NEW JERSEY FOREST WATCH

Summary of Science Debate Issues Involving Logging

There are at least eleven key science-based issues surrounding climate change mitigation, logging, wood removal, habitat, fire prevention and forest ecloglcial services issues, which have been contentious.

The eleven issues are.

1. Young Forest Initiative (YFI)
2. Bird Habitats
3. Carbon Storage and Sequestration – Young vs. Old Forests
4. Forest Regeneration
5. Proforestation
6. Removal of Wood from the Forest
7. Thinning for Fire Protection
8. Carbon Storage in Wood Products
9. Effectiveness of Afforestation and Reforestation
10. Logging to Reduce Leakage (logging NJ to reduce logging in other states)
11. Protection of Soil and Water

It is imperative that the members of the legislature and their staffs who will create legislation have an understanding of these topics. Below is a short tutorial on the positions and arguments of both sides on these key science issues. While the NJDEP has supported all the arguments in the left column these have also been advocated or omitted from relevant discussions by both local organizations such as NJ Audubon and the NJ Forestry Association and national forestry organizations.

Young Forest Initiative (YFI)[1]	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Populations of many songbird species needing early-successional habitats (ESH) are declining. ESHs have declined since their peak in the 19th and early 20th centuries.	Documentation of the decline of early-successional species is almost invariably based on a very recent baseline, generally dating to the 1960s or later. Using a mid–1960s baseline for wildlife populations is fundamentally misguided as it does not provide a sufficiently long-term view.
ESH refers to the plants (and the animals that rely on them) that develop in an area shortly after a	Every history of the region shows that at the time of the first Breeding Bird Survey the Northeast had unnaturally high amounts of early successional habitat such as

[1] Most material in this section is taken from Kellett, M. J., Maloof, J. E., Masino, S. A., Frelich, L. E., Faison, E. K., Brosi, S. L., and Foster, D. R. (2023). **Forest-clearing to create early-successional habitats: Questionable benefits, significant costs.** Front. For. Glob. Change. https://doi.org/10.3389/ffgc.2022.1073677

disturbance. This is also referred to as "edge habitat" and is often found along the forest edges of utility line cuts and other natural and artificial forest boundaries.	abandoned farmland and forests recovering from intensive clearing and historically anomalous levels of fire, grazing and other human disturbances. There is little acknowledgement that, although these species are truly declining, they were artificially elevated in their abundance by colonial and relatively modern land-use practices that were abandoned in the 19th and especially the 20th century. As a result, the 1960s populations of wildlife species that occupied and thrived on such habitats were likely inflated well beyond what they would be in natural forests before European settlement. This set the stage for a decades-long dramatic downward population trend due to recovering landscapes that are not yet within their true ecological trajectories. While early-successional habitats have declined since their peak in the 19th and early 20th centuries they are still widely represented, actively created by natural and human disturbances and likely undercounted. There is ample evidence that expanded wildland preserves (with appropriate deer and invasives controls) governed by natural disturbance regimes would provide early successional habitats at least equivalent to the natural conditions in which native species evolved.
The YFI website asserts that, "if we fail to actively create and renew young forest [m]any songbirds will rarely be seen or heard [and] the New England Cottontail and Appalachian Cottontail could go extinct."	This mid-1900s baseline has created a false sense of endangerment for early-successional bird species that: (1) although declining are still common and of "least concern;" (2) were historically uncommon (i.e., naturally rare, and at a natural population level); or (3) are non-native (i.e., did not occur in that State prior to European settlement and whose listing by that State as of conservation concern contributes to under-estimating populations of mature and old-growth forest species). A further problem is that forest-clearing advocates exaggerate the number of species that "require" or "need" early-successional habitat. A YFI publication claims that, "more than 40 kinds of birds need young forest," yet only 12 species of birds in the Northeast are actually considered early-successional forest specialists. Including species of questionable "conservation need" on state SGCN (species of greatest conservation need) lists has helped to validate and encourage forest-clearing and other intensive management to expand early-successional

	habitats.
Forest-clearing advocates assert that, in parallel with the presumed lack of "young" forests, there is an overabundance of "mature," and "even-aged" forests across the landscape. They contend that these forests do not provide an adequate diversity of habitats, and that "active management" can "restore" forest diversity and resiliency by "mimicking" natural forest disturbances and conditions.	Although foresters may regard 60 to 80 year old trees as "mature," or even "overmature," they are at far less than half their natural lifespan and likely at far less than 20% of their potential carbon accumulation. Most importantly, forests that are relatively even-aged will transition naturally toward old-growth and uneven-aged conditions if simply left alone.
Advocates contend that widespread and increased forest clearing will not have significant negative environmental impacts and can even benefit species associated with mature and old-growth forests.	There is ample evidence that such clearing will result in the loss of mature forests and future old-growth habitats, reduced connectivity among forest patches, an increase in edge habitats, the spread of invasive species, and deleterious effects due to mechanical disruption of the soil and species isolation. These forests host vast networks of plant roots and mycorrhizae, which may link trees to each other and allow the transfer of resources between mature trees. There is evidence that millions of species of fungi and bacteria swap nutrients between soil and the roots of trees in an interconnected "wood-wide web" of organisms. "Resetting" a forest to age "zero" by clearing it reduces ecological complexity immediately because it prevents the full expression of structural and ecological diversity as well as myriad ecosystem services. Managed forests have been found to have as much as three times more invasives than fully protected national parks or wilderness areas.
	Forest-clearing is not equivalent to natural disturbances; it has significant costs in biodiversity, carbon accumulation, and other ecosystem services; and because of soil disruption, dramatically reduces the possibility of recovering old-growth forest ecosystems dramatically. Moreover, unlike the conservation of mature and old-growth forests, creating and/or maintaining (every 10– 12 years) early-successional habitats requires a permanent resource-consuming commitment of intensive management to replace openings lost to forest succession. Such artificially created "restoration" areas are expensive to maintain and there is no assurance that adequate

	funding will continue to be available. Furthermore, loggers cannot make money harvesting young trees, so the likelihood is that—instead of rotating cuts on already disturbed areas—forest managers will simply continue to open up new areas of mature forest to logging. These are serious disadvantages that argue against the current clearing of established natural forest ecosystems.
	The YFI has been developed and promoted to the public by organizations that are primarily traditional forestry and game species management interests, such as timber companies, federal and state forestry agencies, federal and state wildlife agencies and sportsmen's organizations. **All of these partners benefit from forest-clearing through increased profits from timber sales, larger agency budgets, more staff, direct payments for creating young forest habitat, or elevated populations of desired game species. Other organizations, such as NJ Audubon, benefit handsomely from payments and grants to develop logging plans and perform services associated with those plans.** Despite its wide-ranging and long-term implications, the campaign to clear mature forests for early-successional species was formulated by a small number of agency, academic, and special interest professionals, with little comprehensive research and analysis, controlled experimentation, strategic planning, monitoring and evaluation, or public involvement and accountability. This organized and aggressive campaign has confused the public and made it challenging for a range of scientists to engage in an open dialogue about an optimal and balanced approach that prioritizes climate stability, ecosystem integrity and public health. Yet, public awareness has grown regarding the evident impacts of forest-clearing projects on biodiversity, climate change, and natural green spaces and, in turn, so has public opposition to these projects.
Bird Habitat[2]	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Forest-clearing not only "restores"	These claims are based on a few studies that are limited in

