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May/June 2018

BREEDING SOFTBILLED SONGBIRDS

Roland and Ilana Cristo

ASA
BULLETIN

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 egg *Macrocephalon maleo,* Photo Julie Larsen Maher©WCS Inside Cover: Chestnut backed thrush chicks *Geokichla dohertyi* top. Magpie Robin male *Copsychus saularis bottom* Photos by Ilana and Roland Cristo.

Volume 86, Number 3 May/June 2018

CONTENTS

FEATURED.....

FAVORITES.....

WHO WE ARE.....

May/June 2018

President's Message

Greetings, fellow Aviculturists:
In this final installment of Maleo, by Wildlife Conservation Society at the Bronx Zoo, we get to learn about Maleo chick housing, diet and care.

WCS implements creative housing and diet presentation for the chicks and documents their growth through the first year.

I hope you have enjoyed this series as much as I have.

If you would like to submit an article, please send to info@asabirds.org

Yours truly,

Carol Stanley
President, YOUR Avicultural Society of America

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Maleo *Macrocephalon Maleo*

HUSBANDRY AND CONSERVATION AT THE WILDLIFE CONSERVATION SOCIETY - PART III of III

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

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Chapter 6. The Chick: First year of Development

The Chick

Perhaps the most spectacular aspect of megapode biology is the super-precocity of the chick. After kicking through the shell to hatch, the maleo chick digs up to the surface of the burrow, and ventures off into the forest where it finds food and evades predators with no assistance from conspecifics. The complete independence and spectacular capabilities of the megapode neonate is a direct result of the prolonged incubation and delayed hatching that occurs. Megapode chicks in actuality have the same developmental trajectory as other gallinaceous birds, but reside on a different position along that trajectory due to the prolonged incubation which results in a more developed hatchling. This is illustrated by the fact that megapodes possess an egg tooth around day 20 of incubation, when other Galliformes hatch, but lack it by the time they hatch, as they do not pip.

It is ideal in one sense that due to their breeding biology there is virtually no threat of imprinting when chicks are raised in captivity. However, it is the extreme precocial nature of the chicks that can be the most challenging to deal with in a captive setting. In addition to being highly developed and very adept, chicks are anti-social, extremely skittish and easily stressed.

A common incorrect belief about megapodes chick's is that they hatch, dig themselves out and fly away all within a short time frame. In actuality, the emergence of the chick on the surface post-hatch is dependent on several factors: the energy reserves of the individual hatchling, the type of substrate and most importantly the depth of the substrate. The digging process has been seen in mallefowl to take 2-15 hours, and 1-2.5 days for the Australian brush-turkey. Australian brush-turkey hatchlings have been shown to take an average of 40 hours to emerge at a depth of 40cm. While there has not been a study conducted on emergence times for burrow nesters, it has been noted that maleo hatchlings appear to be slower diggers, often remaining in the substrate for several days. This must be kept in mind when comparing the behavior of captive maleo hatchlings, which have not been afforded the digging process, to the behavior of any other megapode chick in general following emergence.

Day 0

It may take several hours for the hatching process to be complete. A visual assessment of the chick is completed to ensure there is no urgent need for medical intervention. The hatchling is then maintained in the incubator, within the container with the substrate for 24 hours post hatch. The environment surrounding the incubator is kept quiet and dark to reduce stress.

Day 1 – Day 5

The hatchling is removed from the incubator and substrate one day

after hatching. It is then weighed and undergoes a full physical exam. If there is no apparent health issue, the umbilicus is swabbed with a tamed iodine solution and the chick is transferred to a brooder box. If there is an open umbilicus or other medical problem, appropriate measures are taken.

The chick is maintained in a double long-brooder box for a few days post hatch to gauge mobility, strength, and alertness before being transferred to a large flight cage. The smaller space allows the chick to be easily caught up, if necessary, for additional examinations or veterinary treatments. If the chick is handled for any reason during this period, a weight is recorded.

Brooder Box set-up

Two wooden brooder boxes (each 1.17m X 60cm X 40cm high) are arranged side-by-side. The two boxes are adjoined by a matching shift door in each measuring 30cm X 30cm. This door allows the chick to be separated into either box for a more contained capture. The floor of the brooder is 1.3cm gauge box wire, covered by a thick layer of mats, which consists of a combination of nomad drainage mats and outdoor carpeting. The top of the brooder is 12.7mm gauge netting covered by plastic foliage and dark colored shade cloth to provide privacy.

Two or three small plastic shelters, measuring 15-20cm wide, 20-24cm long, and 15-20 cm high, are provided as cage furniture. A small plastic transfer crate, approximately 24cm X 34cm X 17cm high, can be kept in the brooder as well. Chicks may seek the crate as a hiding place and can then be captured with ease. Maleo chicks are very shy so it is important to offer them numerous hiding places. An electric heating mat is provided in one of the brooders, underneath the matting/carpeting. No perching is provided in the brooder boxes.

The chick should be able to thermoregulate at room temperature. The brooder is kept within a temperature range of 21-26ºC. The brooder is illuminated utilizing both overhead fluorescent bulbs and skylights during the day. At night, a single incandescent bulb is kept on near the brooder to offer a small amount of light. Because newly hatched maleo chicks are so wary the area around the brooder box is kept as quiet and calm as possible, with disruption to the chick kept to a minimum.

Maintenance

The chick is housed in the brooder box for a short amount of time and there is very little, if any, food consumption during this period. Cleaning of the box should not be a concern until the chick is transferred to a larger space. Once the chick has graduated from the brooder box, the box and all of its furniture and matting should be disinfected before it is used to house another chick.

Diet Presentation

Food and water are each provided in shallow dishes in each of the brooder boxes. Interest in food typically is not seen until day four at the earliest. This is the point at

which food dishes appear disturbed and offered insects are discovered pounded. No significant amount of food is actually consumed and visits by the chick to a food dish are infrequent and rarely seen at this stage. Because it is unlikely that there will be any substantial food consumption by the chick at this age, items that are likely to spoil quickly, such as hard boiled eggs, can be excluded from the diet.
The diet can then be offered once a day since servicing the brooder boxes can be stressful to the chick, particularly within individuals that demonstrate higher levels of nervous behaviors.

Chick Behavior

Maleo chicks can sometimes be initially unsteady on their feet when first released into a brooder box. Their coordination improves on its own within a day or two, post hatch. All maleo chicks are shy and may instantly cower in shelters at the slightest disturbance, and stay hidden for hours. Others are not quite as reactionary and will stay out in the open and remain perfectly still. Chicks should be making full use of both brooders within a couple of days.
The timing of when to move the chick to a larger space (i.e. flight cage) has to be assessed on an individual basis. Some chicks are clearly ready for a larger space by day three while others may need to stay in the brooder box for up to a week. At the WCS/Bronx Zoo, we typically move chicks to a flight cage on day five, although we

FIGURE 17: TWO ADJOINING BROODERS ALLOW THE CHICK TO BE SEPARATED FOR MAINTENANCE OR REDUCED STRESS DURING CAPTURE. PHOTO: JULIE MAHER©WCS

FIGURE 18: THE TOP OF THE BROODER IS NETTED AND COVERED WITH ARTIFICIAL FOLIAGE TO PROVIDE A SECURE ENVIRONMENT. PHOTO: JULIE MAHER©WCS

have also moved them earlier or later depending on the individual circumstance. If the chick is making repeated attempts at flight within the brooder box, or servicing the brooder is becoming difficult or stressful because of the actions of the chick, it is best to move the chick to a larger space rather than risk injury.

