Chapter 4

THE HUMAN POPULATION AND THE ENVIRONMENT

Case Study: Earthquakes and Cyclones

● During the past few years, earthquakes, cyclones, and tsunamis have killed hundreds of thousands of people on a worldwide basis. But even with this great loss of life, Earth's population continues to increase because with a growth rate of 1.2% a year, we add 84 million new people to the planet. Has the human population exceed the carrying capacity fo the planet? Are more catastrophes in store for our species? How can we know" This chapter provides a basic understanding of the human population grows and changes over time.

4.1 HOW POPULATIONS CHANGE OVER TIME: BASIC CONCEPTS

● Define population, species, birth rates, growth rates. The science of human population growth, or **demography**, has a basic terminology that should be mastered in order to understand the processes that regulate growth and to understand the statistics of population growth.

● **Age structure** Discuss the feedbacks between age structure and population growth (see Fig. 4.2). In nations that presently are growing exponentially, population growth would continue for decades even if TFR were magically reduced to 2, because of the age structure of the population. The present age structure of the human population as a whole is shaped like a pyramid. There are vastly more young people who have not reached reproductive age. A simple numerical example will make the point.

<u>Example:</u> Assume there are 10 adults of reproductive age and 100 children. The 10 adults are told they can produce 10 children, no more. The population then adds 10 new children, to replace those 10 adults. But the 100 existing children will be producing 100 children of their own when they mature, and the population will continue to grow until the age distribution stabilizes. A stable human age distribution is one in which there are equal numbers of people in all age groups, except in the oldest age groups when significant mortality reduces the numbers. Show examples of age distributions from Italy (Fig. 4.x), as an example of a stable distribution, and from any developing nation, as an example of an age distribution from an exponentially growing population. There are some excellent animations of age distributions that are available on the WWW (references are provided below).

● **Crude Birth and Death Rates (CBR and CDR)** are defined as the number of people in a particular population that are born or die, respectively, per 1000 of population.

<u>Equations:</u> The crude birth rate is analogous to the annual birth rate expressed as a percentage of the population (e.g. 10% per year, which is equivalent to 10 births per 100 population), but the crude birth rate is always expressed as the number of births per 1000 population (also note that the rate is expressed per total population, not per female population), or

CBR= number of births in a given year x 1000/mid year population size

It is easy to calculate the annual population growth rate as a percentage change from the CBR and CDR. The formula is:

% annual growth rate = (CBR-CDR)/10

We will refer to the % annual growth rate as capital R to distinguish it from r in the exponential formula. R and r are the same concept, but R is expressed as a percentage and r as a fraction:

$$R = 100r$$

Example: In the last quarter of the 20th century, the global CBR was 29 and the CDR was 12. The percent annual growth rate of the population was (29-12)/10 = 1.7% per year. This means that if there were X number of people present at the beginning of the year, there were 1.017X present at the end of the year.

● **Total Fertility Rate and the Lag in Response of Populations.** The total fertility rate is the average number of children that females have during their childbearing years (officially defined as ages 15-49). Total fertility rate is the single most important determinant of population growth. Control of population growth ultimately boils down to controlling fertility. In theory, if a woman and her mate replaced themselves with 2 children (TFR=2), then the population should reach a stable state, or a state of zero population growth (ZPG). In reality, the TFR needed for ZPG is slightly greater than 2. In industrial countries it is 2.1. Why? Infant mortality. In poor countries the TFR needed for ZPG is about 2.4, because infant mortality is greater. The total fertility rate that results in ZPG is known as the replacement rate or **replacement level of fertility**.

Example: Industrial nations today, like the U.S., have TFRs that are very close to 2.1 or even lower. Sweden has a TFR estimated to be 1.54 and has been well below the replacement level for some decades, while the United States has a TFR of 2.07. The Italian population is essentially stationary (stable), while the U.S. population continues to grow. Why? A major factor in the U.S. is immigration, which you may want to address in a second lecture on problems particular to the U.S. Also, the U.S. is demographically not as mature as Italy. Italy and the U.S. have very different age structures, and the age structure of a population, as we will see later, has quite an important effect on population growth. So if the industrial nations have growth rates that are so low, why is the earth's population growing and what's all the fuss about? Recall our village of 100 people, 80% of earth's inhabitants are poor, and birth rates in poor nations are still high.

