

Leucistic American Alligator Hatchlings in Coastal South Carolina

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Abstract - Leucism (white skin, dark eyes) is a rare color disorder occurring in a range of invertebrates and vertebrates, and as a result, relatively few reports exist of leucistic individuals in the wild. In March 2014, we found 6 leucistic *Alligator mississippiensis* (American Alligator) hatchlings in coastal South Carolina. All individuals were basking under cool, cloudy conditions within ~15 m of the den, appeared moderately emaciated, and were somewhat lethargic upon capture. The animals were removed from the field and treated for malnutrition under veterinary supervision. Three Alligators died within 6 days of collection, and the remaining 3 individuals were transferred to different institutions for long-term care and display. These animals also eventually died after surviving in captivity for ~4.5–45 months. Leucistic Alligators are known to suffer from a variety of health problems, and the mortalities and associated causes of death in the animals we describe here were consistent with previous reports of other leucistic Alligators. The incidence of leucism among wild crocodilians is very low, and disease, increased susceptibility to predation, and collection by humans further exacerbate its rarity.

Leucism is a rare congenital color aberration in animals generally defined as the partial or complete absence of all pigment in the skin, hair (mammals), feathers (birds) or scales (reptiles, fish), resulting in individuals that are all or mostly white but with dark eyes (Bechtel 1995, Dyrkacz 1981, Miller 2005, van Grouw 2006). In contrast, albinism is characterized by a complete lack of dark pigments (melanins), although other pigments may be present, resulting in white or pink individuals, in some cases with residual red or yellow patterning, and pink eyes (Bechtel 1995, Dyrkacz 1981, Garret et al. 1996, Miller 2005, van Grouw 2006). The most common form of albinism results from the inherited absence of tyrosinase, the enzyme necessary for the production of melanin pigments (Bechtel 1995, van Grouw 2006). In leucistic animals, melanin production is usually normal (tyrosinase present), but the deposition of melanins in skin, hair, feathers, and scales does not occur due to an inherited disorder in pigment transfer (van Grouw 2006). The occurrence of both mutations is uncommon, but leucism is generally considered to be the rarer of the two

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(Bechtel 1991, 1995; Bustard and Kar 2019; but see Miller 2005). Though reports are few, leucism has been observed both in invertebrates and vertebrates, including arachnids (Lira et al. 2016), mammals (see Arriaga-Flores et al. 2016), birds (Forrest and Naveen 2000, van Grouw 2006), fish (Veena et al. 2011), amphibians (Dyrkacz 1981, Frost et al. 1984, Galán 2010, Mitchell and Church 2002), and reptiles (Bechtel 1995, Dyrkacz 1981).

For reptiles, multiple definitions are often used to describe leucism. These include individuals that are completely white (e.g., Dyrkacz 1981), predominantly white with some dark spots or patches (e.g., Bechtel 1995), and whitish or light colored but still retaining dark skin patterns (e.g., Bustard and Kar 2019), but all with dark eyes. Animals falling under the second definition are further characterized by a pure (“snow”) white skin color, dark blueish eyes, no residual pattern (Bechtel 1991, 1995; Bechtel and Bechtel 1985; Glasgow 1991; Larsen and Cardeilhac 1996), and often a small, dark patch or patches on the head, neck, or back (Barnett et al. 1999; Hollingsworth and Reinert 2015; Huchzermeyer 2003; Lobo and Sreepada 2016; Mendyk et al., in press). Leucism of this type has been reported in most reptile groups, including crocodylians (Barnett et al. 1999; Glasgow 1991; Mendyk et al., in press), turtles (Erickson and Kaefer 2015), snakes (Bechtel 1995, Bechtel and Bechtel 1985, Chaudhuri et al. 2018, Hollingsworth and Reinert 2015, Krecsák 2008, Lobo and Sreepada 2016, Noronha et al. 2013, Stephenson and Drace 2014), and lizards (De Ayala-Monedero and Álvarez-León 2014, Grisales-Martínez and Arias-Alvarez 2018).

