

Opinion

Aging Human Populations: Good for Us,
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As the nations of the world grapple with the task of creating sustainable societies, ending and in some cases reversing population growth will be necessary to succeed. Yet stable or declining populations are typically reported in the media as a problem, or even a crisis, due to demographic aging. This is misguided, as economic analyses show that the costs connected with aging societies are manageable, while the economic, social, and environmental benefits of smaller populations are substantial. Earth's human-carrying capacity has been exceeded; hence, population growth must end and aging societies are unavoidable. They should be embraced as part of a just and prosperous future for people and the other species with whom we share our planet.

An Achievement Misdescribed as a Problem

How often do we read that aging is the great economic challenge of this century? Yet it is the natural outcome of achieving society's fundamental goals. Thanks to modern health care and sanitation, increasing proportions of people born are living longer and healthier lives. Simultaneously, contraception has enabled families to avoid impoverishment from too many dependents and liberated women to participate more equally in social, economic, and political realms, enhancing democracy [1,2]. Fewer children means larger proportions in older age cohorts, as well as deceleration and potential reversal of population growth. That is a very good thing, since the future sustainability of human societies, avoiding resource wars, and halting the loss of species and wild ecosystems all depend on ending population growth. Thus, making the 'demographic transition' (see [Glossary](#)) to small families with long-lived members, of which aging populations are part and parcel, should be a goal of all countries around the world.

Figure 1 shows the association between increasing median age and decreasing population growth rates. Over time, most countries will progress down this curve, while the curve itself shifts to the right as **life expectancy** increases. At least 32 countries around the world have decreasing populations and according to UN projections [5] one in four people are expected to live in countries with a decreasing population by 2050.

There are many environmental benefits to these trends. Halting population growth is essential to mitigating global climate change [6–9], avoiding a mass extinction of Earth's species [10–12], feeding millions of malnourished people in the developing world [13], limiting freshwater withdrawals from natural ecosystems while providing sufficient water for human and wildlife populations [14,15], and in general staying within the limits of prudent human use of the biosphere [16–20]. If currently projected population growth occurs, reduction of *per capita* consumption, while also essential, will be insufficient. The recent 'World scientists' warning to humanity' advocates humane measures to reduce global **fertility** rates, noting that 'continued rapid population growth [is] a primary driver behind many ecological and even societal threats' [21].

Highlights

Despite ongoing social and environmental crises driven by human population increase, public concern has instead focused on demographic aging as the greater challenge, even suggesting that population growth should be rekindled to combat it.

The economic and demographic literatures suggest that the problems associated with aging societies are both overstated and manageable, whereas trying to avoid aging by boosting births or immigration is relatively ineffective and creates even greater problems.

A range of social, economic, and environmental benefits are associated with older age profiles and stable or declining populations, which more than compensate for any economic imposts to support the elderly.

Ecologists should study and communicate the negative impacts of human population growth and excessive population density and should not be deterred by misguided economic arguments favoring continued population growth.