4.2 Kinds of Population Growth

● **Exponential Growth**: One often hears that the human population is growing exponentially. What does this mean exactly? Technically it means that rate of growth is a constant proportion of the base, or $dN/dt = rN$ That proportion is r, and in this equation r is analogous to the percent annual growth rate as was discussed above.

If we integrate dN/dt we get the exponential formula: $N_t = N_o e^{rt}$

where t is time (years), N_o is the starting population size at t=0, and N_t is the population size in

year t (measured in number of years from the start).
What is r for the human population and how is it biologically, sociologically, economically and politically regulated? First, r has an upper limit that is determined by human physiology. Simply put, the maximum birth rate is fundamentally determined by the gestation period of 9 months and the reproductive life span of a woman.

● A Brief History of Human Population Growth

4.3 Present Human Population Rates of Growth

● Presently, 6.48 billion people inhabit earth with an annual growth rate of 1.2%. 84 million people are added annually.
● There is a correlation between poverty and population growth

4.4 Projecting Future Population Growth

● Exponential Growth and Doubling Time: The **doubling time** is the time required for a population to double in size. This can be readily calculated from the percent annual growth rate: DT = 70/R. <u>Example:</u> The doubling time of the human population in 1978 was 70/1.7 or approximately 41 years. Usually there is one student in the group who wants to know where the 70 comes from. The answer is that it comes from the calculus of exponential growth:

$$N_1 = N_o e^{rt1} \text{ and } N_2 = N_o e^{rt2}$$

The doubling time is t_2-t_1 and that is what we want to calculate. In one doubling time, $N_2/N_1 = 2$

$$2 = N_o e^{rt2}/N_o e^{rt1}$$

<u>or</u>

$$2 = e^{rt2}/e^{rt1} = e^{(rt2-rt1)} = e^{r(t2-t1)}$$

$$\ln(2) = r(t_2-t_1)$$

$$\ln(2) = .693 = r(t_2-t_1)$$

$$\text{doubling time } (t_2-t_1) = 0.693/r$$

r in the original exponential growth equation is not expressed as a percentage, so if we substitute the % annual growth rate (R) for r, we have to multiply by 100, which means:

$$DT = 69.3/R$$

where R is expressed as a percent. We round off to 70 just to simplify it. The students probably will not object if you give them the first line of this explanation and leave it at that.

● **Logistic Growth**: Population density exerts important controls over population size, termed **density-dependent effects**. The **logistic growth curve** assumes its characteristic shape because of density-dependent effects: the number of nesting sites for a bird population are fully occupied, or the available food becomes limiting, or physiological stress disorders take their toll when a population is crowded, and so on.

Example: Is there any evidence for density-dependent control of human population growth? Not if you look at just the broad patterns. For instance, some of the highest population growth rates occur in the most crowded nations like Bangladesh and some of the lowest growth rates in nations with low population densities like the United States. However, when natural disasters such as coastal flooding hit nations like Bangladesh, the mortality rates can be in the thousands. Such mortality would not occur if people were not crowded into the most hazardous corners of the landscape (Case Study: Death in Bangladesh). The population density of Bangladesh is 1,019/km^2. Contrast that with the United States with its population density of 31/km^2 and its low fertility rate. It appears that population density is not the major regulator of population size in humans as it is in natural populations, but it is also fair to say that where density is high, there is evidence of episodic, high mortality. One could say that density-dependent effects are beginning in parts of the world.

● Forecasting Human Population Growth Using the Logistic Curve

4.5 THE DEMOGRAPHIC TRANSITION

● Advocates of economic development point to empirical data and a phenomenon known as the **demographic transition** (Fig. 4.8) as the best means of controlling population growth. During the course of the social and economic development of nations, birth and death rates have tended to change in succession. In the early stage death rates decline markedly. This leads to explosive population growth as the birth rates greatly exceed the death rates. Then, gradually, birth rates decline as nations accumulate wealth. This has happened in today's wealthy industrial nations without any direct government intervention. In industrial nations, women are better educated, they enter the work force, they delay marriage and childbirth, there are systems of 'social security' that governments have devised to care for elderly citizens, and there are fewer people working on farms. Further, do not discount the importance of distractions such as entertainment.

