LETTERS

Edited by **Jennifer Sills**

Putting Russia on the genome map

IN THE NEWS story "Who has your DNA—or wants it" (25 September, p. 1475), J. Kaiser listed 17 projects that aim to chart human genetic diversity across the globe in the context of a dozen ongoing national genome sequencing initiatives (*1*). Yet Russia—a country with 1/10th of Earth's landmass, 1/50th of the world's people, and descendants from critical crossroads across human migration history—has a relatively unexplored human genome landscape (*2*). The modern Russian population presents an opportunity to study population history in the wake of the founding of Eurasia, historical relocations throughout the Great Migration Age, the Great Silk Road diaspora, and the forced population displacements of the recent centuries (*3*). The time has come for Russia to build a national genome project of its own.

Genetic admixture occurs when individuals from separate populations interbreed. Mapping Russia's admixture history, and analyzing it in light of the diverse environments faced by the local populations, could create a unique opportunity for disease gene discoveries (*4*). Genome mining of function-altering variants in modern Russian genomes could reveal risk/protective alleles that neither exist nor associate with disease elsewhere. Studies of population ancestry and natural history in Russia would further illuminate the origins of Native Americans, and also provide genomic links to the lost Neandertal and Denisovan cultures discovered in Russia's fossil beds. Russian biomedical research will receive immediate benefit from a database for precision/personalized medicine. Finally, engaging Russian researchers and communities in international projects like this (*1*, *2*) would help integrate its people into the world genomics community.

The Genome Russia Project would close the largest gap in the genome map of the world (*5*). The beginnings of a Genome Russia Project are happening, endorsed by the Russian Academy of Sciences and the Ministry of Education and Science. The Genome Russia Project can and should become an example of open international collaboration and data access with the shared goal of improving human health.

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Tempering threats to temperate forests

C. I. MILLAR and N. L. Stephenson ("Temperate forest health in an era of emerging megadisturbance," Review, 21 August, p. 823) review the increasing susceptibility of temperate forests to stresses such as increasing droughts, insect outbreaks, and more frequent and intense fires ("megadisturbances"). They accurately point out how forests are exceeding critical thresholds and can no longer recover their original composition and ecosystem services. However, they overlook data showing that the opposite is also true: Many temperate forests are suffering from declines in the frequency and intensity of fires (*1*, *2*).

Surprisingly, Millar and Stephenson hold up northern mid-successional oak-hardwood forests of the eastern and central United States as models of "resilient" forests capable of sustaining structure, function, and services. In fact, these forests are undergoing rapid changes in composition and structure, losing diversity and the ability to regenerate key species (*3*–*6*). These changes reflect responses to many drivers, including habitat fragmentation, ungulate browsing, and exotic species invasions, all of which threaten ecosystem services just as observed in western forests (*7*–*9*).

To address these threats and avoid catastrophic collapse, Millar and Stephenson argue that we should anticipate incipient changes and manage forests to facilitate their inevitable transitions, such as by thinning stands and planting species adapted to future conditions. This may be worthwhile, but it presupposes our ability to correctly predict responses to these treatments. Given that we are still learning about the susceptibility of temperate forests to various stresses and the ensuing dynamics, it is premature to assume that we can accurately anticipate and counter these incipient shifts. Cutting trees to save the future forest will also concern those who have seen "forest health" used to justify logging and subvert environmental analysis (*10*). We should instead acknowledge the susceptibility of temperate forests to a spectrum of stresses and admit our uncertainty by treating such interventions as "adaptive management" experiments rather than a mature paradigm to apply widely.

