

# Use of Surrogate Parental Models and Age Periods in a Successful Release of Hand-Reared Sandhill Cranes

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Ten sandhill crane chicks were reared in isolation from humans to prepare them for an experimental wild release. They were imprinted on realistic models using crane brooding calls and were fed by crane-like puppets. Six of the chicks were simultaneously imprinted on a human in a crane costume. The other four chicks were introduced to this surrogate parent at 5-7 days of age. The chicks were fed natural foods by the parent at two wild sites, one of which, the release site, was a staging area for migratory cranes. Observations were made on their behavioral development, including the time spent close to the model or costumed parent and the percentage of time spent foraging. The chicks spent the initial month close to the surrogate parent but moved away more to forage during the second month. The chicks regressed to again spend a great deal of time near the parent during the third and fourth months. They were released during this regressive period by removing the surrogate parent. All five of the released chicks showed increased interest in wild cranes within days of the release and formed a continuous association with wild cranes within 30 days. Four of the five were relocated by telemetry the following spring back in Wisconsin. These young juvenile cranes were excellent candidates for release due to their adaptable nature and their level of social development. The artificial stimuli of the surrogate parent helped the chicks to generalize their attachment to wild cranes. Once with wild cranes they quickly learned additional survival skills.

**Key words:** reintroduction, imprinting, development

## INTRODUCTION

Because so many crane species are threatened with extinction [Johnsgard, 1983], the development of a successful method for releasing numbers of captive cranes into the wild could bolster these endangered populations. Of the 15 species, the whooping (*Grus americana*), Siberian (*Bugeranus leucogeranus*), and red-

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crowned cranes (*Grus japonensis*) are so reduced in numbers that their existence may depend on continued conservation programs, and the hooded (*Grus monachus*), white-naped (*Grus vipio*), black-necked (*Grus nigricollis*), and wattled cranes (*Bucconeranus carunculatus*) number only in the low thousands [Archibald et al., 1981].

Three main practices have been tried in rearing cranes for release: parent rearing, cross fostering with another species, and handrearing. Captive birds that have been parent reared for between 1 to 2 yr have proved the most successful in the releases of Mississippi sandhill cranes using gentle, well-prepared releases [Zwank and Derrickson, 1982; Mitchell and Zwank, 1987]. However, parent rearing is expensive, as it depends on maintaining many breeding pairs of adult cranes in captivity. Accumulating such a store of an endangered species would be an extremely difficult, costly, and lengthy process. Additionally, the success rate of parent rearing is often lower than hand rearing.

Cross fostering of whooping cranes with sandhill crane parents in the wild has met with uncertain results [Whooping Crane Recovery Team, 1987]. Although this creative technique has produced a second population of whooping cranes that interact with each other (Lewis, personal communication), they are not breeding. Cross fostering may have created sexual imprinting problems, retarding or preventing the whooping cranes from breeding normally with their own species.

Large numbers of crane chicks have been successfully hand reared with a high survival rate [Archibald and Viess, 1979]. Two major problems of released hand-reared captives are their inability to feed themselves [Nesbitt, 1979] and their affinity with humans.

Working with sandhill cranes as a common experimental species, I developed a successful method of hand rearing crane chicks that solved those problems. Using artificial parents and a knowledge of regressive growth periods to determine release time, the technique produced chicks that rapidly joined their species in the wild, fed themselves, survived migration, and assumed normal flight distance to humans [Horwich et al., in press; Horwich, 1985, 1986; Wood and Anderson, in press].

## METHODS

Ten eggs were obtained from the nests of sandhill cranes in Wisconsin (2) and Idaho (8) (Table 1). They were transferred to incubators at the International Crane Foundation (ICF) after estimating their ages by floating them in water. At 2 days prior to hatching, when peeping was heard, recordings of white-naped crane brooding calls were played to the eggs for 5 min every 3–4 hr or when handling the eggs (sandhill crane brooding calls being unavailable, the similar white-naped crane calls were used). Prior to, or at pipping, the eggs were placed in a hatcher away from the sight of humans.