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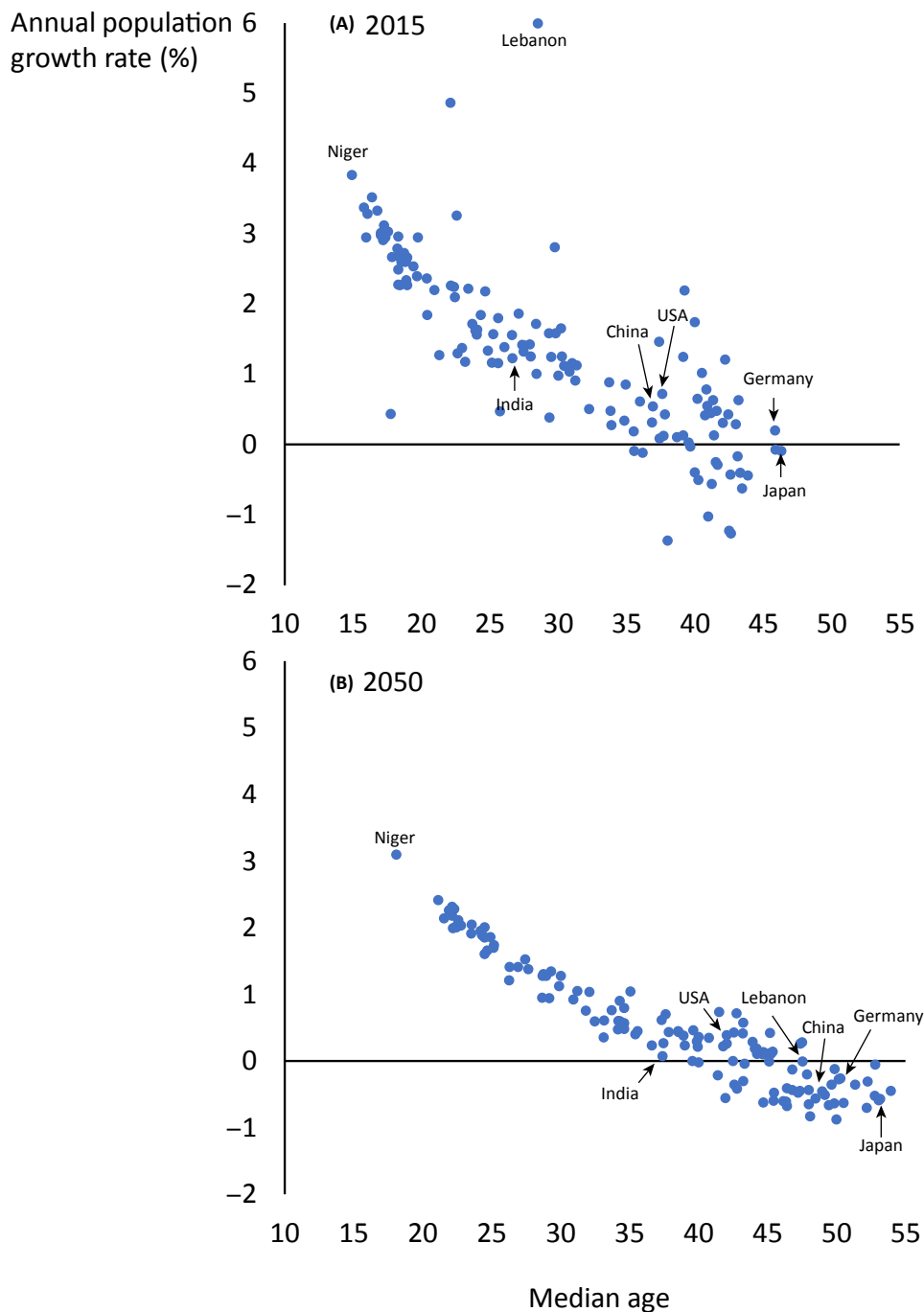


Figure 1. Annual Population Growth Rate and Median Age of Population Are Two of the Correlated Parameters That Characterize the Demographic Transition. The 136 countries depicted comprise 90% of the world population. (A) The situation in 2015; (B) the same countries in 2050, based on the UN 2017 medium-fertility variant population projections. Under the 2050 UN scenario, 43 (32%) of 136 countries will have declining populations, up from 14% in 2015. The UN model assumes that fertility in all countries will converge toward near-replacement rate (two children per woman) by 2100. Such projections should not be taken for granted, since they depend on continued improvements in

(Figure legend continued on the bottom of the next page.)

Glossary

Demographic aging: a

community's composition changing to contain smaller proportions in young age cohorts and larger proportions in older age cohorts.

Demographic transition: the shift from relatively stable populations with high mortality and high fertility to relatively stable populations with low mortality and low fertility. Population growth is entailed by the lag between mortality and fertility decline. The transition is not automatic, as sufficient delay in fertility decline may cause mortality to rise due to overpopulation.

Dependency ratio: the ratio of age groups deemed to be dependent to age groups deemed to be economically productive. Ages 0–14 and 65+ years are usually deemed dependent, while those aged 15–64 years are deemed 'working age'. Ratios may be given for youth dependency, old-age dependency, or total dependency.

Ecological footprint: environmental impacts resulting directly and indirectly from an individual's, group's, or country's behaviors, affected by both voluntary and involuntary choices of consumption, technology, resource management, waste disposal, and reproduction.

Fertility: while ecologists define fertility as the capacity to reproduce, demographers are referring to the reproduction actualized, often quantified as the number of live children born per woman (see '**Total fertility rate**').

