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Husbandry of the Indochinese Box Turtle (*Cuora galbinifrons*: Geoemydidae) at Woodland Park Zoo

Since the late 1990s, conservationists have warned about the effects of unsustainable pressures such as habitat alteration, over collection for human consumption, and the traditional medicine and pet trades on the world's chelonian species (van Dijk 2000; Parham et al. 2001). Although habitat preservation is preferred for slowing the global decline of turtle populations (Seigel and Dodd Jr. 2000), the magnitude of threats facing Asian turtles makes *in situ* efforts alone unlikely to curb the tide of extinction. As such, the chelonian conservation community (e.g., the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group) has advocated for an integrated management approach including establishment of assurance colonies and breeding programs, habitat conservation, enforcement of existing laws to combat illegal collection and trade, and development of local community awareness (Rhodin et al. 2011).

Semi-aquatic geoemydid turtles in the genus *Cuora* are small to medium sized and inhabit rainforests in south and east Asia. They also are among the world's most endangered chelonians, making them a top priority for conservation breeding efforts (Rhodin et al. 2011). Like most members of the genus, the Indochinese Box Turtle (*Cuora galbinifrons*) is categorized by the IUCN as Critically Endangered (McCormack et al. 2016). This species inhabits high altitude (300–1000 m) closed-canopy, broadleaf, evergreen forests (Blanck 2013) on Hainan Island and Guangxi Province in southern China, northern and central Vietnam, northern Laos, and Cambodia (Wang et al. 2011). *Cuora galbinifrons* is assigned to the clade also containing *C. bourreti*, and *C. picturata,* and collectively are referred to as the Flower-Backed Box Turtles. Like other members of this lineage, *C. galbinifrons* has low annual fecundity, laying one to three eggs per year in human care (Struijk 2010) and in the wild (McCormack et al. 2016). The species also has slow growth to maturity (10–15 years). Its carapace can be shades of rust, yellow, and brown, making it a highly attractive turtle which demands high prices in the illegal wildlife trade (Hendrie 2000, Stuart and Timmins 2000). The slow maturity and low reproductive output of *C. galbinifrons* contribute further to its increasing scarcity in the wild. As early as the 1960s, Indochinese Box Turtles began arriving in the western pet trade (Rhodin et al. 2011). In the late 1980s and early 1990s, Indochinese and other Asian box turtle species continued to be imported into Europe and the United States in large numbers (J. Pramuk, pers. obs.). Many of the imported wild-caught animals did not acclimate well and did not live beyond their first year in captivity; however, those that have survived have adapted well, but with generally low reproductive success. The former influx of wild-caught *C. galbinifrons* into the United States has slowed significantly, due in part to it being listed as CITES Appendix II in 2000; however, it is still being collected in large numbers in Vietnam, Lao PDR, and potentially Cambodia for sale in markets in Vietnam, Hong Kong, and China (Hendrie 2000; Stuart et al. 2011).

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The conservation organization Turtle Survival Alliance recently bolstered the North American population with the recent importation and acquisition of 105, wild-caught, long-term privately-owned Flower-Backed Box Turtles (*Cuora galbinifrons*, *C. bourreti*, and *C. picturata*) from Hong Kong (Hagen 2015). Additionally, there are global, concerted breeding efforts in European zoos (managed by the European Associations of Zoos and Aquaria) and at the Turtle Conservation

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Fig. 1. During most of the year, adult turtles were housed individually in a Vision® cage, similar to the one illustrated here, measuring 91.4 cm x 134.6 cm.