Following hatching, the chicks were removed in a closed box and placed in a pen (Fig. 1) that included a mounted crane body with a speaker in the breast, a red food and water dish with a red spoon in it, a heat lamp over the model, and a thermometer set on an artificial plastic turf rug. The main enclosure was 1.8 m × 3 m × 2.4 m and was connected through a door to an outdoor enclosure, 1.8 m × 6 m × 2.1 m. The whole enclosure was visually isolated by layers of black tennis netting. We attempted to maintain a no-talking regime in the hallways behind the cages. For the first 3 days the chicks were restricted by a temporary low barrier 1 m

TABLE 1. Chick histories

Chick	Hatch date	Source	Group	Last weight (Aug. 6)	Sex—known or supposed	Fate
Foxy	May 7	Wisconsin	One-parent		?	
Cyclops	May 30	Idaho	One-parent	3.5 kg	Male(?)	Euthanized at 7 wk
Chicken lips	May 30	Wisconsin	One-parent	3.0 kg	Female(?)	Located spring 1986 in Wisconsin
Noah	May 30	Idaho	One-parent	3.4 kg	Male(?)	Located spring 1986 in Wisconsin and winter 1987 in Florida
Titan	June 1	Idaho	Two-parent	3.9 kg	Male	Died at 9 wk, myopathy in transport
Siren	June 1	Idaho	Two-parent	4.0 kg	Female	Died at 9 wk, myopathy in transport
Medusa	June 1	Idaho	Two-parent	3.6 kg	Male(?)	Last seen in a flock, presumably migrating south at 5 months
Ratibida	June 2	Idaho	Two-parent	1.4 kg	Female(?)	Located spring 1986 in Wisconsin
Doink	June 5	Idaho	One-parent	2.0 kg	Female(?)	Died at 13 wk, predator bites and lack of food
Dude	June 5	Idaho	One-parent	2.6 kg	Male(?)	Eaten at 8 wk by predator after tornado

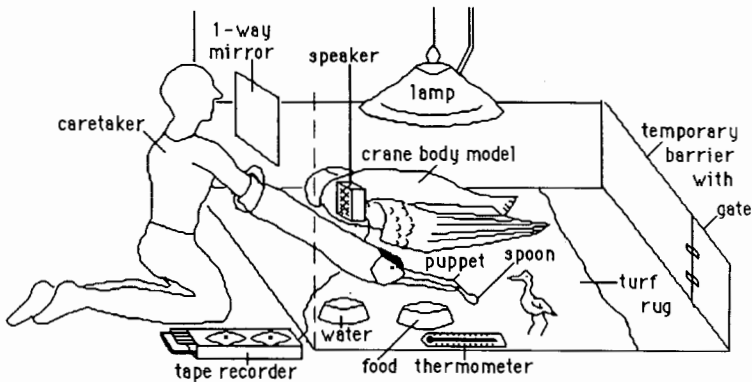


Fig. 1. Set-up for puppet rearing crane chicks in isolation from humans.

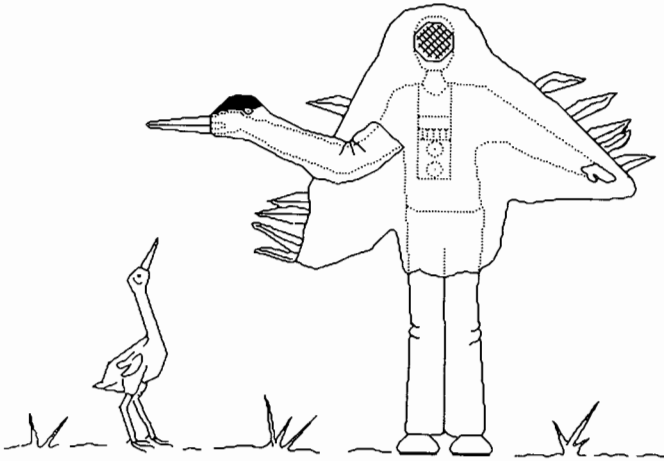


Fig. 2. Costume used for rearing crane chicks in isolation from humans.

