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I. Introduction

Socialization Background

Successful pair formation is a crucial component in captive crane propagation and conservation. Often, a female will not become physiologically capable of producing eggs until she has formed a strong pair bond with a compatible mate (Gerencser, 1998). Managing captive crane pair formation is a delicate and time intensive process with remarkable variation among different pairs and individuals. Understanding how to conduct socializations and interpret interactions, therefore, is invaluable in crane captive breeding.

Here at the International Crane Foundation (ICF), we use a socialization method called “Forced Pairing,” which has resulted in a significantly higher percentage of pairs successfully laying eggs than have other methods (Gerencser, 1998). In this technique, an aviculturist acts as matchmaker and chaperon to the birds. The socialization process at ICF is described, in detail, in Section II of this booklet.

Purpose for this Booklet

This booklet is intended as a resource to help train new ICF employees in conducting socializations, and as a reference for other facilities housing captive cranes. Zoos and other captive breeding facilities may use ICF’s successful techniques as a guide in developing their own crane socialization methods. In addition, ICF began developing a new behavioral sampling protocol during the fall of 2001, and this booklet describes these new techniques. The final section provides brief descriptions and illustrations of the behavioral ethons recorded during socializations at ICF.

II. Socialization Techniques

Getting Started

Mate Selection—In captivity, the following dynamics impact how birds are paired

(adapted from Gerenscer, 1998):

- **Genetics:** One of ICF's primary intentions is to help to preserve the genetic integrity of the world's 15 species of cranes. Therefore, pairs are often selected with the intention of breeding genetically heterozygous offspring.
- **Behavior:** Aviculturists seek to pair birds exhibiting balanced dominance/submission and confidence levels. It is generally very difficult to pair birds with a strong imbalance in these characters.
- **Age/Rearing History:** These factors may affect both the birds' willingness to pair and their post-socialization breeding and behavior patterns. For example, pairing a younger female with an older confident male may decrease time to first laying. Nervous, wild caught birds may also calm down more in captivity if paired with hand-reared birds (Derrickson & Carpenter, 1987).

Divided Pens—Once two birds have been selected as a potential pair, they are ideally moved to a subdivided pen (see Figure I below). Total pen size at ICF is 50' x 60', with a 14' x 14' (also divided) house. When divided pens are in short supply, or if the birds require more space, both are given full pens, and a divider is erected inside the house.

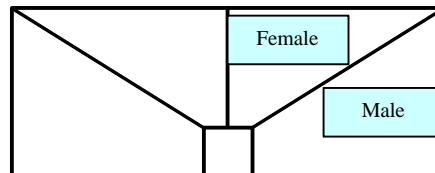


Figure I: Divided Pen Design

Behavioral Observation & Encouraging Positive Interactions

From the time that the potential future pair is placed in a divided pen (see Figure III on following page for example), aviculturists monitor their interactions along the divider and use several tools to attempt to advance the process toward physical socialization and eventual pairing. The following are all potential elements of this strategy.

Behavioral Observation— This can be done both during specific times and when performing any of the routine husbandry duties here at ICF. Aviculturists are particularly interested in the following suite of behavioral categories (See Section IV for further details), along with more general attitude characteristics:

- **Nervousness:** Behaviors may include pacing, being easily startled, excessive head rubbing, avoiding closeness to other bird, and general skittishness
- **Threats:** Generalized common threats include ruffle threats, preen threats, foraging threats, and more intense threats such as crouch or stomp.
- **Synchronous Behaviors:** This category refers to any time the birds are performing the same activity while in close proximity. Synchronous threats or guard calls toward intruders are particularly noteworthy.
- **Pair Behaviors:** These include behaviors that establish and strengthen pair bonds, such as unison calls and dancing.



Figure II: Siberian Cranes in Divided Pen

Visual Barriers—When the birds are first placed adjacent to one another, tennis-netting covers all or most of the divider fence, creating a partial visual barrier to the new neighbor. This is intended to raise the birds’ sense of security in their new environment next to an unfamiliar bird. In the case of an aggressive or extremely nervous bird, it can also help to prevent injury if the bird is pacing a great deal or protruding its head through the fence. While most cranes are often nervous when first moved, they usually calm down within a reasonable amount of time. As this

occurs, the tennis netting is pulled back in stages, and the birds are gradually more exposed to each other.

