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MAY 1998

A Special Moment in History

The fate of our planet will be determined in the next few decades, through our technological, lifestyle, and population choices

by Bill McKibben

The online version of this article appears in three parts. Click here to go to part two. Click here to go to part three.

BEWARE of people preaching that we live in special times. People have preached that message before, and those who listened sold their furniture and climbed up on rooftops to await ascension, or built boats to float out the coming flood, or laced up their Nikes and poisoned themselves in some California subdivision.

These prophets are the ones with visions of the seven-headed beast, with a taste for the hair shirt and the scourge, with twirling eyes. No, better by far to listen to Ecclesiastes, the original wise preacher, jaded after a thousand messiahs and a thousand revivals.

> One generation passes away, and another generation comes; but the earth abides forever.... That which has been is what will be, that which is done is what will be done, and there is nothing new under the sun. Is there anything of which it may be said, "See, this is new"? It has already been in ancient times before us.

And yet, for all that, we may live in a special time. We may live in the strangest, most thoroughly different moment since human beings took up farming, 10,000 years ago, and time more or less commenced. Since then time has flowed in one direction -- toward *more,* which we have taken to be progress. At first the momentum was gradual, almost imperceptible, checked by wars and the Dark Ages and plagues and taboos; but in recent centuries it has accelerated, the curve of every graph steepening like the Himalayas rising from the Asian steppe. We have climbed quite high. Of course, fifty

years ago one could have said the same thing, and fifty years before that, and fifty years before *that.* But in each case it would have been premature. We've increased the population fourfold in that 150 years; the amount of food we grow has gone up faster still; the size of our economy has quite simply exploded.

But now -- now may be the special time. So special that in the Western world we might each of us consider, among many other things, having only one child -- that is, reproducing at a rate as low as that at which human beings have ever voluntarily reproduced. Is this really necessary? Are we finally running up against some limits?

To try to answer this question, we need to ask another: *How many of us will there be in the near future?* Here is a piece of news that may alter the way we see the planet -- an indication that we live at a special moment. At least at first blush the news is hopeful. *New demographic evidence shows that it is at least possible that a child born today will live long enough to see the peak of human population.*

Around the world people are choosing to have fewer and fewer children -- not just in China, where the government forces it on them, but in almost every nation outside the poorest parts of Africa. Population growth rates are lower than they have been at any time since the Second World War. In the past three decades the average woman in the developing world, excluding China, has

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- **More *Atlantic* articles looking ahead to the 21st century.**

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From the archives:

- **"How Many is Too Many?" by Charles C. Mann (February, 1993)**

Biologists have argued for a century that an ever-growing population will

bring the apocalypse. Economists argue that man and markets will cope -- so far none of the predicted apocalypses have arrived. The near-term questions, though, are political, and they are overlooked in the fierce battles.

- **"Do We Consume Too Much?" by Mark Sagoff (June, 1997) From a strictly materialistic point of view, the author argues, the common idea that increasing consumption will lead to depletion and scarcity is mistaken.**

- **"No Middle Way on the Environment" by Paul R. Ehrlich,**

gone from bearing six children to bearing four. Even in Bangladesh the average has fallen from six to fewer than four; even in the mullahs' Iran it has dropped by four children. If this keeps up, the population of the world will not quite double again; United Nations analysts offer as their mid-range projection that it will top out at 10 to 11 billion, up from just under six billion at the moment. The world is still growing, at nearly a record pace -- we add a New York City every month, almost a Mexico every year, almost an India every decade. But the rate of growth is slowing; it is no longer "exponential," "unstoppable," "inexorable," "unchecked," "cancerous." If current trends hold, the world's population will all but stop growing before the twenty-first century is out.

And that will be none too soon. There is no way we could keep going as we have been. The *increase* in human population in the 1990s has exceeded the *total* population in 1600. The population has grown more since 1950 than it did during the previous four million years. The reasons for our recent rapid growth are pretty clear. Although the Industrial Revolution speeded historical growth rates considerably, it was really the public-health revolution, and its spread to the Third World at the end of the Second World War, that set us galloping. Vaccines and antibiotics came all at once, and right behind came population. In Sri Lanka in the late 1940s life expectancy was rising at least a year every twelve months. How much

Gretchen C. Daily, Scott C. Daily, Norman Myers, and James Salzman (December, 1997)
"In his recent article regarding the state of our planet, 'Do We Consume Too Much?' Mark Sagoff.... has done a disservice to the public by promoting once again the dangerous idea that technological fixes will solve the human predicament."

