

CAPTIVE BREEDING BEHAVIOR

AMERICAN GOSHAWK – PART 2

by Robert B. Berry
Yellow Springs Road
Chester Springs, Pennsylvania 19425

Part 1 of my experiments with Goshawks appeared in *Raptor Research News*, 2(3):58-97, July 1968. The contents of Part 1 are summarized as follows: Jill, an American hen Goshawk was taken from the nest as a "downy." She was flown in falconry in her first year. As a yearling she exhibited extreme territorialism and was probably sexually mature. Her third year was interrupted by the stress of room construction activities. Jill became very territorial in her fourth spring. She started building a nest immediately after being placed in a suitable breeding chamber. All attempts to introduce her to a wild trapped male Goshawk were futile and it appeared she accepted me as a mate. Jill laid four infertile eggs and successfully fledged a Red-shouldered Hawk.

Late in November of 1966, I met with Frank Beebe of Saanichton, British Columbia, and arranged to borrow his adult male Goshawk, Fritz, a European eyas in his twelfth year. He had been flown in falconry off and on for those many years and proved an exceptional game hawk. He was, however, of independent character, given to extensive hunting on his own which made practical falconry very difficult.

Mine was not the first attempt to breed Fritz. Two years earlier he had been introduced to a first year haggard Swedish hen. They were tethered on lawn perches and fed from a common block placed mid-way between them. It appeared that a pair bond was established in this manner. When they were placed in a breeding chamber, one or both birds constructed a rudimentary nest. The project was unfortunately interrupted by the premature death of the hen.

Fritz arrived on December 12, 1966. He was a beautiful grey brown European Goshawk with a well defined eye stripe and broad dark horizontal barring on the breast. He weighed 28 ounces and was a compact bundle of wild muscle and energy. Jill weighed approximately 36 ounces.

On December 14, I placed Fritz in the inside chamber which joined the outside pen (see Figure 1). All windows were darkened except one. Perches were arranged on each side of the open window so that the hawks, separated by one inch mesh plastic wire, could virtually touch one another. Fritz sat at the window, but Jill seemed

unaware of the stranger.

The first few days passed without incident, so I brought Jill inside to eat with Fritz. She immediately left her food and attacked, chasing him about the room. After the fourth such onslaught, he held his ground, standing straight and tall and appearing very large indeed. Jill back peddled in mid-air and the chasing ceased. Fritz acted as I had hoped, and I was much encouraged. The door was opened allowing free passage for both hawks to the inside and outside chamber.

The first week passed with relative calm. Except when feeding, Fritz spent all of his time inside the semi-darkened chamber. Jill remained outside, so there was little opportunity for social interaction.

Both birds were fed a diet of chicken heads, fresh pigeon and an occasional pheasant. All feeding was carried out under cover of darkness. If the evening was warm and the meat would not freeze, it was allowed to remain to be consumed at dawn. On cold nights, the pen was illuminated at varying intervals from one to three hours after depositing the food. The purpose of the night feeding was two fold: 1) Fritz was extremely shy and upset when approached during day light hours and 2) I hoped that Jill would not associate my presence with feeding time. I hoped that varying the time interval prior to illumination would further disguise any link between myself and feeding.

Late in December Jill's placid behavior changed radically. She called wildly, worked on her nest, and was extremely aggressive towards Fritz. Thinking that her nest might be a stimulus to aggression, I removed the entire platform. Her hostility continued. Fritz was totally unable to cope with her and behaved in exactly the same manner as the prior male (see *Raptor Research News*, 3:69, 1968). Compatibility on such short notice was obviously wishful thinking.

On January 1, I chased both birds into the darkened inside chamber and closed the door. For the next few days I worked feverishly to install a wire partition dividing the outside chamber into equal parts. Jill would have access to the inside shelter and adjoining outside area. Fritz was confined to the extreme outer portion and was provided an enclosed ceiling and wind break in one corner (see Figure 1). He could no longer escape to the inside chamber, and I hoped that in the next few months he would become acclimated to the new environment and would establish a territory of his own. Jill was forced to observe Fritz occupying her favorite perches and would perhaps become accustomed to his presence. A common nest site, a wire basket with elevated sides, was erected so that it extended into both chambers.

