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Secretary Deb Haaland
U.S. Department of the Interior
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Comment on the Proposed Rulemaking to Protect, Conserve and Manage the National Forests — The rulemaking process and subsequent rules must ensure immediate and permanent protection of all Mature and Old Growth Forest on federal lands.

We Advocate Thorough Environmental Review, more commonly known as W.A.T.E.R., is a grassroots, nonprofit 501(c)(3) organization dedicated to protecting Mount Shasta's waters and other natural attributes for the benefit of current and future generations. In our ten-plus years as an organization (seven-plus years as a nonprofit) we have focused on protecting our water resources from depletion by extraction and corporate privatization, protecting surface and groundwater from contamination by industrial activity, and protecting the regional environment from other inappropriate and polluting industrial/commercial activities. Our work has clarified for us the following realities:

- The climate crisis is the most urgent existential threat to humanity.
- "Environmentalism" in the 21st century cannot exist without addressing economic and social justice issues.
- Achieving social, economic, environmental, and climate justice requires confronting the dysfunctional economic and political systems that are ruining the planet and stonewalling efforts to change.
- Local issues are not strictly local; they are impacted by what happens regionally, statewide, nationally, and globally. And what we do in our communities can have far-reaching impacts around the globe.
- It is a moral obligation to protect Mount Shasta's water and other natural attributes.

We believe in the inherent value of all Life. This planet is our only home and each generation has the responsibility to steward the Earth so the biosphere can regenerate and thrive now and for countless generations to come.

Leading climate and biodiversity experts recently concluded that we must tackle the intertwined Climate and Biodiversity Crises simultaneously to protect a livable future for all of earth's inhabitants[1] including the creatures we share the Earth with. This amounts to changing how we look at Nature and breaking away from destructive ideas about economic progress.[2] We must stop subsidizing activities that harm biodiversity. This must in particular include jettisoning the destructive notion that we must convert forests to tree plantations on short harvest cycles to maximize timber production. To this end, **<u>ALL</u> Mature and Old-Growth Forest must be immediately and permanently protected.**

Reading the constant, ongoing litany of current climate news about Canadian wildfires now burning 1,597 percent of the average area to date[3], the lowest recorded extent of sea ice in Antarctica "in excess of 2.5 million sq. km (965,255 sq. miles) below average for the time of year[4]", people perched atop their cars being swept away by flash flooding in Zaragosa, Spain[5], fatal flooding in New York's Hudson Valley[6] and hail crushing[7] drought-stressed crops[8] in the Midwest is sobering and completely clarifies and validates the absolute necessity to halt carbon emissions. Carbon must also remain sequestered to refrain from adding even more emissions to the atmosphere. Greenhouse gas emissions from the energy industry continued to increase last year despite record growth in wind and solar power with fossil fuels continuing to make up 82 percent of the world's total energy consumption in 2022 as the world used more energy overall.[9]

> "To halt global warming, the emission of carbon dioxide into the atmosphere by human activities such as fossil fuel burning, cement production, and **deforestation** needs to be brought all the way to zero. The longer it takes to do so, the hotter the world will get. Lack of progress towards decarbonization has created justifiable panic about the climate crisis.[10]" (emphasis added)

The sharp increase in north Atlantic surface temperatures over the past three months[11] has prompted fears among veteran climate scientists that the world's climate has entered a more erratic and dangerous phase with the advent of an El Niño event exacerbating human-made global heating.[12] The 1.5°C limit adopted in the Paris Agreement of 2015 is expected to be breached in at least one year between 2023 and 2027.[13]

> "We're taking colossal risk with the future of civilization on earth. We're degrading life support systems that we all depend on. We're actually pushing the entire earth system to a point of destabilization; pushing earth outside of the state that has supported civilization since we left the last ice age 10,000 years ago. This requires a transformation to safe and just earth system boundaries for the whole world economy.
>
> Dear friends, scientifically this is not a climate crisis. We are now facing something deeper — mass extinction, air pollution, undermining ecosystem function. Really putting humanity's future at risk. **This is a planetary crisis.**" (emphasis added)

Johan Rockström, speaking at the World Economic Forum, Davos 2023[14]

So we must act.