× 1.3 m to ensure they would not wander too far from the heat source and to facilitate their feeding. They were fed every 2–3 hr by a simulated sandhill crane puppet through a hole in the door and could be viewed through a one-way mirror (Fig. 1). Feeding was accompanied by playing the brooding calls. The puppet was left in the cage in between feedings, usually dangling from the feeding window.

Experimental observations were conducted two times per day in the morning and afternoon, during which the chicks were observed 10 min before, 10 min during, and 10 min following playing of the brooding call. There were two experimental groups. The two-parent group (six chicks), had access to both a surrogate model and a costumed parent at hatching (Table 1). The crane costume had the same puppet and brooding calls that were used in feeding the chicks (Fig. 2). The model remained in their cage for 4 wk. The one-parent group (four chicks) had the model for the initial 5–7 days; it was then removed with the introduction of the costumed human. Both groups were exposed to the costumed parent at least twice per day for a half hour. They were encouraged to follow it, through brooding calls, feeding with the beak, and by tapping the beak on the substrate. Data were taken while in the costume for a half hour per day, noting at each half-minute interval the distance to the parent and behaviors performed.

At 2 wk of age, pairs of chicks from the same experimental group were put together for short periods. The chicks had had exposure to neighbors through cage mesh but aggression levels were very high at this age, making it difficult to form larger groups. By 4 wk of age, the chicks could be led in their groups once per day into a nearby field and marsh, where they were encouraged to forage. They were fed insects with the puppet during this time and at other times.

At 4 wk, each chick was individually led into the field by the costumed parent and a mock chase by humans was staged to instill fear of humans. Two yelling humans chased each chick, grabbed it, gently shook it, and were then “chased” off by the costumed human. The chick was then led back to its cage.

Health checks were conducted on all chicks at 5 wk of age while at ICF and again at 10 wk after the move to the release site at Necedah National Wildlife Refuge