Initially, Fritz sulked on the lowest corner perch, the same perch

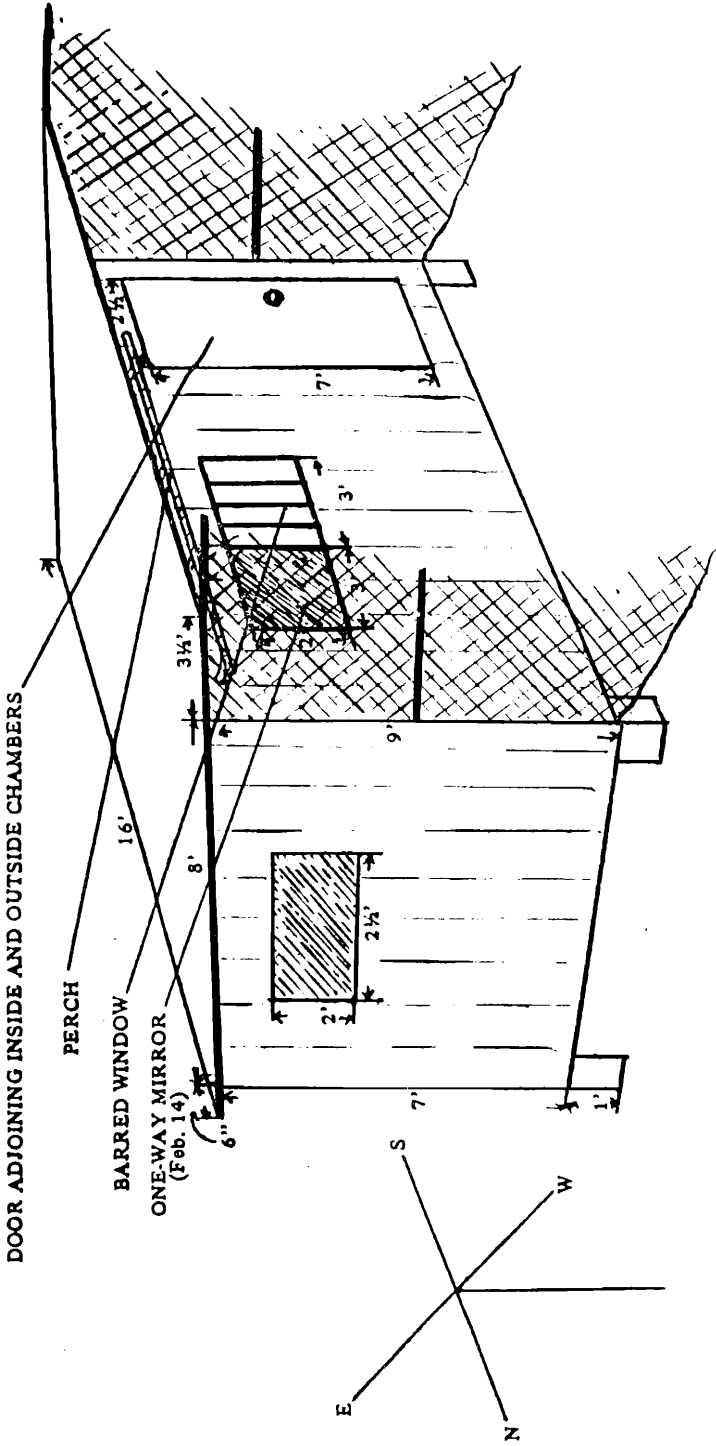


Figure 1a. Breeding Chambers (Inside Chamber).

