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Captive Propagation of Scarlet Macaws

AVICULTURAL RESEARCH

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The scarlet macaw (*Ara macao*) is among the largest and most vividly marked members of the parrot family. With origins from Mexico to Brazil the scarlet macaw has been rapidly decreasing in number through non-restrictive exportation and non-selective destruction of habitat. Currently, the scarlet macaw retains "protected" status in several South American countries. In essence, the survival of this once numerous colorful species in the years forthcoming will be dependent upon captive propagation programs by dedicated aviculturists.

In conjunction with intensive breeding programs, hybridization of those potentially endangered parrots must be kept to a bare minimum or completely eliminated in order to maintain an accurate species genome in our captive populations. The data and procedures submitted in the following text are for the benefit of those who share an interest in propagating potentially endangered or threatened species of psittacine birds. Currently at our facilities at Avicultural Research, pairs of hyacinthine, green wing and blue and gold macaws are nesting under identical conditions described for the scarlet macaws.

Mating and Egg Laying Behavior

Two wild-caught adult scarlet macaws housed in a large common flight with other psittacine birds were noted to show strong pairing behavior and aggressive/defensive interaction with the other psittacines in the flight enclosure. We observed these birds to become aggres-

sively territorial and possessive of feeding bowls and perch areas in what had previously been an open and casual flight. These birds were never surgically sexed, however a sexual pair was suspected based on the observed behavior.

In the fall of 1980, the pair was placed in an electronically controlled environmental breeding chamber four feet wide, five feet deep and six feet high. A nest box was constructed of wood with dimensions of four feet wide, two feet deep, two feet high and was an integral part of the internal area of the breeding chamber. The nest box was lined with pine shavings which were periodically sprayed with water to augment the system humidifier in maintaining a relative nest box humidity content of approximately 60%.

On June 6, 1981, after three weeks of a 14 hour photoperiod, the female laid her first clutch of three eggs, of which two were fertile. Egg laying was suspected to be close at hand because of a change in stool coloration (to dark brown or black) and increased time spent within the nest box. A new egg was discovered approximately every 48 hours. Fertility was determined by removing the eggs, candling and returning the eggs to the nest box.

In the following 12 months of the study the pair produced a total of five clutches. The first four clutches were left with the parents for incubation and the fifth clutch was artificially incubated and hatched in our laboratory facilities.

Mating behavior and subsequent egg

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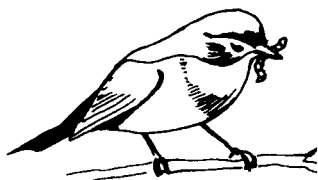
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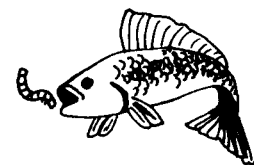
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laying for the five clutches was artificially induced by gradually shortening the photoperiod from a base line of 12 hours to a minimum of seven hours over a period of 10 days. This minimum photo period was then held for a duration of 14 days and followed by a one-half hour photoperiod increase per day until the photoperiod reached its maximum duration of 14 hours. Egg laying usually commenced within 20 days after this maximum point was reached.

Typically, the pair produced three fertile eggs per clutch. Eggs were laid every other day (48 hour intervals) and usually discovered by us during early morning hours. Our mean incubation period was 24 days, which from our review of the literature, is perhaps four days short of the norm (Bates and Busenbark 1969). However, our average weight of newly hatched chicks did correspond to the 24.0 grams typically cited in psittacine breeding references.

We experienced early hatching (as much as one week premature of the 28 day norm), both when the eggs were left with the parents, and when the eggs were artificially incubated. However, this phenomenon could be specific to this particular pair of macaws. Eggs left in the box were sprayed with warm water every other day during the incubation stage to augment humidity content. The parents would typically move off the eggs during this procedure and considered the water spraying of eggs and nesting media a ritual which they would tolerate with some reluctance.

Artificial Incubation Techniques

Artificially incubated eggs were weighed to .01 gram every other day on an OHAUS solid/liquid beam balance model 7401-02 and were rotated between a "wet" and "dry" incubator as dictated by weight in order to keep the developing embryo within our extrapolated weight loss curve. It has been determined that a weight loss of 16% during the incubation period is congruent with a successful hatch (Stoodley 1982). This value can vary as much as 4% above or below the theoretical value of 16% (Stoodley 1982). However, with the proper equipment and care we found we could hold our weight perimeter within $\pm 2\%$.

We utilized the Marsh Farms Roll-X automatic incubators with manual turn and have experienced a 100% hatch rate. Extreme care was maintained during the egg turning procedure by initially marking the eggs with pencil to designate an "A" side and a "B" side. In addition, rotational marks were noted so that the

egg was not continuously rotated in one direction thus causing embryo strangulation.

