Zero Population Growth in Michigan

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DESPITE a substantial decrease in birth and fertility rates, the number of Michigan residents has been increasing 1 percent annually because of an excess of births over deaths. Inmigration and outmigration have been virtually in balance. Michigan, as well as the United States, currently has nearly twice as many births as deaths. This growth in population, if unchecked, would lead to a doubling of the State's population in 60 years. In a number of foreign countries and among some segments of the U.S. population, the annual growth rate has been 3.5 percent, which produces a doubling of the population every 20 years.

Awareness of the dangers inherent in uncontrolled growth has led to a number of proposals for checking or reducing this expansion. One of the most widely rec-

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ognized is zero population growth (ZPG), a term that within a few years has become part of the English language. ZPG has been defined by some as an immediate balance between live births and deaths, but such a balance would not be attainable for some time because it would limit women to an average of 1.3 children, or approximately half the current average of 2.56 children. (Current in this report refers to 1970.)

We employ the more realistic ZPG concept that each generation of women should reproduce only enough children to establish an eventual balance between live births and deaths. Based on current survivorship rates in Michigan, the number would be 2.11 children per woman. This average is slightly more than two, reflecting early mortality and the ratio of male to female births (1.04 : 1.00). A reduction of 18.4 percent, or 139,170 births, rather than the 170,510 births reported in 1970, would decrease the annual fertility rate from the current 85.3 births to 70.3 per 1,000 women aged 15 to 44 years.

If women were to continue having 2.11 children, a gradual aging of the population would occur, with a resultant decrease in the number of births and a concomitant increase in deaths. Ultimately, around the year 2030,

a balance between the two would be reached that essentially would remain unchanged.

We define and describe certain assumptions related to the ZPG concept and consider some implications for Michigan should this concept become reality. In this paper we do not take a stand for or against ZPG. Our purpose is limited to promoting an awareness of the important changes that can be expected with population stability.

Analysis of the Data

Between 1960 and 1970, the number of Michigan residents increased more than 1 million, or 13.4 percent, from 7,823,194 to 8,875,083. Proportionally, this growth was almost identical to that of the U.S. population, and 97.4 percent of it was the result of an excess of live births over deaths. Net inmigration of 151,000 nonwhites slightly exceeded the net outmigration of 124,000 whites; the difference accounted for the remaining 2.6 percent of increase. If this growth rate were to continue, Michigan's population would total 10.1 million in 1980, 13 million in 2000, 16.7 million in 2020, and 21.5 million in 2040.

In projecting the effect of zero population growth on Michigan's future population size, we assumed that—

1. Inmigration will equal out-migration.

The two have balanced in recent years, although not in each age group, and we do not believe that this trend will change.

2. Age-specific death rates for males and females will remain constant at current levels (table 1).

In virtually all age and sex groups, death rates changed only negligibly during the past decade. This trend is expected to continue unless a cure or method of prevention is found for heart disease, cancer, or one or more of the other leading causes of death.

3. Age-specific birth rates will remain constant at levels computed by multiplying all current rates by $\dfrac{2.11}{2.56}$ (table 2).

Birth rates (table 3) have decreased most rapidly among older women (35–44 years) and least among younger women (15–19 years). Births among older women are now at a low level, and it does not seem likely that women in this age group could account for a disproportionate share of further decreases in the number of births.

Table 2. Age-specific birth rates per 1,000 women, by age groups and adjusted age-specific birth rates on a ZPG basis, Michigan, 1970

Age group of mother (years)	Birth rate	Adjusted birth rate
10–14	0.888	0.732
15–19	65.020	53.569
20–24	171.225	141.071
25–29	173.938	143.306
30–34	64.441	53.092
35–39	27.319	22.508
40–44	8.914	7.344
45–49 [1]	.553	.456

[1] Includes a few births to mothers older than 49.

If the foregoing three assumptions are valid, we could then anticipate that—

1. The number of Michigan residents will increase an average of 0.5 percent per year until 2030, as compared with the current annual growth rate of 1.0 percent.

The current population of 9 million should reach a maximum of 12 million around 2030 and will remain essentially in balance thereafter. This is 6.9 million (or 36.5 percent) less than the 18.9 million residents anticipated on the basis of continued current annual growth rates (table 4).

2. The median age of the population will increase from 26.5 years in 1970 to 28.3 years in 1980, 31.8 years in 1990, 33.6 years in 2000, 35.1 years in 2010, 35.3 years in 2020, 36.3 years in 2030, to 36.3 years in 2040 (table 5). These increases in age average 0.16 per year.