- **Read Sagoff's reply to Paul Ehrlich, et. al., in the March, 1998, issue.**

- **For more *Atlantic* articles on the environment, see the environment index.**

difference did this make? Consider the United States: if people died throughout this century at the same rate as they did at its beginning, America's population would be 140 million, not 270 million.

If it is relatively easy to explain why populations grew so fast after the Second World War, it is much harder to explain why the growth is now slowing. Experts confidently supply answers, some of them contradictory: "Development is the best contraceptive" -- or education, or the empowerment of women, or hard times that force families to postpone having children. For each example there is a counterexample. Ninety-seven percent of women in the Arab sheikhdom of Oman know about contraception, and yet they average more than six children apiece. Turks have used contraception at about the same rate as the Japanese, but their birth rate is twice as high. And so on. It is not AIDS that will slow population growth, except in a few African countries. It is not horrors like the civil war in Rwanda, which claimed half a million lives -- a loss the planet can make up for in two days. All that matters is how often individual men and women decide that they want to reproduce.

Will the drop continue? It had better. UN mid-range projections assume that women in the developing world will soon average two children apiece -- the rate at which population growth stabilizes. If fertility remained at current levels, the population

Related links:

- **6 Billion Human Beings**
A presentation about the population problem, put together by the Musem National d'Histoire Naturelle, Paris, France.

- **Population Reference Bureau**
Regularly updated information on U.S. and international population trends.

- **Population and Consumption**
Articles from the Natural Resources Defense Council.

- **Zero Population Growth**
"The nation's largest grassroots

would reach the absurd figure of 296 billion in just 150 years. Even if it dropped to 2.5 children per woman and then stopped falling, the population would still reach 28 billion.

But let's trust that this time the demographers have got it right. Let's trust that we have rounded the turn and we're in the home stretch. Let's trust that the planet's population really will double only one more time. Even so, this is a case of good news, bad news. The good news is that we won't grow forever. The bad news is that there are six billion of us already, a number the world strains to support. One more near-doubling -- four or five billion more people -- will nearly double that strain. Will these be the five billion straws that break the camel's back?

Big Questions

WE'VE answered the question *How many of us will there be?* But to figure out how near we are to any limits, we need to ask something else: *How big are we?* This is not so simple. Not only do we vary greatly in how much food and energy and water and minerals we consume, but each of us varies over time. William Catton, who was a sociologist at Washington State University before his retirement, once tried to calculate the amount of energy human beings use each day. In hunter-gatherer times it was about 2,500 calories, all of it food. That is the daily energy intake of a

organization concerned with the impacts of rapid population growth and wasteful consumption."

- **Population Council**
An organization that aims to promote "a humane, equitable and sustainable balance between people and resources."

- **Population Action International**
An organization "dedicated to advancing policies and programs that slow population growth."

- **Facing the Future**
A site designed "to inform young people about the problems associated with increasing world

common dolphin. A modern human being uses 31,000 calories a day, most of it in the form of fossil fuel. That is the intake of a pilot whale. And the average American uses six times that -- as much as a sperm whale. We have become, in other words, different from the people we used to be. Not kinder or unkinder, not deeper or stupider -- our natures seem to have changed little since Homer. We've just gotten bigger. We appear to be the same species, with stomachs of the same size, but we aren't. It's as if each of us were trailing a big Macy's-parade balloon around, feeding it constantly.

So it doesn't do much good to stare idly out the window of your 737 as you fly from New York to Los Angeles and see that there's *plenty* of empty space down there. Sure enough, you could crowd lots more people into the nation or onto the planet. The entire world population could fit into Texas, and each person could have an area equal to the floor space of a typical U.S. home. If people were willing to stand, everyone on earth could fit comfortably into half of Rhode Island. Holland is crowded and is doing just fine.

But this ignores the balloons above our heads, our hungry shadow selves, our sperm-whale appetites. As soon as we started farming, we started setting aside extra land to support ourselves. Now each of us needs not only a little plot of cropland and a little pasture for the meat we eat but

population."

