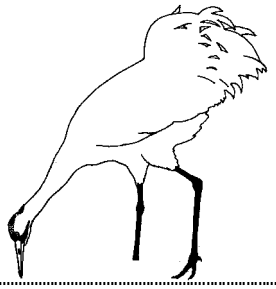
CHAPTER 5

Chick Rearing



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Rearing method has a profound and lifelong effect on a crane's behavior. Because cranes sometimes live longer than seventy years in captivity, it is imperative to rear according to need. Cranes reared for display should be reared differently than breeding stock or birds for release to the wild.

There are two primary crane chick rearing methods. The first, parent-rearing, is when a chick is reared by one or both of its own parents, or surrogates of the same or another species. These chicks are usually correctly imprinted and can be released into the wild or serve as natural breeders. The second, hand-rearing, is when the crane chick is reared by humans with or without the use of costumes and with or without live conspecific crane imprinting models (see Chapter 11D for details on raising hand-reared chicks for reintroduction).

The amount of preparation, time, labor, and expense incurred rearing chicks will vary greatly depending on the method chosen, and must be carefully considered to ensure success. Husbandry practices applicable to both rearing methods are discussed first, followed by the techniques specific to each method and veterinary techniques for chicks.

General Husbandry for Chick Rearing

Facilities

Parent-rearing facilities are modified breeding pens (see Chapter 12). Facilities that allow caretakers to lock adult cranes in or out of a shelter while capturing the chick reduce the risk of injury to birds and keepers. Young crane chicks are surprisingly mobile, and can easily pass through typical chain link fence. To prevent this, a smaller (0.56 cm or 0.25 in) plastic coated mesh, or solid material, should be added to the fence from just below ground level to a height of 30 cm (12 in). Install the "chick proofing" on the inside surface of the chain link to prevent chicks from getting trapped between the two fencing materials.

Optimally, chicks should be reared in flight-netted pens. If this is not possible, the flight capabilities of chicks must be monitored closely around fledging (60-100 days depending upon species) and appropriate flight restraint measures must be taken before the chicks escape (see Chapter 11E).

Hand-rearing facilities should include brooder boxes (Fig. 12.1) or commercial incubators and predator proof indoor/outdoor covered pens large enough to provide chicks with adequate exercise (see Chapter 12). The indoor pen should provide a controlled environment with food and water. Each should be equipped with at least one heat lamp of adjustable height. If outdoor runs are large enough (ca 3 × 7 m) to allow growing chicks adequate space for exercise until they are fully grown, they are also large enough to house calm adult conspecifics in neighboring pens to serve as imprinting models. If a parent-reared chick requires intensive care, the runs can also serve as adequate housing for a dam and her chick. Of course, use caution when bringing sick animals into the rearing facility.

To promote strong imprinting on conspecifics, visual contact with an adult or subadult crane in a neighboring pen is beneficial during the first days after hatch. Older chicks can be housed adjacent to adults or subadult conspecifics, which we call socialization models, that are housed in large pens built adjacent to outside chick runs. These birds provide an opportunity for chicks to observe social behavior within a group, something the imprinting model does not provide.

At Patuxent, chicks young enough or sick enough to be kept in a brooder box are not usually exposed to live conspecifics because of the added stress associated with trying to watch and follow the adult. Instead, taxidermic heads are left in sight of the chick and pelt fragments of gray or white feathers are left for

the chick to cuddle. Because chicks readily respond to the heads and pelts, when the chick is strong enough to be returned to a rearing pen, recognition of the live adult is usually immediate.

If brooder boxes are used, they should have an exercise area of at least one square meter, be easily cleaned, and allow easy access to the chick. Because of aggression, chicks must often be housed in individual pens and brooder boxes. Ideally, partitions between brooder boxes, incubators, and indoor/outdoor pens or runs should be made of a material (e.g., plexiglass) which allows chicks visual contact with neighboring chicks and adult imprinting models while preventing injuries. Wire barriers or flexible, plastic mesh (0.45-0.56 cm, 0.2-0.25 in) also provide for visual contact with neighbors. Even with these barriers, there remains some risk of eye or beak injuries if the chicks fight through the fences.

Adult cranes housed next to chicks as imprinting models may be curious or may perceive young chicks as prey. Install an adequate barrier between chicks and adults to prevent adults from jabbing through a wire mesh barrier or digging under the plexiglass. Plexiglass must be carefully secured and buried at least 2 inches in the ground. If adult cranes are not housed next to chicks, partitions made of flexible, plastic mesh (0.45-0.56 cm, 0.2-0.25 in) can be used to separate chicks. However, as chicks get older and fight more aggressively, they may need plexiglass partitions to prevent permanent beak damage or eye injuries.

Indoor pens are easier to clean and maintain if they have concrete floors with substrate such as 5-6 cm (2 in) of wood chips, shavings, or sand. Wood shavings should be dust free, laboratory grade if possible (e.g., Beta-chips), to reduce respiratory problems. In addition, carpet pads or rubber matting may be placed over the concrete and under the wood shavings to help prevent chicks from slipping on the smooth surface. Using 2.5 cm (1 in) deep sand bedding diminishes the chances of slipping and decreases pathogens which might grow in wet shavings, but sand can fill the air with dust when sifting out feces. Sand and shavings can cause eye injuries or irritation when trapped under the lid. Placing a carpet on top of the sand or shavings is highly recommended for the first two weeks.

Natural turf is the best substrate for outdoor runs and provides a stimulating environment for the chicks, but is difficult to disinfect. To reduce parasite and pathogen loads, pens can be used on alternating years, lime can be tilled into the soil, or sod can be removed and replaced. Another option in temperate climates is to leave the pen fallow for 4-5 months and maintain imprinting models in the same pen every year. Some institutions also treat the ground with One Stroke Environ (see Chapter 2 and Appendix).

Outdoor runs can also have concrete floors covered with a sand (2.54 cm, 1 in) deep. Sand is easily removed at the end of the season. The concrete slabs can be scrubbed and disinfected.

A hand-rearing facility may also include an exercise yard (where chicks can be walked or allowed to run freely and are socialized under supervision) and a swimming pool at least three feet deep for hydrotherapy (see Exercise, this chapter). Flight netting outside runs ensures that older chicks cannot fly out and protects them from avian and terrestrial predators.

Protocols and Record Keeping

Current protocols for specific rearing methods should be available in chick rearing facilities. Detailed records should be kept on each bird (see Chapter 10). Important milestones in the chick's life, such as when the chick begins eating and drinking on its own, must be carefully noted. Physical problems, medical treatments, weight gain, changes or supplements to the diet, amount and type of exercise, socialization with other chicks, exposure to imprinting models, and behavioral changes should all be recorded.

Diet

Crane chicks must be provided with a nutritionally balanced diet suitable to the needs of a rapidly growing animal with a high metabolism. Specially formulated crane chick (starter) diet should be fed from hatching (day 0) through fledging (day 70+) or until all primaries are completely grown (up to 4 or 5 months).

Serafin (1980, 1982) recommended a diet containing no more than 24% protein and 0.73% sulfur amino acids for slowing growth of hand-reared cranes and thereby reducing the risk of abnormal leg development. Higher protein levels, especially animal protein, increase the incidence of leg and wing problems.

Pelleted, commercially prepared food is a convenient, reliable alternative to mixing special diets. Different feed formulas are needed for growing chicks, non-breeding adults, and breeding adults (see Table 2.2). Local feed producers may be able to

TABLE 5.1

Vogelpark, Walsrode crane chick starter diet.

Ingredient	% Composition
"Insekt-futter" (Insect-feed, red)[1]	50
Beef Hearts (finely ground)	25
Quark (yogurt-like dairy product)	10
Mealworms (1/2 quick-boiled, 1/2 live)	10
Green feed (lettuce, other greens)	5
Yeast powder (fortified)	trace
"Osspulvit-pulver" (calcium supplement)	trace
Crickets (Family Gryllidae) (fresh-killed)	(5-8 per bowl)

Mixallingredientstofor m a moist,butnotsaturated,mixture. Watercanbeaddediftoodr y. Approximately 50-100 g per bird are fedtwicedaily. Cricketsar e placedontopofeach foodbowl. Pelletedfood isalsoalwayspr ovided.Asthechicks grow, lessofthefreshmixtur e isprovidedandtheyeatmor e pellets.After 6-8 weeks,the youngbirdseatonlypelletedfood.

[1] *Type I (rot) Trocken-Weichfutter (mixture for small birds and quail) from: Claus GmbH, Spezial-Futtermitt Postfact 100, 6703 Limburgerhof, Germany.*

manufacture feed when provided the formula, or prepared crane feed may be purchased from Zeigler Feed Company (see Appendix).

Food must always be recently milled (within three months), dry, intact, and free of contaminants including mold and vermin. Crumbles are fed from hatching to 2-3 weeks of age. As the chick begins eating on its own, pelleted starter ration (diameter 5 mm or 0.1875 in, 24% protein) is mixed into the crumbles. The percentage of pellets is slowly increased until the chick is eating only pellets by three to four weeks. Parent-reared chicks can be fed a mixture of crumbles and pellets from day 1.

Many zoos feed a poultry (usually turkey) starter ration augmented with insects, fish, rodents, or other protein. At Vogelpark Walsrode (Walsrode, Germany), young cranes are fed a combination of the pelleted diet and a mix similar to a "soft bill" diet (Table 5.1).

Ideally, any institution raising crane chicks will have access to a complete, balanced diet. However, if this is not feasible, or if the diet available is questionable, a standard dose of water soluble poultry vitamins and electrolytes can be added to the water. The poultry additive should be discontinued as soon as a balanced diet is available.

After fledging (day 70+) or when primaries are fully grown, chicks are taken off starter ration and put on maintainer ration (protein 15-19%).

Supplementary Feeding

For very young chicks that are ill or otherwise slow to learn to eat, supplementary feeding may be necessary. Of the two methods available (i.e., force feeding pellets and gavage [intubation or tube feeding a liquid diet]), gavage is preferred. Instructions for supplemental feeding and tube feeding diets are found under Veterinary Techniques in this chapter. Tube feeding, unless done excessively, usually will not discourage a chick from eating on its own. In fact, for neonatal chicks, tube feeding small quantities 2-3 times a day may help stimulate their appetite while it also staves off dehydration.

Water

Fresh water should be kept constantly available and replaced daily or whenever contaminated. Non-spillable bowls must be deep enough to enable the chick to drink, but still allow it to escape should it stumble in (Fig. 5.1). Standard one gallon plastic poultry water jugs with red lids work well. Shallow bowls with a large, open surface area require more maintenance, because they are more easily contaminated by the chick's droppings.

Because cranes are wading birds, it seems reasonable that teaching the chick to drink would be a simple matter, however, it is not. Videotapes of wild Mississippi Sandhill Cranes show that the adults

Fig. 5.1. *Chick feeder and waterer should be "non-tipable."* Photo ICF

spend hours coaxing the chick to take its first sip, even while the chick sits in open marsh water.

Dehydration is a significant health concern when raising chicks. It reduces the desire to eat *and* drink, and may cause the chick to act dazed and lethargic. Chicks that have been eating well may stop entirely when dehydrated. Both hand-reared and parent-reared chicks must be carefully monitored in their first week for dehydration, and receive fluids when necessary. For clinical signs associated with dehydration and treatment, see Table 5.2.

Handling

Crane chicks are very fragile. Improper handling can cause lacerations, broken or damaged limbs, and ruptured yolk sacs, all of which can end in death. Some amount of handling is necessary in order to evaluate the health and growth of the chicks. Whenever deciding to handle chicks, consider the amount of information gained versus the amount of stress to the cranes.