By 2030 a little more than 15.2 percent of the population will be 65 years old or older as compared with the current 8.4 percent. Conversely, the proportion under 20 years old will decrease from 40.3 to 28.3 percent. Those between 20 and 64 years will increase from the present 51.3 to 56.5 percent of the total population.

3. The number of residents under 15 years old will decrease 4.9 percent by 2030. All other age groups will increase: 15 to 24 years, 1 percent; 25 to 44 years, 50.8 percent; 45 to 64 years, 62.7 percent; 65 to 84 years, 151.2 percent; 85 years and over, 43.9 percent.

The largest percentage increase will be for the group between 65 and 84 years, but the largest numerical increase will be for those between 25 and 44 years. This younger group accounted for 24.7 percent of the total population in 1970 and is expected to include 27.5 percent of all residents in 2030.

4. The ratio of dependent population (under 20 years and 65 years or over) to working-age population (20 to 64 years) will

Table 1. Age-specific death rates per 1,000 estimated population, by age and sex groups, Michigan, 1970

Age group (years)	Total	Male	Female
Under 1	21.65	24.72	18.47
1–4	.85	.97	.73
5–9	.45	.54	.36
10–14	.40	.49	.31
15–19	1.11	1.63	.58
20–24	1.43	2.33	.64
25–29	1.66	2.28	1.10
30–34	1.40	1.87	.96
35–39	2.06	2.55	1.61
40–44	3.80	4.78	2.81
45–49	6.18	7.80	4.60
50–54	9.84	12.76	6.97
55–59	13.77	18.48	9.27
60–64	20.47	27.89	13.59
65–69	31.72	41.01	22.98
70–74	49.17	61.47	38.22
75–79	66.13	86.51	51.48
80–84	112.46	140.32	94.67
85 or over	193.03	212.98	181.70

decrease from 0.95 to 1 in 1970 to 0.77 to 1 in 2030.

This changing ratio reflects the sum of two divergent trends. While the ratio of older to working-age population will increase (from 0.16 to 1 in 1970 to 0.27 to 1 in 2030), the ratio of younger to working-age population will decrease (from 0.79 to 1 in 1970 to 0.50 to 1 in 2030). That is, while less than one-sixth of the dependent 1970 population was 65 years or older, by 2030 this proportion will be more than one-third.

5. Because of the gradual aging of the population, the crude death rate per 1,000 population will increase an average of 0.7 percent per year, from 8.8 in 1970 to 12.8 in 2030.

The annual number of deaths will then be double the current figure. Chronic conditions related to old age should cause an increasing proportion of this increasing number of deaths. That is, unless major cures or preventive measures are found, the number of deaths from such causes as heart disease, cancer, vascular lesions, diabetes, and arteriosclerosis will increase significantly.

6. Because of the declining proportion of women in the childbearing ages, the crude birth rate per 1,000 population will decrease an average of 0.3 percent a year, from 15.7 in 1970 to 13.0 in 2030.

Despite this gradually declining rate, the number of live births will increase, reflecting the growth in the total population, and then will reach a plateau somewhat above current levels.

7. Because of the greater life expectancy of women at all ages (table 6), the current excess of women in the older age groups will increase considerably.

In the age group 65 to 84 years, in 1970, there were 120 women for every 100 men. By 2030 this ratio will be 144 to 100. Among those 85 years or

Table 4. Projected population, based on current growth rate and zero population growth, Michigan, 1970–2040

| Year | Projected population | | Difference | |
	Based on current growth rate	Based on ZPG	Number	Percent
1970..............	8,901,381	8,901,381	....	
1980..............	10,068,306	9,607,064	461,242	4.6
1990..............	11,422,084	10,421,627	1,000,457	8.8
2000..............	12,957,881	11,026,545	1,931,336	14.9
2010..............	14,700,180	11,424,558	3,275,622	22.3
2020..............	16,676,745	11,828,016	4,848,729	29.1
2030..............	18,919,339	12,017,783	6,901,556	36.5
2040..............	21,462,792	11,967,431	9,495,361	42.8

