

Critical depensation: The case of the passenger pigeon

The Hon. Charles T. Dunning of Goshen, ex-Chief Clerk of the New York State Senate, has a fine collection of mounted specimen of birds, and among them is one of a bird that is to-day extinct, so far as any one has been able to discover, although less than fifteen years ago it was abundant on this continent and to the people of this State was as familiar as sparrows are. Its disappearance came as suddenly, one might say, as the snuffing out of a candle. One day in 1889 these birds were apparently as numerous as they had ever been within the memory of man. The next day they had disappeared, and no one has seen or heard positively anything of them since.

This bird was the wild or passenger pigeon, which was the wonder of naturalists from the earliest discovery of America. It was found nowhere else but on this continent and was not infrequently the mainstay of the pioneer backwoods settler and for time out of mind a source of great pleasure and profit to the sportsman and pothunter and snarer.

[...] As long as that roost lasted, which was until the last of April, the pigeon were slaughtered and snared by thousands of hunters and netters, not only by day, but by night, and the squabs that were taken were beyond computation, yet it is the testimony of those who participated in the onslaughts on the colony during those three months that there were more pigeons in the woods when the colony abandoned them than when the birds came in. [...] They left the Michigan forests at the end of the nesting time that year, just as they had left them time and time again, but they never returned to that roosting place nor to any other roosting place they had been known to frequent as long as the memory of man could recall, and they have never been seen or heard since. Where did they go? No one knows nor has any one been able to advance any satisfactory theory to explain their sudden and mysterious passing.

©August 18, 1901, New York Times

Halliday (1980) concurs with the New Times' account by pointing out that "It does not seem credible that human destruction, severe as it was,

could have accounted for so rapid a decline. As the species became rarer and its breeding colonies smaller, trapping must have become a less viable economic proposition, and the hunters would have had to turn their attention to other species or go out of business. (158)” Halliday proposes the theory that “social factors, namely colony size and reproductive success, were related in such a way that, though the species was apparently still quite common, its breeding rate was insufficient to offset mortality. (157)” The following exercise proposes a model that accounts for the presence of “social factors”.

Suppose that the efficiency of reproduction increases with the stock size. This could be due to the fact that as the population size becomes very small, finding a mate becomes more difficult; because a larger group makes it easier to locate food sources; or because predators are easier to locate with larger groups. If group effects are very important for reproduction and survival, it may be that below a certain size, recruitment drops below the mortality rate. Let us denote this size as the minimum stock size below which the natural growth of the stock becomes negative. This possibility is illustrated in figure 1 by the fact that population growth becomes negative for stock sizes below \underline{S} .

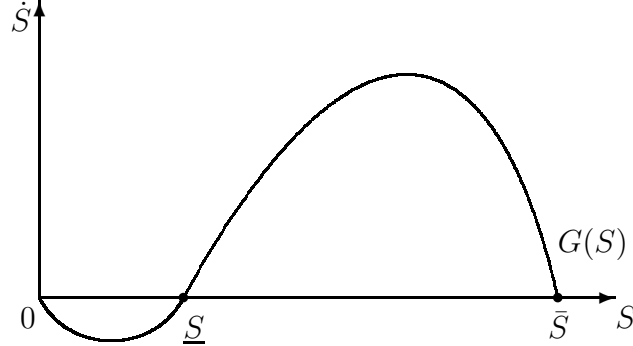


Figure 1: Passenger pigeon and critical depensation

- a) Draw the steady-state yield-effort curve assuming that the harvest rate is given by $h(t) = \alpha X(t)S(t)$.
- b) Assume a constant unit cost of effort equal to c . Illustrate graphically a case where c is such that both restricted access and open access regimes lead to positive sustainable harvest rates.

- c) Use the graphic to argue that when c is low enough, there is no steady-state harvest rate which is compatible with an open-access exploitation regime. Can you say the same for a restricted-access regime?
- d) Propose a (sufficient) condition under which open access leads to the extinction of the bird's stock. (Hint: The value of \underline{S} plays an important role.) Argue that extinction won't occur under open access when $\underline{S} \approx 0$.