At hatching, crane chicks weigh between 100 and 130 grams and can fit in the palm of a hand. When picking up such a small, delicate animal, the "scoop" method is the safest (Fig. 5.2). Chicks can be "scooped" up from either the front or from behind. One or two fingers are slipped between the chick's legs, and its body is held gently in the palm, while the legs dangle between the fingers or over the side of the hand. The other hand covers the chick's back to prevent it from jumping off the palm. The legs are left unrestrained, but must be prevented from clawing the chick's neck or face. When releasing chicks, support

Fig. 5.2. *Scoop method of carrying newly hatched chick. Thom Lewis pictured.* Photo David H. Ellis

TABLE 5.2

Clinical Signs and Treatment of Dehydration

Dehydration	Clinical Signs	Treatment
>5%	Not detectable	No treatment may be required
5-6%	Slight loss of skin elasticity. Some tenting of skin (over hocks or elsewhere). Dull appearing eyes. Tacky mucous membranes.	Subcutaneous fluids
7-9%	Some loss of skin elasticity with distinct tenting of skin possible, but not pronounced.	Subcutaneous fluids
10-12%	Mucous membranes dry. Chick dull and depressed. Extremities cool to the touch. Heart rate increased.	Intravenous bolus therapy and subcutaneous fluids; warmth, other supportive care (antibiotics, etc.)
12-15%	Chick extremely depressed and near death.	Intravenous fluids, warmth, antibiotics

the body until the legs support the bird's weight. Be especially careful to prevent the chick from falling onto its back. A supine chick will flail with its legs and can easily tear its own neck or injure its eyes with its nails.

A safe method of carrying birds over 10 days old is the bouquet method. One palm supports the bird's chest or keel while the legs are gently restrained by the other hand (Fig. 5.3). The legs are held apart with one or two fingers between them. The bird's body is held horizontally with the legs held back out of the way so the chick cannot claw itself. Legs must not be twisted, crossed over, or allowed to rub together. Two versions are available: either the bird is held horizontal or more upright.

As chicks grow older, care must be taken during handling so that emerging feathers are not damaged or broken. As wings and primaries grow, wings must be carefully restrained to reduce the risk of injury and feather damage.

Chicks over six weeks of age are normally carried like small adults. The body is held to the side like a football tucked under the arm, with the forearm holding the bird's body against the caretaker's side and the fingers of that same arm holding the legs (Fig. 5.4).

Fig. 5.3. *Lorie Shaull demonstrates "bouquet" method of carrying a mid-sized chick.* Photo David H. Ellis

Fig. 5.4. *Jane Nicolich holding an adult Sandhill Crane using the same "football carry" that is used on large chicks.*
Photo Glenn H. Olsen

Weighing

Monitoring a chick's growth (expressed as percent weight gain per day) is the primary factor in determining the chick's health. Weight gain can also be plotted and compared to a normal growth chart for the individual species (Fig. 5.5).

It is advisable to weigh a chick in a box on a standing scale (Fig. 5.6) rather than a hanging scale to reduce the risk of leg injuries. The scale should have an accuracy of 1% until chicks are over 2000 g. The floor of the box should be covered with a non-slippery material (i.e., carpet). To reduce human contact, chicks may be placed in a closed box during weighing.

Hand-reared chicks, when larger than 1 kg, can be guided or trained to walk onto a platform scale to reduce the chance of injury during weighing. However, many walk-on scales provide only 20 g increments.

Ideally, the first weighing should occur as soon as possible after hatching. Chicks should be weighed at the same time each day, until it is determined that the chick is no longer losing weight. The frequency of weighing the chick will depend on the chick's health and the rearing method used. Normal weekly weight gains for six species are summarized in Table 5.3.

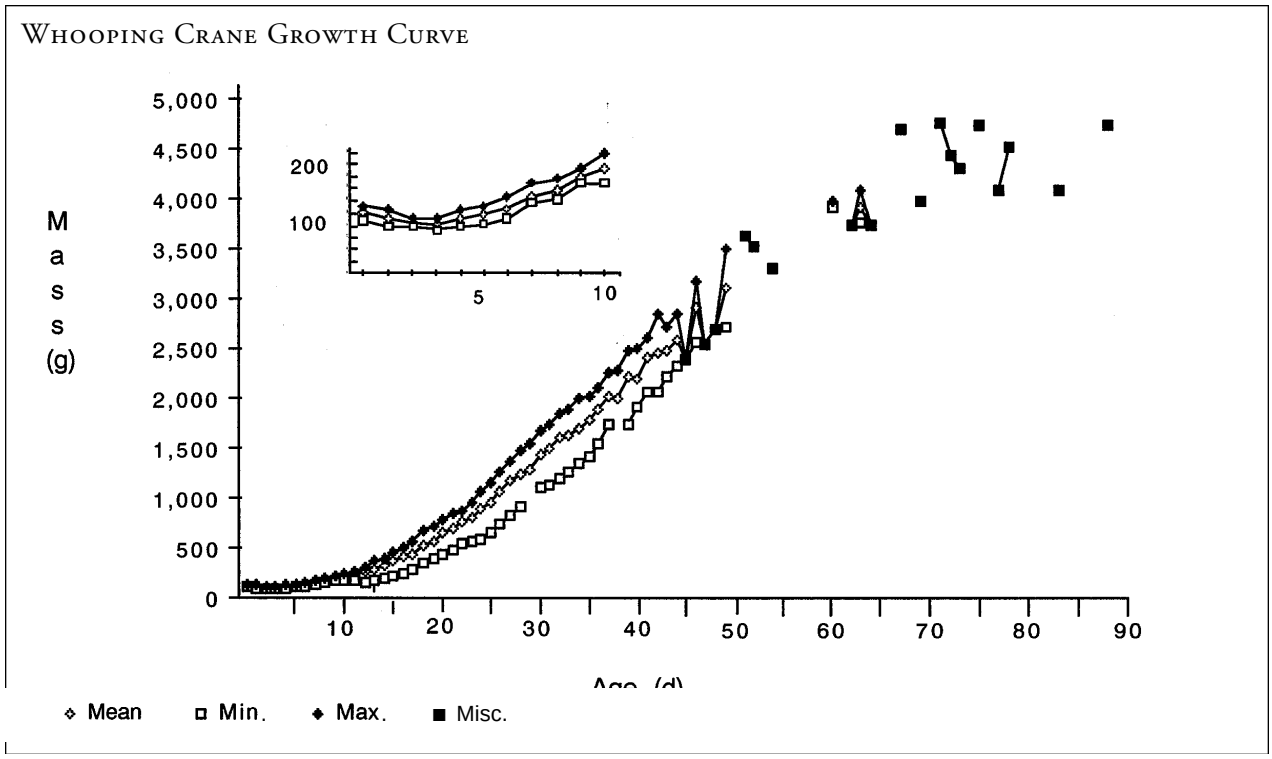

FIG. 5.5. *Growth curve for Whooping Crane chicks. The brief weight decrease following hatching is normal as are sizeable fluctuations around the mean.*

FIG. 5.6. *Kathy O'Malley weighing a chick in a box.*
PHOTO DAVID H. ELLIS

Growth Problems

A 10-15% weight loss in the first 3-5 days is normal as the chick absorbs its yolk sac (Fig. 5.5). Chicks that lose more than 15% of their body weight should be monitored closely and encouraged to eat (see Training Chicks to Eat and Drink under Hand-rearing in this chapter). If weight loss continues or lethargy sets in, support by subcutaneous injection of fluids or by gavage feedings (see Veterinary Techniques in this chapter or Chapter 8).

Excess weightgain (and resulting legorwing problems)is a majorconcernin rearingcrane chicks(see Veterinary Techniques section).This problem, present in all rearing methods,is more common inhand-rearing.Chick weight shouldbe monitoredcarefully during the period ofmost rapidgrowth, approximately days 10-40. Weight gainmustbe considered overthe courseof severaldays, butcontinuous weight gains exceeding 10% to 15% perdaycancause problems. However, evenchicksunder tendays ofage,or whose weightgains are less than 10%, occasionallysufferleg deformities.Therefore, dailymonitoringis critical.

At Patuxent, leg problems seldom occur with the small, Mississippi Sandhill Crane, but are common

TABLE 5.3

Percent weight change[1] over one-week periods for six species of cranes.[2]

Week	Species[3]					
	Siberian Crane	Sandhill Crane	Sarus Crane	Brolga Crane	White-naped Crane	Red-Crowned Crane
1	49	34	60	35	48	50
2	93	47	112	85	99	67
3	90	73	88	61	89	80
4	47	65	63	60	67	67
5	43	42	39	46	54	53
6	35	35	31	45	35	41
7	26	23	25	38	29	37
8	24	20	18	32	19	31
9	14	11	10	18	10	22
10	13	10	9	13	9	17
11	11	8	5	8	6	15
12	9	6	4	5	4	11
13	7	6	3	4	4	8
14	5	4	1	3	3	7
15	4	4			3	6
16	4	4			2	
17	3	3			1	
18	3	2			1	

[1] *For example, during week 10, Siberian Cranes increase in weight by an average of 13%.*

[2] *Source: 1982-1988 data from ICF compiled by Ian Fisher.*

[3] *Species and number of chicks weighed: Siberian Crane, N = 15; Sandhill Crane (Florida), N = 46; Sarus Crane (Eastern), N = 19; Brolga, N = 7; White-naped Crane, N = 23; and Red-crowned Crane, N = 22. Chicks were eliminated from this presentation if they developed leg rotations problems. Not all chicks were weighed every day.*

with the larger Whooping Crane. Parent-reared chicks grow faster than hand-reared chicks, but in spite of their rapid growth, they rarely suffer from leg problems. Several factors probably contribute to this lack of leg deformities. First, parent-reared chicks typically have their diet supplemented by their parents with live food captured in the pens, and they are continuously fed over the course of the day. Second, parent-reared chicks are never on concrete, and, perhaps most importantly, the quality and quantity of exercise the chicks receive following their parents contribute to the low prevalence of leg problems.

To monitor for leg deformities, check each chick's legs daily. When the chick walks on a flat surface, the middle toes should be parallel, pointing straight forward. When the chick stands, legs should be evenly spaced, perpendicular to the ground. If the chick's middle toes begin to point either outward or inward, the bird may be showing the first signs of a leg rotation. When a chick has bowed legs, another common deformity, its middle toes may still be parallel, but the legs are splayed either inward or outward at the hock.

To prevent leg problems, exercise should be encouraged (see Exercise under Hand-rearing Methods, this chapter). Chicks raised near active, live imprinting models may not need supplemental exercise if they spend a lot of time following the adult. If any bird shows signs of leg deviation or too rapid weight gain, respond with a combination of exercise, food rationing, and/or taping of legs (see Veterinary Techniques).

Food Rationing for Hand-reared Chicks. Some birds gain excessively even with regular exercise. In such cases, the following food withholding techniques can be used to limit weight gain.

1. Remove food only at night. Usually chicks do not consume much food at night so removal limits only the amount of food available to them in the early morning hours when cranes normally feed.

2. Provide food four times a day for 15-60 minute intervals, then leave it in the pen overnight. This is the preferred method for most chicks, because the chick still has access to enough food to grow properly, to stem its hunger, and to prevent it from developing vices such as eating bedding or feces.

3. If the chick is eating pelleted food, provide either crumbles only or a mixture of crumbles and pellets so the chick has to expend more time and energy to eat the same amount of food.

4. Remove food at night and provide it three or four times a day for an hour at a time. On this regime, chicks may become frantic or consume bedding in which case using one of the other options must be implemented.

Regardless of which technique is used, food rationing ends as soon as the chick's weight gain slows for several days or abnormal behavior develops. Weight gain should be monitored daily, however, until the period of rapid growth is over (ca 40 days of age).

In a group-rearing situation, if even one chick is showing excessive weight gain, the entire pen should be rationed or the bird of concern can be temporarily removed to limit its feeding opportunities. However, carefully monitor the social interactions of the chicks because deprivation of food can result in increased aggression.

Parent-rearing Crane Chicks

The parent-rearing process involves a pair of cranes, or occasionally a single bird, raising their own or an adopted chick. The process closely parallels the rearing of a chick in the wild. From its parents, the chick learns to drink, forage, avoid humans and predators, and learns how to interact with other cranes. Cranes reared by their own species imprint properly and make good candidates for release into the wild. With some taming, they can also be good birds for captive breeding with the advantage of having reduced need for artificial insemination (AI). Without taming, they are wary of humans and rarely attack caretakers during routine interactions, but unless tamed, they sometimes injure themselves or caretakers during handling or other disturbances.