Forests as potentially the major method of reversing Global Warming

On his first day in office, President Biden signed an order to rejoin the Paris Agreement declaring climate change a "global, existential crisis.[15]" The Agreement calls for a 50 percent reduction in Greenhouse Gas (GHG) emissions by 2030 and achieving net-zero emissions by 2050.[16] A week after his inauguration, President Biden also issued Executive Order 14008 pledging "to achieve the goal of conserving at least 30 percent of our lands and waters by 2030.[17]"

Last year on Earth Day, April 22, 2022, the Biden Administration issued Executive Order 14072 directing the Secretary of the Interior, with respect to the Bureau of Land Management (BLM) and the Forest Service branch of the U.S. Department of Agriculture, to "define, identify, and complete an inventory of old-growth and mature forests on Federal lands" within one year.[18] This year in time for Earth Day, the Mature and Old-Growth Forest Report[19] was released identifying 32.7 million acres of old-growth forest and 80.1 million acres of mature forest on BLM and Forest Service lands.

The old-growth forests identified amount to only 4 percent of the over 800 million forested acres in the US.[20] Adding the mature forest land identified, the sum of mature and old-growth forest in both BLM lands and National Forests encompasses less than 14 percent of forested land while more than half of US forests are privately owned.[21] Mature and old-growth forests hold the promise of helping address simultaneously the climate, biodiversity and water crises that confront us by sequestering the carbon from CO_2 emissions[22], conserving habitat for wildlife[23,24] and regulating the water cycle.[25]

It is imperative that the 91,813,380 acres of mature and old-growth forest on the lands managed by the US Forest Service be completely protected from any logging or other management and preserved. Beyond the 2050 goal of net-zero GHG emissions, atmospheric CO_2 levels thereafter need to be further reduced to 350 parts per million or less (negative emissions) to stay within the safe climate zone for human civilization. Trees are the major known method currently capable of capturing CO_2 from the atmosphere at the scale required without the need for any additional energy. Globally, forests now absorb about 30 percent of all CO_2 emissions from fossil fuel burning and net deforestation and store large reservoirs of carbon, holding more than double the amount of carbon in the atmosphere.[26]

> "Despite regional negative effects of climate change on the net amount of carbon removed from the atmosphere annually by land ecosystems, their removal of carbon dioxide from the atmosphere has remained fairly constant over the last 60 years at about 31% of emissions, with **forests contributing the most.**[27]" (emphasis added)

Reversing the degree to which forests have been removed and degraded globally actually provides a tremendous potential for addressing climate warming through proforestation and reforestation should decarbonization be achieved.

> "(I)n the Pacific northwest USA, an analysis of inventory and remote sensing data indicated that the current carbon storage on forest land is half of the potential, and it could increase by 15%

> over the next several decades if allowed to grow and accumulate carbon. This can potentially result in hundreds of additional years of forest carbon accumulation.[28]"

Additionally, Mature and Old-Growth forests must be preserved and more recruited as it is these stands that amass and sequester CO_2 faster than younger, managed forest stands.

> "Ecosystem services accrue as forests age for centuries. Far from plateauing in terms of carbon sequestration (or added wood) at a relatively young age as was long believed, older forests (e.g., >200 years of age without intervention) contain a variety of habitats, typically continue to sequester additional carbon for many decades or even centuries, and sequester significantly more carbon than younger and managed stands. Temperate forests in particular have the highest CO_2 removal rates and overall biological carbon sequestration.
>
> In sum, proforestation provides the most effective solution to dual global crises — climate change and biodiversity loss.[29]"

Even viewed on an individual tree level, it is the larger trees that sequester the most CO_2, continually increasing their rate of sequestration for centuries or even millennia.

