ASA

A JOURNAL FOR BIRD BREEDING, CONSERVATION, RESTORATION AND EDUCATION

MARCH/APRIL 2018

NEXT ISSUE

MALEO *part III*

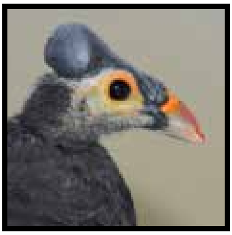
Wildlife Conservation Society

The purposes of the Society are the study of foreign and native birds to promote their conservation and protection; the dissemination of information on the care, breeding, and feeding of birds in captivity; the education of Society members and the public through publications, meetings, and available media; and the promotion and support of programs and institutions devoted to conservation. Front Cover: Maleo pair *Macrocephalon maleo,* Photo Julie Larsen Maher©WCS Inside Cover: Maleo fertile egg *Macrocephalon maleo,* Photo Julie Larsen Maher©WCS

Volume 86, Number 2 March/April 2018

CONTENTS

FEATURED



FAVORITES

WHO WE ARE

President's Message

Greetings, fellow Aviculturists:
I hope you enjoy part II of the Maleo article by the Wildlife Conservation Society at the Bronx Zoo.

I personally find it a fascinating read. Maleo are so unlike the species I have had the opportunity to work with. Yet, the husbandry information transcends specific species and I find ideas and methods that can be adapted to keeping other avian species.

Aviculture is a broad and diverse field. One will never live long enough to know it all! That's what makes it exciting.

Yours truly,

Carol Stanley
President, YOUR Avicultural Society of America

Officers & Staff

Avicultural Bulletin [USPS 925-380] ISSN 0567-2856 is published bi-monthly by the Avicultural Society of America, Inc., P. O. Box 3161, San Dimas, CA 91773. Postage paid at Arcadia, California and additional office, Alhambra, California.
The Society year begins the month following receipt of payment for membership: 1 yr. $25.00, foreign countries, please add $8.00 to cover postage. Remit in U.S. funds.

POSTMASTER: Send address changes to Avicultural Bulletin c/o Steve Duncan, Membership Director P. O. Box 3161, San Dimas, CA 91773.

ASA Yahoo Email Group

Did you know ASA has an email group? It's easy to join. Email: asabirds-subscribe@yahoogroups.com and you will start getting messages.

Like Us on Facebook

ASA has several pages on facebook. "Like" them all!

- Avicultural Society of America: https://www.facebook.com/asabirds
- ASA Conference: https://www.facebook.com/ASA-Aviculture-Conference-324481397748582/timeline/
- ASA Bulletin: https://www.facebook.com/groups/asabulletin/

Maleo *Macrocephalon Maleo*

HUSBANDRY AND CONSERVATION AT THE WILDLIFE CONSERVATION SOCIETY - PART II

Figure 1: Male (left) is larger and brighter in color than the female. Photo: Julie Maher©WCS

ORNITHOLOGY DEPARTMENT
WILDLIFE CONSERVATION SOCIETY
WCS/Bronx Zoo
2300 Southern Boulevard
Bronx, New York, USA

Authors:

A. O'Sullivan[1]

C. Rettenmund[2]

D. A. Oehler[1 3]

[1]WCS, Bronx Zoo, Ornithology Department, 2300 Southern Blvd, Bronx, NY, USA

[2]Maryland Zoo, 1876 Mansion House Drive, Baltimore Maryland, USA

[3]Corresponding author (doehler@wcs.org)

Reviewers:

B. Raphael

K. Huth

C. Sheppard

Nest pits

Functional nesting sites for maleo are paramount for successful breeding in captivity. It is extremely doubtful that a pair, or any single female for that matter, would invest in the extremely energy taxing process of egg laying unless assured of a suitable place to excavate a nest burrow in which to deposit it. Artificial nest pits constructed for captive birds are simple and relatively easy to construct. The design of the pit itself can be varied in many different aspects but there are a few critical criterions that must be met in order to achieve success with not only egg laying but also egg harvesting.

Temperature is an essential criterion to meet in this endeavor. Nesting grounds on Sulawesi vary markedly in the source of heat (geothermal vs. solar radiation), soil structure, vegetation density, and level of disturbance, however, sufficient incubation temperature is the key factor in determining maleo use of a site. The majority of eggs are laid in the sand that ranges in temperatures of 32-35ºC. This is also observed in other burrow nesting megapodes (Micronesian Megapodius laperouse and Polynesian Megapodius pritchardii) whose burrow depth in a variety of substrates is solely dependent on the prerequisite temperature. A recent study on Sulawesi found nesting ground temperatures in a range of 30-35ºC with an average of 33ºC. At WCS/ Bronx Zoo, maleo eggs are typically laid at a temperature gradient of 31-34ºC. When constructing a nest pit, for maleo use, the goal should be to achieve temperatures within this range, at a suitable depth.

Eggs are deposited at depths as shallow as 10-15cm from the surface to as deep as one meter. A recent study on Sulawesi nesting grounds found an average burrow depth of 63.3 cm in a range of 51 -87cm. Pairs, at WCS/Bronx Zoo demonstrate a preference for pits with greater depth, if given a choice between two of similar temperature gradients. This does not preclude the use of shallow pits, if the options are restricted, as long as temperature requirements are within acceptable parameters. This may be that the indicative of the excess energy cost of excavating a deeper nest burrow being outweighed by the anti-predatory benefits of the deeper laying depth. While the constructing a shallow artificial nest pit benefits easier location and harvest of eggs, deeper pit ensure that the egg is less likely to be broken or compromised by the actions of the birds before it can be harvested. A deeper pit will also accommodate a greater range of temperatures, which could be conducive to the selection of egg production site. At the WCS/ Bronx Zoo, birds have shown a preference for pits with dimensions of 1.22m X 1.93m and 61cm deep. This size nest pit fulfills the birds' needs while remaining manageable for the caretaker/harvester. While a variety of pit sizes may be successfully employed, in terms of egg placement, factors such as easy accessibility by the birds, sufficient depth to accommodate both the egg and to cover it at least 10cm below the surface and at the ideal temperature, and practicality with which an egg can then be located and harvested should be taken into consideration when constructing the nest site.

The design of nest pits at the WCS/Bronx Zoo is straightforward. The walls of the pit are cinder blocks stacked up length wise to form a rectangle. The cinderblocks are filled with the substrate to reinforce the pit, and to prevent any gaps or holes where a bird's leg might be caught. Installation of plastic sheeting, on the walls, contains the substrate from when the birds excavate the pits. A single electric heat pad is installed at the bottom of the pit, attached to a rheostat. The temperature within the substrate is then adjusted, using the rheostat, to achieve the desired temperature range within the pit. This design was upgraded from the original plywood boxes used on SCI. The goal is to achieve the desired temperature range through a safe design, which can vary to accommodate the situation.

Use of a variety of types of substrate is possible. The substrate used in nest pits at the WCS/Bronx Zoo is medium grain filter sand. In the past, soil has been used with success at both the WCS/Bronx Zoo and St. Catherine Island, although this practice was discontinued to reduce dust and improve general cleanliness within the enclosure. Usable substrates should inhibit organic growth (i.e. mold); it should be fine enough for the birds to excavate through, and soft enough to not compromise the shell of the egg. The birds are quite well adapted to dig through a range of soil and sand densities, any of which will retain adequate heat from the supplied heat source.