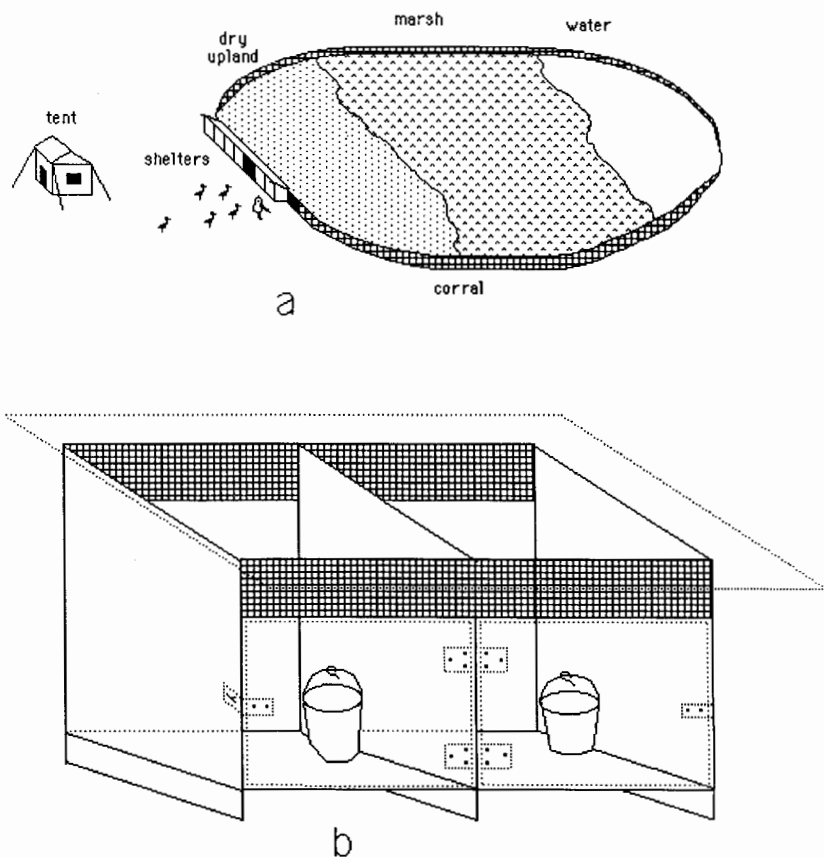


Fig. 3. Diagram of field set-up for maintaining crane chicks at release site. **a:** General set-up; **b:** nocturnal pens for protection from predators.

at Necedah, Wisconsin. In both cases the chicks were captured without the use of the costume. Swabs were taken from the throat and cloaca. Blood was taken from the neck and each bird was weighed. Radio transmitters on leg bands were attached at the latter check [see Wood and Anderson, in press].

At 9 wk, the chicks were transferred in cardboard crates to the release site, a 1 hr journey by truck. The chicks had to be rapidly unloaded by humans for expediency due to the death of two chicks from stress myopathy (Table 1).

The set-up at Necedah included two outdoor chicken-wire enclosures approximately 100 m in diameter, bordered in one area by four or five individual houses for nighttime locking in. These were 1.2 m  $\times$  1.2 m  $\times$  1.5 m with sloping roofs and screened sections at the top for ventilation (Fig. 3). A tornado 2 days later resulted in the destruction of one compound and the death of another chick. At this point, the six remaining birds were placed together in the remaining compound which was reconstructed with six houses (Fig. 3).

The birds only interacted with costumed humans, who at other times remained out of sight in a nearby tent. The chicks were taken twice daily out of their enclosure

to various areas in the marsh at which time they were fed and induced to feed on wild arrowhead root (*Sagittaria latifolia*), insects, and corn kernels that were spread around the release site. General daytime food consumption was measured each evening and nocturnal individual food consumption was measured each morning. At 12 wk, because it became difficult to bring the chicks inside at night, we began feeding them only at night. At this time, they were eating only one to two thirds of their normal consumption.

At 12 wk, they fledged and began exiting the corral at will and congregating around the tent, "recognizing" that their parent was inside. At 14 wk all chicks were able to fly large quarter-mile circles around the corral and tent. They had regressed so strongly that they were spending most of their time around the tent, rarely foraging on their own. Therefore, on September 16, they were "released" by removing the corral, houses, supplementary feeding, and the costumed parent. Observations were then made with a 15 × 60 powered spotting scope from a distance of 200 yards, and the birds were monitored with AVM, Telonics, and Cedar Creek receivers [Wood and Anderson, in press]. One bird whose bill had been injured, possibly by the long transmitter band, died from a combination of inability to feed properly and predator bites (Table 1).

## RESULTS

The release was successful, with all five healthy chicks interacting with wild cranes within days and continuously associating with a flock within a month after the costume was removed. Four of the five were positively located the following spring after the migration back in Wisconsin. One of these was relocated the second winter in Florida. Further observations were ended because of lack of funds and transmitter failure [see Horwich et al., in press; Wood and Anderson, in press].

Observations on the distance of the chicks to the models and costumes showed that attachment behaviors recurred in cyclic patterns, as noted in mammals [Horwich, 1974a] and birds [Horwich, 1987]. Figure 4 shows an average of a composite of the percentage of time in which the five chicks were next to (within 6 inches) either the model or the costumed human. Weeks 4–5 were weeks of overlap when data were taken on distances to both the model and the costumed parent. Those data were averaged to get the resulting points in Figures 4 and 5. Figure 4 shows that the chicks spent over 60% of the time within 6 inches of the model during the first 2 wk, after which they began spending less time next to the model. At about 4 wk of age, they began to show the beginnings of interest in foraging by following and pecking at insects or pecking at things on the ground and at plants (Fig. 5). After 5 wk, they were mainly interested in foraging and consequently showed almost no interest in following the costumed parent when taken outside of their cages. Between 5 and 10 wk of age, the chicks showed little interest in following and would sometimes remain 100–200 m away and we were constantly afraid of losing them. However, they were well aware of the location of the costumed parent as indicated by their eventual joining of the group.