Tossing Treats—At the discretion of the aviculturist overseeing socializations, people may toss treats (usually corn) on both sides of the divider fence. This is intended to encourage the birds to interact next to each other along the divider, and to share a positive experience while in close proximity.

Socialization Pond—Aviculturists may dig a small, simple pond along both sides of the divider fence (see Figure III below). This pond serves much the same purpose as tossing treats, in that it encourages positive interactions along the divider fence. *Along with tossing treats, this technique could potentially lead to aggressive competition between the two birds for the resource. If such aggression does occur, the techniques should no longer be used.*



Figure III: Socialization Pond

Confidence Mounds—If one of the birds is excessively submissive to its potential mate, it can be helpful to mound an area of shavings or other materials in it's side of the house. Mounds may also be built with ground materials in the outside pen. As cranes often use height to intimidate one another, these mounds may give the submissive crane a psychological edge next to its potential mate.

Conducting Socializations

Physically Combining Birds in Same Pen—When the aviculturists feel that the two birds are ready to be physically socialized, the first step is to join them together in the same pen. At this point in the process, the birds should appear comfortable near each other, and possibly even be displaying pair or synchronous behaviors. As each pen and pair are slightly different, there are many angles at which to approach the physical combining of two birds. However, the male is nearly always introduced into the female's pen. This hopefully gives the female a bit more confidence and discourages the male from becoming aggressive immediately while defending his territory. The following is a description of a generalized first introduction for a divided pen. Depending on the pen and house structure and the personality of the birds, the actual introduction is usually accomplished in some variation on this theme.

Step 1. While both birds are both locked out of the house, open the door of the inside divider. Prevent the door from closing by mounding shavings in front of the door or clipping the door to the divider.

Step 2. Open both of the birds' access doors and encourage the male to enter the house. This is the step with the most significant variation depending on the personality of the male. Most commonly, he can be herded in by a person entering his pen and walking him toward his access door. In some cases, the bird may become submissive and run directly in, or he might become nervous and pace along a fence near his door. In this case, the handler should physically nudge the bird into the house while gently but firmly holding the neck and a wing. Another possibility is that the male will become very aggressive and attack the aviculturist. This can be dealt with in a few ways. Some males will enter the house in pursuit of a person, so the handler may go into the house and entice the bird to come in. In many cases, the male will be more cooperative if two people herd him in. While many of the divided pens at ICF have wooden slats

beneath the outside divider door, a few do not. In these more convenient cases, the male may be run directly into the female's pen through the outside door.

Step 3. Once the male is in the house, he must be locked out of his pen and encouraged to enter the female's pen. Often, the bird will enter the pen directly, without any prodding, but occasionally the handler may need to nudge him in that direction by entering the house and walking toward the female's access door. The birds are locked outside to prevent them from going out of view of the observer and having a conflict inside the house. In later socializations, if the birds show little aggression toward one another, they will be given access to the house.

Observing Interactions

For a more complete treatment of this aspect of socializations, please see "Conducting Observations," under Section III. More generally, after introducing the male into the female's pen, the aviculturist then stations him or herself behind a blind or in an area where he or she won't disturb the birds. He or she observes the birds for all or part of the socialization, depending on how far the potential pair has progressed. While conducting the observation, the viewer records behavioral data in a systematic manner. At ICF, the aviculturist observes for the 1st hour of all socializations. If the observer views aggressive behavior that may endanger one or both of the birds, he or she first may yell or create a distraction to try to separate them. Often, this is enough to stop the aggressive interaction, and the socialization may continue. In some cases, however, the aggression is extreme and doesn't halt, and the birds must be physically separated immediately.

Separating the Birds

In most cases, the birds are separated after the socialization is ended for the day. They may also need to be separated earlier in aggressive situations such as the one described above. Most often, the male may be simply herded back into the house in a reverse of the introduction steps. Once the male is back in his pen, the inside divider door is closed, and both birds are again

given access to the house. Each situation must be evaluated and treated in the best method available to the aviculturist at the time. In addition, if a single aviculturist does not feel comfortable handling a situation on his own, he should always call for backup.