Life expectancy: the years of remaining life, from a designated age (e.g., at birth, at age 65 years), when half of the people currently of that age will have died, given current age-specific death rates.

Overpopulation: exists when a human population is too large to preserve ecosystem services (broadly defined) or too large to share the landscape fairly with other species.

Ponzi scheme (or pyramid scheme): a fraudulent arrangement that requires the recruitment of ever-more investors to pay unsustainably high returns to earlier ones; named after fund manager Charles Ponzi, who used deposits from new investors to pay dividends to prior investors.

Demographic aging thus should be seen as a desirable accomplishment [17,22]. Unfortunately, many policymakers fixated on maximizing economic growth instead treat aging populations as a major problem [23,24]. Policies enacted to fight this alleged threat include incentives for citizens to have more children [25] and increased immigration levels [26]. These policies could stall the transition to stable or smaller populations in many countries [27], hindering progress toward national and global sustainability.

Here we review the pros and cons of aging and decreasing populations, with a view to providing information to help conservation-minded ecologists more effectively advocate for sustainable population policies. Aging populations pose challenges, yet the literature suggests that they are manageable and often overstated [28,29]. Given smart, long-term economic planning, necessary services can continue to be supported, while smaller populations provide opportunities to advance environmental sustainability and maximize human wellbeing [30–32,88]. Thus, under the assumption of such long-term planning, our hypothesis is that reduced population growth and particularly population decline in aging countries benefit people and the environment.

Solutions to the Manageable Problems of Aging and Shrinking Populations

Concerns about the economic impacts of aging fall into three main areas: potential worker shortages, excessive expenditure on health services and old-age care, and shortfalls in pension funding.

Most commentary has focused on a shrinking workforce, although this concern has the least basis. We have found no evidence that aging populations have resulted in too few workers to meet employment demands nor that they are likely to do so in the future. This misconception arises because economic models typically assume that the proportion of people employed in each age cohort (the ‘age-specific workforce participation rate’) will remain unchanged regardless of changes in a society’s age structure, locking the size of the workforce to the relative size of age cohorts [24,33]. Basic market theory, by contrast, anticipates that tightening labor markets will recruit people who are currently not working, by offering them better terms of employment or addressing their barriers to access, while also driving productivity gains through greater investment in staff and equipment [34]. Historical data support these hypotheses of elastic labor supply: among the 36 countries in the Organization for Economic Cooperation and Development (OECD), although some countries are much more demographically mature than others, aging is not related to the proportion of total population employed [35] nor to changes in GDP *per capita* [36].

Given stagnating wages and high youth unemployment in many developed nations, and the potential for automation to render many jobs redundant in the future, worker shortages do not appear to be a pressing problem. Tighter labor markets increase wages [34] and thus can help reduce economic inequality – which is a growing problem. In the developed world, countries with rapid population growth tend to have greater economic inequality than countries with older, more stable populations, as high underemployment leads to low-paid or insecure work [28]. Economic inequality, in turn, is more closely related to personal and societal wellbeing than GDP *per capita* [37]. So while aging, shrinking societies might have fewer total workers than they would if they continued to grow, those workers could do better economically, socially, and environmentally than they would in a fast-growing country.

access to contraception and acceptance of smaller family norms in patriarchal societies [3,4]. These projections also assume relatively low levels of international migration; historically, migration levels have proved even harder to predict than changes in fertility. Data source: UN World Population Prospects 2017 [5].

Total fertility rate: the average number of live children women would bear in their lifetimes, if they had the same probability of child-bearing in each year of age as currently prevails across the population and survived to the end of their reproductive life; not to be confused with birth rate (births per 1000 people per year).

Regarding the second main concern, expenses for geriatric health services and old-age care are indeed likely to increase as societies age, due to there being a higher proportion of people in their final years of life. However, this increase will be much less than is implied by the often-cited ‘old-age **dependency ratio**’. This ratio gives an exaggerated impression of the financial burden of aging. As longevity has increased in the developed world, people have remained healthy and independent for longer [38]. The over-65s are contributing more to society, including in paid work and in care-giver roles. Alternative measures of aging, such as proximity to death and prevalence of disability, better capture this reality [38–41]. They reflect much smaller and more manageable changes (Box 1).

