



Alligator Production: Breeding, Egg Collection, Incubation, and Hatching

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The concept of farming American alligators, *Alligator mississippiensis*, has developed over the past 50 years resulting in a lucrative industry with sound conservation principles. Acquiring stock, whether from captive breeders or wild collected eggs, is essential for commercial production. This publication describes how farmers collect, incubate, and hatch eggs to produce hatchlings. There are two other SRAC publications in this series focusing on alligator production (SRAC Publications Nos. 0230 and 0232).

Captive breeding

Captive breeding experiments of alligators were conducted in Louisiana and Florida in the 1970s and 1980s. Researchers evaluated age and growth factors, diet, stocking densities, wild versus farm-raised stock, pen design, and many other factors. While captive breeding is possible, research results showed that it takes 6 to 10 years to achieve consistent egg production.

Researchers compared egg production and hatchability of stocks of wild-caught and farm-raised alligators. The advantage of using wild-caught brood stock was that mature alligators could be selected so that nesting could potentially begin during their first summer in captivity. Farm-raised alligators take 6 to 10 years to reach maturity before they attempt to nest. Egg production and hatchability were typically lower than average for the first several years.

Male alligators obtained from the wild were aggressive toward other males resulting in the death of subordinate males unless they could escape the pen.

Only one male could be stocked in a 1 acre (0.4 ha) size pen with two females. At this density, it would take a large number of pens to generate enough eggs to supply a commercial farm.

Farm-raised alligators which were raised in captivity from hatchlings are tolerant of higher densities in breeding pens but still take years to mature. Stocking rates of 10 to 20 alligators per acre (0.4 ha) are possible and a sex ratio of 1 male to 3 females appears to be optimum. While one male can service more than three females, fertilization rates can drop resulting in fewer hatchlings.

Research facilities and some of the early commercial farms in the 1980s tried various pen designs. A 3:1 land to water ratio seemed to work well with the water areas in a random arrangement instead of a single pond in the middle of the pen. The water areas needed to be far enough away from perimeter fences to prevent alligators from burrowing under and escaping. Durable fencing material such as galvanized, heavy gauge welded wire or chain link fencing worked well. Fence height must be at least 6 feet (1.8 m) with a wire-mesh barrier on the top to prevent alligators from climbing over the fence, particularly in the corners. Measures also need to be taken to prevent alligators from digging under the fence. Because breeding pens have to be maintained for many years, maintenance including vegetation control, feeding sites, and access points must be considered.

Density, diet, and other stress factors were found to have an effect on mating, nesting, egg laying, and fertil-

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ity. Not all females will successfully lay eggs every year. Employee safety was another concern since the captive animals grew accustomed to workers feeding the animals and readily approached farm staff attempting to collect eggs from nests.

Many of the commercial farms which started in the 1970s and 1980s eventually discontinued captive breeding in favor of collecting eggs from nests found in the wild. Captive breeders required years to reach maturity, were costly to maintain with respect to feed and pen maintenance, required a large, secure land area, and were dangerous with which to work.

Alligator ranching

The concept of “alligator ranching” was developed in the 1980s whereby producers could collect eggs from nests found in the wild. Louisiana, Florida, and Texas developed programs that allowed licensed alligator farmers to collect eggs from wild nests and bring them back to the farm for incubation and hatching. In Louisiana, farmers are required to return a certain percentage of alligators back to the habitat where the eggs were collected once they reach a certain size. In Florida and Texas, farmers can only collect eggs from a portion of the nests found in the habitat but are not required to release juvenile alligators back to the wild for recruitment. Typically, farmers pay a negotiated fee to the landowner (private or public) for each egg collected. Prospective farmers should contact the respective state agency for the current regulations on egg collecting.

Breeding

Being a cold blooded reptile, alligator activity, including mating and egg development is greatly influenced by temperature. The breeding season begins in April in southern Florida and extends into July in the swamps of north Louisiana. Peak nesting can vary by a few weeks from one year to the next depending on air and water temperature in the preceding months. In the coastal marshes along the northern Gulf coast, nesting usually occurs over a three week period in June.

Courtship activity begins with males bellowing to attract females. Fighting between males for territories is common. Mature females usually spend the winter near their nest site from the previous summer and only venture away to seek male company during the breeding season. Copulation usually occurs at night in deep water ponds, bayous, or canals. Females can breed with more than one male. In one study, multiple paternity occurred in 51 percent of clutches examined.

Nesting and egg laying

Female alligators have an affinity for the general area where they nested the previous year unless significant changes in the habitat have occurred. Floods or droughts right before nesting can cause alligators to move to other nest sites. Prolonged flooding or droughts in some cases can cause females to abort their eggs or resorb the eggs and not nest at all.