Following the first 2 wk when we began putting the chicks into groups, they were very aggressive and it took 2 additional wk before this aggressive peak passed and the groups were socialized to harmoniously follow the costumed parent.

The birds began again to show more attention to the costumed parent at 11–14

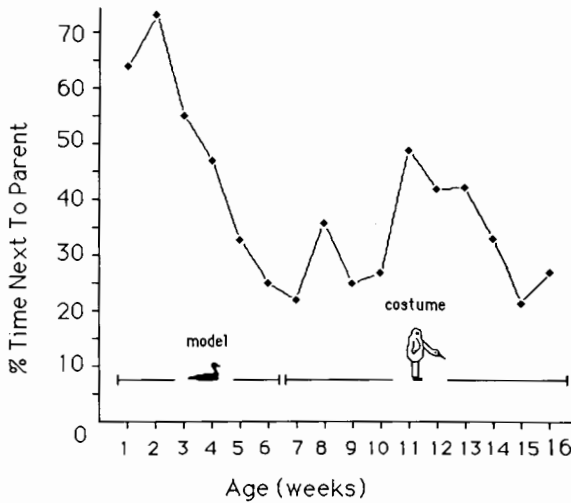


Fig. 4. The percentage of time the chicks spent next to the surrogate parent (model or costumed human) as a function of age in weeks (average of five chicks).

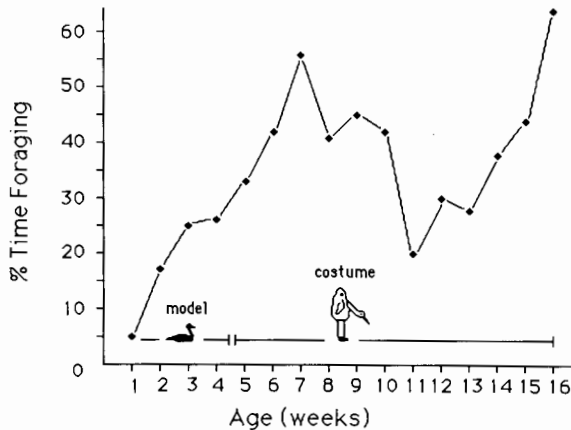


Fig. 5. The percentage of time the chicks spent foraging as a function of age in weeks (average of five chicks).

wk (Fig. 4), staying around it much of the time and often pecking its feathers. This was also the time when they began to fly. Some of the more aggressive chicks would defend their position around the costumed parent. One individual that spent most of its time foraging far from the parent showed interest in pecking the parent during these later weeks.

The chicks also spent much of their time near the tent where the parent was last seen. They would peer into the windows and peck at them and mouth strings on the tent, as they would do to the costume and as they had done earlier to the surrogate model. This is a regressive behavior similar to thumbsucking in primates [Horwich, 1974b] or tail sucking in ungulates [Horwich et al., 1983].

At 14–16 wk they again began to forage more, partly because the prepared food was removed during the day. This was a normal developmental recurrence of foraging, similarly noted in captive red-crowned cranes [Horwich, 1987]. Despite this increased foraging, interest in the parent and tent remained intense and the chicks were not getting enough wild foods, so they were released. Once released, they foraged as a group but maintained attachment to the site, often staying near the pile of wood and chicken wire from their broken-down corral.

Within 2 days of their release they became more interested in wild birds and were joined by a wild adult and chick on two different occasions [Horwich et al., in press]. Thirty days following the release, three of the birds whose location we knew began a continued association with a flock of wild cranes. Two weeks following that they showed normal flight distance of about 100 m when approached by humans and when not in the vicinity of wild cranes. The remaining two chicks disappeared and were not relocated until the following spring [Horwich et al., in press].