Example: Returning to the demographic transition, it will help your students to show a table, like the following, with selected demographic and economic data for nations that represent different stages in the demographic transition. In the following table Kenya and Bangladesh are poverty stricken nations with high birth rates, and high population growth (see case study: Death in Bangladesh). India has the 2nd highest population density on the chart, very high birth rates, low death rates, and a rapidly growing population. China has the 3rd highest density on the chart, but has almost the lowest birth rate on the chart. China also has the lowest death rate (it has a relatively young population in comparison to the U.S. and Italy), high life expectancy, and a fairly low infant mortality, all of which speak to the rapid progress made in China in recent years.

	Kenya	Bangladesh	India	China	U.S.	Italy
CBR	28.8	29.9	23.3	12.96	14.1	9.2
CDR	16.0	8.63	8.5	6.74	8.4	10.1

Density (no./km2)	55	1019	324	136	31	191
TFR	3.47	3.17	2.91	1.7	2.07	1.26
% Infant Mort.	6.34%	6.61%	5.9%	2.5	0.7	0.6
% Arable Land	7	60.7	54.4	13.3	19.3	28.1
R (%/yr)	1.27	2.06	1.47	0.6	0.92	0.01
Life expec.(yr)	45.2	61.3	63.6	72.2	77.4	79.4
% pop. <age 14	41.3	34.1	32.2	23.1	20.9	14
GDP($)/person	1020	1700	2540	4400	37600	25000

data sources: Allen, J.L. and Leppman, E.J. 2003. Student Atlas of World Politics. 198 pp. McGraw-Hill; and http://www.cia.gov/cia/publications/factbook/index.html

4.6 POPULATION AND TECHNOLOGY

● Human population poses a threat to the environment for two reasons: numbers and per capita impact. The total environmental effect (T) is given by P x I, where P is population size and I is impact per person.

4.7 THE HUMAN POPULATION, QUALITY OF LIFE, AND CARRYING CAPACITY

● Carrying Capacity
● Potential Effects of Medical Advances on the Demographic Transition
● Human Death Rates and the Rise of Industrial Societies
● Longevity and its Effect on Population Growth

4.8 LIMITING FACTORS

● Basic Concepts: Limiting factors can be grouped into three categories: 1) those having short-term effects such as disruption of food supply due to drought; 2) those having intermediate-term effects, such as that cause by desertification, and 3) those having long-term effects, such as soil erosion, ground water depletion, or climate change.

4.9 ACHIEVING ZERO POPULATION GROWTH

● The alternative to economic development or direct government control as a means of population control is **family planning**. The family planning approach is one of education and promotion of birth control. Family planning tries to influence behavior through education:
● Age of First Childbearing – A delay in the age of first childbearing has a large impact on population growth.
● Birth Control: Biological and Societal: Can promote breast feeding, abstinence, the pill, sterility, and abortion as control mechanisms.
● National Programs to Reduce Birth Rates: India was the first to adopt an official population policy in 1952. India has taken a family planning approach. China is an interesting case because of its ‘only 1 child policy’. The effect of this policy shows up in the TRF statistic, which is the

lowest, 1.7, of the group in the chart. The fact that the TFR is 1.7 is an indication that the enforcement of the 1 child policy is perhaps not as draconian as has been depicted in some press reports. Discuss this with your students. They will have strong opinions relating to individual freedoms, but few will have thought about it from the perspective of the well being of the population. Perhaps the U.S. can still afford individual reproductive freedom, whereas others cannot.

Technology

- Show a short **animation** of the history of geographic distribution of the density of the human population. This is available on DVD from the Population Connection, 1400 16th St. Suite 320, Washington DC 20036 for a small fee. Their web site is: http://www.populationconnection.org/education/catalog/items/item58.html. The animation, ‘World Population Video’, is a 7-minute simulation of world population from 1 A.D. to 2030. The video shows a global map that is populated with dots, each representing a population of 1 million people. For about 6.5 minutes of the film very little happens. You have to warn the students to pay attention because they will miss the action. Finally, in the last 30 seconds or so the map lights up and the number of dots explodes. There is little space left on the map at the end of the video that is not occupied by dots. There is a history to tell during the progression of the film. In the beginning the population centers were in Asia and the Mediterranean, a few in Africa; the new world was relatively unpopulated. Dots next appear in significant numbers in Europe; the number of dots declines noticeably in Europe at the time of the plague. After European colonization of N. America dots appear on the East Coast. Then starting about 1800 the action begins, and the number of dots accelerates rapidly, exploding in the 1900s. It is dramatic and has a noticeable effect on the students.