Females will use available vegetation to form a mound approximately 3 to 5 feet (0.9 to 1.5 m) in diameter and 18 to 24 inches (45 to 61 cm) high (Fig. 1). She will scratch a cavity in the middle of the mound and lay all of her eggs at one time. She will add 6 or more inches (15 cm) of vegetation on top to cover the clutch of eggs. The decomposing vegetation will maintain a fairly constant temperature between 85 and 91° F (29 to 33° C).



Figure 1. Female alligators will use marsh vegetation to construct their nest.

The sex of the alligator is determined during days 30 to 45 of incubation. Higher temperatures will produce males, lower temperatures will produce females. Very high temperatures can again produce females but with high mortality.

Clutch size can vary from just a few eggs to more than 50. The average clutch is about 30 to 35 eggs. Size, age, and health of the female will affect the number of eggs produced, fertility, and hatching rate. Farmers with a captive breeding program typically have smaller clutch sizes, and lower hatching rates as compared to eggs collected from the wild.

Egg collection

Farmers locate nests in the wild by conducting aerial surveys. Most use helicopters to spot the nests and mark the location using GPS (Fig. 2). Some farmers will also drop a bamboo pole at the location to further assist crews



Figure 2. Helicopters are used to find and mark a GPS location of alligator nests.

on the ground in locating the nest. Spotting the nests from the air requires some amount of experience to notice nests in tall vegetation such as Roseau Cane (*Phragmites* spp.) and to distinguish nests from muskrat lodges.

Ground crews use airboats in marsh habitats to access points marked by GPS (Fig. 3). Working in pairs, one person will use a long pole to ward off the female alligator guarding the nest while the other person collects the eggs (Fig. 4). If eggs are not present in the nest, it could be that the female has not laid them yet or it is a false nest. Sometimes alligators will make several nests before settling on one nest in which to deposit the eggs.

In contrast to bird eggs, once deposited, reptile eggs cannot be rolled or turned. Within the first 24 hours, an alligator embryo will attach to the eggshell membrane at the uppermost spot. From then on, turning the egg more than a few degrees will detach the embryo and cause death. Farmers carefully remove the grass layer on top of the nest until the clutch is located. They then use a marker to mark the top of each egg and that orientation is maintained during transport and placement in the incubator.

Ideally, farmers prefer to collect eggs less than 7 days old or wait until the eggs are more than 4 weeks old. During the 7 to 28 day time period, embryos are most fragile and stand a greater chance of injury and death. Since nesting can occur over a 2 or 3 week period and because of the threat of flooding or predation, farmers usually



Figure 3. Airboats are used to access nests in the marsh.



Figure 4. Some alligators will aggressively defend their nests.

don't wait to collect eggs. They do try to be extra careful with eggs that are 1 to 4 weeks old to avoid mechanical trauma.

Farmers can tell the approximate age of an egg by its outward appearance. Eggs that have been laid only a few hours are referred to as “slimy” due to the viscous discharge of fluid from the oviduct. The color of the egg at that point is uniform. After 24 hours, a chalky white dot will appear on the top of the egg where the embryo has attached to the underlying eggshell membrane. Over the next few days, the dot will elongate to form a band around the middle of the egg (Fig. 5). The band will get wider



Figure 5. A chalky white band indicates eggs are fertile. The band enlarges over time, giving an index to the age of the embryo.

with time until the chalky color extends to both ends of the egg after 40 to 50 days. The chalky color corresponds to the area on the inside of the eggshell membrane where a network of blood vessels is attached. This allows for the exchange of oxygen and carbon dioxide by the embryo.

The noticeable band on the eggs allows farmers to recognize any infertile eggs that might be in the clutch. It's common for one or more infertile eggs to be present.



Figure 6. Farmers will mark the top side of the eggs as they collect them.



Figure 7. Eggs are transported to the farm in an upright position and set in an incubator.

Fertility and development throughout incubation can be checked using a bright flashlight to candle the eggs. Infertile eggs have a yellow glow when candled. Developing embryos will have a dark area in the middle with lighter spots on the ends. Should the embryo die during the collection process, the band will not progress as it does in live eggs.

Farmers collect the eggs from the nests and place them in containers with foam padding or some of the nest material to prevent shaking or rolling over (Figs. 6 and 7). Several layers of eggs and nest material can be transported in a standard plastic tote. Farmers are careful to always maintain the upright position of the egg and prevent rolling. During the first several weeks of incubation, alligator eggs are fairly durable. Even if the shell cracks, the embryo is still alive as long as the egg membrane is intact.