Other factors besides aging have played a much greater role in driving recent health care cost increases, including an expanding range of costly treatments and diagnostics, and price gouging by service providers and drug companies in some countries [45–47]. Addressing productivity and institutional factors and investing more in preventive care can help keep

Box 1. Ill-Conceived Problems, Ill-Conceived Solutions

The ‘aging crisis’ is most commonly argued citing ‘old-age dependency ratios’, the number of people aged 65+ years divided by the number aged 15–64 years (nominally ‘working age’). This implies that all people aged 15–64 years are productively employed and all people over 65 years are dependent on them. This is not only wrong in the present, but it ignores the likelihood that work and health patterns will shift over time. As people remain healthy for longer, they are choosing later retirement and deferring rather than extending their ‘burden’ on health- and aged-care services (Figure I).

Solutions to aging are equally ill conceived. Boosting population growth, through more births or immigration, is often presented as necessary to address aging. However, these ‘remedies’ have much greater impact on the size of the population than they do on the extent of aging (Figure II). Since population growth cannot go on forever, aging is not avoided but merely deferred. The result is a large and persistent increase in population pressure for a small and ephemeral lessening of aging. These conclusions have been reached repeatedly in analyses of a range of countries. According to Germany’s Federal Statistical Office, ‘a higher level of inward migration over the long-term . . . would only have a marginal impact on the relative populations of age groups’ [43]. Australia’s Productivity Commission concluded ‘Realistic changes in migration levels also make little difference to the age structure of the population in the future, with any effect being temporary’ [44]. For both Germany and Australia, however, increased net migration has the potential to add many millions to their total future populations, countering any improvements in ecological footprint per person.

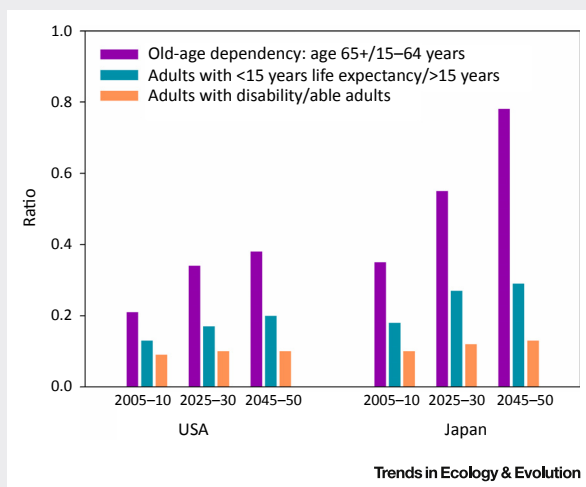


Figure I. How Can We Measure Aging Meaningfully? Using the flawed ‘old-age dependency ratio’, aging is projected to rise alarmingly. Using an alternative ratio based on years of remaining life expectancy is likely to better reflect health care-burdens, while a ratio of disabled to able-bodied adults better reflects aged-care burdens. These two measures anticipate modest and manageable change. Data from [40].