> "A single large tree can add the same amount of carbon to the forest within a year as is contained in a single mid-sized tree of the same species. The relationship between large-diameter trees and overall forest biomass suggests that forests cannot accumulate aboveground carbon (AGC) to their ecological potential without large trees. Overall, as trees grow larger, each additional centimeter of stem diameter corresponds with a progressively larger increase in tree carbon storage. The sharp increase in carbon storage with increasing tree diameter speaks to the importance of preserving mature and old large trees to keep this carbon stored in the forest ecosystem where it remains for centuries.[30]"
>
> "Old-growth forests accumulate carbon for centuries and contain large quantities of it. We expect, however, that much of this carbon, even soil carbon, will move back to the atmosphere if these forests are disturbed. Because old-growth forests steadily accumulate carbon for centuries, they contain vast quantities of it. They will lose much of this carbon to the atmosphere if they are disturbed, so carbon-accounting rules for forests should give credit for leaving old-growth forest intact.[31]"

Moreover, undisturbed forest lands annually sequester 67 percent more carbon per hectare compared to managed timberlands.[32] (See table 4)

The Intertwined Nature of Forests and Biodiversity

The often maligned Northern Spotted Owl, along with the California Spotted Owl and Mexican Spotted owl, actually serve as indicators of the health and extent of suitable habitat preferring closed-canopy, uneven-aged, late-successional, and old-growth forests. But they are not the only inhabitants of these forests. Amongst the many other negative effects, loss of natural forests due to clearcutting and the establishment of tree plantations after logging produces an associated critical loss of biodiversity caused from the decrease of richly complex habitat and shown clearly by the dwindling population of spotted owls.

The current global tree plantation area is approximately 7 percent of the forested area of the world, and this value is expected to grow to more than 20 percent over this next century with natural forests likely becoming more fragmented and smaller with an accompanying decrease in their native biodiversity.[33] The loss of species richness engendered by plantations has to be concerning as it can actually be a harbinger of ecosystem collapse.[34] New research shows total ecosystem collapse is inevitable if biodiversity losses are not reversed.[35] The accelerating pace of extinctions globally show we have already entered the Sixth mass extinction — the Anthropocene extinction.[36]

> "Research has suggested that loss of certain life forms could substantially alter the structure and functioning of whole ecosystems. Ecosystem functions, like biomass production and nutrient cycling, respond strongly to changes in biological diversity. There is now unequivocal evidence that biodiversity loss reduces the efficiency by which ecological communities capture biologically essential resources, produce biomass, decompose and recycle biologically essential nutrients.
>
> The impact of biodiversity on any single ecosystem process is nonlinear and saturating, such that change accelerates as biodiversity loss increases. The form of biodiversity and ecosystem functioning relationships in most experimental studies indicates that initial losses of biodiversity in diverse ecosystems have relatively small impacts on ecosystem functions, but increasing losses lead to accelerating rates of change. The impacts of diversity loss on ecological processes might be sufficiently large to rival the impacts of many other global drivers of environmental change.[37]"

Scientists have simultaneously issued a warning of tree extinction that we must heed, definitively binding forests and biodiversity together.

> "New evidence indicates that a third of tree species are threatened with extinction, representing a tree extinction crisis. Tree species extinction will lead to the loss of many other plants and animals and significantly alter the world's ecosystems.
>
> Loss of tree diversity could lead to abrupt declines in biodiversity, ecosystem functions and services and ultimately ecosystem collapse. The evidence suggests that a third of the world's tree species are currently threatened with extinction, which represents a major ecological crisis. Large-scale extinction of tree species will lead to major biodiversity losses in other species groups and substantially alter the cycling of carbon, water and nutrients in the world's ecosystems. Tree extinction will also undermine the livelihoods of the billions of people who currently depend on trees and the benefits they provide.[38]"

Habitat loss from the expansion of agriculture globally is the main threat to tree species and forests, followed by logging and wood harvesting, livestock grazing and urban development. We must address all these issues if we ever hope to benefit from the potential significant contributions for regulating ecosystem processes at the scale of the entire Earth system.