Maintenance of the nest pit is also important and these areas must be maintained in a sanitary manner; remove feces, food, pebbles etc., on a regular basis, to reduce contamination and ensure the integrity of the eggs. If the pit is sheltered, it is best to thoroughly dampen the top layer of the pit and rake it through at least twice a week. While this will reduce the temperature of the substrate, the effect is temporary and diminishes at greater depths. Dekker discovered moisture content in nesting sites in Sulawesi varying markedly between 1.6 to 45.0%. More recent study of nesting grounds, documented higher humidity levels in a range of 60.2 to 71.1% with an average of 68.55%. A drier pit can be more difficult for birds to excavate a nest burrow in, especially if the desired temperature is very deep inside the pit. The birds are very adept and can usually manage something after several collapses. Humans, however, are not nearly as proficient, so harvesting from a deep and very dry pit will be considerably more difficult. Anecdotally, it seems birds do prefer a more clayish moist pit to a drier one, as it is energetically less costly to excavate. Any activity, such as moistening and raking, at the nest pit will generally encourage the birds to investigate, possibly spurring breeding behavior.

Maintaining proper temperatures within the nest pit is critical, regardless of the pit's moisture content. Monitor the temperature of the pit regularly and adjust if necessary. Place temperature probes permanently at varying depths, within the pit, or inserted probes attached to a metal bar into the pit to assess temperature at different depths. The goal is to achieve the most desired temperatures of 32-35ºC, within the most frequently utilized depths for geothermal heating of 30-50cm below the surface. At the WCS/ Bronx Zoo monitoring, recording, and adjusting the temperature of the pit as done as follows:

Record temperature readings in the nest pit at six equidistant, intersecting points, within 12 quadrants of the pit. Register temperatures at 10cm intervals to a depth of 60cm (bottom of the pit) at each of the six points. No less than four out of six temperature readings at the 50cm depths should be within the 32-35ºC range. Adjust the rheostat if temperatures are not within the accepted range. Once the desired temperature at the bottom of the pit (on the mat itself) is achieved, and the most suitable range within the pit obtained, develop a system to monitor the temperature parameters, on a weekly basis. Once the microclimate of the nest pit is established, the need for adjustments should be less frequent.

FIGURE 5: OVERVIEW OF TEMPERATURE PROBE USED TO MONITOR NEST PIT TEMPERATURES. PHOTO: JULIE MAHER©WCS

FIGURE 6: TEMPERATURE PROBE WITH DEPTH CALIBRATIONS. PHOTO: JULIE MAHER©WCS

FIGURE 7: EXAMPLE OF GRID SAMPLING TO DETERMINE TEMPERATURE VARIABILITY. PHOTO: JULIE MAHER©WCS

FIGURE 8: INSERTION OF TEMPERATURE PROBE AT SPECIFIC DEPTH TO DELINEATE TEMPERATURE GRADIENT. PHOTO: JULIE MAHER©WCS

Sample of temperature record keeping:

Reading #1		Reading #2		Reading #3	
Depth	Temperature	Depth	Temperature	Depth	Temperature
10cm		10cm		10cm	
20cm		20cm		20cm	
30cm		30cm		30cm	
40cm		40cm		40cm	
50cm		50cm		50cm	
Bottom of pit		Bottom of pit		Bottom of pit	
Reading #4 Reading #5 Reading#6					
Depth	Temperature	Depth	Temperature	Depth	Temperature
10cm		10cm		10cm	
20cm		20cm		20cm	
30cm		30cm		30cm	
40cm		40cm		40cm	
50cm		50cm		50cm	
Bottom of pit		Bottom of pit		Bottom of pit	

Maleo are particularly adept at negotiating heated substrate given their breeding biology. However, high-temperature tolerances have not been established for these birds so the upper-level temperature criteria for the WCS/Bronx Zoo are to keep all temperatures within the pit ≤46ºC in order to prevent the possible injury to the birds.

Having a camera focused on a nest pit has proven to be paramount in locating eggs post-lay. The installation of a video monitor recording on the nest pits on St. Catherine Island made a tremendous difference in the ability to locate and harvest eggs for artificial incubation before they were broken or otherwise compromised. These cameras only recorded in short sequences but even this snapshot of footage was enough to aid in egg harvesting. At the WCS/Bronx Zoo, all nest pits for breeding pairs have cameras continually recording activity to a digital video recorder (DVR). Footage from the DVR can then be reviewed to help assess if an egg was laid and the general location of the burrow within the pit.

Courtship

Maleo are thought to become sexually mature at two to three years of age. At the WCS/Bronx Zoo, no female has ever produced eggs before five years old, although males have proven to breed at the age of three years of age. Given the proper diet, usable nest pit, adequate space, and a compatible mate it would certainly seem feasible that breeding success at the younger ages shown by other megapodes would be possible.

Maleo are monogamous and pairs are believed to stay together year-round and possibly for life. On St. Catherine Island, a single male was alternately run between two different females. Permanent placement of the male with more compatible females resulted in breeding success. Once a pair forms, the bond is very strong and the birds continually stay in very close proximity. We have documented one occasion of a male choosing a different mate, once the initial pairing was established. Developing further husbandry protocols to determine if we can manipulate these pair bonds in the future will be of benefit to the long-term management of this taxon.

Introduce birds to each other by placing the individuals in adjacent cages with visual access. Provide physical access and monitor interactions closely, although compatibility is apparent quickly. With the exception of solidly formed territorial pairs, aggression rarely escalates beyond body posture. As the birds tend to be social in nature, most pairings should work themselves out quickly. Dominance over food and preferred roosting perches has been observed. Adding multiple feed stations will ease tension until the birds settle into a peaceful dynamic.

FIGURE 9: COURTSHIP FEEDING AS THE MALE PRESENTS A FOOD ITEM TO THE FEMALE. PHOTO: JULIE MAHER©WCS

Courtship feeding appears to play a very large role in maintaining the pair bond. Females are estimated to produce 120-180% of their body weight in eggs in a single nesting season and reproductive success is dependent on the number of eggs that can be produced. It is therefore in the interest of the male to ensure the female receive adequate nutrition. Males have been observed to offer their mates food items in the similarly monogamous megapodes Nicobar megapode (Megapodius nicobariensis) and quite extensively in the Polynesian megapode (Megapodius pritchardii).

Courtship feeding in maleo can be divided into 2 types: presentation and passing. This first occurs when a male pounds a choice nut, another piece of food, or even a pebble. The male will then bow-down (see posture) and fluff up his breast, leaving the item on the ground as he calls to the female with a soft string of "kuks". The female is then presented with both the choice food prize and the display of the now visually larger male. This behavior has been noted in some birds to occur year-round. The second type of courtship feeding occurs when the birds physically pass a food item for consumption one from bill to another, as they forage together. The majority of this feeding is male to female passing, but female to male passing occurs as well, and on occasion, the same food item might be passed several times back and forth between the pair. There is not an associated display, but body posture appears to play a role in communicating the intent. The item that is passed is always small enough for immediate consumption by the receiver. This type of feeding begins to occur prior to the start of the breeding season and then continues throughout the female's laying period. It may be that these are simply different techniques employed by the birds to the same end, or that the first form of feeding plays a role in mate selection while the second strengthens the pair bond.