Table 3. Total fertility rates and age-specific birth rates, by color, United States, 1940, 1950, 1960–68

| Year and color | Total fertility rate [1] | Age group of mother (years) [2] | | | | | | | |
		10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49
Total:									
1968................	2,476.8	1.0	66.1	167.4	140.3	74.9	35.6	9.6	0.6
1966................	2,736.1	.9	70.6	185.9	149.4	85.9	42.2	11.7	.7
1964................	3,207.5	.9	72.8	219.9	179.4	103.9	50.0	13.8	.8
1962................	3,473.5	.8	81.2	243.7	191.7	108.9	52.7	14.8	.9
1960................	3,653.6	.8	89.1	258.1	197.4	112.7	56.2	15.5	.9
1950................	3,090.5	1.0	81.6	196.6	166.1	103.7	52.9	15.1	1.2
1940................	2,301.3	.7	54.1	135.6	122.8	83.4	46.3	15.6	1.9
White:									
1968................	2,368.4	.4	55.3	162.6	139.7	72.5	33.8	8.9	.5
1966................	2,609.2	.3	60.8	179.9	146.6	82.7	40.0	10.8	.7
1964................	3,073.7	.3	63.2	213.1	176.2	100.5	47.7	13.0	.7
1962................	3,347.5	.4	73.1	238.0	187.7	105.2	50.2	14.1	.8
1960................	3,532.9	.4	79.4	252.8	194.9	109.6	54.0	14.7	.8
1950................	2,976.8	.4	70.0	190.4	165.1	102.6	51.4	14.5	1.0
1940................	2,229.1	.2	45.3	131.4	123.6	83.4	45.3	15.0	1.6
Nonwhite:									
1968................	3,196.9	4.4	133.3	200.8	144.8	91.2	48.6	15.0	1.2
1966................	3,614.9	4.0	135.5	228.9	169.3	107.9	57.7	18.4	1.4
1964................	4,153.4	4.0	138.7	268.6	202.0	127.5	67.5	20.9	1.5
1962................	4,395.8	3.9	144.6	285.7	217.4	132.4	72.0	21.7	1.5
1960................	4,522.1	4.0	158.2	294.2	214.6	135.6	74.2	22.0	1.7
1950................	3,928.3	5.1	163.5	242.6	173.8	112.6	64.3	21.2	2.6
1940................	2,870.2	3.7	121.7	168.5	116.3	83.5	53.7	21.5	5.2

[1] Total fertility rate = sum of the age-specific birth rates × 5.

[2] Age-specific birth rate = $\dfrac{\text{number of births to women in specified age group}}{\text{number of women in specified age gronp}} \times 1{,}000$.

older, there were 177 women for every 100 men. By 2030 this ratio will be 254 to 100. The number of women 65 years or older will increase 163 percent by 2030, compared with an increase of 120.1 percent for men.

8. The median age of Michigan's female residents will increase more rapidly than for males.

The median age of women in 1970 was 27.4, or 1.9 years more than the 25.5 years for men. By 2030 the median age for women will be 37.5 years, or 2.3 years more than the 35.2 years projected for men. This widening disparity primarily reflects the greater increase of women in the older age groups.

Validity of Assumptions

Mortality. We do not know if the assumption that age-specific mortality rates will remain at current levels will be correct. The President has proposed a greatly expanded program to find methods for preventing or curing cancer. This program, if funded and successful in attaining its objective, would increase the average life expectancy about 5 years.

Similar efforts are underway for other chronic illnesses. Should these be successful, we would experience (a) a more rapid aging of the population, (b) an average annual increase in the population greater than the 0.5 per-

cent projected with ZPG, and (c) an extension of the period required to achieve population stability — a balance between births and deaths.

Migration. Similarly, the migration patterns of 1970 may or may not continue. Much of the recent inmigration has consisted of persons—in many cases with their families—seeking employment in automobile factories and related industries. Parts and assembly plants are now located in 28 States. This dispersal to other parts of the country, as well as technological advances, could negate the need for additional workers from other States. Should this occur, Michigan, then, like most States of the Northeast and Midwest, would have a net outmigration, with a resultant slowing in growth of population.

Age-specific birth rates. The attainment of zero population growth is dependent on the number of births per woman and on

the age of the mother at the time of delivery. Should the median or average age of mothers continue to decrease, the average number of children per woman would have to be less than 2.11, or it would take longer to achieve the desired balance between births and deaths.

We do not believe that there will be any significant further reduction in the average age of mothers. Our conclusion is based on the rapid decline in births to older women that has already occurred. These births are now at low levels, and further sizable decreases are unlikely.