[2] Unless indicated otherwise, material in this section is taken from Kellett, M. J., Maloof, J. E., Masino, S. A., Frelich, L. E., Faison, E. K., Brosi, S. L., and Foster, D. R. (2023). **Forest-clearing to create early-successional habitats: Questionable benefits, significant costs.** Front. For. Glob. Change. https://doi.org/10.3389/ffgc.2022.1073677

early-successional bird species whose populations are in decline, but also benefits many forest interior species.	their targeted species, timeframe, and geographic scope, and rarely examine alternative hypotheses. For instance, although interior forest bird species may use available early-successional habitats to some extent, **there is little evidence that such habitats are favored or necessary for their survival.** Despite 14 years of logging on Sparta Mountain the DEP has yet to show the return of a single nesting pair of golden-winged warblers, the poster bird for this project and has declared that several logged sites failed to produce the desired ESH, while others have regrown past that stage but are not being maintained.[3] In NJ there is no scientific evidence to date that such forest-clearing efforts are effective in increasing Golden-winged Warbler populations. "**It appears that the New Jersey Golden-winged Warbler population is declining despite the availability of habitat, which suggests that threats outside of the state maybe driving declines (S. Petzinger, pers. comm.)**"[4] Creating and maintaining ESH is expensive and without its own funding the only tool available to the DEP is to log and sell mature trees, so it continues to do this regardless of the results. Basically, this is a DEP science experiment. Numerous special concern, threatened, and endangered wildlife species depend upon mature and old-growth forests and their ecosystem services. These species include migratory birds such as the Cerulean Warbler and Wood Thrush and permanent residents such as Red-shouldered Hawk and Barred Owl. The fragmentation of forests, particularly with roads and other human intrusion, can result in the decline of forest interior species. This can have significant impacts on the abundance, species richness, and community dynamics of both migratory and permanent-resident bird species. Much[5] of the justification offered for logging of NJ public forests has been to create early successional/young forest habitat (ESH) for birds, attributing population declines of ESH-breeding birds to lack of this habitat. However,

[3] NJDEP communications obtained through OPRA request

[4] Roth, A. M. Rohrbaugh, R. W., Will, T., Swarthout, S. B., and Buehler, D. A. (2019). Golden winged Warbler Status Review and Conservation Plan. 2nd Edition. Available online at: https://gwwa.org/wp-content/uploads/2022/08/GWWA_Conservation-Plan_191007_low-res.pdfpage 1-55

[5] The following material is from Dr. Sharon Wander's proposal to the NJFTF, **Protect Nesting Habitat for Forest-Interior Breeding Bird Species on Public Land in New Jersey**

	clearing mature forests does much more harm than good to birds of NJ. Since 1970, Eastern Forest bird populations have declined by 166 million, with 63.5% of species exhibiting losses, including 31 of New Jersey's 59 forest bird species. Of NJ forest birds, 2 are State Endangered (E), 2 are Threatened (T), and an alarming 21 are Special Concern (SC). ESH bird species include 3 E, 1 T, and only 4 SC. Obviously, forest-breeding birds need at least as much habitat protection as ESH species. It makes no sense to log the decades-old habitat needed by one group of declining species to create, for another group, habitat of short-lived effectiveness. (The number of species using ESH created by logging at Sparta Mtn. WMA starts to decline after only 3-4 years). Further, many NJ forests are so severely degraded they cannot support the normal complement of breeding birds. Overabundant deer have greatly impacted the species composition and abundance of forest understory vegetation in central NJ and "pose a significant threat to forest health and plant regeneration throughout [NJ]." The resultant loss of cover, nesting sites, and food sources, combined with effects of invasive plant species on vegetation structure, has reduced abundance of ground- and mid canopy-nesting forest birds in NJ. So, with forest-breeding birds facing habitat losses at least as serious as those of ESH-breeding species—and with many more Species of Concern involved—further conversion to ESH of forest nesting habitat must be restricted — particularly when NJ owns thousands of acres of open fields (notably on WMAs) where ESH could be created relatively quickly. Also, some 950,000 acres of forest in NJ is privately owned and ESH is likely being created on much of this acreage through Forest Stewardship Plans. Therefore, management activities on publicly owned forests in NJ that would temporarily or permanently reduce the area of nesting habitat for forest-interior breeding birds should be restricted. Any management to create ESH by mimicking natural disturbance within maturing forests (both for ESH-breeders and to provide habitat heterogeneity for forest breeders) must be small-scale (suggested ≤3 acres), implemented without the use of heavy machinery, and not involve killing of large trees or removal of wood. It is also important to understand that habitat has been lost for ESH species not only through forest maturation, but through the almost TOTAL loss of insect food in forest-edge and hedgerow habitats owing to the replacement of native shrubs by invasive species such as Autumn Olive and Multiflora Rose. In his book The Nature of Oaks, Dr. Doug Tallamy reports that he and his students compared

	caterpillar (i.e., bird food) biomass in native hedgerows (which were extremely difficult to find!) vs. invasive-dominated hedgerows.[6] They recorded 96% less biomass in the latter. With virtually EVERY YARD of the thousands of miles of hedgerows and forest edges in NJ severely degraded by invasive species, the many ESH birds that use them have lost a catastrophic amount of usable habitat. This is likely at least as important a factor in their declining populations as the purported lack of age diversity in our forests. Not all species thrive under a closed forest canopy, but a no-harvesting approach does not compromise efforts to support these species. A good example is the Tranquility Ridge habitat restoration project where openings usable by Timber Rattlesnake and Golden-winged Warbler were created at a reasonable cost by girdling trees without requiring roads, skid trails, soil compaction and rutting or the introduction of invasive species on equipment. Over 17,000 native shrubs and wildflowers were planted in openings. Monitoring has documented subsequent habitat use by both the rattlesnake and the warbler. Past arguments for improving biodiversity by clear cutting have cited an increased number of species that utilize such environments, but the fact is that **nondestructive approaches can be used to achieve similar results.**[7]
Active management defends against climate change and provides critical wildlife habitat	A 2019 report from the National Audubon Society[8] found that two-thirds of North American bird species will be vulnerable to extinction if global temperatures are allowed to rise at the current rate. The report states: "By stabilizing carbon emissions and holding warming to 1.5°C above pre-industrial levels, 76 percent of vulnerable species will be better off, and nearly 150 species would no longer be vulnerable to extinction from climate change." The only way to reduce global warming is by reducing carbon in the atmosphere by a combination of reducing new emissions and absorbing the carbon in the atmosphere through plant sequestration and ocean absorption. We cannot control ocean absorption of carbon but we can control and optimize plant absorption of carbon by maximizing leaf areas and underground carbon in