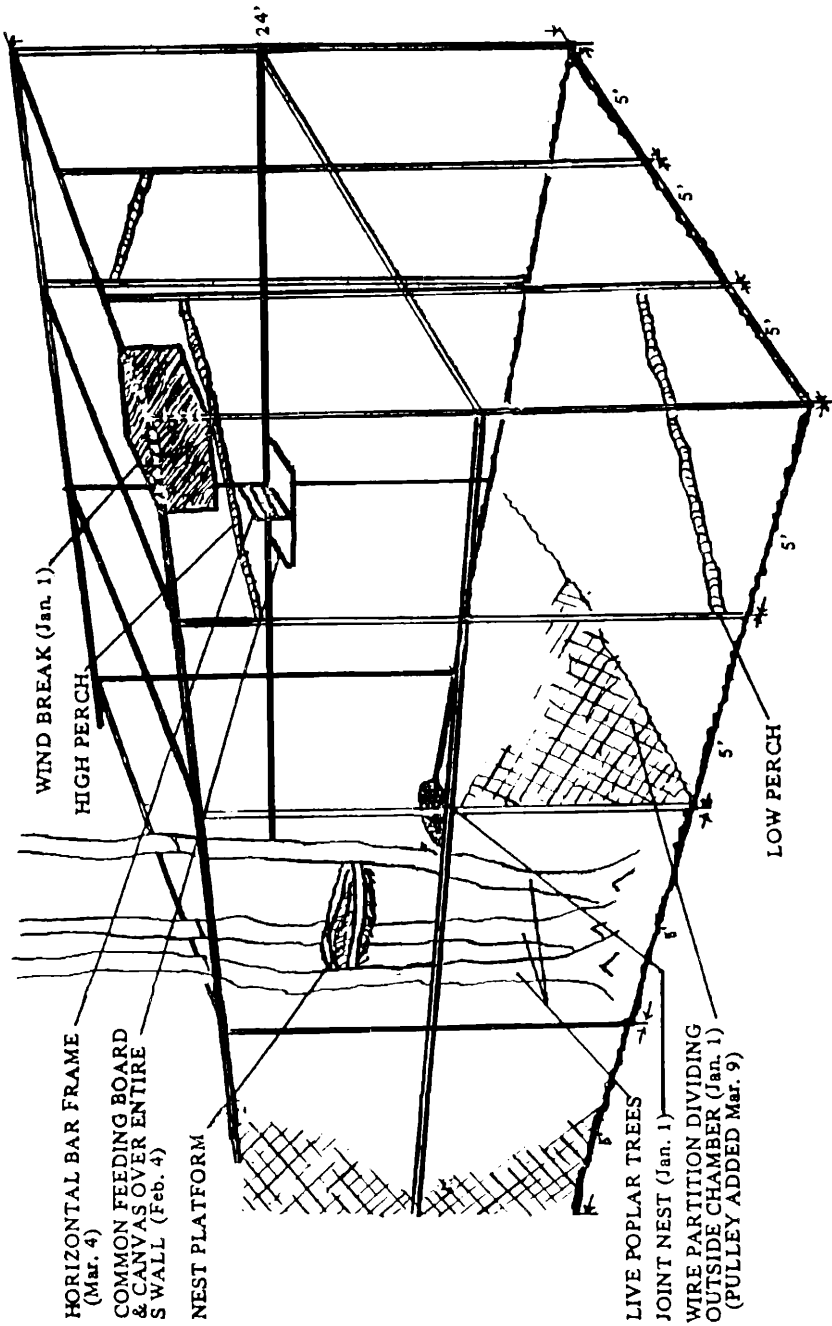


Figure 1b. Breeding Chambers (Outside Chamber).

avored by the prior male. Within the next ten days, however, he began to utilize the medium and high perches and by the middle of the month he actually tried to attack Jill. By the end of January, he appeared a self-assured and dominant Goshawk. Jill, on the other hand, appeared nervous and flew incessantly at the wire divider. Her behavior was not aggressive and she was strangely silent. When she fluttered against the divider, he attacked and tried to grab her through the wire. He even developed his own hoarse "kac kac kac." Jill was obviously frightened and I was beginning to have doubts about re-introduction. I felt I knew Jill's propensities for homicide, but Fritz was an unknown entity.

According to the Weather Bureau, the final week of January was the warmest ever recorded, with the temperature zooming into the seventies for practically a full week. Jill reacted vocally and began to carry an occasional stick to the joint nest. Once I saw Fritz take a piece of bark in his beak to the lower perch, but he displayed no interest in the common nest bowl.

On the evening of February 3, I replaced Jill's tree nest, lowered the barrier and turned on the lights. They had been separated by the thin wire divider for thirty-two days. Fritz seemed ready to cope with Jill's aggression. He flew almost immediately to the tree nest and chirped in an unfamiliar manner. She flew to a high perch and was otherwise unconcerned. He chased her briefly, flew to a perch of medium height, and both settled for the night.