Day 5 – Day 90
Flight Cage Set-up

Once it has been ascertained that the chick is sufficiently alert and mobile it is transferred to a flight cage. The flight cage is set-up with the following criteria in mind: safety of the very unpredictable chick, providing an environment of security that is as stress-free as possible for the chick, and ease with which the space can be thoroughly disinfected and serviced by the care-taker while keeping the risk of excess microbial growth and associated disease to a minimum. With the exception of the wooden perches, no organics are used as part of the chick's environment. Every effort is taken to also maximize airflow within the enclosure and to keep the temperature within a range of 18-27°C.

The flight cage measures 1.72m X 4.34m X 3.25m high. These cage dimensions should be considered the minimum space requirement for a single maleo at this stage of development.

The ceiling of the flight is in actuality a soft mesh netting of 12.7mm gauge. The chick is very

likely to fly straight up if flushed. The mesh ceiling is an important preventative measure against trauma while the chicks are alarmed. The mesh netting that comprises the ceiling is pulled taut and secured along all of the walls of the cage.

Two high perches are fixed at either end of the cage at a height of at least 2.1m above the floor. One low perch is fixed in the middle of the cage at a height of 56cm above the ground. Diameters for perches used with chicks should fall within a range of 2.5 – 4.0cm.

The entire exterior of the cage, with the exception of the ceiling, is covered by dark-colored breathable shade cloth in order to give the chick as much privacy as possible. In addition, about 30% of the cage is covered by a shade cloth canopy suspended from either end of the cage at a height of 60cm above the ground. This extra cover provides a further layer of security encouraging the chick to forage on the ground with more confidence.

At least two A-frame type shelters, approximately 44cm high and 38cm wide, constructed of dark colored hard plastic are also provided. A small air-kennel is kept in the cage as well in order to condition and reinforce the chick inside the kennel.

The floor of the cage is lined with cushioned, breathable, Nomad (3-M, Saint Paul, MN) drainage mats. A tub, 43.2cm diameter and 12.7cm high, filled with triple-cleaned "playground sand" is provided. The sand tub is placed on top of the matting and is heated from underneath by an electric heating mat. A full spectrum light (Zilla Products, Franklin, WI 53132) measuring 43cm long is fixed just above the sand tub. The chicks are attracted to the warm sand for scratching and dusting bathing, and therefore benefit from the proximity to the full spectrum light. The cage is otherwise lit from the ambient light from fluorescent fixtures that filters into the cage, as well as skylights above the mesh ceiling. A single incandescent bulb outside of the cage serves as a nightlight so that there is always some ambient light that filters into the cage, and the chick is never in complete darkness.

Fresh water is provided daily in a dish measuring 22 X 12 X 5cm deep. Small grain oyster shell is also provided daily in a shallow dish.

As the chick ages and depending on the individual demeanor, the shade cloth covering on the front of the cage can gradually be raised. This allows the chick to have more visual access to both humans and conspecifics. As the chick becomes more comfortable with its environment, the amount of cover and shelters can be reduced. Sand is gradually introduced as the primary substrate once the chicks are several months old. By the time the birds are sub-adults they are typically calm enough to be housed in a manner similar to Galliforms that are more gregarious.

FIGURE 19: THE CEILING OF THE FLIGHT FITTED WITH A SOFT MESH TO PREVENT TRAUMA IF THE CHICK IS FLUSHED.PHOTO: JULIE MAHER©WCS

FIGURE 20: ONCE THE CHICK IS ALERT AND MOBILE, IT IS TRANSFERRED TO A FLIGHT CAGE. PHOTO: JULIE MAHER©WCS

Maintenance
A mirror image of the original flight cage is arranged in an adjoining cage, so that the chick can be shifted between cages in order to disinfect the housing without causing additional stress to the chick. All nonporous surfaces are disinfected with dilute bleach and all porous surfaces, including matting, are disinfected with a chlorhexidine diacetate solution. All matting and cage furniture are returned to the cage, as per original setup, once it is thoroughly dry. The sand is sifted clean, or replaced with fresh sand.

Shifting the chick between cages initially may be complicated, and cause a certain amount of stress to the young bird. Keeping the two cages as identical as possible, paying particularly close attention to the substrate/matting, will help the chick transition from one cage to another. Since very young maleo chicks do not eat large quantities of food, and they are kept in a very generous amount of space given their size, there is very little fecal matter to be concerned with during the first few weeks. The cage can be kept sufficiently sanitary with a thorough cleaning of only once per week to start. As the chick gradually becomes conditioned to the process and the need for cage maintenance becomes more frequent a recurrent cleaning schedule can be developed.

Diet Presentation
Food dishes that are used for chicks once they are transferred to the flight cage are shallow, round, stainless-steel dishes measuring 24cm diameter by 3.5 cm deep. These food dishes do not allow the escape of insects, which are used to attract the young birds to the diet. They are also stable enough for the birds to stand in without issue. Initially, when the chick is first transferred to the flight cage, two food stations are offered, one in the front of the cage and another in the back of the cage. The back of the cage can be easily accessed from a secondary door. If the back of the cage is not easily accessible then one food station at the front of the cage will suffice. Once the chick is reliably being attracted to the food dish at the front of the cage, the second food dish in the back of the cage is no longer offered, this usually only takes a few days.

The food dish is always placed on top of a platform that is 30cm x 30cm x 4cm high. These are the dimensions of the scale platform that is used to weigh the birds. Having them already conditioned to the platform will expedite the process of obtaining daily weights of the chicks. Obtaining a daily weight of the chick remotely is usually possible by day eight, or within a few days of being transferred to the flight cage. The platform or 'dummy scale' is replaced with a bench scale with a remote readout, once the chick is coming to the food dish with some regularity. Having a camera focused on the scale's readout is helpful when the chicks are very young and not very food motivated, as it

may take several hours for a chick younger than three weeks old to come to a food dish.

Once the chicks become food motivated, they will start the typical maleo feeding behavior of scratching and pounding at their food. They may start to make a mess of their diet very quickly and as housekeeping of the cage is limited by the chick's nervousness, transitioning them to a large food tub for better diet containment as soon as possible is recommended. Most chicks will transition to an adult-sized food tub by two to three weeks of age.

All maleo are attracted to trickling water, and the chicks are certainly no exception. Examinations of the stomach contents of specimens on Sulawesi revealed both species of land snails and freshwater snails, suggesting that the birds forage along riverbeds as well as the forest floor. It is helpful to run water lightly, from a hose for example, in the front of the cage. Very young chicks are enticed by the flowing water for drinking and are lured near the food station as a result.

