose or have clinical signs that slowly manifest over several months or years may go unnoticed by handlers. However, there were no apparent differences between facilities that had veterinarians visit the facilities on a regular basis and those that did not. There was also no reference in the survey as to how these reported problems were diagnosed. This may affect the accuracy of the data. Some diagnoses are fairly obvious, such as bumblefoot or physical injuries, and can be made by experienced handlers. Others, such as bacterial infections or *Salmonellas*, require a veterinarian to diagnose. Detailed information regarding infections, diseases, and injuries was not obtained through our survey. This area of nonreleasable raptor management deserves further attention. A survey of veterinarians who commonly handle raptor medicine and management may provide further insight into common problems.

Nonreleasable raptor management practices from throughout the United States and Georgia, current USFWS regulations, management practices in print from respected raptor centers (Arent and Martell 1996, Weaver and Cade 1991), falconry publications (Parry-Jones 1994, Fox 1995), veterinary manuals (Beynon et al. 1996, Enderson 1986, Fraser 1991), and scientific publications were combined to create a set of best management practices for captive raptors in Georgia (Caudell and Riddleberger 2000). Our approach used the best available information on which to base acceptable management practices.

An unexpected benefit from our research was that the majority of the facilities inspected appreciated our interest in their program. Most wanted an opportunity to interact with knowledgeable professionals and to showcase their facility. Suggestions for improvements were also taken well, especially in regard to the health of their birds. Caretakers were also pleased to learn that our manual would not only be a compilation of published management techniques, but would also include techniques used at their facilities.

The type and amount of formal training of the primary caretaker varied considerably. However, this did not appear to impact the level of care provided to the birds. Most facility management practices followed suggestions from the literature, as evident from enclosure construction and design,

feeding strategies, and other aspects of management surveyed in our study. Providing continuing education is an area where wildlife agencies can become involved. By providing a time where caretakers, wildlife officials, and guest lecturers can meet and discuss current trends in management and regulations, permit holders will become better informed and feel as if they have a stake in the permitting and regulatory process.

Even though our sample was not random, it did provide an indicator of common management practices used throughout the United States. In general, caretakers who responded to the survey appeared to be practicing sound management of captive raptors. Most facilities already met or exceeded the recent USFWS changes to the regulations regarding the use and management of captive raptors before they were implemented. The most apparent deviation from accepted practices (i.e., floor substrate) was one of the simplest aspects of facility management to modify. Additional surveys followed by random inspections may prove to be an accurate, cost effective alternative to inspecting all facilities throughout the United States. Whether surveys or inspections or both are utilized, we recommend that regulatory officials maintain regular contact with caretakers.

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