



Overshoot in a Nutshell

David M. Delaney, Ottawa, October 2003

Thomas Robert Malthus, 1766-1834, famously observed that human population, if unchecked, would grow faster than its food supply. He argued that education in "moral restraint" might prevent starvation from being the operative check on population growth. It is implicit in his writings that uncontrolled population growth, failing "moral restraint", would stall near the natural limits of the food supply. The population would remain stable thereafter, with most people living on the edge of starvation. But general undernourishment of a stable population is not a likely result of the current fantastic expansion of the human population. Like many who have commented on population growth, Malthus did not understand overshoot.

A species may greatly overshoot the long-term carrying capacity of its environment. (Its population may become greatly larger than its environment can

sustain.) Overshoot becomes possible when a species encounters a rich and previously unexploited stock of resources that promote its reproduction.

The creation of stocks is due to ongoing geological and biological activity. A resource stock forms when a part of the daily production of a resource, a *flow*, accumulates slowly without being exploited, perhaps over millions of years. An enormous stock of a resource may accumulate before it encounters a species that can exploit it easily. After such an encounter, only predation and disease limit reproduction of the species.

Without significant predation or disease, and while large amounts of the stock remain easily available, the population of a species can grow to a size hundreds of times that which can be supported by the flows that created the stock. The daily production of a resource is a mere trickle compared to the flood available from a stored accumulation.

After a long period during which more of the stock is consumed each day by the growing population than was consumed on the preceding day, the stock starts to exhaust. Deposits of the stock become harder to find. Less can be obtained from the stock each day than the day before.

The time now remaining before complete exhaustion of the stock may be much shorter than the time that elapsed between encounter with the stock and the first signs of approaching scarcity. Soon, individuals begin to compete desperately for the remaining stock. To stay alive, they resort to alternative resources of lower and lower quality. By consuming the sources of flow, they destroy the capacity of their environment to produce the original flow. They also destroy the capacity of their environment to produce flows of alternative resources. Most of the population dies.

Ecologists call the resulting collapse of the population a *crash*, or *die off*. As a result of a crash, the carrying capacity for the overshoot species, and for other species, becomes less than if the overshoot species had not stumbled onto the stock in the first place. The population may remain at a very low level for a shorter or longer time--or forever. Because of the exponential nature of population growth in the presence of abundant resources, a single generation of the population--the most numerous generation--experiences abundance in its youth, starvation in maturity, and premature death for most of its members. "Crash" is an apt term--a population crash can happen very quickly..

Malthus thought that population might approach a carrying capacity limit, then hover there, with most people living in poverty and misery. He did not imagine

overshoot and sudden collapse. He did not understand that technology was converting mineral concentrations and much of the biosphere into windfall stocks that would stimulate rapid population growth. Now, two hundred years after Malthus, humans have multiplied their numbers far beyond any sustainable limit, and the end of the windfall stocks is in sight.