Progressive Steps toward Pair Formation

As the birds progress through the socialization process, there are several small additions to the basic socialization that help to determine whether the pair can be left together permanently. These elements can best be described in terms of the following “socialization phases”:

Phase 1: Birds are together for one hour, locked outside, usually without food or water (these things can cause competition which aggravates aggression between the newly introduced birds).

Phase 2: Before introducing the male to the female’s pen, the aviculturist places two food and two water buckets in the female’s outside pen. Each of these buckets should be placed at least 5-10m from the next. During the socialization, the observer watches for any aggressive interactions around these buckets, and notes whether each bird is able to eat and drink without harassment. At this stage, if the aviculturist feels comfortable that the birds will not harm or unduly stress each other, he or she may choose to leave them together unattended for several hours, with periodic visual checks. In successive socializations, the buckets are moved closer and closer to one another, and eventually the birds are given just one bucket each of food and water, which are set close to each other. Additionally, the aviculturist often leaves small piles of corn to observe whether the birds compete excessively for the resource or if they are able to forage together without aggression.

Phase 3: During this phase, the birds are first given one food and one water bucket outside, and they are given inside access. The observer watches and listens for any altercations taking place inside the house. If, after the first hour of observation, the birds are interacting well,

the aviculturist may leave them together with access for the entire day, again with periodic visual checks. If there is no aggression inside the house, a food and water bucket are placed indoors.

Phase 4: This is the final phase before permanently leaving the birds together. At this stage, the birds should be interacting harmoniously, synchronizing behaviors, acting comfortably when in close proximity, and ideally exhibiting some pair behaviors such as unison calling. This phase involves all of the elements of phase 3, as well as leaving the birds together overnight, given that the birds appear to be comfortable with each other all day. The next morning, the pair's chaperon performs another 1hr observation. If the birds continue to interact well together, they may be left together permanently. For the following weeks, the pair is carefully watched during routine ICF duties to determine whether they are still living harmoniously and whether they appear to be strongly pair bonded (unison calls, synchronized threats toward intruders, etc are noted in the Daily Report). The length of time in each phase and the number of socializations conducted before the pair can be left together varies greatly from one pair to the next. The aviculturist must use a combination of objective observation and intuition to determine when is the right time to make this final move.

III. Behavioral Sampling Protocol

Conducting Observations

Immediately after introducing the two birds, the observer should station him or herself in a location where he or she will not disturb the pair. At ICF, we often conceal ourselves behind a blind placed in the access door to the female's pen. In some cases, this is not logistically possible, or the birds may be disrupted by a human's presence in the house despite the visual barrier. The observer should then find an alternate location from which the birds are still visible. If this location is at a significant distance, he or she may need to use binoculars or a spotting scope to distinguish between the two birds and to properly classify various behaviors. Once stationed, the observer begins to record data, noting the observation start time. Throughout the

observation, the aviculturist attempts to minimize his or her movements and noise in order to reduce his or her impacts on the birds' behaviors.

Sampling Methods

Here at ICF, we are currently developing and polishing a standardized protocol for behavioral sampling during socializations. This protocol primarily employs a combination of "Focal Pair Sampling" and "Scan Sampling" at 30-s intervals. Focal Pair Sampling involves data collection from any two animals at a time (Lehner, 1992). We chose this method because we are interested recording and comparing the behaviors of both the male and female of a potential pair. In Scan Sampling, a variation of Instantaneous Sampling, the observer records behaviors of more than one animal at fixed points in time (such as our 30-s intervals). When sampling intervals are short relative to durations of behavior and the behavior occurs at high rates, this sampling method can provide a reasonable approximation of both frequency and duration of behaviors (Lehner, 1992). Our 1hr observations are divided into 120 sample intervals. In order to obtain an approximation of the proportion of time spent performing a particular behavior, we may divide the number of times the behavior is recorded by the total number of sample intervals. The method also helps to determine activity budgets and behavioral synchrony (Lehner, 1992).