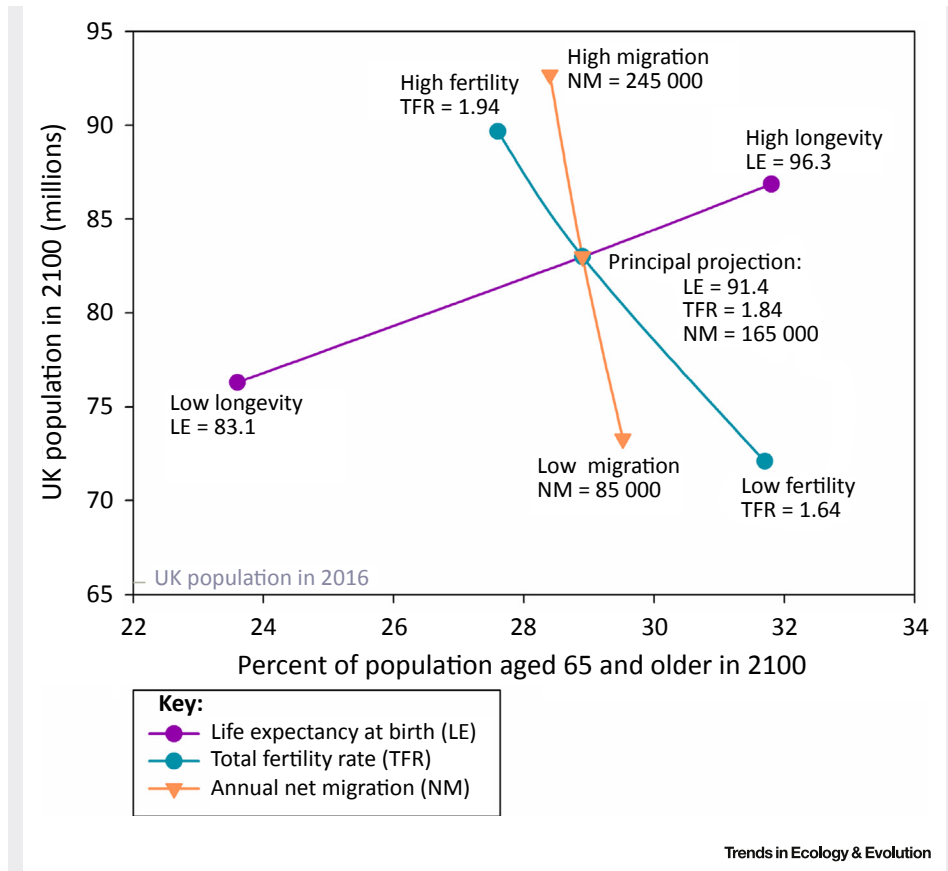


Figure II. Effects of Demographic Variables on the UK's Projected Aging and Population Growth

For a Figure360 author presentation of Figure II, see the figure legend at <https://doi.org/10.1016/j.tree.2018.08.015>. The 2016-based projections by UK's Office of National Statistics provide a principal projection and projections that vary longevity, fertility, or migration singly while keeping other variables constant [42]. The chart maps outcomes for the high and low assumptions for each variable. While the span of each line depends on the arbitrary choice of high and low levels, the slope indicates the 'cost' of increasing population growth relative to the 'benefit' of lowering old-age proportion. Old-age proportion is particularly sensitive to increasing lifespan. Longevity also increases population, but lengthening generations (deferred childbearing) can counter this. Higher fertility is somewhat effective at lowering the proportion of older people, but mainly by lifting the proportion of children, not of working-age people. Raising immigration is particularly ineffective at moderating old-age proportion, relative to the amount of population growth caused.

medical costs manageable as societies age [35,39,45,48]. Achieving better health through better treatments is a success that is worth a little more spending.

Finally, the issue of pension funding is complex because developed countries have a wide diversity of pension arrangements. The most common remedy recommended to reduce costs is to lift the pension entitlement age, and many developed countries have already scheduled increases. However, mandatory increases can be regressive and arguably unjust [49]. Longevity gains have not been enjoyed equally by all economic classes; for example, rich Frenchmen can expect 13 years more life than the poor [50]. As poorer workers also have less capacity to save for retirement and may perform more physical work that is difficult to sustain, it hardly seems fair to make them pay for the longevity enjoyed by rich people. Also, unless job markets

are tight, deferring retirements can increase youth unemployment. Increased pension costs are at least partly offset by the economic benefits of smaller youth cohorts and less population growth. Such savings, which could be used to shore up pension financing, include reduced expenditure on family allowances, schools and education, unemployment benefits, and infrastructure creation [51].

Sensible policy changes can address potential funding shortfalls by enhancing voluntary trends, such as removing disincentives for those who want to defer retirement, or making actuarially fair pension adjustments that pay higher annuities to later retirees [52,53]. For example, Australia's means-tested government pension discourages both saving and work beyond retirement age by low-income people, while the cost of making the pension universal could be readily recouped by capping over-generous retirement-savings tax concessions to the rich. With a universal pension, New Zealand achieves higher levels of over-65 workforce participation than Australia and lower levels of poverty among the elderly [54]. Likewise, in Norway removal of a pension earnings test considerably increased the labor supply from older workers [53].