[6] Richard, M., D.W. Tallamy, and B.W. Mitchell. 2018. Introduced plants reduce species interactions. Biol. Invasions https://link.springer.com/article/10.1007/s10530-018-1876-z

[7] Leslie Sauer, **Climate Emergency Management of NJ's Public Forests: Proforestation and Ecological Restoration -- Perfect Together!** Leslie Sauer is the author of The Once and Future Forest, a Guide to Forest Restoration Strategies, Island Press

[8] https://www.audubon.org/climate/survivalbydegrees

	forests and elsewhere. Leaf area and soil carbon are maximized by allowing all trees to grow to maturity and reach their largest size. Mature forests contain more carbon per acre than young forests. (See information on the science of sequestration elsewhere in this document). Therefore, arguments that it is necessary to clear cut large swaths of intact forest for the benefit of bird species – actions that will add carbon to the atmosphere and reduce sequestration – are refuted by the National Audubon findings that these same actions will harm two-thirds of all North American bird species. Recent scientific studies of forest management practices show remarkable consistency in demonstrating that **managed forests perform worse** in every aspect of ecological health: reduced carbon sequestration in vegetation and soils, reduced fire prevention/resiliency, reduced biodiversity, increased destruction of bird and animal habitats, reduced resistance to invasive species, destruction of vernal pools, disruption to soils and their essential network of mycorrhizal fungi and increased harms to water supplies including increased pollutants/siltation, decreased purification and increased storm runoff.[9]
Carbon Storage and Sequestration – Young vs. Old Forests	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
The ability of a forest to sequester or pull carbon out of the atmosphere reaches a peak where it's kind of *neutralized* at some point. Rick Lathrop of Rutgers conducted a study in 2011[10] looking at this and assessed the carbon sequestration potential of a lot of our forests. He found that at about age 70 most of our forests in NJ are going to peak at their potential to sequester carbon. (Citation from study "A typical New	A March 9, 2023 article in The Conversation by Drs. Beverly Law and William Moomaw states:[11] "The carbon dioxide that human activities are releasing into the atmosphere today will elevate global temperatures and raise sea levels for 1,000 years or more, unless societies can find ways to remove it. In its 2022 climate assessment report, the Intergovernmental Panel on Climate Change concluded that protecting existing natural forests was '**the highest priority for reducing greenhouse gas emissions**.'" [12] "Conserving forests is one of the lowest-cost options for

[9] Summary of findings from many of the sources cited in this document and other peer-reviewed science studies used as source material for proposals to the NJ Forestry Task Force.
[10] Assessing the Potential for New Jersey Forests to Sequester Carbon and Contribute to Greenhouse Gas Emissions Avoidance, Richard G. Lathrop, Jr., March 2011
[11] https://theconversation.com/the-biden-administration-has-called-for-protecting-mature-us-forests-to-slow-climate-change-but-its-still-allowing-them-to-be-logged-199845
[12] https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter02.pdf

Jersey forest is predicted to be a carbon sink for the first 75 years. A typical NJ forest is predicted to reach its maximum carbon sequestration at 75 years with density of approximately 150 tons/ha. After the peak growth state, the amount of carbon stored in the forest stand starts to decline as the stand matures and thins in tree density. Assuming a 100 year time frame, we estimate approximately 140 tons/ha of carbon stored.") The Lathrop study of annual carbon flux was simulated using a forest **ecosystem** carbon flux model, IntCarb (Song and Woodcock, 2003). (p 14). The IntCarb model simulates the growth of a forest on land that has been cleared and allowed to regenerate back to forest. Young forests sequester carbon faster than old forests. Managing tree densities through forest management maximizes carbon sequestration.	managing carbon dioxide emissions, and it doesn't require expensive or complex energy-consuming technologies. In our view, **sufficient science exists to justify a moratorium on harvesting mature trees** on federal lands so that these forests can keep performing their invaluable work." Described below is the result of research in 2022 that unequivocally proves that maturing and mature forests store and sequester more carbon per acre than young forests and that young forests are usually net carbon emitters for decades. Sequestration does not reach a peak where it is neutralized. Controversy and confusion over the age at which forests sequester the most carbon arises because young trees grow in height faster than old trees and the rate of sequestration in a young forest can be very high. However, the key factor is volume of carbon, not rate of storage. **It is not how fast carbon deposits are made but how large those deposits are. Young forests are limited in the size of their deposits by their leaf area.** (M. Anderson) **Three factors in existing studies have likely contributed to the long-held theory that younger forests have greater NPP (added carbon). One is that the underlying theory was based on dense pure [single species] stands of forests. The second is that the theory is based on laboratory microcosms and the third is that findings were based on observations of older, mostly arid, coniferous evergreen forests and assumed to be universal among temperate forests.** (Gough & Curtis) Recently published, peer-reviewed science has established that unmanaged forests can be highly effective at capturing and storing carbon. It is now clear that trees accumulate carbon over their entire lifespan and that old, wild forests accumulate far more carbon than they lose through decomposition and respiration, thus acting as carbon sinks. This is especially true when taking into account the role of undisturbed soils only found in unmanaged forests. **Older temperate deciduous forests store and sequester more carbon per unit area than younger forests**. (Mark Anderson) An analysis of 18,507 forest plots in the Northeast found that old forests (greater than 170 years of age) supported the largest carbon pools and the highest simultaneous

levels of carbon storage, timber growth, and species richness (Thom et al. 2019).

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**. (Luyssaert)

Intact forests are the most carbon-dense, and if allowed to grow to their greatest potential they will contribute orders of magnitude more removal of greenhouse gases than working, managed forests. Moreover, when starting over with seedling trees after forest harvest, it will take many decades for an acre to recover its carbon biomass and uptake rates. **We cannot wait for young forests to get established; instead we should protect today's existing intact forests.** (Moomaw)

The theory has always been that old forests are net carbon sources to the atmosphere or they are net zero. If they're sources it means they give off more carbon dioxide to the atmosphere than they take up. And that was based on some fairly crude measurements decades and decades ago. We **measured** diameters and took tree cores to get their age and **measured** the height with lasers. We found that these forests are much more important than people imagined. Mature and old forests are the workhorses. They take up more carbon annually, and they have a lot more stored in the wood. That was astounding and it put more people to work on trying to look at different age classes of forests to see what was happening at different stages of development.