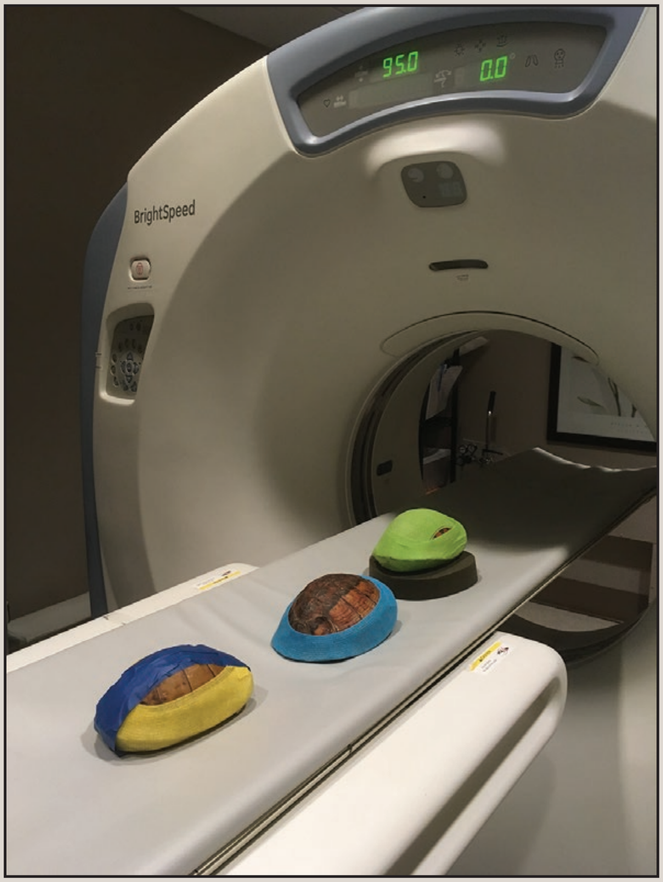

Fig. 2. The breeding trio of *Cuora galbinifrons*, just prior to computed-tomographic scanning at the Center for Diagnostic Imaging, Seattle, Washington. During the procedure, no sedation was used, however the turtles were wrapped in 3M VetRap® bandaging tape to limit movement during the procedure.

Center in Cuc Phuong National Park in Vietnam (Rhodin et al. 2011). Husbandry advancements over the past two decades have indicated that conservation breeding programs might become a viable option for assuring the long-term survival of these species.

In North America, Flower-backed Box Turtles (*Cuora galbinifrons, C. bourreti*, and *C. picturata*) are managed through programs within the Association of Zoos and Aquariums (AZA) (Augustine and Spevak 2018) as a Species Survival Plan (SSP). As of May 2016, the AZA regional studbook reported the North American population consisted of 43 males, 77 females, and 17 juveniles of unknown sex (Augustine 2016). This relatively small population demonstrates the rarity of individuals in human care and the importance of every specimen to the population's long-term genetic sustainability. Yet, little has been published on the specifics of *C. galbinifrons* husbandry (Petzold 1965; Buskirk 1988; de Bruin 1994; Baker and McCord 2001; Hiller 2005). Some herpetoculturists have reported husbandry obstacles such as low fertility and hatchability in their programs (Fritzsche and Fritzsche 2005; Hiller 2005) perhaps as a result of not hibernating breeding pairs and/or suboptimal incubation parameters. Herein, we provide detailed data on the husbandry program (including dietary, breeding, and incubation data) for *Cuora galbinifrons* at Woodland Park Zoo (WPZ) in Seattle, Washington, USA.

Table 1. Clutch size and hatch rate for *Cuora galbinifrons* at Woodland Park Zoo. Fertility was determined upon dissection and examination of unhatched eggs, approximately two months after close of hatch window.

Year of oviposition	Clutch size	# Hatched	% Fertile	% Success
2013	1*	0	0	0
	1	0	0	0
2014	3	1	33%	33%
	1	0	0	0
2015**	2	0	0	0
	2	0	0	0
	1	1	100%	100%
	1	0	100%	0
2016	2	1	100%	50%
	2	2	100%	100%
	1	1	100%	100%
2017	1	0	100%	0

*The first egg laid in 2013 was found broken in the enclosure.
**The turtles were first hibernated in 2015.

Specimen History at Woodland Park Zoo

Woodland Park Zoo (WPZ) acquired its first breeding group (1.2.0) of Indochinese Box Turtles in the fall of 2012. The male (WPZ 204465) had a carapace length of 188 mm, width of 151 mm and mass of 1235 g. One female, WPZ 204466 had a carapace length of 181 mm, width of 117 mm and a mass of 926 g. The second female, WPZ 204467 had a carapace length of 174 mm, width of 130 mm and a mass of 1046 g. This breeding trio arrived to WPZ from a member of the public, a hobbyist with strong expertise in chelonian husbandry and natural history who kept these turtles for more than 10 years. These wild caught turtles were imported legally to the United States from Hong Kong in 2001. The collection locality of these turtles is not noted on the CITES import permit, but their species identification was verified as *C. galbinifrons* (vs. a hybrid of *C. bourreti* and/or *C. picturata*) via DNA analysis (Augustine, pers. comm.). During their first decade in human care, the trio had not produced viable offspring, although their owner reported that she had at least one late-term embryo death (J. Lindell, pers. comm.). Woodland Park Zoo has successfully produced viable offspring from the pairing of female WPZ 204466 with the male in 2014 (1 hatchling), 2015 (1 hatchling), and 2016 (4 hatchlings) for a total of six offspring. Unfortunately, just as we were beginning to optimize our hibernation and incubation protocols, our breeding male died in a fire that occurred in our hibernaculum on 15 December 2016. At the time of writing (December 2017), five of the six offspring produced were thriving while the sixth turtle (hatched in 2014) perished in the fire.