At dawn the next morning, Fritz flew directly to the tree nest and made a series of sharp chirps accompanied by a bowing of the head with raised tail and flashing undertail coverts. His behavior seemed either sexually or territorially motivated and, excepting the chirping, similar to the female's gestures. Jill's approach was cautious, almost as if she expected trouble. Fritz reacted violently and attacked her. She retreated to a high perch and he flew directly to his accustomed low perch in the far corner of the pen. It appeared that he had lost his courage.

There was little activity until about 1:00 P.M., when Fritz flew to the nest, chirped, flew at Jill, and then withdrew to his corner and sulked. Now Jill began to scream and to carry sticks. By late afternoon, she was as hostile and aggressive as ever and Fritz just as frightened. The following morning was worse and I raised the barrier once more.

In just a few short hours, Jill had completely regained her superiority and once again exhibited extreme aggression in defense of territory. Fritz's brief interval of dominance had come to an end, and he appeared positively terrified of his antagonist.

Fritz continued to be extremely shy and flew frantically about his quarters at the slightest glimpse of human activity. Jill's aggression appeared to be stimulated by this fear. I suspect that poor Fritz felt

both human and hen Goshawk were involved in one big plot against him, no joke intended! This behavior did suggest possible benefit if human interference could be reduced.

For the second time, both hawks were herded into the darkened inside shelter for major alterations on the breeding chambers. I completely covered and blocked off the south side of the chambers with a large heavy canvas. All visual contact with people was now effectively eliminated. I also installed a common feeding board directly behind the canvas. A small trap door in the center of the canvas facilitated placement of food, which was secured to the feeding board by dog leash clips. Neither bird could carry food from the platform and close interaction was mandatory at least while feeding. Finally, for watching I placed a large one way plastic mirror (from Edmund Scientific Company of Barrington, N. J.) over one window of the enclosed chamber. Now I could approach the chambers at any time of day and make observations from only a few feet away without being detected.

During the following weeks, Fritz would not leave the lowest perch. Even though protected by the wire divider he panicked at Jill's hostile screaming or at her slightest aggressive movement. His only refuge appeared to be the ground or the low perch-stations which would appear to me to place the dominated partner in the most vulnerable position.

On February 11 I removed the nesting platform--the nucleus of Jill's territory--hoping to decrease her aggression, but hostility continued. Before taking down the platform, I had first to remove Jill from her perch almost directly above the nest. In spite of no contact whatsoever with me for the past six weeks, Jill was completely tame. Any ostriger who has placed a Goshawk in solitary moult can attest, this is most extraordinary behavior for the species.

Towards the end of February, Fritz began to relax and to utilize the high perches in his chamber. Soon he was screaming sporadically and making mock attacks at Jill. Jill appeared frustrated and nervous with little purpose to her existence as she seemed psychologically unable to build effectively in the joint nest. She was neither vocal nor hostile towards Fritz.

On March 4, Fritz was seen carrying a stick to the feeding block--not to the joint nest bowl. Soon a second stick was found on the platform. Immediately, and again under the illusory cover of darkness [Jill appeared capable of recognizing me as opposed to strangers on the darkest of nights], I installed a rectangular frame about one by two feet long with thin stainless horizontal bars spaced three inches apart, which replaced the wire section in the middle of the feeding platform. The widely spaced bars would allow Jill to seize any sticks deposited on the platform. I even lodged a few sticks in the bars, but Jill never used them even though any sticks hanging

in the wire had been eagerly accepted the year before.

It is significant to note that during the next few weeks, Fritz made no further attempt to carry sticks. I do not feel that the horizontal bar framework in lieu of the wire division discouraged Fritz, nor did my activity associated with its erection. Stick transfer may well have been the catalyst necessary to stimulate establishment of the normal pair bond relationship.

Mid-March was approaching and I was becoming increasingly frantic. A year ago at this time, Jill has a mammoth nest, and was apparently paired with me. This year her sexual development was retarded to the point of almost total sexual quiescence. Fritz now appeared confident while behind the wire divider. He had displayed aggression towards the hen, called occasionally the "kac kac kac" of the territorial Goshawk, and had carried at least two sticks to the common feeding platform. Their behavior was far from encouraging.