Taming can best begin as soon as a chick is independent of its parents (ca 5 months of age), but can also be accomplished with older birds. When possible, pen the wild, parent-reared cranes with tamer, hand-reared conspecifics of similar age. Prior to taming, most of a parent-reared crane's interactions with people have been negative. In taming, gradually increase the amount of positive or neutral experiences with people. For example, provide treats such as corn, pinkies (baby mice), or smelt on a daily basis (see also Chapter 6). Toss treats to the birds, then move far enough away for them to approach and eat the treats. Purr, avoid sudden movements, and crouch down (i.e., decreasing height decreases threat). Through time, the birds' retreat distance gradually decreases and eventually some birdswill approach. Parent-reared craneswill usually remain somewhat aloof and will not approach closer than 3-5 m. However, some parent-reared breeding adults will attack to protect eggs or chicks.

Another taming technique is to merely linger in the open in a non-threatening way. Begin at the distance beyond which cranes no longer pace the far fence (ca 30 m or more), then move closer as the birds grow accustomed to your presence. After the cranes are tame toward their caretakers, they, with time, will accept other humans as well.

Parent-rearing is less labor intensive than conventional hand-rearing, but requires more extensive facilities to maintain breeding pairs and replacements. Parent-reared chicks are subject to more danger than chicks reared by hand (e.g., inclement weather, parasites, and greater risk of predation). Predator proofing the perimeter fence and flight netting the enclosure will help reduce the mortality due to terrestrial and aerial predators (see Chapter 11F).

Choosing Parents

In choosing pairs to raise chicks of endangered species, evaluate the previous parenting experience of the pair. All captive cranes do not make good parents; some kill or neglect chicks. Before a pair is allowed to raise a genetically valuable or endangered crane, we recommend that the pair be closely monitored and have at least one successful year in raising non-endangered cranes or even a chick of

some other large-bodied species of precocious fowl (e.g., Anseriformes or Galliformes). Preferred pairs tolerate routine disturbances (such as caretakers feeding and administering treatments). They do not redirect aggression to eggs or chicks, nor do they neglect chicks when disturbed. Good pairs are attentive to their chicks (feeding, brooding, defending, and sheltering them), and both members participate in incubation.

Cross-fostering , the rearing of a chick by parents of another species, results in near-normal behavior development, however, the chick may be sexually imprinted on the foster species and thus may experience difficulty pairing with its own species when sexually mature (see Chapter 6). In captivity, this imprinting may be altered or reversed by removing the chick from the foster parents before fledging, socializing it in a juvenile cohort of conspecifics, and then force pairing it at two years of age.

If a chick will be reared by foster parents, careful planning is required to have a suitable pair ready at the hatch date. Normally, eggs of two or more potential surrogate pairs are manipulated to ensure that a suitable pair is ready.

Adoption Methods

Five different adoption methods have proven successful. In the preferred method, a pair hatches an egg they have been incubating and raises the resulting chick. The egg can be their own or one from another pair. A second alternative is to introduce a pipped egg in exchange for an egg that has been incubated at least 21, but preferably 25-30, days. (ICF has had pairs hatch eggs after as little as one week of incubation in the pen.) To decrease the chances of the pair rejecting or destroying the egg, place the egg with the pip-hole down. This method is used when a pair's incubation performance has been poor or is unknown.

In the other three fostering methods, small chicks are introduced to surrogate parents. Because of high risk to the chick, these methods should not be used routinely nor should they be used with chicks of an endangered species. The success of these techniques depends on the behavior of the chicks as well as the parents. Only chicks that have had previous exposure to live cranes or taxidermic brooder models and heads should be used. No matter how attentive the adults are, if the chick is afraid of or unresponsive to live cranes, the attempt will likely fail.

In one approach, if a pipped egg is unavailable or if a pair has a history of problems during hatching, a young chick is introduced in place of an egg or dummy egg. At Patuxent, this has been successful in three out of six attempts with Sandhill Crane chicks and parents, and four of four attempts with Sandhill Crane chicks and Whooping Crane parents. Generally, only experienced parents will tolerate such abrupt changes. If this method is tried with an inexperienced pair, only expendable chicks should be involved.

In the fourth method, the pair's chick is replaced by another chick. The chicks being exchanged should be similar in age, weight, appearance, and activity level. This technique is often used when a chick becomes sick or dies. Replacement of a sick chick with a healthy one utilizes the parent rearing capabilities of a valuable pair while allowing more intensive care to be given to the sick chick.

In the final method, a chick is fostered to a pair without eggs or another chick. Patuxent has fostered Sandhill Crane chicks to Whooping Crane pairs that had never laid or had not recycled after an earlier clutch and were not sitting on dummy eggs. Four of twelve attempts were successful (i.e., chicks survived at least two weeks). Chick ages in successful adoptions ranged from 1-12 days. ICF attempted to introduce 2-hour- to 3-day-old Florida Sandhill Crane chicks to five pairs of Whooping Cranes. Some adults showed extreme interest and/or aggression toward the chicks, while others completely ignored them. Chicks that were initially reared by surrogate crane parents (versus hand- or isolation-rearing) showed the most normal interactive behaviors with the adults. ICF uses special pens (which are placed in the pair's enclosure prior to the breeding season to acclimate the pair to the new structure) to introduce the chick to the adoptive parents and assess their responses before actually releasing the chick in their pen.

Wing tags or leg bands should be removed from chicks before adoption is attempted because parents are likely to peck or pull at these objects and injure the chicks. If either parent behaves aggressively toward the chick, if both ignore the chick, or if the chick flees from the parents, the adoption should be terminated.

Egg adoptions are useful in stimulating parental behavior and to increase chick rearing in the colony (for details see Chapter 3). Patuxent attempted egg adoptions with nine pairs of non-productive birds. Seven did not adopt the eggs. Of the two pairs that accepted the eggs, one later adopted a chick

exchanged for the egg and one hatched the egg. Both females (ages 5 and 6) laid the following season for the first time. Patuxent has also attempted egg adoptions eight times with breeding pairs that either did not lay in that particular year or did not re-lay after an earlier clutch was removed. Five of these attempts were with the same Whooping Crane pair in consecutive years. This pair adopted the eggs and raised chicks in two years. In the other three years, they rejected the dummy eggs, but later accepted foster chicks. Another Whooping Crane pair which did not lay one year rejected an introduced dummy egg. Finally, a Mississippi Sandhill Crane pair which did not lay for two years, but had in previous years, was given dummy eggs. Each year they immediately adopted the dummy egg and subsequently hatched or adopted and reared a Sandhill Crane chick.

ICF has attempted six egg adoptions with Whooping Cranes, three with non-layers who did not exhibit signs of egg laying and three with post-molt layers. None were successful. Two of two egg adoption attempts with Siberian Cranes were successful. One was to a female who exhibited intense nest building and bill-down behavior, but did not lay an egg. Another was to a pair in which the male had prior incubation and chick rearing experience. He immediately accepted the egg, built a nest around it, and began incubating. Over the following 9 days, the female showed complete disinterest and never joined in incubation. On the ninth day, the egg was replaced with a pipped egg. The male successfully hatched, brooded, and fed the chick, but after several hours it was found dead (presumably killed by the female). The pair laid eggs and raised a Siberian Crane chick two years later.

To adopt an egg, first watch for **signs of laying** . To avoid disrupting natural reproduction, egg adoptions should not be attempted if a pair seems likely to lay. If towards the latter part of the expected laying season, birds show no clear signs of laying or show a decrease attention given to the nest, an egg adoption may be attempted.

Proceed by surreptitiously **placing a dummy egg** in a handmade nest in an area of the pen where the pair seems most likely to lay. If the pair initially ignores or attacks the egg, continue the adoption. It sometimes requires a week for the pair to accept the egg and begin incubating. After incubating for at least 21 days (longer if possible), exchange the dummy egg for a pipped egg. If all goes well, allow the pair to hatch or adopt and rear the chick.

Routine Care of Parent-reared Chicks

A special protocol for parent-reared chicks outlines the schedule and methods for daily care, routine examinations, health care, and weight monitoring. Diagnostic tests (such as fecal parasite screening) and prophylactic treatments should be scheduled if disease history of the flock warrants (see example, Fig. 10.3). Chicks should be examined and weighed once a week after the first week until 40-50 days old.

All chicks, regardless of treatment schedule, are visually inspected from a distance daily to detect abnormal behavior (e.g., gait problems, impaired respiration, lethargy, or wing abnormalities). Avoid handling birds in temperature extremes. Frequency of handling should be determined by the health of the chick, the need to monitor growth, the treatment schedule, and the tolerance of the family to stress.

Once the down of a newly hatched chick is dry, the chick is removed from the pen, weighed, checked for general physical condition (including examination and disinfection of the umbilicus), and given prophylactic treatments prescribed by a veterinarian. After treatment, the chick is placed back in the pen at the hatching location. When returning a chick to its pen, make sure the parents can see the chick and that the chick is never placed between caretakers and aggressive parents. Otherwise, the pair may accidentally step on the chick while rushing after the caretakers as they withdraw from the pen.

The flight capabilities of chicks housed in unnetted pens must be monitored closely after about 55 days. A juvenile that flies into a neighboring pen could be killed by its occupants; one that flies from the facility could become exposed to predators. Appropriate flight restraint methods are discussed in Chapter 11E.

Natural foods (e.g., insects) provided by the parents are supplemented with commercially prepared crumbles or pellets. Fresh food and water is placed near the nest until the chick is mobile (at 2-3 days). If possible, make food and water containers accessible to both the parents and the chick. This will reduce the number of containers needed and allow the parents to teach the chick where to locate food and water. After the first few days, the food and water bowls are placed near the adults' feeder (Fig. 5.7). If separate chick feeders and waterers are used, they can be removed when the chick is large enough to use those of the adults (i.e., at ca 30-40 days of age). Some parents redirect aggression by knocking over waterers or food bowls. If this is a consistent problem, secure the vessels in place.

Fig. 5.7. *After about 10 days, the chick's food and water are moved near its parents' feeder.* Photo Jane M. Nicolich

In the wild, juvenile cranes leave their parents on spring migration or at the onset of the next breeding season. If a captive pair is intended to breed again, it is best to remove the juvenile from their pen at least three months before the planned egg-laying date. Upon separation from the foster parents, juveniles are normally penned with same-aged conspecifics to form social groups.

Working with Parents

Working around parent cranes requires care and training. Previously shy pairs become aggressive and aggressive pairs become very dangerous when they have a chick to defend. A crew of three caretakers is often required to tend a chick: two caretakers fend off the adults while the third person provides fresh food and water and, when necessary, captures the chick. When the chick becomes larger and faster, a fourth person sometimes participates in the capture. Use extreme caution to avoid stepping on a hidden chick. While servicing the pen, brooms and flexible plastic shields (made from toy sleds) are useful in fending off aggressive parents. Hold the broom so that the brush end parts in the middle and is held at the base of the crane's neck. This keeps the crane at a distance, minimizes the crane's ability to rush left or right around the broom, and also reduces the chance of injury to the crane. Be constantly prepared to grab the crane because some birds leap over or slip around the broom.

Hand-rearing Methods

Hand-rearing cranes has some advantages over parent-rearing: many chicks can be reared without the need for a large colony of surrogate parents; the chick's health and growth can be more easily monitored; the environment, including temperature and sanitation, can be controlled; and chick mortality can be considerably reduced.

Disadvantages to hand-rearing include the cost of building the facility, complete with pens large enough for adequate exercise, room for adults to encourage proper imprinting, pools, offices, equipment storage areas, laundry rooms, etc. Hand-rearing is also laborious, results in more leg and toe problems than parent-rearing, and is more likely to result in imprinting problems.