Housing, Temperature, and Humidity

During most of the year, adult turtles were housed individually in either a plastic, glass-fronted Vision® cage measuring 91.4 cm × 134.6 cm (Fig. 1) or a concrete "bunker style" enclosure built into the reptile building measuring 96.5 cm × 182.9 cm. The ambient temperature of the building ranged between 25°C–28.3°C. A

Table 2. Egg masses and dimensions for eggs of *Cuora galbinifrons* at Woodland Park Zoo.

Egg #	Mass (g)	Length (mm)	Width (mm)
1	Not obtained	Not obtained	Not obtained
2	8.00	56.00	28.00
3	17.50	52.70	28.50
4	27.88	52.71	29.57
5	28.38	54.76	28.95
6	20.60	45.20	26.30
7	18.52	54.07	28.40
8	26.01	53.73	28.77
9	22.86	59.27	29.05
10	29.80	58.24	29.35
11	23.09	53.52	26.82
12	23.14	53.00	27.00
13	30.48	59.42	28.68
14	32.17	61.15	29.23
15	28.77	56.56	28.48
16	29.15	57.11	28.65
17	27.86	56.58	27.74
18	21.40	57.30	29.40

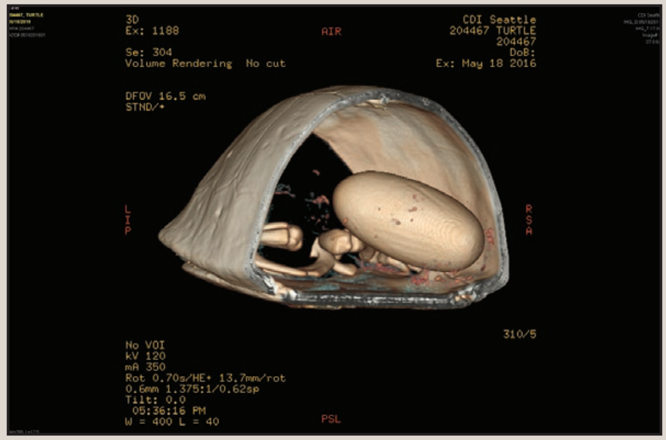

Fig. 3. Volume-rendered CT-scan of WPZ 204467, showing well-developed, shelled egg, confirming the sex of this individual. This technique, although unable to distinguish between ovarian and testicular tissues in the three individuals scanned, was able to confirm the sex of this turtle given the visibility of the shelled egg.

relative humidity of approximately 75–80% was maintained via misting with a pump sprayer or hose once or twice daily, taking care to not saturate the substrate with moisture. All turtles were kept indoors, except in summers when our zoo interns take many of our reptiles outside for supervised basking sessions and the associated benefits of UVB exposure. From 2014–2016, this adult trio went outside for a total of 112 hours of sun exposure. Additional UVB was provided with ZooMed 5.0 Reptisun® T5 fluorescent bulbs and a ZooMed 100W Powersun® bulb. Indoor lights were plugged into Intermatic® timers and periodically changed to coincide with the day/night cycle of Hainan, China.