We found that this site [a young forest] was a net carbon source (not taking up as much carbon for photosynthesis as is given off by respiration from the soil and the trees) for about the first 20 years. People are being told or thought that young trees grow fast and vigorously **but when you look at the [young] forest the net of all the respiration and photosynthesis makes them a source.** Why is there less photosynthesis in this forest? The easy way to think of it is you look at the leaf area and you see all this open space on the ground – which means the forest has not reached canopy closure yet. So, that's what they (young trees) have to photosynthesize with. They're not taking up as much carbon, but they are still releasing a lot from the soil, and they are still respiring maybe 80% of

	what they take up. (B. Law) Young temperate forests growing on previously logged areas are **<u>net emitters of carbon for decades as an aftermath effect of logging</u>**. The tree roots decompose over decades and the soil in logged areas continues to lose carbon for decades (40% of forest carbon is in soil). (B. Law) The often-touted fast growth and high sequestration **rate** of young eastern forests (optimized at 30–70 years) helps the forest return to its previous state as quickly as possible, but recovery is a two-step process. First, the forest must regrow its leaf area and return to being a carbon sink (10–30 years). Second, because the forest has been losing carbon, it must make up for those losses before it reaches neutrality (i.e., breaks even). If we assume it takes an equal amount of time to replace the carbon as it did to sequester it originally, then after 20–60 years the forest may just have compensated for the early losses from respiration and will again start to sequester "new" carbon. **<u>Comparing this cycle to that of an old forest slowly and steadily sequestering carbon every year over the same timespan, *the old forest will remove considerably more carbon from the atmosphere despite its slower growth rate.*</u>** (Mark Anderson) A single big tree can add the same amount of carbon to the forest **<u>every year</u>** as the cumulative total contained in an entire mid-sized tree. (Stephenson, N.L., et al. Rate of Tree Carbon Accumulation Increases Continuously with Tree Size.) The findings of the Rutgers Lathrop study - that NJ forests are net sinks for the first 75 years of life and then the amount of carbon stored in the forest stand starts to decline - are clearly disputed by every study cited above. The findings by Dr. Beverly Law, based on actual measurements, that young forests are generally carbon emitters for their first few decades are particularly antithetical to the Lathrop study. It is also important to note that the Lathrop report is based on a model and not on actual measurements It states: "While the IntCarb forest carbon dynamics model is useful in exploring various scenarios, it is still just a model (i.e., our best approximation of reality) and the results should be assessed with a certain degree of skepticism. For instance, the IntCarb model suggests an approximately

	25% decline in carbon stocks after forest stands reach maturity till some equilibrium is reached at age 300+ years. **Taken to extremes, these results might be misconstrued to suggest a lower value be placed on older growth forests as compared to younger age forests in terms of their carbon sequestration capacity."** It would seem likely that the IntCarb model is based on earlier research whose wide applicability has been discredited, as described above.

Forest Regeneration	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Seventy to 100 year old forests with high stem density have a lot of trees crowding each other and not a lot of sunlight reaching the forest floor, preventing regeneration, because only certain species could regenerate under the canopy with limited light. NJ forests are of even age and will mature at the same time and will not have another new generation to replace them.	Several arguments disprove the pro-logging position. First, intact canopy mature forests have been practicing the prescription of **proforestation** and regenerating perfectly well for over 350 million years without the aid of humans. If this had not happened we would not have forests today.[13] Second, a walk through any intact canopy forest that has not been disturbed will show trees with a wide variety of ages, ranging from small saplings to 100+ year olds. Third, the argument for regeneration is often made in regard to oaks, which are valuable timber and also support the widest range of biodiversity. The argument is that we have to cut down maturing 100- or 150-year-old oaks in order to grow new ones. However, oaks of this age will continue to thrive for centuries and will sequester far more carbon than young oaks (see section on carbon sequestration above). They are far more valuable to all forest life and to us than young oaks. Eighty- to 100-year-old oak trees are a keystone species at a prime age for carbon accumulation and resilience and a rare opportunity for future old-growth in this region.[14] Why would we cut down the most ecologically valuable trees in order to let new ones grow that will not be of similar value for 100 years? This sounds like the excuse used in Vietnam for war crimes: "We had to destroy the village in order to save

[13] https://en.wikipedia.org/wiki/Forest#Evolutionary_history

[14] Eisen, K., and Barker Plotkin, A. (2015). Forty years of forest measurements support steadily increasing aboveground biomass in a maturing, Quercus-dominant northeastern forest. The Journal of the Torrey Botanical Society. Vol. 142, No. 2 (APRIL-JUNE 2015), pp. 97-112.

	it." The fact is that young oaks and other trees do sprout even in intact-canopy forests. Small disturbances create small pockets/light gaps of open area that do support regeneration. Often, however, we see an almost total lack of regeneration which is not surprising as virtually no sites in NJ meet advanced regeneration requirements - largely owing to deer herbivory. The biggest obstacles to regeneration today are deer that devour young trees and the increase in invasives that carpet the forest floor. Regeneration requires protecting forests against deer, not cutting down maturing oak trees. Until the NJ Division of Fish & Wildlife acknowledges the deer problem and seriously tries to reduce the deer herd to 10 deer per square mile, oaks and hickories will not regenerate. Deer are causing the conversion to sweet birch —even in the seed tree harvest (clearcut) areas. Forest gaps would regenerate with much greater diversity other than birch and maple if deer were under control. The Div of F&W assertion that "deer are not a problem on large state land holdings with ample hunter access," is not credible. Modern ecological study after study shows that deer are causing the forest regeneration problem. Any regeneration efforts will be useless if the NJ Div of F&W continues to ignore the overabundant deer problem.[15] A recent study by the US Department of Energy has shown that it would take 151 newly planted oak trees 16 years to equal the yearly carbon capture of one 40-foot oak tree, yet today we are cutting down 80 to 175-year-old trees on public lands.[16]
	The following observations were made by members of the NJHC Natural Heritage Committee on sections of Sparta Mountain scheduled to be logged. Stand 18, which was logged in 2018 was analyzed in July 2019 and found: Tree-ring data from stumps showed many very old trees (at least 19 were between 92 and 168 years old, 13 of which were red oak - this follows the consistent DEP pattern of harvesting areas with mature oak trees because of their high value to loggers who must find the effort to be

[15] Comments from Emile DeVito at 3/28 NJDEP stakeholder meeting on NWLS strategy
[16] We Can't Plant Our Way Out of the Climate Crisis, https://www.treeib.com/carbon-storage-in-large-trees-by-robert-leverett

	financially worthwhile) There was a very wide age range of trees, disputing the DEP/NJAS FSP claim that NJ forests are all of the same "middle" age of 50-70 years. This forest was decades older than what the WMA stewardship plan claims. Many saplings and understory trees were also removed by the logging action, and will not return due to deer browse. In October 2021, the same team analyzed Stand 9A, prior to its being cut in January 2022, and found: The area was one of the oldest, most intact forest stands at Sparta Mountain WMA. Several oak trees were 99 to 129 years of age, again demonstrating the wide range in tree ages. (It was not possible to determine the age of as many trees as on Stand 18 because they had to be cored). Invasive plants were virtually absent. Opening the canopy always increases their presence, which is costly and difficult to control. Many seedlings and tall saplings of red and chestnut oak were present. These were cleared as part of the logging and will not return due to deer browse. Many of these young trees were above the deer browse line, challenging the assertion that logging is necessary to promote young oak. As canopy trees died naturally these young trees were already present on this stand growing into another generation of oaks on their own. Logging causes the exact opposite of its touted benefit. It removes the young forest already in place and prevents its return by making more foliage available to deer.
	The silvicultural approach has been to log in order to create new young forests. Valuable maturing habitats are sacrificed to create a younger forest stage that over time accrues an invasive understory and also takes more than 80 years to break even on carbon sequestration. These treatments **rarely produce any net increase in oaks**. An especially serious problem with this approach is that relatively undisturbed sites are selected in order to make invasive species management easier. The alternatives primarily entail better gap management. Many deer exclosures have oak seedlings and saplings **despite heavy canopy cover**. Prescribed burning can stimulate the sprouting of oak seedlings under canopy as well, though they would be vulnerable where deer are not