General Requirements for Hand-Rearing

The Newly Hatched Chick

A crane chick being hand-reared should be moved from the hatcher to its properly heated pen or brooder box once it has dried (4-24 hours after hatching). The hatchling should be weighed and examined. The umbilicus should be viewed and swabbed or sprayed with betadine (a povidone iodine solution). Some institutions administer prophylactic antibiotics during the first few days of the chick's life (see Veterinary Techniques this chapter). All pertinent information, including identification numbers, parental information, hatching history, and medical information is recorded on the chick's individual record (Fig. 10.3).

Temperature

For the first week, hand-rearedchicks shouldbe maintained inambienttemperaturesbetween 35-37° C (95-98° F). Monitor notonly the temperature, butalso thechick's behavior. Coldchicksshiverandcall; over-heatedchickspant and/orholdtheir wingsawayfrom theirbody. Temperaturescan bedecreased by 3° C (5° F)each week forhealthy chicks,butshould not dropbelow 21.5° C (70° F) untilthechicks are at least

three weeksold.Chicks canhave accessto cooler areas throughthe day, but shouldbecoaxedinto or returned tothe warmerareawhen chilledand forthenight.

Indoor/outdoor pens with one or more heat lamps allow chicks to walk away from the heat source and thus self-regulate body temperature. Placing a taxidermic crane brooder model or food and water bowls near the heat source will encourage the chick to return to the heat source. Once accustomed to returning to the heat lamp for warmth, chicks will investigate their pen, including outdoor runs, and still return to the warmth of the heat lamp to sleep just as they would brood under a parent. Heat lamps can be removed once the chick is thermocompetent (i.e., at approximately 40-50 days).

Chicks are locked in the indoor pen (controlled environment) at night, especially when weather is cold or wet. After a chick exceeds 1250 g, it can be allowed out all night if weather conditions permit and if pens are predator proof. Adjust these guidelines according to the chick's health and weather conditions.

Substrate

Because hand-reared chicks often collect debris in their eyes during the first 7-10 days, they are not usually kept on sand or wood shavings during this period. However, smooth flooring can also cause problems (e.g., splayed legs, hock rotation, joint damage, or slipped tendons). Be aware that these leg problems may also be due to genetic flaws or incubation problems. To improve footing, use outdoor carpeting without backing or foam padding. Choose carpet that dries quickly, does not unravel or fray, and does not have loops that can catch small, sharp toenails.

During cleaning, replace soiled or wet carpet pieces with clean ones, or replace wet bedding with dry. Allowing carpets to dry in sunshine helps destroy bacteria and fungi. To sift feces and spilled food from bedding, use cat litter scoops or scoops constructed of wire mesh.

Training Crane Chicks to Eat and Drink

In the wild, parent cranes teach their young what to eat by offering food in their bill tips. When hand-rearing a chick, similar methods must be used. Tests on color and shape preference have shown that most crane chicks respond best to long, thin, red shapes (Kepler 1978). Red plastic spoons, red-tipped dowels, or red tape attached to the bill of a puppet, taxidermic head, or feeding syringe can all be used in training crane chicks to eat and drink. Not all chicks respond to red. Mississippi Sandhill Cranes and African Crowned Cranes respond better to a black bill tip. It is important to accommodate the individual needs of each chick.

Chicks are introduced to food within a day of hatching. Many chicks are exhausted after hatching and spend most of the first day resting. Offer food to chicks when they are alert and active.

When offering food to chicks, the caretaker either imitates a crane's "purr" or plays a tape recording of a parent brood call. The caretaker then offers food in a feeding spoon in the puppet's bill (Fig. 5.8) or dips the tip of the feeding utensil in water, then dips the wet tip in dry crumbles, and offers the adhering food to the chick. Even newly-hatched chicks will usually stab at the food. If they successfully "hit" it, they will get some crumbles in their beaks and will swallow them. Feed the chicks until they lose interest, which may be in as few as five minutes for newly hatched chicks.

As the chick grows more coordinated and has better eyesight, move the feeding utensil closer to the food bowl. Within 2-3 days, the chick will begin to peck at the food where the utensil dips into the bowl. In several days, the chick will eat the crumbles from the bowl anytime the feeding utensil is moved around in the food. The puppet, taxidermic head, or dowel can be suspended on a string passing through an eyelet in the ceiling and tied to the pen wall, so the handler can purr and "bob" the puppet or dowel by flexing the string without entering the pen. Chicks should be offered food five or six times a day until they are gaining weight and routinely eating on their own (usually 4-14 days). At this time, the chick no longer needs training.

Fig. 5.8. *Feeding chick with puppet head.*
Photo David H. Thompson

Most newly hatched chicks will readily eat crumbled food, however, chicks that have been parent-reared often much prefer live food and may completely reject crumbled feed. They may also fail to respond to the color red. Sick chicks may also reject crumbled feed.

Several techniques can be used on chicks reluctant to accept crumbles:

1. Add mealworms, waxworms, or other enticing insects to crumbles. For chicks that have been parent-reared, this may be the only way to get them to eat. If chicks have not been parent-reared, mealworms or other live food should be used with caution because the introduction of live food may further decrease the chick's willingness to eat crumbles. A diet of live insects is nutritionally incomplete, and provides excessive levels of methionine and cystine which have been correlated with bone growth problems (Serafin 1982). To avoid this problem, crumbled feed should be incorporated as soon as possible.

When introducing live insect food, place moving insects on top of the crumbles so the chick sees them. Mealworms will quickly burrow to the bottom of the bowl. Chicks accustomed to live food will start digging through crumbles within 2-3 days. For chicks unaccustomed to live food, it may be necessary to offer insects using a puppet or to place mealworms in their mouths.

2. Offer moistened crumbles. This has several benefits. Moistened food stays on the feeding utensil and increases the chances of the chick getting a "good bite." Moisten food just prior to feeding and discard it after the feeding session to avoid proliferation of bacteria and mold. Moistened food also provides the chick with some fluids during the initial training period.

3. Offer liquid food in a red-tipped feeding syringe. A drop of liquid food, suspended from the end of the syringe, is consumed by the chick as it pecks at the tip. Eventually, the moistened syringe tip can be dipped in crumbles and offered to the chick.

4. Dip the chick's beak in crumbles to accustom him to the food bowl.

5. Place crumbles in mouth to accustom chick to texture.

Although methods 4 and 5 above have been used successfully, chicks are occasionally so disturbed from this handling that they become frightened of the keeper and/or bowl. Thereafter feeding sessions are even more time consuming. We recommend using techniques 1 to 3 to limit handling.

Sometimes it is best to tube feed reluctant chicks, especially if dehydration is a concern. Tube feeding provides nutrition as well as fluids and often stimulates the chick's appetite thus promoting self feeding (see Veterinary Techniques in this chapter for formulas and methods).

The following are **techniques to encourage drinking**. Patience is required because it often it takes a combination of techniques over several days before the chick is observed drinking on its own.

1. Use the mounted head, puppet or dowel, to lure the chick to the water. Stir the water, allow water to drip from the tip, or move the tip under water to stimulate the chick to pursue it.

2. Attract the chick's attention to the water bowl by placing marbles or other shiny objects such as marble-sized stones in the water. Vogelpark Walsrode (Walsrode, Germany) uses live insects for this purpose. Once the chick is drinking on its own, remove any inedible objects.

3. A red-tipped syringe or a gavage tube can be filled with water and held with a drop suspended from the tip. As the chick grabs the red tip, the drop will fall into its mouth. To avoid aspiration, water should never be squirted from the syringe into the chick's mouth.

4. Water can be dripped from a height of several feet so it splashes into the chick's water bowl at regular intervals. Birds are naturally attracted to moving water, and many chicks will investigate.

5. If there is no evidence of drinking, the handler should lift the chick above the water at an angle so the chick's bill dips into the water once or twice. Repeat the process, then set the chick down. Alternately, the bill may be gently dipped into the water, but this must be done cautiously to prevent the chick from aspirating water, and to avoid making it fear water. This technique is effective for both hand-reared and parent-reared chicks.

6. Provide the chick with a small pool. They will sometimes drink after wading into the water.

Dehydration can be detected by noting the signs listed in Table 5.2. Determine elasticity by gently pinching the bare skin of the leg just above the hock. If significant dehydration is evident, administer fluids subcutaneously. Injecting fluids sometimes leads a chick to drink on its own. Once the chick's activity level increases, it becomes easier to teach the chick to find and use water.

Exercise

Regular exercise is necessary for normal development and growth of strong, straight legs. Unfortunately, an exercise program does not seem to prevent toe problems. Wild and parent-reared crane chicks are on the move much of the day. Human caretakers can hardly produce an equivalent amount of exercise for hand-reared chicks, but several techniques can partially substitute.

Healthy chicks are fairly active by one or two days of age. Depending upon facilities and the species of crane, the chicks may get enough exercise if given a large pen (ca 400 m^2) with lots of stimuli (e.g., insects, pools, plants, and toys) and a live adult crane next door. If pens lack stimuli and are <20 m^2, conduct 20 min exercise periods at least twice a day.

Chicks can be **taken for walks** from 10 minutes to all day depending on the age of the chick and on manpower availability. Avoid exercising chicks on smooth, slippery surfaces such as concrete or blacktop. Walking in natural areas provides good footing and exposes the chick to new experiences and new foods. At ICF, chicks are exercised and socialized under supervision in cohorts of two to four beginning a few days after hatching. As chicks get older and their aggressiveness decreases, more chicks can be exercised together. Terminate walking before a chick becomes exhausted, pants, grows frantic, or becomes overheated. Excessive exercise can cause the same leg problems as lack of exercise.

Disadvantages of walking are that it is labor intensive and may encourage excessive attachment to caretakers. For birds with leg deviation problems, walking can adversely affect the legs. Chicks that are walked too long can suffer joint injuries. The veterinarian can advise if walking or swimming (aqua therapy, discussed next) will better correct leg problems.

Vogelpark Walsrode has experienced few leg abnormalities in chicks reared in small pens lined with corrugated cardboard and covered with 13-18 cm (6-8 in) of woodwool (excelsior). The chicks receive little exercise other than walking through this thick carpet of woodwool. The diet used at Vogelpark (Table 5.1) may also contribute to their success.

Swimming (Fig. 5.9) is a useful method of exercise for all chicks and is especially important for birds with certain leg problems (e.g., rotated or bowed hocks, and traumatic injury of leg joints). To more efficiently use caretaker time, swim two to several compatible chicks at the same time. Chicks should not swim in cool weather.

FIG. 5.9. *Whooping Crane chick swimming for exercise.* PHOTO DAVID H. ELLIS

Disadvantages of swimming include the expense of purchasing and maintaining the pool, and the intolerance of some chicks to the stress of forced swimming. Many chicks protest swimming, and some may injure themselves while clambering to escape from the pool. By contrast, others become so accustomed to the technique that they are content to gently float on the water and fail to exercise. Reluctant swimmers may be encouraged to be more active by providing insects scattered on top of the water for them to catch, and caretakers purring to encourage chicks to follow or gently nudging them. Sometimes swimming chicks in groups of 2-4 will keep them moving. If several chicks are swum at once, control aggression by keeping them separated with brooms, long-handled brushes, or your hands.

A caretaker should always be present to observe the chicks in the pool. Young chicks are often not buoyant enough to swim for more than a few minutes and will sink if not rescued. Swimming sessions should range between 5-20 minutes and be terminated before chicks become chilled or sink. Chicks with leg problems can be swum either more frequently, or for longer periods (up to 30 minutes), depending upon their behavior. When chicks are removed from the pool, place them indoors near heat lamps unless it is above 27° C (80° F) and sunny outside. A chick may be unsteady after swimming, so use care when placing it back in the pen.

Whether chicks are walked, swum, or put into a program that combines both techniques, they must be introduced to exercise slowly. Swimming is less stressful to most chicks and requires less time than walking for similar benefits.

Chicks that are sick may need to have their exercise regime modified or restricted until they are fully recovered. Sick chicks routinely develop leg problems if exercise is not provided.