We chose intervals of 30-s for a combination of reasons related to logistics and methodology. While 30-s intervals do meet the above criteria for some behaviors (e.g. preening), shorter intervals would certainly give a finer resolution, particularly for shorter, event-type behaviors. However, this is a new protocol, and the aviculturists and interns at ICF are not necessarily trained behaviorists. Intervals of 30-s strike a nice balance between rigorous data collection and the comfort and confidence levels of the observer. In addition to utilizing these primary sampling methods, the observer also records noteworthy behaviors *ad libitum* ((opportunistically (Lehner, 1992))).

Data Sheets

Behavioral data are recorded on newly implemented data sheets, which employ a modified version of a socialization ethogram used at Disney Animal Kingdom (reference). The data sheet is a grid, with columns indicating behavioral categories and rows indicating successive time intervals. The behavioral categories are arranged according to type and intensity, with positive, pair-related behaviors on the far left, followed by concordant, general, and finally extremely discordant on the far left. At each 30-s interval, the observer records each bird's behavior by writing its first initial in the appropriate ethon box. In the current ethogram, it is occasionally possible that a bird could be performing more than one of the behaviors at a time (e.g. alert and locomoting). In such cases, both behaviors should be recorded. In addition to recording behaviors, the observer also notes the pair's proximity to one another in the following manner: <5', 5-10', 10-15', etc. At the end of the 1hr observation, the aviculturist writes a brief summary of the socialization and his or her impressions of the pair's progress in the space indicated at the bottom of the data sheet.

The observer also records physical data on the primary data sheet. These data should be recorded in the following manners:

% cloud cover: enter one of the following: 0-25, 25-50, 50-75, 75-100

winds: low (L), medium (M), or high (H)

fog: circle yes (Y) or no (N)

current precip: circle yes (Y) or no (N) and record type

previous precip: circle yes (Y) or no (N) for whether there has been precipitation in the last 12 hrs, and record type

temp: temperature (or 5 degree range)

In addition to the primary data sheet, ICF also uses an "Active Notes" sheet to record further important socialization information and observations (see example in Appendix B). On this sheet, the chaperon first documents the methods used to introduce the male into the female's pen, both birds' behaviors during introduction, and the observation location. He or she also notes whether or not the birds have indoor access, whether or not they have food and water and the number and location of the buckets, whether corn or other treats were thrown, and the presence of any other enrichment items such as a pond. Noteworthy behaviors occurring between data points

are recorded on this sheet, with the time (either the exact time or the 30-s data interval in which the behavior occurred) in the left column and the observation in the right column. This sheet is also used to describe in detail any complex interactions and any disturbances occurring during the socialization (e.g. airplanes, people walking by). For long socializations, observations made during periodic checks are included on this sheet. Finally, time of separation, methods used in separating the birds, and their behaviors during and after separation are noted.

Each potential pair's socialization file will also include a pre-socialization data sheet (See Example in Appendix C). This sheet should be filled out by the aviculturist who will act as primary chaperon to the pair. The form provides background information about the birds' rearing, pairing, and behavioral histories that may inform the socialization process and provide an important reference for future socialization attempts.

IV. Description of Behavioral Ethons (adapted from D.H. Ellis et al, 1998)

Pair Related Behaviors

Unison Call (UC): Unison calls are antiphonal duets performed by mated pairs of all crane species. In general, the two birds stand side by side with necks upright, calling alternately. The male usually raises his wings higher than the female. In *Anthropoides* and *Buggeranus* species, each male call is answered with one female call, and the duet has a determinate length of 5-7-s. Siberian (*Grus leucogeranus*) cranes also emit one male call per female call; however, the duet has an indeterminate length, and can last several minutes (Fig. IV). In all other *Grus* species, one male call is answered with two female calls, with the duet lasting for an indeterminate amount of time. Holding the head down and the bill drawn against the neck, crowned (*Balearica* spp.) cranes perform sexually monomorphic duets consisting of a long series of synchronized guard calls and alternate gular booms (*B. regulorum*) or honks (*B. pavonina*). The unison call is used to express and strengthen pair bonds, as well as to defend territory.