It should be noted that during the non-breeding season, tension over food could occur with even the most compatible of paired birds. A once doting male may even defend a feed station, keeping his mate from eating at all until he has been satiated. This is a stark contrast to the extremely generous cooperation that can be seen during courtship feeding, and may explain to some point the fluctuations in the bird's weight during the year.

Copulations

There is a particular coordinated display that the pairs engage in just prior to copulation. Typically, the male initiates, but displays by a female to an uninterested male have been seen. It begins by the male running a couple of steps forward, then gradually moving in the opposite direction, alternating with strong powerful backward kicks, as the female stands within a couple of feet. With each kick, the male is grasping at the substrate with his feet and tossing it back behind him. He will repeat running

FIGURE 10: COURTSHIP FEEDING AS THE MALE PASSES A FEED ITEM TO THE FEMALE. PHOTO: JULIE MAHER©WCS

forward, then kicking the substrate backward angling in different directions, usually in a circular pattern. During the behavior, the bird's back is arched, and the wings are pointed upward. If the female is receptive, she will begin the exact same behavior pattern. The pairs will alternate the display with one beginning just as the other is finishing, both working in a circular pattern. This display can last anywhere from a few seconds to several minutes, and the birds may begin to synchronize rather than alternate their display. At some point, the female will bring her breast toward the ground and the male will mount. The duration of copulation is two to three seconds and ends with a distinct vocalization from the female. Evidence of copulation, or at least an attempt, can easily be appreciated as the substrate will be very disturbed in the process and may even reveal a circular crater where the pair's displays converged.

It should be noted that copulations on Sulawesi never happen at the nesting grounds. Similarly, copulations in captivity never happen on a nesting pit. Copulations have certainly occurred while pairs were being held in the smaller inside holding cages. The associated display, when attempted in a confined space, is frequently met with failure as the mate scrambles to avoid the onslaught of the ricocheting substrate. The majority of displays resulting in successful copulations occur in the larger, more open, outside yards, which are a significant distance from the nesting pit. Very young males, (<1 year) in particular, will sometimes engage in the same patterned kicking of the pre-copulatory display. This is done most often over a preferred patch of the substrate. It is not yet known whether this is a territorial display or practice mating display.

It is not known how long a female maleo can retain sperm. Copulations by a pair have been observed to occur as few as two days to as many as 18 days prior to egg production. Since these birds are believed to be monogamous for life and the importance of the pair bond, it would seem feasible that copulations without the intent of reproduction are possibly as a means to strengthen the pair bond. The vast majority of copulations, resulting in fertile eggs, have been observed to occur between five and eight days prior to egg production. In addition, evidence of the pre-copulatory displays is often observed a week before an egg is laid. Due to the very long egg-laying period, megapodes are thought to copulate frequently throughout the breeding season to ensure fertilization. Copulations outside of the breeding season are seen frequently in the similarly monogamous megapode Malleefowl (Leipoa ocellata), although do not appear to be as common in the maleo.

Egg-Production

Quantifying the maleo breeding season can be a somewhat

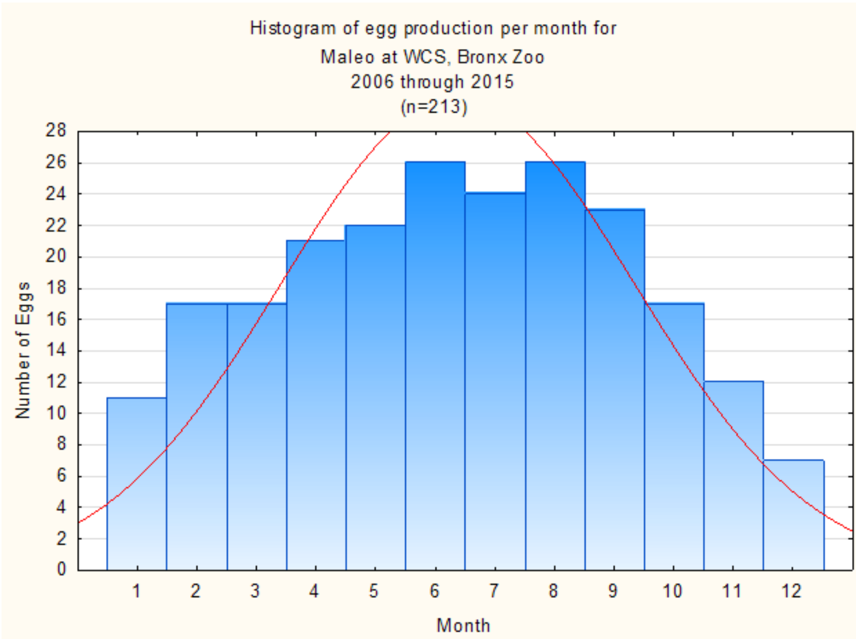


FIGURE 11: MALEO EGG PRODUCTION BY MONTH (2006 THROUGH 2015) AT THE WCS, BRONX ZOO

confusing matter. On Sulawesi, egg production occurs year-round with a clear peak from October to January in the geothermally heated grounds of the north. On the coastal beaches and sun-exposed river banks where solar heating of the substrate is affected by the rainy season, egg production is seen more often in the drier months of September to March. On southeast Sulawesi nesting grounds see a peak from November to January. Almost all nesting grounds do see some activity perennially, but egg-laying patterns differ between nesting grounds. There was initially no clear nesting season or pattern noted within the birds on SCI with the exception that the birds produced eggs in every month of the year except for the hottest months of July and August. By 1990, a regular nesting season of March to November developed. At the WCS/Bronx Zoo, eggs have been laid in every month of the year, although a nesting pattern can be discerned. One established pair has been exhibiting a breeding season of February to October, while a neighboring pair will lay mostly January to July. Peak egg production occurs between June and August.

The breeding biology of megapodes does not lend to the traditional ways of thinking about clutch size in birds. In order to simplify, all eggs laid by a female maleo in a single season are defined as the clutch. The number of eggs in a clutch and the number of days between eggs laid in a clutch can vary significantly, confusing the matter even more. As the birds are colonial nesters, gathering correct information from maleo on Sulawesi seems to be a daunting task. Estimates have varied from 8-12 eggs per season laid 7-9 days apart to 30 eggs per season laid 12-13 days apart. Observation of discernible birds at nesting grounds have led most to believe clutch size is more likely in the 8-12 egg range. SCI had incomplete egg records for the birds housed there but believed the recycling period to be between 10-30 days.

With the increase in nutrition and resources afforded in captivity, it follows suit that an increase in clutch size will be reflected. At the WCS/Bronx Zoo, detailed observation of sole pairs have revealed clutch sizes ranging from 12-18 eggs, more often 16-18. The time between eggs laid in these clutches have been as much as several weeks, but tend to stay in a tight predictable range of 16-19 days, in compatible pairs, at the peak of the nesting season. The shortest amount of time recorded between eggs for a female at the WCS/Bronx Zoo has been 15 days. Females housed together at the WCS/Bronx Zoo with access to a nesting pit would excavate burrows and lay eggs, but did so in a very haphazard manner. There was no pattern or evolving pattern to help define their season, clutch size, or recycling time. From observations at the WCS/Bronx Zoo, it would seem that timing of nesting season, clutch size, and days between eggs in a clutch all begin to develop into patterns within compatible pairs. The more successive seasons a pair is together the clearer and more predictable the nesting pattern becomes.

