MCDB 150 Global Problems of Population Growth
Lecture 24 Notes

This course started with animal reproductive strategies and then focused on human reproductive activities.

Many of our fundamental behavioral propensities are still similar to our Chimp cousins.

Desire to engage in sex.

Status determines access to sex.

Within group Male-male competition for status

Status determined largely by alliances w/ other community members

Social approval essential

social demands an important component of human fertility

Male on female battering

Between groups: violent hostility

1. Video of Population Growth

We are in absolutely unprecedented times for humanity and for the planet.

As you can see from the slide (11) rate of population growth has not changed much since 1970.

So, the video (though made in 1990) is pretty much accurate up to the present.

What does the future hold?

2. UN Projections: UN World Pop Prospects 2006 CURVES SLIDE 11

Highest is most conservative – fertility remains constant at current level

World TFR=~2.8.

All other projections are optimistic.

They assume that fertility will fall from today's level. ASSUMPTIONS SLIDE 12

HIGH Globally fertility drops by ~½ child to 2.35

MEDIUM: Globally fertility drops by ~1 child to 1.85

That's BELOW replacement

LOW Globally fertility drops by ~1½ child to 1.35

Obviously pretty arbitrary assumptions:

Projections not predictions

The curves simply say, that IF such-and-such an assumption eventuates,

THEN, the curve of population growth will be as shown.

The UN makes no statement as to the likelihood of the different scenarios,

Huge range from 8 billion in 2050 to 12 billion.

That's a 50% uncertainty.

Only the most optimistic projection envisages

population starting to decrease by 2050.

The others continue rising throughout the period.

In the medium variant, population is expected to reach 9.2 billion in 2050 and to be increasing by about 30 million persons annually at that time. UN World Pop Prospects 2006

No projection imagines that fertility rises again

Reasons it MAY rise

The list I presented is in the Pop Envir Article in your reading packet

1. Economic collapse. I was referring to the 1997 collapse of Asian currencies.

That one was limited to Asia and was resolved fairly quickly.

Now we have a truly worldwide collapse of much greater proportion –

And no one knows when or whether it will resolve.

2. Religious fundamentalism.

Has continued to get more extreme.

(a couple of examples from the recent news)

Many oppose invitation to Obama for Notre Dame commencement.

http://notredamescandal.com/

Taliban resurgent in not only Afghanistan, but now in Pakistan. NYT 4/22/09

3. Decline in international support for FP programs

Foreign aid for all sorts of good projects has already declined.

The future is unknowable, but, even under optimistic assumptions, the population is going to get a lot larger than it is now.

Each of those people has to live somewhere, they need food from somewhere, their wastes have to go somewhere, they need a job somewhere, and maybe even they need a schoolhouse somewhere.

All of these somewheres are the environment.

3. How does one conceptualize the relation of population to environmental destruction?

The simplest statement is that the total human environmental footprint is proportional to the number of people.

Footprint prop to Population.

Whatever the footprint that people have at any given time – the more people the larger the footprint.

That's pretty obvious.

This simple statement was amplified by John Holdren.

On 20 December 2008, President-elect Barack Obama named Holdren as Director of the White House Office of Science and Technology Policy

I=PAT SLIDE 15

IMPACT = POPULATION X AFFLUENCE X TECHNOLOGY.

The idea is that population is not the only factor you have to consider.

Affluence refers to the fact that rich people consume more than poor people.

Because of this consumption, rich people have a larger footprint than poor people.

High affluence increases Population's environmental impact.

Technology: A technology that uses bull-dozers and chain-saws to clear a forest will do more destruction than a technology that uses hand axes or even stone axes.

A technology that mines with dynamite and enormous dumptrucks will do more destruction than a technology that uses a pick, shovel and wheelbarrow.

High technology increases Population's environmental impact.

The unit used for "Affluence" is the standard income per capita ($/person).

The unit used for technology is amount of impact on whatever environmental factor one is interested in per dollar spent in the economy.

For instance, if one is interested in the carbon footprint, it would be Kg of carbon per dollar of GNP. For instance SLIDE 16

The equation is a tautology, it is always true. SLIDE 15

$$\text{Impact} = \text{Persons} \times \frac{\$}{\text{Person}} \times \frac{\text{Impact}}{\$}$$

Impact = Impact

Even though the equation is always true, one still has to be careful in interpreting it.

The equation leads you to think that rising affluence always increases impact.

But as people get rich, they devote more money to having a nice environment.

