PART I: OUR CONVERGING CRISES

Population and Consumption

We humans have certain advantages over other animals. Our larger brains have enabled us to develop language, which in turn helps us coordinate our behavior over space and time. Also, our opposable thumbs allow us to make and use tools. Many other animals communicate through sounds or gestures, and a few make tools, but humans are far and away the champions at both communication and tool-making.

Some of our tools—like weapons for hunting, and clothing for staying warm in cold climates—enabled us to expand our range into new habitats as we left Africa over 100,000 years ago. Control of fire enabled us not only to cook food but also to alter ecosystems so they could produce more of the food we liked. Wherever we went, we tended to take over habitat from other creatures; we also hunted some large game animals like mastodons to extinction.

Our adoption of agriculture, starting about 10,000 years ago, entailed harder work, but also produced food surpluses that allowed groups of us to build permanent communities. Storable food surpluses also led to full-time division of labor, which in turn led to writing, money, and the development of even more new tools. Meanwhile, more people could be supported per unit of land area.

Eventually we developed cities, and thus, ***civilization***. Cities became centers of knowledge-sharing, administration, and resource consumption. They drew food, firewood, pelts, ores, and people from the countryside, often leaving cleared forests and depleted soils around the urban periphery.
Civilization was evidently a perilous social development: after all, early civilizations had a tendency to collapse. We'll discuss that inherent instability in video 9.

The development of agriculture caused a pulse of human population growth, but otherwise our numbers ebbed and flowed through the millennia, with a very small long-term trend toward growth.[1] Population dynamics for humans were still largely subject to the same forces as in the rest of nature. Let's examine those forces and dynamics briefly.

Take the field mouse. Its numbers in any given area vary according to the relative abundance of its food, which is typically small plants, and that food abundance in turn depends on climate and weather. The local mouse population size also depends on the numbers of its predators—which include foxes, raccoons, hawks, and snakes. A wet year can result in heavy plant growth, which temporarily increases the land's ***carrying capacity*** for mice, allowing the mouse population to grow. This growth trend is likely to overshoot the mouse population level that can be sustained in succeeding years of normal rainfall; this eventually leads to a partial ***die-off*** of mice. Meanwhile, during the period that the population of mice is larger, the population of predators—say, foxes—increases to take advantage of this expanded food source. But as mice start to disappear, the increased population of predators can no longer be supported. Over time, the populations of mice and foxes can be described in terms of ***overshoot and die-off cycles***, again tied to external factors like longer-term patterns of rainfall and temperature.

Using tools, language, and agriculture, humans gradually found ways to overcome some of these natural checks and balances. With our weapons we could kill off our predators, like lions and tigers. Now the only direct challengers we had to worry about were other humans. We could expand into new territories. We could adapt to using new and different resources. These were the reasons for our long-term population growth trend.

Still there were other limiting factors, one of which was energy. As long as we depended on firewood for fuel, our numbers were limited by the availability of trees. Ancient civilizations consumed forest after forest—indeed, one of the oldest known human stories, the Epic of Gilgamesh, revolves around the hero chopping down trees. But the resulting deforestation was sometimes associated with the decline of civilizations.

In the last few centuries—and especially the last decades—fossil fuels began to substitute for firewood. And this soon enabled a massive increase in the global human population.

[1] Source: http://www.census.gov/population/international/data/worldpop/table_history.php

With so much energy now available, we have developed far more tools to use it. We've used some of these tools—like those related to sanitation and medical care—to lower the human death rate. At the same time, we have developed artificial fertilizers, tractors, and other tools to increase food production. We also developed ways to transport resources and goods longer distances, from places of abundance to places of scarcity, so that people can live in even the most harsh and barren environments. In effect, we have dramatically and quickly increased the carrying capacity of Earth for humans.

Especially during the past century, our population growth has largely escaped the overshoot and die-off cycles that characterize population dynamics in other species. In the mid-nineteenth century, the global human population stood at about one billion; in the century-and-a-half since, it has grown to well over 7 billion. Our current rate of growth is 1.1 percent per year. That may not sound like much, but *any* constant rate of increase is unsustainable over the long run: at one percent compounded growth, any quantity will double in about 70 years. If our numbers were to continue growing at just one percent per year, our population would increase to over 115 *trillion* during the next thousand years. Of course, that's physically impossible on planet Earth. So one way or another, our population growth will end at some point.

Currently, on a net basis (births minus deaths, that is) we are adding about 80 million new people to the planet each year. Think of that as the populations of New York City, Los Angeles, Tokyo, and Mexico City added together. Each year we must find ways to feed, house, and otherwise care for that many more of us. It's the highest annual number of increase in human history. That's because, even though the percentage rate of population increase is slowing, it is now a percentage of a very large number.

The United Nations predicts that world population will reach more than 11 billion by 2100—and most of the growth will be in the less-industrialized countries.

Demographics is the statistical study of population; demographers speak of a "demographic transition," which describes the tendency for population growth rates to decrease as nations become wealthier. So, can we reduce population growth by increasing per capita wealth throughout the world?

This is how most people would like to solve the problem of unsustainable population growth. However, growth in per capita

consumption is also unsustainable over the long haul. During the past few decades we have accelerated the rate at which we consume commodities and products of all kinds—everything from water, steel, plastic, and copper to smart phones and cars. Indeed, increasing consumption is, in effect, how we've come to measure progress.

But our planet's ***nonrenewable*** resources—like minerals, metals, and fossil fuels—are finite. There's only a certain amount, and once these are gone they're gone forever. We also use ***renewable*** resources like forests and fish, but in many cases they are being harvested faster than they can replenish themselves.

Ecological footprint analysis measures the human impact on Earth's ecosystems. Our ecological footprint is calculated in terms of the amount of land and sea that would be needed to sustainably yield the energy and materials we humans consume. According to the ***Global Footprint Network***, at our current numbers and current rate of consumption we humans would need 1.5 Earths' worth of resources to sustainably supply our current appetites. At the U.S. standard of living, we would need the equivalent of *four* Earths to sustain us. Of course, we don't have four or even one-and-a-half planets at our disposal—yet we are still using *more* than one Earth by drawing down resources faster than they can regenerate—in effect, reducing the carrying capacity that would otherwise be available to future generations.

Human impact on the environment results not just from population size, and not just from the per capita rate of consumption, but from both together.

Clearly, different countries' per capita rates of consumption vary greatly: the ecological footprint of the average American is almost eleven-and-a-half times as big as that of the average Bangladeshi. And within a nation like the United States, there is also a great deal of economic inequality—and thus vastly different levels of consumption. Later in this series we will examine some of the historical, political, economic and military reasons behind this inequality.

But first, we're going to dig deeper into the subject of resource depletion, to see whether this is an issue that concerns us now, or whether it's merely a theoretical problem for future generations to worry about.