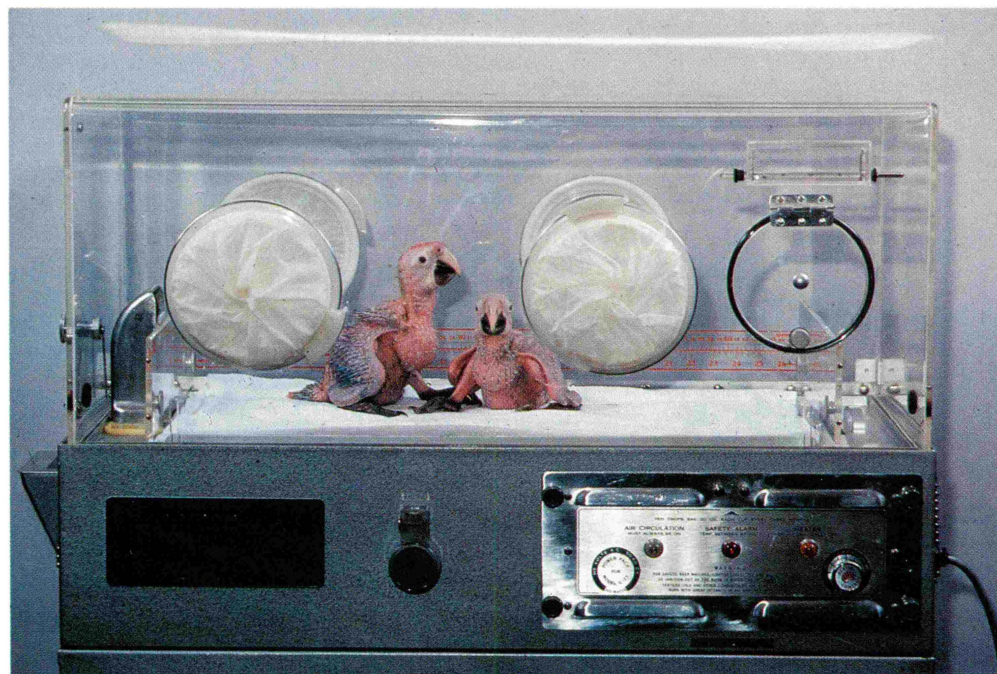
Eggs were turned every two hours for a total of seven times per day. The egg was turned an odd number of turns to insure that it "slept" on an opposite side during the night.

Eggs were candled every other day and pencil lines were placed tracing the outer limits of the air sac space. The average humidity requirement of our eggs was between 50 to 70% relative humidity. All incubator humidity measurements were obtained by using a wet bulb ther-

mometer and converting the relative humidity values with a conversion table available in most standard incubation reference books. Our incubation temperature was 98.5 °F with a flux variation of $\pm .75$ °F. Incubator humidity requirements are completely dependent upon varying weight measurements which are primarily dependent upon individual egg transpiration rates. It was noted that each egg must be tracked individually to insure a successful hatch rate. Our two incubators normally run at identical temperatures but at a 10 to 15% differential on relative humidity



Newly hatched scarlet macaw.



A sanitary incubator home with controlled temperature and humidity was provided for these handfed youngsters.

values. Therefore, we can rotate a specific egg from the "wet" incubator to the "dry" incubator or vice-versa in such a manner as to keep the specific egg within its mathematically projected weight loss curve.

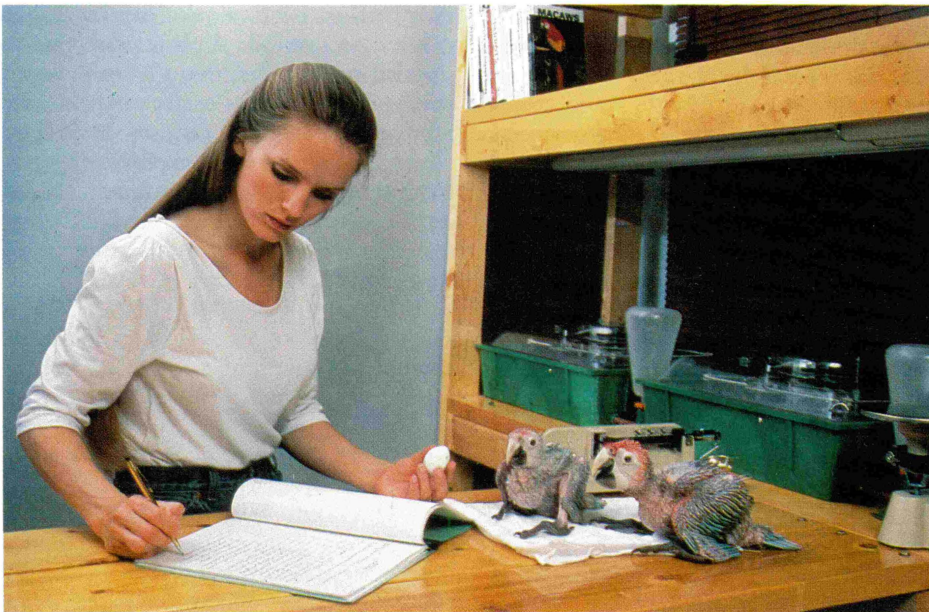
Approximately two days before the anticipated hatching date, or as soon as pipping was observed, the eggs were placed in a shallow plastic tray lined with paper towels within the incubator. Humidity content was lowered 20% relative value for a drier environment to assist the chick in penetrating the inner membrane in the process of entering the air