Imprinting and Socialization

Penning hand-reared chicks in close visual and acoustical contact with a live, conspecific crane (i.e., imprinting model) helps reduce imprinting on humans. Observing interactions of a group of adults (i.e., socialization models) may also facilitate the development of normal behavior. This is critical for hand-reared chicks that are to be used as captive breeders or release birds. Socialization is also encouraged by penning small groups of fledged chicks together.

Provide adults or subadults in pens within sight of the chicks' outdoor runs, or place individual conspecific models in adjacent pens. These model cranes should be selected based on their behavior including their ability to adapt to the chick facilities. Cranes which are nervous or call constantly should not be used. Loud calling can terrify the chicks, and may incite other models to call, creating a stressful environment.

Frequently, hand-reared subadults make the best models because they are young and curious, have not yet become aggressive to humans, adapt more readily to the pen (especially if raised there), and may actually interact with the chick by purring and tapping on the plexiglass. The model's interest in the chick may be curiosity or aggression. It should be assumed that a model will kill a chick if given the opportunity. Older hand-reared birds may be difficult, even dangerous, to use as models because of their aggression toward caretakers.

Different species show different propensities to serve as models. At Patuxent, male, female, subadult, and mature Whooping Cranes have consistently proved to be good imprinting models. They have shown interest in chicks, vocalizing to them, interacting with them continually, and protesting when caretakers handled the chicks. It is not unusual to see Whooping Crane models feeding chicks through the fence. Sandhill Cranes, on the other hand, have consistently been uninterested in the chick's welfare and have shown aggression toward, or predatory interest in, the chicks. At ICF, some Whooping, Wattled, and Siberian Cranes are interested in the chicks and some are not.

Chicks may also be socialized with chicks of their own or another species. Socialization can be combined with exercise by taking two or three chicks on walks together. Younger chicks are often aggressive and must be closely supervised to prevent fighting. As chicks grow, aggression decreases so cohorts of pre-fledged birds can be formed, but until fledging age, chicks are housed singly at night. Closely monitor any newly formed cohort to prevent injuries. In a new cohort, a dominance hierarchy will be established and aggression or dominance at feeding stations frequently occurs. Provide 2-3 feeding stations to reduce chances of injuries while ensuring adequate nutrition for all cranes. Caution is especially important when combining parent-reared and hand-reared crane chicks in one cohort.

If no other chicks or conspecific adults are available for imprinting models, mirrors can be added to the chick's pen. Taxidermic cranes (brooder models) and taxidermic heads (feeding models) can help in imprinting very young or sick chicks. These can be left in sight of the chick and pelt fragments of crane feathers in the appropriate colors can be left with the chick for "cuddling." Chicks may respond strongly enough to the heads and pelts that, when placed in a pen near a live conspecific, acceptance of it is immediate. For more information on imprinting see Chapter 6.

Types of Hand-rearing

Conventional Hand-rearing

These chicks are raised by humans without imprinting models (alive or taxidermic). Talking is not excluded from the rearing area, and chicks are housed singly or in small groups. These birds can be used for captive exhibition, breeding, and for non-behavioral research, but may not be suitable for behavioral or reproductive studies.

At one time, this was the most common hand-rearing method. Many institutions have modified conventional hand-rearing to reduce labor, aggression to caretakers, and the risk of these cranes becoming sexually imprinted on people.

Group-rearing. Chicks of some species can be successfully housed and reared together from hatching. At Patuxent, Florida Sandhill Cranes have been

successfully reared in groups of up to four, and Mississippi Sandhill Cranes have been reared as pairs and kept together in groups of up to four for as long as two weeks. Greater Sandhill Cranes and Whooping Cranes are too aggressive to be put together, even briefly, when very young.

Group-rearing is more likely to be successful when lighting is reduced in the indoor pen and in the spring when it is cooler. When attempting group-rearing, all chicks should be of similar age (i.e., within one day), and be placed together at the same time. Because chicks spend most of their first 48 hours sleeping, this is a safe period for shared housing.

Chick aggression often seems related to hunger, so chicks housed together should receive more frequent feedings, and have more than one feeding station available. Introducing live food (insects) can also reduce aggression. Aggression usually diminishes naturally around fledging time. However, chick aggression is unpredictable, and chicks raised together may be amiable for weeks or months, but suddenly commence fighting and seriously injure or even kill each other. Move the most aggressive chicks to separate pens.

Some species of cranes may be group-reared by including turkey or chicken poults to receive much of the aggression. Patuxent has used broad-breasted bronze (not white) turkeys and Cochin chickens because these breeds are placid birds. These aggression targets help crane chicks learn to feed, and they appear to stimulate the crane chicks to chase, move around, and get more exercise.

Crane chicks should not be allowed to kill poults. At least one poult should be used for every two crane chicks, though a 1:1 ratio may be better. Although this method reduces the risk of cranes injuring each other, some crane chicks are occasionally injured by other crane chicks and poults. Here again, the most aggressive chicks will still need to be moved to separate pens.

Using poults increases caretaking needs because pens are fouled more quickly with the additional birds. Poults should be tested and determined to be clean of any disease or parasite which could be transmitted to the crane chicks. Patuxent has used this method only when it was necessary to group-rear chicks for research, and has discontinued using poults with endangered chicks in favor of housing the chicks singly. Although this method has been used successfully, it is not highly recommended by the authors.

Conventional Hand-rearing with Imprinting Cues

Precautions are taken to reduce the risk of the chicks sexually imprinting upon people. These birds are hand-reared by uncostumed caretakers, but with exposure to various imprinting cues (e.g., puppet heads, taxidermic heads, brooder models, live conspecific imprinting models, and tape recordings of crane calls; see Imprinting in Chapter 6 and Fig. 11D.3). Talking is not excluded from the rearing area but is generally discouraged when interacting with the chicks. When interacting with chicks, caretakers either play recordings of crane vocalizations or imitate the appropriate crane call.

The newly hatched chick has access to a taxidermic conspecific crane mounted in a brooding posture (brooder model) with its carpels extended and its neck arched downward so its beak almost touches the ground (Fig. 5.10). Sometimes the model's beak is placed in water or food to encourage the chick to drink or eat. A small, portable tape recorder placed near the model provides prerecorded brood calls during feeding sessions. Alternately, the caretaker feeding the chick can imitate the crane brood purr and better coordinate the vocalizations with food presentation. However, playing the recordings during feeding sessions may help the chick differentiate between the imprinting cues (i.e., brooder model and puppet head) and humans. Vocal cues should be used selectively. Observations of cranes rearing cranes indicate that parents tend to decrease the frequency of vocalizations after two weeks of age (Hartup and Horwich 1994). After the chicks have learned where

Fig. 5.10. *Two Sandhill Crane chicks with brooder model and head used to promote imprinting.* Photo Kathleen O'Malley

to locate food and water, vocalizations should be used only to attract the attention of the chick.

The brooder model can be left in the pen until the chick loses interest in it. Many chicks at Patuxent cuddle the model and sleep beside it even after thirty days of age. Models should be removed from any chick that tries to tear it up or from chicks that refuse to leave it for exercise.

Chicks are housed separately in visual contact with one another. They may be exercised and socialized in groups under supervision. At ICF, we have observed that if more than four chicks, preferably of the same species, are raised together, their interest in the human caretaker is reduced.

Around 10-12 weeks of age, the chicks are grouped (2-8 birds depending on pen size and other needs) and moved to pens next to adults of the same species. Chicks are allowed to see these socialization models until the following breeding season when the adults are sometimes screened off for to promote breeding (see Chapter 6).

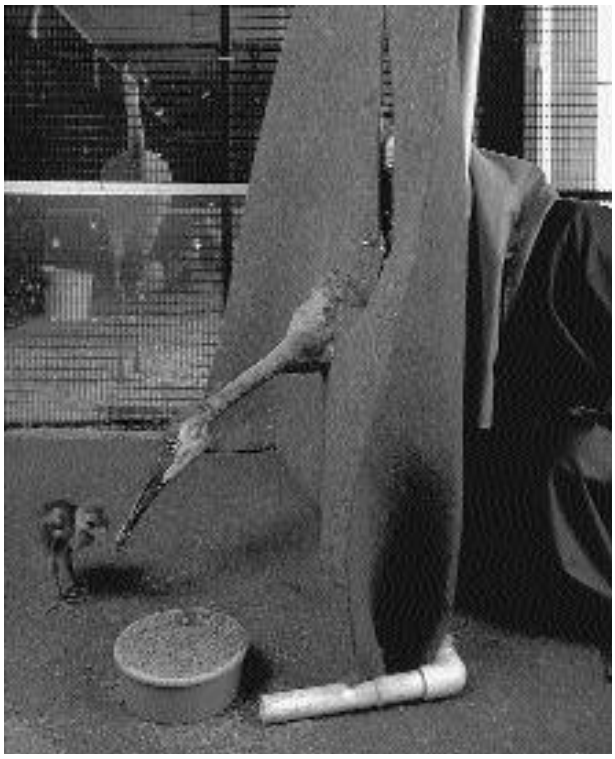

Fig. 5.11. *Screen-rearing. Note imprinting model (adult Sandhill Crane) in adjacent pen.* Photo Vickie Lewis

Rearing in Isolation from Human Contact

For brevity termed **isolation-rearing** , this method involves hand-rearing crane chicks while minimizing the visual and auditory interaction with humans. Use of this technique produces birds suitable for captive breeding and release.

Three variations of isolation-rearing are screen-rearing, costume-rearing, and strict isolation-rearing. From early experiments in strict isolation-rearing, the other two methods evolved. Each method differs in the props (i.e., equipment, costumes, and adult cranes) required, and the amount of human contact with the chicks.

Screen-rearing (Fig. 5.11) describes the situation where chicks are fed by an uncostumed caretaker concealed by a portable screen. Talking may or may not be eliminated in the facility, but the caretaker remains silent when weighing or medicating the chicks. Visual contact with imprinting models is maximized. The chicks are imprinted on cranes, but remain tolerant of humans. Adults reared by this method are good display animals that breed readily in spite of considerable human contact.

In **costume-rearing** , the chick is reared with all of the imprinting and socialization techniques, models, and equipment discussed earlier, but with uncostumed humans visible only during stressful activities. For all positive interactions, humans wear a loose fitting hood and mantle that conceals the human form (Fig. 5.12; see also Chapter 11D). Birds so reared are suitable for captive breeding or release. If a strong bond between the costume and chick is not required, the routine medical management can be done by costumed personnel, otherwise all negative experiences are given by uncostumed humans. If the costume will be used at the release site, all capture episodes are by uncostumed humans except those

Fig. 5.12. *Costume-rearing Sandhill Crane chicks.* Photo David H. Ellis

occurring when the chicks are only 1-2 weeks of age. Disadvantages to costume-rearing are that it is labor intensive, and birds may need to be acclimated to humans if they are to remain in captivity.

Facilities used for costume-rearing should prevent chicks from seeing uncostumed humans entering or leaving the facility, and should limit motor vehicle traffic noises and distant human voices. Solid fencing, tennis netting, or vegetation can be used to isolate a facility from its surroundings. Inside the facility, solid opaque walls, tennis netting, and portable screens can be used to restrict the chick's ability to see caretakers. A one-way viewing window and puppet hole can be installed in the main door (Fig. 5.13). Feeding can be accomplished with the hand puppet from outside the pen or the costumed caretaker can enter the pen and interact with the chick.

The costumes are specially made or can be a modified Hindu sari. They should be constructed of opaque, breathable material, loose fitting, and cover the caretaker from head to knee. The purpose is simply to disguise the human figure. The head covering or hood should be made of the same material as the costume body, with a face made of camouflage screen fabric to hide facial features. Some costumes are made to look more crane-like by sewing a scattering of feathers to a separate piece of material which can be attached to the wing sleeves with velcro or snaps, allowing removal when the costume is laundered.