Chick behavior

When a chick that is only a few days old is first transferred to a flight cage it may stay hunkered down inside the transfer crate for several hours or until it is nighttime. It is best to let the young chick emerge from the crate on its own to avoid triggering unnecessary stress. Some individuals, on the other hand, may bolt from the crate immediately upon release. Placement of cage furniture should be considered before opening the crate to avoid possible injury.

Agility of the chick at this stage is completely individualistic. Some are already strong flyers and can make it to all perches and even the cage ceiling instantly. Others are not as advanced and can only make very short distance vertical trips, or are uncoordinated at landing on perches. By the time they are transferred to the flight cage, at approximately five days of age, they should be navigating around well on the cage floor and able to at least make it up to the provided low perch to roost. Most will easily be able to roost on the high perches by the time they are a week old.

Maleo chicks are nervous and this behavior may be displayed in different ways by different chicks. Some chicks will flush repeatedly and fly as high as possible if threatened, some may pace on the ground or attempt to gain height by climbing. Some frightened chicks will hide in shelters, while others will freeze in plain sight. The first couple of weeks in the flight cage are the most stressful for the chicks, but in the end, they calm down or at the very least are not as intolerant of disturbance.

It is helpful, during this time, to keep human interaction with the chick brief, positive in nature and in a steady routine. The sooner the chick is conditioned to the presence of the caretaker the less stressful

any interactions will be for the chick. If kept in relative peace and quiet, maleo chicks will explore their surrounding with confidence and exhibit typical Galliform behaviors, such as foraging, dust bathing and preening.

A couple of behaviors exhibited by young birds require further explanation as they do appear to be unique to megapode chicks.

Unprovoked flushing: The chick quickly runs or bolts along the cage floor, frequently with one or both wings extended; maneuvering proficiently around cage furniture, then comes to a controlled and abrupt halt. This behavior may then be repeated. The movement of the chick is not in response to any detectable external stimuli and appears to be completely intrinsically motivated. A similar behavior has been noted to occur in captive malleefowl chicks. The behavior itself should not cause alarm or thought to be a sign of stress. On the contrary, chicks appear to require a certain level of comfort with their environment before engaging in the behavior. At the WCS/Bronx Zoo this behavior has been noted when chicks are approximately seven days of age. At this stage, these dashing behaviors are very short in both duration and in distance. The duration of a few seconds, a distance of two to three meters, and frequency of the behavior gradually increase as the chick ages but then dissipate again once sexual maturity is reached. The onset of the behavior by day seven is particularly interesting and calls attention to its significance, especially since it seems a very energy taxing behavior and birds at this age are still typically losing weight and not yet reliably consuming energy on their own. By the time the chick is a few weeks old it can frequently be seen running elaborate laps at full speed around the entirety of the cage weaving deliberately around all cage furniture. Chicks of varying ages housed together can engage in the behavior simultaneously. This illustrates the amount of control the young birds actually have when exhibiting the behavior. Three or more birds may all be bolting around a cage at full speed concurrently and they never make contact with cage furniture or each other.

The reasons behind the behavior are unclear but most likely are an adaptation of precocial nature of the chick is predator evasion. Although the behavior occurs daily, randomly, and in the absence of external stimuli, one mechanism does appear to cue it. When chick or chicks are shifted into a different cage for maintenance, upon return to their original cage they will almost certainly be prompted to bolt around the cage, weaving around furniture. It is unclear if they are somehow detecting the slightest change in the arrangement of furniture and therefore are re-learning, or if the behavior itself provides for a sense of confidence in their immediate environment. Until further research

is conducted, the behavior itself is probably best defined as a play behavior for the species. Every healthy maleo chick housed at the WCS/Bronx Zoo has regularly exhibited this behavior.

Knuckling: This term is used to describe the position in which maleo chicks will frequently hold their feet. When maleo chicks are standing they will regularly stand with one foot flush on the ground, while the other foot may have digits 2, 3, and 4 or any combination of them curled underneath, so that the dorsal surface of the digits that are "knuckling" are touching the surface of the ground. When this is happening the foot that is flush on the ground is bearing most of the bird's weight. This is a very common resting stance for maleo chicks. If the chick is forced to move locations quickly, it may take a couple of tentative steps, bearing weight on the dorsal surface of the digits. Bearing weight on the dorsal surface of the digits however, is rare and for the most part the chicks will stride with the normal positioning of digits. The behavior will occur regardless of the type of substrate, but doesn't appear to occur while the birds are perching. The behavior can be seen in birds that are only a few weeks old and continues into the time the birds are sexually mature. Adults can sometimes be seen with this posture, but not nearly as frequently as when they are chicks. Every maleo chick housed at the WCS/Bronx Zoo has exhibited this posture.

Socialization

Very little is known about the behavior and social habits of maleo chicks after emergence. However, like the other megapode species, certain effects of the novel breeding strategy would indicate a solitary existence during the first few weeks following emergence. The timing of a chick's first social experience with conspecifics is unpredictable due to the fact that chicks do not form bonds with their parents or clutch mates since eggs hatch asynchronously, in varying locations, and with the unlikelihood of parental attendance. Australian brush-turkey chicks have been shown to occasionally aggregate into small groups with other similar-aged chicks in both the wild and in captivity. Captive malleefowl chicks have also been successfully housed together in aviaries.

The social experience of a young megapode chick is an interesting one and one that has been studied somewhat extensively in the Australian brush-turkey. All social behavior patterns in chicks are innate occurring in the same form and frequency as adults when birds are housed together, the only behavioral difference being the use of and response to vocalization, chicks instead use primarily visual cues. Furthermore, Australian brush-turkey chicks do not appear to learn from conspecifics.
Maleo chicks are typically housed individually in the WCS/Bronx Zoo until they are three months old. At this age, healthy chicks are fairly calm and responsive to cues by the

FIGURE 21: LARGER NURSERY ENCLOSURES CONTAIN AMPLE PERCHING, THREE A-FRAME TYPE SHELTERS AND A SHADE CLOTH CANOPY.

FIGURE 22: THE CHICKS ARE PROVIDED WITH MULTIPLE HEATED SAND TUBS IN AT LEAST TWO DIFFERENT LOCATIONS.

caretaker so that if any particularly troublesome situations arise, it can be easily managed. Chicks at this age tend to be naturally more curious about conspecifics, will frequently posture towards each other, and occasionally begin to vocalize. By 90 days old the average daily growth rate has slowed somewhat so that any low-level stress, or competition over food during the introduction process will not have a drastic effect on the chick's development.