The length of the season can be another confusing matter to deal with since the birds are colonial nesters that may produce eggs perennially. On Sulawesi, the length of the laying season varies for each nesting site, which may be affected by weather, and probably varies somewhat for each pair. Most put the length of the nesting season between three to eight months. To simplify record keeping at the WCS/Bronx Zoo the laying season is defined by the largest gap in the laying sequence for a particular female. This non-laying period may vary for each female and from year to year. It can be as short as a month or be several months long. The first egg laid by a female after the single largest gap within a calendar year should be considered the first egg of the clutch.

Observations on nesting grounds on Sulawesi have revealed that eggs are most often laid in the morning. Pairs usually reach the nesting ground the night before, roost in a nearby tree, and begin to search for a suitable nest site the next day. They will frequently deposit an egg in a burrow that they have used before, this then becoming their "nest". On St. Catherine Island, a behavior pattern became clear; although the birds were known to dig at the nest site year-round, there was a marked increase in digging three days prior to an egg being laid and then a noticeable decline in digging. At the WCS/ Bronx Zoo, the vast majority of eggs are laid between dawn and noon. Several behavior patterns that indicate when a female is egg forming, when a nest burrow is excavated, and when a female has laid, have become more obvious. Determining exactly when and where a female has laid greatly increases the ease of egg harvesting and helps determine the specific breeding pattern of the pair.

In general, the behavior pattern of the female pre-egg laying period is as follows. A few days before egg production, the female will begin to increase the amount of oyster shell she consumes and conversely her interest in the regular diet decreases. To aid in making dietary preference more apparent it is best to offer the standard diet completely separate and some distance away from the oyster shell. Approximately one day before laying the egg, oyster shell consumption slows to a stop and the female demonstrates a marked level of inappetence, a phenomenon we refer to as "off peanut". While there may be some individual fluctuation in appetite and preferences, peanuts remain the ultimate litmus test for aberrant behavior. Several instances have been recorded in which females have consumed peanuts within hours of laying, although they appear to have done so reluctantly. The enthusiasm with which the peanut is greeted is the test. An offered peanut that is met with anything less than extreme eagerness should be taken as a sign of either an impending egg or severe illness. Offering an allotted number of peanuts at a fixed time in the morning and evening will condition the birds to approach caretakers on a regular basis. This will then allow for close examination of the birds as well as an assessment of behavior.

The other behaviors that may be appreciated during this time are general aloofness, vocalizations, defensive posturing, and an increase or change in digging patterns. The female, in particular, may become noticeably more indifferent towards the caretaker. This is most likely due in part to her decreased appetite, having little interest in food thus the little interest in the provider of food. The pre-lay vocalization can usually be heard while the female is in very close proximity. However, not hearing this should not be considered a deciding factor as to when the female lays, as it is often produced for several hours after an egg has been laid as well. Both birds may become more defensive towards conspecifics, the male may even begin to posture towards the caretaker. The time and effort a pair affords to dig are a somewhat perplexing matter. As mentioned before, pairs dig continually and will

Steve's Photo Pick

Green Singing Finch, also called Yellow-fronted Canary, Serinus mozambicus, is native to much of sub-Saharan Africa where its population is stable. It occurs in woodland and savannah and is often a common around farmland. Mature males have a solid yellow throat as pictured. Females and juveniles have a necklace of gray spots and slightly duller overall. The males have a very pleasing song much like their close relative, the canary. Green Singing Finches can be kept in a communal aviary of mixed species of finches and doves, but they are territorial with their own kind or birds that are similar in appearance. Nesting is in an open cup-shaped nest and extra insect food should be provided while rearing chicks. Steve Duncan
Avian Resources

even excavate sizable nest burrows with no obvious intention of egg production. It is possible that there must be a confirmation of suitable and sustained nest sites before the pair will breed. General digging occurs mostly on the surface of the pit, with perhaps one or two nest burrows being excavated at the deeper depths per day. In the days leading up to an egg being laid, digging becomes much more frequent, assiduous, and coordinated. Several nest burrows may be excavated within hours.

When a pair excavates a nest burrow one bird digs while the other stands as sentinel nearby, usually in the nest pit as well. The birds then alternate and take turns, one digging while the other stands guard. It would seem that on the colonial nesting grounds of Sulawesi there is as much competition from conspecifics for suitable nesting sites as there is danger from predators. Egg laying females housed together will also help each other dig and stand watch, while exhibiting no other courtship or bonding behaviors. Along with access to a suitable nest site, having a partner to aid in digging, or at the very least stand as sentry, may be of benefit to the pair's success.

As the birds excavate they stand on one leg and dig several times with the other leg before switching. They will periodically pause to taste the substrate in order to determine temperature. As previously mentioned, this excavation can occur daily, but increases in frequency a few days prior to egg laying, and occurs almost constantly in the hours just prior to laying. The excavation is a slow and continual process. The burrows that are excavated and not used for egg laying are simply abandoned and another burrow is started. When beginning another burrow a previously excavated one nearby may be filled in or dissipated by the substrate that is displaced in the process. When laying the egg the female pauses from digging the cavity, there is a final tasting/testing of the substrate, and then only the slightest body movement visible as the egg is deposited. As soon as this happens the process of covering the egg begins, and it is accomplished completely by the female. The female quickly pulls substrate down and over the egg, alternating using one leg after the other in a dance-like pattern. Egg covering is accomplished very hurriedly and is a stark contrast to the slow, restrained method of excavation. It is somewhat remarkable that the majority of eggs are not broken in the process. Once the female has sufficiently hidden the burrow, she may walk directly over it a couple of times in a tight circle. She will then leave the nest pit in search of food.

Pair behavior in the post egg production period can be varied. Dekker reported the female as digging additional burrows after egg production as an anti-predatory tactic. This has been noted regularly at the WCS/Bronx

FIGURE 12: MALE EXCAVATES A NEST BURROW, ACCOMPANIED BY THE FEMALE
PHOTO: JULIE MAHER©WCS

FIGURE 13: AS EXCAVATION OF THE NEST CONTINUES, THE PAIR SWITCHES DUTIES AND THE MALE STANDS AS A SENTRY. EXCAVATION, BY THE PAIR, INCREASES IN FREQUENCY AND COORDINATION IN THE DAYS LEADING UP TO EGG PRODUCTION.
PHOTO: JULIE MAHER©WCS

Zoo, where a female, which has just produced an egg, will first satiate herself with food, then return to the nest pit and immediately begin the process of burrow excavation yet again. This post-egg production excavation can continue for several hours, creating multiple cavernous burrows, and all the while the female may continue to emit the "pre-lay" vocalization. The male in sustained pairs will almost inevitably stay close to the female through the entire process, even if this means abandoning his post at the nest site. With young, nascent pairs, it has been observed on several occasions that once the female has produced an egg, covered, and retreated in search of food, her mate will excavate out the same burrow, completely exposing the freshly produced egg. It has also been reported on St. Catherine Island that one female would posture and threaten her mate in an apparent effort to protect the recently used nest site. It would seem that there is a learning curve for pairs in the entire process. It is important to note that this post-lay time frame can be the most precarious for the egg in captive situations, where the amount of space afforded to nesting is limited. It is therefore critical to harvest the egg for artificial incubation as soon as possible. Once it has been determined with certainty that an egg has been laid the birds should be denied access to the nesting site until the egg can be harvested.