- **The KZPG Overpopulation News Network E-mail lists and discussion forums for activists and professionals to discuss population-limitation strategies.**

also a little forest for timber and paper, a little mine, a little oil well. Giants have big feet. Some scientists in Vancouver tried to calculate one such "footprint" and found that although 1.7 million people lived on a million acres surrounding their city, those people required 21.5 million acres of land to support them -- wheat fields in Alberta, oil fields in Saudi Arabia, tomato fields in California. People in Manhattan are as dependent on faraway resources as people on the Mir space station.

Those balloons above our heads can shrink or grow, depending on how we choose to live. All over the earth people who were once tiny are suddenly growing like Alice when she ate the cake. In China per capita income has doubled since the early 1980s. People there, though still Lilliputian in comparison with us, are twice their former size. They eat much higher on the food chain, understandably, than they used to: China slaughters more pigs than any other nation, and it takes four pounds of grain to produce one pound of pork. When, a decade ago, the United Nations examined sustainable development, it issued a report saying that the economies of the developing countries needed to be five to ten times as large to move poor people to an acceptable standard of living -- with all that this would mean in terms of demands on oil wells and forests.

That sounds almost impossible. For the moment, though, let's not pass judgment.

We're still just doing math. There are going to be lots of us. We're going to be big. But lots of us in relation to what? Big in relation to what? It could be that compared with the world we inhabit, we're still scarce and small. Or not. So now we need to consider a third question: *How big is the earth?*

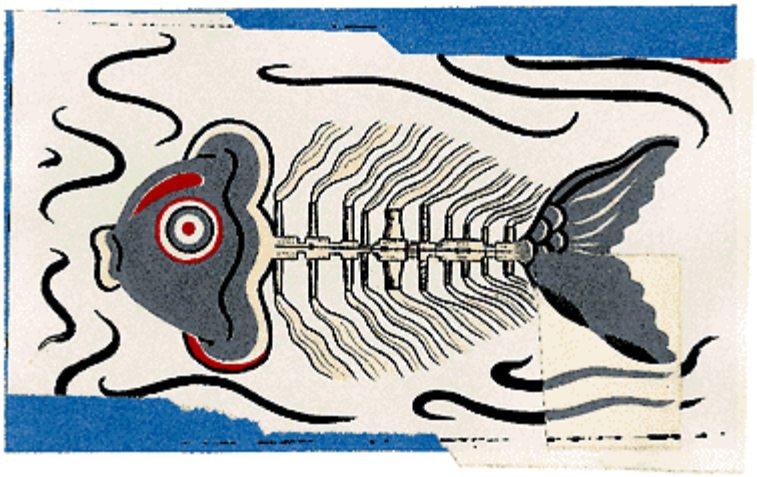
ANY state wildlife biologist can tell you how many deer a given area can support -- how much browse there is for the deer to eat before they begin to suppress the reproduction of trees, before they begin to starve in the winter. He can calculate how many wolves a given area can support too, in part by counting the number of deer. And so on, up and down the food chain. It's not an exact science, but it comes pretty close -- at least compared with figuring out the carrying capacity of the earth for human beings, which is an art so dark that anyone with any sense stays away from it.

Consider the difficulties. Human beings, unlike deer, can eat almost anything and live at almost any level they choose. Hunter-gatherers used 2,500 calories of energy a day, whereas modern Americans use seventy-five times that. Human beings, unlike deer, can import what they need from thousands of miles away. And human beings, unlike deer, can figure out new ways to do old things. If, like deer, we needed to browse on conifers to survive, we could crossbreed lush new strains, chop down competing trees, irrigate forests, spray

a thousand chemicals, freeze or dry the tender buds at the peak of harvest, genetically engineer new strains -- and advertise the merits of maple buds until everyone was ready to switch. The variables are so great that professional demographers rarely even bother trying to figure out carrying capacity. The demographer Joel Cohen, in his potent book *How Many People Can the Earth Support?* (1995), reports that at two recent meetings of the Population Association of America exactly none of the more than 200 symposia dealt with carrying capacity.