Costume-rearing begins two days before an egg hatches at which time human voices are no longer permitted in the incubator room. Tape recorded crane brood calls are played during routine checks. (Patuxent protocol for release birds calls for 15 min tape bouts, four times per day until hatching; ICF bouts vary in length from 30 sec to 2 min). Excessive use of the tape may stimulate chicks to hatch too quickly and suffer an exteriorized yolk sac or other problems. Once the egg pips and is moved to the hatcher, caretakers checking the egg wear the costume so the emerging chick will not see an uncostumed human. A chick needing assistance hatching has its head covered if it has emerged or is assisted by costumed caretakers. The welfare of the chick is paramount, and the ability to assist the chick has priority over concern for it seeing people. After the chick has hatched and dried, it is removed from the hatcher by a costumed caretaker and transported to the chick-rearing facility in a closed box (see Chapter 11D for details on rearing cranes for release).

Fig. 5.13. *Caretaker uses a one way window to observe and feed the chick while remaining out of sight.* Photo K. R. Langford

Strict isolation-rearing was the term originally (and appropriately) used to describe the method of rearing cranes with minimal contact with both humans and most other living stimuli. Chicks were housed and reared in visual (but no physical) contact with other chicks. Live imprinting models were not used. A puppet head fed the chick through a hole in the pen door. Chicks were captured by a person covered by a sheet and placed in a box while pens were serviced.

Around fledging time the chicks were introduced to humans in an abrupt manner. People entered the pen to capture the chicks to do physical exams and to move them to larger pens amidst the flock.

The results of isolation rearing varied greatly by species (Putnam 1981). Some Sandhill Cranes were first hesitant upon seeing people, then willingly followed people and were quite curious. These birds acted like typical hand-reared chicks. Sandhill Cranes reared at Patuxent and Red-crowned Cranes at ICF, by contrast, were nervous and flighty like wild caught birds.

Human Avoidance Conditioning.

For those chick-rearing methods where exposure to uncostumed humans is minimized, deliberate negative exposure called Human Avoidance Conditioning is often provided, especially if chicks appear too tame for release to the wild. Two different types of conditioning have been used successfully. Both are intended to train costume-reared chicks to differentiate between the costumed and uncostumed humans.

The first type of training involves normal handling. All positive and parental interactions (e.g., feeding and protecting) are done by a costumed parent. Slightly stressful interactions are done costumed, but with the chick hooded. For extremely negative procedures (e.g., taking blood from large chicks), the human is uncostumed. If the chick does not appear upset, upon release we chase it, yell, and clap our hands.

The second type of training (detailed below) involves mock attacks on the chicks. During these sessions, the live imprinting and socialization models are usually present so that their alarm calls verify the "danger" to the chick. Tape recorded alarm calls are played if no adults are available or if there is concern that the activity will not sufficiently alarm the adults. If facilities permit, visually isolate the birds that are about to be trained from the rest of the chicks (i.e., lock target chicks into their outdoor runs and lock non-target chicks indoors).

For costume-reared Mississippi Sandhill Cranes destined for release, training bouts began at about twenty days of age and were staged once or twice a month for chicks that were slow to develop wariness (Ellis et al. 1992). Once the chicks and adults are in place, one or two uncostumed humans surprise the chicks by bursting into view and racing through the chick area while shouting and making loud noises, sometimes banging on pots and pans to deliberately frighten the chicks. If a chick does not show fear (either by fleeing, freezing in an erect position, or squatting and hiding in the grass), the noisy humans pursue and grab the chick roughly then release it. The humans leave as abruptly as they appeared.

During Human Avoidance Conditioning, the costumed parent may or may not be present. If the costumed parent is with the chicks, the parent should flee from the humans or may turn and chase them away, thus protecting the chicks. If costumed parents are not present during the avoidance session, it is often helpful to have the costumed parent interact with the chicks shortly after the session in order to assess the effect of the training session.

Scheduled bouts of Human Avoidance Conditioning are probably not needed for already wary birds, but appear necessary for calmer, tamer birds. Nervous chicks or adult models can injure themselves by running or flying into fences, so caretakers should rush in quickly, end the activity as quickly as possible, and discontinue the "attack" if birds appear likely to injure themselves. Because all chicks receive a dozen or so negative contacts with uncostumed humans during the rearing process, it is normally unnecessary to conduct more than 1-5 bouts of actual Human Avoidance Conditioning least the chick grow accustomed to the activity.

Veterinary Techniques for Rearing Crane Chicks

contributed by Glenn H. Olsen and Julia A. Langenberg

Each rearing method has advantages and disadvantages from a medical viewpoint. Survival of crane chicks averages higher in a more controlled environment (i.e., the hand-reared chick survival rate, from hatching to fledging, is often higher than for parent-reared chicks), however, medical management is only one factor in choosing which rearing method to use.

Good medical management of the crane chick begins with the care of the parents, especially the female. Her nutritional deficiencies or debilitating diseases may adversely affect the developing embryo (Olsen 1989; Olsen et al. 1990). In addition, infectious diseases and parasites carried by the adults may be passed to offspring either in the egg or directly to a hatched chick.

Preventative Health Program

Chicks should receive regular veterinary examinations especially during the critical first week (see Fig. 10.3 for health care schedules). The type and frequency of health problems seen in crane chicks will vary between species, between collections, and often between hand-reared and parent-reared chicks. A veterinarian should also review the chick's weight gain and nutritional program.

If, in your environment, neonatal infections are rare, prophylactic antibiotic injections are not advised. Where advisable, give gentamicin (5 mg/kg) or amikacin (8 mg/kg) injections (Fig. 5.14) for the first 3 days. Frequent parasite examinations are part of a good preventative medicine program. Prophylactic treatment for parasites may be necessary if parasites are common in your collection (see Fig. 10.3). Screening for other infectious diseases (such as *Salmonella*) that are carried by adults and dangerous to chicks is also recommended.

Fig. 5.14. *Antibiotics and antihelminthics can be administered if infections are prevalent in a colony.* Photo David H. Ellis

Yolk Sac Problems

Exteriorized Yolk Sac. The yolk sac, a diverticulum of the intestine, is a major source of nutrition for the developing embryo and the newly hatched chick for the first 3 days of life. The yolk sac should be drawn into the abdominal cavity through the umbilicus prior to hatching. This retraction normally occurs with the spasmodic contractions of the abdominal muscles during hatching (Olsen 1989). Too high humidity during incubation, incorrect incubation temperatures, or pulling the chick from the egg too soon may all contribute to an exteriorized yolk sac (Fig. 5.15).

Fig. 5.15. *Exteriorized yolk sac.* Photo Glenn H. Olsen

If the yolk sac remains exteriorized, it may become torn or infected. If possible, gently manipulate an exteriorized yolk sac into the abdominal cavity after cleaning the area with a 10% povidone-iodine solution. The remaining umbilical opening can be closed using fine, absorbable sutures such as 4-0 Dexon (braided polyglycolic acid suture). Use a purse string pattern or 1-2 simple interrupted sutures. If the yolk sac cannot be manipulated into the abdominal cavity, it should be surgically removed using a ligature around the stalk (Hartman et al. 1987). Follow up care should include applications (twice daily) of povidone-iodine solution to the umbilicus or incision site and antibiotic injections (gentamicin, 5 mg/kg subcutaneous) twice daily for the first 3 days.

Another condition occasionally seen in chicks is delayed closure of the umbilicus, sometimes accompanied by a small (<5 mm diameter) yolk sac protuberance. When first seen, these small protrusions are often starting to dry and turn black as the knob is strangulated by the sealing umbilicus. In such cases, do not attempt to force the yolk sac remnant into the abdominal cavity. Rather, bathe the area 2-3 times dailywith 10% povidone-iodine solution andmaintain the chick on gentamicin or amikacin. Within 2-4 days the necrotic yolk sac remnant falls off and no further treatment is required. Until it sloughs off, these chicks should not be housed with other chicks to prevent penmates from pecking the umbilicus stump.

Omphalitis. Gram negative organisms, especially *Escherichia coli*, cause infection in the umbilical area or in the yolk sac (Flammer 1986). As a preventative measure, the chick should be hatched and reared in a clean environment. The umbilicus should be swabbed or sprayed with a dilute solution of povidone-iodine soon after hatching. If loss of young chicks from bacterial infections is common in your colony, maintain such chicks on antibiotics (such as gentamicin, 5 mg/kg daily) for the first 72 hours.

When an infection develops, clinical signs often include poor appetite, failure to grow, depression, a swollen abdomen, or reddening of the umbilical area. Culture the site to identify the organism and place the chick on antibiotics. Use fluid therapy if the chick is dehydrated, and swab the umbilical area with 1% solution of povidone-iodine. Surgical removal of the infected yolk sac has been used as an alternate treatment in other avian species (Kenny and Cambre 1992). This has been attempted several times in cranes, and the chicks often survive several days after the operation but succumb to peritoneal infections.

Yolk Sac Peritonitis. Occasionally, trauma or infection results from a rupture of the yolk sac within the abdominal cavity. Clinical signs include depression, poor appetite, abdominal distension, respiratory distress, weight loss, and sudden death. If peritonitis lasts several days, adhesions (scarring) within the abdominal cavity frequently occur. Supportive care (fluids, tube feeding, etc.) and treatment with antibiotics are recommended, but are often unsuccessful.

Respiratory Disease

Typical **signs** of respiratory disease in young chicks include open-mouth breathing, raspy breathing, a respiratory click, lethargy, reduced appetite, and cyanotic (blue) or pale mucous membranes. At Patuxent, parent-reared chicks are especially vulnerable to respiratory diseases following cool, rainy weather, especially if the parents are ineffective or inexperienced. At Patuxent, respiratory disease is more common in chicks raised by Florida Sandhill Cranes than in chicks raised by Greater Sandhill Cranes.

In chicks under 20 days of age, bacterial respiratory infections are most common following stress or chilling. In older chicks, disseminated visceral coccidiosis and fungal infections are the most important causes of respiratory disease. Cultures and a cytology workup from the anterior choana (roof of the mouth) and trachea can be important in arriving at a diagnosis.

Initial treatment will include **antibiotic therapy**: gentamicin, amikacin, piperacillin sodium, and enrofloxacin are all good choices prior to receiving antibiotic sensitivity test results (see Table 8.1). Supportive care is important including fluid therapy for dehydration and tube feeding if anorexia is a problem.

Nebulization therapy is often beneficial to chicks with respiratory infections. Nebulizing oxygen itself is helpful for a dyspneic or cyanotic chick. Therapy should not exceed 1 hour daily, and should be divided into 2-3 equal time periods. Antibiotic medications used include: erythromycin (200 mg in 10 mL saline), gentamicin (50 mg in 10 mL saline) (gentamicin is not absorbed by respiratory epithelium and therefore does not effect concurrent injectable doses), polymyxin B (333,000 U in 5 mL saline), sulfadimethoxine (200 mg in 15 mL saline), and tylosin (100 mg in 10 mL saline) (Spink 1986). A mucolytic agent, such as acetylcysteine, can be added to the nebulizing solution to help reduce thick mucous secretions. Acetylcysteine is given at l mL (2% solution) in 15 mL saline or saline/antibiotic combination.

Nebulization of chicks is done with the same equipment as recommended for adults (see Chapter 8). An Ultra-Neb 99 nebulizer or similar product producing a small particle-size mist is most effective. The small disposable cups with 30 cc maximum capacity are most effective, as small quantities of medicine can be mixed for each nebulization. The only difference is that the cage for the chicks is smaller. At Patuxent, we use a Snyder oxygen cage (see Appendix).

Fungal infection, specifically aspergillosis, is another cause of respiratory disease. Aspergillosis can also occur as a secondary infection in a chick already compromised by bacterial pneumonia and long-term antibiotic therapy. The diagnosis of aspergillosis can be made by radiography, respiratory cytology, culture, or serology. One effective antifungal treatment used in a variety of bird species is to nebulize with amphotericin B (Olsen 1991; Olsen et al. 1995). A solution is prepared by adding 2 cc of stock solution (5 mg/cc amphotericin B) to 15 cc sterile water. Amphotericin B has the potential for forming a precipitate with saline, therefore sterile water is preferred. Birds are nebulized for 20 min twice daily. Amphotericin B can also be administered intratracheally or intravenously (1 mg/kg 2-3 times a day). In addition, fluconazole is given orally at the rate of 100 mg/kg twicedaily forup to 30 days,oritraconazole (6 mg/kg) twice daily for up to six months.

