Title
Evolution of maternal investment strategies for the Leghorn chicken, *Gallus gallus domesticus*

based on environmental risk factors.

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Abstract

The chicken (*Gallus gallus domesticus*) live on farms and in the wild around the world, where they are free to roam and lay eggs. Chickens can lay about 200-300 eggs a year if you don’t let the chicken brood. If you don’t take the eggs away a chicken will lay an average of 12 eggs per clutch. The eggs take about 21 days to hatch. A chicken can lay about two sessions of fertile clutches then is given a six month rest. Egg quantity and quality was plotted to determine the risk management strategy used by chickens. We conclude that starvation is a greater threat to offspring than predators.
Introduction

Chickens (*Gallus gallus domesticus*) are farmed and bread throughout the world. It is a bird that, belonging to the family Phasianidae. The average weight of a hen is about 3-5 lb. and 5-8 lb. for a rooster. Hens lay their eggs in a nest and have been known to share a nest with other hens. Females lay an average of 12 eggs per clutch. The eggs take about 21 days to hatch. A chicken can lay about two sessions of fertile clutches then is given a six month rest. During the rest the hen can still lay unfertilized eggs. A chick reaches sexual maturity at about 18-25 weeks and has a life span of 15-20 years. Newly hatched chicks weigh 2-5 ounces. Chickens eat grains, seeds, fruit, vegetables, and insects.

The lifetime fitness goal of each sexually mature female, like the leghorn chicken, is the survival of two sexually mature offspring to replace her and her mate. Given that most offspring perish before reaching maturity, how do mature females of any species—clam, insect, fish, frog or elephant—reach this goal? According to the maternal risk management model (D. L. Cassill, manuscript in preparation), utopian environments favor investments in a few, low quality offspring, predation environments favor investments in offspring quantity, seasonal environments with periods of scarcity favor investments in offspring quality and multi-risk environments with high predation and periods of scarcity favor investments offspring diversity—usually a few high-quality offspring and many-low quality offspring. In this study, we measured offspring quality and quantity for the saltwater crocodile and then used these metrics to predict the environmental risk factors that shaped the evolution of maternal investment strategies.
Method

Offspring number and relative offspring body-size were plotted on the inner “x” and “y” axes. The outer “x” and “y” axes are qualitative probabilities of predation or starvation. The relative body size of offspring at independence and thus the probability of starvation was estimated as $S = m/M$ where $S =$ expected probability of offspring mortality based on cycles of food scarcity; $M =$ mass of mother at the time of offspring independence; $m_x =$ mass per offspring at the time of its independence.

The expected probability of offspring mortality by predation was estimated as $P = 1 - (2/N)$ where $P =$ expected probability of predation; $2 =$ expected lifetime fitness per mother; $N =$ the number of offspring produced by a mother per clutch or lifetime. The expected probability of offspring mortality in multiple-risk environments is estimated as $PS$.

Results

Offspring quality was estimated using 2lb as the average weight of offspring at independence. Maternal weight was estimated as 5lb. Relative offspring quality represents the probability of offspring mortality by starvation, which was calculated as $2/5 = 0.40$. Offspring quantity was estimated at 12 eggs per clutch. The probability of offspring mortality by predation was calculated as $1 - [2/12] = 0.833$. To summarize here, the percent of offspring that will die of starvation (83.3%) far exceeds the percent of offspring that will die of predation (40%; Fig. 1).
Figure 1: The maternal investment strategy by the saltwater crocodile. P: Predation environments favor investments in offspring quantity rather than quality. S: Seasonal environments that cycle between abundance and scarcity favor investments in offspring quality rather than quantity. R: Multi-risk environments with high predation and periods of scarcity select for a few high-quality offspring and many-low quality offspring. U: Utopian environments favor few, low quality offspring.

Discussion

Chickens are omnivores and feed on whatever they find. They catch insects, snakes, mice, worms. They also scavenge for seeds, grains, grass, leaves, and pedals. They would also eat fruits and vegetables. In the wild if these things could not be obtained they will die from starvation. Some predators chickens have are raccoons, skunks, humans, dogs, foxes hawks, possums, and owls. Some animals who eat their eggs are snakes, mice, crows, squirrels, cats. Even though a hen will stop taking care of her chicks at about 4-6 weeks the chickens will stay together their whole life. A chicken can produce about 200-300 eggs a year if the hen is not
allowed to brood. It doesn’t matter if the eggs are fertilized or not. Over a lifetime a hen can produce over 5000 eggs.

Based on our calculations we can deduce that the leghorn chicken’s maternal investment strategy, investing more in offspring quality than quantity. The leghorn chicken have a high probability of starvation and predation.
References


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