Figure IV: Siberian Cranes Performing Unison Call

Dance (D): Crane dances incorporate many elements of agonistic display and attack, but are distinguished from these behaviors by their active and flowing nature. Often one bird will initiate the dance by bobbing tucking and bobbing his or her head and then leaping into the air. It may also pick up and toss objects (e.g. feathers). The bird often continues to leap and hop around its partner. If the recipient joins the dance, the two alternately leap and hop in a circle while facing each other (Fig. V.). Depending on the intensity of the dance, other elements such as bill-stab, run/flap-glide, wing spread-hold, and gape (bill held open for several seconds) or gape-sweep (bill rotated laterally away from recipient, then returned toward) may be incorporated.



Figure V: Sandhill Crane Pair Dancing

Unison Walk (UW): The two birds walk synchronously in close proximity. The male often leads just a few paces ahead of the female. This occurs most often when an intruder is present or during some other disturbance.

Concordant Behaviors

Approach (A): One bird locomotes toward the other.

Appeasement (AP): The bird has a horizontal posture with its wings loosely folded, its crown reduced, and its neck retracted, and it walks in a non-stiff manner.

Contact Call (CC): This call is a quiet, low gargle in all species but the Siberian (*G. leucogeranus*) crane, in which it is a continuous, horn-like note. It is given at several second intervals, and is primarily used to communicate during maintenance activities.

Guard Call (GC): This call is a loud guttural squawk usually uttered in response to intruders. In pairs, the male and female typically alternate, with the female's note slightly higher pitched.



Figure VI: Blue Crane Guard Calling

Pre-flight (PF): The body is sleeked, with the head and neck extended horizontally or arced. Often, the bird will hold its carpi slightly out from the body.



Figure VII: White-naped Crane Chicks in Pre-flight Posture

Pre-flight Call (PFC): Often uttered while in pre-flight posture, this call is a brief, hoarse gargle similar to, but louder than, the contact call. It is typically performed in a long series, at intervals of about one second. The crowned cranes do not perform this call.

Run/Flap and Flight (R/F): The bird flaps its wings while running, and sometimes takes off in flight.

General Behaviors

Rest (R): The bird maintains a relaxed posture, with its body held horizontally and its neck slightly curved or resting on its back. *Rest* includes standing-rest, sitting, or sleeping.

Forage (F): The bird walks with its head down while searching for food items. Foraging style varies from species to species due to different diet compositions and food-handling methods.

Once a food item is located, the bird may pick, probe, dig, or stab at it.



Figure VIII: Siberian Crane Foraging

Eat (E): The bird eats out of its food bucket.

Drink (Dr): The bird drinks out of its water bucket or pond.

Locomote (L): The bird purposefully moves from one place to another by walking or running.

Bathe (Ba): The bird crouches in the water or, as is often the case for socializations, next to its water bucket, and flaps and ruffles its wings while bobbing its body. This is often followed by or incorporated into preening.

Preen (PR): The bird performs a range of activities in the care and maintenance of its plumage. It nibbles, strokes, oils, combs-out, and paints its feathers. Neck scratching is also included in this category.

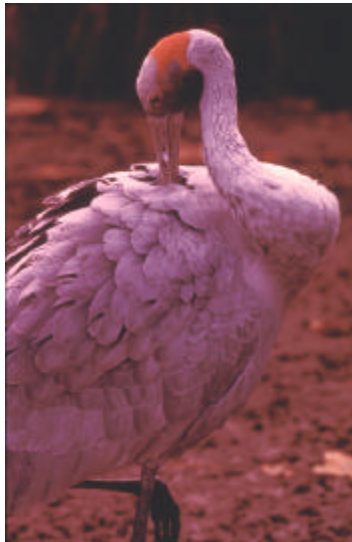


Figure IX: Brolga Crane Preening

Discordant Behaviors

Submission (Su): The bird exhibits one of the two following submissive postures: Cower: the body is held nearly horizontally, with the neck retracted and the head and neck feathers fluffed; Wing-flare Cower: the head and neck are held as in cower, and the wings are spread and drooped.



Figure X: Sandhill Crane Cowering

Pace (Pa): The bird ritualistically locomotes back and forth along a given pathway.