In the US, some rivers have gotten cleaned up, smog has been cleaned up, etc.

But you have to ask – how much of the increase in the US economy has been devoted to the environment and how much to consumption.

Is our total impact on the environment less than it was 10, 20 30 years ago?

A similar consideration applies to the technology factor.

As well as being used to destroy the environment, technology can be used to reduce the environmental impact of manufacturing or using something.

Cars can be made to run more miles on a gallon of gas.

Less damaging resources can be SUBSTITUTED for scarce or more damaging

ones: A good example is fiber optics cable replacing copper wire cable.

The glass for fiber optics is made from sand.

And again, you have to ask, has the improvement of the technology of the world led to more or less destruction of the planet?

The answer is unequivocal

1. OUR CARBON EFFICIENCY HAS IMPROVED. Left side, panel A SLIDE 20

Between 1970 and 2000, the earth went from emitting 0.35 kg carbon/dollar of GNP to 0.25 kgC/$ (converted to pounds of CO_2/$ that's a change from ~2.8 pounds of CO_2/$ to about 2 lbs). So everytime you time you spend a dollar, the processes to make whatever you bought emitted (on average) 2 lbs of CO_2.

Among factors leading to the improvement in efficiency is

a. The increasing price of fuel, leading to greater economic incentive to reduce fuel use.

b. The public demand for cleaner air caused a switch from (dirty) coal fired plants to (cleaner) oil and natural gas plants. Oil and natural gas emit less CO_2 for the same amount of energy.

From 2000 to 2007 got worse again. It went from declining ~1.3%/yr (1970-2000) to increasing by ~0.3%/yr. Proceedings of the National Academy of Sciences US 104:18867 Nov 20, 2007

Among the reasons are:

a. The low hanging fruit in energy conservation has been picked. Improvements will now be more difficult.

b. The surge in coal use by China and India which both have abundant supplies.

If the loss of efficiency continues, the global carbon picture will be grim indeed.

2. INCREASES IN CONSUMPTION HAVE OVERWHELMED THE IMPROVEMENT IN CARBON EFFICIENCY.

Despite the improvement in efficiency, global fossil fuel combustion has risen in pretty much a straight line since 1960. blue-gray area Left side, panel B SLIDE 20

A very important consideration is that the I=PAT factors multiply.

I have read some very important environmental works that try to make the factors add. That is just arithmetic nonsense.

Population multiplies any other factors you think of.

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So, the bottom line on IPAT is that it is heuristic.

It is meant to make you think of the different factors that mediate between population and environmental impact.

Affluence and technology can be good or bad influences.

But, whatever the affluence or technological level, the impact is always multiplied by the population.

So, population is the one factor you can't turn to the benefit of the environment.

4. A lot of environmental destruction is [essentially] irreversible:

loss of species

through overutilization – fishing out stocks of fish

or destruction of habitat.

loss of habitat in general

splitting of habitat by roads

tropical forest fungal mat laterite in NE Brazil

CO2 residence time 200 years

Cutting off a mountaintop for strip mining in Appalachia.

Using up a resource like oil.

Oil was first used because it was oozing up from the ground in Pennsylvania. Now huge amounts of capital in extremely tech operations are needed to find oil.

The easily available resources that made civilization possible. Are gone.

If we should mess up badly, nuclear holocaust, or global warming really getting out of control, and civilization regresses. The resources to start up again are gone. etc.

How much is destroyed irreversible depends on the peak pressure.

How many species will be driven extinct depends on the peak demand by humans for space and resources.

Lets imagine that population grows but eventually levels off and then declines.

Now, as the population grows, all the extra people have to live somewhere, their food and other resources must come from somewhere, their wastes have to go somewhere, etc.

All those somewheres take up space, they use up habitat.

So, the peak demand for habitat is going to happen at the peak of population.

After that, hopefully, the population declines and its demand for habitat is reduced.

Same goes for fish resources or wood resources.

The peak demand will probably coincide with the peak population.

Since species loss is irreversible, the number of species lost is going to be determined by the peak human demand for habitat and for wildlife for food.

Hence, it is the peak of environmental stress that matters most.

It is the peak of population that matters most.

You've seen the UN projections, there will be another 1 billion, 2 billion, 3, billion … 6 or more billion people on earth before the numbers decline (if they decline).

The future of the environment depends desperately on which of these projection curves actually occurs.

And, of course, which curve happens depends on what we do now.