Careful observation of the pair's behavior should provide enough information to ascertain when an egg is produced. An additional factor that can be utilized is the female's weight. Eggs in megapodes can comprise up to 20% of the female's body weight, and maleo are certainly no exception. The increase in body weight may be detected as much as a week before the egg is produced. It is unclear, however, if the weight gain at this early stage is from the forming of the egg or from increased nutrient consumption in anticipation of the energetically costly process. It is helpful to have the female conditioned to the weighing procedure; compliance may become more difficult the closer to egg production, as the female's appetite and motivation decrease. A sudden sharp decline in weight of 200 grams or more will indicate that the egg has been laid.

Egg harvesting

If the location of the egg was not directly observed, camera footage will help narrow the search so that the entire nest pit does not need to be excavated in the search. The excavation is accomplished cautiously, by hand, so that the egg is not accidentally broken in the process. Most eggs are deposited in the vertical position and should be kept in this position when extracted from the substrate, until they can be set for incubation. A temperature reading should be taken at the site where the egg was deposited. The thin-shelled egg should be handled with care, using surgical gloves and inspected thoroughly. A few eggs in the WCS/Bronx Zoo that had small holes or cracks in their shells were treated with New Skin® liquid bandage prior to incubation. Only one of these compromised eggs was determined to be fertile and resulted in an early embryo death (EED).

Molt

Adult maleo are capable of suspended molt. Examinations of wild specimens have not determined if maleo have a distinct molting season, as birds may possess several generations of feathers simultaneously. Primaries have a serial descendant molt starting with the outermost primary, and may be suspended at any time in adults, and occasionally in immature birds. Suspended molt does not appear to occur in chicks.

At the WCS/Bronx Zoo molt appears to occur, for pairs, exclusively during the non-breeding season. Since there is a great amount of flexibility in the timing of the breeding season for individual pairs, the molting season is also somewhat variable, although this does occur outside of the breeding season. It is unknown how synchronous a molt may be for a pair or any group of birds housed together.

The Egg

Maleo eggs have been found in a weight range of 178-267g with an average of 231g, the heaviest egg weight of any of the megapode species. The egg is noticeably more long than wide, with length measurements ranging from 92.1 to 112.6mm and width measurements ranging from 57.6 to 65.5mm. At the WCS/Bronx Zoo, mean egg mass has been found to be 233g (n=213, δ26) and mean linear measurements consist of 102mm in length (n=202, δ4) and 63mm in width (n=202, δ2). The average length/width ratio for maleo eggs is 1.72 and is higher again than for any other megapode species, due to the larger yolk volume. The width of the egg, being limited by the size of the oviduct and pelvis, shows little variation. An increase in the yolk content, 61-64% of the maleo egg, results in the elongation of the egg as well as being responsible for the substantial egg weight. The large yolk volume then being a necessity for the highly developed, super-precocial chick that hatches. The yolk content proportions for all the burrow nesting megapodes are higher, as is indicated by their egg weight and shape, than for the mound building megapodes, and provides further evidence to support the idea that burrow nesting developed from mound builders as a breeding strategy.

The egg has a light brown color due to the “red powder” covering that has been noted within the other burrow nesting megapodes, as well as some of the mound building species. This red powder may become dislodged as the egg is naturally incubated. Thus, eggs that have been incubated for longer periods may appear paler than those that are freshly produced.

The shell itself is very thin, occurring at only 69% of the shell thickness that would be expected for a similarly sized bird. To a certain degree, since the eggs of megapodes are incubated underground, there is less of a chance that they will be broken by the activity of the adults and the shell can therefore be less substantial. The thinner shell being energetically less costly for the adults to produce, also serves a few very important functions for the development of the embryo in such an unusual and inhospitable gestational environment. Underground nests can be very moist with high carbon dioxide and low oxygen levels. The thin shell allows for increased diffusion of gases across the shell. The gas conductance is more than double that would be seen in the thicker shells of other birds, so that the gas tensions actually remain similar to that of other non-megapode avian eggs. In addition, the shell continues to thin during incubation and the growing embryo assimilates the calcium from the shell for bone formation. This causes the pores of the shell to change shape and widen during incubation allowing for even greater shell conductance. The vast majority of weight loss in megapode eggs occurs during the second half of the incubation and is due in part to the water loss caused by this increase in shell conductance. The increased metabolic function of the growing embryo causes an increased temperature differential across the shell, thus compounding the water loss.

Megapode eggs do not have an air cell and so the chicks do not pip internally. The chick kicks through the shell with its feet in order to hatch. The thinness of the shell aids in the abrupt and necessarily quick transition from chorioallantoic to pulmonary respiration.

Another unique aspect of megapode eggs is that they are viable over a wide range of temperatures. Temperatures ranging from 32ºC to 38ºC have been successful in the artificial incubation of malleefowl, with an ideal temperature of 34ºC. Temperatures as low as 28ºC have been tolerated for at least four days. The mounds of Australian brush-turkeys have been seen to fluctuate between 25ºC to 40ºC. Since megapodes and specifically the burrow-nesting megapodes have little direct control over incubation temperature after the egg has been laid it follows suit that the embryo would be somewhat resilient to temperature fluctuations. As incubation temperature is negatively correlated with incubation time there is also a spectrum of incubation periods within the megapode species spanning two to three months.

Artificial Incubation

In initial attempts at harvesting maleo eggs and relocating them for incubation in safer locations, on Sulawesi, it was discovered that the mean incubation time for the eggs that hatched was 78.6 days. Although there were no detailed records kept on temperature or depth, it was discovered that the eggs could tolerate temperatures as low as 28ºC, although eggs subjected to this temperature were already at a very advanced stage of development. A significant finding of this early study was that eggs buried upside-down do not successfully hatch and the embryo mortality was observed in the latter stages of development. Maleo eggs have a pointed end and a blunt end. 82% of these eggs are laid in the vertical position and should be incubated in the vertical position in which they are laid, with the blunt-end up. They should not be turned at all throughout the incubation period.

It was determined on St. Catherine Island that when eggs remaining in nest pits, to incubate naturally, developed fungal and bacterial growth. Those that were set in commercial forced air incubators desiccated. In 1988, a technique was implemented in which the eggs were placed in a mixture of sterilized sand, vermiculite, and water. The eggs were then incubated in a forced air incubator at a temperature of 32.2ºC. This resulted in four successful hatches that same year with a mean incubation period of 79.25 days. Only two of those chicks survived, one died of suffocation shortly after hatching and another of an umbilicus infection several days after hatching. In 1990, the incubation temperature was increased to 33.3ºC. This resulted in one successful hatch after 70.6 (δ1.6) days of incubation.