	managed. Exclosures may be needed.[17]
Proforestation	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Proforestation would not work in a state like NJ where we have so many stressors that are on our forests, just from the adjacency of the population, bringing in invasive species and other problems.[18] "Our restoration focus is tied to a focus on landscape-scale conservation. Especially in an era of climate change, we need to restore the resilience of America's forests to disturbances of all kinds. The treatments needed will meet our shared vision of healthy, resilient forests and local economic opportunities." Tom Tidwell, chief of USFS.	"Proforestation"[19] is a prescription for forest management in which forests are protected from logging so that they can achieve their highest ecological potential. This is in contrast to "sustainable" forestry in which the goal is to foster continuous production and removal of lumber, firewood, or other products. Proforestation instead requires that all the forest resources remain on site, and that there be no removal of trees or other forest resources. These forest resources, including trees, understory vegetation, herbaceous plants, ferns, mosses, fungi, etc. are needed to restore the forest ecology. Fallen, dead, charred and diseased trees provide nutrients for other trees and plants to grow, and create the foundation upon which the entire forest's ecology is based. They eventually become sequestered as soil carbon, providing nutrients to other organisms and building the soil food web, while incurring very limited loss to the carbon pool. Proforestation has worked very well in NJ. As demonstrated in the GWRA's historical data on the increase in sequestration, this was all based on letting existing forests grow and increase their tree size and leaf area. The GWRA 2020 Report stated:[20] *Terrestrial carbon sequestration in New Jersey has incrementally increased over the last decade. Between 2006 and 2018, New Jersey realized an increase of 2.1 MMT CO2e in carbon sequestration. **The slight gains in sequestration totals are attributed to carbon accumulation in biomass and soil due to continued maturation of New Jersey forests** and wetlands.* (emphasis added) It goes on to say that the net gain in sequestration could have been much greater but was limited by decreases in

[17] Leslie Sauer, **Climate Emergency Management of NJ's Public Forests: Proforestation and Ecological Restoration -- Perfect Together!** Leslie Sauer is the author of The Once and Future Forest, a Guide to Forest Restoration Strategies, Island Press
[18] NJ Audubon video
[19] All material in this section (unless cited otherwise) is taken from a paper by Leslie Sauer, **Climate Emergency Management of NJ's Public Forests: Proforestation and Ecological Restoration -- Perfect Together!** Leslie Sauer is the author of The Once and Future Forest, a Guide to Forest Restoration Strategies, Island Press
[20] https://www.nj.gov/dep/climatechange/docs/nj-gwra-80x50-report-2020.pdf

	acreage of upland forests, cropland, grassland and wetlands. **The fact is that the vast bulk of any increase in sequestration in NJ forests will come from proforestation**. The IPCC has also acknowledged the principle of Proforestation. In its 2022 Working Group II Contribution to the Sixth Assessment Report it states, "***protection of existing natural forest ecosystems is the highest priority for reducing GHG emissions*** *(Moomaw et al., 2019).*[21] Recent scientific studies of forest management practices show remarkable consistency in demonstrating that **managed forests perform worse** in every aspect of ecological health: reduced carbon sequestration in vegetation and soils, reduced fire prevention/resiliency, reduced biodiversity, increased destruction of bird and animal habitats, reduced resistance to invasive species, destruction of vernal pools, disruption to soils and their essential network of mycorrhizal fungi and increased harms to water supplies including increased pollutants/siltation, decreased purification and increased storm runoff.[22] **The Focus of Management in Our Public Forests Should Be Ecological Restoration.** Ecological restoration seeks to restore a site to a natural successional trajectory. While foresters might be counting and sizing trees, restoration is more focused on the ground. What is reproducing? What is not? Is succession arrested by over-browse by deer or overwhelmed by invasive species? Where is this forest headed, and what would it look like if allowed to mature naturally? The goal is to achieve the highest level of ecological development on each site.
Proforestation has often been defined as a total absence of any active management.	**Proforestation does not limit ecological restoration activities** management as typically described by foresters. The only tool that proforestation removes from the forest manager's tool box is the ability to remove the trees that are the most important means of combating climate change: the bigger, older trees. When viewed from an ecological lens rather than a timber focus, proforestation places no limitations on fostering native species and/or addressing concerns related to forest health and safety.

[21] https://report.ipcc.ch/ar6/wg2/IPCC_AR6_WGII_FullReport.pdf, page 303
[22] Summary of findings from many of the sources cited in this document and other peer-reviewed science studies used as source material for proposals to the NJ Forestry Task Force.

	Many Forest Stewardship Plans (FSP's) for private land involve no harvesting at all and focus instead on management of invasive species and other non-timber concerns. It is true that proforestation protects older and larger trees and older forests from logging because it is focused on maintaining and expanding carbon sequestration and storage. On the other hand, removing young, small trees that likely do not yet even store carbon is an acceptable practice where control of woody material is necessary to address habitat or other concerns. Safety also may at times require removing some larger trees, but to the extent feasible, they should be left behind on the ground (perhaps cut up and strewn in pieces) to slowly convert into soil. **Pests and Invasive Species Management.** The common methods for managing invasive species may involve mechanical removal as well as Integrated Pest Management (which may include use of herbicides/pesticides). Addressing the problem of invasive trees with logging would only exacerbate any existing problems with invasive species. Logging roads are also notorious pathways for invasive plants and ATV's. Logging to address bark beetles has been found to be less effective than maintaining a largely unmanaged forest. (See New Jersey Forest Action Plan.) Infected and infested species should be treated on-site to avoid spreading the problem.
Removal of Wood from the Forest	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Supports removal of cut wood for sale. Eileen Murphy of NJAS stated in her presentation to the joint Senate and Assembly Environmental Committees on March 1, "If wood can be removed then might as well sell it." Anjuli Ramos, Director NJ Chapter of Sierra Club made a similar statement in her presentation to the NJ Sierra Club.	**Proforestation[23] also protects the forest from the negative impacts of logging.** Perhaps most importantly, proforestation keeps all wood on site, which is a crucial component of restoration and soil building. Trees and branches resting on the ground are the primary food of the soil fungi that characterize the older forest with the highest levels of sequestration and water retention. Up to 40% of the carbon stored in a forest is below ground, in the roots and soils. Not only are deer and invasive increases slowed when logging stops, the soil is no longer being repeatedly

[23] All material in this section is taken from a paper by Leslie Sauer, **Climate Emergency Management of NJ's Public Forests: Proforestation and Ecological Restoration -- Perfect Together!** Leslie Sauer is the author of The Once and Future Forest, a Guide to Forest Restoration Strategies, Island Press

damaged by heavy equipment and grading access.