Challenge the students to think about the following questions:

- What is the current state of the human population? If you could shrink the population of the earth to a village of precisely 100 people, while preserving the existing demographic proportions, the village would:

1) Contain 57 Asians, 21 Europeans, 14 from the Americas, and 8 Africans.
2) 70 persons would be non-Christian, 30 would be Christian
3) 50% of the entire world's wealth would be in the hands of only 6 people, and those 6 would be citizens of the U.S.
4) 70 people would be unable to read, 50 would suffer from malnutrition, and 80 would live in substandard housing, only 1 would have a university

Critical Thinking Issue. How Many People Can Earth Support?

Working it Out 4.1 shows how one might make projections based on assumptions about changes in the parameters in a growth model. Other indirect methods involve projecting the availability of limiting resources. For example, assume that the earth's cultivated land area will be as productive as the best that science and technology can provide today. We will also assume that people will consume only grain (there isn't land available for raising meat and dairy products). And we will project the population size by calculating the total food energy that can be produced under those assumptions:

1. energy requirement of people: 1×10^6 kcal/yr for an adult
   (Note: one kcal = 1 dietary calorie)
2. U.S. grain production = 4000 kg grain/ha or 4×10^5 kg/km^2 (1 km^2= 100 ha)
3. world has 14×10^6 km^2 of arable land
4. total potential grain production = land area x yield
   or 14×10^6 km^2 x 4×10^5 kg/km^2 = 56×10^{11} kg/yr
5. energy content of plant matter is roughly 4.5 kcal/g or 4.5×10^3 kcal/kg
6. Total food energy production = energy content x total grain production
   or 4.5×10^3 kcal/kg x 56×10^{11} kg/yr = 252×10^{14} kcal/yr
7. total population size = total energy production/calorie requirement per person
   or 252×10^{14} kcal/yr / 10^6 kcal/(person-yr) = 25×10^9 people

Nearly 25 billion people by that calculation! There are all sorts of problems with this naive calculation. It ignores the fact that arable land is not equally productive, that agriculture in many areas is not sustainable (water supply problems, desertification, future supply of fertilizer is uncertain); it assumes we can will eat grain only; and it ignores other possible limitations besides food such as water, energy, disease, or war, and so on. Ask your students to critique these calculations. Ask your students what the quality of life might be like if we did have 25 billion people on the planet. Then calculate how many years, with a DT of 40 years, it would take to reach 25 billion. Can the earth sustain this or larger numbers? Our large population size, supplied as it is with certain technologies, is great enough to cause global changes in the environment of planet earth. Think of the earth as a space capsule with its own life support system. What is the carrying capacity of space ship earth? Is quality of life important? The question should not be, what is the maximum number of people the earth can support. Rather, it should be how many can we support at some basic level of quality of life? Resources, even renewable resources are finite. Already, there are areas of the planet were the local population cannot be sustained and resources must be imported from regions of surplus. Nearly every year now there is some corner of the world where thousands of people die of hunger.

education.

- Are the resources on this planet sufficient to raise the standard of living of the 80% of us to the level of the 6% from the United States? As students will learn in the course of these lectures, one of the solutions to the population problem, championed by people opposed to direct government intervention, is to raise the standard living and wealth of people in poor countries. Call this the economic development school of population control. Is this realistic?

CRITICAL THINKING

1.) Discuss the history of human population growth. Records were not kept until about 1650, when the population was about 500 million (rough estimate). This represented between 6 and 7 doublings in 10,000 years, or a DT of about 1500 years. In more recent times the doubling time has been falling, which means that r has been increasing. Why has r increased? Recall the derivation of the exponential growth equation (lecture on regulation of natural populations): r has two components, the specific birth rate and the specific death rate (r=b-d). If r is not constant, then either b or d or both are not constant. In the case of the human population it is actually d, the specific death rate. (**A Brief History of Human Population Growth—Section 4.2.2)**