> "There is mounting evidence that biodiversity increases the stability of ecosystem functions through time. Diverse communities are more productive because they contain key species that have a large influence on productivity, and differences in functional traits among organisms increase total resource capture. Research and syntheses over the past 10 years have made it clear that both the identity and the diversity of organisms jointly control the functioning of ecosystems.[39]"

Wild animals need to be understood as providing consequential enhancement to natural processes. The natural biogeochemical processes within terrestrial and marine ecosystems already remove up to 50 percent of all human-caused CO_2 emissions annually. Scientific evidence shows that protecting and restoring wild animals and their functional roles can enhance natural carbon capture and storage.

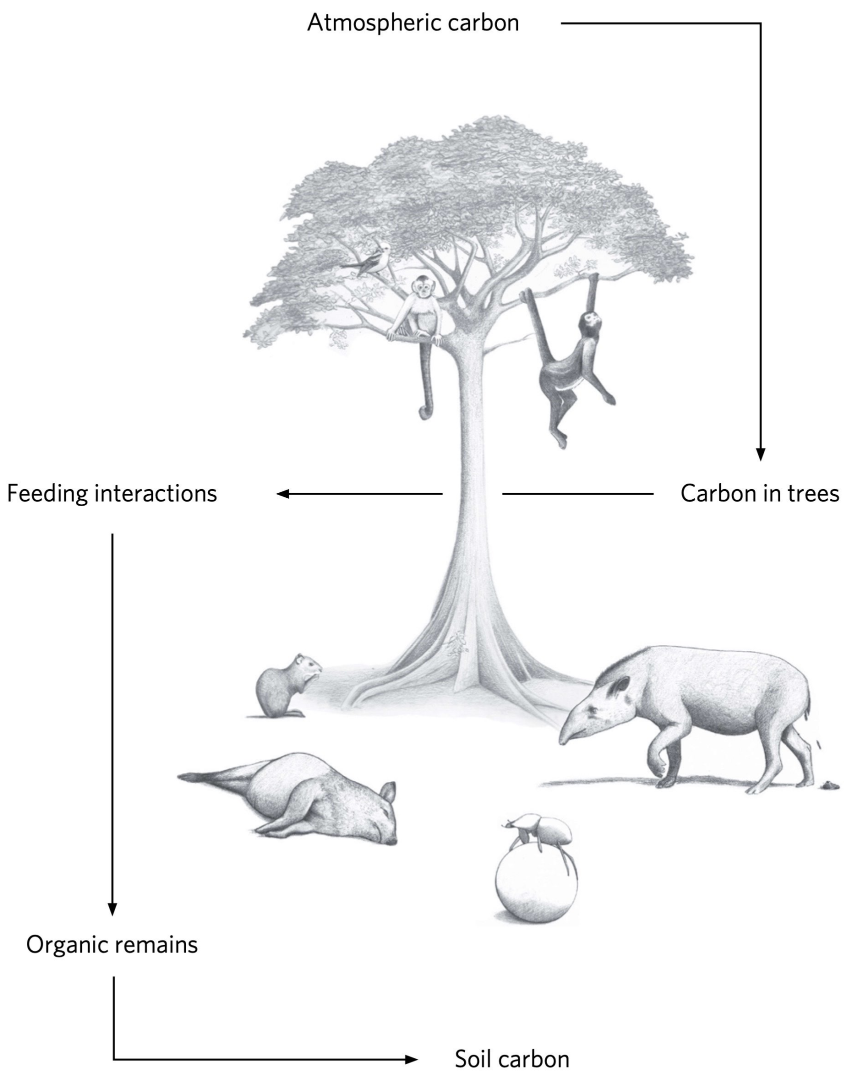

Figure 1 — Diagram of hypothesized ecological interactions that link atmospheric, biotic and soil carbon pools

"Biodiversity affects many ecosystem functions and services, including carbon cycling and retention. While it is known that the efficiency of carbon capture and biomass production by ecological communities increases with species diversity, the role of vertebrate animals in the carbon cycle remains undocumented. Securing animal and plant diversity while protecting landscape integrity will contribute to soil nutrient content and carbon retention in the biosphere.[40]"