If housing more than one maleo chick together, regardless of age, it is best to afford them the largest space possible. At the WCS/ Bronx Zoo maleo groups of two or more chicks are housed in a cage measuring at least 4.34m X 3.66m X 3.25m high. This larger nursery cage contains ample perching at varying heights to accommodate for the number of chicks. At least three A-frame type shelters are provided as visual barriers for the birds. The exterior of the cage is lined with dark-colored breathable shade cloth, and a shade cloth canopy is fixed to cover approximately 30% of the cage at a height of about 60cm. The floor of the cage is lined with cushioned, breathable, drainage mats. Mesh netting acts as the ceiling to the cage to prevent trauma if a bird was to flush upwards. The chicks are provided with multiple heated sand tubs in at least two different locations. Multiple feed stations are provided depending on the number of chicks. At least two different water sources are provided as well. Before two chicks are physically introduced to each other, they are first housed in adjacent cages and given visual access to one another. An opening is made in the shade

cloth covering between cages and the interactions between the birds at that opening are monitored. Very young chicks will sometimes cower away from the opening and avoid any interfaces with conspecifics. By the time the chicks are a few months old they are instead drawn to the opening and show great interest in conspecifics.

Birds at this age primarily use visual cues to communicate and the body language they use to assert dominance is identical to that of adults. Dominance seems to have little to do with the age or sex of the chicks and more to do with the individual demeanor of the birds. It does seem that, at least anecdotally, chicks that are somewhat calmer when they are very young and those that are quicker to tolerate human presence transition into a group setting than those who are more skittish and reactive to human disturbance. A stable hierarchy within the group will usually develop on its own within a few days. Birds at this age will rarely cause physical harm to each other but initial interactions must be monitored closely so that no individual bird is over-stressed or being kept from foraging. If a chick is being consistently chased or aggressed by a conspecific removing the aggressor temporarily is the best solution. Building up confidence and a feeling of security in the more submissive chick will generally dissipate the antagonism. This is especially important at nighttime, as birds that have become tolerant of each other on the ground, will frequently battle over preferred roosting perches at night. A submissive and naïve chick should be afforded at least one night in relative solitude in order to learn the perching lay outs of a new cage before the added pressure of conspecifics. The aggressor can then be reintroduced back into the group setting regularly until the behavior is no longer an issue.

From the age of about six months on the young birds gradually become much more of a cohesive group. Birds housed together will rarely be seen on their own and will engage in almost all activities as a group. If given multiple feeding stations they will choose to only eat from one at a time, foraging as a group, before moving on to the next feed station as a group. The use of vocalizations becomes much more frequent at this stage as well. Birds that may still be a little more nervous than others may, calm down considerably whilst they are in the group setting, and become much more tolerant of human interactions if they are in proximity to conspecifics.

Targeting

It can be challenging to manage the behavior of very young maleo chicks, as they are so intolerant of human presence. Even once the chicks have become sufficiently food motivated, it can be difficult to bridge reward and behavior since chicks are so innately shy of humans. It has been helpful at the WCS/Bronx Zoo to use a target of sorts to condition young chicks.

FIGURE 23: MULTIPLE FEED STATIONS AND WATER SOURCES ARE PROVIDED IF MULTIPLE CHICKS ARE PRESENT.

As soon as the chick has begun to eat, it is ascertained what the most preferred food item is. Sometimes it is peanuts, but insects, especially wax worms, will typically work best for most chicks. The preferred item is then only offered in the target. The target is a small shallow cup measuring approximately 7cm in diameter with an easily recognizable contrasting color. The chick quickly makes the association between the target and the food item. The target can then be placed wherever it is desired for the chick to go: inside of kennels, different cages, even different perches. Chicks younger than two weeks are routinely conditioned inside of kennels using the target. Young birds will stay motivated by the target for quite some time, however, once the chicks are several months old, they will regularly begin to move the target on their own and the object then loses its function. By this stage, the birds have become tolerant of human presence, and more traditional methods of behavior management can be employed.

Diet and weight

It is believed that since megapode chicks are completely independent of the time they hatch, they survive off their yolk reserves for several days post hatch and therefore require very little food during this time. Thus, the birds will initially lose weight for several days post hatch, before beginning to gain weight. This has been documented in both Australian brush turkeys and Malleefowl. Maleo hatched at the WCS/Bronx Zoo from artificially

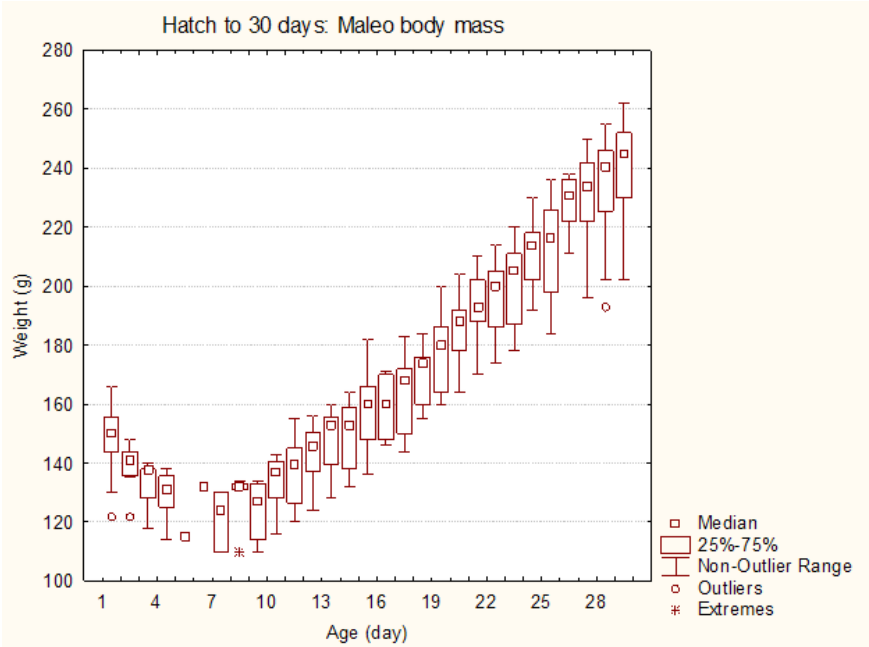

FIGURE 24: WEIGHT GAINS (G) OF CAPTIVE REARED MALEO AT WCS/BRONX ZOO; 0-30 DAYS OF AGE (N=17). INITIAL WEIGHTS WERE TAKEN VIA HAND CAPTURE; WEIGHTS AT ≥5 DAYS OF AGE RECORDED USING A REMOTE VIDEO CAMERA AND FEED STATION MOUNTED ON AN ELECTRONIC BALANCE.

incubated eggs typically begin to show a positive change in weight at approximately day 10, post hatch. Most have either reached or surpassed their hatch weight between days 14 to day 17, post hatch. The prolonged time before weight gain is achieved may seem remarkable even when compared to other megapode species, but it is important to note that these hatchlings have not been afforded the energetically taxing process of digging to the surface. It is also important to consider the space that the chick is housed in: chicks that are housed in flight cages with roosting perches will have greater calorie demands than those kept in smaller spaces without the facility to fly or perch.