2.) Discuss why the death rate (d) has declined dramatically (see section 4.2.2). After the hunter-gatherer stage, the development of agriculture meant that the yield of food per unit of land increased to the point where small cities were now possible. And probably then as now, children in agrarian cultures are valued as laborers in the fields, which is an incentive for larger family size. Then starting in the 18th century there were advances in science and technology. Soap was invented. Sanitation facilities improved. The sewer system in Paris was designed in 1860 (note: advise your students to visit the Paris sewer museum, where you actually descend into a section of the sewers). The flush toilet was invented. These developments (improved sanitation) had a major effect on **survivorship**, not on specific birth rates. Transportation was also improving during this period, which made it possible to transport food into cities from longer distances. This made it possible for populations in cities to grow even larger. Finally, the 20th century ushered in the rise of public health. Antibiotics and immune therapies were developed. This technology also directly impacts survivorship, not specific birth rates. While longevity has been increasing, it is really the survivorship of female children that has had the greatest impact on human growth rates. After a woman has born all her children, it matters little if she lives to be 55 or 105. It makes a huge difference if she does not survive to childbearing age. Ask the students why it's the survivorship of the female and not the male that makes the difference. (**A Brief History of Human Population Growth—Section 4.2.2)**

3.) (**China's Only One Child Policy**—**Section 4.4)**

4.) Do some homework on the funding for family planning; it derives primarily from the United Nations, sometimes without the support of the United States. Discuss where it works and why it doesn’t. Family planning has been actively practiced for decades in India with the support of the Indian government, and the numbers (in the chart) speak for themselves. But are India and other nations better off today because of family planning? Consider that the TFR in Kenya has fallen from 8.1 (1975-80). (**Birth Control: Biological and Societal—Section 4. ?)**

5.) One can see that population growth in the industrial nations, represented by the U.S. and Sweden, has abated, and this has happened without any direct government intervention. This is the empirical evidence used by advocates of economic growth. Returning to a question posed earlier, is it reasonable that 80% of the world’s population can develop economically as we have? What kinds of resources are needed to develop economically? Oil? Minerals? Assuming that the resources are so plentiful that we can all share equally in the wealth, how long will this take? How long did it take the United States to develop economically to the point where we are today? Remember the doubling time of the human population is about 40 years. (**The Demographic Transition—Section 4.5)**

6.) Returning to one of the original questions, how many people can the planet support? There is no consensus answer to this question. This critical thinking issue (also see **4.4.3**) discusses a number of issues that will impact future populations. **Thomas Malthus** in 1798 posited in ‘Essay on the Principle of Population’ that (unchecked) population growth always exceeds the growth of means of subsistence. Actual (checked) population growth is kept in line with food supply growth by "positive checks" (starvation, disease and the like, elevating the death rate) and "preventive checks" (i.e. postponement of marriage, etc. that keep down the birthrate), both of which are characterized by "misery and vice". Malthus could not have foreseen the technological advances that have allowed our population to reach 6 billion. Our crystal ball is also rather cloudy. So how can we forecast population growth? **(How Can We Achieve Zero Population Growth—Section 4.7)**

7.) Discuss the issue of population growth as it pertains directly to the United States. First, the issue of global population growth is strategically important to the U.S. Desperately poor people ferment revolution and war. This has a destabilizing effect on commerce, on nations, and threatens our security. Secondly, communicable diseases are spread much more rapidly in crowded conditions. Thirdly there is increasing pressure from people all over the world to immigrate to the U.S. This is a sensitive issue and one that your students will probably have strong feelings about. One can draw an analogy to a life boat where the occupants must decide when has the boat reached its capacity and who among the survivors in the water to will take the remaining seats. In fact, immigration does account for a large fraction of the present and future population growth in the United States. Immigration benefits the U.S. economy in several ways, and it also carries a price.

8.) Start with the history of immigration and the relevant legislation. Three significant pieces of legislation since 1980 have shaped our current immigration system. First, the Refugee Act of 1980 established a new refugee policy and removed refugees (oppressed persons fleeing persecution, torture, etc.) from a world limit of 270,000 annually. Second, the 1986 Immigration Reform and Control Act (IRCA) introduced the concept of employer sanctions against companies that "knowingly" hired illegal aliens. It also provided amnesty for many undocumented immigrants. The legacy of this amnesty is still felt today, as many of the recipients are becoming citizens and sponsoring their spouses and minor children for immigration. The amnesty created an artificial "bulge" in immigration numbers from 1988 into the early 1990s. It was artificial since these amnesty recipients were already in the U.S. The 1990 Act increased total immigration under an overall “flexible cap” of 675,000, to consist of 480,000 family-sponsored, 140,000 employment-based, and 55,000 “diversity lottery” immigrants. There were 0.4 million new arrivals (legal) in 2000. Categories such as immediate relatives remained unlimited by the cap. There are also quotas by geographic region. There are numerous sources of information to consult, including a variety of web sites, some of it with a clear agenda and suspect data. One of the very best sources of information is the annual Statistical Abstract of the United States, also available at http://www.census.gov/compendia/statab/