Alert (AL): The bird halts any activities, faces the direction of the stimulus, and it stretches its neck straight and often raises its chest. The axis of the body is usually at a greater than 60° angle with the ground. The bird may begin to locomote or guard call while holding this alert posture.



Figure XI: Sandhill Cranes in Alert Posture

Wing Flap (WF): The bird spreads its wings and may hold them out for a short time before flapping them. Crowned and wattled cranes perform a variation of this display, in which the wings are spread wide and high and then held for 1-5s before being folded. Occasionally, a bird may flap its wings during a preening or bathing bout to align the feathers, in which case it is not an agonistic display.

Bill Down Hold, Growl, or Sweep (BD): Usually triggered by the presence of an intruder, the bird lowers its head and holds it near the ground (Crowned Cranes). All other species likely utter a growl vocalization while performing this display, and the Siberian Crane may additionally turn slowly.

Ruffle Threat (RT): Each crane species performs either a head-lower ruffle or ruffle-bow up or down threat. These threats all involve a rapid shaking back and forth of the head or body while the feathers are elevated.



Figure XII: Grey Crowned Crane on Right Performing Ruffle Display

Head Rub (HR): In this moderately intense displacement behavior, the crane rapidly rubs the crown and side of its head on its back or wing.

Preen Display (PD): The crane ritualistically “preens” a localized spot on its dorsal or ventral surface. This display may be distinguished from maintenance preening by its abbreviated and interrupted nature. The dorsal preen often involves a drop wing component for all but the crowned and long-trained species, and this component is most exaggerated in Siberian Cranes.



Figure XIII: Eurasian Crane Dorsal Preen with Drop-Wing Component

Strut Walk (SW): The bird walks slowly and stiffly while presenting its lateral aspect to the intruder, often with its crown expanded and tertials elevated, and sometimes with its thigh and tibio-tarsi feathers raised.



Figure XIV: Black Neck Crane Strut Walking

Arch (Ar): Performed by Red-Crowned Cranes only, this display involves the lifting of the wings while the neck is arched over the back with the head pointing upward.



Figure XV: Red Crowned Crane Arching

Butterfly (Bu): This display, likely related to the arch of the Red-Crowned Crane, is performed by Whooping, Black Neck, Hooded, and Eurasian Cranes. The crane lifts its wings high and back, often straining its neck forward and holding the posture.



Figure XVI: Whooping Crane Performing Butterfly

Chase or Charge (Ch): One crane aggressively charges toward the other, often with its neck extended down or out.



Figure XVII: Siberian Crane Charge Threat

Additional Behaviors to Note When Observed

Several interesting crane behaviors are not included on the socialization data sheets either because of their relative unimportance in the socialization process, or because they are not expected to be seen at a high frequency. Whenever an observer views an unusual behavior or interaction, he or she may note the behavior and the context in the Active Notes. A few behaviors, while not included on the data sheet, are critically important to note. The following are high intensity aggressive behaviors that indicate a setback in the socialization and often an immediate need to separate the birds:

Jump-Rake (Jr): The crane jumps into the air and slashes at another bird with its talons.

Crouch (C): The crane abruptly drops to the ground, often with its beak pointed downward and its wings spread to some degree, depending upon species and display intensity.



Figure XVIII: Red-Crowned Crane Crouch Threat

V. Suggested Future Improvements in Sampling Protocol & Socialization References

Several worthy modifications and additions to the sampling protocol and reference materials may warrant an ICF intern or aviculturist's attention. First, it is important that the socialization data are gathered and entered in a way that facilitates analysis and long-term storage. This element of the protocol has not received enough attention, and it would be extremely helpful if someone adept at data analysis and computer programs could help to modify the current Microsoft Excel format. Because the socialization process encompasses so many elements of crane behavior and husbandry, there are several additional reference materials that could prove useful, in both training new socialization chaperons and expanding knowledge of the process. These materials include: 1) video clips of introductions and interactions, 2) an audio catalogue of unison, guard, and contact calls of the 15 crane species, and 3) PowerPoint presentations and web page that incorporate the above elements.

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