In crocodylians, albinism or “partial albinism” has been reported in multiple species including *Alligator mississippiensis* Daudin (American Alligator; Allen and Neill 1956, Ferguson 1985, Garrett et al. 1996, McIlhenny 1935, Neill 1971), *Caiman latirostris* Daudin (Broad-snouted Caiman; Alejandro Larriera, Proyecto Yacaré Santa Fe, Argentina, pers. comm.), *Caiman* spp. (unidentified caiman; Campbell and Winterbotham 1985, Troiano and Román 1996), *Crocodylus acutus* Cuvier (American Crocodile; Neill 1971), *C. johnstoni* Krefft (Australian Freshwater Crocodile; Ferguson 1985), *C. novaeguineae* Schmidt (New Guinea Crocodile; Ferguson 1985), *C. niloticus* Laurenti (Nile Crocodile; Blake and Loveridge 1975), *C. porosus* Schneider (Estuarine Crocodile; Campbell and Winterbotham 1985, Kar and Bustard 1982), and *C. siamensis* Schneider (Siamese Crocodile; Bezuijen 1996). In contrast, leucism (based on the second definition above) has rarely been reported in crocodylians. Bustard and Kar (2019) recently described wild leucistic Estuarine Crocodiles in India, but photographs accompanying this account indicate the retention of normal dark patterning on the skin of these animals, which more closely resembles a melanin reduction in the skin (hypomelanism) rather than a total absence of melanins (Bechtel 1995; Mendyk et al., in press; Turner 2011). Others (Grigg and Kirshner 2015; Grahame Webb and Charlie Manolis, Wildlife Management International Pty. Limited, Karama, Northern Territory, Australia, pers. comm.) have also reported similarly colored and patterned Estuarine Crocodiles from the Northern Territory of Australia. Chávez (2006) provided a photograph of a white *Caiman crocodylus* L. (Spectacled Caiman) on a riverbank in Peru, but because the eye color of this animal was undetermined, leucism was only speculative. Mendyk et al. (in press) recently reviewed all known and potential cases of leucism in American Alligators. While many anecdotal accounts may indeed have involved leucism, in only a few cases has this color anomaly been verified in Alligators (Mendyk et al., in press).

The most well-documented leucistic crocodylians are 19 “white” American Alligators found as hatchlings at a nest site in Terrebonne Parish, LA, in 1987 (Armand and James 1994; Mendyk et al., in press; Walls and Walls 1991). Because of their rarity and exotic appearance, many of these animals, including an additional 4 leucistic individuals found in the same area over the next 24 years, have been on display at the Audubon Park Zoo in

New Orleans for decades, and others have been loaned out to several other institutions for temporary exhibition throughout the United States and abroad (Mendyk et al., in press). Three leucistic Alligator hatchlings were found and illegally collected on Hilton Head Island in Beaufort County, SC, in September 2003 (Mendyk et al., in press). Within a few days of capture, these animals were confiscated by the SC Department of Natural Resources and donated to the Riverbanks Zoo in Columbia, SC (Mendyk et al., in press). In 2014, a single leucistic Alligator from captive parents was hatched at an alligator farm in Florida and briefly displayed at a wildlife park in DeLeon Springs, FL (Mendyk et al., in press). All of these Alligators exhibited dark eyes and opaque, pure white skin with a few small dark patches on the head, neck and/or back (Mendyk et al., in press).

Despite accounts of leucistic Alligators being found in Louisiana and South Carolina wetlands, no reports have yet included information on the habitat, environmental conditions, and behavior of Alligators associated with these encounters. Here, we report on 6 leucistic Alligator hatchlings found in coastal South Carolina in 2014 and provide details on these associated variables. We also provide, to the best of our knowledge, the first photographs of leucistic Alligators in the wild.