Soils, like forests, succeed over time as they mature. Young soils are typically bacteria-dominated but the older forest soils become increasingly fungi dominated. Every disturbance of the ground however, such as rutting and compaction caused by mechanized equipment, impacts this process negatively and allows bacteria to become dominant again. Nutrients are then released more rapidly, fueling growth of invasive species and retarding the development of rich native understory and ground layers. Deer browse may suspend this state indefinitely. When its soils are undisturbed by logging and the removal of wood, the forest can mature to its highest levels of carbon storage and water retention as well as biodiversity.

A USGS study of clearcutting in the Catskills found it caused large releases of nitrates and aluminum in stream water resulting in 100% mortality of brook trout and increased water purification costs.[24]

Ecological management recognizes that - like forests - soil food webs succeed over time. A complex array of amphibians, invertebrates and other soil organisms is a key component of native soils and should be protected. The basic rule with soil is: Don't disturb it - protect it, and support it with wood and other high-lignin food to foster the maturing soil food web.

Hazardous, Downed, and Dead Trees. The only difference in the proforestation management of trees that pose a hazard or that have just simply died is the need to keep all wood and woody debris on site rather than removing it. Wood retention is vital for rebuilding the soil and maintaining high levels of sequestration. While a standing dead tree may be a fire hazard, logs and branches that rest on the ground are sponges, and become "nurse logs" for newly sprouting tree seedlings. Where safety is a concern and many trees have been downed, on-site work is required to make sure that each trunk is on the ground rather than propped in the air. Larger branches may have to be managed for greater safety. In some locations, a sequence of brush piles can be created to provide valuable shelter for birds, small mammals, reptiles and amphibians.

[24] https://www.usgs.gov/publications/effects-forest-harvesting-ecosystem-health-headwaters-new-york-city-water-supply

Thinning for Fire Protection	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Proponents of thinning claim that NJ forests throughout the state are choked with carbon and, therefore, at risk from massive and catastrophic wildfires such as seen in Western States. They argue that to reduce this risk we must thin these forests and use prescribed burns.	Thinning is oversold as a treatment and does little to stop wildfire or make it burn less intensely. In fact, the major driver of the Western fires is climate change and long-term drought, not unthinned or unmanaged forests. Thinning actually causes forest fires to burn more intensely and destructively, while unmanaged forests, especially those with old mature trees fare the best in forest fires. A 2016 review[25] of 1500 fires found that **fire severity was higher in areas treated by fuel reductions compared to wilderness and parks where no logging is allowed.** **Thinning removes much more carbon than fire.**[26] Mechanical thinning results in a substantial net loss of forest carbon storage, and a net increase in carbon emissions that can substantially exceed those from wildfire emissions. Even in a large, intense wildfire, only about 2% to 3% of the carbon in the trees is actually consumed and released to the air. ***Logging conducted as commercial "thinning," under the rubric of fire management, emits about three times more CO2 than wildfire alone***. Broad-scale thinning (e.g., ecoregions, regions) to reduce fire risk or severity results in more carbon emissions than fire, and creates a long-term carbon deficit that undermines climate goals. **Larger areas are removed than would normally burn.** To make thinning operations economically attractive to logging companies, commercial logging of larger, more fire-resistant trees often occurs across large areas. However, the amount of carbon removed by thinning is much larger than the amount that might be saved from being burned in a fire, and far more area is harvested than would actually burn. **Thinning promotes intense burning.** It reduces the cooling shade of the forest canopy, creating a hotter, drier, and windier microclimate, and leaving behind logging "slash debris" made up of the easily combustible tops, branches and needles of the previously standing trees.

[25] https://esajournals.onlinelibrary.wiley.com/doi/pdf/10.1002/ecs2.1492

[26] Cited in letter: *Over 200 Top U.S. Climate and Forest Scientists Urge Congress: Protect Forests to Mitigate Climate Crisis* https://johnmuirproject.org/wp-content/uploads/2020/05/PressReleaseANDClimateANDForestScientistLetterMay2020.pdf

	Thinning on today's large scale dries out the land and increases fire risk. In addition, logging machinery spreads easily ignitable, highly combustible invasive grasses. Thinning trees, including overstory trees in a stand, can increase the rate of fire spread by opening up the forest to increased wind velocity, damage soils, introduce invasive species that increase flammable understory vegetation, and impact wildlife habitat. **Thinning removes the most fire resistant trees.**[27] Most of the carbon removed from the forest in "thinning" logging projects is in the form of mature/old trees. This means that nearly all of the wood, and carbon, killed and removed from forests by thinning for "fuel reduction" is literally non-combustible in a forest fire. While moderate to high severity fire can kill trees, most of the carbon remains in the forest as dead wood that will take decades to centuries to decompose. **There is a weak relationship between areas logged/thinned and extent and severity of fires.** The Congressional Research Service, in a review of thinning and fuel reduction effectiveness, came to the very same findings: "From a quantitative perspective, the CRS study indicates a very weak relationship between acres logged and the extent and severity of forest fires. … the data indicate that fewer acres burned in areas where logging activity was limited." It also stated, "Logging does little to reduce fuel loads."[28] Forests protected from logging, and those with high carbon biomass and carbon storage, more often burn at equal or lower intensities when fires do occur. Even if thinning were effective at slowing fires and reducing intensity **there is no way to ensure that a given thinning project will be implemented in an area where a future fire will occur**. Most thinning in Western states has not coincided with later fire events and, therefore, has had no effect on fires. **NJ Forests at much less risk than Western Forests** There are big differences between the Western forest

[27] Open Letter to President Biden and Members of Congress from Scientists: It is essential to Remove Climate-Harming Logging and Fossil Fuel Provisions from Reconciliation and Infrastructure Bills
https://johnmuirproject.org/wp-content/uploads/2021/11/ScientistLetterOpposingLoggingProvisionsInBBB_BIF4Nov21.pdf
[28] https://crsreports.congress.gov/product/pdf/R/R40811/12

	ecosystem and New Jersey's forest ecosystems: New Jersey forests are not suffering from a 1,000 year drought and do not have nearly as much dry tinder. All counties in Central and Northern NJ (counties north of Ocean and Burlington) with the exception of Middlesex have less than 100 properties with at least a 0.2% annual burn probability from wildfire.[29] New Jersey forests, outside the Pine Barrens, have not had a long history of natural wildfires followed by recent years of suppression. Intact contiguous forests have been critical to protecting water and wildlife in New Jersey. Cutting 10-acre holes in the canopy is highly destructive and has not shown to be of any value in fire suppression.
Carbon Storage in Wood Products	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Carbon storage in wood products is a viable climate change solution.	No scientific evidence supports the practice of increased logging to store more carbon in wood products - as a natural climate solution. In the United States in 2015, 76% of the annual domestic harvest input to the wood products pool was offset by releases.[30] Carbon removed from trees - whether stored in products or burned or dumped into landfills - cannot sequester further carbon and, therefore, cannot contribute to NJ GHG reduction objectives, which are based solely on emissions and sequestration. The potential carbon sequestration from all the trees cut to produce wood products is forever lost. Converting mature and older forests to younger forests results in a significant loss of total carbon stores, even when wood products are considered. For example, a comparison of carbon stored in an unharvested versus harvested mature forest using the Forest-GHG life cycle assessment model to track harvested carbon from forest to landfill shows that the unharvested forest has a much