Pensions are part of a social contract: by and large, citizens of wealthy developed nations have agreed that they owe one another a decent retirement. With appropriate policies, continued productivity increases can cover rising pension costs without imposing on workers. Talk of pension deficits or shortfalls apply only when pension funds are quarantined from other revenue. This might have made sense when public pensions were phased in but is less equitable than simply funding pensions like other income support, through progressive taxation, as many countries do. The most generous pension systems could need trimming back; a recent OECD report stated that 'over the last two years, the statutory retirement age was changed in six OECD countries' and 'about one-third of OECD countries changed contributions and another third modified benefit levels for all or some retirees' [55]. However, from a welfare-maximizing perspective, most countries have better options than reducing retirement incomes for common citizens or artificially boosting populations. As with increased health-care costs, potential pension-funding shortfalls can be met in ways that further the common good.

The most commonly prescribed policies to address aging endeavor to boost birth rates or increase immigration levels [89]. The goal is to dilute older citizens with ever bigger youth cohorts in an endless **Ponzi scheme** [56]. Such measures have little impact on aging (Box 1) or on the economic challenges that aging can cause. However, they can rapidly boost total population numbers and hence are quite effective at increasing countries' **ecological footprint**. Even from a purely economic perspective, such 'cures' for a nonexistent 'disease' make little sense: the cost of additional infrastructure to accommodate population growth is far greater than the extent to which it could reduce aging-related costs to the economy [51].

Note that we are not arguing against all immigration, any more than we are arguing for childlessness. We argue only that population aging is not a valid reason for elevating immigration or births. When setting policy, we should consider the benefits of older and smaller populations as well as their costs.

The Benefits of Aging and Shrinking Populations

While aging and shrinking societies bring manageable economic challenges, they also bring economic benefits. Shrinking labor pools can tighten labor markets, increasing workers' wages. They help make potential workers in overlooked groups, such as women, young people who require training, or older people themselves, more appealing to employers. In

rapidly growing cities, increased housing costs have priced many younger and poorer people out of home ownership, making it impossible for them to build equity in the way previous generations did; slowing population growth in such cities can ease this problem. Decreasing populations also ease crowding, an often overlooked issue that harms quality of life through excessively long commutes and degraded or unavailable public amenities [57]. In all of these and other ways, even if the economy is shrinking, *per capita* incomes and wealth can rise, along with many other determinants of wellbeing [30].

Lower fertility rates lead to smaller families. One important yet often overlooked economic benefit of this is an increase in the *per capita* value of bequests, as older generations pass on their wealth to younger ones [31]. Not only through inheritance but throughout life, investment per child is increased when children are fewer [29]. A well-resourced start in life leads to greater wealth accumulation throughout life. In this way, smaller families help to decrease poverty and lead to greater economic equality across society as a whole.

Above all, smaller populations have potentially enormous environmental benefits. In their most recent report, the IPCC [7] identified population and consumption growth as the main drivers of increased anthropogenic greenhouse gas emissions leading to climate change. Despite energy-efficiency improvements in recent decades, carbon emissions have continued to rise. In regard to total energy use, population growth has a multiplier effect, such that 'At the global level, *per capita* primary energy consumption rose by 30% from 1970–2010; due to population growth, total energy use has increased by 130% over the same period' [7]. However, following a lower global population growth path could provide 16–29% of the emission reductions needed by 2050 to keep average global temperature increases below 2°C, with the effect becoming even more significant by the end of the century (delivering 37–41% of necessary emission reduction) [58].

Aging populations provide a potential for further emission reductions due to declining age-specific consumption at older ages. Although there are sector, timing, and scale-effect discrepancies [33,58–60], in the long run population aging is expected to reduce emissions [31]. For example, by 2050 population aging in China could reduce global energy-related emissions by 700 Mt carbon dioxide [60]. Thus, the trends of population decline expected in 43 countries in 2050 (Figure 1) are likely to have climate-related benefits [61].

Excessive human numbers strongly contribute to the Earth's sixth mass extinction of wild species [10–12,62,63]. Habitat loss is a major cause of species endangerment, and population growth contributes strongly to habitat loss [64]. The highest-ranked threats against red-listed species are all partly population driven, including overexploitation, agricultural expansion, urban development, invasive species, pollution, and climate change (in that order) [65]. In aging and low-fertility countries, all of these current and future extinction drivers can be reduced by declining human populations.