But the difficulty hasn't stopped other thinkers. This is, after all, as big a question as the world offers. Plato, Euripides, and Polybius all worried that we would run out of food if the population kept growing; for centuries a steady stream of economists, environmentalists, and zealots and cranks of all sorts have made it their business to issue estimates either dire or benign. The most famous, of course, came from the Reverend Thomas Malthus. Writing in 1798, he proposed that the growth of population, being "geometric," would soon outstrip the supply of food. Though he changed his mind and rewrote his famous essay, it's the original version that people have remembered -- and lambasted -- ever since. Few other writers have found critics in as many corners. Not only have conservatives made Malthus's name a byword for ludicrous alarmism, but Karl Marx called his essay "a libel on the human race,"

Friedrich Engels believed that "we are forever secure from the fear of overpopulation," and even Mao Zedong attacked Malthus by name, adding, "Of all things in the world people are the most precious."



Each new generation of Malthusians has made new predictions that the end was near, and has been proved wrong. The late 1960s saw an upsurge of Malthusian panic. In 1967 William and Paul Paddock published a book called *Famine -- 1975!*, which contained a triage list: "Egypt: Can't-be-saved.... Tunisia: Should Receive Food.... India: Can't-be-saved." Almost simultaneously Paul Ehrlich wrote, in his best-selling *The Population Bomb* (1968), "The battle to feed all of humanity is over. In the 1970s, the world will undergo famines -- hundreds of millions of people will starve to death." It all seemed so certain, so firmly in keeping with a world soon to be darkened by the first oil crisis.

From the archives:

But that's not how it worked out. India fed herself. The United States still ships surplus

- **"Forgotten Benefactor of Humanity," by Gregg Easterbrook (January, 1997)** Norman Borlaug, the agronomist whose discoveries sparked the Green Revolution, has saved literally millions of lives, yet he is hardly a household name.

Related link:

- **Paul Ehrlich and the Population Bomb** The companion Web site to a PBS television show on the subject.

grain around the world. As the astute Harvard social scientist Amartya Sen points out, "Not only is food generally much cheaper to buy today, in constant dollars, than it was in Malthus's time, but it also has become cheaper during recent decades." So far, in other words, the world has more or less supported us. Too many people starve (60 percent of children in South Asia are stunted by malnutrition), but both the total number and the percentage have dropped in recent decades, thanks mainly to the successes of the Green Revolution. Food production has tripled since the Second World War, outpacing even population growth. We may be giants, but we are clever giants.

So Malthus was wrong. Over and over again he was wrong. No other prophet has ever been proved wrong so many times. At the moment, his stock is especially low. One group of technological optimists now believes that people will continue to improve their standard of living precisely *because* they increase their numbers. This group's intellectual fountainhead is a brilliant Danish economist named Ester Boserup -- a sort of anti-Malthus, who in 1965 argued that the gloomy cleric had it backward. The more people, Boserup said, the more progress. Take agriculture as an example: the first farmers, she pointed out, were slash-and-burn cultivators, who might farm a plot for a year or two and then move on, not returning for maybe two decades. As the population grew, however, they had to

return more frequently to the same plot. That meant problems: compacted, depleted, weedy soils. But those new problems meant new solutions: hoes, manure, compost, crop rotation, irrigation. Even in this century, Boserup said, necessity-induced invention has meant that "intensive systems of agriculture replaced extensive systems," accelerating the rate of food production.

Boserup's closely argued examples have inspired a less cautious group of popularizers, who point out that standards of living have risen all over the world even as population has grown. The most important benefit, in fact, that population growth bestows on an economy is to increase the stock of useful knowledge, insisted Julian Simon, the best known of the so-called cornucopians, who died earlier this year. We might run out of copper, but who cares? The mere fact of shortage will lead someone to invent a substitute. "The main fuel to speed our progress is our stock of knowledge, and the brake is our lack of imagination," Simon wrote. "The ultimate resource is people -- skilled, spirited, and hopeful people who will exert their wills and imaginations for their own benefit, and so, inevitably, for the benefit of us all."

Simon and his ilk owe their success to this: they have been right so far. The world has behaved as they predicted. India hasn't starved. Food is cheap. But Malthus never goes away. The idea that we might grow too big can be disproved only for the moment --

never for good. We might always be on the threshold of a special time, when the mechanisms described by Boserup and Simon stop working. It is true that Malthus was wrong when the population doubled from 750 million to 1.5 billion. It is true that Malthus was wrong when the population doubled from 1.5 billion to three billion. It is true that Malthus was wrong when the population doubled from three billion to six billion. Will Malthus still be wrong fifty years from now?