Another product used for nebulization is clotrimazole. This product is nebulized in a small pediatric nebulizer. We use 3 cc per nebulization, using O_2 to produce the mist. Birds remain in the nebulizer 20-30 min twice daily with a schedule of 3 days on nebulization, 2 days off for up to one month.

Diarrhea and Cloacal Prolapse

Diarrhea. Crane chicks, both parent-reared and hand-reared, sometimes develop diarrhea around day 6. Cultures often yield heavy growth of *E. coli* suggesting it as the causative organism. However, *E. coli* is normally found in healthy chicks. Therapy includes antibiotics (see Table 8.1), oral kaolin/pectin, or bismuth subsalicylate (Pepto-Bismol) to reduce diarrhea, and subcutaneous or intravenous fluid supplementation to correct dehydration (use lactated Ringer's solution).

In older chicks, several causes of diarrhea have been identified including bacterial infections, parasites, reactions to medications, and gastrointestinal foreign bodies. Symptomatic treatment similar to that described above is used until laboratory results indicate a specific diagnosis.

Cloacal prolapses occur in crane chicks. Some are secondary to diarrhea and some are associated with chronic vent dermatitis. Most prolapses respond to topical treatment with lubricants (petroleum jelly), steroids, or Preparation-H, but a few need surgical replacement (see Chapter 8). Using gentle finger pressure or a moistened, cotton-tipped applicator, the prolapsed cloaca is carefully reinserted and then held in place using a purse-string suture (Fig. 8.18d) in the skin around the vent opening.

DEHYDRATION. Dehydration, associated with many diseases, often results in death if left untreated (see Table 5.2). Weighing sick chicks daily, or even twice daily, allows the clinician to monitor fluid loss. Packed cell volume, plasma total solids, BUN (blood urea nitrogen), and uric acid can also be used to monitor hydration (see Table 8.3) because all are elevated in dehydrated birds. Without proper hydration, other therapeutic measures are not as effective.

In the severely debilitated chick, intravenous bolus therapy (Redig 1984; Harrison 1986) is the most effective initial treatment. For a less severely ill bird, oral or subcutaneous administration can be used. The best site for subcutaneous fluids is along the sides just behind the wings.

The fluid needs of a bird can be estimated by calculating the daily maintenance need (44 ml/kg body weight) plus the dehydration deficit (5-10% is average, see Table 5.2). Generally, 50% of the calculated deficit should be replaced in the first 12 hours. During the next 24-hour period, 25% of the deficit plus maintenance should be given.

The rapid restoration of fluid balance in the debilitated chick is probably more important than the type of solution used, providing that the fluid is isotonic. Lactated Ringer's solution (similar in composition to avian plasma [Redig 1984]), normal saline, or half-strength lactated Ringer's solution (mixed 50:50 with 2.5% dextrose) are often used. Fluids should be administered at body temperature, so a supply of warm fluids (37-39° C; 97-102° F) can be kept in an incubator or each bolus can be heated in warm water.

HEAT STRESS. During weather with high temperatures and high humidity, some birds exhibit symptoms of heat prostration or heat stress. Whooping and Siberian Crane chicks appear to be especially susceptible. Signs of heat stress include open-mouth breathing, panting, wings held away from the body, and staggering. If no action is taken, a chick can suffer brain damage or die. The bird should be immediately moved indoors or into the shade, and should be cooled with cold water. Fluids should be given intravenously or subcutaneously to counteract stress and shock.

Heat stress is often associated with handling birds in hot weather. If a bird must be handled when ambient temperatures exceed 32° C (90° F), move the chick to a cool, shaded, or air-conditioned environment or handle only in the cool early morning hours.

Nutritional Support

Insufficient intake of calories leads to cachexia and emaciation. The bird will first mobilize body fat and then will catabolize muscle. Because young crane chicks do not have large fat reserves, loss of muscle tissue can occur rapidly and early in disease processes. Signs of emaciation in birds include a prominent keel and translucent skin due to lack of dermal fat (Lowenstine 1986). Crane chicks do not have well-developed pectoral muscles prior to flight. Therefore, assessment of pectoral muscle mass (Body Condition Index, Fig. 8.5), even though a valid technique in adult-sized cranes, is not used in chicks. Rather, the muscles surrounding the caudal, thoracic, and lumbosacral spine (palpated as a soft flat mass lying between the shoulders and to the side of the dorsal processes of the anterior portion of the synsacrum) are evaluated. These muscles are depleted in the emaciated crane chick.

Daily maintenance energy requirements for the crane chick should be calculated. Approximate caloric maintenance requirement is determined by finding the basic metabolic rate (BMR), $BMR = K(W_{kg})^{0.75}$, where K equals a theoretical constant for kilocalories and W_{kg} is the bird's weight in kg (Quesenberry et al. 1989). For cranes, K = 78, therefore $BMR = 78(W_{kg})^{0.75}$. The daily energy requirements in kilocalories (Kcal/day) are normally at least 1.5 times the BMR (see also Nutritional Support of a Sick Crane section of Chapter 8).

Blood glucose levels are useful in determining the degree of nutritional depletion. Normal Florida Sandhill Crane chicks at ICF maintained blood glucose levels over 200 mg/100 mL from hatching through fledging. No critical levels have been determined in cranes, though levels as low 80 mg/100 mL have been documented in emaciated chicks. Values less than 50 mg/100 mL are considered critical in birds of prey and lead to hypoglycemic convulsions and coma (Lowenstine 1986). Immediate correction of low blood glucose is best accomplished with intravenous or subcutaneous administration of 2.5% dextrose in half-strength lactated Ringer's solution.

Any bird suffering from cachexia and emaciation should receive a thorough examination to determine the cause of the condition (disease, diet, and management problems are all possible). If the chick is failing to gain weight, supplemental feeding should be initiated. Long-term caloric and nutritional support of debilitated chicks is best accomplished with oral alimentation (tube feeding and gavage are synonyms) using a flexible rubber tube (Fig. 5.16) made from a French urinary catheter (size 5 to 12 depending on the chick's age) mounted on the tip of a 5-60 cc syringe. Pass the tube over the tongue and down the esophagus to the level of the thoracic inlet. Palpate the neck to locate the tube and to assure that you are not in the trachea. If the tube is in the esophagus, you will palpate two cylindrical structures, the tube and the trachea. Delivering food in the trachea will be fatal for the chick.

Chicks under 10 days of age can be tube fed every 2-3 hours if necessary. For safety, start with about 3 cc for a hatchling; use larger amounts (up to 100 cc) for older chicks. Chicks weighing less than 100 g may be unable to receive 3 cc/feeding; administer the liquid diet slowly and watch responses. If the chick starts to regurgitate, stop the tube feeding, clean out the mouth, and gently stroke the neck in a downward motion. On subsequent tubings, decrease either the rate or the amount of formula to prevent further regurgitation. Because tube feeding also contributes to fluid balance, adjust total fluid therapy accordingly.

For extremely debilitated chicks of any age, Lafeber's Emeraid I (see Appendix) is very helpful. This product contains only carbohydrates and is used for chicks too sick to digest anything else. It also helps elevate dangerously low blood glucose levels. A second product, Emeraid II, has protein, fat, and fiber for crane chicks that can tolerate more nutrition (i.e., chicks that are not affected by gastrointestinal stasis).

Fig. 5.16. *Glenn Olsen tube feeding a Whooping Crane chick.* Photo David H. Ellis

Another formula, known affectionately as Mother O'Malley's Crane Stew, is listed in Table 5.4 with two variations. The basic formula is used for severely debilitated adults or chicks. If a crane can benefit from complex nutrients, crane pellets are added using starter pellets for chicks or maintainer pellets for adults. The fine solids in this tube-food will give the chick's digestive system something substantial to process, and are believed to stimulate the chick's appetite and normal digestive processes better than a more easily digestible food. At Patuxent, young chicks have gained weight when fed solely on this tube feeding diet.

Severely debilitated adults should be fed the original formula (Table 5.4); however, most others can be fed one which includes adult pellets. Several cranes at Patuxent have survived solely on this diet, and even gained weight over the course of a month.

In addition, *Lactobacillus* products (1.4 tsp/kg; 7.0 g/kg) have been given to both young and adult cranes to promote digestion and to restore normal gastrointestinal flora. However, there have been no studies in cranes documenting the effectiveness of this therapy.

TABLE 5.4

Mother O'Malley's Crane Stew—Basic Formula

4 cups (946 mL) of warm water
2 tablespoons (30 mL) Vionate (or other vitamin powder)
4 heaping tablespoons (80-100 mL) Prosobee, Isomil, or other soy-based powdered infant formula
1/3 tube of Nutri-Cal (concentrated food for debilitated animals, sold in a 4¼ oz [120 g] tube)
1/4 cup (59 mL) vegetable oil
2 cups (274 mL) dry baby cereal, preferably mixed style
Water
Mix all ingredients in a blender (minimum 5 cup [1,200 mL] container) and process on high speed until smooth. If the formula seems too thick, add a small amount of water. Mix well before drawing up, and bring to about 21° C (70° F) or warmer before feeding. This formula can be divided into small containers and fr ozen for up to three months. After defrosting, the formula should be mixed thoroughly before use.
Variation 1: For chicks that can benefit from complex nutrients, add 2 cups (ca 250 g) crane starter pellets to the original recipe. Put the starter pellets in a 4-cup (946 mL) container, and add hot water to the top. Allow pellets to soak until fully expanded and soft (5-20 min). Place half of the pellet mixture into a 5-cup (1,200 mL) blender. Add enough water to blend the pellets easily (1-2 cups, 137-274 mL) and blend on high speed. Strain all the material through a fine sieve. Discard the solids. (This is a tedious process involving straining and constant stirring to enable the fine solids to pass through the mesh. Without this step, however, none of this food could pass through the small tube needed for young chicks.) To flush fine solids through, you may occasionally need to add more water. Once the solids are strained out, use this for the base and add the rest of the ingredients in the original formula.
Variation 2: For tube feeding sick older chicks (after all primaries are grown) and sick adults, substitute adult crane pellets for the starter pellets and eliminate the straining step. This food should be thick and able to pass through a large tube, although it may block occasionally when some of the coarser solids swell.

Ophthalmic Conditions

Eye injuries ranging from traumatic conjunctivitis to punctures of the cornea have been observed in crane chicks. A common cause is one chick pecking at another's eyes. Other causes of traumatic eye lesions include sharp objects (e.g., wires and thorns), abrasive cage materials such as sand substrate or wire partitions, and self-inflicted injuries caused by the chick flailing with its sharp toenails. Fluorescein dye is used to determine the presence and extent of corneal defects. Extensive lacerations, including corneal lacerations, can be sutured using fine (5-0 to 7-0) suture material. Antibiotic ophthalmic drops or ointments are also used.

Ocular discharges can result from debris (especially sand or wood chip bedding) under a lid, traumatic injury, a respiratory infection, or infection of the eye. The preferred treatment for debris in the eye is to pull the lid away from the eye and flush the debris out with a saline eye wash squirted from a plastic squeeze bottle or syringe (without needle). After flushing, apply antibiotic ophthalmic drops to the eye every 2-4 hours or ointments 2-3 times/day. Because ointments are more viscous than drops, they are more likely to allow pieces of bedding to cling to the eye area. As a result, drops are often preferable to ointments in young birds.

Severe corneal infections associated with *Pseudomonas aeruginosa* have been seen in Whooping and Siberian Crane chicks (Miller et al. 1994). These infections are probably secondary to minor corneal trauma, but rapidly progress to complete corneal destruction and perforation. If ocular discharge does not decrease quickly with topical antibiotic treatment, a culture should be evaluated and intensive topical and parenteral treatment with an aminoglycoside antibiotic should be started.