Smaller populations reduce pressures to convert forests and wetlands to agriculture or to dam and drain rivers to provide water for agriculture and growing cities. They open possibilities for rewilding lands [66] that are no longer needed for agriculture, forestry, or other intensive human use (Figure 2).

In areas such as the Great Plains of the USA [74] or the Oder Delta (Figure 2), population declines give opportunities to protect and restore wildlife. Fewer people provides space to conserve more biodiversity and share the landscape fairly with other species [75].



Trends in Ecology & Evolution

Figure 2. Declining Populations and Lower Population Density in Aging Countries Increase Opportunities for Self-Sufficiency, Nature Conservation, Rewilding, and Nature-Oriented Tourism and Education. While population growth reduces the capacity of individual nations to provide food and freshwater to their citizens [67,68], declining populations could improve agricultural self-sufficiency and food security. In addition, with less emphasis on yield maximization, more ecologically friendly food production systems could be adopted, with fewer pesticides and energy-demanding artificial fertilizers and more biodiversity preserved in agricultural systems [69,70]. (A) Mixed agricultural landscape in Italy (photograph Creative Commons) and (B) organic farm, Hungary (photograph by Dr László Kiss). Many countries are struggling to meet the Nagoya goal of the UN's Convention on Biological Diversity to preserve 17% of their land, lakes, and watercourses for nature conservation (itself a woefully insufficient target). Continued population growth will make this even harder, while population decline will open more land for 'hands-off' protection, restoration, or rewilding [71–73]. (C) Spontaneous forest regrowth on abandoned agricultural land, which over time can develop into old-growth forest (Vosges Mountains, eastern France; photograph by Annik Schnitzler). (D) An actively managed site in the Rewilding Europe Network: the Oder Delta of Poland and Germany (Peene River, near Anklamer Stadtbruch, Germany; photograph by Solvin Zankl). (E) Habitat conservation and rewilding open new opportunities for nature-oriented tourism and education (photograph by Doru Oprisan).

Box 2. Japan: Showing the Way with Successful De-Growth?

Japan's population density (351 persons per km²) is one of the highest in the world; approximately 94% of Japanese people live in urban areas, and at 37 million Tokyo is the most populous metropolitan area in the world. Urban crowding and long commutes take a toll on Japanese quality of life and the country has a large global ecological footprint [76].

Increasing life expectancy (83.3 years in 2015) and a low fertility rate (recently 1.4) has led to an aging population, with median age 47 years [5]. The population slowly began to shrink in 2009 and depopulation of rural areas began much earlier. With a restrictive immigration policy, Japan's population is likely to continue to decline. This opens the possibility of a 'depopulation dividend', defined by Peter Matanle as the 'achievement from depopulation of positive gains that contribute to socio-cultural, political-economic, and environmentally sustainable living' [77].

One example comes from Sado, a self-proclaimed 'eco-island' where rain forest habitat, a protected ibis species (*Nipponia nippon*), and unique traditions have favored tourism. In addition to ecotourism, Sado has tertiary education courses in environmental management, traditional crafts, and caring for the elderly. These initiatives have opened career opportunities and consequently younger people feel less need to leave the island [77]. Examples of such 'creative depopulation' [78] have inspired Japanese policy analysts to explore how demographic de-growth can be a positive experience. Economist Matsutani Akihiko [30] emphasizes the opportunity to reduce production capacity and public-works spending and to rethink public services and retirement policies systematically, with a focus on quality of life instead of economic growth.

For the most part, observers outside Japan have failed to notice such positive approaches. David Pilling, a former Tokyo bureau chief for the *Financial Times*, found that Japan is 'regularly written about as though it were some kind of basket case stuck in perpetual stagnation and without the wits to haul itself out of misery. And yet Japan's supposed misery – as measured by nominal GDP – really didn't feel like misery at all [when Pilling lived there.] Unemployment was extremely low, prices stable or falling, and most people's living standards rising' [79].

Just as it led Asia in the booming post-war growth period, Japan now is positioned to lead the region into an era of successful demographic de-growth. Fewer people in Japan (potentially 18 million fewer by 2050) would create benefits such as reduced greenhouse gas emissions, fewer demands on ocean fish stocks and tropical timber, and quite possibly more enjoyable lives for the people of Japan [80].