In 2008, a study was conducted on Sulawesi to compare the effectiveness of artificial incubation of maleo eggs in incubators, as a conservation strategy. Incubating eggs at a temperature of 34ºC and a relative humidity of 71% resulted in a 70% hatch rate; approximately 50% of the eggs hatching after 59-61 days, 25% of the eggs hatching in the range of 53-58 days, and less than 10% hatching after 62-64 days. In a later study, conducted in Indonesia, eggs were collected from two different nesting sites on Sulawesi and incubated without substrate. The average temperature was 34ºC, with a relative humidity of 70%. These parameters yielded a hatching success rate of 67.5%. In that study, it was suggested that the main factor in embryonic death included the egg orientation in the incubator resulting from the hatching of a neighboring egg. The hatch rate in both these ex-situ studies is higher than what has been typically achieved in the natural incubation hatcheries that have been utilized on Sulawesi in conservation attempts. Hatching success rates at the natural incubation hatcheries vary each year, being heavily influenced by any climatic change, but average about 50%. In a similar study on Sulawesi hatching success was achieved over a range of microhabitats with parameters ranging from 31.7ºC with an RH of 67.5 yielding an average incubation period of 78.4 days to 33.8ºC with an RH of 71% yielding an average incubation period of 59.3 days.

The WCS/Bronx Zoo began artificially incubating maleo eggs in 2006 using a variety of parameters and techniques. Temperatures ranging from 32.9º - 35.5ºC and 58-80% relative humidity yielded a 46% hatch rate after 58-67 days. Of those that hatched an additional 27% presented an open umbilicus and died soon after hatching. Raising the temperature to 36.0º-36.6ºC with a relative humidity of 60% resulted in 0% successful hatching of three fertile eggs (one EED, two others died during the hatching process at 55-58 days of incubation, not having their yolk sac internalized). A technique of suspending the eggs vertically in a rack for incubation was implemented at one point, but resulted in a failed hatch. The rack technique was also used in a separate study and resulted in the greatest mortality of any of the microhabitats, as it appears to interfere with the hatching process. As of 2012, the most effective methodology, resulting in a 91% successful hatch rate at WCS/Bronx Zoo, was implemented and is outlined below.

The egg is weighed and length and width measurements are taken using calipers. The egg is then set vertically with blunt end up in a clear plastic container. The medium used is sterilized plastic beads, measuring 5mm in diameter, burying 30% to 50% of the lower end of the egg below the surface of the beads. The container with beads and egg are then reweighed so that that the amount of weight loss in the egg throughout incubation can be assessed without having to handle or remove the egg from the medium. The plastic container is set in a GQF 1550 Digital Hatcher set at 32.5ºC with a relative humidity of 89-90%. These parameters lead to an average incubation time of 70.6 days (range 68-71 days, δ1.6). The eggs are candled and weighed weekly for seven weeks without removing them from the container and substrate. After the seventh week, they are weighed and candled in the same manner, at three-day intervals, and set to hatch.

Each incubating egg is logged and labeled as followed:

Egg log #	
Sire ID	
Dam ID	
Date laid	
Date set (if different from above)	
Length X width (in mm)	
Egg weight (in grams)	
Weight of egg in container with substrate (in grams)	

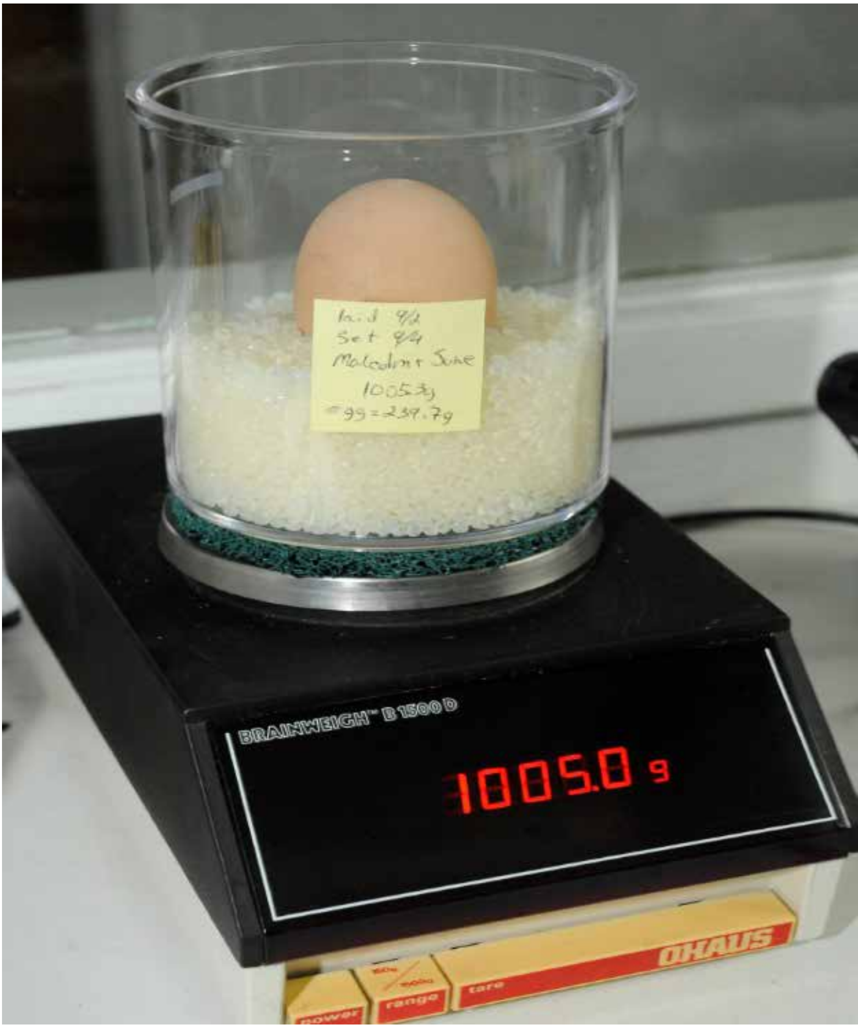


FIGURE 14: MALEO EGGS ARE SET VERTICALLY, WITH BLUNT END UP, IN A CLEAR PLASTIC CONTAINER. THE MEDIUM USED IS STERILIZED PLASTIC BEADS (5MM DIA.) AND THE EGG IS BURIED POINTED END DOWN, INTO THE BEADS. PHOTO: JULIE MAHER©WCS

FIGURE 15: MALEO EGGS ARE CANDLED AND WEIGHED WEEKLY FOR SEVEN WEEKS WITHOUT REMOVING THE EGG FROM THE CONTAINER AND SUBSTRATE. PHOTO: JULIE MAHER©WCS

The egg is candled using a Powerlux Egg Candler, directing the light through the top (blunt-end) of the egg. In fertile eggs, blood vessels can be detected forming under the air pocket at this end of the egg starting at 15-16 days of incubation. Between 30-40 days of incubation, embryo movement can be observed.

Evaporative weight loss initially occurs very slowly in the incubation process, averaging about 0.1% daily until about day 45 of incubation. Weight loss increases exponentially in the final quarter of incubation up to a maximum of 0.4% the day before hatching.

Eggs that are fertile and nearing expected hatch time should be separated away from other incubating eggs, approximately four days prior to the anticipated hatch date. In a separate incubator, either entirely or by encasing the container in mesh so that any blood or debris from the hatching process does not contaminate any other eggs. Once the chick and container have been removed from the incubator, the incubator and all associated mediums should be disinfected.