Orthopedic Problems

BEAK DEFORMITIES. Chicks should be observed daily for signs of abnormal beak growth which can lead to permanent beak crossing or malocclusion (popularly known as wry bill or screw bill). Most beak deformities are seen at a young age, and some can be corrected with careful beak trimming or by applying a splint to the beak for 2 to 6 hours each day for several

days. Beak deformities have also been observed following exposure to mycotoxin contaminated feed (Olsen et al. 1995).

Wing Problems. When the rapid growth of the primary and secondary feathers exceeds the development of the muscles and other support tissues in the wing, the wing may rotate outward at the carpus or may droop. This condition, called **angel wing**, can also be associated with excessive protein in the diet or too-rapid growth. Larger species are more prone to this condition. Supporting the affected wing in a normal position, using elastic bandage (Vetwrap) or adhesive tape in a figure-8 bandage around the carpus and radius/ulna or elbow, is the best means of correcting the problem (Fig. 5.17). To use adhesive tape, tear off a 2.5 cm (1 in) wide strip 30-60 cm (12-24 in) long, depending on the bird's size. Fold the adhesive strip over longitudinally leaving only about 5-10 cm (2-4 in) at one end with the adhesive side exposed. Wrap the folded tape around the hand (metacarpals) and forewing (radius-ulna), securing the wing in a normal folded position. Continue to wrap the tape around the wing eventually sticking the exposed adhesive section to the folded section of tape. No adhesive tape should be allowed to stick to the down or feathers.

The wing should be bandaged for **two days only** in any one treatment. Tape left longer than 2 days can alter feather (or even bone) growth, and can constrict blood vessels in the rapidly growing wing. Usually one treatment is sufficient to correct angel wing, however, additional bandaging may be required if the problem is still evident. Generally, a 2-4 hour rest without a bandage is allowed between successive two-day bandaging episodes.

During development, feathers or blood quills, especially the large primary or secondary feathers, can break due to trauma, aggression, excessive grooming, or with handling. Blood loss from damage to a large feather may be significant and can lead to shock. Immediate treatment is to remove the bleeding feather by grasping the shaft with hemostats or pliers at the base and pulling it directly out. In most cases, the hemorrhage will stop immediately. When hemorrhage continues, the hole from which the quill was removed can be packed with gel-foam or hemostatic powder and the wing bandaged with a figure-8 wrap so pressure is applied to the point of hemorrhage. The bandage can be removed a few hours after treatment. If the bird is in shock or if the blood loss has been excessive (>10% of blood volume), fluid therapy should be given immediately (see Dehydration).

Fig. 5.17. *Sandhill Crane chick taped for angel wing.*
Photo Glenn H. Olsen

Foot and leg problems. Foot and leg problems are common during captive rearing. Their frequency can be reduced through careful attention to diet, adequate exercise, proper substrate, controlled weight gain, and proper handling methods (Olsen 1994). When these problems do occur, early treatment is critical to normal chick development.

Curled toes are seen immediately post-hatching and may result from incubation or genetic problems. Curled toes range in severity from mild cases that respond to treatment with splints to severely club-footed chicks that fail to respond to any therapy and must be euthanized. Recognizing the problem can, at times, be difficult because neonatal cranes normally have edematous (swollen) legs and feet. The toes may appear curled, but are normal when the edema subsides. Splinting of toes is usually not done until 1 day post-hatching, unless the chick is unable to stand or eat (Olsen 1994).

Deviated or **crooked toes** are frequently encountered with hand-reared chicks at any age prior to fledging. The deviations appear to be due to laxity of the ligaments and tendons of the toes. Whether this laxity is due to problems with substrate, exercise, nutrition, or a combination of all three, is not clear. The most commonly encountered toe deformity is a single bent or curved digit. Hand-reared chicks under 10 days of age frequently have one or two bent digits. Older chicks of larger species frequently have curved middle toes.

To detect the problem, observe the gait of each chick daily; the middle toe should point straight forward with the other toes pointing ca 45^{o} to each side. Toe misalignment can be corrected with a splint (Olsen 1994); sometimes only 1-2 days of support may be adequate. Splints made of small wooden dowels

(1.5-4.0 mm dia) or popsicle sticks are taped to the crooked toe using low-tack tape such as filament packing tape (Fig. 5.18) (Olsen 1994). For chicks under 3 days of age if two or more toes are crooked, the foot can be taped in a normal walking position to a thin cardboard or plastic "snowshoe" splint (Fig. 5.19). Snowshoe splints cause problems in older chicks (i.e., the birds fight the snowshoe, the snowshoes collect feces and dirt, and they are slippery), but if used they can be made using moldable cast material (Orthoplast or Roylan Polyflex II, see Appendix). The splint should be removed every 1-2 days and the foot reevaluated. Leave the snowshoe off for several hours before replacing it. Snowshoes are usually helpful for chicks under three days of age. After that age, applicator sticks and tape work better.

When using wooden applicator sticks as splints, cut the stick to lie parallel to the chick's toe from the junction of the foot to the toenail. Sand the cut ends of the stick or cover the ends with tape to avoid abrasion. Place the applicator stick against the outside of the curve on the side of the toe. Do not place the stick above or beneath the toe. If the toe is rotated as well as laterally bent, try to twist it gently back to the normal position.

FIG. 5.18. *Taping for crooked toes using dowels and filament tape.* PHOTO GLENN H. OLSEN

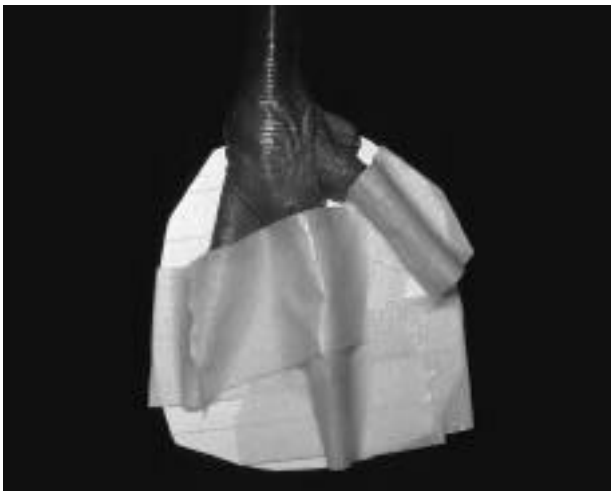

FIG. 5.19. *"Snowshoe" splint for crooked toes.* PHOTO GLENN H. OLSEN

When chicks are older than 14 days, their toes cannot be adequately straightened by one small applicator stick. Instead tape two sticks together as the brace, or use one stick on each side of the toe. Using pre-cut strips of low-tack tape, wrap the tape around the toe. Do not pull tape tightly, but rather place the tape against the toe and loosely wrap it. Use the minimum amount of tape to do the job, but the toe should be completely encased from toenail to foot (Olsen 1994). Leaving part of the toe exposed can cause circulatory problems. Leaving the splint on young chicks longer than two days can cause constriction of blood vessels and damage the toe.

Some chicks limp when a toe splint is applied. When this occurs, make sure the tape is not too tight, and observe the chick for other leg problems which can occur if a chick does not adjust to a toe splint. Crooked toes, if uncorrected, can eliminate birds from release programs, can leave adults severely deformed (Fig. 5.20), may inhibit natural breeding, and may lead to arthritis and bumblefoot as birds age.

In newly hatched chicks, deviation of the legs from the hip area, called **splayed leg**, is associated with improper incubation or chicks raised on slippery surfaces, but it may also occur spontaneously. Hobbling the legs above and/or below the hocks for 1-2 days in a normal position (Fig. 5.21) using adhesive tape or elastic bandage can be helpful (Olsen 1994). In some parrots, this condition responds to vitamin E and selenium injections (Harrison 1986), but the effects on cranes are unknown.

Hand-reared crane chicks sometimes develop other deviations of the legs (e.g., **leg rotation**, **angular limb deformities**, or **bowed legs**). The most common form is angling or rotation of the leg below the hock, although inward rotation is also occasionally seen. A chick's leg position and gait should be closely observed and checked daily by caretaker staff. The middle toes should be parallel and point forward; if one deviates, examine that leg carefully for changes at or below the hock. The causes of this problem are not known, although improper diet, excessively rapid growth, inadequate exercise, and genetics probably all play a role (Serafin 1980, 1982). Treatment is much more

Fig. 5.20. *Severely deformed toes in an adult Sandhill Crane.*
Photo David H. Ellis

Fig. 5.21. *Whooping Crane taped to control leg rotation.*
Photo Patuxent

successful when the problem is detected early and at a young age. Tension taping of the rapidly growing side of the hock (i.e., outside of the curve) using a strip of adhesive tape, can be effective in slowing growth on one side of the growth plate to allow the leg to straighten out (Haeffner 1988). Tape hobbles or splints have also been used with limited success to reposition deviating legs. For severe cases, surgical correction using techniques like periosteal stripping and wedge osteotomies have been tried by ICF, but with limited success.

All splinting/taping methods must be accompanied by correction of the contributing causes. If lack of exercise is suspected as a contributing cause, the safest way to increase exercise once a deviation has developed is hydrotherapy, swimming the chick at least twice daily for at least 20 min each time. Supervised walking can also be helpful. Excessive weight gain can be controlled by limiting food availability, increasing exercise, and monitoring weight carefully. Food can be withheld for part of the day, or food and water can be placed at opposite ends of the enclosure.

Fractures can occur in crane chicks and are usually associated with trauma. Fractures at growth plates are commonly seen and are the most difficult to manage. The same external splints and internal surgical correction techniques are used for chicks and adults. Wing fractures often heal, but with some loss of wing function. This is usually not a problem for captive birds, though it can affect natural fertility if the bird is a male. Fixation of leg fractures is only occasionally successful. Chicks frequently die from complications post-surgery such as premature closure of growth plates, osteomyelitis, and stress-related diseases. Survival depends on intensive care, and even then, survivors are difficult to resocialize with penmates after healing.

Parasites

Helminth parasites can severely debilitate crane chicks. Gapeworm (*Cyathostoma* sp. and *Syngamus* sp.), capillarids, and ascarids are the common nematodes of captive cranes. *Acanthocephala* sp. can cause intestinal perforation and peritonitis. Close monitoring of chicks for parasites is essential. Weekly laboratory testing for parasite eggs in the feces is recommended (see Chapter 8). However, feces can test clear even when chicks are infested, especially with gapeworms. Infected chicks can be treated with ivermectin (1% solution 0.02 mg/kg subcutaneously or orally), fenbendazole (100 mg/kg orally), or pyrantel pamoate (4.5 mg/kg orally). Often two treatments 7-10 days apart with one of these anthelminthics is needed to clear the parasites; repeat fecal examinations should be done 10-14 days after treatment to insure that the parasites are gone. Prophylactic doses of these medications can be given if there is a history of parasite problems in the flock. (See Fig. 10.3 for an example of a parasite screening and prophylactic medication schedule.)

Coccidiosis, from infection with *Eimeria gruis* or *E. reichenowi*, is a particularly devastating disease in crane chicks. In cranes, coccidiosis is not just a gut parasite; it can also be visceral (i.e., the organisms invade the internal organs including the heart, liver, lungs, and kidneys). Because coccidiosis is a clinical problem mostly in young cranes, it is recommended that a coccidiostat be used in the food and/or water of crane chicks. Very often parent-reared chicks initially consume mostly insects, so the coccidiostat may need

to be supplied in the water. Amprolium in food and water (0.0175%) or monensin sodium in food (90 g/ton) can both be effective coccidiostats. However, if a treatment regime using one of these two drugs is used long-term without alternation, it becomes less effective as resistant strains of the parasite develop. Adults should be monitored for the presence of oocysts, and treated as appropriate. This will reduce pen contamination and the exposure of the chicks. Chicks and adults with coccidia can be treated with trimethoprim-sulfamethoxazole, sulfadimethoxine, metronidazole, nitrofurazone, or pyrimethaine (see Chapter 8 for details).

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