On 20 March 2014, we were notified that “some baby white alligators” had been observed in a small pond in coastal South Carolina (specific locality withheld due to conservation concerns related to the collection of exotic reptiles for the pet trade; Auliya 2003, Lyons and Natusch 2013). On 22 March 2014, at ~1000 h, we encountered 6 leucistic Alligator hatchlings in and adjacent to the pond. The ambient temperature at the time of the encounter was 22 °C (daily extremes: high = 22 °C, low = 11 °C), and skies were overcast. The surface of the pond was largely covered in *Lemna minor* L. (Common Duckweed) and *Azolla* spp. (water fern). During the preceding months, the water’s edge in the pond had receded ~10–30 m, revealing the opening to an Alligator den at the base of a *Juniperus virginiana* L. (Red Cedar) on the pond’s northern bank. We observed 4 normally pigmented hatchlings in the den, which still contained water. All visible leucistic hatchlings were located outside the den at varying distances from the den and each other (closest to den ~5 m; farthest from den ~15 m; closest distance between 2 hatchlings ~1 m; farthest distance between 2 hatchlings ~10 m). Five hatchlings were positioned atop dry leaf litter (Fig. 1) beneath the canopy of multiple Red Cedars, and 1 was partially positioned on a small log with its posterior half submerged in water (no canopy) (Fig. 2). An adult Alligator, presumably the maternal female, was observed in the water ~3 m from this last hatchling (Fig. 2). We collected each leucistic individual by hand for further examination and searched the area (including the den) extensively for additional hatchlings but found none. All 6 hatchlings appeared moderately emaciated and were somewhat lethargic, making little or no attempt to flee or escape when approached. We captured 2 normal hatchlings from the den and these individuals exhibited the same body condition and vigor as the leucistic animals. Each leucistic hatchling was uniformly white or pinkish in coloration with dark blue eyes (Fig. 3) and 1–2 dark mottled spots on the top of the head (Fig. 4). Some individuals appeared to have a small amount of greyish or yellowish coloration on the body, possibly the result of temporary staining from water in the den or pond as this coloration eventually disappeared (Fig. 5). Upon capture, 2 hatchlings vocalized, and the putative maternal female responded by raising its head above the water, hissing with mouth slightly agape, and slowly approaching the shore. After all visible leucistic hatchlings were collected, we captured the adult Alligator using a self-locking cable snare attached to a pole. Following restraint, we measured the animal (total length = 259 cm, snout-vent length = 128 cm) and confirmed it to be a female by cloacal examination of the genitalia (Allsteadt and Lang, 1995); this Alligator displayed no abnormal (e.g., leucistic) coloration.

Due to the high likelihood of natural mortality (Frye 1991, Klauber 1956, Krecsák 2008) or collection by reptile traders (Auliya 2003; Lyons and Natusch 2013; Mendyk et al., in press), we removed the leucistic Alligator hatchlings from the wild and transported them to Hollings Marine Laboratory in Charleston, SC, where they were treated for malnutrition under veterinary supervision. One animal died shortly after arrival at the laboratory. The mean (\pm SE) body mass of the remaining 5 hatchlings (measured on 24 March 2014) was 35.64 ± 0.27 g (min–max = 35.1–36.4 g) (Table 1). We estimated the age of the hatchlings to be ~6 months, as the peak of hatching for Alligators in coastal South Carolina is late August–early September (Wilkinson 1983). Mean birth weight of 278 normal (non-leucistic), healthy Alligator hatchlings from eggs collected from the South Carolina coastal plain and incubated in the laboratory was 52.97 ± 0.30 g (L.J. Guillette Jr., unpubl. data). Thus, at ~6 months of age, the weight of the leucistic hatchlings was only 67% of the estimated birth weight of non-leucistic healthy hatchlings.

On 27 August 2014, at ~1000 h, we returned to the leucistic Alligator hatchling collection site to search for other individuals that may have gone undetected during our initial visit and possibly new leucistic hatchlings produced by the same female in the event she nested again at the pond during 2014. On the opposite side of the pond from the den, we observed a small pod ($n = 5$) of normally pigmented yearlings (presumably from the 2013 clutch with the leucistic hatchlings) and heard vocalizations of multiple other juveniles but found no additional leucistic hatchlings. Further inspection of the area revealed an old Alligator nest mound, presumably the one from which the leucistic hatchlings had emerged in August/September 2013. The nest mound was constructed at the base of a *Sabal palmetto* (Walter) Lodd. ex Schult. and Schult. f. (Cabbage Palm); composed mostly of soil, small sticks, and leaves; and had been excavated from the side by the female to liberate hatchlings. The nest was 17 m from the water on the den (north) side of the pond. We estimated the canopy cover



Figure 1. A leucistic hatchling *Alligator mississippiensis* (American Alligator) basking on leaf litter adjacent to a pond in coastal South Carolina on 22 March 2014. Photograph © Louis J. Guillette Jr.



Figure 2. Putative maternal female *Alligator mississippiensis* (American Alligator) (background) guarding a leucistic hatchling (foreground) in a pond in coastal South Carolina on 22 March 2014. Photograph © Louis J. Guillette Jr.

to be ~90%, and the understory was thick with vines but otherwise open (no grass or other vegetation available for use as nest material). We saw no sign of another nest near the pond and did not see the maternal female or any other adult Alligators in the pond.



Figure 3. Comparison of coloration between normal (left) and leucistic (right) *Alligator mississippiensis* (American Alligator) from coastal South Carolina. Note the pure (“snow”) white skin, dark blue eye, and dark spot on the head of the leucistic Alligator. Photographs © Tara Gancos Crawford (left) and Bill Hughes (right).