A study in 2011 demonstrated that maleo chick growth could be accelerated by feeding a high-protein diet. At the WCS/Bronx Zoo maleo chicks first start to show interest in food at around day four or five, but significant food consumption typically does not begin until they are at least one week old. Like most megapode chicks, they have a definite inclination towards live food when they are very young. Preference for insects begins to wane for most chicks once they are a few months old. Some chicks also have an

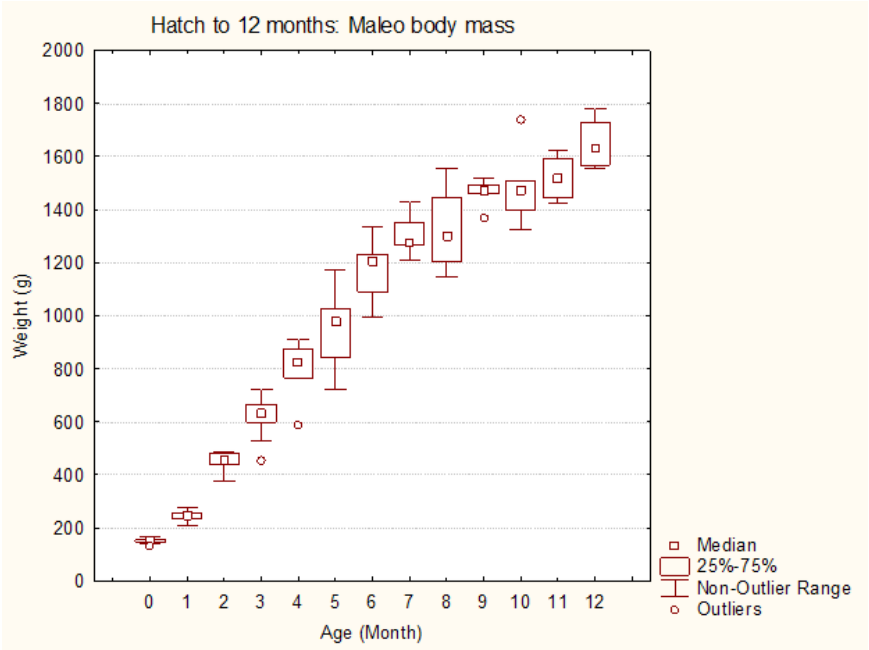

FIGURE 25: WEIGHT GAINS (G) OF CAPTIVE REARED MALEO AT WCS/BRONX ZOO; 0-12 MONTHS OF AGE (N=17). INITIAL WEIGHTS RECORDED VIA HAND CAPTURE; WEIGHTS OF ≥5 DAYS OF AGE RECORDED USING A REMOTE VIDEO CAMERA AND FEED STATION MOUNTED ON AN ELECTRONIC BALANCE.

immediate predilection for peanuts as well, but for others it may take several weeks before peanuts will be consumed.

Once comfortable in their environment, chicks will forage along the cage floor pecking at anything unusual. Keeping insects in a food dish will keep their attention focused on the offered diet. Very young maleo chicks have a common habit of pounding and hammering on a food item repeatedly without ever eating any of the delectable pieces that were generated in the process.

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

Starter crumble	Hard-boiled egg	Softbill	Diced greens	Insects*	Peanut*	Dog kibb
Week 1	X	X	X	X	X	X
Week 2	X	X	X	X	X	X
Week 3	X	X	X	X	X	X
Week 4-12	X	X	X	X	X	X
Week 13-16	X		X	X	X	X
Week 17-24	X		X		X	X
Week 25-32			X		X	X
Week 33-52			X		X	X
1 year						Adu

TABLE 6.2 – DIETARY ITEMS OFFERED TO MALEO CHICKS AT DIFFERENT A

*Young chicks will preferentially consume insects and/or peanuts. These items are limited in very young chicks so that the chick consumes a more nutritionally complete diet. For the first month, each chick is offered no more than 18 insects, consisting of a combination of mealworms, wax worms and crickets, per day and no more than 1.0g of peanut per day.
**Dog kibble offered to chicks under 2 months old is first soaked in water to thoroughly soften it. The softened kibble will be easier for the chick to pound, break-up, and consume.

Additional supplements
Chicks are given a multivitamin solution (Ecotrition Vita-Sol™) daily until the age of 12 weeks.
All offered diets are always dusted with CaCO3.

le**	Fruit/ vegetable mix	Primate diet	Avian pellet	Pigeon seed	
	X				
	X	X			
	X	X	X		
	X	X	X		
	X	X	X	X	
	X	X	X	X	
	X	X	X	X	X
lt diet					

GES

Maleo should be evaluated daily by animal care staff for any signs of illness and evaluated by veterinary staff as needed when signs of illness persist. Veterinary evaluation should occur on an as needed basis. There are no veterinary resources available which specifically address care of Megapodes. However, general avian texts and those specific to Galliformes, of which the Megapodes are members, are helpful to consult.

Drugs used without adverse effects include meloxicam, metronidazole, enrofloxacin, doxycycline (Vibramycin®), vitamin B complex, ceftiofur crystalline free acid (CCFA) , itraconazole, terbinafine, ivermectin, and fluids (2.5% dextrose and 0.45% saline, lactated ringers or 0.9% saline).

Administration of meloxicam, enrofloxacin, doxycycline (Vibramycin®) and ceftiofur crystalline free acid are subcutaneously or intramuscularly. Vitamin B complex and ivermectin are administered subcutaneously. Itraconazole, terbinafine, and metronidazole are administered orally. Fluids can be administered subcutaneously or intravenously. Injectable medications are administered by veterinary personnel; oral medications are administered by animal keepers.

No specific safety hazards are associated with these medications. Specific information about side effects of overdosing of these medications can be found in Plumb's Veterinary Drug Handbook, Saunders Handbook of Veterinary Drugs, or similar veterinary literature.

Identification

Ensuring that Megapodes are identifiable through various means increases the ability to care for individuals more effectively. Animals must be identifiable and have corresponding ID numbers whenever practical, or a means for accurately maintaining animal records must be identified if individual identifications are not practical.

The current method of identification of the Megapodes is with colored plastic (celluloid) poultry bands (Plastic Bandettes size 9) which have an interior diameter of 13-15 mm. These are typically placed when chicks are approximately 4 months old or 750 grams in weight. Two of the adults also have metal bands which were placed at previous institutions. Transponders are used (intramuscularly in the pectoral musculature or subcutaneously) at the WCS/Bronx Zoo.

To identify chicks prior to permanent banding, food coloring applied to the feathers and breakaway plastic bands have been used but these bands tend to have

a short retention time (about 7 days).

Prior to the transfer of animals, a physical examination and weight, as well as blood collection for a complete blood count and chemistry panel, is recommended. If desired, West Nile Virus titers or vaccination can also be performed. No other specific testing is recommended.

No reference ranges are available for blood values in maleo. Adult maleo weights at the Wildlife Conservation Society's Bronx Zoo have ranged from 1.6 kg to 2.2 kg.