Admittedly groping for alternatives, I decided to install a pulley arrangement to raise and lower the wire divider. The antagonists could now be together for controlled periods—namely in the late afternoon preceding feeding time. I could separate them in the early mornings when Jill had always been most aggressive.

This scheme worked well for the first few days. Once the barrier was lowered, Fritz generally assumed a position on a middle or low perch with Jill perching in apparent contentment well above him. There was occasional sparring, but the situation was far from intolerable. Shortly after dark, food was deposited on each side of the lowered barrier. Without exception, the hawks flew to their accustomed feeding stations and the barrier was raised until the following afternoon. The program was abruptly discontinued when Jill learned to push her way through the unfastened edges of the wire divider. The brief use of her favorite high perches had kindled her desire to regain them permanently. The pulley arrangement was a failure without major alterations. The barrier would either have to be fixed or discarded.

Early in the evening on March 12, I hustled both hawks from the outside pen into the illuminated inside chamber and turned off the lights. The stage was set for the last of many physical modifications to the breeding pen. I removed the wire divider completely and hung freshly cut eight to ten foot tall white spruce trees throughout the chamber. The spruces were arranged to provide protection for Fritz, the male and naturally the smaller. I thought they might create avenues of escape and hiding places.

At the outset, hostility was moderate. In the days to follow, however, Jill's now familiar pattern of ever-increasing aggression began. Slowly at first she approached Fritz, with characteristic hunched shoulders and flaring undertail coverts. Her attacks were encouraged and sustained by his increasing escape behavior.

In an effort to re-direct Jill's aggression, I placed two live guinea hens in the breeding chambers. I had recently observed Jill's hostility toward the dozen or so guinea fowl which parade about the property. The next evening, one was dead and partially eaten. Although Jill had been aggressive towards the guineas, I suspect that Fritz, the seasoned hunter, was responsible. Another hen was added and within a few days, they were roosting side by side with the Goshawks, apparently completely ignored.

Jill became so aggressive the last days of March and early April that on April 9, 1967, I felt that it would be best to remove Fritz permanently from the breeding chamber. My primary concern was that he would injure himself in his frantic efforts to escape.

Stangely enough the spruce trees were of little value for hiding or in facilitating successful escape tactics. I had heard that the Germans installed boxes in their aviaries with holes large enough to accommodate the male goshawk and not the female: the male would flee into a box and find complete sanctuary, only emerging when the hen was in better humor. I have never been able to confirm the authenticity of these reports and seriously question their validity. Not once was Fritz observed within the thick foliage of a spruce tree. Fritz did to an increasing degree utilize those perches that were partially obscured by the spruce trees. Ironically, however, he preferred a station which was unprotected, apparently to provide a number of alternative escape routes.

Final separation of the Goshawks, and dissolution of any further attempts toward natural breeding, was my emotional reaction to a particularly dreadful series of attacks. I rushed into the pen in broad daylight with full intent to chase Fritz once and for all into the inside chamber. As I climbed to the medium perches at the far end of the pen, Jill was screaming and displaying with, I thought, sexual intent. I could not have been further mistaken. I was met head on by a maniacal Goshawk and eight needle sharp talons that felt more like ice-picks. I managed to save my face only by sacrificing my arm to her attack. Jill would not relax her initial grasp and hung tenaciously while I extracted her talons one by one. At last I retreated in pain with one eye on Jill and my arms covering my head. Fritz had long since beat it to the inside chamber.

The next few days were spent converting the breeding chamber to its status quo, *e.g.*, removing the canvas tarp, the wire divider, the joint nest, the common feeding platform, the spruce trees and finally re-installing the natural tree nesting site. During this period, the Goshawks were in the darkened chamber.

On April 11, Jill was permitted access to her once familiar open chamber and nesting platform. She was noticeably more at ease. She no longer flew nervously from perch to perch and into the vertical sides of the pen. Within a few days, she was productively

constructing her nest—a process she had been unable to handle all spring. I suspect her contentment can be largely attributed to resumption of familiar surroundings and Fritz's absence.