5. Because of momentum, what we do now cumulates for the next 100 to 150 years. Reshow momentum slides, Stopping momentum growth is how fast you can change the shape of the pyramid. If it doesn't change now, those extra people remain for their lifetimes and (at any TFR), they have more children than would happen w/o them. ➔Fertility changes get vastly amplified. Very similar to CO2 problem. Residence time in atmosphere is ~150-200 years.

➔What we do now determines the max environmental destruction.

5. Quote from environmentalist on Elephant Carcasses.

Conde Nast TRAVELER, Dec. '93 p126-161. From Peter Beard, an American who is one of the most famous conservation writers in Africa. He is very outspoken and doesn't always use polite language.

"I broke my ass to do these conscientious books. But the public's not getting it at all. You show them a photograph of 30,000 carcasses with the ivory tusks still in place and they try to tell you we should be prosecuting poachers. Doesn't anyone realize that people are hungry and using these animals for food. People still think it's wild Africa! Doesn't anyone realize that this is all about population pressure? What the Fuck's going on out there in the CONservation world? Nothing but lies, fund raising lies!" (CON for CON job).

In July 2007 the world population will reach 6.7 billion, 547 million more than in 2000 or a gain of 78 MILLION PERSONS ANNUALLY. UN World Pop Prospects 2006 Rev

The earth's population is increasing by a Billion people every 13 years.

COMPARE THE FOOTPRINT OF A BILLION NEW PEOPLE EVERY 13 YEARS

vs ALL THE CONSERVATION EFFORTS EVER DONE.

ENVIRONMENTALISM IS A LOSING BATTLE UNLESS POPULATION STABILIZES.

YET, ENVIRONMENTALISTS BASICALLY IGNORE THE PROBLEM

THEY ARE BLIND –

One of the major effects of human population growth is the expansion of humans into almost every habitat.

There is almost no limit to the type of habitat that humans will use.

I want to say a word about subsistence environments.

Remember how Malthus talked about the increase in food production as population increased.

How was it done. Well, all the really good agricultural land was already farmed, so new people had to clear marginal land and farm it. They added to the amount of food. But each farmer on marginal land produces less than a farmer with good land. So while the total amount of food goes up, the per capita amount of food goes down.

Malthus was talking about when individuals have to move to poor land.

The extreme of that scenario happens when whole groups of humans are pushed out into marginal land.

Azawak province, in Niger, is a vast region on the edge of the Sahara. SLIDE 22

The 50,000 people who live there have just two wells for the dry season.

Only one works regularly.

During the rainy season, families send their young daughters to collect water from ponds – which are also used by people and animals for bathing. SLIDE 23

When the nine-month dry season comes, these young women must travel 35 miles to one of the wells; they can carry back only enough water for their families to drink one glass a day."

p68 in Yale Alumni Magazine Sept/Oct 2006.

You must ask yourself, why do people live in such a god-forsaken place?

The answer is that, at sometime in the past,

they were pushed out of more hospitable regions by population pressure.

Probably their tribe got pushed out by a more numerous, stronger tribe.

The book "War before Civilzation" that you read some from mentions some recent cases of one tribe being pushed into marginal land by another.

Of course, the great modern example of that is the European settlers to the US pushing the Native American into god-awful dry and desert regions.

A lot of old Western movies glorify the US cavalry for what a great job they did pushing Indians off their land.

Azawakh is a very dry place – but you read about the opposite – the BanglaDeshis that live out on the mud flats in the delta of the Ganges river.

Azawakh and Bangla Desh are very hot places – but you also know of the polar Eskimos that live (or lived) on the North Polar ice cap -

WATER

The population environment relationship is circular.

People affect the environment – and then the environment comes back and affects people.

Of all the things humans need from the environment, fresh water is almost certainly what will give out first.

Much of the world, right now is starving for water.

Water comes from two sources: renewable water (rainwater) and mined water (from wells)

Mined water comes from aquifers, water trapped in pockets under layers of rock.

The great productivity of much of the US Midwest comes from mined water.

The Ogallala aquifer underlies much of the US Midwest.

Farmers just drill a well into it and suck up the water.

How does water get into rock?

Ogallala aquifer (underlies US midwest) was formed from

melt water from the last ice age (peak 18,000 years ago)!

Melting time: for ~8,000 years the earth was soggy and

Drip by drip it entered the rock reservoirs through tiny cracks.

Is being used 100X faster than it is being replenished.

Now the land kind of floats on top of water.

When the water is pumped out, the now empty rock caverns collapse

And the land on top sinks.