Quarantine
WCS/Bronx Zoo utilizes holding facilities or procedures for the quarantine of newly arrived animals and isolation facilities or procedures for the treatment of sick/injured animals.

Quarantine procedures which can be used to prevent zoonotic disease transmission include the use of footbaths and disposable gloves when handling animals or cleaning enclosures. If aerosolization of dried feces is expected to occur during cleaning, wearing a mask is recommended.

There are no specific disinfection techniques which are more frequently used than others. Use of disinfectants according to package instructions with regards to dilution, contact time and animal safety is recommended.

Quarantine of Megapodes should be performed as for all other avian species with quarantine duration of 30 days. If an avian species enters a quarantine facility with quarantined megapodes, the megapodes would remain in the quarantine facility until all animals in that facility have completed a minimum of 30 day quarantine period.

Diagnostic testing typically performed during quarantine includes blood sample collection to evaluate a complete blood count and chemistry panel. Fecal samples are also collected at weekly intervals for direct evaluation as well as a fecal float for parasite identification. Three fecal samples are typically collected during quarantine. A fecal culture is also performed during quarantine.

Ectoparasites have not been identified in the Megapodes at the WCS/Bronx Zoo. Gastrointestinal parasites identified via fecal examination consist of flagellates and amoebic cysts. Gastrointestinal parasites are typically treated with oral metronidazole administered at 20 mg/kg orally. There are no recommended vaccinations for this species. West Nile Virus vaccination (1 mL intramuscular) has been administered infrequently at this institution.

Megapodes would be released from quarantine if they are apparently healthy based on a physical examination, negative fecal examinations, and unremarkable blood work parameters.

Preventive Medicine
Preventative medical procedures include physical examinations, weights, and blood collection for complete blood count and chemistry panels. Weights should be obtained every 6-12 months if possible as weights are an important monitoring parameter. These birds can generally be trained to step onto a scale so manual restraint is not required. Due to the inherent stress associated with manual restraint in these birds, physical examinations and/or blood collection are only performed opportunistically when animals are transferred to other locations within the zoological park. These procedures are also performed prior to shipments or as part of a health assessment if birds are displaying clinical signs of illness. Fecal samples are collected yearly to monitor for gastrointestinal parasites.

Maleo chicks are precocial and require no parental care. These chicks also lose weight for the first five days post hatch. However, these animals can be susceptible to umbilical infections and subsequent septicemia. Thus, antibiotic administration after hatching may be prudent and can be continued for 5-14 days depending on the appearance of the umbilicus, demeanor, and clinical signs. Antibiotics utilized in chicks at the Wildlife Conservation Society's Bronx Zoo include enrofloxacin and doxycycline (Vibramycin®). Currently, chicks hatched at the Bronx Zoo are not receiving prophylactic antibiotic treatments unless clinical signs indicate this is needed.

Zoonotic disease transmission is uncommon when working with Megapodes. However, these birds are in the Galliformes order so should be susceptible to diseases such as Salmonella spp., Chlamydia psittaci, and Mycobacterium sp. which are all zoonotic and have been documented in other avian species in this order. These diseases have not been documented in Megapodes.

Prevention of zoonotic disease transmission can include the use of footbaths between enclosures as well as use of disposable gloves when handling birds or cleaning enclosures. If dried feces are being aerosolized when cleaning, wearing a face mask is recommended.

If keepers are working with both healthy and quarantine animals, footbaths should be utilized between enclosures and keepers should change gloves and wash their hands between enclosures. If clothing becomes heavily contaminated when working with birds, clothing should be changed as well but otherwise clothing changes are likely not necessary. Quarantine animals should always be serviced after healthy animals.

There are no specific disinfection techniques which are more frequently used than others. Use of disinfectants according to package instructions with regards

to dilution, contact time and animal safety is recommended.

There are no recommended vaccinations for Megapodes. However, if desired, birds can be vaccinated with West Nile virus vaccine (1 mL intramuscular). A subset of adult birds has received one West Nile virus vaccination but subsequent vaccinations were not given. Administration of West Nile virus vaccination is not routine in Megapodes at this institution.

Management of Diseases, Disorders, Injuries and/or Isolation

Behavioral indicators of disease in Megapodes are similar to any other avian species. Specific clinical signs to look for include decreased or loss of appetite, lethargy, fluffed appearance, unwillingness to move/ambulate, lameness when ambulating, and difficulty breathing.

Animal care staff should alert their supervisor if there are concerns about a Megapode's behavior and the veterinary staff can then be informed, if this is deemed necessary. After an evaluation by a veterinarian, a course of treatment or monitoring can be implemented depending on disease severity.

Few disease processes have been noted in the Megapodes. The most concerning disease concerns occur in chicks. Initially, maleo chicks were successfully hatched but they were hatched with an open umbilicus. These animals were treated with antibiotics enrofloxacin (5-15 mg/kg SC or IM with or without fluids) and betadine on the umbilicus. Despite this therapy, four of six chicks died (3 of sepsis related to an open umbilicus and 1 of a patent urachus with failure to internalize the yolk sac). Thus, a more aggressive antibiotic protocol was instituted including enrofloxacin initially and then doxycycline (Vibramycin®) (70-75 mg/kg SC q7 days) for 2-4 doses. Over the next four years, only one of nine chicks hatched died of sepsis related to an open umbilicus although the diagnosis of an open umbilicus was still common in the hatched chicks. Thus, the incubation parameters were modified to increase incubation temperature and subsequently incubation time by two weeks. After that change in incubation was instituted, eleven chicks have been hatched and none had an open umbilicus diagnosed. Less aggressive antibiotic treatment was instituted in ten of these chicks which included betadine on the umbilicus, enrofloxacin SC or IM with or without fluids for 3-5 days and one injection of long acting doxycycline (Vibramycin®) SC when these chicks were moved to a larger enclosure. The doses are listed above. Currently, we are no longer routinely treating chicks with antibiotics post hatch and one chick has been successfully reared without antibiotics since that change was initiated. The only complication associated with antibiotic therapy was irritation at the enrofloxacin injection site

in one individual which resolved without further treatment. Curling toes were documented in one chick but resolved when the perching in the enclosure was modified. Hospitalization of chicks is uncommon but could be done since chicks are solitary for the first few months of life. Other causes of death in chicks less than one-year-old include trauma (3 cases) and fungal pneumonia and/or airsacculitis (3 cases) with subsequent sepsis in 2 of those cases. Of the three cases with fungal pneumonia, two died acutely without clinical signs while the third had nonspecific signs including lethargy, diarrhea, regurgitation, and decreased appetite. This animal was treated with enrofloxacin (10 mg/kg), meloxicam (0.1 mg/kg), metronidazole (20 mg/kg), SC fluids (30 ml/kg) and terbinafine (20 mg/kg) but died despite supportive care. This animal also had a gastrointestinal foreign body but this was thought to be incidental.