Substrate of indoor enclosures included a layer of soil mixed with mulch, approximately 50:50 by volume, and the entire land area of the enclosure was covered with a layer of leaf litter (leaves from maple [*Acer* spp.], alder [*Alnus* spp.], oak [*Quercus* spp.], sycamore [*Platanus* spp.], beech [*Fagus* spp.], poplar [*Populus* spp.], etc., collected from zoo grounds typically were used). Leaf litter was not chemically or heat treated prior to use. The soil/leaf mix facilitated burrowing and nesting activities, and provided a microenvironment of high (~80–90% relative) humidity. Multiple cover objects such as cork bark rounds or logs, provided moist, cool areas that broaden thermal and humidity gradients, in addition to a place for animals to hide from conspecifics. Enclosures were planted with live plants (pothos [*Epipremnum aureum*] and peace lily [*Spathiphyllum* spp.]). In the "bunker style" enclosure, a round, tap water-filled basin, 43.2 cm in diameter and 12.7 cm deep, (large enough for the turtles to nearly or fully submerge) was provided. In the Vision® cage, a larger, plastic tub measuring 45.7 cm × 64.8 cm and 15.2 cm in depth, with a plumbed drain was provided. Both types of water basins contained a stack of flat rocks against one edge of the container to facilitate the turtles' egress. Water was changed daily.

Diet.—Each adult was offered approximately 8 g of chopped produce daily, which included the WPZ Reptile Leafy Salad mix (25% kale, 25% Romaine, 18% rotational greens, 8% broccoli, 8% celery, 8% carrot and 8% yam, by weight) and 4 g of WPZ Reptile Fruit Mix (33% each of apple, banana and orange, by weight). In addition, adults were offered 4 g of seasonal/rotational produce item(s) which could include green beans, pumpkin, corn, strawberries, zucchini, blueberries, grapes, raspberries, carrots lettuce, beet greens, collard greens, clover, marigold, hibiscus, pansy, nasturtiums, roses, dandelions, sprouted grains, and mushrooms, etc. Added to this mixture was approximately 8g of canned cat food (e.g., Trader Joe's brand Chicken, Turkey and Rice Dinner). Occasional substitutions of other protein items included the following: chopped pink mice, salmon, lake smelt, shrimp, Nebraska Carnivore Diet®, Nebraska Bird of Prey Diet®, bison meat, Repashy Superfoods Meat Pie® gel, Mazuri Aquatic Turtle Chow®, clams, and hardboiled egg. Each turtle also was offered 2–6 invertebrate prey daily (primarily mealworms (*Tenebrio molitor*), super mealworms (*Zoophobas morio*), and crickets (*Acheta domesticus* or *Gryllus assimilis*), with occasional wax worms (*Galleria mellonella*) and black soldier fly larvae (*Hermetia illucens*). Insect and other protein substitutions were offered approximately 6–8 times per month as enrichment items, which included any of the following: tobacco hornworms (*Manduca sexta*), ZooMed® freeze-dried grasshoppers (*Valanga nigricornis*), hissing cockroaches (*Gromphadorhina portentosa*), Brazilian cockroaches (*Blaberus giganteus*), silkworm larvae (*Bombyx mori*), ZooMed® freeze-dried caterpillars (*Erionota thrax*), and locally collected live snails, slugs, etc. Mineral and vitamin supplements were sprinkled onto to all food items and include Repashy Calcium Plus® and a 1:1 Osteoform® and Vionate® mixture. The 1:1 vitamin dust and Repashy® were used on alternating days. Cuttlebone was offered *ad lib* as a calcium source and for beak conditioning.

Hibernation

We allowed the turtles' behavior to guide our hibernation schedule: the turtles naturally began to decrease their food consumption in late fall (September–October) and we used onset of this behavior to initiate the cooling cycle. Because our turtles are wary of people and slow to acclimate, we preferred to leave them in an enclosure where they could experience annual seasonal changes (as opposed to moving them

Table 3. Incubation temperature and duration and hatchling morphometrics for *Cuora galbinifrons* at Woodland Park Zoo in 2014, 2015, and 2016.

Egg #	Incubation parameters	Incubation time (days)	Measurements recorded (days post-hatching)	Weight (g)	Max. carapace width (mm)	Max. carapace length (mm)	Max. plastron length (mm)
4	29.4°C for 26 days then ambient 26.7–27.8°C	71	11	22.35	38.90	54.16	50.00
11 *	28.9°C for 26 days then ambient 26.7–27.8°C	49	2	13.52	32.20	39.00	38.95
13	28.9°C for 26 days then ambient 26.7–27.8°C	49	2	18.00	37.12	45.25	42.77
15	28.9°C for 26 days, then 27.8°C daytime, 25.6°C nighttime	65	0	20.54	37.30	47.05	Not obtained
16	28.9°C for 26 days, then 27.8°C daytime, 25.6°C nighttime	65	0	21.93	35.35	49.30	Not obtained
17	28.3°C daytime, 25.6°C nighttime entire duration of incubation	49	1	17.27	37.76	48.08	45.22