## DISCUSSION

### “Gentle” Release and the Age for Successful Release

Although a number of techniques for releasing cranes have been suggested [Erikson, 1975; Konrad, 1976], few have been attempted [Derrickson and Carpenter, 1987]. Initial introductions of young sandhill cranes released without any prerelease conditioning or supplemental feeding had low success. In one study, none of the 14 hand-reared 5–7-month-old chicks survived over 4 months, due to tameness, inability to forage adequately, and their lack of association with wild cranes [Nesbitt, 1979]. Older birds, released later with supplemental feeding survived longer and associated with wild birds, but still retained their affinity to humans, although a single parent-reared bird rapidly affiliated with wild birds and survived to pair with a wild male [Nesbitt, 1979].

Derrickson and Carpenter [1987] noted three points to take into consideration in future releases: 1) conventional hand rearing is not suitable for releasing birds, 2) 1–2-yr-old birds appear to be the best candidates, and 3) gentle release procedures should be followed. These points, incorporated into Mississippi sandhill crane introductions, have engendered a much higher success rate [Zwank and Derrickson, 1982; Mitchell and Zwank, 1987]. The most successful release, in 1982, included parent-reared birds that were presocialized in captivity, released in the fall, and given supplementary food.

The present study was most gentle, providing a parent substitute that protected the chicks and taught them a few foods for survival until they joined wild cranes. It reaffirms the need for preparation and gentle releases and confirms that newly fledged chicks are exceptionally good candidates for release. The method might be modified for parent-reared chicks as well. Captive wing-clipped pairs could produce free-flying young in open-topped corrals [Konrad, 1976], or wing-clipped parents could teach the young and be removed, allowing the orphaned chicks to join wild cranes.

Orphaned chicks at fledging are very flexible and will adopt wild cranes and learn from them [Horwich et al., in press]. The rapid learning to fear humans from wild cranes in this study showed their flexibility. Similarly, a lone wild chick joined and warily approached humans, following our chicks who showed little fear of humans at that point. The presence of lone chicks at Jasper Pulaski, a main migratory



stopping point in the midwest, indicates the probability that many wild chicks lose their parents. They ensure their survival and migration by linking up with wild cranes because of their high social drive during their regressive periods.

### **Regressive Periods, Sexual Imprinting, and Reattachment to Wild Cranes**

Regressive development periods are important in rearing and reintroduction programs for two reasons: 1) the high social drive during regressive periods make them good release times, and 2) they seem to be related to sexual imprinting. Regressive periods, one type of recurrence or cycling of behaviors in development, have been commonly noted in mammals [Horwich, 1974a] and documented in birds as well [Voss, 1976; Ellis, 1979; Horwich, 1987]. Specifically, the recurrence of contact with the parent has been termed the regression or reattachment period. They are at the roots of sociality in mammals [Horwich et al., 1982] and in birds. They strengthen social bonds during periods of social stress such as rut and calving in ungulates [Horwich et al., 1982] and infant birth in primates [Horwich and Wurman, 1978]. They may be modified to fit the species, even reversing the mother-infant roles when necessary for survival. The giraffe mother, for example, instead of the calf, enforces the regression for the calf's protection within the giraffe's social system [Horwich et al., 1983].

Periodic regressions may synchronize with seasonal behaviors [Horwich et al., 1977, 1982; Horwich, 1972] as in cranes. The initial close bond of crane parent and chick during the first month protects the chick when it is most vulnerable and needs parental feeding. As the chick grows stronger and can feed itself, it begins a period of independent foraging, and follows its parents at a greater distance. This age may be a very risky time (McMillan, personal communication) making the chicks more susceptible to predators in the wild. The chicks regress again to contact the parents more during fledging when they could potentially get lost the easiest, having only recently gained the ability to fly [Horwich, 1987]. They show a second regression or reattachment period during the migration when all cranes show high sociality and flocking [Horwich, 1987; Horwich et al., in press]. Many other bird species, both migratory and nonmigratory, show this tendency, as do mammals [Nievergelt, 1974; Guinness et al., 1979]. Besides functioning to keep the cranes on a successful migratory route, this social period may also function to allow lost chicks to learn the route in the absence of their parents.