ZPG implications. ZPG's most apparent effect is the resultant aging of the population, with a sizable reduction in the proportion of younger residents and a concomitant increase of those 65 years or older. Thus, for example, we can anticipate that the need for additional school teachers will be minimal unless

Table 6. Average life expectancy, by age and sex, Michigan, 1970

Age (years)	Average life expectancy (years)		
	Total	Male	Female
0	70.3	66.9	74.2
5	67.0	63.7	70.6
15	57.3	54.0	60.9
25	47.9	45.0	51.2
35	38.6	35.8	41.7
45	29.6	26.9	32.5
55	21.6	19.2	24.1
65	14.6	12.8	16.3
75	9.2	7.9	10.2
85	5.2	4.7	5.5

Table 5. Distribution of projected population by age, Michigan, 1970–2040

Year	Total	Age group (years)						Median age (years)
		0–14	15–24	25–44	45–64	65–84	85 and over	
1970	8,901,381	2,710,440	1,589,470	2,194,971	1,658,383	701,227	46,890	26.5
1980	9,607,064	2,341,060	1,894,503	2,614,788	1,876,794	835,223	44,696	28.3
1990	10,421,627	2,498,333	1,579,445	3,400,942	1,947,926	949,551	45,430	31.8
2000	11,026,545	2,637,624	1,574,967	3,320,849	2,346,327	1,088,493	58,285	33.6
2010	11,424,658	2,437,058	1,773,675	3,013,796	3,039,066	1,098,078	62,985	35.1
2020	11,828,016	2,490,225	1,623,735	3,267,083	2,929,578	1,443,573	73,822	35.3
2030	12,017,783	2,579,131	1,605,730	3,310,699	2,698,615	1,761,346	62,262	36.3
2040	11,967,431	2,478,696	1,712,650	3,148,215	2,911,497	1,610,049	106,324	36.3

present faculty-student ratios are increased substantially or a higher proportion of students complete high school.

If the number of new teachers is not reduced drastically, we must expect the current excess in all but a few subject areas of this profession to evolve into a chronic problem. Related to this, it should be possible to limit most future construction of schools to new residential areas and to the replacement of obsolete units. Conversely, the number of retirement villages, nursing homes, and other special facilities and services for older residents should continue to increase.

Among physicians, the increase in numbers should be concentrated in such specialities as gerontology, cardiology, surgery, and psychiatry. The need for obstetricians and pediatricians should remain close to current levels. Commonly recommended ratios of physicians to the general population will require either greater efficiency of operations or greater use of auxiliary personnel, or they will no longer be applicable because the larger number of older residents should produce greater utilization of medical services. Obstetrics wards, which in most instances now operate at 50 to 65 percent of capacity, should not experience any sizable increase in patients. Accelerated efforts to reduce bed capacity should therefore be anticipated.

Not so apparent is the large expected increase in the working-age population. The number of residents between 20 and 64 years old will rise nearly 50 percent (or more than 2 million) at the same time that the need for workers in many types of employment remains essentially unchanged or is reduced. Thus unemployment and partial employ-

ment should continue at current or even higher levels unless (a) major new industries are developed, (b) existing industries are expanded significantly, (c) the average workweek is reduced substantially, (d) retirement at an earlier age becomes more widespread, and (e) initial entry into the labor force is delayed appreciably.

Nearly 60 percent of Michigan's population growth in the decade between 1960 and 1970 was concentrated in the metropolitan area surrounding the city of Detroit. Most of the remainder occurred in the metropolitan areas around the State's other major cities (Flint, Grand Rapids, Kalamazoo, Lansing). All of these experienced a significant net inmigration as well as an excess of births over deaths.

The cities and a majority of Michigan's 83 counties had a large-scale net outmigration during this period. Detroit's population declined 159,000 between the 1960–1970 census years as a result of the exodus of about 20 percent of its residents to adjacent suburban areas. Grand Rapids, the State's second largest city, during this decade annexed adjacent areas having a population of 38,955. Without these additions, the city would have lost 18,619 residents as a result of a net outmigration of one-fourth of its population.

A similar pattern was reported in Lansing, Flint, and other major cities. For 13 largely rural counties, the 1970 census reported a population count lower than for 1960. In other counties, a small gain in population resulted from an excess of births over deaths—larger than the loss due to migration.