Perhaps the most important point is that fewer people can lead to comprehensive environmental benefits in many countries in the future: less water use, less energy demand and fewer cars, lower food imports, and less pollution and toxins generated. Societies instead could choose to waste these potential environmental benefits by increasing *per capita* consumption. However, this works in the other direction, too: responsible societies can choose to multiply environmental benefits by driving down *per capita* consumption while also decreasing the number of 'capitas'. There is nothing a society can do to decrease its demands on the environment more effectively than decreasing its population.

Interestingly, countries with stable or declining populations can remain quite robust economically. Some Eastern European countries with stable or declining populations, such as Estonia and the Czech Republic, are advancing strongly and deserve further study. A broad analysis of Germany concluded that the positives of aging societies outweighed the negatives, finding that an older, shrinking population is likely to be more educated (more investment per child), cleaner (generating less pollution and fewer greenhouse gases), richer (through the concentration of inheritance), healthier (with its citizens spending a greater proportion of life in wellness), and happier overall [31]. Germany has been the economic powerhouse of Europe in recent decades, and Japan surpasses OECD averages on many economic and social welfare measures (Box 2).

Concluding Remarks: Smaller Human Populations, a Real Opportunity

We have presented evidence that aging and declining human populations are essential to future wellbeing and environmental sustainability. We argue that the evidence supports our general hypothesis that reduced population growth and population decline in aging countries benefit

people and the environment, with appropriate policies and planning. Several countries are now discussing policies for dealing with aging and decreasing populations, hopefully with a focus on environment protection and social wellbeing rather than maximizing GDP [6,79,81]. One could consider population aging on the basis of alternative hypotheses; for instance, that endlessly growing economies and populations are possible due to human ingenuity [82] or that attempts to limit population growth in modern capitalist economies are futile [83]. As realists, we reject the first alternative hypothesis, while as optimists we have presented evidence and arguments against the second.

The reluctance of ecologists and social scientists to discuss the negative impacts of population growth has given a free hand to advocates of economic growth at all costs to focus selectively on problems attributed to aging, without acknowledging that their remedies entail greater problems. The same coyness might explain the lack of population-related indicators of biodiversity threats in the Convention on Biological Diversity's Aichi targets, compared with the high representation of consumption-related indicators [84]. The UN's Sustainable Development Goals also fail to address population growth as a barrier to the achievement of most of its goals [85]. As the saying goes, we can't manage what we don't measure, and we are clearly failing to rein in unsustainable trends while we ignore human population dynamics.

Sustainability is linked inevitably to population matters and respect for limits [86]. Given current consumption levels, many nations are already grossly **overpopulated**, as is the world as a whole [32,87]. We admit that aging and shrinking populations present challenges. However, ending population growth is not optional; it is a necessary transition that all nations will inevitably face. Aging societies should not be seen as a problem but as an achievement that opens possibilities to create even better societies that are sustainable over the long term (see Outstanding Questions).

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Outstanding Questions

In what ways do smaller human populations further the wellbeing (comprehensively understood) of members of modern industrial societies? In what ways do they harm them?

What rates of population decrease are manageable for modern industrialized societies? What rates cause serious or unavoidable problems?

What roles do population growth rates and population densities play in furthering or retarding human wellbeing, considered economically, socially, and environmentally?

What policies can be effective in limiting any harmful impacts of human population decrease? What policies can help nations maximize the environmental and social benefits of population decrease? What policy lessons can be drawn from national experiences to date?

What roles must limiting total numbers or limiting overall economic activity play in creating environmentally sustainable societies? Can human societies be sustainable without limiting their numbers or without limiting overall economic activity?

Can cross-country studies reveal how aging societies with declining population numbers perform in various respects compared with countries with population increase?

What roles have human population growth and human population density played in biodiversity loss in recent decades? A review of existing studies is desirable. Given identified causes of biodiversity loss (e.g., habitat loss, exotic species, pollution, overharvesting, climate change), can we quantify the role population growth plays in driving each of these?

In what ways might smaller human populations further the conservation and rewilding of former agricultural areas and other developed areas or the creation of parks, nature reserves, and other protected areas? Cross-country studies may be useful. Do protection efforts succeed independently of human numbers or does success depend on limiting population?

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