> "Intensive sampling of 650 plots of 100 m^2 in a 48,000 km^2 tropical forest region in Guyana revealed that tree and soil carbon storage increased by 3.5–4 times across a gradient from 10 to 70 tree species. Yet, across a gradient from 5 to 35 mammal species within this same region, tree and soil carbon storage in the sampling plots increased 4–5 times. This boost in carbon storage is attributable to a diversity of animal species with medium-to-large bodies that have a diversity of functional roles in the ecosystem.
>
> Enlisting animal functional roles for natural climate solutions requires abandoning static allocations of space and creating dynamic landscapes and seascapes. it requires protecting and restoring the ability of animal species to reach ecologically meaningful densities so that as they move and interact with each other they can fulfill their functional roles.[41]"

The annual return of spawning salmon in the Pacific Northwest brings an influx of energy to forests with the embodied ocean nutrients finding their way as far inland as the Rocky Mountains bringing nitrogen, phosphorus, protein and fat. Grizzly and black bears are famously drawn to feast on this return migration, most notably at Brooks Falls in Alaska's Katmai National Park[42] where visitors watch this spectacle from a viewing platform. The bears take their catch into the riparian forests where they can feed relatively undisturbed. They consume a quarter to half of the salmon carcass favoring the parts highest in fat content and leaving the remains.

The remnants attract a variety of scavengers including eagles, pine marten and flocks of crows, ravens and gulls to consume the remaining flesh. A diversity of insects including flies and beetles are also attracted giving rise to added seething masses of maggots, with the arthropods and larvae in turn attracting songbirds.[43] Ultimately, the nutrients supplied by the salmon are measurably dispersed by the attendees at the feast as far as 800 meters inland from the streams.

The heavy but rare isotope of nitrogen, ^{15}N, is more abundant in marine algae than in terrestrial vegetation and salmon are very enriched with ^{15}N. It can thus be demonstrated by assaying small samples of wood extracted from cores of ancient trees that up to 70 percent of the nitrogen used by the streamside vegetation is derived from salmon carcasses, with values dependent on the salmon density in the stream, abundance of bears, plant species and distance from the stream. Examination of yearly growth rings in similar sized Western Hemlock show growth rates two and a half times higher in those trees where salmon carcasses are abundant compared to trees without access to salmon. Along several streams in Alaska, the total amount of nitrogen and phosphorus provided in this manner equals or exceeds recommended concentrations of commercial fertilizer for similar plants in northern forests.[44, 45]

The greater rates of growth stimulated by these ocean derived nutrients also increase the rate of carbon being sequestered by the trees affected by this nutrient influx. This biodiversity enhanced carbon sequestration shows just how important these types of relationships are for addressing climate breakdown. But just as we are discovering how much these relationships functionally impact carbon capture and storage, we are rapidly losing populations of many animal species, both aquatic and terrestrial. Extinctions are estimated to be occurring at 100 to 10,000 times the pre-human extinction rate due to human caused disturbances.[46]

Although degradation and loss of the tropical forests of Brazil are some of the most reported in the global media, some temperate habitats, such as freshwaters in California and old-growth forests in the Pacific Northwest to name but two, are being destroyed faster than most tropical rainforests and stand to lose as great a proportion of their species. Because so much of the temperate zone has been settled and exploited by humans, losses of biodiversity at the ecosystem level have been greatest there so far.[47]

We are become Death, the destroyer of worlds.

The Effect of Forests on the Hydrologic Cycle

Liquid water is a requisite for all life on Earth. Forests play a major role in the hydrologic cycle which deforestation and reforestation can alter. Responding to the force of gravity, all liquid water accumulated in soil and underground aquifers and in lakes, bogs and mountain glaciers feeding rivers inevitably flows down to the ocean. To accumulate and maintain optimal moisture stores on land, it is necessary to compensate the gravitational runoff of water from land to the ocean by a reverse, ocean-to-land, moisture flow. In the absence of a biotic moisture mechanism, air fluxes transporting ocean-evaporated moisture to the continents weaken exponentially as they propagate inland, dampening out over several hundred kilometers. No purely geophysical explanation can be given to the observed existence of highly productive forest ecosystems covering continent-scale areas.[48]