[29] First Street Foundation: 5th National Risk Assessment: Fueling the Flames
https://firststreet.org/research-lab/published-research/article-highlights-from-fueling-the-flames/
[30] https://carbon2018.globalchange.gov/downloads/SOCCR2_Ch9_Forests.pdf

	higher carbon density 120 years later, even when carbon in wood products is summed with the post-harvest carbon storage.[31] Estimates comparing the carbon benefits of wood products to alternative materials have been found to overestimate the benefit by between 2- and 100-fold by not counting the full life cycle of carbon and the shorter durability of wood relative to alternative materials. (B. Law) A May 13, 2020 letter to Congress from over 200 top U.S climate scientists stated:[32] "The logging and wood products industries suggest that most of the carbon in trees that are logged and removed from forests will simply be stored in CLT (cross-laminated timber) and other wood products for buildings instead of being stored in forest ecosystems. However, this is clearly incorrect. Up to 40% of the harvested material does not become forest products and is burned or decomposes quickly, and a majority of manufacturing waste is burned for heat. **One study found that 65% of the carbon from Oregon forests logged over the past 115 years remains in the atmosphere, and just 19% is stored in long-lived products.** The remainder is in landfills (Hudiburg et al. 2019)."[33] As a result of wood waste and decomposition, the carbon stored long-term in harvested wood products may be a small proportion of that originally stored in the standing trees—**across the United States approximately 1% may remain in products in use and 13% in landfills at 100 years post-harvest**. Related processing and transport emissions may in some cases approach the amount of CO2e stored in long-lived solid wood products." (Ingerson)

[31] Creating Strategic Reserves to Protect Forest Carbon and Reduce Biodiversity Losses in the United States
Beverly E. Law 1,*, William R. Moomaw, Tara W. Hudiburg, William H. Schlesinger John D. Sterman and George M. Woodwell, Published May 11, 2022, https://doi.org/10.3390/land11050721
[32] *Over 200 Top U.S. Climate and Forest Scientists Urge Congress: Protect Forests to Mitigate Climate Crisis*
https://johnmuirproject.org/wp-content/uploads/2020/05/PressReleaseANDClimateANDForestScientistLetterMay2020.pdf
[33] https://clearcuttruth.greenoregon.org/wp-content/uploads/2021/02/Examining-OFRI-Claims-Carbon-Storage.pdf

Effectiveness of Afforestation and Reforestation	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Afforestation (planting trees in areas not previously forest) and Reforestation (planting trees in previously forested areas) are significant climate change solutions.	Conversion of old-growth forests to young plantations invariably reduces carbon storage, even when structural components in buildings are considered…forests continue to lose mass for three decades after disturbance. Although reintroducing forests to deforested regions will increase carbon storage, conversion of old-growth forests to younger forests under current harvesting and use conditions has added and will continue to add carbon to the atmosphere. Afforestation and reforestation, while helpful on open land, cannot store or sequester more carbon than existing forests on a per acre basis and cannot be used to justify harvesting of mature forests. A recent study by the US Department of Energy has shown that it would take 151 newly planted oak trees 16 years to equal the yearly carbon capture of one 40-foot oak tree, yet today we are cutting down 80 to 175-year-old trees on public lands.[34] Afforestation and reforestation are costly and labor intensive and can take years based on the amount of labor available. The NJDEP recently awarded $24.3 million in Natural Climate Solutions Grants to local governments and nonprofits to create, restore, and enhance New Jersey's green spaces and tree canopies in urban areas, salt marshes and forests. As part of this award, Trenton will get $1,336,125 in order to plant 1,000 saplings, or $1,336 per tree (there is no indication if this includes routine reviews for years to make sure the trees survive, which is always an issue with planting projects). On the other hand, the cost of retaining 1,000 mature trees on Sparta Mountain is zero dollars. Overall, this DEP program will cost $24.3M and will increase sequestration by 32,710 metric tons - an average of $743/ton. If NJ used this approach to achieve the 2.7MMT increase in sequestration called for in the GWRA 2020 Report it would cost a bit over $2B. (Admittedly, this is not a fair analysis as a good portion of the required sequestration increase will come from leaving existing forest alone, but it still shows how costly these programs are per ton of

[34] We Can't Plant Our Way Out of the Climate Crisis, https://www.treeib.com/carbon-storage-in-large-trees-by-robert-leverett

	sequestration versus stopping DEP's logging programs). Many planted trees are killed by deer browse and drought and need human intervention to save and protect them. Forests store and sequester much more carbon per acre for many many years than newly planted trees and cost nothing to maintain. We can't plant our way out of the climate crisis. The inescapable truth is that we need continuing help from our existing mature trees. There is a storage efficiency gained through their size. We need them for the carbon they are presently sequestering and for the amount they can continue adding if we keep them healthy. To be sure, planting is important, but keeping large trees standing and healthy takes on extra importance during this climate crisis.
Logging to Reduce Leakage	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
Logging to reduce leakage. USDA defines leakage as: Carbon "leakage" is the shift of emissions from one place to another due to efforts to avoid emissions. For example, if a timber producing country entirely curtails their timber harvesting, other countries may increase production to meet demand. Leakage can be quite significant but is very difficult to measure because of societal reliance on the forest system and use, rapid and global nature of market adjustments, and difficulty identifying cause and effect.[35] The argument is that the logging will take place anyway so logging locally is preferable as it reduces the cost and emissions from transportation of wood, reduces the negative impacts of logging on neighboring states and provides local jobs.	The debate over leakage is not based on science, it is a political issue. But it is still important to be included in this list of myths and false/misleading arguments because it is accepted by so many land managers. Actions such as the Young Forest Initiative (see above) and logging one's own state to reduce leakage are ploys developed by the forestry industry to give local supporters cover to increase local logging programs. The leakage argument is false and harmful for several reasons: First, while even the USDA admits it is impossible to ever quantify how much logging in one state reduces logging in other states it still implies this is a beneficial practice. The real answer to this question is that there is no decrease elsewhere because logging is a money making activity, not an ecological activity. No loggers or land managers in another state are ever going to say they will take a cut in revenue because of more logging in NJ. More logging in NJ will not result in less logging elsewhere. Second, this is not what the GWRA empowered. The NJ GWRA statute is focused solely on increasing sequestration in NJ and makes no mention of reducing leakage or cutting local forests to prevent the need to import wood from other states or countries. There is no legal justification for such practices. If anything, they are

