

MODELLING CROCODILE POPULATION UNDER THE INFLUENCE OF ENVIRONMENTAL FACTORS

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Crocodilians are among the most resilient species, demonstrating remarkable survival since the Mesozoic era. The sex of a crocodile hatchling is determined by the incubation temperature of the egg, a phenomenon known as Temperature-Dependent Sex Determination (TSD). Based on thermal variations influenced by proximity to water bodies, crocodile nesting regions in river basins are categorized into three sub-regions: Region I, with the lowest incubation temperatures, producing only female hatchlings; Region II, with moderate temperatures, yielding an equal ratio of males and females; and Region III, with the highest temperatures, resulting exclusively in male hatchlings. Female crocodiles prefer to lay eggs in Region I, but due to space constraints, they may also nest in regions II and III. Considering this movement, a theoretical fraction is formulated based on the carrying capacity of Region I and the number of female crocodiles incubated in that region. Using this fraction and the TSD criteria, a dynamical model of four differential equations is developed. However, periodic flooding in large river basins alters the carrying capacities of regions I and II, while additional factors such as egg predation, seasonal food shortages, and human activities further influence crocodile populations. To account for these effects, a differential equation predicting the dynamic evolution of the carrying capacity of Region I is incorporated, assuming the total carrying capacity of regions I and II remains constant. The impact of periodic flooding and other environmental factors is modelled using a sinusoidal forcing term and a white noise component. The values of carrying capacity are obtained from this equation and, then incorporated into the system of dynamical equations describing the population of male and female crocodiles in each region. Due to data scarcity, model parameters are estimated using synthetic data derived from existing indices. Numerical simulations confirm the system's stability and accuracy, predicting an optimal male proportion of 0.09, critical for species survival.

Keywords: Carrying capacity, Differential equations, Periodic-flooding, Temperature-dependent sex determination, White noise