Through evapotranspiration, forests maintain atmospheric moisture that can return to land as rainfall downwind. These processes operate on timescales of days over distances of 100–1,000 km such that large-scale land-use change may alter precipitation hundreds to thousands of kilometers from the region of vegetation change. Land-use patterns and small-scale deforestation may also alter precipitation locally. Water-balance calculations imply that cumulative increases in evapotranspiration over upstream forested regions more than account for the increase in downstream rainfall. Vegetation affects precipitation patterns by mediating moisture, energy and trace-gas fluxes between the surface and atmosphere. When forests are replaced by pasture or crops, evapotranspiration of moisture from soil and vegetation is often diminished, leading to reduced atmospheric humidity and potentially suppressing precipitation.[49]

Although trees can reduce runoff at the small catchment scale – at larger scales, trees are more clearly linked to increased precipitation and water availability. Trees not only attract rain, but they also can and do recirculate moisture back into the atmosphere in the form of evapotranspiration. Precipitation recycling not only raises the likelihood of local precipitation events, it also favors the cross-continental transport of moisture vapor and thus increased precipitation in locations more distant from the ocean-based hydrologic cycle. Progressive deforestation, land conversion from forest to agriculture and urbanization have potentially negative consequences for global precipitation. Without large forest expanses, the intensity of the water cycle diminishes, reducing water availability. Deforestation has been linked to reduced precipitation, increased low flow events, extended dry spells and drought.[50]

In the Pacific Northwest of the USA, harvesting of old-growth forests followed by replanting with native tree species has profoundly affected both high and low streamflow. Hydrologic processes altered by harvest of old-growth conifer forest more than 50 years ago (transpiration, interception, snowmelt, and flow routing) continued to modify streamflow, with no clear evidence of hydrologic recovery. Examination of a 50-year record from paired-watershed experiments in the H. J. Andrews Experimental Forest, Oregon, USA in which 125 to 450-year-old conifer forests were harvested in the 1960s and 1970s and converted to tree plantations yielded concerning results. Studies documented initial increases in precipitation runoff after harvest in deciduous, boreal and conifer forests.[51] Increases are typically greatest during the period of highest runoff and during the wettest years. Due to this timing, any realized increases may have negligible benefits for water supply, while contributing to increased flooding.[52]

Of greater concern are studies showing that 40- to 50-yr rotations of Douglas-fir plantations can produce persistent, large summer low flow deficits. High evapotranspiration from rapidly regenerating vegetation, including planted Douglas-fir, and from the residual plantation forest in the riparian buffer appeared to explain the persistence of streamflow deficits. However, while the clearcutting of these plantations, with retention of riparian buffers, increased daily streamflow slightly, flows did not return to pre-first entry conditions. Long-term declines in low flows associated with forest harvesting and plantations raise concerns about aquatic ecosystem health and water supply, especially in dry years and may limit fish habitat. Contemporary forestry harvesting practices, including 40- to 50-year rotations of Douglas-fir plantations with riparian buffers, may produce persistent low flow deficits.[53] Several lines of evidence suggest that 30 to 50-year-old forests intercept and transpire more water than mature and old forests, depleting soil moisture, and reducing streamflow.[54]

Deforestation in Brazil has been widely reported in the media for years and has also been the focus of many studies. A very recent study has proven a clear correlation between deforestation and regional precipitation which will probably be shown as globally applicable ultimately.

> "Satellite-based precipitation datasets suggest that tropical forest loss causes statistically significant ($P < 0.05$) declines in median annual mean precipitation at all scales analyzed. Additionally, over the Amazon and Southeast Asia, we see a stronger reduction in precipitation over regions of forest loss during El Niño years. A stronger precipitation response to forest loss in regions and periods impacted by El Niño is probably due to higher transpiration rates observed in tropical forests during El Niño years and because rainfall is more sensitive to reductions in moisture recycling during drought years.
>
> Our analysis suggests that deforestation can drive local and regional precipitation changes that may match or exceed those predicted due to climate change over the same period.[55]"
>
> "One of the authors, Professor Dominick Spracklen of the University of Leeds, said 25% to 50% of the rain that fell in the Amazon came from precipitation recycling by the trees. Although the forest is sometimes described as the "lungs of the world", it functions far more like a heart that pumps water around the region.[56]"

Most distressingly, scientists have confirmed that The Amazon rainforest is now emitting more carbon dioxide than it is able to absorb. The giant rainforest had previously been a carbon sink, absorbing the emissions driving the climate breakdown, but is now causing an acceleration of global heating.