Adult maleo seem to be fairly healthy. Adults have been diagnosed with occasional gastrointestinal parasites (flagellates and amoeba) which are treated with metronidazole (20 mg/kg PO). Musculoskeletal injuries including lameness due to soft tissue injury treated with oral meloxicam (0.1-0.3 mg/kg) and avulsion of toenails which are treated with quickstop or silver nitrate sticks, if hemorrhage is severe, and meloxicam (0.1-0.3 mg/kg PO) if lameness is associated with the toenail injuries. These birds can also be prone to stress so when moved between different facilities they are prophylactically treated with oral itraconazole (10 mg/kg) for 7 days. Two adults had episodes of dyspnea and were treated with terbinafine (20 mg/kg PO SID). One died during an anesthetic work up and was found to have severe Aspergillosis. The other bird survived the dyspnea but died five months later due to trauma. One adult had a mass present on the ventrum which was not surgically resectable. This animal was treated with ceftiofur crystalline free acid (20 mg/kg SC), meloxicam and subcutaneous fluids. No other health problems have been documented in this collection. The diseases listed above generally do not result in hospitalization of these animals.

Avian care staff should be trained to recognize abnormal behavior and signs of illness in Megapodes. Regular assessments of all birds should be made daily to monitor nutritional, physical and social conditions. Daily observations should be recorded, especially with regards to physical abnormalities or behavioral changes. Training can also be implemented to monitor social interactions between birds, stereotypic behaviors, diet consumption, and behavioral abnormalities.

Chapter 8. Conservation and Research

Conservation past and present

The maleo is one of Sulawesi's most extraordinary and celebrated endemic birds. The concentrated, communal nesting grounds of the maleo allows pressures from habitat loss, uncontrolled harvesting of eggs, increased hunting of adult birds and the introduction of predators such as dogs and rats to lead to rapid population declines. In 2002, the IUCN listed this species as Endangered, based on the declines in populations and increased risk of extinction. Based on evolutionary distinctness, along with assessments of habitat risk, range size, maleo have been designated as a high priority taxon in terms of conservation value. Identification of conservation efforts, including protection of habitat through analysis of ecological criteria and community awareness programs, are underway. Initial work began near Panau to protect maleo eggs and continued in the Dumoga Bone National Park in the 1980's. The Nature Conservancy began a project in Central-Sulawesi in and around Lore Lindu National Park in 1992, with other programs, such as the Alliance for Tompotika Conservation work beginning in 2006. The Wildlife Conservation Society's Indonesia Program launched in northern Sulawesi in 2001, to increase local programs throughout the region. Activities in South and South East Sulawesi are limited due to access and less favorable conservation research activities.

The Wildlife Conservation Society, Indonesia Program, began protecting maleo nesting grounds in Bogani Nani Wartabone National Park in 2001. The program started in the Tambun and Muara Pusian nesting grounds, both in the area of Bolaang Mongondow, North Sulawesi, and then later in the Hungayono nesting grounds in Bone Bloango, Gorontalo province. This program has expanded to include a maleo protection program at Binerean beach, in South Bolaang Mongondow District, North Sulawesi. The goal of this program is to purchase and secure important sites that contain nesting grounds for endangered sea turtles and maleo. These programs provide protection to these areas and encompass 1,255 adult maleo pairs that visit the four sites. Between 1APR2011 and 25AUG2013, 1,889 eggs were laid and 806 maleo chicks hatched and entered the forest. Outreach and awareness activities at villages, national parks and district levels are underway.

The first use of semi-artificial hatcheries was started in 1972 at Tanjung Panjang, in North Sulawesi. This involved the harvesting of freshly laid eggs at nesting sites and transferring them to nearby protected areas, which are also similarly heated, by geothermal sources. Analogous programs developed for both conservation attempts and research at inland nest sites at Tanbun and Tumokang throughout the 1980's and 1990's.

Of the four nesting sites (Tanbun, Muara Pusian, Hungayaono, and Binerean) that WCS has worked at within the last 10 years all but the coastal Binerean site employ the use of artificial hatcheries to protect eggs and hatchlings from predators and poachers. Hatching success rates at the hatcheries vary each year, as they are affected by natural variation in weather conditions, but are around 50%. Recent conservation attempts using an ex-situ strategy for egg incubation have proven to be more effective at hatching success. Integrating and coordinating research and conservation endeavors from both local universities on Sulawesi, the island of Java, and collaboration from the international community is considered an important key to the successful conservation of this species.

Concentrating resources in the district of Bolaang Mongondow Selatan, in North Sulawesi, WCS Indonesia Program is purchasing coastal properties that contain nesting grounds for green turtle, Chelonia mydas, leatherback turtle, Dermochelys coracea, and olive ridley turtle, Lepidochelys olivacae. In conjunction with the sea turtle nest sites, these areas are important to maleo, and are threatened by unsustainable egg collection. While there is legal protection for all of these taxa, egg harvesting, for food, continues. Protection for nesting areas is significant, but it is also imperative to provide corridors to the inland forests, where the maleo range.

Almost 75% of the known nesting grounds, for the maleo, have been abandoned in the last 20 years. In North Sulawesi, there are 36 remaining nesting sites, with six of these experiencing anthropogenic pressures. WCS is targeting six of these nesting areas for land purchases, due to clear land status and relatively good condition of the surrounding forest. These land purchases are the most effective and cost-effective strategy for the long-term protection of beach nesting sites. The combination of land purchases, coupled with employment of full-time wardens is sufficient to reduce or discontinue illegal egg collection.

As of September 2013, WCS Indonesia Program had purchased an additional 950 meters/1.74 ha of important sea turtle and maleo nesting grounds on the beaches of Cape Binerean. This represents ≈17% of the targeted areas, which consists of 6.2 kilometers of beach in total. Continued efforts to purchase the remaining targeted beachfront properties are critical to the long-term protection of the habitat required for the survival of these animals.

Research needs

There is much yet to be learned about maleo biology if conservation attempts are to be successful in the long run. Physiology, mortality, diet, husbandry, and social structure are all areas of study that need to

be expanded for the species. As it remains now there are far more questions than answers on all fronts. Thousands of maleo chicks that have hatched in semi-artificial hatcheries or protected nesting grounds have been released on Sulawesi but virtually nothing is known about their survivability after release. It is therefore difficult to say how effective conservation strategies are in actuality. In situ and ex situ research should be prioritized to both quantifiable measures and improve both hatchability and survivability of maleo eggs and chicks.

Most of the information gathered on megapodes chick behavior has been learned through the study of the Australian brush-turkey. Megapode chicks are a particularly fascinating bird to study because of their superprecosity. It should be noted, however, that although megapode chicks are independent and particularly adept, the common feeling is that chick mortality is high under natural conditions. Post emergence mortality for the Australian brush turkey chick was found to be 90% and 97% in two consecutive breeding seasons. Chick mortality for the Australian Brush turkey was found in another study to be 88-100% before 3 weeks of age. Work has been done on aspects of predator recognition, foraging preferences, the behavior of hatchlings while underground, chick survival and habitat preferences, the ontogeny of social behavior, and the importance of both visual and auditory cues for young birds. How analogous these findings are to maleo chick behavior should be evaluated to ensure the best survivability of hatchlings.