*Due to operational error, there were significant temperature fluctuations during incubation of egg #11; the hatchling developed significant deformities that might have resulted from these fluctuations.

multiple times per year). Our reptile building had an average daytime ambient temperature of 26.7°C or warmer throughout the year and lacked the ability to be cooled mechanically. Therefore, to provide seasonal temperature fluctuations, we established a hibernaculum for our breeding male in the basement of an adjacent building where the ambient temperatures were much cooler than those of the reptile building. The hibernaculum was a small separate room within the keeper service area. The room measured approximately 3 m × 4 m and had raised concrete pads. The turtle was housed in a rectangular aquarium measuring 76.2 cm × 61.0 cm × 30.5 cm that was placed on an insulating Styrofoam block set onto the concrete pad. The substrate was a mixture of soil and mulch to a depth of approximately 10 cm with an additional 10 cm layer of dry leaf litter on the surface. A small water bowl, approximately 10 cm in diameter was provided and changed periodically. The enclosure was misted every other day. In winter, ambient temperatures would approach 10°C and supplemental heat in the form of an electric space heater (e.g., an oil-filled radiant heater) was provided to maintain an average temperature of 17.8°C for most of the hibernation cycle.

The male's hibernation cycle was started in the reptile building by discontinuing feeding and turning off basking lights for one week prior to moving him to the basement hibernaculum. In November, at the beginning of the hibernation cycle, the temperatures in the basement hibernaculum were comparable to those in the reptile building (27°C with a 12:12 photoperiod), and were then decreased by ~2.8°C degrees every week until it reached the desired hibernation temperature of 12.8°C. This temperature was reached usually by mid-December, with a photoperiod of 10.5 hours of daylight/13.5 of darkness. By 1 January, the middle of the hibernation cycle, daylight was reduced to 10 hours of daylight/14 hours of darkness, with temperature holding at 15.5°C. On 1 February we began the gradual increase of temperatures and daylight to 26.7°C and 12.5 hours of daylight, over a period of six weeks.

Both females, WPZ 204466 and WPZ 204467 were housed in the cement "bunker-style" enclosure described above for the hibernation period. This enclosure was adjacent to an exterior wall and exhibited natural temperature fluctuations making it ideal to use as a hibernaculum. The second female was housed in the bunker with the resident female for hibernation every year. In addition to the natural temperature fluctuations, we also turned off all basking lights in this enclosure. Temperatures in the females' hibernaculum approached a low of 17.8°C but averaged about 21.1°C. The females' appetites typically began decreasing in late September and their hibernation began in October. Lighting cycles for the females were identical to that provided for the male.

Reproduction

Breeding.—Only one (WPZ 204466) of two females in our breeding group has produced viable eggs. We found that relative tail width and length are not as clear an indicator of sex in this species, as it is in most other chelonians. Moreover, individuals can be wary, making courtship behaviors difficult to observe. In our experience, courtship behaviors in this species are ambiguous indicators of gender, making this species somewhat difficult to sex. By mid-2016, WPZ 204467 had not laid eggs and we wanted to confirm her sex without employing an invasive technique (e.g., endoscopic, surgical). Computerized tomography (CT) scans were performed on all three turtles on 18 May 2016 to see

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Fig. 4. A photo of Woodland Park Zoo's first *Cuora galbinifrons* hatchling, produced in 2014. The hatchling is just emerging from the egg, still inside the incubation (S.I.M.®) container.

