The New Trail of Tears

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In 1830, Congress passed the Indian Removal Act, designed to appropriate to the United States lands occupied by aboriginal Americans. The Supreme Court ruled it unconstitutional, but the army under Commander in Chief Andrew Jackson acted anyway. Now a lightning rod for condemnation of the expropriation of Indian property, Jackson was an agent of demographic pressures and a lust for the resources found on tribal lands.

The result of this land grab and ethnic cleansing was the Trail of Tears, a highway of the dispossessed, enroute from their homelands to less favorable situations away from the population centers of the European-Americans and their recently created nation. Those with the means self-deported; those who moved late moved in large numbers and suffered terrible losses.

Nearly two centuries later, we face the prospect of forced relocations on a scale that is difficult to fathom. This New Trail of Tears will involve humans on every inhabited continent, and it will impact countless other species as well. This time, the force is all humanity, agents of climate change through our greenhouse gas emissions and the climate change they wreak.

A major consequence is the global rise in sea level due to the melting of glaciers and the polar ice caps as well as the expansion of warmer oceans. Accompanied by more violent storms powered by the warmer atmosphere, rising seas will have a profound impact on coastal areas. Flooding is already common in coastal Florida; with just the few feet of sea-level rise expected by the end of the century, sizable portions of Miami and Fort Lauderdale will be inundated.

Other low-lying coastal cities will be affected similarly. The economic impact will be enormous: Miami alone is spending half a billion dollars over the next few years to combat sea-level rise, an effort destined to be obsolete within a few decades. The human impact will be similarly enormous. Those with the means will self-deport; those who move late will do so in large numbers and suffer terrible losses.

Our planetary fellow travelers are being impacted just as we are. Warmer winters have reduced the mortality of the mountain pine beetle, resulting in the destruction of a hundred million acres of pine forest in the mountain west. Trees don't migrate to escape environmental threats, but their range can expand northward, given the

proper soils and other requirements and absent obstacles such as human appropriation of the land. Some plants and animals will move uphill; the cooling rate of 3.5 Fahrenheit degrees per thousand feet of elevation provides relief. But this trudge along the New Trail of Tears is lined with a gauntlet of perils; moreover, the available area of Earth shrinks with increasing latitude, just as the available area of a mountain shrinks with increasing elevation. The *refugia* to which many species will be confined as their living space shrinks will become extinction traps for some.

Like forests, coral reefs are threatened, as this year's vast bleaching event in the Great Barrier Reef makes clear. And while some northward retreat of these great oceanic nurseries is possible, there is nowhere to run to escape the acidification of the oceans that accompanies the increasing atmospheric concentration of carbon dioxide. Fish can and do migrate, as have the herring in the North Atlantic. They have left behind some of their predators, glued to their habitats by instinct as surely as the corals are fixed to the ocean floor. For example, the Atlantic puffins of Maine are now hard pressed to feed their offspring with the herring gone. Unable to raise their chicks to maturity, they nevertheless do not migrate in response to the change. Instead, their range is contracting to the remaining viable colonies farther north.

Migration is occurring and will occur in time as well as in space. Times of plant flowering, insect appearance, and bird nesting have moved forward in the year throughout the northern hemisphere. There is no guarantee that animals and their food sources will remain synchronized as this process continues. Already there is evidence that this "phenological synchrony" has been disrupted for many food-chain relationships. For example, black guillemots in Alaska initially benefited from the increased likelihood of eighty frost-free days to raise their chicks, but now are retreating once more due to the recession of the pack ice upon which they depend for their food.

Our own fate is of course of the most immediate interest to us, though it is inextricably intertwined with the fate of Earth's other inhabitants. When it comes to human migration, the route is perilous. In a fully-settled world, space is not easily made for refugees, as we have seen time and time again when people have been obliged to move to escape privation or war. Indeed, privation and war are often closely connected, as the Syrian refugee crisis reminds us.

While the drought that accompanied the Arab Spring uprisings and subsequent Syrian civil war may not have been a direct consequence of climate change, the situation provides a compelling model of what might happen on an even broader scale when the consequences of climate change take hold in the coming decades. Indeed, increased temperatures accompanied by high humidity may render great swaths of the Middle East simply uninhabitable by humans before the end of the century. The 1951 U.N. Refugee Convention, lacking provision for environmental refugees, is showing its age.

Domestically, memory of the dust bowl migrations has faded with the passing of the generation that was hardest hit. But ample photographic and written evidence is available to remind us of the human cost of this human-induced disaster. Suffering on a Grapes of Wrath scale edges nearer as surface water and water table levels fall in the arid, now more heavily populated west. How ironic that the thousands of Conservation Districts, created to ensure that poor land management practices do not create another such disaster, are now targets for cuts as state and municipal budget exigencies force difficult choices.

Heat can attract as well as repel. While species and peoples are fleeing the heat at lower parallels, the warming of the Arctic and the melting of the polar sea ice will attract humans to the significant resources there. Nations are already jockeying for position to exploit these resources, resulting in a nasty feedback loop: further disturbance of the fragile tundra and extraction of the petroleum below will accelerate the warming that has powered this northward migration in the first place.

The irony of the situation cannot have escaped the notice of world leaders. As they push poleward, competing interests will encounter one another with increasing frequency, fueling conflict. A better approach for all the inhabitants of the globe would be to declare the polar region an international scientific study area, off limits to resource extraction.

In any disruption, there are winners and losers. The world is a complex place, and it is beyond difficult to distinguish them in detail in advance. But we know the broad outlines of the categories. As usual, the biggest losers will be the weak: those already struggling, already few in numbers, or specialized to niches that are being extinguished. The winners, as usual, will be the strong: those with the resources to move, the numerous, and the generalists prepared to exploit new situations as they arise.

Despite all kinds of assurances, many Indian nations suffered renewed pressure repeatedly as broader economic and demographic developments engulfed them. Similar gestures will likely be made on behalf of the climate-dispossessed, and they will be similarly empty as long as global temperatures continue to rise. The April signing of the Paris Agreement in New York is the world's current best opportunity to act to stave off the worst effects of climate change.

While only the beginning of a long process, it is the start we have. The nations of the world, and the U.S. in particular, should embrace their commitments by acting swiftly to start curbing emissions of greenhouse gases. Having inadvertently set in motion a New Trail of Tears, we owe it to ourselves and future generations to take corrective action before the consequences overwhelm us.