35 https://www.fs.usda.gov/sites/default/files/Forest-Carbon-FAQs.pdf

	illegal since they work to reduce sequestration and violate the GWRA statute. In addition, if DEP wants to pursue practices such as preventing wood importation it would have to build the bureaucracy to do this, which it simply cannot do. The DEP needs to stick to fixing the sequestration problem in **New Jersey**. Third, leakage is only logical if one ignores all the associated harms from logging. Accepting logging to combat leakage is like saying a person who needs to lose weight must cut down on their caloric intake but it is acceptable for them to eat high calorie foods all around them because it prevents other dieters from eating them. The DEP is arguing that it is acceptable to destroy NJ public forests and accept harms to all the forest related ecological benefits (e.g., clean water) so other states don't have to bear such harms. These include harms to climate from increased CO2 emissions and reductions in sequestration; harms to the soil and vernal pools from mechanized logging; harms to most bird species, especially interior species requiring intact canopies (including nesting hawks and owls - which were observed and reported at Sparta just before logging); increased spread of invasive species into previously pristine areas, increased deer browsing habitat, harms to habitat for many animals such as amphibians (salamanders), bobcats and bears; harms to the essential network of mycorrhizal fungi - required for healthy forests and harms to water supplies including increased pollutants/siltation and increased storm runoff.
Protection of Soil and Water Resources	
Arguments for Logging (DEP et al)	**Ecologists' Arguments Against Logging**
The damages to soil and water from logging have been largely ignored or minimized by logging advocates.	A 2024 study by the Open Space Institute[36] of the water quality benefits of 21,000 forested acres across New Jersey, New York, and Pennsylvania in the Delaware Watershed that were permanently conserved found: • **Forests keep water clean.** Stream sampling studies found nitrogen levels spiked when forest cover levels fell below 66 percent. When forest cover is maintained at 70 to 90 percent or greater, streams and rivers stay healthier and cleaner, and wildlife thrives. • Protecting **forests along streams filters pollutants from the surrounding landscape**. Forestland protection is widely recognized as a strategy to

[36] Protecting Forests for Clean Water, https://www.openspaceinstitute.org/research/protecting-forests-clean-water

maintain clean water by preventing the passage of pollutants to waterways.

- Allowing protected land to return to forested conditions results in quantifiable reductions in pollutants.
- In largely forested headwaters, **loss of forest cover was most strongly correlated with reductions in water quality, rather than increases in upstream farmland or development**. Water condition was gauged by the presence of macroinvertebrates such as insect larvae, snails, or worms, **which are good indicators of water health**.
- Across the 21,000 acres protected, land protection resulted in the **avoidance of an estimated $57 million in total stormwater capital costs and $6 million in annual maintenance costs** for projected development—more than three times the cost of the land protection itself.
- Overall, the cost per ton of pollutant load reduced by restoration was **much less than the cost per ton of pollutant load avoided by land protection. Protecting water sources from deforestation is much more economical than restoring them after deforestation.**

A 2008 USGS[37] study of the Catskills on the impacts of logging to the water supply found:

- **Clearcutting caused a large release of nitrate (NO_3^-) from watershed soils and a concurrent release of inorganic monomeric aluminum (Alim),** which is toxic to some aquatic biota. The increased soil NO_3^- concentrations measured after the harvest could be completely accounted for by the decrease in nitrogen (N) uptake by watershed trees, rather than an increase in N mineralization and nitrification. **The large increase in stream water NO_3^- and Alim concentrations caused 100-percent mortality of caged brook trout** (Salvelinus fontinalis) during the first year after the clearcut and adversely affected macroinvertebrate communities for 2 years after the harvest.
- Results of this study indicate that brook trout and macroinvertebrates in many Catskill streams, particularly in the highly acidic Neversink River basin, are likely to be adversely affected by clearcutting.

[37] Effects of Forest Harvesting on Ecosystem Health in the Headwaters of the New York City Water Supply, Catskill Mountains, New York, https://pubs.usgs.gov/sir/2008/5057/SIR2008-5057.pdf

	Many of the most serious and irreversible impacts from logging include the damage to soils and vegetation from the use of heavy logging equipment, which reduces and replaces invertebrates, fungi, and other parts of the forest food web with bacterial decomposers more characteristic of an agricultural and younger soil. These adverse impacts would end with the cessation of logging in public forests. Proforestation – the forest policy that keeps all wood on site - is a crucial component of restoration and soil building. Trees and branches are the primary food of the soil fungi that characterize older forests with the highest levels of sequestration and water retention. Up to 40% of the carbon stored in a forest is below ground, in the roots and soils. When logging stops, the soil is no longer being repeatedly damaged by heavy equipment and grading access. The January 2024 Massachusetts Report of the Climate Forestry Committee: Recommendations for Climate-Oriented Forest Management Guidelines[38] stated: "*The Committee strongly agreed on the importance of the soil carbon pool, which is underappreciated and often larger than the amount of carbon found in living biomass. They concluded that the most important way to preserve soil carbon (and advance related climate and environmental objectives) is to allow forests to mature naturally.*" Soils, like forests, succeed over time as they mature. A complex array of amphibians, invertebrates and other soil organisms is a key component of native soils and should be protected. Young soils are typically bacteria dominated but the older forests are increasingly fungi dominated. Every disturbance of the ground however, such as rutting and compaction caused by mechanized equipment, impacts this process negatively and allows bacteria to become dominant again. Nutrients are then released more rapidly, fueling invasive species and retarding the development of rich native understory and ground layers. Deer browse may suspend this state indefinitely. Without logging and the removal of wood, the forest can mature to its highest levels of carbon storage and water A study[39] in 2000 by Dr. Beverly Law of the College of Forestry at Oregon State University compared carbon storage and fluxes in young and old pine stands in

38 https://www.mass.gov/info-details/forests-as-climate-solutions

39 Carbon storage and fluxes in ponderosa pine forests at different developmental stages, Global Change Biology (2001) 7, 755±777

	Oregon, including plant and soil storage. The result debunked the theory that old forests are net carbon sources to the atmosphere or they are net zero (emit as much carbon as they absorb). "People are being told or thought that young trees grow fast and vigorous **but when you look at the forest the net of all the respiration and photosynthesis makes them a source."** The study compared a young forest next to an old forest. It measured diameters and took tree cores to get their age and measured the height with lasers. It also measured carbon flows with sensing devices. The study found the young forest was a **net carbon source** (not taking up as much carbon for photosynthesis as is given off by respiration from the soil and the trees) **for about the first 20 years of its life**. "They're not taking as much carbon up, but **they are still releasing a lot from the soil**, and they are still respiring maybe 80% of what they take up. These results suggest that the net ecosystem production of young stands may be low because heterotrophic respiration, **particularly from soils**, is higher than the NPP[40] of the regrowth. In other words, **cutting trees causes a significant loss of carbon in soils.**

[40] NPP is the annual rate of Carbon accumulation in plant biomass, measured as gC/m^2/yr or gC/tree/yr or some other form of carbon mass per unit land area per time period. While closely related to carbon stock it measures the change in stock over time.