Finally, regressive periods may be important in species sexual identification through sexual imprinting. Although the term "imprinting" has been used in a variety of ways, it commonly refers to two kinds of situations; 1) filial imprinting, which generally refers to the following response attachment of young chicks to a parent or parental model, and 2) sexual imprinting, which refers to an attachment that takes place before any sexual activity but reasserts itself in a mate choice once sexual maturity is reached. The first days in the chick's life are important in its learning to follow its parents. This learning seems to be renewed during regressive periods as a secondary imprinting in which species sexual identification occurs. Indeed, animals that are cross fostered or hand reared can reverse mate choice from the foster to the correct species if reintroduced to their own species during or before this sensitive period.

Despite the great number of instances in which birds have sexually imprinted on humans or another species [Immelmann, 1972], studies have shown the reversibility

of the process. Cross-fostered zebra and Bengalese finches showed a reversibility of sexual choice if they were put with their own species between 21–40 days of age [Immelman, 1972]; if not, the sexual imprinting was irreversible. Thus reversibility depends on age. Similar reversible results were shown in ringdoves [Klinghammer and Hess, 1964]. Squabs, hand reared for the initial few weeks, showed a normal sexual preference after living for 8 months with their own species. Primates may have a similar critical period. When infant macaques are isolated at 3 to 6 months, it may irreversibly affect their ability to adjust socially [Harlow and Harlow, 1962]. This age concurs with the two earliest regressive periods in a number of Old World monkey species [Horwich, 1974a,b].

Vidal [1980] neatly delineated these two imprinting periods. He observed a period in chickens, at 4–6 wk, when adult plumage had grown in and when the initial attachment could be reversed [Vidal, 1976]. Using models, he showed a sensitive period for following by the second day of life. However, cockerels that were exposed to the model between 30–45 days became sexually imprinted on it despite their earlier training. His results are strongly supported by similar earlier experiments in chickens [Baron et al., 1962].

Judging from other developmental parameters, this age in chickens seems comparable to the 3–4 month age period in cranes. Vidal's results indicate that this reattachment period in cranes may be a sensitive period for species and sexual identity. The rapid association with wild cranes that our crane chicks showed [Horwich, 1986; Horwich et al., in press] indicates the intense sociality at this age. The release by K. Archibald of two young hand-reared cranes, which resulted in the eventual pairing of one crane with a wild mate (K. Archibald, personal communication), supports this idea.

### Stimuli Generalization

The data suggest that this reintroduction was successful because we used stimuli that allowed the chicks to generalize from the puppet and sounds in the model to wild cranes when the costumed parent was removed. This attraction to wild cranes was boosted by socializing with other chicks and by the innate attraction to wild crane sounds and behaviors, especially during flight, when the chicks seemed most interested in following wild cranes.

Additionally, the costume, though not overly crane-like, broke up the human figure gestalt by deemphasizing the head, face, and hands, while emphasizing the crane head and voice. Although the chicks did not show affinity to humans, they also did not show much fear, due to hearing human sounds, seeing humans from a distance, and eventually associating humans with the tent and their costumed parent.

### CONCLUSIONS

1. Young sandhill cranes raised with surrogate parents can be taught or shown environments, techniques, and foods that can aid their survival in the wild.
2. Sandhill cranes have a regressive or reattachment period at 12–16 wk when they are most easily resocialized with their own species.
3. Hand-reared sandhill cranes that have been resocialized with wild cranes at

- 3–4 months are very behaviorally flexible and easily learn feeding areas, migratory routes, and fear of humans from wild cranes.
4. Young sandhill cranes generalized species stimuli recognition from artificial characteristics of their surrogate parent to wild cranes.

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