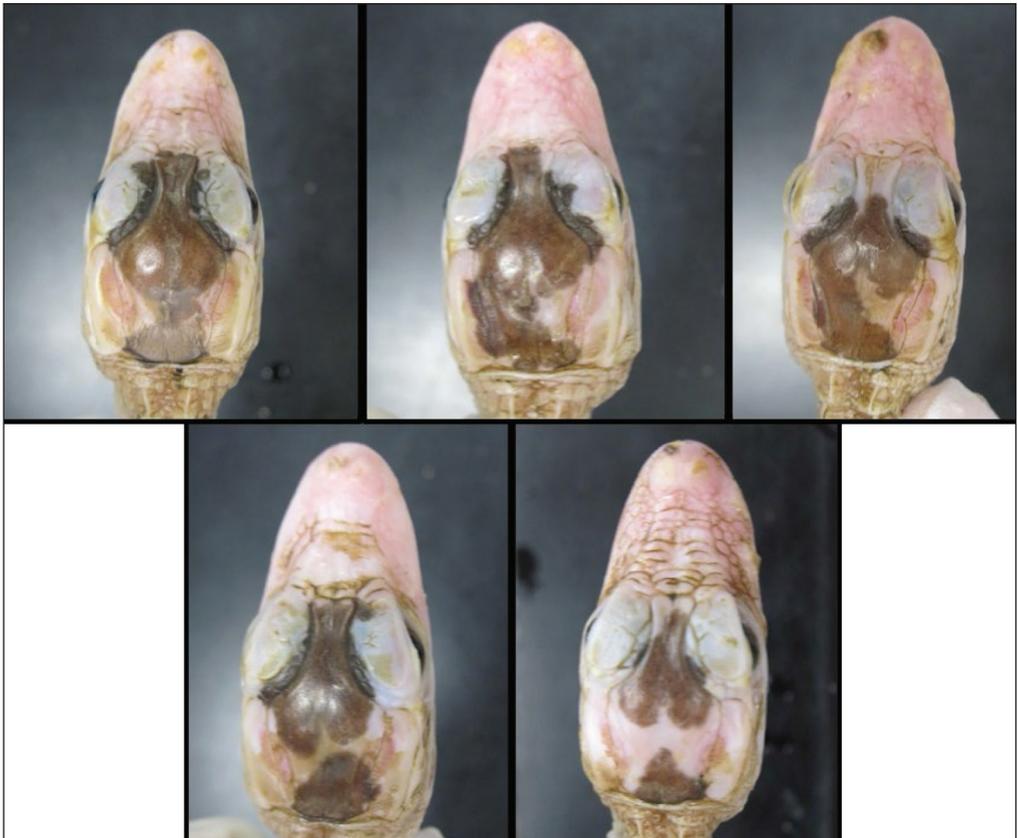


Figure 4. Dorsal view of 5 leucistic *Alligator mississippiensis* (American Alligator) collected in coastal South Carolina on 22 March 2014 showing dark patches of pigment on the top of the head between and posterior to the eyes (a 6th individual was not photographed). No other skin pigmentation was observed. Photographs © Satomi Kohno.

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Of the 5 remaining leucistic Alligator hatchlings found on 22 March 2014, an additional 2 died on 28 March 2014 (Table 1). The other 3 hatchlings continued to eat and gain body mass over the next several weeks until being transferred to 3 different institutions



Figure 5. A leucistic hatchling *Alligator mississippiensis* (American Alligator) from coastal South Carolina on display at the Tennessee Aquarium in Chattanooga on 14 October 2014, ~7 months after collection from the wild. Note the uniformly white coloration, blue eye, and dark patch on the top of the head. Photograph © Todd Stailey.

Table 1. Body mass (measured on 24 March 2014), date of death, and cause of death of 6 leucistic *Alligator mississippiensis* (American Alligator) hatchlings found in the coastal plain of South Carolina on 22 March 2014. Animals were originally maintained under veterinary supervision at the Hollings Marine Laboratory (Charleston, SC), and surviving individuals were later transferred to different institutions for long-term care and display. Animal #1 died shortly after transport to the laboratory and its body mass was not recorded.