if this method could yield more information on the breeding condition of the group, and to verify the sex of this turtle. The CT scans were performed by an outside consultant (Rob Liddell, MD, Center for Diagnostic Imaging, Seattle, WA). During the procedure, the turtles were wrapped in 3M VetRap® bandaging tape to limit movement (Fig. 2) but no sedation was used. In order to improve delineation of the GI-tract from adjacent oviducts and gonads, the turtles were fed dilute CT barium for the four days prior to the exam. Just prior to the CT scans, each turtle received cloacal enemas of additional contrast solution (3cc Omnipaque 300® diluted with 6 cc normal saline) but all the turtles expelled the contrast. Cloacal contrast was utilized in an attempt to identify the retracted penis in male turtles, but because the contrast was expelled immediately after instillation, the anatomy was not delineated. While gonads were identified on CT for each of the turtles, we could not discriminate between ovarian and testicular tissue, and therefore this information did not aid in differentiating the sexes. Although sex could not be determined by differentiation of sex organ tissue type, follicle-laden oviducts were visible on both females' images (Fig. 3) thereby confirming the sex of WPZ 204467 as female. Additionally, multiple non-shelled follicles could be noted in both females on CT that would not be seen on a conventional radiograph, demonstrating the ability of this technology in providing detail that radiographs do not provide. This turtle subsequently laid the egg two weeks following the CT scan, but it was unviable and is therefore not included in the tables below.

Turtles were maintained individually outside of hibernation and the behavior of the turtles guided their schedule of breeding introduction. For example, introductions began in February through March when the turtles became active following hibernation. We always moved the male to the female's enclosure and allowed their behavior to guide how long they remained together. If one or both turtles was unreceptive, indicated by agonistic (*sensu* Gillingham 1995) behaviors (e.g., closing up in their shells, burying themselves in the dirt, or moving to separate areas of the enclosure), they were separated. If the turtles were both receptive they were allowed to remain together, sometimes for several days, until they again exhibited agonistic behavior. When receptive, the male often pursued the females, but in at least one instance the female was observed pursuing the male. Some courtship and other reproductive activities of *Cuora*, such as post-copulatory "sniffing" (Augustine and Mendyk 2012) and circling and biting (Fritzsche and Fritzsche 2005; Hiller 2005) have been noted in the literature. Similar courtship behaviors were seen in our turtles. For example, prior to copulation, they performed a "dance," walking in circles, nose-to-cloaca (both male-female and female-male). Other courtship behaviors observed included mounting and head-to-head rubbing. These behaviors were observed of the male on both females and by female WPZ 204467 on female WPZ 204466. However, female WPZ 204466 was never observed performing these behaviors on the other turtles. The female's nests were constructed in a nearly identical manner: all eggs (measurement data provided in Table 1) were laid partially buried in the substrate and covered with leaf litter. Temperatures at the site of oviposition ranged from 22.2–25°C. In clutches with multiple eggs, they were laid side by side.

Incubation.—All eggs were placed into a Suspended Incubation Media® (S.I.M.) container. Horticultural perlite was used beneath the plastic grid in the lower portion of the S.I.M.® container and covered with water. Two holes, approximately 2 mm in diameter, were made in the lid to provide passive air exchange. Additionally, the lid was lifted gently every three days to allow for additional air exchange and to remove excess condensation from the lid of the container. The first viable egg was discovered on 31 July 2013. This egg was incubated at 29.4°C in a zoo-constructed incubator for the duration of incubation. The embryo in this egg died mid-development, so we evaluated and refined our incubation protocols for future eggs. Because recent research has demonstrated the importance of temperature fluctuation to reptile egg incubation (Bowden et al. 2014; Augustine, pers. comm.), we proceeded with lowering nighttime temperatures of subsequent clutches. The following clutch of three eggs, laid 20 February 2014, was incubated at 29.4°C for the first 26 days of incubation, then the temperature was decreased to the ambient temperature of our reptile building to approximately 26.6–28.3°C, with a nighttime drop to approximately 25°C. When removed from the incubator, the eggs remained in the S.I.M.® container, which was placed in a Styrofoam®-lined cardboard box to moderate temperature extremes. In spring of 2016, we purchased a Nature's Spirit Reptile® incubator, outfitted with a HerpStat® thermostat and temperature controller. We set up the new incubator in the basement of the same building housing the turtles' hibernaculum, enabling us to achieve reliable nighttime temperatures below 26°C. The new digital controller provided the ability to program more flexibility into the incubation thermal cycle, maintaining the initial temperature of 28.9°C for 26–30 days, then reducing to a daytime high of 27.8°C and a nighttime low of 25.6°C with a 4-hour ramp back up to 27.8°C. We also used these temperature parameters for the clutch laid 10 April 2016. For the clutch laid on 20 June 2016, the new temperature controller and incubator were again used and the temperature regime was modified slightly to the following for the entire duration of incubation: a daytime high of 28°C and nighttime low of 26°C with a 4-hour ramp up to 28°C. Egg candling was performed with an LED flashlight to detect evidence of fertilization. Some eggs showed banding as early as the day following oviposition. One egg appeared clear (i.e., not banding or other development) 12 days into incubation but then veining became visible 24-days post oviposition. On average, the hatchlings took 58 days to develop (N = 6). Typically, neonates were fully emerged from the egg within 24 hours of initial pip.