On April 15, I had time for watching so I opened the door separating the Goshawks' respective chambers. Jill inspected the inside chamber only once, but even though Fritz remained in the semi-darkened chamber, her attitude changed. She stopped constructive nest building and literally destroyed the entire nest she had worked so diligently to create the past week. She kept carrying new sticks to the platform, but in the process of re-arranging sticks, large quantities of nesting material were dropped. Soon I closed the door between the chambers and within hours Jill resumed normal nest construction. Jill appeared incapable of carrying out productive nesting activity while subject to the stress of territorial defense.

Toward the end of April, it became increasingly obvious that Jill's display was no longer oriented towards aggression—at least as far as I was concerned. Whenever I approached, the aggressive vertical defense posture (see Figure 4 in Part 1) changed to a horizontal posture, with head down and wings slightly extended. Her defensive "kac kac kac" modulated to a soft cluck, similar to that of a mother hen with chicks. She tore at bits of spruce bark and allowed them to float to the ground below. Her undertail coverts were fanned in brilliant pre-copulatory display. When I laid my hand gently on her back, she cocked her tail to one side and separated her panel feathers. Her oviduct protruded from the cloaca, extending and retracting rhythmically. Throughout the ritual, she called softly. When I retired from the pen, she appeared revitalized, and began working on her nest with renewed vigor. I am quite certain that as far as Jill was concerned, her sexual needs for nesting had been completely fulfilled.

On May 9, with Ryan Walden's assistance, I made a vain attempt to secure semen from Fritz. Ryan had had some experience with chickens, as had I, but neither of us could be classified as experts—a must in my opinion. We had little difficulty in getting Fritz to prolapse and a rather poorly developed penis (in comparison to sexually mature chickens) was easy to locate. Stroking of the back, after perhaps five minutes, produced involuntary convulsions of the body with both wings and leg muscles contracting sharply. He seemed mesmerized and required little restraint other than to facilitate the stroking. When no semen was ejaculated, we allowed him to rest awhile and then tried again. Our second and last attempt was also in vain and this time failed to produce the convulsions too.

A. J. Marshall's *Biology and Comparative Physiology of Birds*, Volume II, indicates that the process of maturation of the male gonads in birds is a complex and lengthy process brought about by a combination of external stimuli, including photoperiod, weather,

territory, and absence of stress. While Fritz was certainly a mature hawk at 12 years of age, under the circumstances, I feel safe in stating that he was not fully developed sexually.

On May 11, Jill laid her first egg. As in the previous year, it was dropped from a high perch, probably during the night. On May 13, the second egg was laid—this time in the nest. Incubation began immediately. Three days later, the third and final egg came and incubation continued with the two egg clutch. Again Jill experienced a dramatic weight reduction during laying and drank vast quantities of water. She was not inclined to eat by herself and had to be hand fed. However, during this entire period and for about a week following her final egg, Jill appeared eager to copulate. Her behavior suggests that feeding of the female by the male may be encouraged by an ability to copulate well beyond the time period necessary to achieve maximum fertility. Once laying was complete, Jill seemed quite capable and willing to feed herself.

My efforts to introduce an adult male Goshawk to Jill's chambers had been in vain for the past two seasons. Jill appeared irreversibly mated to me and was hostile towards every other living creature—with one exception: Jill had lived in complete harmony with the young Red-shouldered Hawk she had raised the year before. I began searching for a Goshawk nest. I theorized that familiarity and uninterrupted association with her own adopted offspring might inhibit Jill's aggression. It also seemed likely that a male raised in this manner would have absolutely no fear of his parent. Once the male reached maturity, a natural conclusion to a close association might be the establishment of a pair bond relationship.

On June 4, Jill was introduced to a tiny male Goshawk chick, which was a week old at the very most. Incubation had been uninterrupted for the past several weeks and she accepted the youngster without hesitation. I am exceedingly grateful to Ryan Walden and Roy Froch for contributing the young Goshawk.

Jill treated the fledgling as she had the Red-shouldered Hawk. On July 4, 1967, the day I left for the Yukon Territories, Jill was a completely devoted parent. The youngster was flying about the pen and would be hard summed in two weeks. For his age, he appeared far more advanced than the Red-shouldered Hawk and pursued Jill aggressively for food. He was somewhat nervous, but tame enough to allow me to enter the breeding chamber and to photograph him.

