Title
Using geometric probability to compare the random and actual mating successes of the American Alligator, *Alligator mississippiensis*.

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Abstract

The American Alligator, *Alligator mississippiensis*, is a large crocodilian reptile where their habitat is the southeastern United States. In this study, I compare the calculated “random” probability of mating success between coupling alligators and the actual probability of mating success. The random probability of mating success was calculated to be around 1%. Male alligators increase their chances of mating success to 100% by using their tails and feet to roll the female into the correct position, and holding her still underwater. The male aligns their vents and everts his penis from his cloaca into her cloaca to inseminate the female.
Introduction

The American Alligator is only found in the southeastern United States, from Texas to North Carolina. It’s the state symbol of Florida, Louisiana, and Mississippi. These alligators prefer freshwater but can tolerate brackish water. Alligators help to preserve the ecosystem by digging alligator holes and tunnels that retain water, which organisms can inhabit during dry season. They hunt invertebrates as young alligators, their diet mainly snails; as they grow older and bigger they incorporate many more vertebrates into their diet. As adults they eat mainly snakes, aquatic salamanders, and snails. Birds and mammals are consumed in small quantities. Alligators are apex predators at the top of their food chain, with humans being their only real predator as they are harvested for their skin and meat.

The American Alligator breeds in spring with the peak months being April and May. Nighttime behavior during mating season includes alligators gathering together in large groups for group mating, called “alligator dances”. Female alligators build nests of vegetation, sticks, leaves, and mud in or near the water in a secluded area. The female will lay 20-50 white eggs which are covered with more vegetation to heat the eggs. The temperature determines the sex: if the egg hatches at 86 °F or lower, the clutch is female; if the eggs hatch at warmer temperatures, the clutch becomes male. The sounds that the alligators make are a large part of mating success, they bellow and slap their heads and tails which send vibrations through the water, and let the other alligator know that he or she is ready to mate. In this study I use geometric probability to compare the random mating success to the actual mating success.

Method

Random mating is calculated by using geometric shapes to determine a surface area of the animal, and comparing the ratio of the area of insemination to the entire body, and is thought
of like a bull’s-eye. The shapes are supposed to represent what the male sees. Random mating success was calculated with two shapes, a rectangle which covers the whole body of the alligator and a small circle where the cloaca is, the bull’s-eye. The bull’s eye is where the male deposits his sperm. Random mating success is calculated by dividing the surface area of the bull’s-eye by the surface area of the entire body.

Figure 1: This image was obtained from Google Images. The rectangle represents the entire body and the small circle represents the cloaca. This is how the male sees the female.

Results

Target surface area (rectangle): 15.6cm x 3.6cm = 56.16cm²
Target surface area (Bull’s-eye): $3.14 \times 0.5 \times 0.5 = 0.785$

Random probability of mating success (bull’s-eye / target): $0.785/56.16 = 0.01 \times 100 = 1\%$

Based on my geometric calculations, the surface area of the bull’s-eye is only 1% of the total surface area of the target. By chance alone, 1 out of 100 darts would hit this bull’s-eye.

**Discussion**

In this study I have discovered that with no intervention from either party the random success of mating will only be one percent. Males and females increase this mating chance in several ways. The male positions the female with his tail and legs then rolls her into the correct position. Mating is done underwater and can last up to 15 minutes at a time, to do this Alligators have evolved to slow their heart rate down considerably when underwater for long periods of time to allow them to mate for as long as possible. Alligators mate for several days at a time, sometimes with different partners and sometimes with the same partner, so the female can get as much semen in her as possible. Many clutches of eggs have baby gators from different fathers. To further increase the success of the species, when there is no male alligator to mate with, females can still produce fertilized eggs by storing sperm for, what has only been recorded so far, as up to two years.

A female will choose the loudest and most aggressive male. Sometimes during mating the male is so aggressive that he fatally wounds his partner during copulation. The father does not parent, but the female guards her nest aggressively for 65 days until the babies hatch, after which she carries them in her mouth to the water. Baby alligator’s stay with their mother for one year.
When they start getting big the mother will start to act more aggressively towards the baby, which encourages them to leave on their own.
References


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