Should the current patterns of population movement continue,

zero population growth would have a most profound effect on the State's central cities and non-metropolitan areas. These sections, in particular, should anticipate a rapid aging of the population, a rapid decrease in births, a concomitant increase in deaths, and an accelerating loss of population. Related economic problems, now widespread in these areas, can be expected to become more pronounced.

In the 19 suburban counties, changes would probably be much more gradual. Since there is little outmigration, and inmigration is mainly in the younger age groups, these areas can expect that the age composition of the population will change minimally for some time, birth and death rates will remain near current levels, and the population will continue to increase.

The 1970 census showed that, for the first time, a majority (51.3 percent) of Michigan residents lived in the areas surrounding the State's major cities. This trend, particularly for those under age 45, should accelerate in coming years. By 2030, with zero population growth, three-fourths or more of the State's population will reside outside central city limits in these counties.

Plausibility of ZPG Concept

As mentioned before, zero population growth would require a reduction of nearly 20 percent below the number of births reported in 1970. Although an annual decrease of 30,000 births to Michigan women might seem to be a mammoth endeavor, it is actually attainable quite readily.

The fertility rates of American women decreased by nearly one-third between 1960 and 1968 (table 3). Although this decline

did not continue in 1969 and 1970, preliminary data for 1971 and for the first half of 1972 indicate a resumption of this trend with fertility rates that are at the lowest level in our country's history.

In Michigan, as in the remainder of the United States, the number of births in 1971 was lower than in 1970 despite an increase in the number of women in the childbearing ages. Although final data are not yet available, we estimate that there were 161,000 live births to Michigan mothers last year, or about 9,000 fewer than in 1970. This decline was quite unexpected because most demographers had assumed that the rising proportion of women in this age range would result in an increasing number of births and a rising birth rate. We anticipate that the number of births will decrease further in 1972 to 150,000. Should this decrease occur, the average number of children per woman would be only slightly above the ZPG level of 2.11.

A number of studies have shown that although the desired family size did not differ greatly among women of varied socio-economic, ethnic, and racial backgrounds, actual family size differed significantly. The ready availability of the pill and other devices and methods of birth control enables an increasing number of women to limit the size of their families to the levels desired. One indication of this has been the sharp drop in births of higher order (four or more) and to women in the older age groups.

The rapid expansion of family planning services underway in Michigan (the number of women enrolled doubled to 35,-000 between 1971 and 1972) should lead to a further reduction in fertility rates. A bill, supported by the Governor and the department of public health, which has been approved by the State Senate, would permit instruction in family planning to teenagers in the schools.

Abortions are now virtually prohibited in Michigan, and an estimated 8,000 State residents currently go to New York and other States each year for this procedure. Michigan residents will vote in November 1972 on a referendum to legalize all abortions up to the 20th week of pregnancy. Should this action be adopted, we estimate that there may be as many as 35,000 abortions per year in the State. Although many of these would merely be a change from illegal to legal abortions, some acceleration of the trend to lower fertility would result. Nationally, the President's Commission on Population Growth and America's Future has submitted a report containing recommendations that are strikingly similar to the changes which seem to be evolving in Michigan.

Japan and a number of countries in northern, central, and eastern Europe have achieved, or are near, zero population growth. We believe there is a distinct possibility that this goal will also be reached in Michigan, as in the rest of the United States, within a few years. In fact, there is a definite likelihood that the decrease in births will not stop at this level but will dip below it, with a resultant population balance (except for possible inmigration) considerably before 2030. The implications of this occurrence merit careful and serious consideration.

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Selected data for Michigan on zero population growth and resulting implications for the State have been considered. With the assumptions of (a) an average of 2.11 children per woman, (b) no changes in present age-specific mortality rates, and (c) a continuing balance between outmigration and inmigration, the number of births and deaths would balance around the year 2030. In 2030 there will be 12 million Michigan residents as compared with 18.9 million if the actual growth rates of 1970 continue. The median age of the population will increase an average 0.16 year annually, from 26.5 to 36.3. The number of residents under 15 years of age will decrease 4.9 percent.

The number of residents 65 to 84 years of age will increase 151.2 percent, and those 85 years or more, 43.9 percent. The largest numeric rise will be between 25 and 44 years of age. The ratio of dependent to working-age population will decrease from the current 0.95 to 1 to 0.77 to 1.

The crude death rate will increase from 8.8 per 1,000 in 1970 to 12.8 in 2030. The crude birth rate will decrease from 15.7 per 1,000 to 13.0.

The current excess of women in the older age groups will increase considerably.