Most of the emissions are caused by fires, many deliberately set to clear land. But even without fires, hotter temperatures and droughts mean the south-eastern Amazon has become a source of CO_2, rather than a sink.

The Northeastern and Southeastern regions of the Amazon rainforest have the largest fractions of historically deforested land and stand out. This has been driven by deforestation to clear land for raising livestock and, to a lesser extent, for growing crops. The Northeastern region, 37 percent of which has been deforested, is the only region where annual mean precipitation has exhibited a statistically significant decrease in the past 40 years (9 percent or 208 ± 167 mm), with the largest reduction of 34 percent during the dry season (August, September, October). Although annual mean precipitation upwind of the Southeastern Amazon region did not change significantly, dry season precipitation decreased by 24 percent. Temperature increases over 40 years for the eastern regions are also larger than for Amazonia as a whole. Moreover, these changes appear to be accelerating.[57]

The effects of deforestation on soil, particularly from logging, need to be mentioned. Time matters in the forest–water relationship during ecosystem regeneration. Soil properties may take the longest to recover from the impacts of harvesting. Post-harvest soil carbon storage first reaches a minimum after 32 years of growth – at a level of only 50 percent compared to soil carbon storage in intact forests – and reaches 100 percent only after 100 years. Forest ecosystems potential for soil water storage and groundwater recharge presumably also require exceptionally long regeneration periods.[58]

The effect of deforestation on the hydrologic cycle across the scale of land area from watershed to continent and time from seasons to centuries is profound.

In summation —

With the emergence of trees on Earth, like the globally widespread Archaeopteris in the Devonian period some 385 million years ago, the Earth's atmosphere changed rapidly and finally stabilized from perhaps 10 percent to 1 percent CO_2 and from about 5 percent to 20 percent oxygen over a 50 million year period.[59] Trees of course inspire CO_2, cleave off the carbon by photosynthesis for growing their tissues and transpire O_2. This process produced the environment which allowed for the existence and evolution of land animals at length giving rise to Homo Sapiens. For early man, wood from trees was used for heat and cooking and other primitive utilitarian purposes. With the advent of agricultural civilization, the use of wood expanded into erecting permanent dwellings and eventually rudimentary metallurgy.[60] The clearing of land for the expansion of agriculture began the period of deforestation which is still occurring in the present day.

A kindred tale is chronicled in the Epic of Gilgamesh. After cutting down cedar forest stands to build the city of Uruk, the Euphrates River was diverted to irrigate the newly cleared fields of barley. However, irrigation ultimately caused a buildup of salt on the soil turning the land to desert, an environmental catastrophe.

A hypothesis has been put forward asserting the anthropogenic greenhouse era actually began 8000 years ago instead of at the start of the industrial revolution 150 to 200 years ago.[61] These anthropogenic changes originated from early agriculture in Eurasia, including the start of forest clearance by 8000 years ago and of rice irrigation by 5000 years ago and these changes have continued to the present as forests continue to be cleared.

Figure 2 — This Giant Sequoia was named the Mark Twain Tree. It was felled in 1891 and was 1341 years old. The stump is preserved as part of the Big Stump Picnic Area in Kings Canyon National Park.

For hundreds of millennia, CH_4 (methane) concentrations in the ice cores from the Antarctic Vostok Station had followed the 23,000-year Milankovitch orbital precession[62] insolation cycle. The highly coherent match between methane and insolation reveals this natural orbital control.

This expected pattern continued until 5000 years ago, with the decline in CH_4 values matching the decrease of insolation. Nearly 5000 years before the present (BP), however, the CH_4 signal began a slow increase that departed from the continuing decrease expected from the orbital precession theory. Humans had adapted wild rice to cultivation by 7500 years BP and had begun to irrigate rice nearly 5000 years ago.