Hatchling husbandry.—Once the turtles began hatching, they were transferred to a new S.I.M.® container (without the grid, substrate or rails in order to eliminate potential hazards to the hatchlings) and housed on damp, unbleached paper towels within the incubator. Hatchlings (Fig. 4) were allowed to leave the egg fully prior to removing them from the incubator. Following yolk sac absorption, they were set up in an aquarium measuring 25.4 cm × 50.8 cm, with a thick layer of moist New Zealand sphagnum moss, and water. Early on, water was changed daily, but later in the program we used a Tetra Whisper 10i® submersible filter, able to accommodate water levels as low as 5 cm. A filter basket was made from a round, plastic deli cup perforated with holes (made with a soldering iron) to prevent the larger pieces of moss and other debris from entering the filter. The tank was propped up on one end on a ~15-degree angle to provide a gradient of water depth for the young hatchlings. Flat rocks were provided for haul outs and areas for the turtles to rest partially submerged. Fluorescent ZooMed T5 5.0 Reptisun® bulbs were oriented above the tank, and a ZooMed Powersun® 100W bulb was used to create a ~32°C basking spot on the rocks and a temperature gradient within the tank. The hatchlings were tong-fed small (~0.5–1 cm long) pieces of earthworms four days after hatching. Once they consumed a few meals, a diet identical in composition to the adults' (but chopped more finely) was offered daily with additional supplementation of earthworms offered on tongs 4–5 days per week.

Discussion

Woodland Park Zoo's breeding program for *Cuora galbinifrons* described here represents considerable institutional investment in this species. With the success of four hatchlings produced in 2016, WPZ was leading breeding efforts for *C. galbinifrons* in the North American population. Unfortunately, this success ended abruptly on 15 December 2016 when we encountered a significant obstacle: the loss of our breeding male, our first hatchling, and a recently-acquired adult breeding pair in a fire in the nocturnal animal building. The cause of the fire was not determined by Seattle fire investigators. Despite this unfortunate setback to our program and the North American population, we are planning to rebuild our breeding efforts, once we can acquire an additional breeding male or additional breeding pairs.

Acquisition of our original breeding trio of *C. galbinifrons* initiated our breeding efforts for *Cuora* species and since has since grown to include five *C. flavomarginata* (Yellow-Margined Box Turtles); this breeding group has produced four viable hatchlings since 2016. Notably, four of the five adult *C. flavomarginata* in our collection also were well established, wild-caught animals, acquired as donations at two different times from the public. This further highlights the importance of identifying rare turtles in need of permanent homes, for establishment into long-term, research-focused breeding programs. Although husbandry information for *Cuora* species has grown in recent years, there are few published, detailed accounts on hibernation schedules, incubation protocols, and dietary information relating to *C. galbinifrons*. Woodland Park Zoo's husbandry data for this species have been archived in the Zoological Information Management System (ZIMS; Species 360, 2018, zims.species360.org). It is our hope that the summary of these data, presented here, will help inform similar breeding projects for these critically endangered and beautiful turtles.

Acknowledgments.—We thank Julie Lindell, who initially loaned to us her beloved "galbies," which quickly became the focus of our Asian turtle breeding program. We also thank Julie Tougas, who presented her *C. galbinifrons* breeding information at the 10th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles. Julie's information helped to inform our first refinements to our incubation protocols. Thank you to Nancy Hawkes and Tina Mullett for providing comments on our manuscript. We also thank and are grateful to Robert Liddell, MD, and Kristin Kessler, RT and CT technologist from the Center for Diagnostic Imaging, who performed *pro bono* CT scans of our turtles. Additional thanks go to the entire Woodland Park Zoo herp team who assisted in developing our husbandry techniques and with the daily care of these animals. Finally, we thank and are grateful for the Seattle Fire Department for extinguishing the fire that originated in our turtle room on 15 December 2017 and all zoo employees who aided in safely evacuating 183 animals from the reptile building that night.

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