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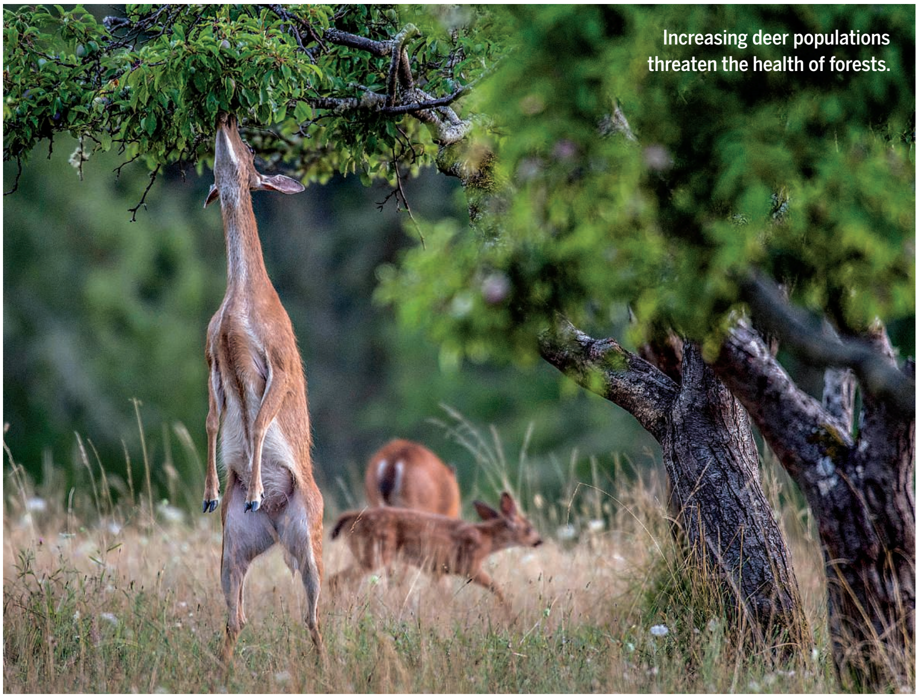

Increasing deer populations threaten the health of forests.

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How to measure sustainable progress

IN SEPTEMBER, THE United Nations General Assembly adopted Sustainable Development Goals (SDGs), to be met by the year 2030. These important goals range from poverty eradication and improvements in education and health to the protection of global assets, including the oceans and a stable climate. Unfortunately, neither the SDGs nor their background documents explain how governments should judge whether the development programs they undertake to meet the goals are sustainable.

The system of national accounts (SNA) that is in common use today records resource flows such as consumption, investment, employment, and government expenditure. The SNA is designed to measure gross domestic product (GDP), which is a flow of income (so many international dollars per year). However, because GDP can increase despite the depletion of natural resources, the SNA is ill-equipped to judge the sustainability of the SDGs.

Governments will need a measurement tool that records wealth, comprehensively, including reproducible capital (roads, buildings, and machines), human capital (education and health), and natural capital (land, fisheries, forests, and subsoil resources). GDP does not record the depreciation of capital assets. Although the SNA does account for depreciation of reproducible capital, it arrives at figures for Net Domestic Product (NDP), not wealth. Economic growth should reflect growth in wealth, not growth in GDP or NDP (*1*). If the average wealth per person (adjusted for distribution of wealth) increases as governments attempt to meet the SDGs, the SDGs will be sustainable; if it declines, the SDGs will be unsustainable.

Economic statisticians have begun estimating past movements of wealth over time. The authors of the Inclusive Wealth Report 2014 (IWR2014) (*2*), for example, measured movements in the wealth of 140 nations over the period 1990 to 2010. They used official statistics to arrive at the value of reproducible capital, and they estimated human capital by using data on educational attainment. Owing to severe limitations of data, items of natural capital that were included were limited to agricultural land, forests as stocks of timber, subsoil resources, and fisheries. The national costs of global climate change, although only partially covered, increased during the period. Similarly, the ecological services that are provided routinely by, for example, forests and coastal waters, though incomplete, have decreased. Estimates of wealth changes between 1990 and 2010 were therefore, in all probability, biased upward.

The authors reported that wealth grew at a positive rate in 92% of the countries in the sample, but that the proportion of countries where growth in wealth per person was positive was only 60%. The UN ignored population growth in framing the SDGs, which should be a point of public concern. Moreover, a reliance on growth in world income to finance the SDGs would be a mistake. IWR2014 reported that GDP per capita grew in 90% of the countries in their sample, even as wealth in many of those countries declined.

As nations work to meet the SDGs, their Statistical Offices should begin to prepare wealth accounts and track movements in wealth through time. Just as firms create annual balance sheets, governments should prepare annual wealth accounts. Limiting data to GDP will hinder our ability to evaluate development programs.

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