Incubation and hatching

Nests in the wild are subject to temperature variations as well as the threat of predation and flooding. At best, the hatching rate in the wild is about 70 percent. With careful handling and close monitoring, farmers can achieve over 90 percent hatching rate.

Eggs are brought to the farm and placed in containers along with vegetation collected from the nest or other similar material. Some farmers use 1 inch \times 1/2 inch (2.5 cm \times 1.7 cm) plastic coated wire to construct baskets that are 24 inches long \times 10 inches wide and 7 inches deep (61 cm \times 25 cm \times 18 cm). A layer of vegetation is placed on the bottom of the basket and the eggs are set in a single layer making sure that the top of the egg is upright. Another layer of vegetation is placed on top before the lid is closed to allow for air flow around the clutch.

Alternately, some farmers use plastic boxes with holes drilled in all sides for air flow. Instead of nest material, water-soaked hay or Sphagnum moss can be used. It is critical that the vegetation is not too wet as this will cause the eggs to swell during incubation and jeopardize the embryo. Conversely, if the vegetation is too dry, the membrane can detach from the eggshell resulting in an air pocket on one end of the egg.

As long as the temperature and humidity can be controlled, it does not matter how the incubator is designed. Some farmers use a grow-out shed with racks supporting the egg baskets above a shallow pool of water. Others use a well-insulated building with egg baskets arranged on vertical racks (Fig. 8). Humidifiers are used to maintain the humidity above 90 percent. A circulation fan is used to insure the temperature and humidity is the same at all levels within the building.



Figure 8. Nesting material is used to pack the eggs in wire baskets and then set into the incubator.

In the early 1980s, Dr. Mark Ferguson discovered that temperature of incubation during incubation determined the sex of alligator embryos. Eggs held at 91° F (33° C) during that time resulted in all male hatchlings. Females were produced at 86° F (30° C). Farmers set their thermostats at 87 to 88° F (30.5 to 31.1° C) which results in healthy, fast growing alligators of both sexes.

Eggs hatch in approximately 65 to 70 days after they were laid. As they begin to hatch, baby alligators will make a chirping sound which is actually a distress call recognized by the mother alligator. In the wild, the mother will sometimes open the nest to allow the hatchlings to crawl out of the nest. When farmers hear the chirping noise, they will check the egg basket and sometimes assist some of the hatchlings out of the eggs once 10 to 15 percent are emerging. Occasionally, a hatchling has trouble making a hole in the membrane and will die in the shell if left alone.

Hatchlings should remain in the egg basket until the umbilical cord dries (Fig. 9). When assisting a hatchling to emerge from the shell, care must be taken to not detach or pull on the umbilical cord which may cause injury or problems with absorbing the yolk sack. The umbilicus takes 2 to 3 days to completely dry and heal. Only then should the hatchlings be introduced to water.

By the third or fourth day, the hatchlings can be moved to grow-out chambers with approximately 16 inches (40 cm) of water depth and a feeding/resting platform in the middle of the pen. Hatchlings tend to pile up in corners. If one side of the pen is dry or if the pen only has a few inches of water, some of the hatchlings on the bottom of the pile can suffocate or drown. Deeper water allows the ones on the bottom to swim out from under the pile. Food can be offered five to seven days after hatching.

Alligators are very susceptible to West Nile Virus (WNV), especially as hatchlings (Fig. 10). Besides controlling mosquitoes around the farm, some producers will vaccinate their hatchlings. A special WNV vaccine has been developed for alligators. Treatment protocol is to administer two doses injected into the tail muscle three weeks apart. A booster is required for protection beyond one year.



Figure 9. The umbilicus will completely dry and heal in 2 to 3 days.



Figure 10. Baby alligators can be initially vaccinated for West Nile Virus when they are just a few days old. A second dose is administered after 30 days.

Summary

Captive breeding programs are less commonly used by commercial alligator farms due to time to maturity, the land area required for pens, the care and maintenance of the alligators, and the safety of workers. Most commercial alligator farms now rely on the collection of eggs from nests located in the wild.

Alligator eggs must be collected, transported and set in the incubator in an upright orientation. The eggs are incubated at 88° F (31° C) and hatch in approximately 65 to 70 days. Both sexes are obtained at this temperature.

Hatchlings can be transferred to heated grow-out facilities after 3 or 4 days. Mosquito control is important to reduce the risk of West Nile Virus.

Anyone interested in becoming an alligator producer should consult with the wildlife conservation agency in their state regarding specific regulations.

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