Animal #	Body mass (g)	Institution (transfer date)	Date of death (months after collection)	Cause of death
1	-	Not applicable	22 March 2014	Not determined
2	35.2	Not applicable	28 March 2014	Not determined
3	36.2	Not applicable	28 March 2014	Not determined
4	35.1	Tennessee Aquarium (15 May 2014)	15 December 2017 (~45)	Severe necrotizing enterocolitis
5	36.4	North Carolina Aquarium at Fort Fisher (27 May 2014)	9 December 2014 (~8.5)	Pneumonia
6	35.3	South Carolina Aquarium (27 May 2014)	11 August 2015 (~16.5)	Severe and necrotizing enteritis, moderate to severe brain mineralization

accredited by the Association of Zoos and Aquariums for long-term care and display (Table 1). All 3 animals died in less than 4 years, and veterinary necropsies identified multiple causes of death including pneumonia, severe enteritis and brain mineralization, and severe necrotizing enterocolitis (Table 1). Although captive leucistic Alligators do not appear to suffer from the same health deficits as those observed in albino conspecifics (e.g., reduced immunocompetence, fibrotic internal organs, poor vision, and poor hearing; Larsen and Cardeilhac 1996), the former still often exhibit a variety of acute and chronic health problems including egg yolk peritonitis, inappetence accompanied by rapid weight loss, ulcerative bacterial dermatitis, bacterial enteritis, pneumonia, heart disease, and cataracts (Mendyk et al., in press; S. Pfaff, Riverbanks Zoo, Columbia, SC, pers. comm.). Indeed, some of the leucistic Alligators found in Louisiana and all of those found in South Carolina (2003 and 2014) eventually died from these or similar complications (Mendyk et al., in press; S. Pfaff, pers. comm.). The fact that the 2 normal colored hatchlings and the 6 leucistic individuals in South Carolina in 2014 (all putative siblings) were similar in size upon capture suggests the moderately poor body condition observed in these animals may have been at least partially the result of reduced food intake during winter dormancy (Dietz 1979, Fischer et al. 1991). However, the mortality and necropsy results of the latter indicate multiple underlying health problems.

Finally, notwithstanding congenital health deficits, it has been suggested that white (leucistic, albino) or lighter than normally colored crocodylians and other reptiles are at a greater survival disadvantage compared to typically colored and patterned conspecifics, primarily because the former may be more easily seen by predators due to a lack or reduction in natural camouflage (Frye 1991, Klauber 1956, Krecsák 2008, Neill 1971). While the selective pressure against leucistic or albino reptiles probably differs among classes, species, and body sizes (Bustard and Kar 2019, Erickson and Kaefer 2015, Hollingsworth and Reinert 2015, Neill 1971, Watkins-Colwell 2002), it appears to be particularly strong in hatchling crocodylians. High selective pressure in the wild is supported by the ability of some leucistic and albino individuals to live many years in captivity (e.g., >33 years; Mendyk et al., in press) coupled with the very few verified accounts of white or light-colored non-hatchling crocodylians in the wild (Bustard and Kar 2019; Chávez 2006; Mendyk et al., in press). Limited reports indicate the incidence of wild leucistic crocodylians is very low, varying from 0.01% (Richardson et al. 2002) to 0.06% (Bustard and Kar 2019) in lightly colored but partially patterned Estuarine Crocodiles. Incidence estimates for pure white and patternless leucistic American Alligators appear to be much lower. For example, commercial ranching programs in Florida and Louisiana incubate and hatch hundreds of thousands of wild eggs annually, and except for the single Florida individual in 2014, no leucistic hatchlings have been reported (Dutton et al. 2002, 2014; LDWF 2019). In Louisiana alone, from 1986 to 2018 a total of 9,075,637 wild Alligator eggs were hatched as part of the state's Alligator Ranching Program, and while occasional albino hatchlings were found, no leucistic individuals were reported (LDWF 2019; R. Elsey, Louisiana Department of Wildlife and Fisheries, Grand Chenier, LA, pers. comm.). Including the 24 individuals found in Terrebonne Parish since 1987, these data yield an incidence of 0.0002% wild leucistic Alligator hatchlings in Louisiana over 32 years (not including the ~30–40% of eggs that go uncollected in Louisiana each year [R. Elsey, pers. comm.] or the possibility that additional white alligators may have inadvertently gone unreported by egg ranchers or been illegally collected by others for the pet trade). This low natural incidence in conjunction with congenital health defects, increased susceptibility to predation, and possible collection by reptile traders all contribute to the extreme rarity of leucistic (and albino) crocodylians in wild populations.

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