5' Near Houston : abandoned well. Top of well was parallel w/ ground. Irrigation caused land to fall 5 feet. ---->SLIDE 30

8' Near Galveston: Land has fallen 8 feet - Sea water flooded in.

In the Texas Gulf region 3/4 of the water is not being replenished. 1:31 ---->SLIDE 31

30' San Joaquin Valley - The land is falling 6"/year.

Land fell 30 feet from 1925 to 1977. ---->SLIDE 32

If the land has dropped so much - what has the water table done?

WATER TABLES have dropped hundreds of feet:

In parts of Texas and Arizona water tables have dropped by 100s of feet. Even Northwest of CHICAGO there has been a 200-300 foot drop. 1:31

In 3/4 of Texas's irrigated area water tables are falling 6"/yr (15cm)

Internationally same problem

40"/yr North China Plain 40"/yr (1 m)

100"/yr Tamil Nadu (India) 75-100'/decade (25-30m)

Groundwater levels in the Ganges, Brahmaputra, Meghna and Indus basins are declining at a rate of two to four metres per year due to intense pumping.
New Delhi M. Sreelatha 2/16/09 Science and Development Network

from Kim Crews Pop Ref Bureau:

Venice has sunk 9" in this century.

Bangkok sinking 13cm /yr.

MEXICO CITY. Subway built 1960 ----→SLIDE 35

Cities from humans sucking out water:

Mexico City has sunk 30 feet. NYT 1/29/98 Flat section is now a roller coaster ---->

Water pipe laid flat on ground in 1934 - now is 26 feet over everyone's head.

Some suburbs are now sinking 2 feet each year

Vicious cycle:

The cycle is kicked off by population growth:

As city grows, more water is pumped from aquifer.

As more is pumped city sinks further.

Sinkage ruptures more water pipes, sending fresh water gushing into the sewers.

That loss requires even more water to be pumped from the aquifer

Starting the cycle all over again.

So that even if population growth stopped - which it shows no signs of doing, the vicious cycle will continue.

There are 40,000 repaired ruptures a year and many more that are not even reported. Now, about 1/3 of the water pumped into the system leaks out.

Many parts of Mexico city now lie below the sewer lines:

Sewage no longer leaves the city but collects in pools.

The city now has vast pumping stations to elevate the sewage to the level of the existing drainage canal. They are now having to build a whole new much deeper sewage system: 124 miles of 80 foot deep sewers.

The city is starting to pump fresh water almost a mile up (4,000 feet) from a river located 80 miles away. The energy and machinery cost of pumping water up 4,000 feet to a city is enormous: so far the city can get only 8% of its water this way.

In INDIA the green revolution used up huge amounts of soil and water. Now many farms are going bust because they can't drill down fast enough to keep up with the declining water table.

Only the richest farmers can do this.

DUE TO THIS AND OVERGRAZING:

DESERTS EXPANDED BY 300 MILLION ACRES

= MORE LAND THAN IS CURRENTLY PLANTED TO CROPS IN CHINA

7. Environmental solutions are difficult.

Like Global warming: do we adapt, do we prevent?

Ask people to sacrifice now for future benefit. Really nasty trade-offs.

Costs are enormous.

8. Population solutions are comparatively easy

I have presented lots of data showing that people around the world

want fewer children than they are having. Pritchett Graph SLIDE 40

Contraception is often not used for secondary reasons like:

Fear of side effects; anything that happens is the fault of the contraception

You have seen from Bill Ryerson's TeleNovellas in developing countries how a relatively small input of public discussion (one radio or TV series) can spark a tremendous increase in utilization of family planning services.

So, A big revolution in how people view fertility is not needed.

Current contraceptive technology, while not perfect, is sufficient

So, Don't need new technology

Contraception is dirt cheap compared to most environmental fixes.

On the world market, a condom costs 3 cents, a cycle of pills costs 80 cents and a diaphragm is $1.25

So, Don't need huge amounts of money.

Because lower fertility helps the economics within families

Because lower fertility helps the economic development of poor countries

Because lower fertility will ease the stress on the environmental

Low fertility is a win, win, win situation.

individuals and their families win, countries win and the earth wins.

9. For the future of the earth, the key event that is going on is the

Race between falling fertility and rising population.

Hopefully, at some point the earth's population will stabilize.

Will the earth's environment be able to survive at that population level?

We have absolutely no idea.

Enjoy some relevant cartoons SLIDES 45-59

The last two look forward to a wonderful summer!