FIGURE 16: EGGS THAT ARE NEAR EXPECTED HATCH DATE ARE SEPARATED INTO A HATCHER TO PREVENT CONTAMINATION OF OTHER EGGS. PHOTO: JULIE MAHER©WCS

Infertility in Parrots

Tony Silva

Infertility is the vane of the breeder. There is nothing more disheartening than discarding a clutch of eggs because they are infertile. This problem of infertile eggs affects all species, but is most common in macaws, amazons and Eclectus Eclectus roratus parrots. Indeed on a daily basis I receive messages from breeders across the globe describing the frustration they feel at the number of infertile Eclectus eggs they discard. Seasonally I hear the same complaints on macaws and amazons. No one has a secret elixir that can guarantee success. Rather it is often changing husbandry principals, improving diet, dealing with subclinical health issues and treating these, or providing the birds new mates because they are incompatible that leads to success.

Let me address each issue separately:
1) **Husbandry.** Parrots have evolved to fly, to explore and to interact, being in the main very sociable creatures. Very few species are solitary. Kakapo Strigops habroptilus live as isolated individuals, but virtually all other species live in pairs or more commonly in groups. In all groups, mates are carefully selected—they are just not found by coincidence. As an example male Kakapo employ a unique display, including the production of a loud booming sound, to attract females, who may find the display attractive and permit mating or reject the advances. This is how a solitary bird finds and then selects a male.

Allowing a pair to select their mates is often the key to success. A male that a female does not find attractive may be rejected. As an example, I have a Scarlet Macaw Ara macao who had 5 potential partners, each one selected by the breeder and offered in succession. She never produced fertile eggs with these. When I purchased her, I offered her three available males at once. She picked one almost immediately; she climbed the perch, they opened their wings, screamed and began to preen. Seventeen days later she produced a fertile egg—the first out of 67! Infertility is often as aresult of two incompatible birds living peacefully but not amorously together.

Parrots are active. In a cage, a sedentary life is often the norm. The birds become bored. By adding enrichment, toys, providing a larger aviary that meets their biological needs (parrots that are arboreal do well in a suspended enclosure while terrestrial species may be stressed when they are unable to forage on the ground) and offering a surrounding that is conducive to breeding, one can turn a pair of birds that are indifferent to each other into a bonded pair that mate and reproduce successfully. In conures and caiques (Pionites), for example, providing enrichment strengthens the pair bond and having others of their kind that they

ASA BULLETIN

Who's Your Daddy?

Stumped? See answer on page 34

can see and hear has a cascading effect: pairs that may be apart and indifferent to each other will suddenly bond well in order to challenge the other pairs.

Part of the act of maintaining the pair bond is mating. We have found that in Galahs if we do not provide many fresh branches and fill the nest with wood to the entrance, infertility is a problem. By providing both the wood and fresh leafed branches, the male and female must work together at making the nest accessible. They must evacuate the clutter, which must first be chewed, and finally they must make their nest of leaves. This activity brings a pair of birds into direct contact for quite some time, heightening sexual activity.

Wild parrots do not find a readily suitable nest where the hen can lay. In the wild, they must not only find a cavity where they can bring forth their young, but must prepare it to make it suitable. By adding wood chunks to the nest—nature does not provide sawdust or shavings for the hen to lay on!—the pair is forced to spend many hours making the nest suitable; they must chew the cavity to enlarge it. This darkness inside the nest has been found to induce gonadal development. Almost two decades ago I had pairs of Blue and Gold Macaws Ara ararauna endoscoped during the breeding season. Three pairs were offered a standard nest with shavings and three pairs were offered nests filled with wood. The pairs offered shavings in their nest displayed poor gonadal activity, while the pairs that were forced to spend time in the dark nest preparing it had gonads that were engorged. Fertility was almost a third higher in the latter than in the former group.

In some species (amazons, for example) males appear to stimulate each other by both visual and vocal contact. Once actual breeding approaches, the pairs should be visually blocked but still allowed vocal contact. In a group that is notorious for laying clear eggs, this has helped produce far more fecund eggs than simply keeping one pair per aviary away from each other.

In Eclectus, the female is dominant. She is fed by and mates with multiple males. This contact with multiple males prevents her terrorizing a particular male. In groups that have been poorly productive, it is possible to construct a tunnel that gives access to multiple cages, each containing a nest and box. The females tend to take up residence in these cages while the males freely travel in the tunnel to visit, feed and mate with the various receptive hens. This mode of housing can make a collection of Eclecus become productive. Also, in this species the dominant female, when imprinted, often becomes even more aggressive. To prevent these problems, pairs should be formed from a young age, allowing them to mature together. The male then understands the specific behavior of the female, losing to a degree his fear of her.

When colony breeding Eclectus using the above cages, make sure that all the birds are of the same subspecies, as Eclectus hybrids should not be produced.

Having a basic understanding of the biology of the parrots that you are attempting to breed is key to success. This can include diet, nest type and level of socialization. It can mean the difference between fertility and infertility in the clutch.

2) Diet. In aviculture, it is common for the breeder to try to manage all birds in the collection using the same diet. This simplifies the daily care. Unfortunately not all parrots are the same. The Galah Eolophus roseicapillus has evolved to feed on low fat grass seeds while the large macaws have a beak that developed to crush hard palm seeds, which are fatty. The two species cannot be fed the same. Feed a Galah a diet high in fat and the birds will become obese, this affecting fertility. In contrast, fertility can also be affected when a macaw is fed a diet low in fat. Providing the proper diet is key to success. This means having a basic diet of a good seed mix or pellets, but varying this to meet the biological needs of the species; as an example a seed diet with virtually no sunflower or safflower seeds would be provided to the Galahs while a diet with a higher component of these seeds would be acceptable for macaws. Pellets are also available in higher and lower fat content types and these could replace seeds for most species. Adding vegetables, fruits, nuts, whole grain bread and greens, amongst a lost list of items, to provide the individual requirements of the species is important to balance out a diet.

3) Clinical issues. When a pair has produced in the past but suddenly starts laying clear eggs, or the eggs contain fine bubbles, or the pair is compatible and paired from a group but lays only clear eggs, I would look for disease. Culturing from a swab taken from the mouth and another from the cloaca can often reveal pathogens that affect fertility. In such cases, the culture and sensitivity will identify the best drug to use. We invariably culture birds that produce clear eggs and in 37% of the cases have found a pathogen that when treated resulted in the pair producing viable eggs.

4) Incompatibility. If two birds are incompatible, they will not breed successfully. Sitting on opposite perches, feeding independently of each other, forcing the other bird to move away when one bird moves across the cage and outward aggression will rarely produce fertile eggs. With such birds, offering them new mates is the best course of action and will eliminate years of eggs being tossed in the trash bin because they are infertile.

As can be seen from the above, many factors can contribute to failure. Identifying and correcting these is always a challenge, but when this obstacle is overcome, the gratification that the breeder receives is part of what makes aviculture so fascinating.

GREEN-WINGED MACAW (ARA CHLOROPTERUS) FLYING IN PERU PHOTO: [illegible]ARDO SANCHEZ

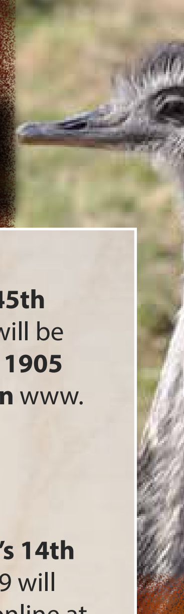
Who's Your Daddy?