9.) Other potentially hot button topics are birth rates and abortion rates in the United States. Some useful statistics pulled from U.S. Statistical Abstracts include birth rates per 1000 women by age.

Table 4a. Live birth rates (#/1000 women) of U.S. women by age and year.

Age	1980	1990	2000
10-14	1.1	1.4	0.9
15-19	53.0	59.9	48.5
20-24	115.1	116.5	112.3
25-29	112.9	120.2	121.4
30-34	61.9	80.8	94.1
35-39	19.8	31.7	40.1
40-44	3.9	5.5	7.9
45-49	0.2	0.2	0.5

There are several points to make about this. One is a tendency for women to delay childbirth. This shows up in higher fertility rates in women 30-39 in particular. But also note that the teenage pregnancy rate is rather high. Teenage pregnancy in the U.S. is probably the highest of any industrial nation. This is probably a function of numerous factors, including inadequate sex education in grade school. You might contrast this with similar data from a country like Denmark.

10.) Show your class a graph of the historical trends in TFR in the United States. It shows a number of interesting features. In 1917, the U.S. TFR was 3.3, then corresponding to the Great Depression, the TFR dropped to 2.1-2.2 during the 1930s. Following WWII, TFR peaked at 3.68 in 1958, part of the baby boom years. Since then it has declined to about 2.0 today. The decline in TFR during the Great Depression is a great example of how human biological (reproduction) and social systems can interact. The changes in U.S. TFR have had some interesting effects on the age structure of our population. Here you can show several figures that document this. The current baby boomers are aging and the younger generations are fewer in number. This will affect our systems of social welfare, health care, and education, to name a few. Showing the age distributions will also reinforce the connection made earlier between age structure and population growth.

11.) Show your class the U.S. abortion statistics. Few people understand how large the numbers really are. Focus on the practical side of the issue. The trends in age-specific rates and time are extremely interesting. We know that the TFR of teens <age 15 has not declined between 1980 and 1996, but the abortion rate has. Likewise, the TFR of women >age 40 has not declined, but the abortion rate has. What does this suggest? What would happen to the population growth rate in the U.S. if Roe v. Wade was overturned? What would be the social and economic costs? In addition to U.S. Statistical Abstracts mentioned above, another great source of information is from the National Center for Health Statistics: http://www.cdc.gov/nchs/hus.htm.

Table 4b. Rate per 1,000 women of live births and induced abortions.

Outcome	Age 10-14	Age 15-17	Age 18-19
Live births	1.2	33.8	86.0
Induced abortions	1.1	19.0	44.9

Table 4c. Ratio of induced abortions: pregnancies by age and year (% of total).

Age	1980	1996
<15	52.0 %	38.5 %
15-19	38.8	29.6
20-24	28.1	27.6
25-29	18.7	19.7
30-34	18.1	14.9
35-39	30.0	16.4
40 and >40	38.9	23.6

Web Resources

- For an animation of the age structure of the United States from 1950 to 2050 see: http://www.ac.wwu.edu/~stephan/Animation/pyramid.html

- For an animation of China's age structure from 1950 to 2050 see: http://www.iiasa.ac.at/Research/LUC/ChinaFood/data/anim/pop_ani.htm

- For all kinds of useful facts about different nations look at the CIA website: https://www.cia.gov/cia/publications/factbook/index.html

- For health-related statistics of all kinds see the National Center for Health Statistics website:
  http://www.cdc.gov/nchs/hus.htm

- For data of all kinds (energy consumption, population, vital statistics, government spending, GDP, etc.), see the U.S. Census Bureau's Statistical Abstract of the United States:
  http://www.census.gov/compendia/statab/
  *There are annual editions of these abstracts and each edition does not necessarily repeat the tables in the previous edition.