Jill's aggression toward intruders continued at a high peak, contributing to a tragic accident. I had made arrangements with Frank Beebe to return Fritz personally to Vancouver, B.C., on my way to the Yukon Territories. The afternoon before I was scheduled to depart, I took Fritz from his mews and placed him temporarily in the semi-darkened chamber next to Jill's perch. Fritz was hooded in preparation for the trip. When I returned a few moments later, I was

horrified to find Fritz lying on the floor mortally wounded. Jill had entered the chamber through a small hole for photography that I had neglected to cover the day before.

Conclusions--Part 1 and Part 2

The theme of my breeding project with Goshawks centers around Jill and efforts to encourage a normal pair bond relationship with a male of her species. I have attempted to utilize certain behavioral patterns identified and analyzed by Konrad Lorenz in his book *On Aggression*, (1966, N.Y.: Harcourt, Brace). To paraphrase Dr. Lorenz, the steps to establishment of the pair bond relationship in aggressive animals are as follows:

- 1) Establishment of territory by either male or female.
- 2) Trespassers (intraspecific) are aggressively pursued in defense of territory.
- 3) A *coyness* behavior is exhibited by the pursued individual--coyness being a mixture of the sex drive and the stimulus to flee--inhibiting aggression.
- 4) The pursued may leave the territory but will return and through habituation, aggression will subside.
- 5) Acquaintanceship will further reduce aggression and allow the sexual motivation to take over--hence the pair bond formation.

Jill has certainly performed steps 1 and 2--that of establishing and defending territory. Why does Jill remain so aggressive even after lengthy acquaintanceship? Why are the males so terrified of the female of their species? Does the problem lie with Jill, her potential mate, or both?

It has often been suggested that I set up a male Goshawk in a separate breeding chamber, allow him to establish a territory and then introduce Jill. This suggestion is based on the idea that in many species of birds, the male of the species is the dominant partner, assuming the role of territory defender, family provider, and protector. To assume an analogous behavior on the part of a Goshawk or for any raptor appears to be unsound. If we can accept a high level of mortality in raptors and a high rate of re-nesting in the same locale, it follows that both sexes must be capable of defending territory and playing the dominant role in pair bond formation.

During his field studies on wild Goshawks, Dr. Heniz Meng (personal communication) received the distinct impression that the female is the dominant partner in the nest locale. She builds the nest, broods the eggs, feeds the young and defends the territory with little assistance from the male. He appears, in fact, frightened of her at the

nest site. Food transfer is accomplished at a considerable distance from the nest. Dr. Meng has not observed Goshawk copulation and can only assume that it occurs at a similar distant point.

Breeding projects with Goshawks in Europe have met with failure like mine. The female Goshawks were highly aggressive, laid infertile eggs in captivity, and raised adopted young while remaining completely hostile toward their terrified potential mates (J. Mavrogordato, personal communication). While far from conclusive, the evidence does indicate a regressive role as normal for the male Goshawk.

Assessments of individual Goshawk behavior are both difficult and speculative. The wild trapped yearling male in Part 1 showed primarily fear. It is significant to note that his fears were far more acute towards Jill than toward human beings. His only sanctuary was the lowest perch or the ground, a position seemingly offering the most vulnerability. The wailing and prostration of the male appeared to be a ritual designed to reduce intraspecific aggression.

Fritz was an intermewed cyas with a long and varied career in captivity and might have been expected to exhibit a more normal Goshawk behavior. He was, however, excitable and nervous, which is characteristic of the species. He relaxed only when all human interference was effectively eliminated.

Fritz's behavior suggested that he did develop sexually even though I was unable to secure semen artificially: while separated by the wire divider, Fritz gradually lost his fears and became aggressive towards Jill. He even developed the "kac kac kac" of the territorial Goshawk. His mock attacks became so vicious in early February that he appeared dominant and in possession of territory. The bowing and chirping immediately after re-introduction were certainly sexually motivated. It seems incredible that the gradual build up of self-confidence over a period of up to six weeks could be dashed to sheer terror in only a few moments. He appeared acutely aware that the wire divider had been removed. Were his fears a product of memory rather than current hostility? Jill always reacted rather slowly and became overly aggressive only when encouraged by escape tactics of the frightened male. I feel certain that a more courageous male would sublimate her aggression as during her initial meeting with Fritz. Unfortunately, however, Fritz followed the pattern of his fearful predecessor in subsequent encounters.