CO_2 also correlates with the orbital precession insolation cycle. A high-resolution, high-precision CO_2 record of the last 11,000 years taken from ice cores extracted at Taylor Dome, Antarctica has been published. CO_2 values reached a peak of 268 ppm between 11,000 and 10,000 years ago. This late-deglacial peak has the same relative placement as the CO_2 peaks reached during the three previous deglaciations. Near 8000 years ago, however, the CO_2 trend began an anomalous increase that has no counterpart in any of the three preceding interglaciations, with values rising in recent millennia to 280–285 ppm, some 15 ppm above the late-deglacial peak.

The hypothesis posits that pre-industrial forest clearance starting in Eurasia explains the CO_2 rise between 8000 years BP and 1800 AD. Several lines of evidence confirm that initial deforestation by humans occurred around 8000 yrs BP. The spread of agriculture into the forested regions of south-central Europe was mapped by the first appearance in well-dated sediments of distinctive grains initially domesticated in the fertile crescent of the eastern Mediterranean. Most sites show early increases of disturbance-related herb and grass pollen, and many show increases in charcoal.

Other naturally forested regions also show signs of disturbance beginning around this time. Agriculture appeared in forested regions of China by 9400 years BP and the fertile crescent grains also first appeared in western India by 8500 years BP. Extensive deforestation had occurred by 2000 years ago as evidenced by Plato and other writers and historians noting the rapid retreat of forests up the sides of mountains within their lifetimes. The 1086 Domesday survey of England found less than 5 percent of the natural forest cover remaining over lowland regions, and less than 15 percent across the entire country. Thus forest clearance appears to have been by far the major early-anthropogenic source of CO_2 in the atmosphere prior to the Industrial Revolution.

This relationship between forests and CO_2 is of great importance to note. Over the past eight or nine millennia, the global number of trees has fallen by approximately 46 percent since the start of human civilization.[63] Timber harvesting has always targeted larger trees (Figure 2). In California, by comparing historic (1930s) and contemporary (2000s) surveys of forests, it has been documented that across 120,000 km^2, large trees have declined by up to 50 percent, corresponding to a 19 percent decline in average basal area and associated biomass, despite large increases in small tree density.[64] Globally, the amount of forest biomass has been reduced by more than half.

Deforestation, due to its impact on the evapotranspiration regime, on soil degradation and loss, and reduced soil water retention represents a significant threat to planetary survival.[65] But despite all of the gloomy statistics and obvious start of ecosystem breakdown observed, an avenue for addressing the multiple climate, biodiversity and water crises exists. Globally, 4 billion hectares of forest ecosystems store large reservoirs of carbon, together holding more than double the amount of carbon in the atmosphere.[66] Given their degraded and diminished state, this represents a huge potential.

Although dependent on the decarbonization of the global economy, protecting and preserving forests could create negative emissions drawing down atmospheric carbon levels much like what happened hundreds of millions of years ago during the advent of trees on the Earth. Although it would take centuries, if forests are protected and allowed to regrow to their fullest potential and the economy converted to near zero carbon emissions, atmospheric CO_2 levels could be reduced to below 350 parts per million to return to the safe climate zone for human civilization. Again, trees are currently the only known method capable of capturing CO_2 from the atmosphere at the scale required without the need for any additional energy.

This is why it is imperative that all Mature and Old-Growth Forest be immediately and permanently protected from all logging or "thinning". Conserving and protecting the forest stands identified in the Mature and Old-Growth Forest Report[67] will be a good start on fulfilling Executive Order 14008 pledging "to achieve the goal of conserving at least 30 percent of our lands and waters by 2030.[68]" Further identifying additional forest lands to be protected will be necessary to reach that goal and moreover achieve the 50 percent conservation of the biosphere by 2050 as pledged in the Paris Climate Accords[69] and that scientists warn us must be protected to prevent ecosystem collapse.[70]

We disregard this warning at our own peril.

Thank you for your attention,

Frank Toriello
President
We Advocate Thorough Environmental Review

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