Of course, one of a fascinating characteristics of megapodes is their incubation biology. The extreme length of the incubation period and the viability of the embryo over a wide range of parameters are unprecedented in any other avian taxa. The situation provides for a generous amount of research opportunities on incubation dynamics. Case in point, an intriguing study on Australian Brush-turkeys showed that there could be a temperature dependent sex ratio. Megapode incubation is similar to reptile incubation, and temperature dependent sex determination has been documented in several reptilian species. However, sex in megapodes, like all birds, is genotypically determined at the point of fertilization. In the study, it was found that more males hatch at lower incubation temperatures, and more females hatch at higher incubation temperatures, with a 1:1 sex ratio at the median optimal temperature. The reasoning behind this is mortality increases at both ends of the temperature spectrum, with male embryos being favored for survival in the lower temperature range, and female embryos being favored for survival in the higher temperature range. It should be noted that the phenomenon only occurred for eggs in which

the incubation temperature was manipulated during the first phase of incubation. Australian brush-turkeys are mound builders, which mean that to a certain degree the parents can influence the resulting sex ratio of their offspring: the male by maintaining the mound temperature, and the female by selective placement of the egg at the time of laying within the mound. Incubation effects like this should be explored for the maleo. Chicks that hatch as a result of semi-artificial hatcheries and ex-situ incubation attempts should be sexed to ensure that incubation parameters are not skewing the sex ratio of chicks released into the wild. Burrow nesting species of megapodes have no control over incubation parameters once the egg has been laid. Volatile climactic fluctuations may have a dramatic effect on future population dynamics for some of the more isolated species.

Additionally, it was found that, with Australian brush-turkeys, incubation temperatures influence the mass but not the size of hatchlings, chick weight increased significantly with incubation temperature. The amount of residual yolk of the hatchling is responsible for the weight differential. Chicks incubated at lower temperatures will take longer to hatch and will weigh less due to a smaller amount of residual yolk. The lighter chicks will then be at a disadvantage while digging to the surface and in ultimate survival during the first month. If optimal incubation parameters for the maleo can be assessed, with a particular focus on chick survivability, then ex situ eggs harvested for incubation, and release conservation strategies may result in a more prolific overall outcome.

Acknowledgement
The Maleo Program and subsequent documentation is a culmination of four decades of work at the Wildlife Conservation Society (WCS). We would like to thank the multitude of WCS staff that has dedicated themselves to the care and conservation of these birds. In particular, we would like to acknowledge the support of Dr. William Conway and leaders of WCS that followed. We also would like to thank Dr. Bonnie Raphael, Ken Huth and Christine Sheppard for reviewing this manuscript and providing editorial direction. The success of the program and production of this manuscript would not have been possible without the effort of all of those involved. Thank you.

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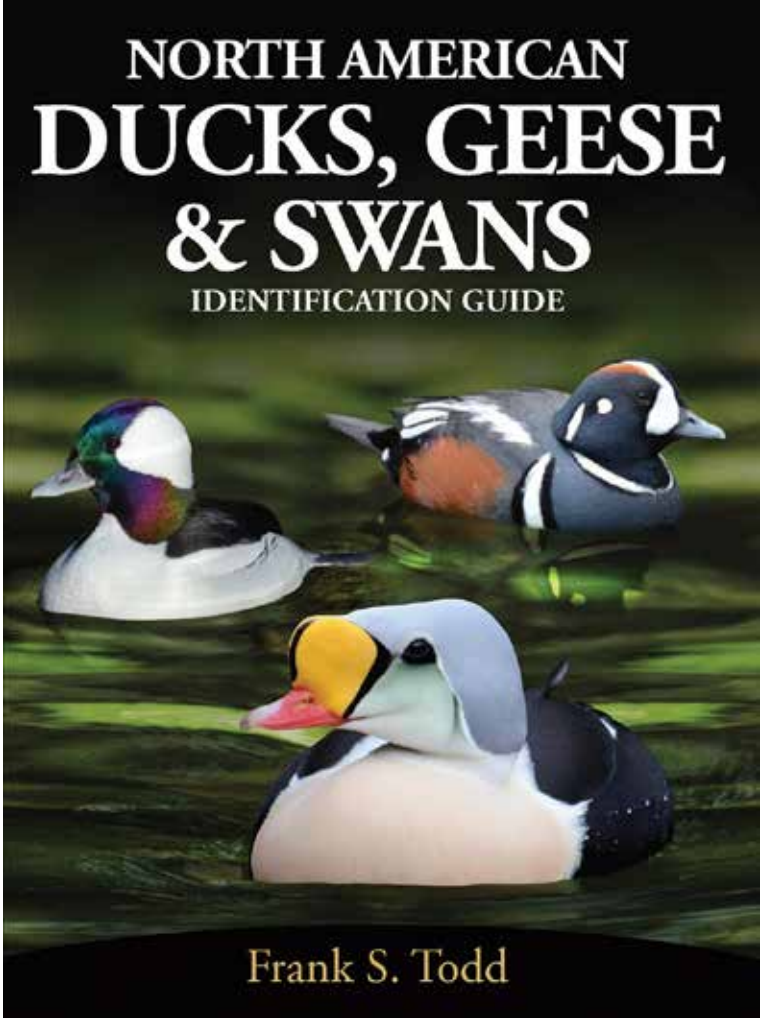
Who's Your Daddy?

Stumped? See answer on page 42



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FEMALE ECLECTUS *ECLECTUS RORATUS*, PHOTO DAYLE JORDAN, AUSTRALIA

Who's Your Daddy?

From page 39, Answer: Eclectus parrot (Eclectus roratus)

The eclectus parrot (Eclectus roratus) is a parrot native to the Solomon Islands, Sumba, New Guinea and nearby islands, northeastern Australia, and the Maluku Islands (Moluccas). It is unusual in the parrot family for its extreme sexual dimorphism of the colours of the plumage; the male having a mostly bright emerald green plumage and the female a mostly bright red and purple/blue plumage. Joseph Forshaw, in his book Parrots of the World, noted that the first European ornithologists to see eclectus parrots thought they were of two distinct species. Large populations of this parrot remain, and they are sometimes considered pests for eating fruit off trees. Some populations restricted to relatively small islands are comparably rare. Their bright feathers are also used by native tribespeople in New Guinea as decorations.

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

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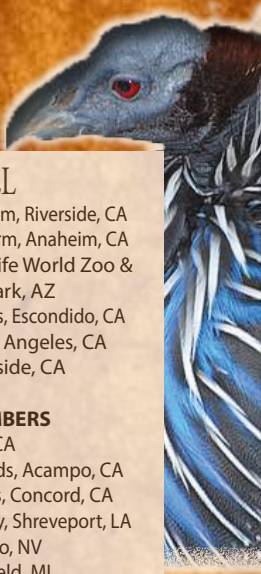

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