From page 29, Answer: Golden Conure (*Guaruba guarouba*)

The green-winged macaw can be readily distinguished from the scarlet macaw. While the breast of both birds are bright red, the upper-wing covert feathers of the green-winged macaw is mostly green but can occasionally sport a few yellow feathers above the band of green (as opposed to mostly yellow, or a strong mix of yellow and green in the scarlet macaw). In addition, the green-winged macaw has characteristic red lines around the eyes formed by rows of tiny feathers on the otherwise bare white skin patch; this is one of the biggest differences from a scarlet macaw to the casual viewer. Iridescent teal feathers are surrounded by red on the tail. If seen together, the green-winged macaw is clearly larger than the scarlet macaw as well.

From Wikipedia, the free encyclopedia

EVENTS

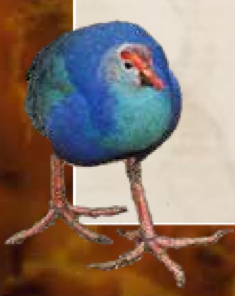


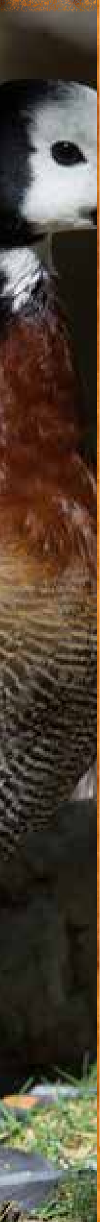
2019 EVENTS

AMERICAN FEDERATION OF AVICULTURE - AFA's 45th Annual Educational Conference and Avian Expo will be held **August 8th – August 10th B Resort and Spa | 1905 Hotel Plaza Blvd. | Orlando, FL 32830 More info on** www.afabirds.org

AVICULTURAL SOCIETY OF AMERICA - ASA's 14th Annual Education Conference in Fall of 2019 will be announced soon. Watch for more details online at www.asabirds.org

Let us know of your avicultural event to be posted on our Events page at: info@asabirds.org





ASA MEMBER CLUBS

Central California Avian Society
PO Box 5067, Fresno, CA 93755
www.ccasbirds.com

Contra Costa Avian Society
P.O. Box 23115 Pleasant Hill, CA 94523
www.contracostaaviansociety.org

Acadiana Bird Club
480 Almonaster Dr Youngsville, LA 70592
acadianabirdinc@hotmail.com

Arizona Seedcracker Society Inc
P.O. Box 26899 Mesa, AZ 85214

Long Beach Bird Breeders
6444 Spring St # 132
Long Beach, CA 90815
longbeachbirdbreeders@gmail.com

Orange County Bird Breeders
www.ocbirdbreeders.org

Fort Worth Bird Club
P.O. Box 1712 Keller, TX 76244
fwbc@fortworthbirdclub.com

Finch Society of San Diego County
4256 10 Ave San Diego, CA 92103
www.finchsocietyofsandiego.com

The Foreign Bird League

The Premier Foreign Bird Keeping Society in the UK
Founded 1932
Overseas membership for 2012 £1800 (to be paid in sterling)
Please visit our website to download a membership form and check on the latest membership fees.
www.foreignbirdleague.com

ASA Affiliations

The Avicultural Society of America is proudly affiliated with:
American Dove Association
American Federation of Aviculture
LoryLeague.org
National Animal Interest Alliance
National Finch and Softbill Society
Zoological Association of America

New Members

Nancy Forrester
Key West FL

Feray J Baskin
Bloomington IN

Margaret Yorio
Poway CA

Paul Lepiane
Ojai CA

Chester Moore
Orange TX

Lori Gaskin
Goleta CA

Christopher Marley
Salem OR

Beau ParksValley
Center, CA

John Gregory
Alexandria, VA

Denise Knight-Trevor
Brentwood, CA

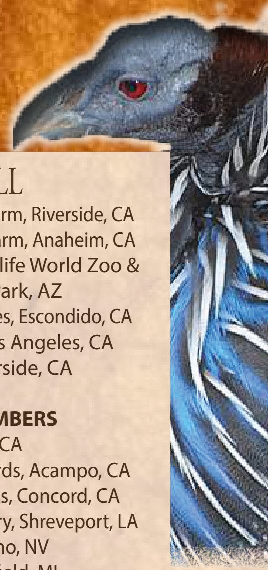
Jan Faresielli
Escalon, CA

Adam Whisenant
Atlanta, GA

Denise DeGood
Amana, IL

Karen Kurd
Dubuque, IA

Wendy Hanson
Hudson, WI



AVICULTURAL SOCIETY of AMERICA HONOR ROLL

PATRON

Diane Bock, Pacific Palisades, CA
Pamela Bompart, Jefferson City, MT
Roger Bringas, Mutations Unlimited, N. Hollywood, CA
Mike Chiaromonte, Consolidated Seed & Pet Inc., Buena Park, CA
Bill Coleman, Carpenteria, CA
Jennifer & Alex Culp, Huntington Beach, CA
Caroll Daunis, Fallbrook, CA
Sheldon L. Dingle, editor, author, Alhambra, CA
Steve Duncan, Avian Resources, San Dimas, CA
M. Jean Hessler, graphic artist, Huron, OH
Clint & Marcelle Hufford, Fountain Valley, CA
Jerry Jennings, Emerald Forest Bird Gardens, Fallbrook, CA
Dave & Tammy Kramer, DJ Feathers Aviary, Fairfax, VA
Mitsuo Kuribara, Sayama City, Japan
Ivo Lazzeroni, West Covina, CA
Bruce Leach, Leach Grain & Milling Co., Downey, CA
Wendy Maclean Soderman, Huntington Beach, CA
Sigie Meyer, El Monte, CA
Frank Miser, Jr., Magnolia Bird Farm, Riverside, CA
Frank Miser, Sr., Magnolia Bird Farm, Anaheim, CA
Connie & Mickey Ollson, Wildlife World Zoo & Aquarium, Litchfield Park, AZ
Dick Schroeder, Avian Enterprises, Escondido, CA
Wm. N Smith, C.T.C., Inc., Los Angeles, CA
Helen Teunissen, Riverside, CA

CONTRIBUTING MEMBERS

Lori Ables, Trona, CA
Eric Antheunisse, Cedar Hill Birds, Acampo, CA
Laurie Baker, Feathered Follies, Concord, CA
Sarah Brabbs, West Branch Aviary, Shreveport, LA
Earlene Douglas, Reno, NV
Scott Karlene, Bloomfield, MI
Phyllis Levine, Seal Beach, CA
Julie Murad, Elizabeth, CO
Mary Nogare, Snoqualmie, WA
Michele Raffin, Los Altos, CA
Natasha Schischakin, Houston, TX

ASA SUSTAINING Members

Joe Carvahlo, Shingle Springs, CA
Terry Clare, Vista, CA
John Del Rio, Del Rio Aviaries, Idaho
Madge Decker, Long Beach, CA
Richard Dickinson, Sun City, AZ
Bob Ervin, Alta Loma, CA
Lauri Grigg, Houston, TX
Gene Hall, San Diego, CA
Sherilyn Hanna, Exotic Endeavors, Moorpark, CA
Richard Heebner, Worcester, PA
Sally Huntington, San Diego, CA
Tiffany Latino, Roseville, CA
Linda & Bill Nichelmann, Citrus Heights, CA
Wade Plouvier, Jacksonville, NC
Arnold & Debbie Schouten, Port Angeles, WA
Carol Stanley, Rancho Cordova, CA