Looking at Limits

THE case that the next doubling, the one we're now experiencing, might be the difficult one can begin as readily with the Stanford biologist Peter Vitousek as with anyone else. In 1986 Vitousek decided to calculate how much of the earth's "primary productivity" went to support human beings. He added together the grain we ate, the corn we fed our cows, and the forests we cut for timber and paper; he added the losses in food as we overgrazed grassland and turned it into desert. And when he was finished adding, the number he came up with was 38.8 percent. We use 38.8 percent of everything the world's plants don't need to keep themselves alive; directly or indirectly, we consume 38.8 percent of what it is possible to eat. "That's a relatively large number," Vitousek says. "It should give pause to people who think we are far from any limits." Though he never drops the measured tone of an academic, Vitousek

speaks with considerable emphasis: "There's a sense among some economists that we're *so* far from any biophysical limits. I think that's not supported by the evidence."

For another antidote to the good cheer of someone like Julian Simon, sit down with the Cornell biologist David Pimentel. He believes that we're in big trouble. Odd facts stud his conversation -- for example, a nice head of iceberg lettuce is 95 percent water and contains just fifty calories of energy, but it takes 400 calories of energy to grow that head of lettuce in California's Central Valley, and another 1,800 to ship it east. ("There's practically no nutrition in the damn stuff anyway," Pimentel says. "Cabbage is a lot better, and we can grow it in upstate New York.") Pimentel has devoted the past three decades to tracking the planet's capacity, and he believes that we're already too crowded -- that the earth can support only two billion people over the long run at a middle-class standard of living, and that trying to support more is doing great damage. He has spent considerable time studying soil erosion, for instance. Every raindrop that hits exposed ground is like a small explosion, launching soil particles into the air. On a slope, more than half of the soil contained in those splashes is carried downhill. If crop residue -- cornstalks, say -- is left in the field after harvest, it helps to shield the soil: the raindrop doesn't hit as hard. But in the developing world, where firewood is scarce, peasants burn those cornstalks for cooking

fuel. About 60 percent of crop residues in China and 90 percent in Bangladesh are removed and burned, Pimentel says. When planting season comes, dry soils simply blow away. "Our measuring stations pick up Chinese soil in the Hawaiian air when ploughing time comes,"he says. "Every year in Florida we pick up African soils in the wind when they start to plough."

The very things that made the Green Revolution so stunning -- that made the last doubling possible -- now cause trouble. Irrigation ditches, for instance, water 17 percent of all arable land and help to produce a third of all crops. But when flooded soils are baked by the sun, the water evaporates and the minerals in the irrigation water are deposited on the land. A hectare (2.47 acres) can accumulate two to five tons of salt annually, and eventually plants won't grow there. Maybe 10 percent of all irrigated land is affected.

Or think about fresh water for human use. Plenty of rain falls on the earth's surface, but most of it evaporates or roars down to the ocean in spring floods. According to Sandra Postel, the director of the Global Water Policy Project, we're left with about 12,500 cubic kilometers of accessible runoff, which would be enough for current demand except that it's not very well distributed around the globe. And we're not exactly conservationists -- we use nearly seven times as much water as we used in 1900. Already 20 percent of the world's

population lacks access to potable water, and fights over water divide many regions. Already the Colorado River usually dries out in the desert before it reaches the Sea of Cortez, making what the mid-century conservationist Aldo Leopold called a "milk and honey wilderness" into some of the nastiest country in North America. Already the Yellow River can run dry for as much as a third of the year. Already only two percent of the Nile's freshwater flow makes it to the ocean. And we need more water all the time. Producing a ton of grain consumes a thousand tons of water -- that's how much the wheat plant breathes out as it grows. "We estimated that biotechnology might cut the amount of water a plant uses by ten percent," Pimentel says. "But plant physiologists tell us that's optimistic -- they remind us that water's a pretty important part of photosynthesis. Maybe we can get five percent."

What these scientists are saying is simple: human ingenuity can turn sand into silicon chips, allowing the creation of millions of home pages on the utterly fascinating World Wide Web, but human ingenuity cannot forever turn dry sand into soil that will grow food. And there are signs that these skeptics are right -- that we are approaching certain physical limits.