sac space. This process was monitored through a careful technique of candling. Turning the eggs at this point ceased and, after penetration of the air sac space had been confirmed, humidity content was increased to approximately 80% relative value to avoid dehydration of the chick during and after pipping. The chicks required several hours to completely hatch.

Physical and Psychological Adaptation of Hatchlings

Within the duration of the 12 month study, hatchling offspring were removed

Photos by Dr. Steven Volk



Lisa Volk logs information into the record book after weigh-in and feeding.



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from the nest box at various stages of development, the earliest being 14 days and the latest being 28 days. Having watched these birds mature and interact with humans, it was noted that the earlier removed chicks adapted much more readily to our handling and feeding, whereas chicks removed after eye opening (18 to 21 days) were suspicious and growled at us for several days after removal. This observation is due to the fact that psittacine birds are altricial (helpless upon hatching) and imprinting normally would be expected to take place within 24 hours of eye opening. Thus, the sample chicks left with the parents for any length of time beyond the eye opening stage, exhibited fear behavioral characteristics not observed in the sample chicks hatched in our laboratory facilities and hand raised. Upon juvenile maturation (three months of age) the chicks in the sample population removed before eye opening or

hatched in the lab were found to be far more independent, affectionate and open to interaction with unfamiliar humans than any of the chicks raised by the adult parents.

Physically, all birds, in terms of weight, coloration, perching and flying capabilities were essentially equal. In tracking weights of the chicks in our sample groups, the birds handfed from the egg in our laboratory facilities showed a slower onset of weight gain. However, the resultant weight after three months time was comparable and sometimes greater than chicks left with the parents.

Hatchling Diet and Feeding Techniques

With each brood, the feeding formulas have varied slightly due to experimentation. Although the various formulas at various stages are presented, a general recipe cannot be recommended. At each progressive stage of a chick's growth, the formulas vary and

Egg Weight Loss Projections

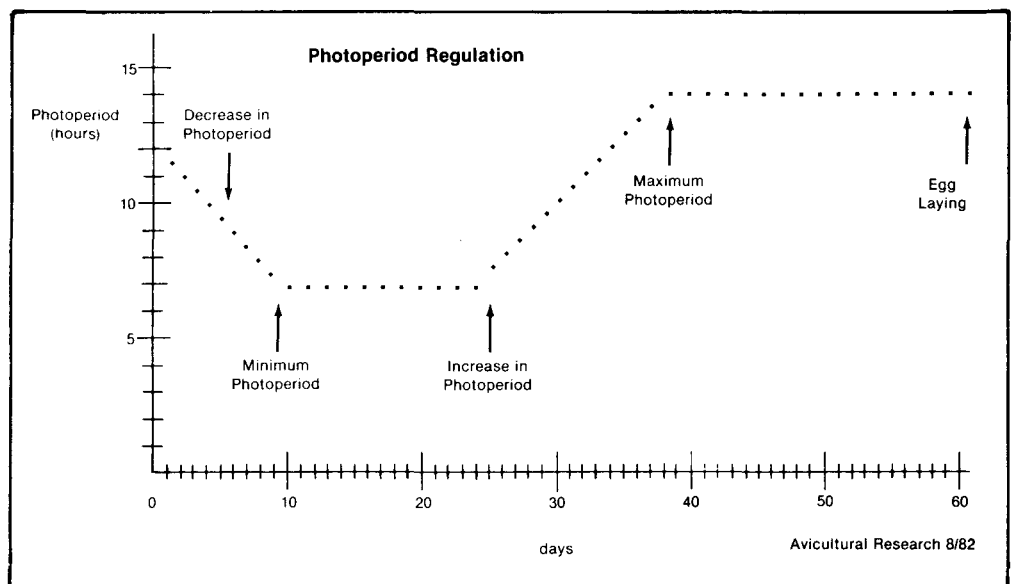
Avicultural Research 8/82

Based upon a mean egg weight loss of 16% over the 28 day incubation period:

	Egg weight loss per day	=	$\frac{\text{Initial Egg Wt.} \times .16}{28 \text{ days}}$
Example I:	Egg weight loss per day	=	$\frac{30.0 \text{ gm} \times .16}{28 \text{ days}}$
		=	.17 grams/day

Example II:	Egg weight loss at incubation day 14	=	$30.0 \text{g} \times .16 \times 14 \text{ days}$
		=	2.4 grams

Thus at the 14th day of incubation the egg should weight 2.4 grams - 30.0 grams or 27.6 grams.



thicken, depending upon the chick's needs. One way to determine these needs is to pay close attention to the chick's stool coloration and consistency. Although coloration should not be a primary quality determination since various foods can alter stool color (i.e. strained carrots or yams can cause the stools to appear reddish), the stools should normally be green (not too light), and well-formed. Also be aware that one day old to three week old chicks will produce stools of a less firm consistency than that of the older chick (two to three months).

Upon hatching, the chicks were ready for their first meal within the hour. Using an eyedropper, a formula of very watery baby cereal and strained meats and vegetables was fed. A vitamin supplement was added and yogurt supplied to introduce bacterial flora into the digestive system. Vitamins, minerals, and bacterial flora must be incorporated with moderation and extreme caution since most human baby cereals are already heavily fortified with vitamins and minerals. Each chick received only 1/8 tsp. of "8 in 1" (a powdered supplement by 8 in 1 Pet Products) per 24 hour period. The chicks were fed every time they cried for food, which was about every two hours around the clock.

With each week, the formula consistency was gradually thickened and strained fruits were added. By 21 days, the chick was fed with a rubber coated baby spoon. Feedings were now four times a day. Purina monkey chow (a high protein bisquit) was ground to a very fine powder and added to the formula at a ratio of 1 to 3. When adding new foods to the formula, it was found that the stools could become grainy. This could be an indication that the new foods need to be cooked or strained to aid the digestive tract in breaking up and absorbing the food particles.

Once the mandible became stronger and more developed (one and a half to two months old) the chicks were taught to drink from a very soft plastic cup. This was the most convenient feeding method and the most enjoyable stage of the chick's growth. Soft foods such as bananas and rice were introduced to the chick's diet by keeping them available in a small bowl. A great variety of soft foods were provided so that the chick would not become finicky about eating, and develop a taste for a variety of foods.

At two and a half to three months old, the chicks began to "go light" in preparation for flight. Therefore, the chicks ate considerably less than usual. Feedings were down to three times a day,

and constant fresh foods such as seeds, vegetables and fruit were kept in the chick's bowl. By four months, the mandible was well developed and the chicks were able to crack peanuts and sunflower seeds. At this point various nuts were added to the chicks' diet.

Each of the chicks have displayed a very individual personality which has been reflected even in its feeding pattern. Some of the chicks that enjoyed greater dependency and attention continued to rely on the handfeeding method for months. Others, that displayed very independent personalities discontinued handfeeding as soon as four months of age.

In essence, we cannot recommend a specific formula for the newborn chick since the chick's growth is rapid and the formula must vary to meet the needs of such growth. However, we believe that the key to raising healthy psittacine chicks is to provide a broad scoped diet aided by close and constant observations of stool color and consistency, and to observe the chick's own feeding patterns which are governed by age, development and personality.

Unquestionably there is a tremendous effort and commitment involved in handfeeding a chick from the egg to juvenile maturity. However, we strongly believe that the end result justifies the exhaustive effort. It is also our firm belief that these particular birds will result in better acclimated adult breeders, providing that they are raised with other birds of their species, because of their familiarity and acclimation to the human environment.

We acknowledge that our study has introduced a wide spectrum of data, most of which is of an experimental nature. Therefore, due to the highly experimental nature of information, and due to the lack of scientific data available on this subject, we urge the serious aviculturist to undertake a logical, empirical approach to captive propagation using portions of the data presented in this study as a foundation. In addition, we also urge the serious aviculturist to formulate a careful data acquisition program and, having recorded information in as precise and objective method as possible, relate this data through any opportunity possible to other aviculturists to ensure the continued propagation of psittacines in our captive populations. ●

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Bates, Henry; Busenbark, Robert. *Parrots and Related Birds*. T.F.H. Publications 1969, p. 469.





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