In retrospect, it may have been presumptuous to expect Fritz to adapt completely to new surroundings in a few short months and to behave like a sexually mature adult Goshawk. It is also possible that the size of the breeding chamber was insufficient to accommodate normal breeding behavior for this species. Indeed it is conceivable that the responsibilities of raising a family are sharply divided between male and female with nearly all social interaction taking

place beyond the perimeter of an invisible boundary rigidly enforced by the female. Lastly, it is entirely possible that the original premise upon which Part 2 of these experiments are based is false: the European male Goshawk may not be close enough genetically to allow pair bond formation with an American hen Goshawk.

An analysis of Jill's aggressive behavior towards the male of her species is as inconclusive and paradoxical as my attempts to evaluate the behavior of her potential mates. As the prime subject of this paper, Jill has proved a mystifying subject. It must first be recalled that Jill was taken from the nest as a "downy" and raised entirely by hand in close association with people. One would therefore assume that Jill is imprinted - the concept of imprinting defined by *Random House Dictionary* as "learning occurring rapidly and very early in life, characterized chiefly by resistance to extinction or forgetfulness." Simply stated, she thinks she is either a human being or that all people are Goshawks. However, experiments with young Mallard ducks (E. H. Hess, 1957. Effects of meprobamate on imprinting in waterfowl. *Ann. N. Y. Acad. Sci.* 67:725-732) indicate that imprinting is at its strongest at between 13 and 16 hours of life, during which time Jill was with her parents. The resulting paradox can be explained as Jill is altricial and not nearly as advanced at a given age as the precocial subjects. It is not unreasonable to suspect that imprinting of raptors at a more advanced stage which would roughly coincide with the development of the precocial youngster.

A number of observations on the other hand, appear to question the validity of Jill being imprinted on human beings. If Jill did not recognize the male Goshawk as one of her species either by memory or instinct, it is questionable that the appeasement ceremony as portrayed by the male would inhibit her aggression and save his life. Furthermore, when guinea hens were introduced as an aggression diverting strategem, Jill was most aggressive towards them and may have killed one. Mere acquaintanceship, however, so inhibited her aggression that within a week the guinea hens were totally ignored even while roosting on Jill's favorite perches. If Jill can learn to accept the interspecific guinea hen, why then is she so intolerant of the male Goshawk? It would appear she is acutely aware that she and the male Goshawks are of the same species.

Lorenz says that imprinting is extraordinarily rigid and long lasting, but subsequent research indicates it is not irreversible (Thompson, A. L., Ed., 1964, *A New Dictionary of Birds*. N.Y.: McGraw-Hill, 393 pp.). Lorenz's imprinted geese have never mated successfully but through habituation have developed their own triumph ceremony and pair bond. Carl Welty in *The Life of Birds* (1962, Philadelphia: W. B. Saunders, 546 pp.) recounts on an imprinted male Tiger Heron to have successfully mated in the Amsterdam Zoo. The heron remained faithful to his species only so

long as his keeper kept his distance. Henry Kendall's female Prairie Falcon "Taka" which successfully raised young in 1968 appears to be at least partially imprinted to humans. She performs the same pre-copulatory gestures for Henry as for the tiercel of her kind. Either her imprinting or the wrong conditioning may be responsible for her hostility toward her natural mate in the spring of 1969.

The process of imprinting is not yet fully understood and its relationship with other forms of learning, e.g., habituation and conditioning, are difficult for the layman to separate. I am undoubtedly generalizing and using the term imprinting too loosely.

I think it is safe to assume that Jill is to some degree imprinted on human beings. Her pair bond relationship with me has been further reinforced by two successful nesting seasons. She may, however, just be *conditioned* to respond to human beings, and the problem now lies in evolving a technique that will enable her to take the next step in establishing the normal pair bond—that of living in harmony with her prospective mate. Experience with the young Red-shouldered Hawk in Part 1 indicates that she may not become aggressive towards her young male Goshawk—the subject of Part 3 in this paper.