I said earlier that food production grew even faster than population after the Second World War. Year after year the yield of wheat and corn and rice rocketed up about

three percent annually. It's a favorite statistic of the eternal optimists. In Julian Simon's book *The Ultimate Resource* (1981) charts show just how fast the growth was, and how it continually cut the cost of food. Simon wrote, "The obvious implication of this historical trend toward cheaper food -- a trend that probably extends back to the beginning of agriculture -- is that real prices for food will continue to drop.... It is a fact that portends more drops in price and even less scarcity in the future."

A few years after Simon's book was published, however, the data curve began to change. That rocketing growth in grain production ceased; now the gains were coming in tiny increments, too small to keep pace with population growth. The world reaped its largest harvest of grain per capita in 1984; since then the amount of corn and wheat and rice per person has fallen by six percent. Grain stockpiles have shrunk to less than two months' supply.

No one knows quite why. The collapse of the Soviet Union contributed to the trend -- cooperative farms suddenly found the fertilizer supply shut off and spare parts for the tractor hard to come by. But there were other causes, too, all around the world -- the salinization of irrigated fields, the erosion of topsoil, the conversion of prime farmland into residential areas, and all the other things that environmentalists had been warning about for years. It's possible that we'll still turn production around and start it

rocketing again. Charles C. Mann, writing in *Science,* quotes experts who believe that in the future a "gigantic, multi-year, multi-billion-dollar scientific effort, a kind of agricultural 'person-on-the-moon project,'" might do the trick. The next great hope of the optimists is genetic engineering, and scientists have indeed managed to induce resistance to pests and disease in some plants. To get more yield, though, a cornstalk must be made to put out another ear, and conventional breeding may have exhausted the possibilities. There's a sense that we're running into walls.

We won't start producing *less* food. Wheat is not like oil, whose flow from the spigot will simply slow to a trickle one day. But we may be getting to the point where gains will be small and hard to come by. The spectacular increases may be behind us. One researcher told Mann, "Producing higher yields will no longer be like unveiling a new model of a car. We won't be pulling off the sheet and there it is, a two-fold yield increase." Instead the process will be "incremental, torturous, and slow." And there are five billion more of us to come.

So far we're still fed; gas is cheap at the pump; the supermarket grows ever larger. We've been warned again and again about approaching limits, and we've never quite reached them. So maybe -- how tempting to believe it! -- they don't really exist. For every Paul Ehrlich there's a man like

Lawrence Summers, the former World Bank chief economist and current deputy secretary of the Treasury, who writes, "There are no ... limits to carrying capacity of the Earth that are likely to bind at any time in the foreseeable future." And we are talking about the future -- nothing can be *proved*.

But we can calculate risks, figure the odds that each side may be right. Joel Cohen made the most thorough attempt to do so in *How Many People Can the Earth Support?* Cohen collected and examined every estimate of carrying capacity made in recent decades, from that of a Harvard oceanographer who thought in 1976 that we might have food enough for 40 billion people to that of a Brown University researcher who calculated in 1991 that we might be able to sustain 5.9 billion (our present population), but only if we were principally vegetarians. One study proposed that if photosynthesis was the limiting factor, the earth might support a trillion people; an Australian economist proved, in calculations a decade apart, that we could manage populations of 28 billion and 157 billion. None of the studies is wise enough to examine every variable, to reach by itself the "right" number. When Cohen compared the dozens of studies, however, he uncovered something pretty interesting: the median low value for the planet's carrying capacity was 7.7 billion people, and the median high value was 12 billion. That, of course, is just the range that the UN predicts

we will inhabit by the middle of the next century. Cohen wrote,

> The human population of the Earth now travels in the zone where a substantial fraction of scholars have estimated upper limits on human population size.... The possibility must be considered seriously that the number of people on the Earth has reached, or will reach within half a century, the maximum number the Earth can support in modes of life that we and our children and their children will choose to want.

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Bill McKibben is the author of several books about the environment, including *The End of Nature* (1989) and *Hope, Human and Wild* (1995). His article in this issue will appear in somewhat different form in his book *Maybe One: A Personal and Environmental Argument for Single-Child Families,* to be published this month by Simon & Schuster.

Illustrations by Brian Cronin

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